



A Holistic Approach to Planning for Wildlife Tourism: A Case Study of Marine Turtle Tourism and Conservation in the Ningaloo Region, Western Australia

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Submitted by

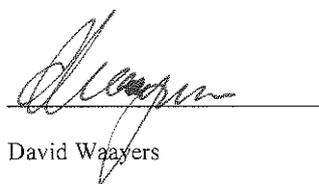
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Wide Fund for Nature and Department of Environment and Conservation.

Declaration

I declare that this thesis is my own account of my research and contains as its main content work which has not been previously submitted for a degree at any tertiary educational institute



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ABSTRACT

This thesis explored the practical issues of sustainable wildlife tourism by examining three fundamental aspects: stakeholder collaboration; the importance of collecting baseline data to inform decisions; and detecting tourism-related impacts on wildlife. These aspects were explored in detail through a case study of turtle tourism in the Ningaloo region in Western Australia and the development of the Ningaloo Turtle Program.

Four interrelated studies were undertaken in the Ningaloo region to quantify the nature and extent of collaborative relationships amongst stakeholders, visitor-use and characteristics of turtle watchers, distribution and abundance of nesting female marine turtles and impacts on turtles from human-turtle interactions. The first study explored the collaboration of stakeholders through action research and by examining workshop dialogue and interactions between interest groups. The key findings from this study were that the selection and number of participating stakeholders within a stakeholder group were vital in collaboration. This study suggests there is often a trade-off between having too many representatives from each interest group and generating positive collaborative outcomes. This study showed that one representative from twelve interest groups was sufficient for generating a collaborative approach. The participants represented several key interest groups including four government representatives (Department of Environment and Conservation (DEC), Australian Defence Force, Fisheries WA and the Shire of Exmouth), two tourism industry representatives (Tourism WA and private tour operators), five non-government organisation representatives (World Wildlife Fund for Nature (WWF), Cape Conservation Group (CCG), Murdoch University, Pastoral Land Group, the Biayungu Aboriginal Cooperation (BAC)), and one stakeholder representing local residents/volunteers. The study also found that the preparation of an engagement strategy, that outlines stakeholder responsibilities and commitments and the employment of a convenor to facilitate workshops are important factors in initiating the collaborative process. The continuation of this process is dependent on long-term coordination by a professional

consultant, who has the capacity to drive the planning processes and apply for funding, stakeholder's commitment to the process and their capacity to transform collaboration into an ongoing learning process.

The second study investigated marine turtle female nesting populations in the Ningaloo region. The study showed that the peak nesting season for all species in the Ningaloo Marine Park is between November and March. Based on a series of turtle population modelling calculations, the total female turtle population in the Ningaloo Marine Park (including Muiron Islands) was estimated to be up to 58,000 individuals. The predominant species of turtle nesting in the region are green turtles (< 35,000 female turtles), loggerhead turtles (< 20,000 female turtles) and hawksbill turtles (< 3,000 female turtles). These estimates for green turtles suggest that the Ningaloo nesting population makes up about a third of the North West Shelf Management Unit and the loggerhead turtle population was estimated to be one of the largest rookeries in Western Australia. However, hawksbill turtles nest occasionally on the Northwest Cape. This study also showed that green turtles predominantly nest in the northern parts of the Ningaloo coast, including the Jurabi Coastal Park where turtle watching occurs, whereas loggerhead turtles are more likely to be found in the southern areas. There are often large fluctuations in the annual nesting activity of turtles, particularly green turtles, primarily due to the inherent variation in their life cycle. This variation in nesting activity can have implications for the development and operations of turtle tourism.

The third study identified key management areas for turtle tourism by comparing the spatial distribution of tourists and turtle tracks in the Ningaloo Marine Park. Management areas were then examined closely at a local-level. On-site studies included a visitor questionnaire to understand tourist characteristics, an on-ground track count survey to monitor turtle nesting activity and a tourist-turtle interaction behaviour study to quantify disturbances associated with tourist-turtle interactions. The visitor questionnaire showed that the majority of independent

turtle watchers were novice international tourists with little experience or knowledge of interacting with turtles.

The fourth study, which investigated the interactions between visitors and turtles, showed that a third of encounters resulted in a disturbance. These results are considerably higher than disturbances recorded at other locations where turtle tourism occurs. The interaction study showed that almost all disturbances stemmed from non-compliant behaviour of turtle watchers, particularly torch-use and closeness to turtles. These results indicate that despite visitors' knowledge of the code of conduct, two thirds of groups continue to breach the code, emphasising the need for developing guided tours and better interpretation for turtle tourism. The development of the Jurabi Turtle Centre, which was built after the data in this thesis was collected, has provided, not only a focal point for turtle tourism in the Ningaloo region, but a facility for guiding and educating turtle watchers.

The knowledge gained from these studies was used to develop a planning model (the Wildlife Tourism Optimisation Management Model (WTOMM)), which was specifically designed for non-consumptive wildlife orientated recreation. This model was based on the structure of the Tourism Optimisation Management Model (TOMM) and concepts of Adaptive Management. WTOMM provides a framework for avoiding the inherent problems associated with developing and implementing sustainable turtle tourism. This model could also provide the foundation for managing other wildlife tourism situations.

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ACRONYMS

CALM	Department of Conservation and Land Management
CITES Fauna	Convention on International Trade in Endangered Species of Wild Flora and Fauna
CMS	Convention for the Protection of Migratory Species of Wild Animals
CRNP	Cape Range National Park
DEC	Department of Environment and Conservation (formally CALM pre-2005)
DEWHA	Department of Environment, Water, Heritage and Arts
DoF	Department of Fisheries
EPBC Act	<i>Environmental Protection and Biodiversity Conservation Act 1999</i>
IUCN	International Union for the Conservation of Nature
MoU	Memoranda of Understanding
NMP	Ningaloo Marine Park
NMP Plan	Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area
NTP	Ningaloo Turtle Program
NTAG	Ningaloo Turtle Advisory Group
RPMTA	Recovery Plan for Marine Turtles in Australia
TOMM	Tourism Optimisation Management Model
WTOMM	Wildlife Tourism Optimisation Management Model

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PUBLICATIONS AND REPORTS

- Waayers, D. (2001) *A management framework for the conservation of endangered turtles (Progress Report: Phase 1)*. Prepared for Environment Australia. Murdoch University, Perth (30 November, 2001)
- Waayers, D. (2002) *A management framework for the conservation of endangered turtles (Progress Report: Phase 2)*. Prepared for Environment Australia. Murdoch University, Perth (13 September, 2002)
- Waayers, D. (2003) *Sustainable turtle-based tourism: A Management Framework for the Ningaloo Marine Park coast (Progress Report: Phase 3)*. Prepared for Environment Australia. Murdoch University, Perth (November, 2002)
- Waayers, D. (2003) *A management framework for the conservation of endangered turtles (Progress Report: Continuation)*. Prepared for Environment Australia. Murdoch University, Perth (November, 2003)
- Waayers, D. (2003) Wildlife Tourism Optimisation Management Model (WTOMM) – Integrating the Community, Tourism and Conservation. Proceedings of the Ningaloo Marine Turtle Conference (compiled by R. Carter), pp 17-18. WWF, Exmouth.
- Waayers, D. (2003) Key Findings from the 2002/2003 Nesting Season (Community Monitoring Program Results). Proceedings of the Ningaloo Marine Turtle Conference (compiled by R. Carter), pp. 21-22. WWF, Exmouth.
- Waayers, D. (2004) *Developing a Wildlife Tourism Optimisation Management Model based on marine turtle tourism in the Ningaloo region (Final Project Report for Environment Australia)*. Department of the Environment and Heritage, Marine and Water Division). Murdoch University, Perth (April 2004)
- Carter, R., Mau, R., McGrath, K. and Waayers, D. (2004) *Ningaloo Community Turtle Monitoring Interim Annual Report 2003-2004*. Written and prepared for the Commonwealth Department of Defence and Coastwest Coastcare. Ningaloo Community Monitoring Programme. Collaboration of DEC, Murdoch University, Cape Conservation Group and World Wide Fund for Nature, Western Australia
- Waayers, D., Newsome, D. and Lee, D. (2006) Observations of non-compliance behaviour by tourists to a voluntary code of conduct: A pilot study of turtle tourism in the Exmouth region, Western Australia. *Journal of Ecotourism*, 5 (3): 211-222
- Waayers, D., Lee, D. and Newsome, D. (2009) Change of perspective: Using aerial surveys to identify human-turtle interactions in the Ningaloo Marine Park. *CAUTHE*, Fremantle Perth (February 2009)
- Waayers, D. (2009) Collaborative approach to marine turtle conservation and tourism in the Ningaloo region. *Proceedings of the 26th Sea Turtle Symposium*, Brisbane (February 2009)

PART 1 INTRODUCTION

CHAPTER 1 INTRODUCTION

1.1 Context of research

Wildlife tourism in marine and coastal areas can provide a range of psychological, educational and conservation benefits for visitors encountering marine animals and local communities (Higham, 1998; Orams, 2000, Birtles *et al.*, 2002; Lück, 2003; Tisdell and Wilson, 2006; Andersen and Miller, 2006; Zeppel and Muloin, 2008b; Kulczycki and Lück, 2009). It is considered the fastest growing sub-sector of the tourism industry, as demands for opportunities to interact with nature have increased (Orams, 2001; Reynolds and Braithwaite, 2001; Newsome *et al.*, 2002; Higginbottom, 2004a). This has been emphasised in the increasing demand to experience wild animals in their natural habitat (Gauthier, 1993; Page and Dowling, 2002; Higginbottom, 2004b). Although there are no reliable global estimates of the economic impact of wildlife tourism, it is clear that the entire industry involves large numbers of participants generating substantial financial growth (Hoyt, 2001; Wilson and Tisdell, 2001; Higginbottom, 2004a; Hara *et al.*, 2003; Kirkwood, 2003; Graham, 2005).

In Australia, tourism based on viewing and interacting with coastal and marine wildlife is considered one of the fastest growing tourism sectors (Higham and Lusseau, 2004; Newsome *et al.*, 2005). According to Hughes (2001), this growth is fuelled by an increasing propensity for travel to be seen as life-enriching experiences involving the outdoors and particularly learning about nature. As with sustainable tourism, wildlife tourism has contributed significantly to a shift in people's perceptions of nature in the western world through wildlife documentaries and heightened awareness of general environmental issues (Hughes, 2001; Gossling, 2002; Kulczycki and Lück, 2009). It appears that human interest in wild animals has also been increased through peoples' isolation from natural ecosystems as a result of urban-living, their deep relationship with and interest in various species, concerns for the environment, relative influence on natural ecosystems, increased transportation and technology and global conservation initiatives (Newsome *et al.*, 2005).

Fundamental to achieving sustainable wildlife tourism is ensuring that the wildlife is not adversely impacted by tourism and the interdependent relationships between tourism and conservation are realised. The key lies in integrating conservation and tourism through understanding the biological, social and economic opportunities and constraints. However, there remains inadequate baseline data on target species and visitor profiles, limited knowledge of tourism-related impact on wildlife, and an understanding of how stakeholder collaboration can contribute to the decision-making process (Manfredo *et al.*, 1995; Vaske *et al.*, 1995; Hammit and Cole, 1998; Higginbottom, 2004a; Newsome *et al.*, 2005; Rodger *et al.*, 2007). Moreover, to make sense of the complex web of relationships between various interdependent aspects of wildlife tourism, planning models need to be developed (Wearing and Neil, 1999). A planning framework is essential if wildlife tourism and its impacts are to be managed in effective cost-efficient ways (Higginbottom *et al.*, 2003; Newsome *et al.*, 2005).

The Ningaloo region, approximately 1,250km north of Perth, is regarded as one of Western Australia's most iconic wildlife tourism destinations. The Ningaloo area is very important for a variety of recreational pursuits and for nature-based tourism that centres on its marine ecosystems. Due to the close proximity of the reef to the shore, visitors can enjoy a wide variety of nature-based tourism activities including seasonal aggregations of whale sharks, manta rays, turtles and whales, as well as the annual mass spawning of coral which act to provide unique opportunities for visitors to observe marine fauna and key biological processes. As a result of increased visitation to the area during the summer period (CALM, 2001), which coincides with the nesting period for marine turtles, turtle tourism is expected to become more popular. This evoked some concern by local conservationists and managers from the Department of Environment and Conservation (DEC) about the impacts from human-turtle interactions and the management of turtle tourism in the region. This thesis therefore presents a series of studies that explore the development of stakeholder collaboration initiatives, gathers baseline data on the turtle population and tourism activities and reports on behavioural studies that attempt to detect impacts from human-turtle interactions in the

Ningaloo region. Although there are broad plans and policies that provide some guidance to the management of turtles in the region (CALM, 1987; Shire of Exmouth and CALM, 1999; DEH, 2003; CALM, 2004), there are no planning models that explicitly deal with turtle tourism management. This thesis therefore explores the development of a planning framework for turtle tourism based on the outcomes of the studies which can be applicable to other wildlife tourism situations.

1.2 Problem statement

The fundamental nature of the problem that this thesis seeks to address can be summarized as follows:

Wildlife tourism continues to expand without management models in place to guide and promote sustainable tourism through establishing symbiotic relationships between wildlife conservation, tourism development and stakeholder involvement.

1.3 Study Approach

A case study method (Yin, 1994) was used as a means of exploring the various components of turtle tourism in the Ningaloo region. Turtle tourism was chosen as a suitable case subject because it covers a range of complex issues inherently associated with wildlife tourism management. These complexities are mainly attributed to the biological requirements of target species. In the case of turtles, they utilise both terrestrial and marine habitats, migrate vast distances possibly across international boundaries, have high conservation values for a wide range of stakeholders, are listed as endangered species, are vulnerable to disturbances during their nesting period and are becoming increasingly popular as a focal animal for wildlife interactions. The outcomes of this case study may provide some insight for wildlife tourism based on similar species such as cetaceans, whale sharks, shorebirds, pinniped and rays.

Action research, also known as “appreciative inquiry”, was also undertaken to facilitate the relationships between the author of this thesis and stakeholders in this research. This research approach involves actively participating within a group of people with a common interest within an organisation or committee, who are often devising a plan to improve some aspect of operation or practice (Jennings, 2001). The author played an active role in the development of the Ningaloo Turtle Program (NTP) (from 2001 to 2004) through his involvement and participation in the steering committee, stakeholder workshops, and design of the monitoring programme. The author subsequently had the capacity to influence decisions made about the development of turtle tourism in the Ningaloo region. The initiation of this current research led to the establishment of the NTP (refer to <http://www.ningalooturtles.org.au/>), which continues to operate in 2009. Although the NTP is still operating, this thesis only presents the development phase of the NTP, which was between November 2001 and March 2004.

1.4 Research objectives and questions

This thesis was guided by the following objectives and associated research questions:

Research Objective 1:

To explore the nature and extent of collaboration between stakeholders relevant to turtle tourism in the Ningaloo region.

The associated questions are:

- *What stakeholders are relevant to turtle tourism in the Ningaloo region?*
- *What is the nature and extent of collaboration amongst stakeholders participating in workshops for the development of turtle tourism in the Ningaloo region?*

Research Objective 2:

To determine the distribution and abundance of nesting turtles along the Ningaloo Marine Park coast.

The associated questions are:

- *Where are the key turtle rookeries along the Ningaloo Marine Park coast?*
- *What is the size of the annual nesting population of female turtles in the Ningaloo Marine Park and Muiron Islands?*
- *What is the extent of the peak nesting season in the Ningaloo region?*
- *Can the nesting success of turtles be used as an indicator for detecting impacts from turtle watchers at the Jurabi Coastal Park?*

Research Objective 3:

To determine the distribution and characteristics of visitors along the Ningaloo Marine Park coast during the turtle nesting period.

The associated questions are:

- *Where are the key management areas for turtle tourism in the NMP?*
- *What are the spatial and temporal distribution and demographic characteristics of turtle watchers seeking turtles in the Jurabi Coastal Park during the nesting season?*
- *How knowledgeable are turtle watchers of DEC's code of conduct and how does this relate to visitor behaviour?*

Research Objective 4:

To explore and quantify the impacts of human-turtle interactions during the nesting process.

The associated questions are:

- *How do the guidance statements within DEC's code of conduct for interacting with marine turtles influence the behaviour of turtle watchers?*
- *How is the behaviour of nesting turtles affected by non-compliant behaviour of turtle watchers?*

1.5 The structure of this thesis

This thesis is divided in three parts. Figure 1.1 provides a diagrammatic outline of the thesis presentation. The first part comprises two chapters. The current chapter introduces the nature of the problem being investigated, study approach, research questions, and structure of the thesis. The second chapter sets the direction of this research by exploring how planning models assist in understanding and facilitating the complex web of interdependent relationships within the nature of wildlife tourism and explores the literature pertaining to the requirements of sustainable wildlife tourism. Chapter 2 then focuses on three key factors that are hindering sustainable wildlife tourism, including the lack of stakeholder involvement in planning processes, lack of and inadequate collection of biological and social baseline data and limited studies that detect tourism-related impacts on wildlife. These factors are then explored in the case of turtle tourism in the Ningaloo region.

Part 2 presents a case study that explores the development of turtle tourism in the Ningaloo region. It comprises five chapters that present four studies that are central to this research. Chapter 3 provides some background to the study area including a general description of the Ningaloo region, tenures, tourism, relevant policies and legislation, turtle populations and turtle tourism prior to the establishment of the NTP. Following Chapter 3, a series of separate studies are presented. These studies include:

- Action research that explored stakeholder collaboration and coordination with a focus on workshop dialogue (Chapter 4);
- Aerial and ground track count surveys that investigated the nesting population of turtles in the Ningaloo Marine Park and Muiron Islands (Chapter 5);
- Aerial surveys that investigated tourist distribution in the Ningaloo Marine Park and questionnaires that gauge the characteristics of turtle watchers along the Jurabi Coastal Park (Chapter 6);
- Interaction observations that investigated human-turtle interactions in the Jurabi Coastal Park (Chapter 7).

The information obtained from these studies informed the development of a planning model and monitoring programme. Each of these studies comprises a literature review, methods, results, discussion and conclusion. Part 3 consists of two chapters. Chapter 8 discusses the development of a planning model for wildlife tourism based on the Tourism Optimisation Management Model (TOMM) and an adaptive management approach. Chapter 9 summarises and concludes the thesis.

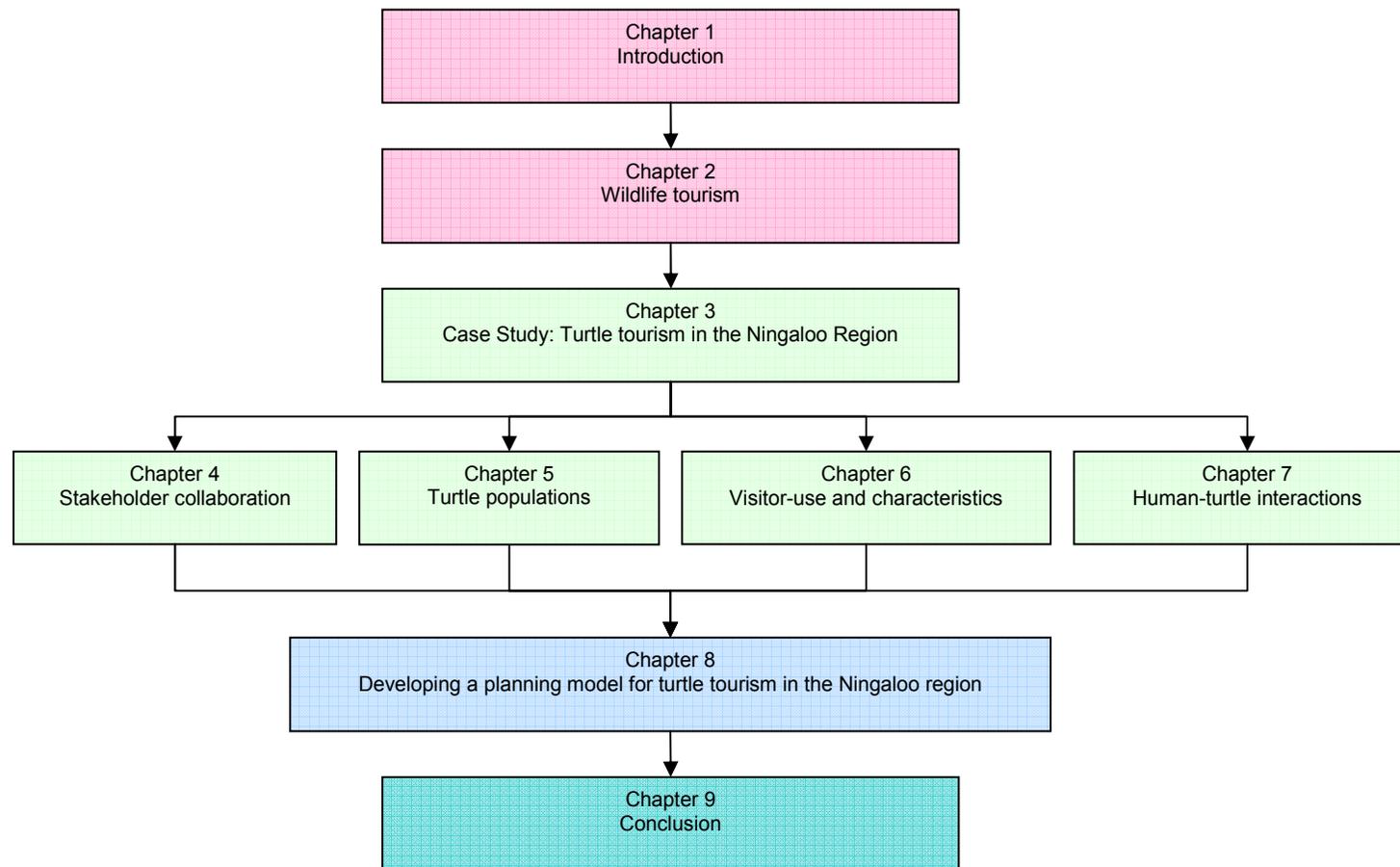


Figure 1.1 Diagrammatic outline of the thesis

CHAPTER 2 PLANNING FOR WILDLIFE TOURISM

2.1 Introduction

This chapter explores the literature relating to sustainable tourism through the provision of planning models and how they might be applied in wildlife tourism. Three core issues were identified in the application of a planning model in wildlife tourism:

- uncertainty surrounding stakeholder collaboration and partnership development;
- lack of baseline data; and,
- inadequate assessment of impacts on wildlife from visitors.

To explore these issues in detail and provide background to the case study, the literature relating to turtle tourism in Australia is also examined.

2.2 Concepts of sustainable tourism

Sustainability has been adopted as the dominant paradigm for tourism industry (World Commission on Environment and Development/World Tourist and Travel Corporation/Earth Council, 1995; Tremblay, 2001; Higginbottom, 2004a; Newsome *et al.*, 2005; Macbeth, 2005), and is widely interpreted as:

tourism which is developed and maintained in an area in such a manner, and at such a scale, that it remains viable over an indefinite period and does not degrade or alter the environment (human and physical) in which it exists to such a degree that it prohibits the successful development and well being of other activities and processes (Butler, 1993:5).

A concept that has emerged as a means of achieving sustainable tourism goals is ecotourism (Harrison, 1997; Ceballos-Lascurain, 1998; Garrod, 2003). The main goals of ecotourism are to

foster sustainable-use through resource conservation, cultural revival, education, economic development and diversification (Newsome *et al.*, 2002; Higham and Lück, 2007). In theory, ecotourism should be an economic and socially sound means to conserve biodiversity, and also provide revenue to improve the lives of people living in or near biologically important areas (Orams, 1997; Hall and Boyd, 2003; Higham and Carr, 2003). This idea applies to forms of ecotourism, such as nature-based tourism, marine tourism, and wildlife tourism.

The real challenge facing ecotourism is how to translate these principles into practices (Bramwell and Lane, 1993; Hunter, 2002). In order to convert ecotourism, as a concept, to a reality, planning models need to be developed (Newsome *et al.*, 2002). Central to the goals of this process is achieving an integrated approach that reflects the concept of ecotourism, which requires a shift in management cultures for both wildlife and tourism managers that recognises the intrinsic balance between natural resource and visitor management.

2.3 Planning in sustainable tourism

Much has been written about planning models that attempt to address the needs of sustainability (Lindberg, 1997; Nilsen and Tayler, 1997; Hammit and Cole, 1998; Fennell, 1999; McArthur, 2000; Newsome *et al.*, 2002). Planning can feed back into policy making processes that determine how the tourism industry is managed. Plans can provide transparency in the way tourism is managed, in turn reducing any political animosity between stakeholders (Newsome *et al.*, 2002). Planning can also provide vehicles for communities to be involved in the decision-making process and provide a means of incorporating economic aspects of tourism into the broader picture of management for sustainable tourism. However, without stakeholder collaboration, readily available scientific knowledge of the environment and visitor characteristics and measurable indicators of tourism-related impacts, planning models are broadly ineffective.

Boyd and Butler (1996) refer to the development of planning models as an evolutionary process rather than a revolutionary process. However, there are subtle differences in the effectiveness of the later developed tourism planning models (Clark and Stankey, 1979; Stankey *et al.*, 1985; Graefe *et al.*, 1990; Manidis Roberts Consultants, 1997). These differences are explored in the following discussion.

Until the mid 1980s, community involvement in heritage and visitor management was limited, so the older models such as the Recreational Opportunity Spectrum (Clark and Stankey, 1979) and recreational carrying capacity focused on the use of recreation and scientific expertise to solve their problems. In contrast, the Visitor Impact Management Model (Graefe *et al.*, 1990) was created during a growing awareness of the need to involve the community. A model that was specifically developed for ecotourism was the Environmentally Based Tourism (EBT) planning model (Dowling, 1993). The EBT model determines opportunities through the identification of significant features, critical areas and compatible activities (Dowling, 1993). Whilst these models provide the foundations for sustainable tourism planning, the most advocated model is Limits of Acceptable Change (LAC) (Stankey *et al.*, 1985), where the emphasis is on the ecological and social attributes sought in an area, rather than on how much use the area can tolerate (Mowforth and Munt, 1998; Pigram and Jenkins, 1999; Herath, 2002). LAC was developed as a management process which transfers the focus from the supposed cause (visitor numbers) to the desired conditions (the biophysical state of the resource and the nature of the recreation) and is considered a viable model for measuring changes in wildlife tourism situations (Higham *et al.*, 2008). Since then and based on the principles of LAC, a new planning model has emerged named the Tourism Optimisation Management Model (TOMM)(McArthur, 1996). This model has been recognised as containing the attributes for achieving sustainable wildlife tourism (Higginbottom,

2004a; Newsome *et al.*, 2005). The following section describes TOMM in further detail as it provides the foundation of thesis.

2.3.1 Tourism Optimisation Management Model (TOMM)

A planning model that has evolved to address the fundamental issues associated with sustainable tourism concepts is the Tourism Optimisation Management Model (TOMM) (McArthur, 1996; Newsome *et al.*, 2002; Higginbottom, 2004a; Duka and Jack, 2005; Miller and Twining-Ward, 2005). TOMM has been developed as a deliberate and purposive process in tourism management (McArthur, 2000) and is thought to comprise the prerequisites for the development and management of wildlife tourism (Higginbottom, 2004a). The model was first conceived by the Australian Commonwealth Department of Industry, Science and Tourism and the South Australian Tourism Commission and currently features a website that describes the progress of the model (see <http://www.tomm.info/>). These institutions initiated a project to produce a model designed to seek and assess solutions to issues that threaten the health of tourism and the resources that tourism depends upon. In essence, they sought a model that could satisfy all the needs of sustainable tourism. The specific objectives of TOMM were

- to monitor and quantify the key economic, marketing, environmental, socio-cultural and experiential benefits and impacts of tourism activity; and
- assist in the assessment of emerging issues and alternative future management options for the sustainable development and management of tourism activity.

TOMM has been applied in six areas in Australia and four in Canada, particularly in areas of natural significance (McArthur, 2000; Duka and Jack, 2005). There are several published documents (Nilsen and Tayler, 1997; Moore *et al.*, 2003; Newsome *et al.*, 2002; Ward *et al.*, 2002; Higginbottom, 2004a) and unpublished documents (Moncrieff, 1997; Duka and Jack,

2005) that describe the processes of TOMM. TOMM comprises three main components: i) A Context Description; ii) A Monitoring Program; and iii) A Management Response (Manidis Roberts Consultants, 1997; McArthur, 2000). The Context Description comprises two parts: stakeholder engagement; and compiling information relevant to the tourism industry (Figure 2.1). Stakeholder engagement involves identifying key stakeholders relevant to the tourism industry, followed by a series of group discussions that outline the objectives of the process and gauge whether participants are committed to the process. Tourism scenarios are then discussed to generate hypothetical scenarios, which can act as a guide as to how to deal with potentially difficult situations (McArthur, 2000). In order to coordinate the planning processes, a steering committee is established, which often comprises influential members of the stakeholder groups. The steering committee often provides the foundation for establishing a group of stakeholders, developing a monitoring programme and implementing management strategies.

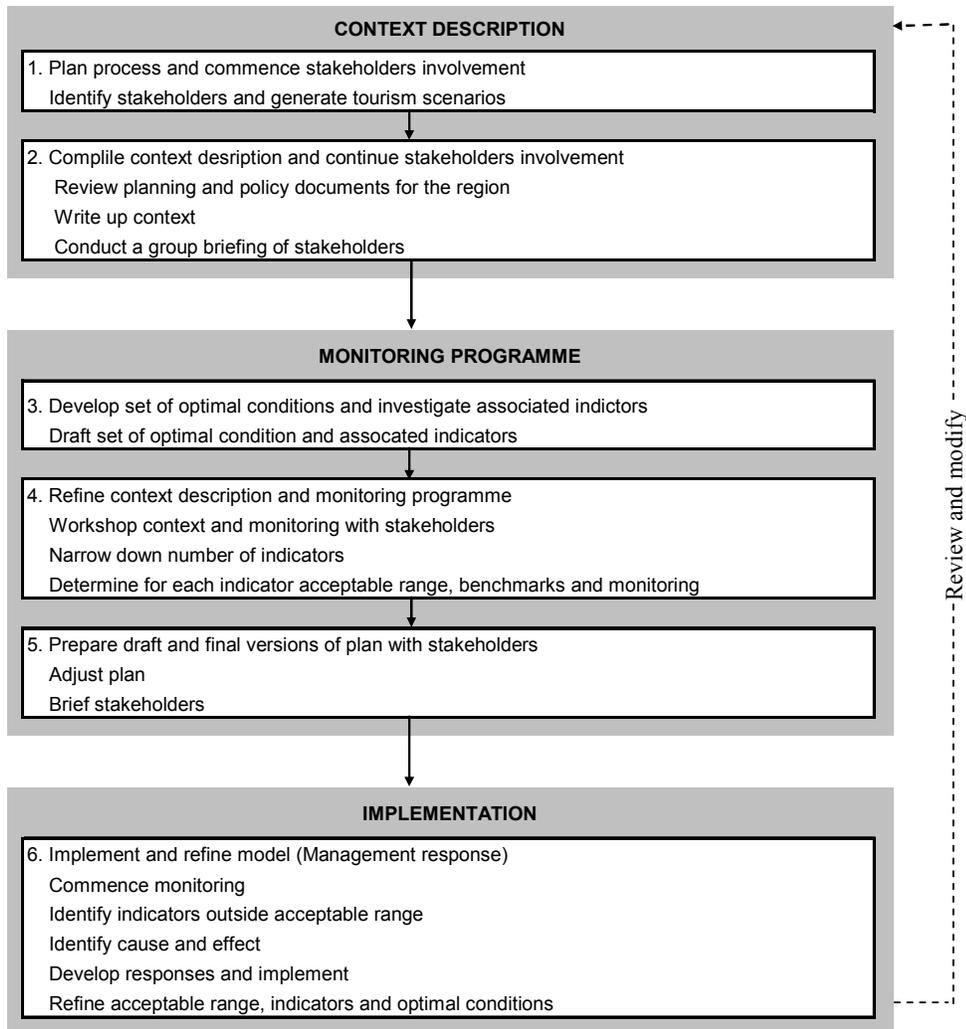


Figure 2.1 Components of the Tourism Optimisation Management Model (TOMM)
Source: Derived from Manidis Roberts Consultants (1997); McArthur (2000)

The Monitoring Program involves identifying optimal conditions, associated indicators, acceptable ranges and benchmarks (Figure 2.1). An optimal condition is similar to a management objective, which acts as a guide to achieving a desirable and realistic outcome. Optimal conditions are often generated through stakeholder consultation. Indicators are then developed as a means of measuring these optimal conditions. This data must be cost-effective to collect, available and accurate (McArthur, 2000; Miller and Twining-Ward, 2005). Acceptable ranges are then developed for each indicator based on previous research, local knowledge and predictive

models (McArthur, 2000). An indicator outside the acceptable range triggers a management response. Similar to acceptable ranges, benchmarks provide a target value that takes into account the natural variation and is often used to reach long-term management objectives.

The final part of TOMM is the Management Response section, which is also referred to as the implementation phase. This component of the model takes into account existing policies and planning initiatives and attempts to modify or develop new initiatives based on baseline data and ongoing monitoring of the optimal conditions set in the Monitoring Program (Section 8.2.2). Figure 2.2 illustrates the process of the implementation phase. A management response is triggered when an indicator falls outside its acceptable range. If this is detected, the cause of the incident is determined (e.g. tourism-related or natural variation or other human-use) and the relevant agency, interest group or organisation is required to mitigate the associated issue.

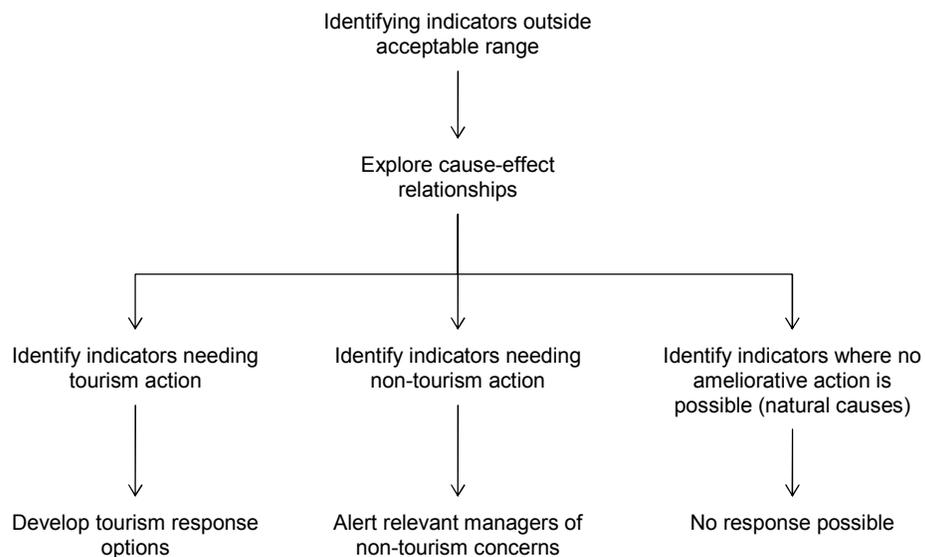


Figure 2.2 Process of the management response of the TOMM (Derived from Manidis Roberts Consultants, 1997)

The most studied examples of the TOMM is work done by McArthur (2000) at Kangaroo Island which investigates the development and implementation of TOMM. TOMM has been developed on Kangaroo Island to tackle the challenges of balancing development and conservation in the interests of both residents and visitors. TOMM is a unique example of a community-driven visitor management system. At the core of TOMM is a set of practical indicators that monitor the status of tourism on Kangaroo Island. TOMM has been developed and implemented to encourage partnerships between community, industry and government agencies. After four years, the impact of TOMM became evident (Duka and Jack, 2005). International tourism promotions showcase Kangaroo Island as an Australian icon for wildlife. Local businesses are more aware of visitor needs and new businesses have developed to take up opportunities that come with increased visitor numbers. Restaurants also provide locally produced food and have helped to promote Kangaroo Island as a gourmet food destination (Duka and Jack, 2005).

While TOMM at Kangaroo Island provides a good example of how TOMM can be applied in reality, its limited application elsewhere reflects the critical need to explore its effectiveness as a planning model. This thesis later examines the application of TOMM in wildlife tourism, with parts of the model being applied to turtle tourism in the Ningaloo region.

2.3.2 Adaptive Management

An emerging approach in addressing issues associated with sustainable tourism and in particular wildlife tourism is “adaptive management” (Newsome *et al.*, 2005; Higham *et al.*, 2008). Adaptive management is based on the idea that planning systems need to be flexible and be able to adapt to change (Reed, 2000). Although the concept and structure of adaptive planning and TOMM have similarities, the strength of the adaptive approach is in its ability to deal with complexities and uncertainties associated with natural variation, stakeholder collaboration and

structural improvements over the status quo (Reed, 2000). Adaptive management is a management approach, designed from the outset to test clearly expressed ideas and hypotheses about behaviour of an ecosystem being changed by human use (Walters, 1997). These ideas or hypotheses about environmental change or impact usually represent predictions regarding how one or more components of the ecosystem will respond as a result of the implementation of a policy. When a management decision is successful in reducing environmental change from anthropogenic activity, the hypothesis is validated. In contrast, when the management decisions fail, the adaptive approach is designed to encourage learning, adjustments are made and future initiatives can be based on the new understanding (Lee, 1993). Rather than attempting to control or stabilize ecosystems, policies and practices should focus on establishing opportunities to learn and adapt. These practices would include providing for a range of objectives, generating indicators of change that are relevant to decisions, screening and evaluating policy alternatives and establishing appropriate communication mechanisms among relevant stakeholders.

A key element of adaptive planning requires collaboration of stakeholders and identification of shared values (Reed, 2000; Newsome *et al*, 2005; Higham *et al.*, 2008). To meet this challenge, participants must have a genuine desire to build consensus and reach mutually acceptable solutions. But desire alone is not always sufficient. Power differentials among members may result in the imposition of one set of values over others. Beyond identifying values, adaptive management includes the measurement of progress through structured improvements and a commitment to continuous learning, evaluation and modification (Dearden and Mitchell, 1998). A focus on progress allows new information generated through a monitoring programme to be used to modify actions before irreversible commitments are made. Reed (2000; p.253) states that “staged implementation allows for the generation of new information, which leads to new knowledge and understanding, which in turn become the departure point for new initiatives”.

This step-wise approach provides the grounding to develop policies and practices that result in greater resilience.

Monitoring is critical to assess the effectiveness of management and monitoring strategies (Gerber *et al.*, 2007; Higham *et al.*, 2008). Nevertheless, data alone does not provide a basis for management decisions alone. Of greater importance is the magnitude of the impact and whether the extent of impact meets model predictions or stakeholders' expectations (Gerber *et al.*, 2007). Despite the widespread recognition of the importance of monitoring and adaptive management to enhance efficacy, few monitoring studies have led to an adjustment of management (Gerber *et al.*, 2007). Adaptive Management is essential for enhancing the efficacy of protected area management as key management decisions can be changed later as information becomes available (Grafton and Kompas, 2005).

To date, the details of how an adaptive paradigm might be applied to wildlife tourism planning have yet to be articulated (Higginbottom, 2004; Newsome *et al.* 2005). This thesis attempts to show how an adaptive approach might be applied to a collaborative planning process in turtle tourism and conservation.

2.4 Planning in wildlife tourism

The potential for using wildlife resources in a non-consumptive manner has been shown to provide benefits associated with ecotourism concepts (Filion *et al.*, 1992; Davis and Tisdell, 1998). Such tourism offers a realistic chance for the conservation of wildlife resources in the long term, especially when wildlife resources are dwindling due to habitat destruction, poaching and other human actions. Wagar (1969) defines non-consumptive wildlife-oriented recreation (NCWOR) as a human recreational engagement with wildlife where the focal organism is not purposefully removed or permanently affected by the engagement.

According to Wilson and Tisdell (2001), NCWOR can be grouped into two categories: (1) tourists that visit a national park or protected area to watch wildlife in their natural environment without a focal species in mind, or (2) tourists visiting a designated area with the intention of watching a focal species in its natural habitat. The latter is the focus of this thesis. This type of NCWOR involves visiting an area and waiting for the species to appear for viewing. Usually, this involves small groups of individuals viewing from a designated place such as a platform or hide. Examples of this type of wildlife tourism include the viewing of fairy penguins on Phillip Island, Victoria, and watching the Northern Royal albatross colony at Taiaroa Head in New Zealand. The formalisation of this form of NCWOR is relatively recent, perhaps dating back to the late 1960s. For example, the right to operate guided tours on a restricted basis to the Northern Royal albatross colony was granted in 1967 (Higham, 1998), Mon Repos for sea turtles in 1968 (Kay, 1995), Hervey Bay for humpback whales in 1987 (Kleinschmidt, 1996); and whale sharks in the Ningaloo Marine Park in 1993 (Davis and Tisdell, 1998).

Duffus and Dearden (1990) proposed a conceptual framework for non-consumptive recreational use of wildlife, which used an interface between ecology, the recreational user and the historical context of the human-wildlife interaction. This concept draws on several models including the Leisure Specialisation Continuum (LSC) (Bryan, 1977), Butler's (1980) model of the evolution of tourist places and concept of Limits of Acceptable Change (LAC) by Stankey *et al.* (1985). They further point out that wildlife resources evolve and change over time in terms of both users and sites where activities take place. Duffus and Dearden (1990) support this notion where they state that "through time, a site particularly attractive for wildlife viewing may develop a public image through the growth in publicity and facilities designed to service the visitors who arrive at the area to encounter wildlife. As the facilities expand, this in turn influences the types of

individuals who visit a site, the expectations, and the satisfaction derived from the attraction” (p. 222).

There has been recent discussion of how planning models could facilitate the management of wildlife tourism (Birtles *et al.*, 2001; Higginbottom *et al.*, 2003; Higginbottom, 2004a; Higham *et al.*, 2008), however there has been few examples where the models have been applied to wildlife tourism specifically. While Duffus and Dearden discuss differences between generalist and the specialist user and suggest some associated management strategies, they do not attempt to analyse the human-wildlife interaction, or motivations of the visitors. Orams (1996) takes a different approach by viewing the range of opportunities in a “Spectrum of Tourist-Wildlife Interaction Opportunities” (SoTWIO). This model is divided into interaction opportunities, management strategies and outcome indicators for both the tourist and wildlife. Within this spectrum, both captive wildlife tourism interacts with wildlife in the wild, are considered. The SoTWIO covers a wide range of management regimes and structures which are used to control the interaction between tourists and wildlife including physical, regulatory, economic and educational. Rather than focus on physical and regulatory strategies, which often dominate wildlife tourism management strategies, the SoTWIO focuses on the role of education-based management strategies and establishes a basis upon which the effectiveness of education can be tested.

Reynolds and Braithwaite (2001) also developed a conceptual framework for human-wildlife interactions based on visitors satisfaction and the protection of wildlife resources. Their model suggests that the principal factors of “effect on wildlife” and “satisfaction” lead to sustainable tourism and ultimately serve the interests of conservation. The framework draws from a variety of wildlife tourism situations in Australia and elsewhere and classifies the major components of wildlife tourism and indicates the roles of and the relationship between these components.

Reynolds and Braithwaite (2001) suggest that the values of conservation, animal welfare, visitor satisfaction and profitability are often in conflict in wildlife tourism and trade-offs are necessary.

While the planning models described in Section 2.3 show promise for managing wildlife tourism operations, their application is limited and possess inherent issues that require further consideration. The following section describes the prerequisites for reaching sustainable wildlife tourism and explores the opportunities and constraints for achieving sustainability.

2.4.1 A holistic approach

Planning for wildlife tourism requires a regional perspective as many animals are recognised as fugitive and common-pool resources (Ciriacy-Wantrup and Bishop, 1975; Briassoulis, 2002; Newsome *et al.*, 2005; Higham and Lück, 2007). Migratory species, such as turtles, can be regarded as a fugitive resource because they can move across lands and waters independent of who owns the land or water. This makes their management difficult, particularly when migrating animals move across jurisdictional boundaries, such as national park boundaries or even countries. Common-pool resources are those where it is extremely difficult to exclude users and potential users from exploiting a resource (Ostrom *et al.*, 1999). Given the nature of fugitive and common-pool resources, multiple stakeholders that have an interest in the resource should be engaged to ensure the resource is managed at various levels and locations.

2.4.2 Stakeholder engagement

2.4.2.1 Stakeholder collaboration

An important component of sustainable tourism is the collaboration of relevant stakeholders (Murphy, 1985; Drumm, 1998; Bramwell and Lane, 2000a; Caffyn, 2000; Hall, 2000a; Jamal and Getz, 2000; Nichols *et al.*, 2000; Richards and Hall, 2000; Newsome *et al.*, 2002; Scheyvens,

2002; Burns, 2004; Newsome *et al.*, 2005). The discourse relating to wildlife tourism is moving towards an integrated approach to planning in recognition of the interactions and partnerships between various interest groups (Dowling and Sharp, 1996; Smith and Newsome, 2002; Higginbottom, 2004a; Newsome *et al.*, 2005). Wildlife tourism, in common with other forms of tourism, occurs within a political and social climate and is considered to be an expression of the intersection of politics, society and management (Newsome *et al.*, 2005; Macbeth, 2005). Therefore, stakeholder collaboration and community involvement is essential to the success of any planning process.

Riveria (2002) explains that up until the 1980s, environmental management was based on public policy (usually developed by government agencies) that emphasised command-and-control tactics and associated mandatory regulation. In the development of wildlife tourism, it is important that tourism should equitably balance the costs and benefits of conservation, which are often borne by local communities. Newsome *et al.* (2005) argue that this balance can be achieved through the creation of mutually beneficial, self-sustaining mechanisms that support tourism, wildlife, institutions and communities. Although a fundamental component of any tourism system, the host community is frequently overlooked in the wildlife tourism literature (MacLellan, 1999; Matt and Aumiller, 2002), and it seems likely that this is often paralleled in practice (Burns, 2004).

Frequently referred to in tourism literature, “host community” is often presented as synonymous with “residents”, “locals”, “public” or “citizens” (Burns, 2004). An important characteristic of the host community is that it does not constitute a unified whole, and its constituent groups of stakeholders and individuals are rarely homogeneous (Ashley and Roe, 1998). In this thesis, residents are the people living in wildlife tourism destinations (Burns, 2004). For the purpose of this thesis, a stakeholder is defined here as “any person, group, or organisation that is affected by

the cause or consequence of an issue” (Bryson and Crosby, 1992, p. 65). Stakeholders relevant to wildlife tourism policy-making can include government agencies, pressure and interest groups, community leaders and members of the community, international organisations, industry associations, environmental non-government organisations, tourism businesses, and landowners (Newsome *et al.*, 2005).

The involvement of stakeholders may have significant benefits for sustainability in light of environmental, social, cultural, economic and political uncertainties (Medeiros de Araujo and Bramwell, 2000). Bramwell and Lane (2000a) suggest that the benefits of involving stakeholders include better decisions, increased accountability, stakeholder acceptance, local community empowerment, and clarity in visitor preferences. It has been shown that better decisions result from sharing information between stakeholders (Bramwell and Lane, 2000a).

Some of the main benefits include providing cost-effective solutions in regions by pooling resources and avoiding the costs of potential stakeholder conflicts (Jamal and Getz, 1995; Healey, 1997; Bramwell and Lane, 2000a; Laing *et al.*, 2008). Politically, the collaboration process is more legitimate and equitable than conventional approaches to planning because it promotes sharing and participation, whereby the opinions and recommendations of non-industry stakeholders are just as legitimate as those of an “expert” (Jamal and Getz, 1995; Healey, 1997). Furthermore, collaboration adds to ongoing policy making, as it provides an opportunity for people who are affected by development to share their knowledge and experiences (Healey, 1997; Bramwell and Lane, 2000a).

Despite these benefits there remains a lack of understanding of why partnerships succeed or fail. Stakeholder collaboration in the planning process relates to whether all relevant parties and interest groups become participants in the collaborative planning process. This presents a

challenge given host communities do not constitute a unified whole and stakeholders within the community are rarely homogeneous (Ashley and Roe, 1998). Divergent interests exist amongst host community members (Burns and Howard, 2003) and recognition of this is essential for tourism planners, developers, and managers. Therefore, it is important to recognize that variations in the level of support exist within the same community (Mason and Cheyne, 2000).

The intensity of collaborative relations is often different between partnerships within a planning process. A major criticism of collaboration theory is based on the assumption that collaboration processes can overcome power imbalances just by involving all the stakeholders in a process. This ignores the existence of systematic constraints, such as the distribution of power and resource flows (Healey, 1997; Reed, 1997a). The intensity of collaborative relations should therefore be viewed as a continuum ranging from “loose” linkages to stronger coalitions where there are broad mission statements and jointly conducted tasks (Hall, 2000a).

Parker (2000) distinguishes between institutional arrangements which take place within a highly institutionalised structure, such as task force and “networked” arrangements, and more open, fluid and *ad hoc* arrangements. The duration of relations will depend on the level of partnership sincerity and the building and retention of trust among participants (Roberts and Simpson, 2000). The potential for partnerships to draw on local knowledge in a systematic and respectful way as a basis to promote shared learning provides an opportunity to build this trust (Reed, 2000). Some participants may not enter into collaborative projects from a true desire to achieve an interest-based agreement. Brown (1996, p.15) found that that some stakeholders “may consider it necessary to participate as a sort of “damage control”, not because they truly see a collaborative solution as their best alternative”.

Consensus amongst stakeholders becomes essential to the success of collaborative processes, particularly when there are limited resources, subsequently requiring prioritization of objectives. As such, prioritising objectives may potentially cause conflicts amongst stakeholders as the urgency for agenda items to be implemented can influence lifestyle and even financial status for individual participants (Bramwell and Lane, 2000a). The consultation process involved in engaging stakeholders can be time consuming and taxing on resources (Bramwell and Lane, 2000a; Newsome *et al.*, 2002). Not only are more resources needed to undertake consultation but also such consultation can exert additional pressures on under-resourced managers, leading to additional implementation costs. Caffyn (2000) stresses the importance of resource flow from the public sector as a critical influence on the capacity of partnership to effect change. Long (2000) described a cyclic effect of resources which notes that resources generate political power, which generate actions that, if seen to contribute significantly to conservation, can generate media exposure, which in turn increases the chances of securing further funds and political power.

2.4.2.2 Community involvement and volunteer tourism

Community participation in natural resource conservation and management is recognized as a critical factor in successful conservation efforts (Bodmer *et al.*, 1997; Robinson and Bodmer, 1999). Members of the local community, such as nature-based tour guides, volunteers or people who have a general interest in wildlife conservation, also play an important role in stakeholder collaboration. According to Bodmer *et al.* (1997), community participation in conservation fosters a sense of ownership on part of the community and can provide valuable knowledge about local environments and current impacts to wildlife. While community involvement is an important aspect of stakeholder collaboration and monitoring of focal species, monitoring programs need to be designed to accommodate for people with often minimal scientific background whilst providing accurate and useful data.

Volunteer tourism has also gained interest among researchers in recent times (Mustonen, 2007). According to most widely used definition, volunteer tourists are people who for various reasons, volunteer in an organised way to undertake holidays that might involve the aiding or alleviating the material poverty of some groups in society, the restoration of certain environments, or research into aspects of society or environment (Wearing, 2003, p.10). Both commercial tour operators and volunteers, for example, have been important to several monitoring programmes developed for whale-watching (Hoyt, 2001; Valentine *et al.*, 2004; Peake *et al.*, 2009), marine turtles (Tisdell and Wilson, 2001; James Scheerer Research Charter, 2004), coral reef protection (Hodgson, 1999), and the Western Australian marine environment (CALM and AMCS, 2000). These programmes rely on training, guidelines and protocols for survey techniques and data collection to ensure that accurate and useful data are collected.

2.4.3 Collecting baseline biological data

Fundamental to developing sustainable wildlife tourism is the collection of baseline biological data on target species, as it provides the basis from which to investigate wildlife (Gilbert and Dodds, 1992) and understand the effects of tourism on wildlife (Higginbottom, 2004a; Newsome *et al.*, 2005). This can be achieved through scientific research and monitoring. The knowledge gained from biological research on wildlife provides a firmer base to inform decisions relating to the management of wildlife tourism (Gilbert and Dodds, 1992; Newsome *et al.*, 2005). Biological data provides the information needed to assess management effectiveness (Hockings *et al.*, 2000). According to Berrow (2003), research on the distribution and relative abundance of the focal species should be carried out prior to the development of any planning framework. The information generated from baseline data can help measure the effectiveness of various management approaches in different situations (Hockings *et al.*, 2000), and be used to develop a suite of practical monitoring methods for particular species (Burns, 2004).

Monitoring is a process of repetitive observation of one or more elements or indicators of the environment according to pre-arranged schedules in time or space (Selman, 1992). Newsome *et al.* (2002) suggest that judgments regarding recreational impact on wild animals need to first consider natural population dynamics, habitat requirements and natural distribution of the species of interest. Secondly, a profile of tourism activity and pressures need to be catalogued. Measures of impact can then be judged according to changes in the population, alterations in distribution and behavioural changes in the target species. Planning for wildlife tourism ideally requires continual monitoring of the animal population variables, animal behavior and the degree of compliance with the regulations and voluntary codes by visitors and operators (Wilson, 2003). However, the systematic monitoring and review of such regulatory and voluntary structures can be expensive and cumbersome, particularly when the conditions under which structures are devised are often dynamic and difficult to conceptualize for practical purposes (Wilson, 2003).

Biological information is becoming more important as natural area managers become increasingly subject to public scrutiny (Newsome *et al.*, 2002). Performance reporting, where monitoring data are made publicly available, is one way of meeting public requests for accountability. Providing access to data may enhance the community's awareness of local issues and strengthen their relationship through transparent management. Monitoring can provide information, not only when management intervention is required, but also to improve the understanding of managers and stakeholders of the cause-effect relationship between levels and types of visitor-use and impacts (Pitts and Smith, 1993). Such understanding is essential if impacts are to be detected early before a threshold of irreversible change is reached (Buckley, 1999).

Despite the need for collecting biological data in wildlife tourism, monitoring of wildlife and their habitats has been a long neglected element of wildlife tourism management (Oliver, 1995; Hammit and Cole, 1998; Newsome *et al.*, 2002; Wilson, 2003; Higham and Lück, 2007). There are few methods suitable for describing and quantifying behaviour (Altman, 1974; Higginbottom, 2004a), population dynamics and wildlife habitat (Berwick and Saharia, 1995; Bookhout, 1996), that purposefully identify tourism-related impacts. This thesis explores the issues associated with collecting baseline biological data on marine turtles in the Ningaloo region.

2.4.4 Collecting baseline visitor data

Without knowledge of the characteristics of use and users of natural areas, management of recreational pursuits is extremely difficult (Cole and McCool, 2000). Since the 1960s, defining visitor and visit characteristics has become an important component of tourism research (Cole and McCool, 2000). A wide range of information can be obtained from assessing visitor and visit characteristics. Information on total visitation allows comparison of use levels among areas over time, which allows managers to focus on areas with the greatest intensity (Hall and Selby, 1998). Knowledge of the distribution of visitor-use can narrow the focus to site-specific investigations to understand the nature of impacts from visitation (Hall and Shelby, 1998; Spencer *et al.*, 1999). Other important information used to inform the management of visitor impacts includes data on visitor length of stay, repeat users and method of travel (Spencer *et al.*, 1999; Cole, 2001).

Rodger *et al.* (2007) highlight the need to better understand the interface between visitors and wildlife. They note that an understanding of the social context of wildlife tourism should make a critical contribution to the sustainability of wildlife viewing. Visitor surveys are commonly used and are an important source of input for management (Roggenbuck and Lucas, 1987) that can provide meaningful and useful information regarding the perception of impacts (both biophysical

and social) and the extent to which environmental change is acceptable (Chin *et al.*, 2000). By asking visitors what conditions contributed to their tourism experience, biophysical and social indicators can be derived to measure these conditions (Manning and Lawson, 2002).

Accurate information on visitor needs and expectations and patterns of use are essential for managers to make informed decisions (CALM 2001b). Pitts and Smith (1993) stated that without baseline information on visitors, there is no benchmark information for monitoring the effectiveness of future management plans and for revising planning documents. Furthermore, management practises tend to be based on personal intuition of the managers and are often dictated by external pressures, such as financial availability and staff constraints, rather than being based on visitor data (Hammitt and Cole, 1998).

The engagement of scientists from both natural and social science disciplines is the first step toward sustainable outcomes. The effectiveness of good science ultimately lies with the ability of policy makers and resource managers to respond to research, and apply the outcomes of the science in a meaningful way (Higham and Lück, 2007). In a recent study of wildlife tours in Australia, Rodger *et al.* (2007) address the place of science and monitoring in wildlife tourism businesses. They found that there was little transfer of information between scientists and businesses and concluded that “given the centrality of science to sustainability, mechanisms for increasing this involvement particularly in impact research, through partnerships and other means, are critical for long term sustainability of this industry” (Rodger *et al.*, 2007, p. 160). This thesis explores the convergence of natural and social sciences in turtle tourism in the Ningaloo region. This thesis also shows how the information derived from studies on turtles and turtle watchers can add value to management through the development of a planning model specifically tailored for wildlife tourism.

2.4.5 Detecting tourism-related impacts on wildlife

The greatest challenge for wildlife managers is to differentiate between recreational impacts and natural variations in the quest for sustainable tourism (Pigram and Jenkins, 1999; Seddon and Ellenberg, 2008; Newsome and Rodger, 2008). Wildlife tourism can result in a range of negative effects on wildlife and target species. These vary from short-term changes in physiology or behaviour of individual animals through to long-term effect such as increased mortality or reduced breeding success of entire populations. For managers, research of short-term impacts is often preferred, due to limited resources and time, long-term impacts of human-wildlife interactions requires ongoing monitoring to minimise the confounding effects of natural variation (Cosgriff, 1997; Higham and Lück, 2007).

Although wildlife tourism interactions are becoming increasingly popular, there remains a dearth of “hard data” on the nature and significance of tourism impact situations (Knight and Cole, 1995; Hammit and Cole, 1998; Valentine and Birtles, 2004). Compounding this is the paucity of systematic and quantitative monitoring of impacts of tourism on wildlife (Manfredo *et al.*, 1995; Hockings *et al.*, 2000; Green and Higginbottom, 2001). The reason for this is due to the absence of, and difficulties encountered in isolating and researching animal behaviour responses of disturbance resulting from tourism activity (Wilson, 2003; Newsome *et al.*, 2005). Furthermore, the tolerance of individual animals to human intrusion and natural variability in their behaviour as a result of external environmental influences is highly variable (Hammit and Cole, 1998; Birtles *et al.*, 2001). The ability to detect real changes that are occurring remains a critical issue, especially in the case of long-lived, slow breeding species, such as marine turtles.

2.5 Planning in turtle tourism

Although wildlife resources are increasingly being utilized for non-consumptive wildlife oriented recreation, both in Australia and elsewhere, and despite the large earnings and employment generated, some wildlife resources such as marine turtles have remained, until recently, a relatively untapped tourism resource (Waayers, 2000; Wilson and Tisdell, 2001). In the past, marine turtles were mostly viewed as a consumptive natural resource (Limpus 2001; Waayers, 2000). Turtle tourism is now considered a conservation tool in both developed and developing countries. Developed countries that embrace turtle tourism include Australia, America, Greece, Turkey, South Africa, Brazil and Israel (Waayers, 2000), while less developed countries that encourage turtle tourism for conservation include Costa Rica (Govan, 1998; Harrison and Troeng, 2003; Troeng and Rankin, 2005), India and Sri Lanka (Baldwin *et al.*, 2004), Indonesia (Sloan, 1994), Malaysia (Arbec Turtle Conservation ATC, 2002), and Mexico (Nichols *et al.*, 2000).

Marine turtles have long fascinated people and figured prominently in mythology and folklore of many cultures including the indigenous Australians and Torres Strait Islanders (Wilson and Tisdell, 2001; Zeppel and Muloin, 2008a). Seri Indians, who still live on the shores of the Gulf of California, believe that the world began on the back of a gigantic (leatherback) turtle. In the Miskito Cays of the eastern coast of Nicaragua, the local people still believe in the story of a kind “Turtle Mother” (a benevolent spirit), who acts as an intermediary between the worlds of animals and humans (Ripple, 1996). Besides the mythology that surrounds the marine turtles, they are considered by many as mystical, uncommon, a unique sea reptile and a source of living wonder and of curiosity (Wilson and Tisdell, 2001). These attributes make marine turtles a valuable NCWOR resource for wildlife tourism development.

2.5.1 Turtle tourism in Australia

In Australia, there are several ways that visitors interact with turtles. Interactions may occur during a scenic boat cruise, driving off-road vehicles on the beach, air charter tours, shore-based encounters, island and reef trips, glass-bottom boat rides, sea kayak tours, snorkelling and diving trips (Birtles *et al.*, 2004). Visitors seeking to view turtles may participate in organised tours or seek an encounter independently. Organised tours can be further divided into dedicated or incidental. A dedicated tour is one whereby the tour operator deliberately intends to encounter a turtle and an incidental event is where the encounter occurs as part of a broader wildlife tour or nature-based experience.

Six of the seven species of marine turtles that visit the northern beaches of Australia, including green (*Chelonia mydas*), loggerhead (*Caretta caretta*), hawksbill (*Eretmochelys imbricata*), flatback (*Natator depressus*), olive ridley (*Lepidochelys olivacea*) and leatherback (*Dermochelys coriacea*) turtles generally nest during the summer months (October - March) (Limpus, 2009). Australia has some of the most important rookeries of turtles in the world (Limpus 1994). The rookeries are utilised by turtles in their hundreds or even thousands. Limpus (1994, p. 100) points out that “Australia is one of the few countries that still has large breeding aggregations of marine turtles comparable to what they would have been like 200 years ago.” The flatback turtle is unique to the Australian continental shelf (Limpus, 1988), which is an added attraction to ecotourists, including wildlife specialists from overseas. Four species of turtle (green, flatback, loggerhead and hawksbill turtles) occur in globally significant numbers around the Australian coastline (Limpus, 1994), while two species (leatherback and olive ridley turtles) occur in smaller numbers. The size of Australia's breeding populations and the variety of species makes turtle tourism an attractive wildlife tourism prospect.

In Australia, there are 60 recorded operators that offer some form of turtle tourism (Birtles *et al.*, 2004) (see Table 2.1). This thesis focuses on shore-based turtle tourism, where visitors watch nesting adults and hatchlings emerging from the nests at night. In 2005, there are 15 dedicated and six incidental shore-based turtle tour operations in Australia (Birtles *et al.*, 2005) (Table 2.1). In Australia, the value of shore-based turtle tourism has been demonstrated by the large numbers of visitors to Mon Repos Conservation Park and Heron Island National Park during the Australian summer. These two relatively small beaches in the southern Great Barrier Reef attract as many as 35,000 visitors each year during the summer (Limpus, 1994). The daily average expenditures of these visitors is AU\$35.00, which amounts to a total of approximately AU\$833,000 for the region (Tisdell and Wilson, 2001). Based on the average number of days spent in the region, expenditure in the region for the 1999–2000 nesting season was approximately AU\$2.68 million. Tisdell and Wilson (2001) also found that 40% of visitors stated that they would not have visited the Bundaberg region if the turtle watching operations was not an attraction, which equate to a loss of AU\$1.07million to the region if Mon Repos did not exist. These figures show that the potential economic value of turtle tourism is evident, yet the cost of disturbances to nesting populations is yet to be assessed.

Turtle tourism viewing can generate income, provide employment, be educational and at the same time support efforts to conserve turtles (Tisdell and Wilson, 2001). Turtle watching can be used to increase public awareness on the threats facing turtles and their habitats (Gampell, 1999). For example, edu-tourism (see Tisdell, 1998) can go a long way in educating the public about threats to turtles and can also help to raise money for conservation. Turtle watching can be further complemented by establishing visitor centres and museums dedicated to turtles, depicting all aspects of turtles ranging from their biology, life at sea, current turtle research, main threats to sea turtles, history of commercial sea turtle harvesting (both Australia and world-wide) and what tourists can do to help the species (Kay, 1995; Waayers, 2000).

Table 2.1 Types of turtle tourism in Australia

Types of turtle tourism	Tour or independent	Dedicated/incidental	Examples
Viewing nesting adults and hatchlings on beaches in their natural habitat	Tour	Dedicated	Heron Island, Mon Repos, Lady Elliot Island in Queensland; Dirk Hartog Island, Exmouth, Coral Bay, Lacepede Island and Dampier Peninsula in Western Australia; Bathurst Island and Bare Sand Island in the Northern Territory; 4WD tours in Cairns and Sydney
	Independent	Dedicated	Ningaloo, Eighty Mile Beach. There possibly more people viewing turtles independently than people guided at shore-based facilities
Viewing swimming turtles from the air	Tour	Incidental	Islands in the Gulf of Carpentaria and Montgomery Reef
Viewing swimming turtles as part of kayaking activities	Both	Incidental	Shark Bay and Ningaloo in Western Australia
Viewing turtles in aquariums and hatcheries	Tour	Dedicated	AQUA in Western Australia, GBR Aquarium in Townsville and hatcheries in Northern Territory
Viewing swimming turtles under the water in their natural habitat	Both	Incidental	Most diving centres in the northern regions of Australia use turtles as an icon species to attract clients (e.g. the GBR and Ningaloo)
Viewing turtles from boat-based activities	Both	Incidental	Hervey Bay, Hinchinbrook Island, Fraser Island, and the Gulf of Carpentaria; Shark Bay and Broome in Western Australia
Participating in research on turtles	Tour	Dedicated	Landscape expeditions at Dirk Hartog Island

(Source: Birtles *et al.*, 2005)

Many turtles and their rookeries in Australia are located in traditional territories of Aboriginal and Torres Strait Islander people. Marine turtles play an important role in the traditions and culture of these native people (Wilson and Tisdell, 2001). In parts of Australia, Aboriginal people have traditionally hunted turtles and continue to consume turtle meat as part of their diets. Making use of the knowledge of Aboriginal people within the context of turtle tourism can, not only provide employment and income-generating avenues for local communities, but also help in the monitoring and conservation of turtles. Turtle tourism can also complement other Aboriginal and Torres Strait Islander attractions, such as cultural art tours.

Turtle tourism is an ideal case study for exploring the inherent issues associated with sustainable wildlife tourism. Turtle tourism requires a holistic approach given the broad distribution and

fugitive nature of turtles. Turtles are a threatened focal species that require protection and management from numerous stakeholders. Given the slow movement turtles as they ascend and descend across the beach, collecting baseline data and observing behavioural characteristics of nesting turtles is logistically achievable.

2.5.2 Existing management of turtle tourism

Managing turtle tourism cannot be effective without the guidance of ongoing monitoring of key nesting populations (Arapis and Margaritoulis, 1994; Wilson and Tisdell, 2001; Limpus, 2002; Limpus and Limpus, 2002; Department of Environment and Heritage, 2003). Although not always developed specifically for turtle tourism, there have been numerous turtle population studies undertaken in Australia. The majority of published work is based in Queensland (Fitzsimmons *et al.*, 1996; Limpus, 2009) and Northern Territory (Kennett *et al.*, 1997), with limited publications presented from Western Australia (Prince, 2000; Waayers, 2004; Pendoley, 2005).

Marine turtles that come ashore at night to nest can be easily disturbed by artificial lights and other human activities, such as driving off-road vehicles and lighting fires on the beach (Ehrenfeld and Koch, 1967; Arianoutsou, 1988; Jacobson and Lopez, 1994; Johnson *et al.*, 1996; Ripple, 1996; Witherington and Martin, 1996). This can result in turtles returning to the ocean without nesting. Some turtles abandon a nesting attempt if approached closely, although interrupted turtles may return on the same or subsequent night to lay in the absence of disturbance (Davis and Whiting, 1977; Talbert *et al.*, 1980). Jacobson and Lopez (1994) found that the presence and behaviour of visitors resulted in some displacement of nesting turtles at Tortuguero National Park, Costa Rica. They showed that less turtles visited the beaches during the weekends, which was when most visitors were present. According to Johnson *et al.* (1996)

organised turtle tours disturbed loggerhead turtles during the camouflage and returning phases of the nesting process. With consistent tourist activity over consecutive nights, it is thought that continued presence of tourists on the beach may cause a shift in nesting locality (Murphy, 1985b; Jacobson and 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 and Musick, 1997).

No detailed study has been carried out to determine the impacts of shore-based turtle tourism at Mon Repos, Heron Island or South Africa (Wilson and Tisdell, 2001). Nevertheless, disturbances of nesting turtles by high tourist numbers at Mon Repos have been a concern for some time (Limpus and Reimer, 1990). Limpus (1994, p. 103) states that “increasing negative impacts on turtle breeding sites are taking place as a result of increased numbers of tourists wanting to watch nesting turtles”. The above-mentioned studies demonstrate that turtle tourism can adversely impact on breeding turtles if insufficient safeguards are adopted. If sustainable use of this valuable resource is to be expanded, then strict guidelines have to be adopted for tourism development. Such guidelines need to be developed in consultation with marine biologists, government agencies, non-government organisations and other stakeholders. In 2004, a research project funded by the Commonwealth Department of Environment and Heritage was established to develop a national Code of Practice for beach-based interactions with turtles and World’s Best Practice Management for turtle tourism in Australia (Birtles *et al.*, 2005). The aim of the project was to identify key issues relating to the biological and cultural aspects of turtle tourism and then test and evaluate a set of improved guidelines at various sites in Australia. The idea was that the adoption of a national Code of Practice by local councils, wildlife managers, NGOs and traditional owners would achieve consistency in the information available to tourists interacting with nesting marine turtles (Birtles *et al.*, 2005).

2.5.3 Case of Mon Repos Conservation Park

The case of Mon Repos Conservation Park is important to this thesis as it provides an example of a developed turtle tourism operation that has been running for up to 30 years (Howard, 2000; Wilson and Tisdell, 2001; Ballantyne, Parker and Bond, 2007; Hughes, 2009). It provides some historical context to turtle tourism planning in Australia and is considered a successful example of turtle tourism management throughout the world. The Mon Repos Conservation Park is managed by Queensland Parks and Wildlife Service (QPWS) (Wilson and Tisdell, 2001). Use of the area by the public is restricted at night. Visitors are taken to the beach to watch turtles at night under guidance of QPWS rangers and volunteers. Each group consists of a maximum of 70 people. The use of torches is restricted and visitors are guided to avoid disturbance of nesting turtles. An interpretative programme is conducted by QPWS staff on the beach to explain the egg-laying process of turtles and hatchling behaviour. A display centre and audio-visual presentations provide further information on turtle nesting behaviour and breeding migrations, life history, biology and evolution, research and conservation problems.

A study conducted by Woodson (1996) at the Mon Repos Conservation Park revealed that there is a cyclical relationship between education, concern and behaviour change and a strong interdependence between education and behaviour change. The study found that once a person gains awareness through education, they then become concerned about the turtle populations. Once this concern becomes important enough to the person, it will lead to a desire to change their behaviour. This change can occur in many different ways, largely including educating others about what they had learnt.

2.6 Conclusion

Achieving sustainable wildlife tourism requires the implementation of planning models that recognise the intrinsic balance between natural resource and visitor management. Sustainable wildlife tourism can offer a realistic chance for the conservation of wildlife resources in the long term, particularly for wildlife resources that are dwindling due to habitat destruction, poaching and other human actions. Although several planning models have been developed to facilitate the management of wildlife tourism, there remains a paucity of research showing examples where these models have been applied to wildlife tourism situations.

Planning for wildlife tourism requires a holistic perspective as many animals are recognised as fugitive and common-pool resources. Subsequently, stakeholder collaboration and community involvement is essential to the success of the planning process. Involving stakeholders in the planning process is known to generate better decisions, increase accountability, enhance stakeholder acceptance, empower local communities, and clarifying visitor preferences (Jamal and Getz, 1995; Healey, 1997; Bramwell and Lane, 2000b; Medeiros de Araujo and Bramwell, 2000). Despite these benefits there remains a lack of understanding of why partnerships succeed or fail.

Another important element in developing sustainable wildlife tourism is the collection of baseline biological data on target species and visitor activities. Baseline data provides the basis from which to investigate wildlife and understand the effects of tourism on wildlife (Gilbert and Dodds, 1992; Higginbottom, 2004a; Newsome *et al.*, 2005). Yet monitoring of wildlife and their habitats and knowledge of the characteristics of use and users of natural areas has been long neglected in wildlife tourism management (Oliver, 1995; Hammit and Cole, 1998; Newsome *et al.*, 2002; Wilson, 2003). Detecting tourism-related impacts is also a challenge for managers because of the complexity associated with human-wildlife interactions such as the difficulty in

measuring the characteristics of tourist interactions and the natural variation often inherent in animal populations (Manfredo *et al.*, 1995; Hockings *et al.*, 2000; Green and Higginbottom, 2001).

Marine turtles have remained, until recently, a relatively untapped tourism resource. Turtle tourism is recognised as a potential conservation tool in both developed and developing countries, whilst generating income and providing employment. In Australia, the tourism value of turtles has been recognised at Mon Repos Conservation Park and Heron Island National Park. The potential for expanding turtle tourism in other parts of Australia is becoming realised with up to 60 operators incorporating turtle tourism in their business (Birtles *et al.*, 2005).

Although there have been numerous population studies undertaken in Australia (Kennett *et al.*, 1997; Fitzsimmons *et al.*, 1999; Prince, 2000; Limpus *et al.*, 2003; Waayers, 2004; Pendoley, 2005), little is known about how tourism impacts on specific rookeries and how this effects the breeding population. Marine turtles that come ashore at night to nest can be easily disturbed by artificial lights and other human activities, such as driving off-road vehicles and lighting fires on the beach. No detailed study has been carried out to determine the impacts of tourism on nesting turtles at popular turtle watching destinations, such as Mon Repos, Heron Island and South Africa, or the Ningaloo region in Western Australia.

The remainder of this thesis presents a case study of the development of turtle tourism in the Ningaloo region in Western Australia. Part 2 of this thesis provides background to turtle tourism in the Ningaloo region and then presents four separate studies that explore the elements of turtle tourism (and also wildlife tourism) that require further investigation, including: stakeholder collaboration, turtle nesting populations, visitor-use and characteristics, and impacts associated with human-turtle interactions.

PART 2

A CASE STUDY OF TURTLE TOURISM IN THE NINGALOO REGION

CHAPTER 3 STUDY AREA AND CONTEXT

3.1 Introduction

The beaches of the Ningaloo Marine Park support important habitat for turtle species: green, loggerhead, hawksbill, and flatback turtles (Prince, 1994b, 1998, 2000; Commonwealth of Australia, 2002; DEWHA, 2008). All these species are protected under the *Environment Protection and Conservation Biodiversity Act 1999* (EPBC Act) (DEWHA, 2008) and *Wildlife Conservation Act 1950* (DEC, 2008). The Recovery Plan for Turtles in Australia recognizes that turtle tourism poses a threat to turtle populations (DEH, 2003). As turtle tourism increases in popularity in the Ningaloo region, the need for baseline information relating to visitors, turtle populations and impacts is vital. At the commencement of this study in 2001, there was little data on turtle populations in the Ningaloo Marine Park, inadequate information relating to the impacts from human-turtle interactions and no structured process in which turtle tourism existed. The aim of this chapter is to describe the study area and provide context in which turtle tourism exists in the Ningaloo region. It describes the general biophysical characteristics of the Ningaloo region with particular reference to turtles and their habitat, identifies protected areas and other tenures, describes the historical and current status of tourism generally and turtle tourism in the Ningaloo region.

3.2 Study area

This study was conducted in the Ningaloo region, which is approximately 1,250km north of Perth, the capital city of Western Australia (Figure 3.1), between November 2001 and March 2004. The study area covers 280km of coast between the North Muiron Island (21°23' E; 114°37' S) and Amherst Point (21°29' E; 113°55' S). The area includes Exmouth and Coral Bay and beaches of the Ningaloo Marine Park and the Muiron Islands Marine Management Area.

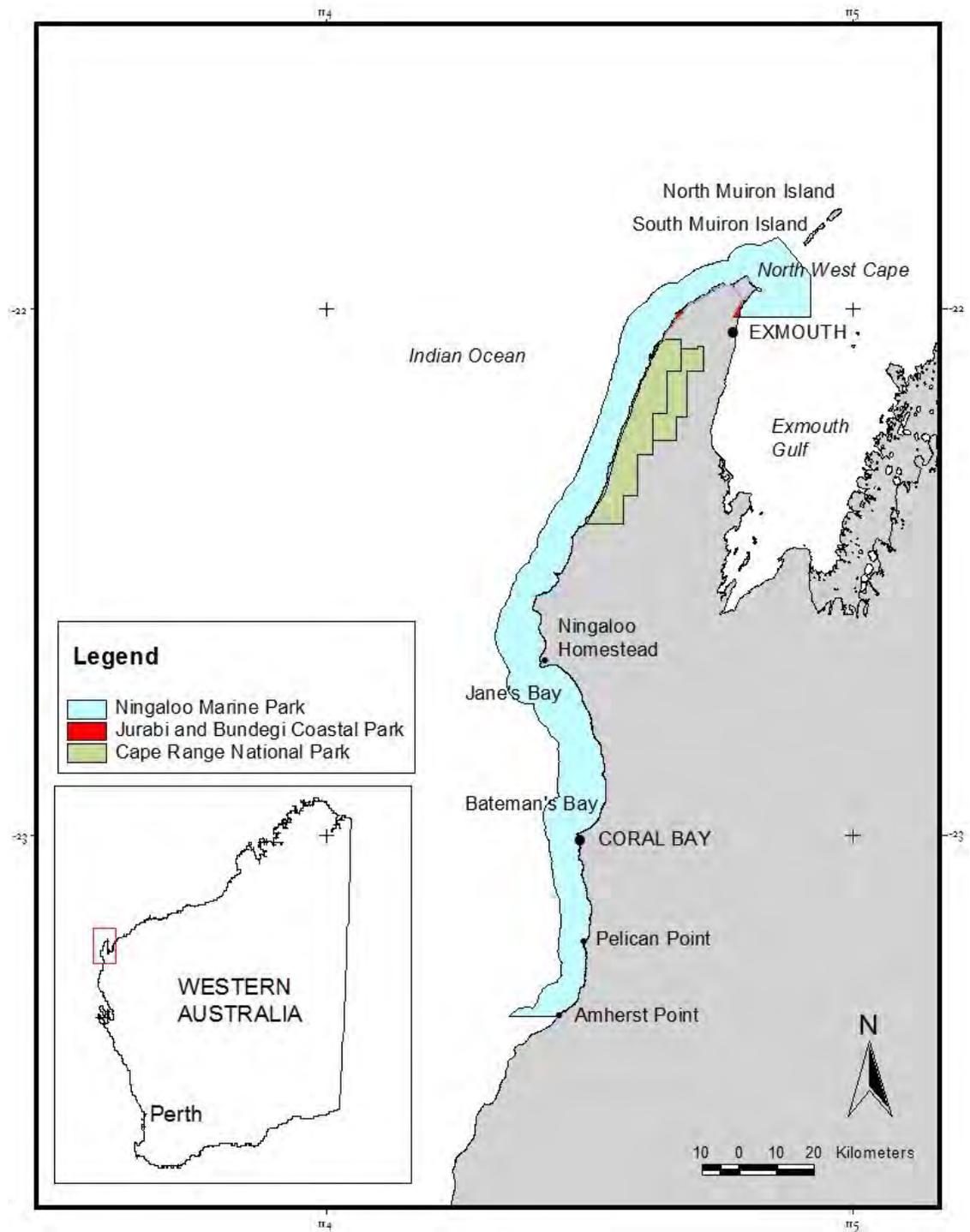


Figure 3.1 Study area covering the Ningaloo Region

3.2.1 Climate

The climate in the Ningaloo region is arid with an annual evaporation of about 2700mm, far exceeding the annual rainfall along the coast of between 200 – 300mm. Rainfall in summer (November - April) is often associated with cyclonic activity, however most rain occurs in June (Bureau of Meteorology, 2005). Although arid, there is considerable variation in the climate both within the region and from year to year. Data taken from the Learmonth Airport shows the average minimum temperature is 24.1°C in July, while the maximum is 38°C in January (CALM, 2005). In the western coast of the peninsula, the winds are predominately from the southwest with velocities ranging from 10m/sec to over 100 m/sec with a sea breeze developing in the late morning. Cyclonic winds although infrequent may be severe, exceeding speeds of 150 km/hr.

3.2.2 Biophysical characteristics

The Ningaloo Reef is the largest fringing coral reef in Australia and is over 300 km in length (CALM, 2005), forming a discontinuous barrier enclosing a lagoon (Figure 3.1). Gaps regularly intercept the main reef line providing for a series of individual elongated reef segments. The lagoonal areas backing the reef are interspersed with occasional patch reefs and nearshore platform reefs. The lagoonal area landward of the reef varies in width throughout the reserves but has an average depth of 2–4m, characterised by coarse calcareous sands in the shallows and fine calcareous sand and silt in the deeper basins and gutters. The shoreline is characterised by sandy beach, rocky benches or low limestone cliffs, sometimes with a sloping beach rock platform or a narrow fringing reef.

Temperate and tropical currents converge in the Ningaloo region resulting in highly diverse marine life with special conservation significance such as turtles, whale sharks, dugongs, whales and dolphins (CALM, 2005). The region is characterised by a diversity of marine ecological

communities including mangroves, macro-algae and invertebrates. The mainland coastline mainly comprises extensive sandy beaches and primary dune, with occasional intertidal rock platforms, which become exposed during low neap tides. The Muiron Islands are characterised by similar coastal habitat with limestone cliffs fronted by sandy beaches and intertidal rock platforms on the west coast and sandy beaches backed by low dunes on the east coast. These islands are known to support significant seabird and green turtle nesting areas (CALM, 2005).

3.2.3 Turtle nesting habitats

The turtle populations in northern Western Australia comprise a significant conservation resource on a worldwide scale (Fitzsimmons *et al.*, 1996; Fitzsimmons *et al.*, 1997; Dutton *et al.*, 2002; Limpus, 2002). Of the six species found in Western Australia, loggerhead, hawksbill and green turtles are known to nest in the Ningaloo region (Limpus, 1982; Fitzsimmons *et al.*, 1996; Preen *et al.*, 1997; Prince, 2000; Limpus and Chatto, 2004). Flatback turtles have not been reported nesting in the Ningaloo region but have been seen in offshore waters near the Muiron Islands and the Exmouth Gulf (Prince, 1994b). The nearest flatback turtle rookery is at Barrow Island 120km northeast of the Muiron Islands (Pendoley, 2005).

The nesting beaches along the Ningaloo coast and at the Muiron Islands provide suitable nesting habitat. Most of the beaches slope upwards to a sand platform elevated 1 - 3m above mean high water spring tides. Primary dunes typically rise to a height of 2 - 4m immediately behind the platform. The dunes and sand platform are usually vegetated, primarily by broad-leaved Spinifex (*Spinifex folius*). The beaches consist of medium-sized, mainly calcareous particles of sand with some larger fragments of coral. The height of mean high tide spring tide at the northern tip of the peninsula is 2.5m (Department for Planning and Infrastructure, 2004).

3.2.4 Impacts on turtles

Since the 1930s, turtle mortality and disturbance has been considered widespread and common in the Ningaloo region resulting from a wide range of human activities (Mack, 1994; Douglas, 2000; Morris and Lapwood, 2001). Historically, green turtles were harvested in the Ningaloo region for the turtle soup industry from 1930 to 1973, when it became illegal (Douglas, 2000; Cassidy, 1998). The full extent of this harvesting is not quite clear, however, there is some anecdotal information that suggests that approximately 70,000 turtles were slaughtered during this period. Former hunters from the Ningaloo region suggest that most of the turtles killed in the Ningaloo area were from the Jane's Bay breeding group (Cassidy, *pers. comm.*, 2001). Although the biological consequences on green turtles in the Ningaloo region from harvesting is not clear, it is likely to have had long-term effects on the population given turtles are long-living animals with late sex maturity (30 – 40 years) and long remigration intervals (green turtles will nest every 2 – 9 years)(Miller, 1997).

More recently, impacts on turtles in the Ningaloo region are mainly derived from commercial fishing industries (e.g. the incidental catch in prawn trawls, long-line fisheries, gillnets, float-lines and lobster pods), the introduction of red foxes (*Vulpes vulpes*), tourism development and four-wheel traffic on beaches (CALM, 1989; CALM, 2005). Little is known about to what extent these impacts affect the Ningaloo breeding population. A preliminary study undertaken by DEC found that up to 70% of nests are destroyed by foxes (NTP, 2009). To reduce the feral population of foxes to the area, the Agricultural Protection Board officers strategically place '1080' baits in the coastal dunes each year (CALM, 1987; NTP, 2009). Baiting in the Ningaloo region has led to a significant reduction in fox presence and predation on marine turtles. As it is nearly impossible to completely eradicate foxes, baiting is an ongoing management programme which ensures long term benefits for many native species.

Off-road vehicles driven on the beach can destroy nests, crush hatchlings as they transverse the beach and create deep wheel ruts that present a barrier to hatchlings attempting to reach the sea (Hosier *et al.* 1981; Cox *et al.* 1994). In more recent years, DEC have become concerned that independent turtle watchers are having an adverse impact on the nesting population as the number of visitors have increased over the years (CALM, 1995).

3.3 Legislation and Management

3.3.1 Relevant legislation

The conservation status of turtles in the Ningaloo area is summarised in Table 3.1. All four species are listed in Schedule 1 (fauna that is rare or likely to become extinct) under the *Western Australian Wildlife Conservation Act 1950* (Wildlife Conservation Act) and are classified as being of National Environmental Significance (NES) under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act). Green, hawksbill and flatback turtles are listed as “vulnerable”, and loggerhead turtles are listed as “endangered” under the EPBC Act. All species are listed as “migratory” under the EPBC Act.

Turtles are also listed under the Convention for the Conservation of Migratory Species of Wild Animals (CMS/Bonn Convention) and the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). The World Conservation Union (IUCN) has assigned “Critically Endangered” status to hawksbill turtles and “Endangered” status to green, and loggerhead turtles. Flatback turtles are listed as “Data Deficient”.

Table 3.1 Policies relevant to turtles in the Ningaloo region

Policies	Loggerhead turtle	Green turtle	Hawksbill turtle	Flatback turtle
IUCN Red List Status	Endangered	Endangered	Critically Endangered	Data Deficient
CMS Appendix	I and II	I and II	I and II	I and II
CITES Appendix	I only	I only	I only	I only
EPBC Act	Migratory, Endangered	Migratory, Vulnerable	Migratory, Vulnerable	Migratory, Vulnerable
Wildlife Conservation Act	Fauna is rare or is likely to become extinct	Fauna is rare or is likely to become extinct	Fauna is rare or is likely to become extinct	Fauna is rare or is likely to become extinct

Source: DEWHA (2008)

In Western Australia, all turtles are protected under the *Wildlife Conservation Act 1950 (WA)*. Protected areas are managed according to the *Conservation and Land Management Act 1984 (WA)* which requires conditional licensing of operations focusing on wildlife. Another piece of State legislation that is indirectly relevant to wildlife tourism and turtles is the *Environmental Protection Act 1986 (WA)*, which provides for the assessment of tourism developments likely to impact on the environment.

3.3.2 Relevant management plans

The Recovery Plan for Turtles in Australia (the Recovery Plan) was first drafted in 2001 and later released in 2003 (DEH, 2003). The overarching objective of the Recovery Plan is “to reduce detrimental impacts on Australian stocks of turtles and hence promote recovery in the wild” (DEH, 2003, p.3). It also identifies tourism as being an unquantified but emerging threat to the survival of turtle populations. The Recovery Plan recognizes the importance of managing light pollution, tourism and recreational activities, and vehicle damage through the implementation of professional codes of conduct where tours operate (DEH, 2003) (Table 3.2).

Table 3.2 Management plans relevant to turtle tourism in the Ningaloo region

Relevant policies	Level	Objectives	Author(s)
Recovery Plan for Turtles in Australia	National	<ul style="list-style-type: none"> • monitor key nesting beaches for turtle stocks • address lighting problems on affected beaches • identify tour operators that currently access turtle nesting beaches • identify nesting beaches that have uncontrolled access • develop a nationally agreed code of conduct for tour operators • encourage the participation and training of volunteers in agency monitoring programs • support the establishment of indigenous coastal community network 	Department of Environment and Heritage, 2003
Ningaloo Marine Park (State Water) Plan	State	<ul style="list-style-type: none"> • Determine the location and relative significance of turtle aggregations sites and rookeries within the reserves; • Ensure interaction activities do not impact turtles, through education and compliance programs and liaison with charter operators, and • Continue turtle monitoring programs within the reserves 	CALM, 2005
Jurabi and Bundegi Coastal Parks	Local	<ul style="list-style-type: none"> • Promote the importance of the conservation values of marine and terrestrial fauna particularly with regard to turtle activities within the Jurabi area; • Guide or restrict public access and wildlife interaction where necessary so that conservation values are protected; • Restrict vehicle access to unauthorized roads and tracks and re-vegetate unnecessary roads or tracks; • Integrate interpretation and education programs with those for Cape Range National Park and Ningaloo Marine Park and liaise closely with groups such as tourism agencies, schools and museums; and • Integrate management and investigate cooperative means of implementing and enforcing management plan strategies 	Shire of Exmouth and CALM, 1999

Although the Western Australian Nature Based Tourism Strategy (Tourism WA, 2004) does not explicitly recognise turtle tourism as a sector of tourism in Western Australia, it does recognise that the integration between conservation and tourism development can provide an economic incentive for protecting the environment. This strategy posits that through the provision of quality tourism experiences, education and information, visitors become more knowledgeable and aware of the natural environment.

At a regional level, the Department of Environmental Protection and the Ministry of Planning developed guidelines for tourism development in the Jurabi Coastal Park (WAPC, 1999). These guidelines recommended low-impact, small-scale tourism development on the Ningaloo coast adjacent to key nesting rookeries. The guidelines also incorporate standards for infrastructure designed to protect the integrity of the Cape Range and Ningaloo Marine Park.

3.3.3 Protected areas

DEC (formally CALM prior to 2005) has legislated responsibility for the management of marine conservation reserves, including the implementation of management plans. It collaborates closely with the Department of Fisheries, which also has significant management responsibilities in marine conservation reserves. It also liaises with other organisations, such as the Conservation Commission of Western Australia and local government authorities to ensure the various regulatory and management practice complement DEC's policies. There are four protected areas in the study area (Figure 3.1), including:

- Ningaloo Marine Park (State Waters) (CALM, 2005)
- Muiron Islands Marine Management Area (CALM, 2005)
- Bundegi and Jurabi Coastal Parks (Shire of Exmouth and CALM, 1999)
- Cape Range National Park Plan (CALM, 1987)

Ningaloo Marine Park (State Waters) and Muiron Islands Marine Management Area

The Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area 2005 – 2015 was formally approved by the Minister for the Environment on 7 January 2005. The Ningaloo Marine Park was originally gazetted in 1987 and was recently amended to include the whole of the Ningaloo Reef. The Muiron Islands Marine Management Area, Western Australia's first marine management area, was also gazetted on 30 November 2004.

The waters of the Ningaloo Marine Park including the fringing reef section are part of the Ningaloo Bioregion, while the Muiron Island's and Sunday Island, which is located 15 km north of Northwest Cape, lie in the Pilbara Offshore Bioregion (Interim Marine and Coastal Regionalisation for Australia, 1997). The waters of the Ningaloo Marine Park and the terrestrial component of the Park (40m landward of the high tide line) are vested in the Marine Parks and Reserves Authority (CALM, 1989). It includes about 90% of the reef extending approximately 26km from Northwest Cape to Amherst Point (Figure 3.1).

The Ningaloo Marine Park (State Waters) Plan identifies turtles as being one of the highest ecologically valued animals in the Ningaloo area. CALM (2005) identified turtles as an ecological value in the Ningaloo Marine Park and developed associated management objectives including the need to:

- determine the location and relative significance of turtle aggregations sites and rookeries within the reserves;
- ensure interaction activities do not impact turtles, through education and compliance programs and liaison with charter operators; and,
- continue turtle monitoring programs within the reserves.

In order to reach these objectives, there will be “no loss to turtle diversity as a result of human activity” and “no loss of turtle abundance as a result of human activity” (CALM, 2005; p.5). The Commonwealth waters adjacent to the Ningaloo Marine Park (State Waters) are also relevant to turtles in the Ningaloo area but are not considered in this study.

Cape Range National Park

The Cape Range National Park (CRNP) encompasses 50,581 ha of the North West Cape peninsula near Exmouth (Figure 3.2). The CRNP comprises a heavily dissected limestone range and a fringing coastal plain directly adjacent to the northern part of the Ningaloo Marine Park. The coastal area of the CRNP stretches from Tantabiddi Creek south to Yardie Creek and includes land from the boundary of the NMP. The Jurabi Coastal Park extends from Mildura Wreck south to Tantabiddi Creek adjoining the NMP and the CRNP (Figure 3.2). The Cape Range National Park Management Plan 1987 – 1997 was prepared to “accommodate public recreation, within its capacity for long-term stability and maintenance of its resources” (CALM, 1987, p. 1).

Jurabi and Bundegi Coastal Parks and Muiron Islands

Jurabi Coastal Park (Reserve 40729, 1287.4 ha) lies on the western side of the North West Cape peninsula and west of the Yardie Creek Road extending from the northern boundary of the Cape Range National Park north to Mildura Wreck (Figure 3.2). Bundegi Coastal Park (Reserve 40728, 462.1 ha) lies on the east side of North West Cape Peninsula and east of Murat Road between areas of Commonwealth land (Lyndon Location 43 and 44, Defence Purposes). The Muiron Islands Reserve (Reserve 31775, 988 ha), consists of two islands located approximately sixteen kilometres north east of Point Murat. Jurabi and Bundegi Coastal Park and the Muiron Islands are jointly vested and managed by the Shire of Exmouth and DEC.

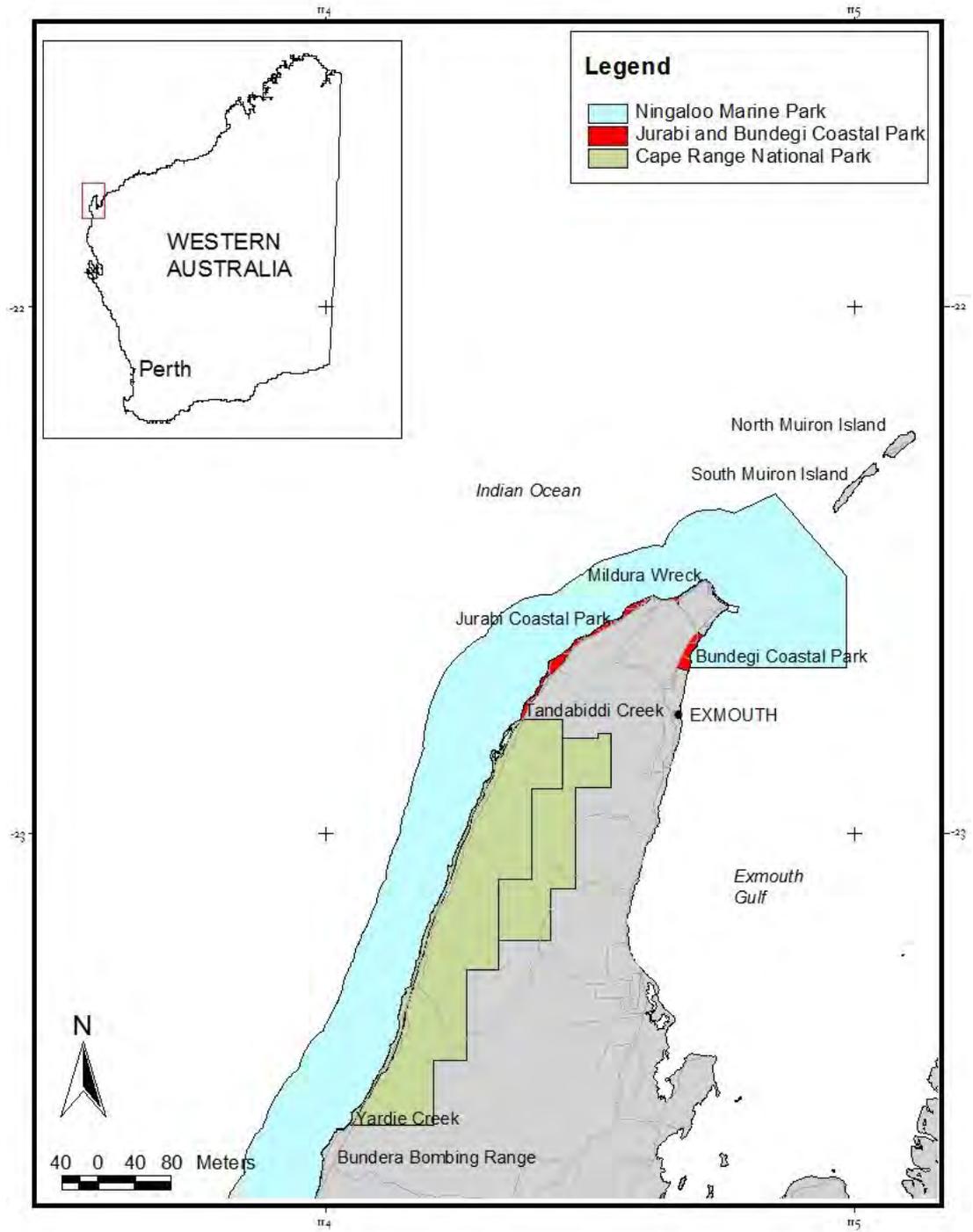


Figure 3.2 Cape Range National, Jurabi and Bundegi Coastal Parks and the Muiron Islands

The Jurabi and Bundegi Coastal Parks and Muiron Islands Management Plan 1999 – 2009 was prepared for the National Parks and Nature Conservation Authority in 1999 and complements management plans prepared for Cape Range National Park and Ningaloo Marine Park. The plan recognises the importance of turtles in the area and the need to manage human-turtle interactions through;

...the establishment of an educational facility within the Jurabi coastal area to complement the tourism attractions of viewing turtle nesting/hatching should be seriously considered. To promote public education and to help development of tourism, it is proposed a research and education facility to study turtle behaviour be constructed in a suitable site between the dunes in Jurabi Coastal Park.
(CALM, 1999, p. 12)

3.3.4 Other tenures

Defence Land

The Department of Defence holds two areas of freehold land adjacent to the Ningaloo Marine Park. They are located at the North West Cape peninsula (Location 44) and at Bundera Bombing Range (Location 97) between Cape Range National Park and Ningaloo Homestead (Figure 3.1). While the extent of recreational use (e.g. camping and fishing) along the Bundera coastal is largely unknown, tourist activities could be impacting turtles.

Native title

On behalf of the Gnulli Native Title Application represented by the Yamatji Barna Baba Maaja Aboriginal Corporation, comprising of the Ingaarda-Teddei, Biayungu and Thalangi peoples, the entire Ningaloo Marine Park has been subject to an application for a determination of native title under the *Native Title Act 1993*, covering 88,000 sq/km (Commonwealth of Australia, 2004).

The key Aboriginal group, which represents the Ningaloo region, is the Baiyungu people. Tindale (1974) mapped the territory of the Baiyungu people as the area south of Coral Bay. The Baiyungu Aboriginal Corporation now manages Cardabia Station near Coral Bay and the Ningaloo area is represented by the Yamatji Land and Sea Council.

There are distinct boundaries of the land and sea for the Baiyungu and Inggarda people. Baiyungu (Payungu¹) is the name of an ethno-linguistic Aboriginal group of the Gascoyne region (Gnulli Working Group, 2004). Baiyungu country encompasses the area between the Minilya River in the south and Yannarie River in the North, extending west to the coast and encompassing the Northwest Cape.

Pastoral leases

There are four pastoral land leases adjacent to the Ningaloo Marine Park, including Ningaloo, Cardabia, Warroora, and Gnaraloo. These are pastoral leases established under the *Land Act 1933* and due to expire in 2015 (CALM, 2004). The coastal areas of pastoral leases are under significant recreational pressure due to increased tourism and the lack of coordinated management.

The *Carnarvon-Ningaloo Coast Regional Strategy 2004* recognises the need to develop the conservation and recreation reserves (WAPC, 2004), which will include several strategically placed tourism nodes, within proposed pastoral lease exclusion zones². These proposed reserve areas will provide access for pastoral and recreational activities under the management of DEC.

¹ The spelling of Payungu follows the orthography used by Peter Austin the prominent linguist in the region. Baiyungu is currently used by the claimants.

² A strip of land about two kilometres wide along the Ningaloo coast

3.4 Tourism development

The Ningaloo area is very important for a variety of recreational pursuits and for nature-based tourism that centres on the reserve's natural attractions. Due to the close proximity of the reef to the shore, visitors can enjoy a wide variety of nature-based tourism activities without the need for lengthy boat trips. Seasonal aggregations of whale sharks, manta rays, turtles and whales, as well as the annual mass spawning of coral provide unique opportunities for visitors to observe marine fauna and key biological processes within the reserves.

The Ningaloo region is serviced by the Learmonth Domestic and International Airport and several bus companies. While no international flights are directed to Learmonth, the majority of visitors arrive in the Ningaloo region via domestic flights within Australia and regional travel in hire vehicles (e.g. Britz and Maui vans) (Wood and Dowling, 2002). The majority of travellers are defined as independent tourists since they do not rely on package deals or have a specified holiday plan or schedule. The area's varying accessibility, via roads and tracks satisfies a variety of recreation and tourism interests from basic bush camping to established accommodation and facilities at development nodes and population centres.

3.4.1 Tourism facilities

The Northwest Cape contains two caravan parks located at Lighthouse Bay and near the Tantabiddi Creek (Figure 3.3). The Cape Range National Park contains 18 "low-key" camping areas with basic facilities along the coast from Tantabiddi Creek to Yardie Creek. The capacity of these camping areas is a total of 70 sites ranging from single sites to 20 sites. There are also camping sites within the Ningaloo Homestead pastoral land south of the Cape Range National Park (Figure 3.3). It is not known how many camping areas are available or the number of visitors that stay at this destination, yet anecdotal evidence suggests this area is a popular destination for visitors seeking an outback experience.

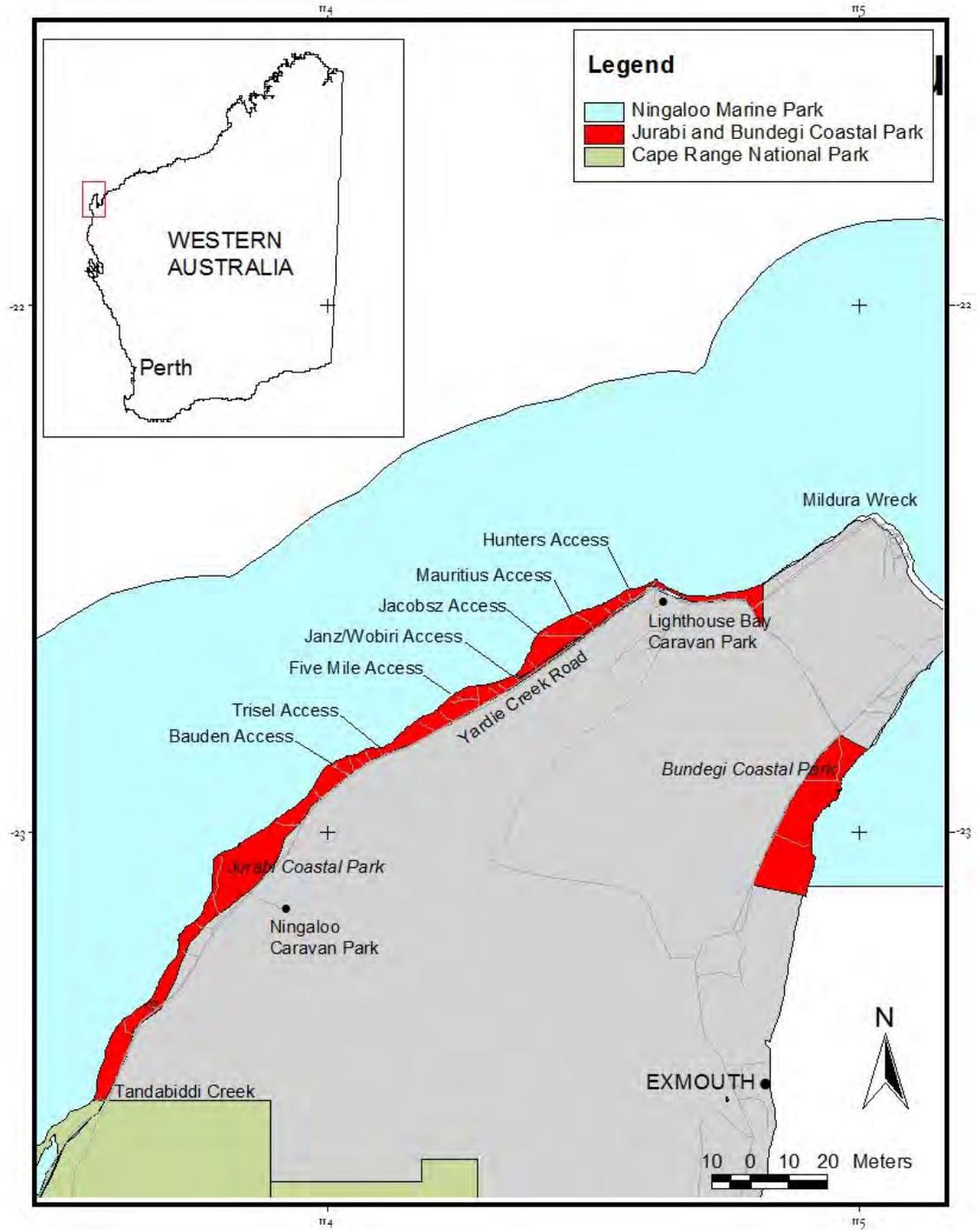


Figure 3.3 North West Cape (Jurabi and Bundegi Coastal Parks)

The Jurabi Coastal Park is accessed by Yardie Creek Road and Murat Road via Exmouth. Eleven unsealed roads lead from Yardie Creek Road to access the beach (Figure 3.3). Access roads that are serviced comprise a carpark area near or on the beach. Five of the carparks (Hunters, Jacobsz, Five Mile, Brooke and Bauden access roads) encroached onto the beach (Figure 3.3), while carparks adjoining the other access roads in the Jurabi Coastal Park were set back behind the primary dune. The carparks are enclosed by fences to restrict access to the beach.



Figure 3.4 Photograph of Five Mile carpark showing the proximity of a nesting beach to vehicles. The blue arrows represent the direction of vehicle lights during the night

3.4.2 Tourism growth

In 2004, approximately 200,000 people visited Ningaloo and participated in a range of nature-based activities including wildlife viewing, boating, fishing, diving, snorkelling, and a variety of coastal uses (CALM, 2005). The tourism industry generates significant income for the region with the whale shark industry being a major contributor. According to Wood and

Glasson (2005), the total yearly expenditure of all visitors to the Ningaloo region is AU\$138 million, which equated to about \$81.30 per person per day. The remoteness, wilderness and seascape values are also important intrinsic aspects of the area that are also valued by the local community (Wood and Dowling, 2002; CALM, 2005).

The peak tourism season for the Ningaloo region is between July and October with an increase of visitation during the mid-year school holidays. Visitor statistics taken between 1989 and 2001 from the Milyering Visitor Centre suggest that annual visitation to the centre doubled from 16,996 to 37,712 visitors over 12 years (CALM, 2001a). This represents an average annual increase in visitation of 8.6 %. These increases have been attributed to a dramatic increase in visitation over the “off-season” (October to February), which is also the nesting period for turtles along the Ningaloo Marine Park coast. The statistics show that visitor numbers over the 1989 to 2001 period increased almost seven fold during the summer months (CALM, 2001a).

3.4.3 Tourism market

According to Williams and Wood (2000), 52% of visitors to the Ningaloo Marine Park are from Western Australia, with the remaining coming from overseas (36%) and other places within Australia (12%). These figures were supported by Wood and Glasson (2005), who conducted surveys between 1997 and 2003. Surveys have shown that travellers from Europe are coming to the region in summer to escape the European winter. In 2001, Europeans (mainly Swiss and German) represented the largest overseas group (17.6% of visitors), making them the second largest group visiting the Milyering Visitor Center. The next largest group was from the United Kingdom followed by North America.

3.5 Turtle tourism in the Ningaloo area

Independent tourists to the Ningaloo region have been watching nesting turtles incidentally for decades with small scale bus tours conducted in the early 1990s (N. McLeod (Ningaloo Safari Tours); P. Turner (Exmouth Cape Holiday Park); R. Prince (DEC), *pers. comm.* 2001). Turtle tourism mainly occurs on the beaches of the Jurabi Coastal Park and Bateman's Bay near Coral Bay (Figure 3.1). Turtle tourism at the Jurabi Coastal Park focuses on viewing adult female turtles as they attempt to nest on the beach at night (CALM, 1995; Shire of Exmouth and CALM, 1999). Low numbers of independent turtle watchers were recorded on the beaches of the Jurabi Coastal Park in January 1995, with a total of 92 turtle watchers recorded over 15 nights (six turtle watchers per night) (CALM, 1995). Unguided watching of nesting turtles in the Jurabi Coastal Park occurs during the night when turtles emerge from the water to nest. It involves walking along the beach looking for tracks that lead to the dunes. Encounters can occur at any time of the night, but often occur during the peak of the high tide period, which is when most of the turtles emerge from the water to attempt to nest. Independent turtle watchers often use torches to navigate in the dark, which can disturb adult turtles and hatchlings. Due to the increased number of independent turtle watchers visiting the Jurabi Coastal Park in the 1990s, and the potential disturbance to turtles, DEC installed signs at access paths in the Jurabi Coastal Park. The signs provided illustrations and information relating to how to behave on turtle nesting beaches (Figure 3.5).

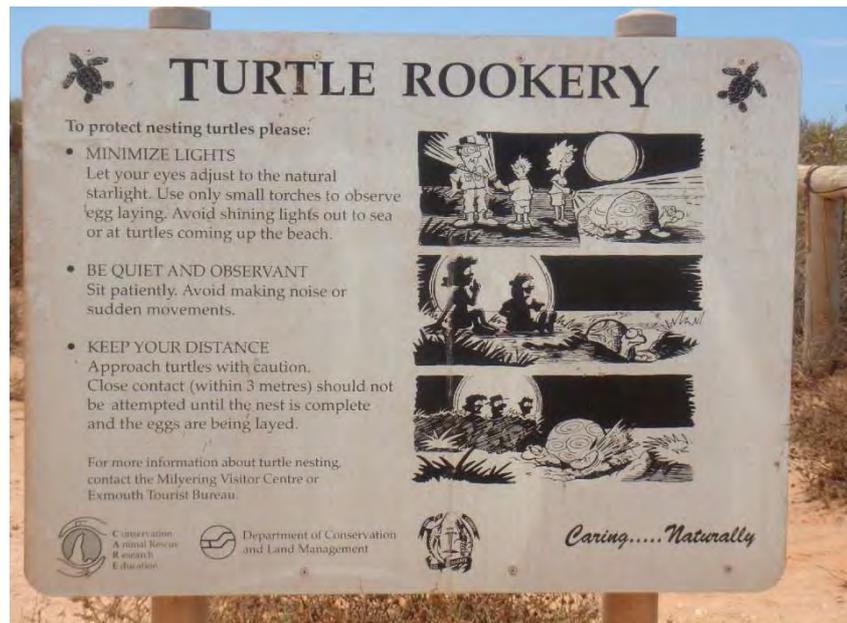


Figure 3.5 Signs installed at beach access areas in the Jurabi Coastal Park (Photography provided by D. Waayers in 2004)

Off-road vehicle activity on nesting beaches often occurs above the high tide within the predominant nesting area (i.e. between high tide and the vegetation). Bateman's Bay is also recognised tourist destination for people seeking quad bike adventures and turtle viewing (Figure 3.1). There are several 4WD access tracks which lead to the beach where driving on the beach is common practise. It is currently unknown how many 4WDs use the Bateman's Bay beach for recreation. There are a few commercial hatchling tour operators in Coral Bay that guide tourists to the beaches at sunset to experience hatchlings emerging from nests and crawl to the water. These tours are not supervised or managed by DEC.

The impact of a vehicle driving over a nest can potentially compress the egg chamber subsequently destroying the clutch of eggs (Hosier *et al.*, 1981; Cox *et al.*, 1994). The indentations left in the sand by off-road vehicles can also prevent hatchlings from reaching the water, as they are usually following the lowest point as a cue to crawl down the beach. Hatchlings therefore remain caught in the indentation until exhausted making them vulnerable to predation (Cox *et al.*, 1994).

3.5.1 Types of turtle tourism

There are currently three types of turtle tourism in the Ningaloo region: (1) watching turtles nesting at night (independent and guided tours); (2) watching hatchlings as they emerge from their nests (independent and guided tours); and, (3) interaction with turtle's whilst driving or snorkeling (incidental). Watching turtle nesting at night is the most popular form of turtle tourism in the Ningaloo region and will be the focus of investigation in this thesis.

Guided tours usually commence in mid-November through to March depending on the activity of nesting turtles. Similarly, hatching can be seen during the night on these beaches, later in the season (between January and April). Commercial operators have been conducting unofficial land-based turtle tours since 1987. It was estimated that an average of 8 - 10 people participate in a single turtle tour (P. Turner *pers. comm.*, 2001). In 2001, a tour operator charges AU\$35.00 per person for a packaged turtle tour which includes transportation, guided tour, and a late-night supper (N. Macleod *pers comm.*, 2001). Prior to 2002, tour operators were able to conduct turtle tours in the Ningaloo region without a license, but were obligated to reduce disturbance under the *Wildlife Conservation Act 1950*. In October 2002, five provisional licenses were issued under the requirements of the *Wildlife Conservation Act 1950* under regulation 15 (R. Mau, *pers comm.*, 2002). These licenses were issued to operators that had some experience conducting turtle tours and satisfied the criteria set in the conditions of approval. These licenses allow operators to conduct turtle tours for one year, which means they will need to reapply once their license expires. Particular operators have been restricted to certain destinations along the Ningaloo Marine Park coast. At present, there are five licensees with three operators restricted to the Jurabi and Bundegi Coastal Park, one at Cape Range National Park and the other along Bateman's Bay.

Guided tours involve transporting tourists from Exmouth to nesting sites on the west coast of the peninsula. Operators usually select beaches where independent travellers do not visit, in

order to maintain the exclusivity of their tour. Tourists are then briefed on code of conduct and given specific instructions relating to how to behave when on the beach, including no use of torches unless signaled by the guide, remain within the group and listen to instructions from the guide, particularly when a turtle is sighted. Once a turtle is encountered, the guide instructs the group to remain in their position until the turtle commences laying eggs. The commencement of egg laying is often determined by the guide to avoid disturbances in the earlier stages of the nesting process. The group will then approach the turtle from behind. At this stage, tourists can use their torches to view the egg laying process. After the turtle completes laying eggs, tourists are instructed to move away from the turtle to allow it to cover the nest without disturbance. Tourists are allowed to watch the turtle crawl down the beach and enter the ocean. Interactions of this nature can take up to three hours per turtle depending on the species.

The greatest concern for DEC managers is the impact on nesting turtles from independent turtle-viewers (R. Mau *pers comm.*, 2001). Prior to the commencement of the current study, there had been minimal effort given to managing independent tourists who seek to encounter nesting turtles without a commercial operator. DEC has only conducted sporadic regulatory surveillance of turtle interactions (A.Hogstrom *pers. comm.*) due to the lack of resources and knowledge of human-turtle interactions. Because DEC has infrequently monitored turtle interactions in the past, most of the reporting of disturbances has come from turtle watchers on the beach (A.Hogstrom, *pers. comm.*, 2001).

In 2001, Tourism WA initiated a specific branding tag for turtle tourism called “Touch a Turtle”. However, this branding strategy was not received positively by the DEC due to the wording of the package, which vindicates close encounters and even touching of turtles. The branding was then changed to “Summer of Turtles” in order to encourage more tourism growth during the summer period, featuring turtles as a major attraction. In the same year, the federal Department of Environment, Water, Heritage and Arts (DEWHA; formerly

Environment Australia) provided funding for investigating the impacts of turtle tourism in the Ningaloo region. This funding was used to undertake the work presented in this thesis. Interest groups in the region that had a focus on turtle tourism included Murdoch University, DEC, Cape Conservation Group (CCG) and World Wildlife Fund for Nature (WWF). These stakeholder groups consolidated to create a steering committee that guided the development and implementation of the Ningaloo Turtle Program (NTP). The NTP was developed in conjunction with this research and established a platform for engaging stakeholder involvement through the Ningaloo Turtle Advisory Group (NTAG), involved the community through the Ningaloo Community Turtle Monitoring Programme (NCTMP) (see Figure 3.6), provided opportunities for further research on turtles and provided advice for the development of the Jurabi Turtle Centre (JTC) (Figure 3.7). Since this research, the NTP has twice been a finalist in the Australian Government Coastcare Community Award and continues to be a successful conservation programme (NTP, 2009)



Figure 3.6 Opening of the 2002-03 monitoring season with volunteers

The JTC was constructed in late 2003 and currently operates behind the dunes between Hunters and Mauritius beaches (Figure 3.3). It is a small-scale, shade-sail structure

approximately 18km from Exmouth. The project is a joint venture between the Shire of Exmouth and DEC with funding and “in-kind” contributions for the centre being provided by DEC, Shire of Exmouth, Woodside Energy, the Commonwealth Government Assistance Scheme, WA Tourism Commission, MG Kailis Group, Coastwest and the NTP (NTP, 2009). As with the Mon Repos Information Centre in Queensland, this facility will play an integral role in controlling increased visitation during the nesting season and provide an educational experience for visitors. The facility is open all year with interpretation, presentations and guiding available during the nesting season (November – March). The facility was designed with the following aims:

- Education of visitors to ensure minimal disturbance interaction with turtles;
- Provide a facility that forms a central focus for turtle management;
- Provide a focal point for information dissemination and congregation of members of the public and tour groups;
- Offer tour operators and general public a high interpretative experience that is an attraction in itself; and
- Promote Northwest Cape as a premier turtle watching site and potentially boost local employment and business stability during the off-peak tourist season.



Figure 3.7 Jurabi Turtle Centre (Taken from <http://www.ningalooturtles.org.au/>)

The JTC was constructed after the fieldwork component of this thesis and will not be considered in the analysis. A study was undertaken by Smith (2006) (a volunteer with the

initial field survey of the thesis research), which investigated changes in the behavior, knowledge and satisfaction of turtle watchers compared to the results presented in Chapters 6 and 7 of this thesis.

3.6 Concluding remarks

This chapter provided background to the study area and context relating the status of turtle tourism between 2001 and 2003. It described relevant policies, legislation and plans that attempt to protect turtles and management the impacts from human activity. This chapter identified several stakeholders and tenures within the Ningaloo region, highlighting the need for collaboration given turtles are a common pool resource (as described in Chapter 2). It also showed how tourism in the Ningaloo region is expanding, which is likely to have implication for the development of turtle tourism. In order to prevent impacts from increased tourism on nesting turtles appropriate planning and management is required. The following chapter's explore the development of the NTP by presenting four interrelated studies that explore stakeholder collaboration of NTAG, activities and characteristics of turtle watchers, the distribution and abundance of turtles in the Ningaloo region and investigate the impacts associated with human-turtle interactions in the Jurabi Coastal Park. The information derived from these studies will then be used to development a planning model for turtle tourism.

CHAPTER 4 EXPLORING THE NATURE AND EXTENT OF COLLABORATIVE EFFORTS BY STAKEHOLDERS IN TURTLE TOURISM IN THE NINGALOO REGION

4.1 Introduction

As discussed in Chapter 2, the collaborative planning approach has emerged as a means of overcoming the fragmented nature of past tourism planning approaches. The collaborative planning approach has the ability to solve the many problems that arise when there is a lack of understanding and few common goals between the various stakeholders often involved in wildlife tourism. The involvement of stakeholders in the planning process can lead to more informed decisions about management and contribute to issues of accountability and stakeholder acceptance of policy (Bramwell and Lane, 2000b).

The rationale for undertaking this research is that whilst there is wealth of literature that explores the theory and conceptual ideas of collaboration in tourism planning (e.g. Bramwell and Lane, 2000; Hall, 2000; Jamal and Getz, 1995), there remains a subsequent need to explore these theories in applied situations. The application and development of turtle tourism in the Ningaloo region aims to provide an example of collaboration in wildlife tourism planning.

As described in Chapter 3, there are a number of problems facing turtle tourism in the Ningaloo region. The problems associated with stakeholder collaboration are the lack of a shared vision and objectives regarding turtle tourism development, insufficient intergovernmental coordination and poor community participation. The creation Ningaloo Turtle Advisory Group (NTAG) was recognised as a positive step forward in attempting to address these problems through the application of a series of workshops. This chapter aims to explore the extent to which a collaborative planning approach is being implemented by

NTAG and explores the main factors that hinder or assist the development of collaborative planning. The research questions associated with this study are:

- What stakeholders are relevant to turtle tourism in the Ningaloo region?
- What is the nature and extent of collaboration amongst stakeholders participating in workshops for the development of turtle tourism in the Ningaloo region?

In pursuit of these questions, this chapter is organized in the following way. Following the introduction, the second section outlines the central components of coordination and collaboration in relation to wildlife tourism planning. The third section explains the methodological approach of the research, while the fourth section presents selected research findings on four key issues identified in Chapter 2. These issues are the vision of wildlife tourism development among tourism stakeholders, collaboration and coordination between multiple parties involved in tourism; input from the tourism industry and other interest groups in tourism planning; and constraints to and facilitators of collaboration and coordination. These issues were selected for analysis as they present some of the central themes of the collaborative process, and they have been explored to some extent in previous research (Bramwell and Sharman, 1999; Timothy, 1998). The final section of the chapter offers an evaluation of the research findings along with some initial conclusions.

4.2 Relevant literature

4.2.1 Coordination and collaboration

There is a recognised need for coordination and collaboration in tourism planning (De Kadt, 1979; Hall, 1995, 2000; Roberts and Simpson, 2000; Newsome *et al.*, 2002). The fragmented nature of the tourism industry has been associated with the lack of coordination, as there are many different stakeholders who have interests in the tourism planning process (Ladkin and Bertramini, 2002). Although there are many definitions for the terms coordination and

collaboration, essentially coordination can be seen as the first steps towards a collaborative process (Ladkin and Bertramini, 2002). Mulford and Rogers (1982) argue that coordination is characterised by “informal trade-offs” and by attempts to facilitate reciprocity in the absence of rules. Collaboration is a more formal institutional relationship among existing networks of institutions, interests and/or individuals. It is a process for joint decision making involving key stakeholders with a shared issue with a view to resolve conflicts and advance visions (Gray, 1989; Hall, 2000). Coordination is one of the stages in the collaborative process and does not by itself solve the problem of the fragmented nature of tourism. The problem of bringing various stakeholders and interest groups together is the first stage in establishing an effective collaborative process (Timothy, 1998).

In the tourism field, it has become increasingly apparent to governments, tourism managers, planners and academics, that no one individual organization can be responsible for the development of tourism (Ladkin and Bertramini, 2002). Collaboration in tourism is often seen in the context of community-based tourism and community integration and participation (Murphy, 1994) and is important to sustainable tourism (Bramwell and Sharman, 1999; Hall, 2000). Jamal and Getz (1995) describe collaborative planning in a tourism context as “a process of joint decision-making among autonomous, key stakeholders...to resolve planning problems...and/or manage issues related to the planning and development” (p.188). A prerequisite for the use of the collaborative approach is at destinations where fragmentation and independent planning decisions by different tourism stakeholders give rise to power struggles over resources (Ladkin and Bertramini, 2002).

4.2.2 Stakeholder identification

Selecting appropriate stakeholders is a vital element of the collaborative process (Boiko *et al.*, 1996; Jamal and Getz, 2000; Mason *et al.*, 2000; Reed, 2000). It is important to consider how to determine who has sufficient capacity to participate and what are the prerequisites for

selecting the most appropriate participants in a collaborative process (e.g. existing partnerships, extent of influence and/or drive in the community, high communication skills, and open mindedness). In emerging tourism destinations, where interests are not collectively organised, the identification of legitimate stakeholders can be a complicated task (Reed, 1997).

4.2.3 Conditions collaboration

The success of efforts to generate a collaborative tourism planning process depends on a variety of factors. The success of the process will depend, not only on formal structures, and conditions on which they are established, but also on the motivations, personalities and perceived roles of the participant stakeholders. Although collaboration in tourism planning is an emergent process that does not take place in a linear and systematic way (Hall, 2000), there is a group of factors that can be used to assess the extent to which a collaborative planning process is being applied. Elements such as recognition of interdependence among stakeholders, feelings of trust, and joint formulation of aims and objectives are all essential in a successful collaborative planning approach (Jamal and Getz, 1995; Healey, 1997; Bramwell and Sharman, 1999; Laing *et al*, 2009).

One of the most important challenges in achieving collaboration are building trust between actors and recognising there is a shared problem (Jamal and Getz, 2000). Roberts and Simpson (2000) suggest that a partnership of sincerity and the building and retention of trust among the community are important for long-term success of collaboration. These authors showed how the Pirin Tourism Forum in Bulgaria gained the trust of the local community through its impartiality, whilst making the community aware of the implications of increased government involvement. Reed (2000) indicates that the potential for stakeholders to draw on local knowledge in a community in systematic and respectful ways is a basis to promote shared learning and the first step to establishing trust in partnerships. However, according to

Tremblay (2000), if convergence and harmony between collaborating stakeholders goes too far, it may lead to “tunnel vision” and other rigidities of structure and strategies, which can reduce the ability to innovate.

As with most strategic plans, the actors who participated in the formulation, vision, mission statement and objectives are primarily responsible for the implementation of the plan (Ladkin and Bertramini, 2002). A joint formulation of aims and objectives of any tourism development should be undertaken at the outset of any planning process (Healey, 1997; Jamal and Getz, 1995). It is the willingness to strive for a “common good” that is an essential precondition to the development of a collaboration approach. Otherwise, a lack of shared consensus can hamper efforts towards collaboration (Parker, 2000).

4.2.4 Evaluation of collaboration

The measurement or evaluation of stages of the collaborative process has been conceptualised by a number of authors (Bramwell and Sharman, 1999; Timothy, 1998; Mandell, 1999). Bramwell and Sharman (1999) put forward an analytical framework to consider whether or not specific collaborations reduce the power imbalance between stakeholders, and they develop the concept of partial consensus. They proposed a series of factors that can be grouped into four categories that measure the extent of the collaborative process including:

- Scope of collaborative arrangements;
- Intensity of collaborative relations;
- Extent to which consensus emerges among stakeholders; and
- Capacity for tangible outcomes.

In terms of measuring the development of collaborative efforts, Mandell (1999) recognises a continuum over time of varying degrees of partnerships, coordination and collaboration. These begin as informal contacts or linkages and pass through a variety of stages until

becoming a collective or network structure where there is a broad mission and joint strategically interdependent action. Networks refer to the development of linkages between actors (organisations and individuals) where linkages become more formalised towards maintaining mutual interests (Mandell, 1999). The continuum of collaborative efforts developed by Mandell (1999) includes the following:

- Linkages or interactive contacts between two or more actors;
- Intermittent coordination or mutual adjustment of the policies and procedures of two or more actors to accomplish some objective;
- *Ad hoc* or temporary task-force activity among actors to accomplish a purpose or purposes;
- Permanent and/or regular coordination between two or more actors through a formal arrangement (e.g. a council partnership) to engage in limited activity to achieve a purpose or purposes;
- A coalition where interdependent and strategic actions are taken, but where purposes are narrow in scope and all actions occur within the participative actors themselves or involve the mutually sequential or simultaneous activity of the participant actors; and
- A collective network structure where there is a broad mission and joint and strategic interdependent actions. Such structural arrangements take on broad tasks that reach beyond the simultaneous actions of independently operating actors.

Although many of the stages are loosely defined and non discrete, it is possible to chart the progress of collaborative efforts over time using these or similar measures. In this research, the continuum established by Mandell (1999) has been used to measure the extent of collaboration.

4.3 Methodology

This research presents a case study that examines the extent of stakeholder collaboration in the development of turtle tourism in the Ningaloo region (Figure 3.1). The Ningaloo region was selected specifically as a case study because it is a well established, popular wildlife tourism destination in Western Australia, it offers a variety of natural, recreational and cultural pursuits and the community has a strong affinity with the natural environment. Turtle tourism in the Ningaloo region also displays characteristics of a fragmented tourism subsector that suffers from limited collaboration between government agencies, industry and local community groups. Since turtle tourism is an emerging industry in the Ningaloo region and in the early stages of developing collaborative planning, Mandell's continuum was selected as an appropriate framework for analysis in this thesis, as it provides a mechanism to illustrate the nature and extent of collaboration among stakeholders.

4.3.1 Selecting stakeholders

Prior to the workshops, formal links were established through the formation of a steering committee, which initially comprised DEC, CCG and Murdoch University, and later included World Wildlife Fund for Nature (WWF). The purpose of the steering committee was to provide guidance to the collaborative process and help select appropriate stakeholders for the workshops.

Key stakeholders for participating in the workshops were identified using the "snowballing" technique (Jennings, 2001). Snowballing is one of the most useful techniques of selecting stakeholders, particularly when small groups are the focus (Clarke *et al.*, 1998) and are locally based (Bramwell and Lane, 2000b). The snowball method is a useful means of identifying relevant stakeholders based on the view of other stakeholders (Finn, 1996; Rowley, 1997). This method involved identifying a core subset of actors associated with

turtle tourism and asking them to nominate other stakeholders they considered to be important in the planning process (Finn, 1996).

Twelve participants from different interest groups were selected for the workshops. Participants were selected based on their legislative role and responsibility within the host community (e.g. government agencies), influence in local decision-making processes (e.g. non-government organisations and interest groups) and people with a proactive attitude to collaborative processes and sustainable approaches. The composition of the sample is shown in Table 4.1. The participants represented several key interest groups including four government representatives (Department of Environment and Conservation, Australian Defence Force, Fisheries WA and the Shire of Exmouth), two tourism industry representatives (Tourism WA and private tour operators), five non-government organisation representatives (WWF), CCG, Murdoch University, Pastoral Land Group and the Biayungu Aboriginal Cooperation (BAC)), and one stakeholder representing local residents (volunteers). An advantage of this exploratory case study method is that the qualitative and participatory approaches allow for in depth analysis to illustrate general issues, trends or traits in a collaborative tourism planning process.

A limitation of the collaborative approach is the availability of selected stakeholders to meet and participate in workshops at the same time (Jamal and Getz, 1995). Furthermore, some stakeholders may refrain from the discussion due to previous history with other stakeholders within the workshop. To this effect, this initial study offers a broad view of the collaborative planning approaches used by NTAG in the Ningaloo region, and acknowledges that further research is required to explore the issues raised, and to gather more detail from these and other stakeholders.

Table 4.1 Stakeholder groups relevant to turtle tourism in the Ningaloo region

Sector	Agency/Organisation	Interest relating to turtle tourism
Government (Public sector)	Department of Environment and Conservation	Conservation and management of turtles in the region including the management of turtle tourism
	Fisheries Western Australia	Management of impacts from trawling such as by-catch and other fishing practises
	Shire of Exmouth	Co-management of the Jurabi Turtle Centre and the Jurabi Coastal Park
	Australian Defence Force	Bundera Bombing Range and the Naval Pier. Provides funding opportunities.
Tourism Industry (Private Sector)	Tour operators	Commercial operation of turtle tours. Seeking cooperation with other stakeholders to achieve mutually beneficial goals.
	Tourism Western Australia	Positioning and marketing turtle tourism in the tourism industry
Non-government Organisations (Interest Groups)	Cape Conservation Group	Conservation of turtles through community involvement in monitoring, training and visitor education
	Biayungu Aboriginal Corporation	Indigenous interest in conservation and potential employment of indigenous people in turtle tourism.
	Pastoral land group (Ningaloo Reef Outback Coast Association)	Management of turtles on pastoral lease land - turtle tourism interactions and fox baiting
	Murdoch University	Researching regionally important rookeries, nesting population, tourism-related impacts
	World Wildlife Fund for Nature	Conservation of turtles regionally and globally
Local residents (Hosts)	Volunteers	Contributing to turtle conservation and protection of the local resources

WWF played an administrative role in the NTP and organised the venue and distributed invitations to key stakeholders. Key stakeholders were approached by the workshop organisers (WWF) to participate in the workshops. An independent workshop convenor from Creating Communities Consultants was employed by WWF to orchestrate the workshop. A single stakeholder from each interest group was invited in order to avoid “sectoral dominance” that may result from multiple participants representing the same interest group. Participants that replied to the invitation received an email confirming their requirement to attend the workshop.

An important step prior to workshops was setting an agenda that is acceptable to all involved. In regional tourism partnerships involving diverse partners, the task is likely to entail considerable delicate debate as the members often differ in their interests and in their level of

expertise and power (Hall and Jenkins, 2000). Partners who feel that their views are not being taken into consideration may drop out of the discussions (Parker, 2000). Dialogue from the workshop was tape recorded and minutes were scribed. The minutes were analysed using “pattern coding” techniques derived by Miles and Huberman (1994). Pattern codes identified themes, processes and relationships within the text. Selective coding (Strauss, 1987) was then used to code the text that corresponded to the collaboration criteria described by Mandell’s continuum (see Section 1.3.4).

4.3.2 Structure of workshops

The methods used to gauge the nature and extent of collaboration amongst stakeholders included examining workshop dialogue complemented by action research techniques. Workshops were examined by recording and analysing the minutes and notes taken during the workshops. Action research techniques relied on the collection of detailed qualitative data from dialogue attained during meetings and discussions with government agencies, local tour operators and community groups.

Two workshops were initiated through the NTP in September 2003 and March 2004. The purpose of these workshops was to foster a collaborative approach to turtle conservation and management. The participants in these workshops were defined as the Ningaloo Turtle Advisory Group (NTAG) and included key informants from the public and private sectors, interest groups and local residents. The workshops involved discussing issues relating to turtle conservation and management.

The main aim of the first workshop was to formulate a vision and broad objectives and identify management issues relating to turtle conservation, whilst the main aim of the second workshop was to define the group and discuss the implementation of objectives. The second workshop was a continuation of the first and should therefore be viewed as the same working

unit. The following section outlines how stakeholders were selected and the structure of the workshops.

The structure of the first workshop was based on the broad principles of general tourism planning models, which involve generating visions and objectives, setting targets and monitoring strategies for measuring the objectives (Higginbottom, 2004a). The first workshop commenced with an introduction from each participant with a brief description of their interest in turtle conservation and management (Table 4.1). The workshops then followed the prescribed agenda with various topics being led by participants with relevant background, interest or expertise. However, prior to establishing a vision, participants were first directed to discuss the need to develop a strategic plan for turtle conservation and management in the region. As a means of generating relevant topics or issues relating to turtle conservation and management, participants were also asked to reflect on how they might like to see turtle management in ten years. This then set the scene for generating a vision and associated objectives and targets.

The aim of the second workshop was to define NTAG as a group, establish the area NTAG would focus on and identify additional stakeholders that may be relevant to the group. Participants also identified existing policies, plans and studies relevant to turtle conservation and management in the region to ensure consistency in the objectives and avoid replicating existing work. Gaps in historical and existing research were identified, which led into discussions relating to the viability of setting realistic targets and generating benchmarks that measure the performance of the management actions.

4.4 Research Findings

Gaining an understanding of the extent and nature of the collaborative process requires an examination of the establishment of NTAG, how a vision and objectives were derived, evidence of collaboration and coordination between the multiple stakeholders and input from

stakeholders. The results of this examination are presented under each of these parameters, in order to measure the nature and extent of collaboration.

4.4.1 Establishment of NTAG

An important aspect in establishing a stakeholder group is ensuring each agency, organisation or interest group is represented by a single individual whom has the greatest knowledge and experience of the topic. Having multiple participants from one organisation, agency or interest group attending meetings can unbalance discussions and arguments for and against specific issues, potentially intimidating other participants and creating animosity within the group. An important outcome of the workshops was the process of defining NTAG. Participants suggested that the purpose of the group, geographical area covered and the level of commitment expected by participants should be established before management actions could be implemented.

Purpose and structure of NTAG

Participants acknowledged that the key purpose of NTAG was to influence and contribute to policy development, share information relating to turtle conservation, establish a platform for decision-making, identify areas of research and to generate funds for implementing management actions within the Ningaloo region. There was consensus that the group would facilitate community-driven conservation activities, such as monitoring turtle populations and measuring impacts from human activities and fox predation on turtle nests and hatchlings.

Due to the complexity and multidisciplinary nature of issues surrounding turtle tourism and conservation in the Ningaloo region, participants suggested that sub-groups or task-force groups should be established to tackle explicit issues, such as issues relating to communication and education, monitoring and research, indigenous cultural knowledge and ecotourism. The stakeholder representing CCG stated that “NTAG should be divided into

working groups which would work on specific issues” and provided an example of where they would form a subgroup of NTAG that would specifically focus on developing educative material for visitors and media releases.

Defining geographical boundaries

The area covered by the group was defined by setting geographical boundaries based on jurisdiction, tenure and potential coastal development proposals. The participant from the local non-government group acknowledged that it was important “...not to bite off more than we [NTAG] can chew” in terms of manageable area. As a result, all participants agreed that the management area boundary should only comprise the coastal strip (i.e. the area between near shore waters and the coastal road) between Northwest Cape and the southern boundary of the Ningaloo Station property near Jane’s Bay (Figure 3.1). The participant from WWF suggested that “it was equally important to understand the broader issues together with local concerns to understand the extent in which external impacts influence the Ningaloo turtle populations”.

Commitment to the process

The level of commitment of stakeholders has been identified as a key issue in the collaborative process (MacArthur 2000; Duka and Jack, 2005). Without a high level of commitment by all stakeholders the drive behind the collaborative process may dissipate over time. This was observed by stakeholders participating in the Tourism Optimisation Management Model (TOMM) at Kangaroo Island, where the initial momentum of the group drove ideas and implemented priority tasks, but later dissolved due to the lack of long-term commitment (Duka and Jack, 2005).

Given that all participants will have the same capacity to participate in the planning process, each stakeholder should sign a commitment statement that outlines their role and responsibilities and commitment to the planning process (e.g. only attend quarterly meetings

or perhaps provide full time assistance and coordination). By establishing the capacity of stakeholders to participate in the planning process from the outset, not only does this provide a measure of commitment, but also assists in planning for future meetings and workshops. Incentives that motivate stakeholders to attend meetings, particularly non-profit organisations who are often not paid to attend, also need to be developed. These incentives could be monetary-based or provide some in-kind contributions to their organisation or group.

Participation of stakeholders was a critical factor in promoting partnerships amongst stakeholders and fostering commitment to the planning process. This research observed certain stakeholder groups taking lead roles to progress the project. These groups were defined by this research as “drivers” within the community. This research defines drivers as “individuals or groups of people within the broader community that exhibit the greatest initiative, motivation and persistence to ensure a project continues to evolve”. In this definition, stakeholders outside the local area may be regarded as broader community.

4.4.2 Generating a vision and objectives

As mentioned in Section 4.2.3, one of the most important factors in developing a collaborative approach towards tourism planning is the existence of a shared vision for tourism development, or the feeling that the stakeholders are sharing a common problem (Bramwell and Sharman, 1999). In turn, this provides the basis to allow stakeholders to act in a coordinated manner and direct their effort towards a common aim (Healey, 1997).

This research explored the extent to which a vision is shared by multiple actors involved in turtle conservation in the Ningaloo region. An important component of formulating a shared vision was to first gauge how participants viewed the future of the NTP. Seven broad aims were identified that emphasised the need for collaborative management, integration of tourism and conservation, increased education, and facilities for research and education

(Table 4.2). Participants then identified key strategies that could address these broad aims. Three central themes arose from these strategies including the need for information, education and communication (Table 4.2).

Table 4.2 Broad aim and strategies for the future of Ningaloo Turtle Programme

Broad aims for the future of the Ningaloo Turtle Programme	Broad strategies for the future of the Ningaloo Turtle Programme
Develop a holistic and collaborative planning model	Communication and networking with similar groups in other regions, states and abroad
More integration between turtle tourism and turtle conservation	Continue collaboration through workshops
Increased enforcement and regulation	Using policy and education as strategies for law enforcement
Increased education for school children and the general public	The creation of a centre for research and education
Increased conservation ethic and stewardship in the region	Involve stakeholders and the community in the development of the Ningaloo Turtle Programme
Increased communication sharing and networking	Researchers to provide feedback on research; Sharing contacts through networking systems
Safeguard critical habitats through community involvement.	Continue the community monitoring programme

Through the initial dialogue relating to the future of NTP, a vision was generated. The following vision statement reflects the value of turtles to stakeholders in the Ningaloo region.

“Our turtles (Mudgin) are an integral part of our community that are respected and conserved for future generations”.

The word “our” indicates a sense of ownership of a “shared resource” suggesting that the participants recognise the interdependence amongst stakeholders. According to Newsome *et al.* (2005), awareness of interdependence between stakeholder’s increases the likelihood of achieving mutually acceptable outcomes. The inclusion of “Mudgin” reflects the recognition of the value of turtles to Aborigines in the local area. “Mudgin” is part of the Biayungu dialogue and refers to all turtles occurring between Onslow and Ningaloo Station in the Ningaloo region (A. Preest, *pers. comm.*, 2003). The vision states “[turtles]...are respected

and conserved for future generations”, which acknowledges the need to respect turtles by not disturbing or hindering them to ensure the following generations can also experience them.

Collaboration was also evident through the establishment of broad objectives. The objectives were divided into environmental, social, educational, economic and planning elements (Table 4.3). The environmental objectives focused on identifying critical habitats for turtles and high-use area of human activity and developing management strategies to reduce potential anthropogenic impacts. The social objectives centred on developing partnerships with key stakeholders and identifying the critical values associated with turtles in the Ningaloo region. The educational objectives focused on preparing an action plan and communicating the implementation of this plan to the wider community. The objectives associated with the economic component involved developing and implementing a ongoing self-sustaining community monitoring programme through generating revenue through the construction and operation of the JTC and supplemented by external funding sources. The planning objectives included the provision of an action plan that could inform planning processes at a regional level, through the generation of benchmarks that reflect the state of turtle tourism and conservation in the Ningaloo region.

If actors involved in joint activities are to explore policy options openly, then they need to abide by shared rules, to consider the perspectives of others, and to develop mutual trust (Healey 1997). The chances of collaborative partners reaching agreement are greater when they are able to express their views freely and to listen respectfully to each other (Bramwell and Sharman, 1999). Agreements among those engaged in joint work usually depend on accepting the value of trade-offs or compromises for the collective interest, even if the position taken is not always in their individual best interest (Bryson and Crosby, 1992).

Table 4.3 Broad objectives identified by participants

Planning Components	Broad Objectives
Environmental	<ul style="list-style-type: none"> Identify critical habitats in the Ningaloo region Determine human impacts on turtle populations in the Ningaloo region
SSocial	<ul style="list-style-type: none"> Prepare strategies to conserve turtles Develop partnerships with all relevant stakeholders in the Ningaloo region Identify the specific environmental, social and economic values of turtles in the Ningaloo region
EEducational	<ul style="list-style-type: none"> Prepare and communicate a action plan to promote education and awareness of turtle conservation and threats to turtles in the Ningaloo region Communicate all efforts relating to turtle conservation and management in the Ningaloo region
EEconomic	<ul style="list-style-type: none"> Develop and implement a self-sustaining community monitoring programme Prepare a business plan for a turtle information centre
PPlanning	<ul style="list-style-type: none"> Provide input into regional planning ensuring that turtle conservation is adequately accounted for within plans Develop strategies and benchmarks to measure the effectiveness of management

The vision and objectives were agreed amongst stakeholders with little competition between individuals. Whilst identifying the vision and objectives, participants showed respect for each person's comments and opinions and recognised that the issues were shared by all stakeholders. The notion of interdependence among stakeholders was also reflected in the vision statement and mutually agreed objectives, indicating a genuine desire for a collaboration approach between stakeholders.

4.4.3 Generating indicators and targets

After generating the above objectives, participants discussed the need to develop specific objectives with associated indicators and targets as a means of measuring the performance of management actions. A fundamental question in this discussion was whether there was sufficient data available to identify measureable indicators and set tangible targets. Without adequate baseline data and impact studies it is difficult to make informed decisions about management actions (Newsome *et al.*, 2002). There was consensus among participants that the information available for turtle nesting populations, impacts on turtles and the

effectiveness of existing management strategies was not adequate and required further investigation.

4.4.4 Collaboration among stakeholders

To determine the extent to which collaboration has formed, the nature of partnerships between stakeholders was assessed against the continuum of collaborative efforts developed by Mandell (1999). The development of the NTP has largely followed this continuum from loose linkages between government agencies, industry, non-government organisations and the local community prior to this research to an alliance between these stakeholders.

Linkages or interactive contacts were established in the initial stages between DEC, CCG, Murdoch University. Some linkages existed within the community mainly between DEC, Shire of Exmouth, Fisheries, CCG and a Biayungu representative, yet these linkages were primarily associated with issues other than turtle conservation. Most interactions between these stakeholders was previously between two actors and often informal.

The next progression in the continuum was intermittent coordination or mutual adjustment of the policies and procedures of two or more actors to accomplish some objective. DEC needed to make some adjustments to their procedures to allow for steering committee meetings and establish a Memorandum of Understanding with CCG and WWF. Given DEC is the regulatory authority and responsible agency for the protection of turtles in Western Australia, their works programme was amended to include a provision for workshops and turtle monitoring by the community.

According to Mandell's continuum, the final progression in collaboration is a coalition, where interdependent and strategic actions are taken, but where purposes are narrow in scope. This has become evident through a "centred approach" or formalised planning structure,

which often takes place in an institutionalised structure (Parker, 2000). Initially, the steering committee recognised the need to formalise the planning process and was highly influenced by the bureaucratic nature of government arrangements. However, it became clear that stakeholders needed to be involved in the decision making process to cover the diversity of issues regarding turtle conservation and tourism in the Ningaloo region.

An integral strategy for reaching a shared collaborative process was developed through the employment of a programme coordinator and convenor. The coordinator of the programme provided permanent part-time coordination throughout the year and intensive full-time coordination during the nesting season. In 2003-04, the total cost of running the NTP was \$50,000, which was resourced through funding and sponsorship from both government (e.g. Coastcare) and non-government (WWF) community-based grants and in-kind contributions from DEC (Richards *et al.*, 2005). Within this budget, \$21,000 was used to employ the coordinator. Partnerships are often led by a convenor, and they may well be more successful when this facilitator is perceived to have legitimate authority (Parker, 2000; Medeiro and Bramwell, 2000). The employment of a professional convenor during the workshops was also a factor that helped reach coalition amongst stakeholders. The convenor's time was donated to the NTP as an in-kind contribution.

4.4.5 Input from stakeholders

The nature and extent of collaboration was evaluated by examining the various forms of collaboration or cooperation among stakeholders in and outside of the workshops. This distinction needs to be made because one of the difficulties in trying to ascertain the extent of collaboration is that whilst respondents might speak of good intentions, they may not be translated into real outcomes (Ladkin and Bertramini, 2002). While this thesis does not explore social representation theory (i.e. the difference between stated attitude and actual

behaviours) devised by Moscovici (1988), this could provide some insight into the dynamic nature of collaboration and requires further research.

Input into workshops

In the workshops, all participants stated that collaboration and coordination were important elements in achieving sustainable turtle tourism. They also agreed that a planning model that fosters the collaboration between stakeholders was needed. It has been stated that one of the first stages in a collaborative process is bringing stakeholders together to solve mutual problems (Timothy, 1998). The attendance of stakeholders at the workshops was one way of measuring their initial commitment to the collaborative process. Of the twelve stakeholders selected to participate in the workshops, ten stakeholders attended each workshop. Stakeholders that did not attend the workshops were not based in Exmouth and were required to travel large distances and may have had budgetary constraints. It is unlikely that stakeholders would have had resources allocated to attend the NTAG workshops. It is common for local non-government organisations to have relatively small budgets that cannot sustain extensive travel requirements, such as in the case of the WWF Arctic Tourism Program in Canada (Mason *et al.*, 2000). In this example, the remoteness of the workshops prevented some of the key stakeholders from attending the initial workshop, which led to a divergence within the group because additional issues were raised and conflicts transpired at future workshops (Mason *et al.*, 2000).

Discussions with a representative from Ningaloo Reef Outback Coast Association, which occurred outside of the workshop forum, indicated that the location of stakeholder meetings should vary to provide participants an opportunity to host the meetings. The process of organising and facilitating the meetings reflected potential to foster a sense of stewardship for each stakeholder. This was seen to be particularly important to establishing a partnership with the Biayungu people who are based in Coral Bay. If the meetings were held at Cardabia Station (near Bateman's Bay; see Figure 3.1), there was potential to instil a sense of

responsibility for the Biayungu people to manage turtles in the south parts of the Ningaloo region and provide an opportunity for other stakeholders to show their respect for the Aboriginal stewardship of marine turtles.

Input into monitoring

Support and coordination outside of the workshops was demonstrated through the development of the monitoring programme. Input from Murdoch University and DEC was evident in the early development of the turtle monitoring programme. During the 2001-02 nesting season, DEC provided housing for university volunteers, office facilities and a quad-bike for conducting turtle track surveys. Later, they provided technical support (e.g. data management) and assistance in applying for external funding and were instrumental in the development of the JTC.

CCG contributed to the development and implementation of the community-based monitoring programme (see Chapter 4) and focused on building capacity within the local community through education and training. CCG held regular social gatherings for all participants involved in the NTP. These gatherings provided an opportunity to build trust and a sense of stewardship within the monitoring team and to receive feedback on results and updates.

While the wider tourism industry stakeholders were focused on marketing and branding turtle tourism as a wildlife tourism product in the Ningaloo region during the summer period, the local tour operators were more interested in developing sustainable turtle tourism product that could have local benefits for Exmouth community. Some local operators demonstrated their commitment to turtle conservation by becoming active participants in a volunteer monitoring programme (see Section 5.3.2.2), complying with guiding protocols and the code of conduct (see Section 3.5). Local residents indicated their commitment to NTP by volunteering their personal time to undertake track count surveys as part of a morning monitoring programme

often prior to their own work commitments. Participation of volunteers the community monitoring programme increased from 35 people in 2002-03 to 106 people in 2007-08 nesting season (Markovina, 2008).

Financial resourcing

The issues associated with gathering resources to implement tangible actions resulting from collaboration is considered one of the greatest problems in sustainable tourism management (Bramwell and Lane, 2000). All participants of the workshops recognised the need to incorporate mechanisms that ensure the longevity of the NTAG in the absence of external support from funding bodies and resource-based institutions. Participants discussed the need for financial assistance from government, industry profits and individual visitors through donations. It was agreed in the workshops that NTP should strive to be self sufficient, with a view to being less dependent on government funding in the future. In the preparation of a funding application, the stakeholders recognized the advantages of submitting a collective proposal from NTAG. Operators were willing to provide in kind support with information relating to their operations but were not willing to donate a portion of their profits. A suggestion was raised that turtle watchers visiting the JTC should be encouraged to pay a gold coin donation, which could then be invested in maintaining the community monitoring programme.

4.5 Evaluation and Conclusion

This research reflects that the success of collaboration relies on building partnerships and trust, recognising interdependence, generating a collective vision and objectives and commitment amongst stakeholders. The establishment of NTAG and associated efforts to collaborate indicate that turtle tourism and conservation is well within the process of developing a collaborative and strategic planning process in the Ningaloo region. Nevertheless, the continuation of this process will depend on stakeholder's commitment to

the process and above all the capacity of institutions and interest groups to transform collaboration into an ongoing learning process.

This thesis highlights some innovative ways of assessing the success of a collaborative process. The “snowball” method was an effective way of selecting a range of stakeholders relevant to turtle conservation, however choosing people who are conducive to a collaborative process needs to be negotiated with care. Issues associated with sectoral dominance were not evident during the workshops, possibly because the workshops were overseen by a professional convenor and that a single representative for each stakeholder group was invited to attend the workshops. The employment of a professional convenor that specifically caters for regional community development brought a sense of professionalism and formalisation to the workshops, which in turn illustrated the importance of the process to all stakeholders. The employment of an external coordinator or experienced consultant to implement the collaborative process could avoid issues of conflict of interest amongst community members, provide more flexibility and promote innovation. Such issues are often restricted by bureaucratic processes and an external consultant may act to help drive the process and encourage collaboration. The consultant’s role should focus on organising and facilitating meetings/workshops and securing funds, actions which often require a person with specialised skills in community development.

Minimising the number of participants at workshops, whilst ensuring that all stakeholders are included, is an important compromise. The number of stakeholders at the workshops was considered manageable for the purpose of maintaining congruent dialogue, which often increases the likelihood of building trust and consensus amongst stakeholders (Medeiro and Bramwell, 2000). Second, the issue of conflicting views and opinions among stakeholders, which is often seen when generating a shared vision, was not evident given in the NTAG workshops given the willingness of participants to develop a strategic plan which incorporates stakeholder collaboration.

The structuring process involves institutionalizing the organization of joint activities, including formalizing the mechanisms required for implementation work resulting from mutual agreements (Jamal and Getz, 1995). An issue identified by stakeholders in this study was their inability to generate viable environmental, social, economic and planning indicators that could measure the impacts of increased turtle tourism and success of management actions. The identification of indicators requires additional studies that examine the health of the turtle population, tourist activities and characteristics and human-turtle interactions. The following chapters investigate these components in more detail and attempt to provide baseline data needed to further develop NTP and inform the collaborative process.

CHAPTER 5 ESTABLISHING BASELINE DATA ON MARINE TURTLES – DISTRIBUTION AND ABUNDANCE OF TURTLES IN THE NINGALOO MARINE PARK

5.1 Introduction

As described in Chapter 2, collecting biological information on target species in wildlife tourism is an essential ingredient for achieving sustainable tourism. Collecting data relating to turtle populations was also raised in the NTAG workshops for the purpose of understanding how tourism might impact on nesting turtles over time and generating indicators that can detect changes in turtle nesting activity (see Chapter 4). Although generally the distribution of turtles is well documented in other parts of the world (Eckert *et al.*, 1999; Lutz and Musick, 1997; Lutz *et al.*, 2003; Bolten and Witherington, 2003; Limpus, 2009), there is currently inadequate data on nesting turtle populations in Western Australia, including the Ningaloo region. This chapter focuses on collecting baseline data on the female turtle nesting population in the Ningaloo Marine Park. As a starting point in collecting baseline data, this chapter will identify important rookeries for turtles. The research questions associated with this study are:

- Where are the key turtle rookeries along the Ningaloo Marine Park coast?
- What is the size of the annual nesting population of female turtles in the Ningaloo Marine Park and Muiron Islands?
- What is the extent of the peak nesting season in the Ningaloo region?
- Can the nesting success of turtles be used as an indicator for detecting impacts from turtle watchers at the Jurabi Coastal Park?

The first part of this chapter sets the background on the known distribution of turtles and their management units in Australia. It then focuses on what is known about the nesting distribution of turtles in the Ningaloo region and presents aerial and ground turtle surveys that were undertaken as part of this thesis. Aerial surveys were used to identify key nesting areas in the NMP, while the ground surveys were largely used to investigate the spatio-temporal variation in nesting activity and, through the identification of successful nesting activity, to determine the nesting success of turtles at the Jurabi Coastal Park. Nesting success is defined as the proportion of nesting attempts that result in a clutch (i.e. laying eggs in the sand) (Limpus and Limpus, 2002) and should not be confused with hatchling or clutch, which refers to the proportion of hatchlings emerging from the nest. Nesting success is often used to measure habitat preference (Pendoley, 2005) and has been used as an indicator to measure potential disturbance from human activity at night (Johnson, *unpublished*). This chapter then discusses how the data collected within the Ningaloo region compares with similar information from other nesting areas in Australia.

5.2 Relevant literature

5.2.1 Status of marine turtles in Western Australia

A recent review of the status of marine turtles in Australia concluded that a significant nesting populations of green, loggerhead, flatback and hawksbill turtles occur in Western Australia however the population size are based upon sparse census data and remains undetermined (Limpus 2009). This section summarises the current knowledge of the genetic affinities, population size estimates and the locations of significant rookeries in Western Australia.

Four separate management units are recognized for green turtles; North Great Barrier Reef, South Great Barrier Reef, Gulf of Carpentaria and the North West Shelf (Figure 5.1). The North West

Shelf Management Unit (NWS MU) includes the rookeries between the North West Cape and the Lacepede Islands in Western Australia. This population was previously estimated to contain 1,000's – 10,000's of turtles (Prince, 1994b). More recent estimates suggest the size of the female green turtle population of the NWS MU to be approximately 125,300 individuals, which is considered one of the largest green turtle populations remaining in the world (Dethmers *et al.*, 2006; Limpus, 2009).

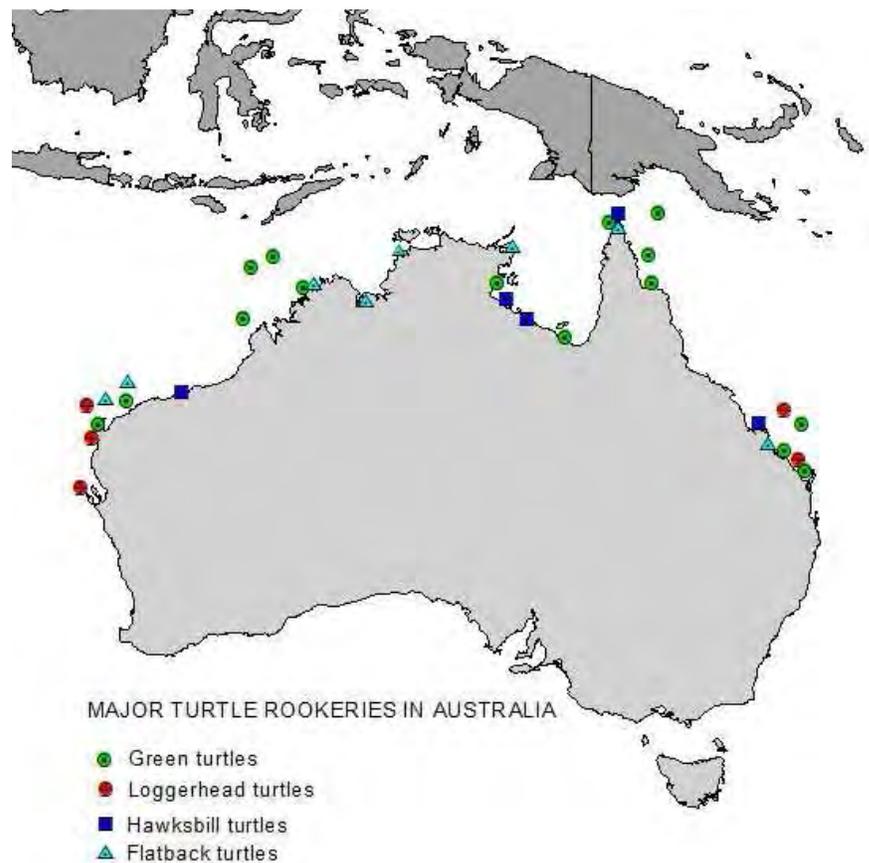


Figure 5.1 Distribution of green (G), loggerhead (L) and hawksbill (H) and flatback (F) turtle rookeries in Australia

Two genetically distinct stocks of hawksbill turtles have been identified and two management units are recognized in Australia: North-eastern Australia and North West Shelf (Moritz *et al.*,

2002, Dutton *et al.* 2002). The North-eastern MU includes rookeries in the Torres Strait, the northern Great Barrier Reef and Arnhem Land (Figure 5.1). The Western Australian MU ranges from North West Cape to the Dampier Archipelago and estimated to contain up to a few hundred turtles (Prince, 1994b).

Two separate management units have been identified for loggerhead turtles in eastern Australia and Western Australia (Dutton *et al.*, 2002). These units are based on rookeries in the southern Great Barrier Reef in Queensland and between Shark Bay and Ningaloo in Western Australia. Loggerhead turtles occur between Dirk Hartog Island and Varanus Island (Fitzsimmons *et al.*, 1996; Dutton *et al.*, 2002) (Figure 5.1). The North West shelf population of loggerhead turtles is one of only four genetic stocks in the Indian Ocean and considered the third largest population remaining in the world (Limpus, 2000). The female nesting population of loggerhead turtles in the Ningaloo area is estimated to contain 100 – 500 females per year (Limpus and Chatto, 2004). Limpus (2003) suggests that the loggerhead turtle population in Western Australia is potentially unstable and the paucity of long term census data from the beaches of the Ningaloo area was a concern.

Flatback turtles are endemic to the Australian continental shelf and all nesting occurs in Australia with one third of the total breeding for the species occurring in Western Australia (Limpus, 2009). Western Australia supports two genetic stocks of flatback turtles (Figure 5.1). The southern genetic stock nests from Exmouth to the Lacepede Islands and is characteristic of summer nesting occurrences and the northern stock nests at Cape Domett and presumably adjacent to western Arnhem Land during the winter months (Fitzsimmons *et al.*, 1996; Dutton *et al.*, 2002). The flatback turtle is known to utilize the Exmouth Gulf as a feeding ground (Prince, 2000). Although flatback turtles have been reported to attempt to nest on the Muiron Islands,

little is known about flatback turtle nesting on the mainland beaches of the Ningaloo Marine Park (Prince, 2000).

5.2.2 Turtle studies in the Ningaloo region

The distribution of turtle rookeries in the Ningaloo region has not been comprehensively assessed with areas along the coast that have not been adequately surveyed. Previous studies have identified the Northwest Cape as an important nesting rookery for green turtles with little known about loggerhead and hawksbill turtle nesting distribution and abundance (Prince, 2000; Limpus, 2009; CALM, 1995). Table 5.1 lists the published studies that have been undertaken in the Ningaloo region. Most of the data has been collected by DEC's Western Australian Marine Turtle Project (WAMTP). The data shows considerable inter-annual variation in nesting activity for green turtles in the Northwest Cape (Figure 5.2). This is the same for loggerhead turtles but in lower numbers (Figure 5.3). However, while tagging studies are often useful for investigating inter-nesting variables and post-nesting migration, they do not necessarily represent the nesting population unless saturation tagging is undertaken (Eckert *et al.*, 1999). Given, the tagging effort for each year is not accounted for in Figure 5.2 and 5.3, these results should be interpreted with caution.

Table 5.1 Summary of studies conducted on turtles in the Ningaloo region

Studies	Description of Study	Year(s)	Author(s)
Distribution of turtles on the Northwest Cape	Preliminary investigation of the distribution of green turtles in the NWC	1980	Limpus (1982); Limpus and Chatto (2004)
Nesting selection on the Northwest Cape	Investigation of green turtle nesting selection in the Jurabi Coastal Park with particular reference to Turquoise Bay	1981	Johannes and Rimmer (1984)
Western Australia Turtle Project (WAMTP)	Tagging programme initiated by DEC to investigate the distribution and migration of all turtle species. Tagging occurred at Lacepede, Barrow, Muiron, Varanus, Rosemary Islands, Northwest Cape and Shark Bay	1986-2000	Limpus (1988); Prince (1993, 1994b, 1994a, 1997, 1998, 2000); Limpus (2002)
Track counts at Coral Bay	Monitoring of loggerhead turtle nesting activity and fox management at Bateman's Bay north of Coral Bay	1990-2004	Mack (1996-2000)
Impacts from human activity in the Jurabi Coastal Park	Investigation of the effects of human presence on green turtles nesting in the Jurabi Coastal Park	1994/1995	CALM (1995)
Genetic studies in Western Australia	Investigation of the genetic stocks in Western Australia and their relevance to other turtle populations in Australia	1995	Fitzsimmons <i>et al.</i> (1996); Fitzsimmons <i>et al.</i> (1997)
Foraging areas in the Ningaloo region	Determining distribution and abundance of turtles (in-water) using aerial surveys in the Exmouth Gulf and Ningaloo coast	1995	Preen <i>et al.</i> (1997)
Foraging areas in the Indian Ocean	Compilation of information relating to loggerhead turtles in the Indian Ocean	2003	Baldwin <i>et al.</i> (2004)

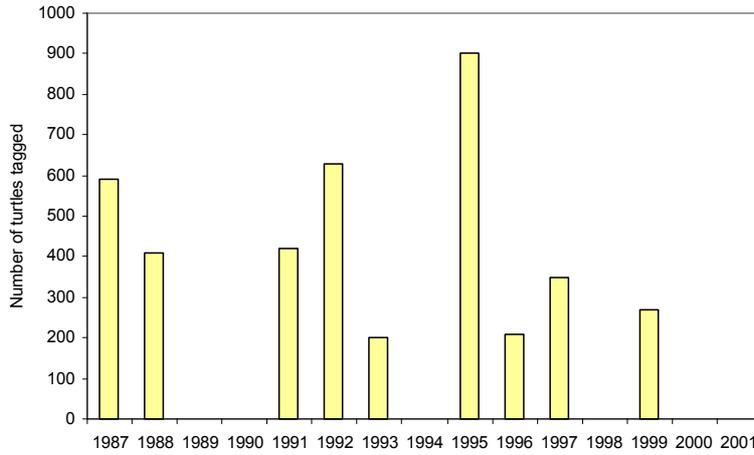


Figure 5.2 Number of green turtles tagged on the North West Cape³ (Source: Prince, 2000).

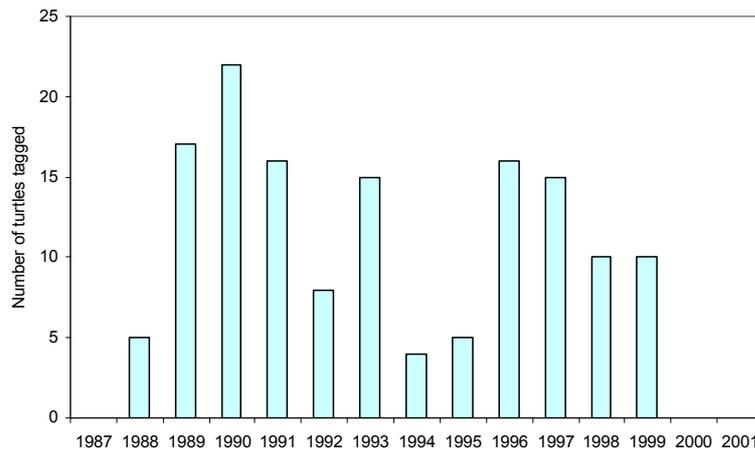


Figure 5.3 Number of loggerhead turtles tagged on the North West Cape (Source: Prince, 2000)

³ Data collected in 1987, 1988 and 1994 represent minimal sampling effort while 1990 and 1998 reflect the scarcity of nesting green turtles at the Northwest Cape in those seasons.

5.3 Methods

5.3.1 Track counts - Aerial

5.3.1.1 Survey area

Six aerial surveys were conducted along the coastline of the Ningaloo Marine Park including Muiron and Sunday Islands in 2001-02 and 2002-03 nesting seasons (Table 5.2). The surveys covered 280km of coastline between Bundegi and Amherst Point including the Muiron and Sunday Islands (Figure 5.4). The coastline area comprised all sandy beaches from the high tide line and the fringing vegetation. The survey area was divided into 15 sections representing different areas of management, tenure and geographical boundaries (Figure 5.4). A description and aerial photograph of each section of the survey area is presented in Table 5.3.

Table 5.2 Flight schedule and weather conditions

Conditions	02 Dec 01	15 Dec 01	14 Jan 02	14 Dec 02	15 Jan 03	12 Feb 03
Wind speed (km h ⁻¹)	5-10	10-12	10-15	5-12	0-5	5-10
Wind direction	S	ESE	SW	SW	SW	SW
Height of high tide (m)	2.41	2.42	2.31	1.86	1.98	1.95

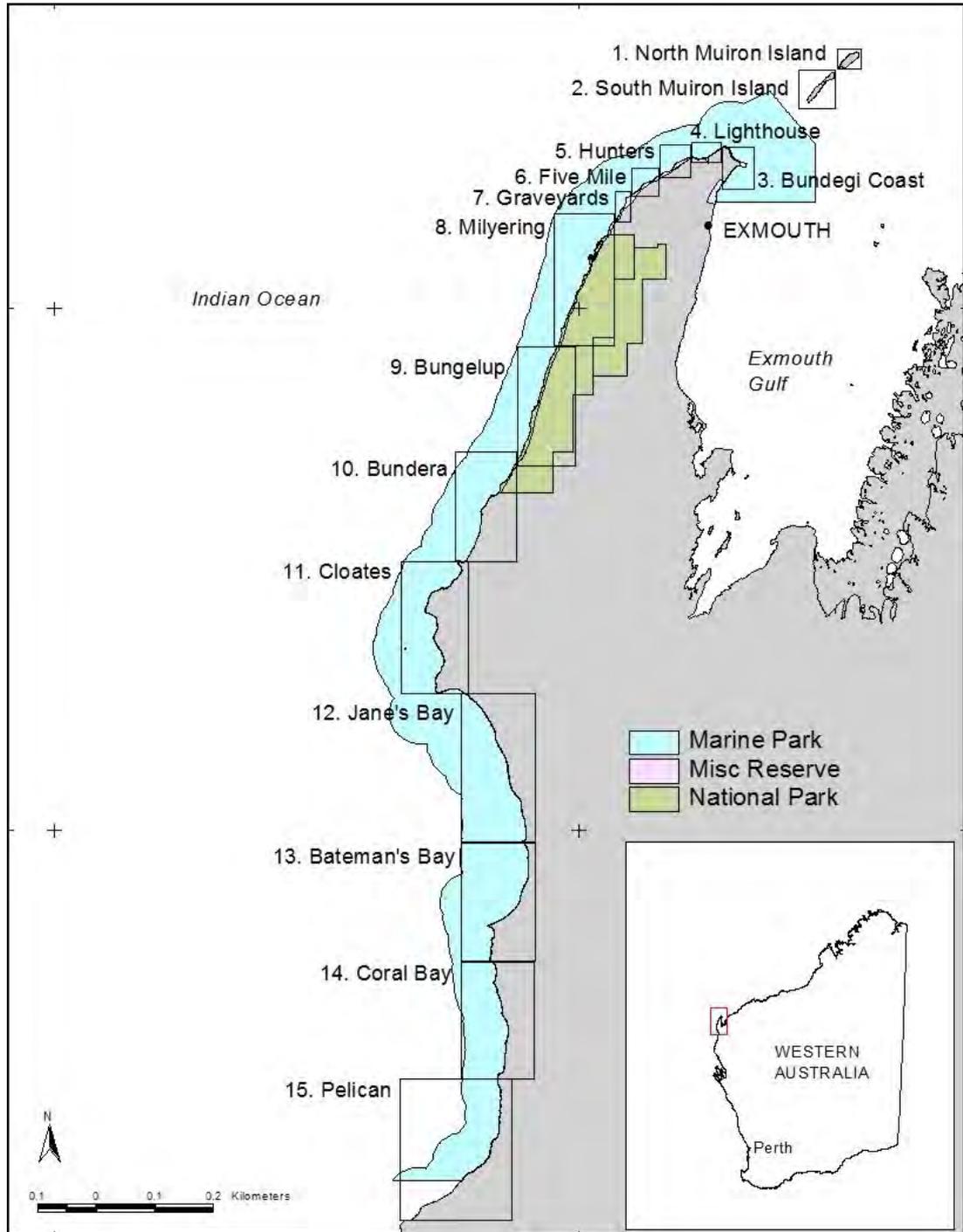
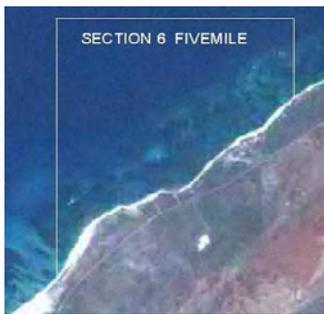
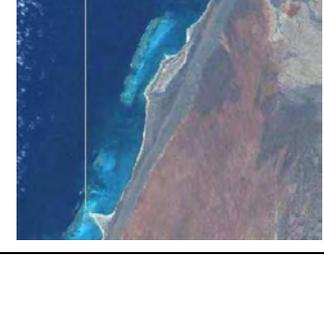


Figure 5.4 Sections covered by the aerial survey

Table 5.3 Description and aerial photograph of each section in the survey area (Note: photographs are at different scales)

Section	Boundaries	Distance	Tenure	Satellite photograph
1. North Muiron Island	Entire parameter of beach	12km	Conservation Reserve; conservation area at southern point (CALM, 2004)	
2. South Muiron Island	Entire parameter of beach	16km	Conservation Reserve; conservation area on western side of island (CALM, 2004)	
3. Bundegi Coast	Bundegi Southern Sanctuary Marker to Mildura Wreck	13km	Bundegi Coastal Park; Bundegi Sanctuary Zone; Murat Sanctuary Zone; Commonwealth Area at Navy Pier	
4. Lighthouse	Mildura Wreck to Vlamingh Head	7km	Jurabi Coastal Park; Lighthouse Bay Sanctuary Zone	
5. Hunters	Vlamingh Head to Five Mile Beach	7km	Jurabi Coastal Park	

Section	Boundaries	Distance	Tenure	Satellite photograph
6. Five Mile	Five Mile Beach to Burrows	6km	Jurabi Coastal Park; Jurabi Sanctuary Zone	
7. Graveyards	Burrows to Cape Range National Park (north)	10km	Jurabi Coastal Park; Jurabi Sanctuary Zone	
8. Milyering	Cape Range National Park (north) to Mandu Creek	24km	Cape Range National Park: Mangrove Bay Sanctuary Zone; Mandu Sanctuary Zone, Lakeside Sanctuary Zone	
9. Bungelup	Mandu Creek to Yardie Creek	30km	Cape Range National Park; Osprey Sanctuary Zone	
10. Bundera	Yardie Creek to Winderbandi Point	17km	Bundera Coastal Protection Area	

Section	Boundaries	Distance	Tenure	Satellite photograph
11. Cloates	Winderbandi Point to Point Cloates	32km	Ningaloo Pastoral Lease: Winderabandi Sanctuary Zone: Cloates Sanctuary Zone	
12. Jane's Bay	Point Cloates to Bruboodjoo Point	36km	Ningaloo Pastoral Lease: Dugong Sanctuary Zone	
13. Bateman's Bay	Bruboodjoo Point to Coral Bay	27km	Cardabia Pastoral Lease: Bateman Sanctuary Zone: Mauds Sanctuary Zone	
14. Coral Bay	Coral Bay to Pelican Point	23km	Warroora Pastoral Lease: Pelican Sanctuary Zone	
15. Pelican	Pelican Point to Amherst Point	24km	Warroora Pastoral Lease	

5.3.1.2 Data collection

The duration of each flight were approximately four hours commencing at approximately 5:30am, to take advantage of the angle of the sun and mild wind conditions. At low angles, the sun cast shadows across the indentations and made them more visible from the air. Light winds during the surveys meant there was minimal erosion of the indentations before each survey. A two-seated Cessna 175 aircraft was used to follow the shape of the coastline from north to south to use the prevailing south-west headwinds to maintain low aircraft speeds. The aircraft was positioned 45 degrees from the high tide mark on the ocean side at an altitude ranging between 85 – 130m. The most effective aircraft speed varied between 80 - 100 knots, depending on the density of turtle tracks, wind speed and direction of wind.

Surveys were undertaken when the tide is high at sun set as night falls. The advantage of this is that all tracks from the previous days are cleared and only fresh tracks left in the sand the night before the surveys are visible (Figure 5.5). The morning high-tides were lower than the evening high tides, which meant that the landward ends of the fresh tracks were not washed away until the following evening.

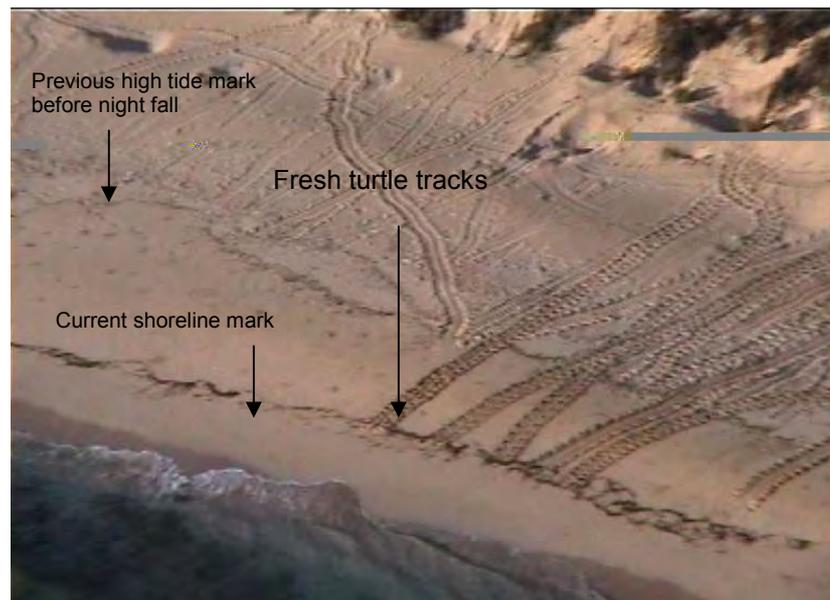


Figure 5.5 Illustration of tracks within the intertidal area

The methods used to record turtle tracks were modified based on approaches used by several authors (LeBuff and Hagan, 1978; Shoop *et al.*, 1985; Chatto, 1997; Schroeder and Murphy, 1999; Pendoley, 2005). The key addition to the aerial surveys conducted in this research was the use of digital video photography to count and identify the species using track identification techniques (Schroeder and Murphy, 1999; Pendoley, 2005).

Personnel undertaking the surveys comprised a pilot and a video camera operator who also recorded the number of tracks and video timeframe. A Sony Digital Handycam DCR-TRV8E (features including Super Steady Shot, Manual Focus Ring, 120x Digital Zoom and 2x Optical Zoom) was used to record turtle tracks. Before recording the tracks, the beaches were observed with the naked-eye. Once tracks were detected from a distance, the camera was positioned between the open windows of the aircraft. Recording commenced once the track(s) were viewed on the LCD monitor. The camera continued to record until no more tracks were visible. The position of multiple groups and single tracks were recorded by Global Positioning System (GPS) (Garman 12). Latitude and longitude coordinates were taken perpendicular (90°) to the track(s). Each set of coordinates possessed a corresponding video time and estimated number of tracks. All tracks were analysed separately using digital video editing software (Apple iMovie) to identify species and tally the number of species for each section. Still frames of tracks from the digital video footage were created and archived.

5.3.1.3 Data analysis

Species identification

All turtles have unique track patterns which can be used to identify species (Pendoley, 2005; Schroeder and Murphy, 1999). Figure 5.6 shows the track characteristics of a typical green, loggerhead and hawksbill turtle. The key diagnostic features of a track include flipper marks in the sand, width of the track, and tail drag mark found in the centre of the track. Flipper marks left in the sand can be symmetrical or asymmetrical. Symmetrical tracks are formed

when the front flippers move synchronously to pull the turtle over the surface of the sand, resulting in a mirror image between the right and left halves of the track (Figure 5.6). Asymmetrical tracks are formed when the front flippers move alternatively to carry the turtle over the surface of the sand (Figure 5.6).

Tracks were divided into three categories: asymmetrical tracks (Figure 5.7), symmetrical tracks (Figure 5.8) and unidentified tracks. Asymmetrical tracks were taken to represent both loggerhead turtles and hawksbill turtles, while symmetrical tracks were taken to represent green turtles (Schroeder and Murphy, 1999). A “turtle track” represents a nesting attempt or emergence of a female turtle and does not necessary constitute a successful nest or a clutch of eggs.

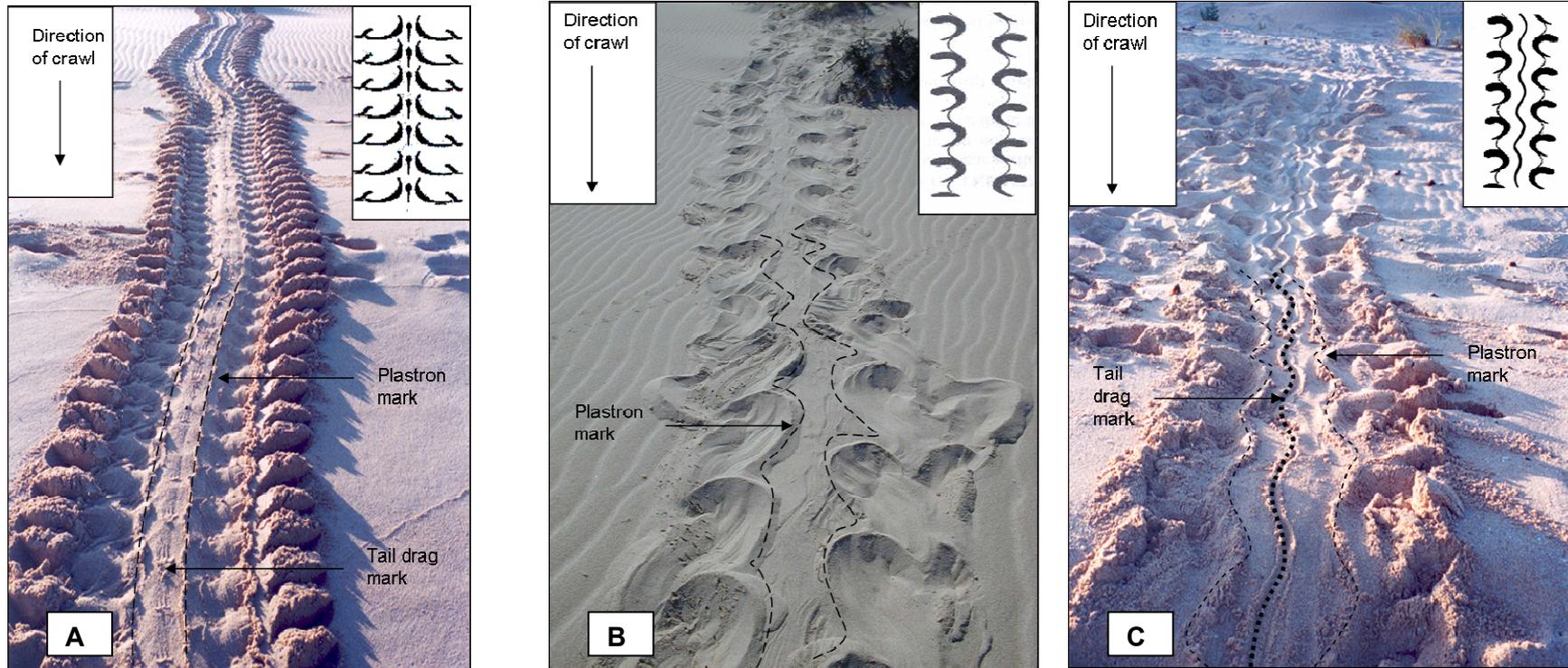


Figure 5.6 Example of green (A), loggerhead (B) and hawksbill (C) turtle tracks



Figure 5.7 Asymmetrical tracks left by a loggerhead turtle (photograph taken from aerial survey)



Figure 5.8 Symmetrical track left by a green turtle (photograph taken from aerial survey)

Spatial analysis

The spatial distribution of tracks was analysed using Geographic Information System (GIS) software (ArcView GIS Version 3.1). The mean number of tracks per km and standard error was calculated for each section to identify areas of high nesting activity in 2001-02 and 2002-03. Spatial maps were also prepared to show the distribution and abundance of tracks and identify key rookeries along the entire Ningaloo coast. The proportion of symmetrical, asymmetrical and unidentified tracks were compared for each section in 2001-02 and 2002-03 to determine the extent of nesting activity of each species along the Ningaloo coast.

Validity of data

The validity of aerial data as a representative sample of the nesting population was examined. The validity of data was determined in two ways: the proportion of tracks positively identified in the aerial surveys; and, comparing the number of tracks recorded during the aerial and ground track counts on the same day at Hunters Section, which is where daily track counts were recorded by volunteers. The proportion of tracks positively identified by analysing the video footage was determined by dividing the sum of symmetrical and asymmetrical and the total number of tracks recorded and converting the result to a percentage. Comparisons between symmetrical, asymmetrical and unidentified tracks from the aerial and track counts were presented in a table and the percentage of the total number of tracks recorded by the aerial survey and track counts was calculated.

5.3.2 Track counts – Ground

5.3.2.1 Survey sites

Track counts were undertaken in the Jurabi Coastal Park from Mildura Wreck south to Tantabiddi Boat Ramp, covering 26km of beach (Table 5.4). The survey area contains four sections within the aerial survey area that were identified as suitable areas for ground-truthing: Lighthouse, Hunters, Five Mile and Graveyards (Figure 5.9). These sections were

further divided into fourteen survey sites based on geographical boundaries (i.e. enclosed beaches), beach access roads and the length of the subsection (Table 5.4). Markers were positioned on the beach to identify the site boundary. Although track counts were conducted at all sites along the Northwest Cape, not all sites were covered every day during the survey period (Table 5.4).

Table 5.4 Sampling schedule of surveys at sites along the Northwest Cape, 2001 and 2002

Sites	Length of site (metres)	2001-02		2002-03	
		Days surveyed	Duration of survey	Days surveyed	Duration of survey
4.1 Mildura Wreck Beach	1500	48	30/11/01-23/01/02	24	7/12/02-18/3/03
4.2 Surf Beach	1900	48	30/11/01-23/01/02	24	7/12/02-18/3/03
4.3 Caravan Park Beach	3500	49	30/11/01-23/01/02	36	26/11/02-18/3/03
5.1 Hunters Beach	1600	52	30/11/01-31/01/02	70	18/11/02-26/3/03
5.2 Mauritius Beach	1800	53	30/11/01-31/01/02	73	18/11/02-27/3/03
5.3 Jacobsz/Wobiri Beach	2400	55	30/11/01-31/01/02	72	24/11/02-27/3/03
6.1 Five Mile Beach	800	56	30/11/01-31/01/02	61	24/11/02-27/3/03
6.2 Trisel Beach	1300	55	30/11/01-31/01/02	46	3/12/02-19/3/03
6.3 Brooke Beach	2000	54	30/11/01-31/01/02	15	3/12/02-19/3/03
6.4 Bauden Beach	1400	54	30/11/01-31/01/02	29	14/12/02-19/3/03
7.1 Graveyards Beach	1800	54	30/11/01-31/01/02	28	19/12/02-19/3/03
7.2 Dunes Beach	2100	54	30/11/01-31/01/02	28	19/12/02-19/3/03
7.3 South Graveyards Beach	1000	54	30/11/01-31/01/02	28	19/12/02-19/3/03
7.4 Tantabiddi Beach	1800	54	30/11/01-31/01/02	28	19/12/02-19/3/03

Volunteer training

Volunteer students were used to collect track count data. All volunteers were trained to ensure consistency and accuracy of the data collection. A total of 35 volunteers were recruited from Murdoch University to work in 2001-02. The process for recruiting and training volunteers involved a series of seminars presenting the background to the research, details of fieldwork and volunteer requirements. Local residents of Exmouth became involved in the track count surveys in 2002-03 through collaboration with the Cape Conservation Group. Thirty local residents and 20 university students volunteered in 2002-03. Volunteers were required to work for at least two weeks after successfully completing a competence assessment (Appendix 1). The assessment involved onsite examination of the monitoring technique and compliance with recording procedures in the field. Volunteers were awarded competency certificates through the NTP once they successfully identified all species and several successful nests and false crawls. Volunteers were also required to demonstrate how to photograph tracks when uncertain about species identification or nesting activity. The photographs were then examined by an experienced turtle researcher to attain a positive identification of species and nesting activity.

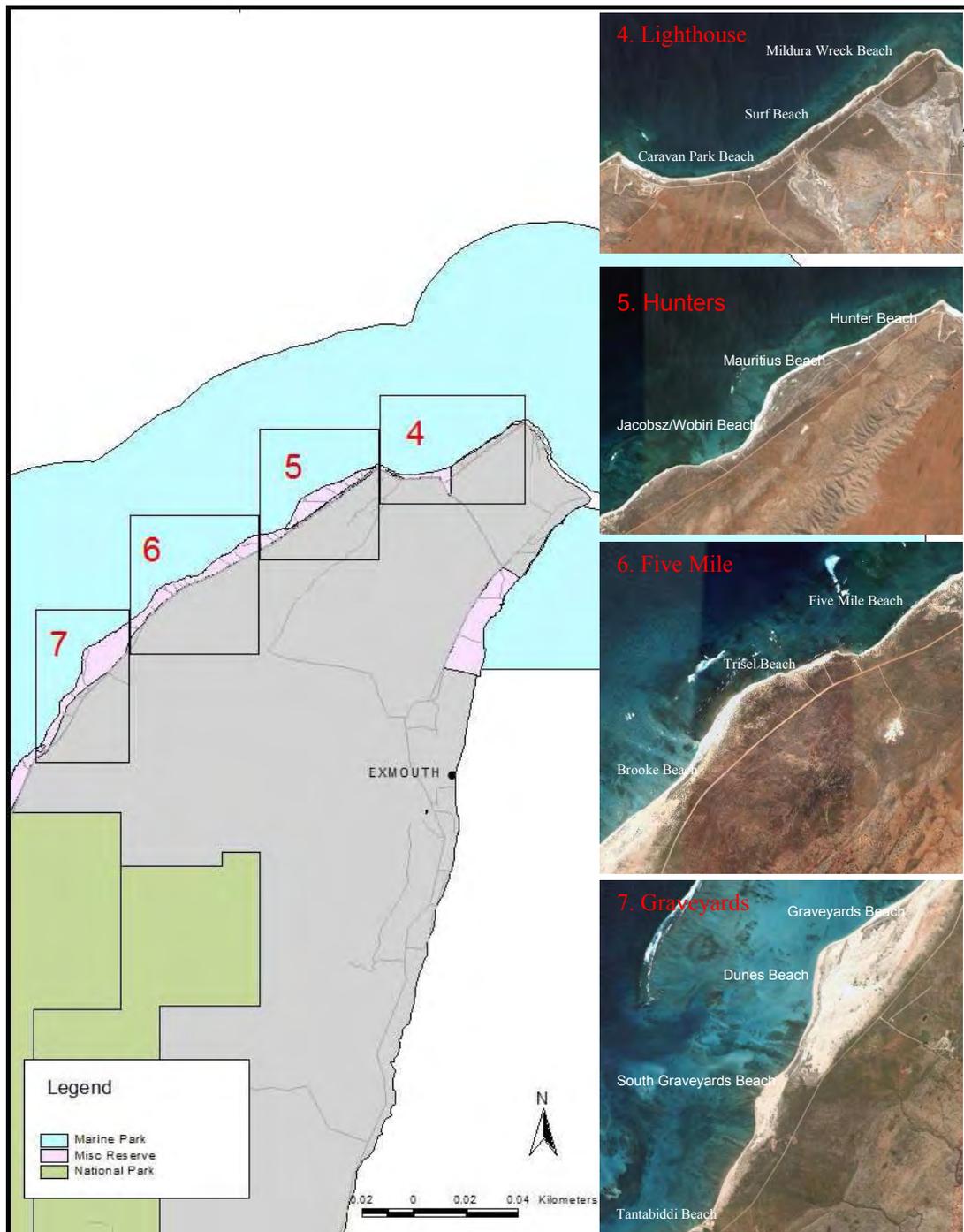


Figure 5.9 Ground survey sites in the Jurabi Coastal Park

5.3.2.2 Data collection

Ground surveys were conducted during the 2001-02 and 2002-03 peak nesting seasons. A pilot study was conducted between 15 and 29 November 2001 to refine the survey plan and methods used to record turtle tracks. In the first season, data were collected between 30 November 2001 and 31 January 2002. In the second season, data were collected between 3 December 2002 and 27 March 2003. The survey effort at all sites at the Northwest Cape was less consistent in the 2002-03 season, primarily due to the availability of volunteers and the quad-bike, which was used in 2001-02 to fill the gaps in survey effort. Surveys commenced at 5:30am to take advantage of the low lying sun and mild wind conditions, and took approximately 2 - 3 hours to complete depending on the density of tracks.

Species identification

Methods used to identify species and nesting activity were based on methods developed by Schroeder and Murphy (1999) and Pendoley (2005). A set protocol for undertaking track counts was developed as part of this research to ensure consistency in data collection. A series of sequential sets were developed which also included several methods for observing the characteristics of the indentations in the sand that are used to determine the species of the turtle (Table 5.5). Evidence of at least two of these characteristics described in Table 5.6 was required to confidently identify the species.

Table 5.5 Process of collecting data from marine turtle tracks

Steps for recording turtle nesting activity	Description of step taken
1. Identify the emerging and returning tracks	<ul style="list-style-type: none"> • Observing sand movement • Length of the track in relation to the high tide line • Observing overlapping of tracks
2. Species identification	<ul style="list-style-type: none"> • Observing track width • Observing the tail drag • Observing the gait pattern
3. Determination of nests	<ul style="list-style-type: none"> • Sand over emerging track • Evidence of covering • Presence of escarpment • Two humps on nest area • Presence of secondary body pit • Moist sand over emerging track
4. Determination of false crawl	<ul style="list-style-type: none"> • U-shape configuration with no evidence of body pit • Little disturbance of sand • No evidence of covering • Exposed egg chamber.
6. Mark the track	<ul style="list-style-type: none"> • Drag a line across the turtle track to indicate that the track has been recorded

Modified from Schroeder and Murphy (1999) and Pendoley (2005)

Table 5.6 Description of track characteristics for green, loggerhead and hawksbill turtles

Characteristic	Green turtle	Loggerhead turtle	Hawksbill turtle
Shape of gait	Symmetrical gait	Asymmetrical gait	Asymmetrical gait
Track size	Large track (100–130 cm)	Medium track (90–100 cm)	Small track (70–85 cm)
Tail drag mark	Evenly spaced central indent	Broken meandering line in the centre of the track	Continuous meandering line in the centre of the track
Flipper marks	Deep rectangular marks; parallel pattern	Deep marks; alternate pattern	Shallow marks; alternate pattern
Plastron mark	Narrow plastron	Wide plastron	Narrow plastron
Size of primary body pit	Large	Medium	Shallow and small
Size of secondary body pit	Large	Medium	Small
Covering	Large covered area; large volumes of sand moved; oblong shape of nest	Medium covered area; oval or round shape of nest	Small area covered; more erratic covering after the nest

Modified from Schroeder and Murphy (1999) and Pendoley (2005)

Nests and False crawls

A “nesting crawl” can be distinguished from a non-nesting “false crawl” by examining the track and any nesting attempts made by the turtle while on the beach. Characteristics of a nesting crawl include an escarpment around a primary body pit, a shallow secondary body pit, and high moisture content in the covering sand (see Figure 5.10). A false crawl will involve little or no disturbance of the sand, in which case the track may form a simple arc, or considerable sand disturbance from digging a body pit without evidence of covering (Figure 5.11). Once the species and nesting activity were recorded, each track was marked with a line in the sand that covered the entire beach above the high tide mark to avoid duplication of records. Personnel were trained in track identification by an experienced turtle biologist prior to the survey and a field guide was developed to assist personnel in the field (Cape Conservation Group, 2007).

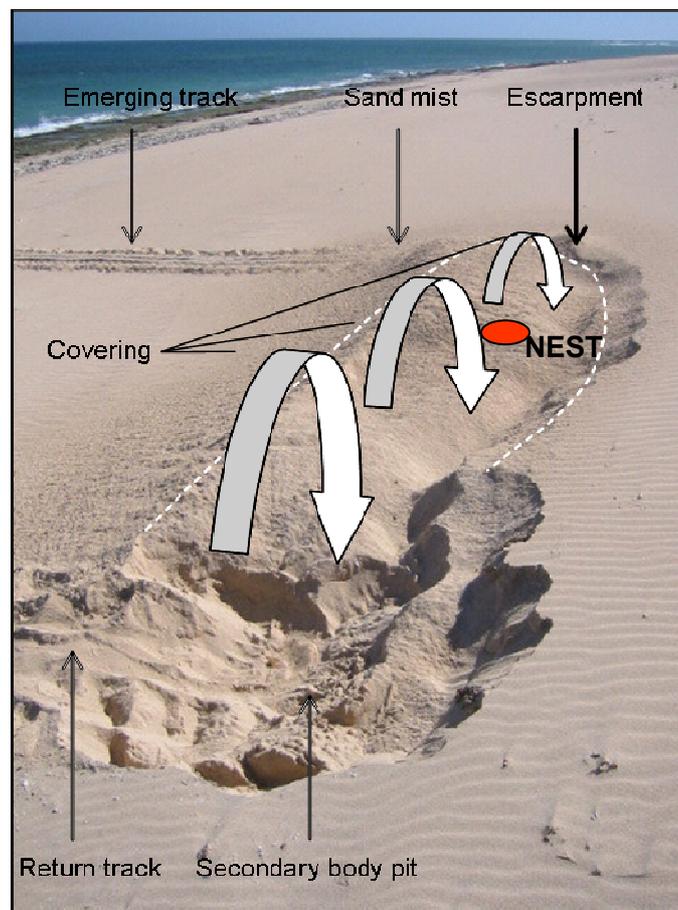


Figure 5.10 A successful nest excavated by a green turtle in the Jurabi Coastal Park

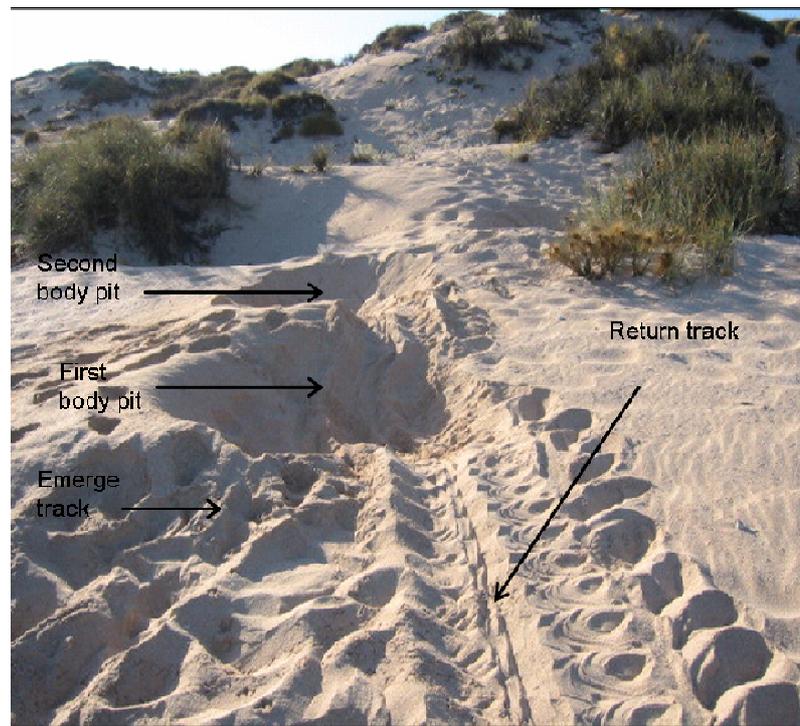


Figure 5.11 A false crawl excavated by a green turtle

Nest location

The location of nests on the beach profile was also examined by recording whether the nest was either in the following beach segments (Figure 5.12):

- Below the spring high tide;
- Between the spring high tide and fringe of the coastal vegetation;
- Within 5m landward of the fringe of the coastal vegetation;
- 5m from the fringe of the coastal vegetation to the base of the primary dune; and
- On the primary dune or beyond the primary dune.

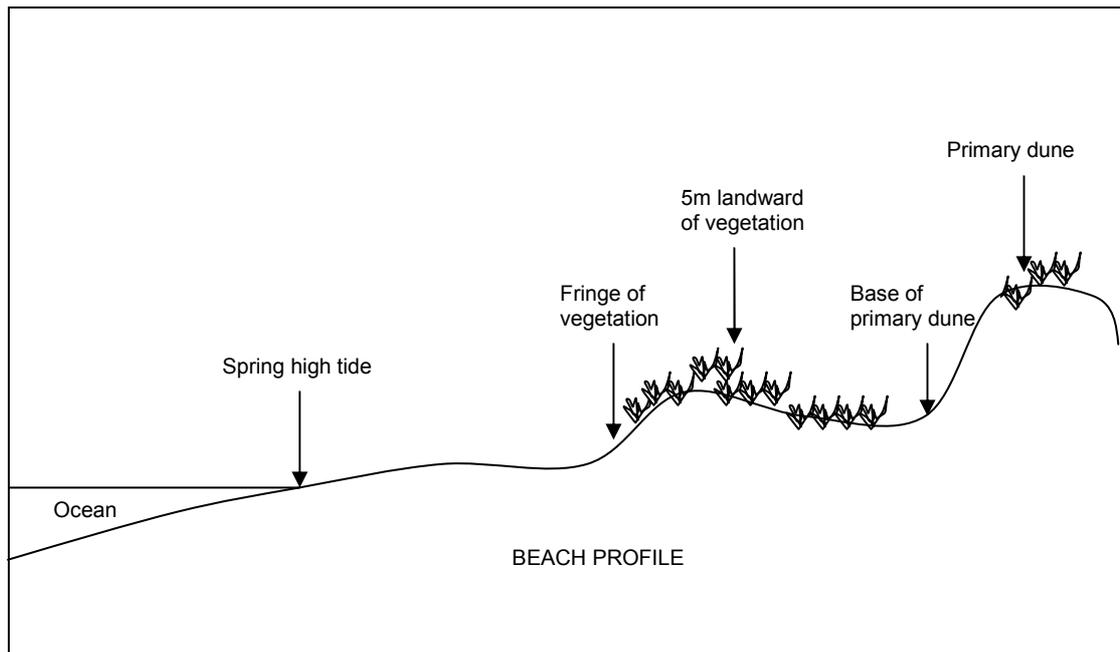


Figure 5.12 Categories of nest locations on the beach

5.3.2.3 Data Analysis

Track counts were undertaken to determine the spatial and temporal distribution of nesting turtles. The extent of the nesting season and temporal variation in nesting activity was presented as the mean number of nests per day of each species for index sites (Hunters – Wobiri beaches). Index sites are often used to represent a broader area. The beaches between Hunters and Wobiri were selected to present the temporal variation of the Ningaloo region due the difficulty in covering all beaches along the Jurabi Coastal Park. The index sites provided easily accessible beaches with consistent nesting activity throughout the survey period. A nesting refers to a turtle that has successfully laid a clutch of eggs. A One-way ANOVA was used to determine whether there was a difference in the abundance of nests between years.

The spatial distribution of turtles was presented as the mean nests/km/day for each site in 2001-02 and 2002-03 nesting seasons. This measure provides a relative density to compare between sites and takes into account days that were not surveyed. Refer to Table 5.4 for days

surveyed during the 2001-02 and 2002-03 nesting seasons. One-way ANOVA tests were used to compare the statistical significance of nesting density and nesting success between all sites and between reference sites and turtle watching beaches.

Nesting success

The number of tracks and successful nests were used to calculate the nesting success of each species at each site along the Jurabi Coastal Park. Because nesting success is presented as a proportion and some of the sites comprised low numbers, only those sites with more than 10 tracks were analyzed. Nesting success refers to the proportion of female tracks on the beach that result in a successful nesting event as shown in the simple formula below. The average nesting success across all sites along the Jurabi Coastal Park was calculated to compare between years.

$$\text{Nesting Success} = \frac{\text{Total number of nests recorded}}{\text{Total number of tracks recorded}}$$

To determine whether nesting success was affected by the presence of turtle watchers, a One-way ANOVA was used to compare the nesting success of each species at popular turtle watching sites (i.e. Hunters, Mauritius and Jacobsz/Wobiri) and reference sites (i.e. Brooke, Bauden and Graveyards). These sites were identified in the on-site tourist surveys (refer to Chapter 6, Section 6.4.2).

Nesting population size

To estimate the number of female turtles nesting during the peak period, the mean number of nests per day in January was calculated for each site. The mean number of nests for each species, which is a surrogate measure of individual female turtles, was multiplied by the average inter-nesting interval (i.e. days between each nesting event within a season) taken from studies conducted in eastern Australia. For green turtles, the inter-nesting interval is 12 days, 14 days for loggerhead turtles and 13 days for hawksbill turtles (Limpus, 2009).

The number of females in an inter-nesting interval was then divided by the Availability Correction Factor (ACF) which account for proportion of the population that are not nesting at the time of the survey. Limpus *et al.* (2001) showed that 70 – 80% of female green turtles at Bramble Cay, in north-eastern Australia, nested within a single inter-nesting interval. While the proportion of nesting turtles within inter-nesting periods has not been confirmed for other species, it is likely that it is similar given they share the same life cycles. Applying these correction factors to the basic population estimates as described above, leads to an estimated population size range; from the lower population estimate based on the maximum value of both correction factors to the upper population estimate based on the minimum correction factors. The calculation for estimating the minimum and maximum number of females in the JCP was as follows:

$$\text{Min. female population} = \frac{\text{Mean nests} \times \text{Renesting interval}}{\text{ACF (0.8)}}$$

$$\text{Max. female population} = \frac{\text{Mean nests} \times \text{Renesting interval}}{\text{ACF (0.7)}}$$

5.4 Results

5.4.1 Track counts - Aerial

Although the mean number of tracks per km (density) was not significantly different in each section between 2001 and 2002 ($p > 0.05$), the data shows that the density of turtles was generally greater in 2002-03 (Figure 5.13). More than half of tracks recorded over the entire Ningaloo region were found at the Muiron Islands in both 2001-02 (77%; $n = 963$ tracks) and 2002-03 (54%; $n = 1704$ tracks). The greatest densities of tracks in 2001-02 were recorded at the South Muiron Island, North Muiron Island with low densities on mainland beaches (Figure 5.13). Refer to Table 5.3 for distances of sections. The greatest densities of tracks in 2002-03 were also recorded at South Muiron Island, North Muiron Island, with the greatest densities on the mainland beaches being Hunters and Graveyards (Figure 5.13).

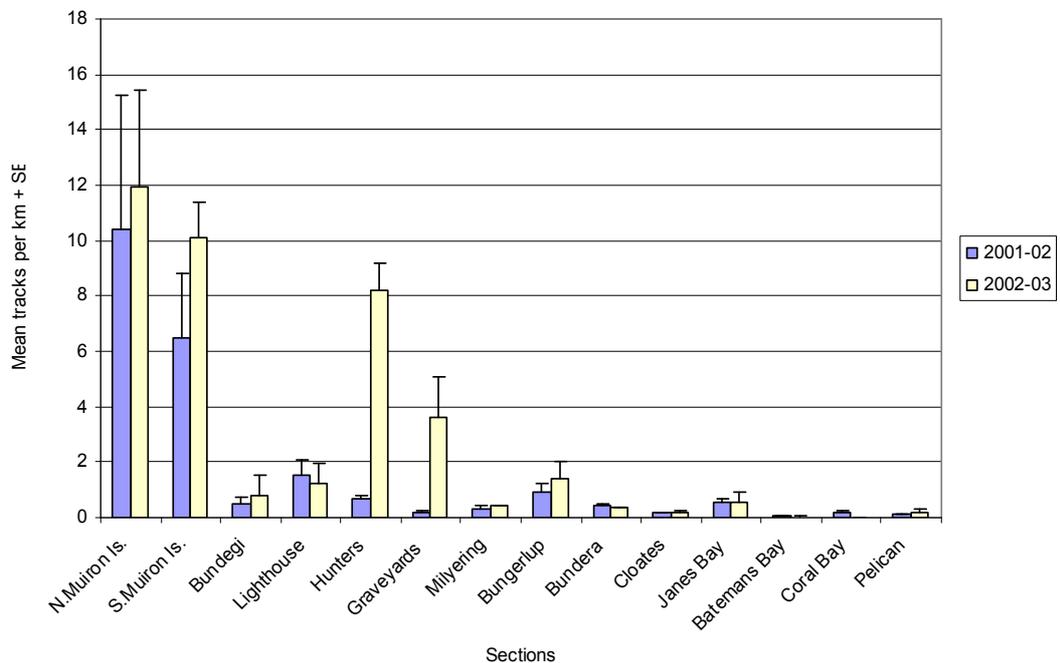


Figure 5.13 Mean number of tracks at each section for 2001-02 and 2002-03 (see Table 5.3 for length of each section)

Tracks were recorded on all sandy beaches of the Muiron Islands. Turtle tracks on the North Muiron Island were mainly found on the northern and eastern beaches (Figure 5.14). A total of 183 fresh tracks were recorded on the north-eastern point of the North Muiron Island on 14 January 2002. Turtle tracks on the South Muiron Island were mainly found on the northern and western beaches (Figure 5.14). Up to 150 tracks were recorded on the western beaches of the South Muiron Island on 15 December 2002. On the Northwest Cape, the main rookeries were recorded at Vlamingh Head (Hunters section), Five Mile beaches (Graveyards section) and Osprey Bay (Bungelup section) (Figure 5.15). Some smaller rookeries were recorded at Turquoise Bay and beaches between Osprey Bay and Yardie Creek. Low densities of tracks were recorded adjacent to the Bundera Coastal Protection Area, with higher densities found between Point Cloates and Bruboodjo Point (Figure 5.16). South of Bruboodjo Point, very low track numbers of tracks were recorded at 14 Mile and between Pelican Point and Amherst Point (adjacent to Warroora Station), with no evidence of established rookeries (Figure 5.17).

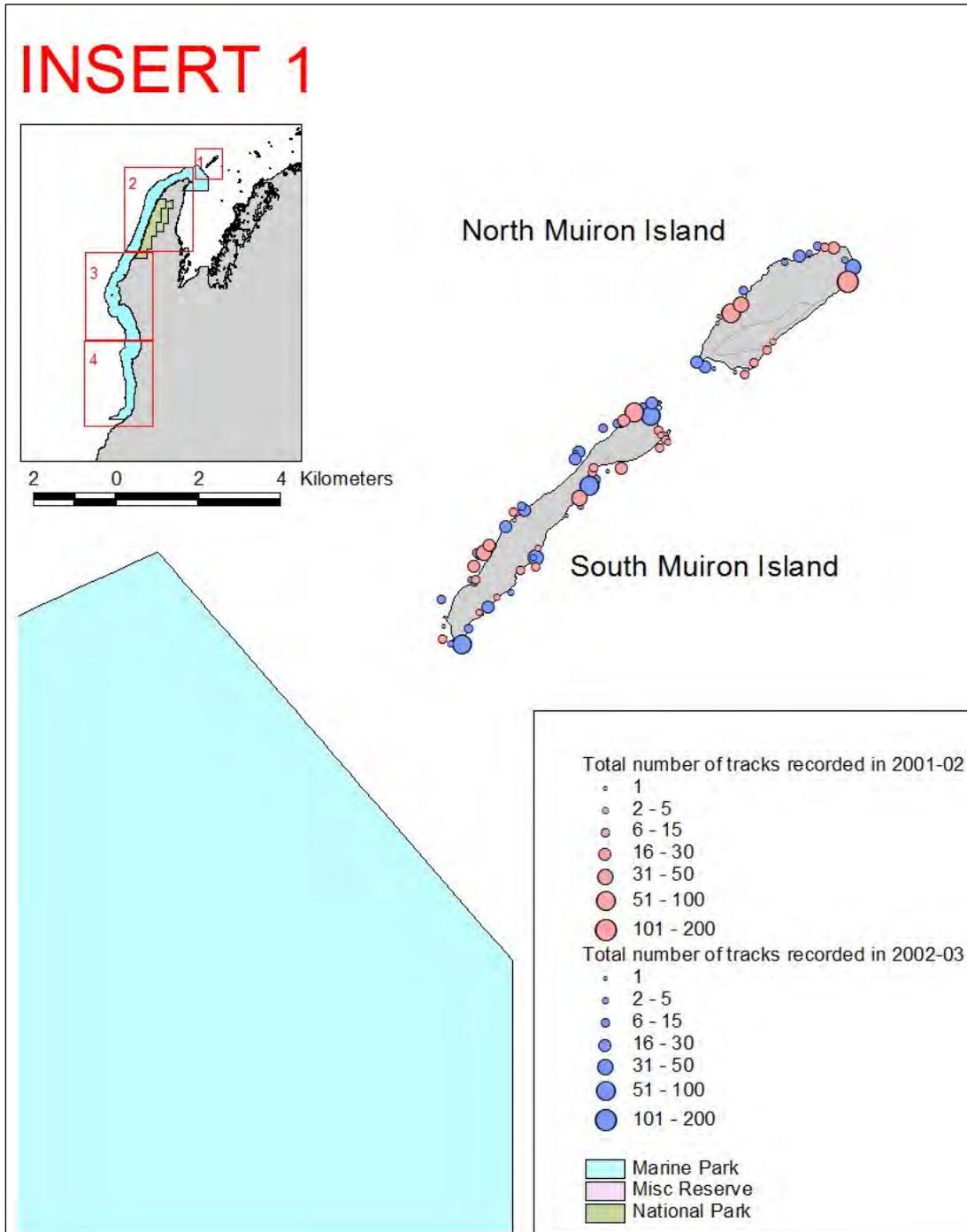


Figure 5.14 Spatial distribution of turtle tracks on the Muiron Islands

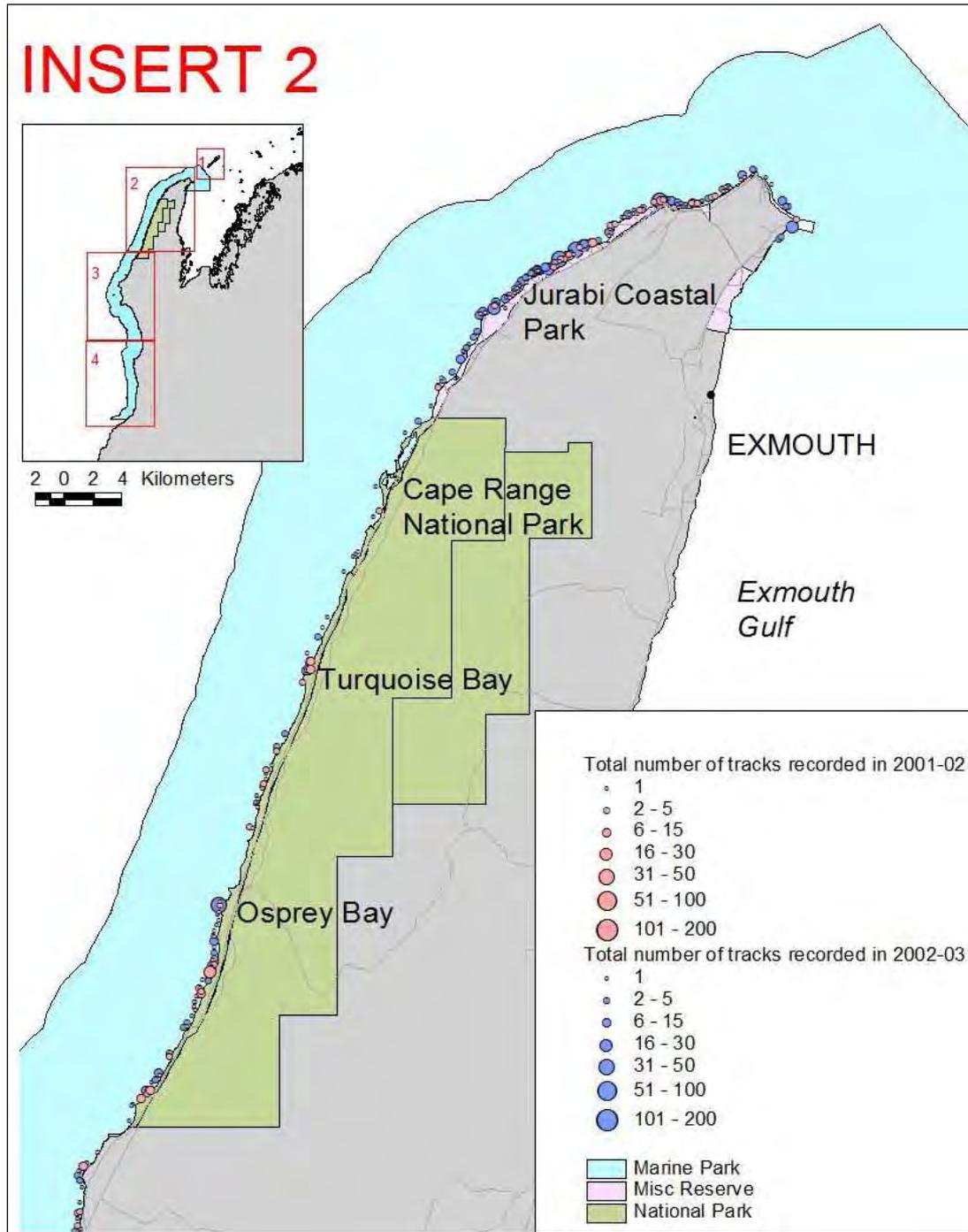


Figure 5.15 Spatial distribution of turtle tracks on the Northwest Cape, 2001-02 and 2002-03
 Points need to be bigger to see distribution

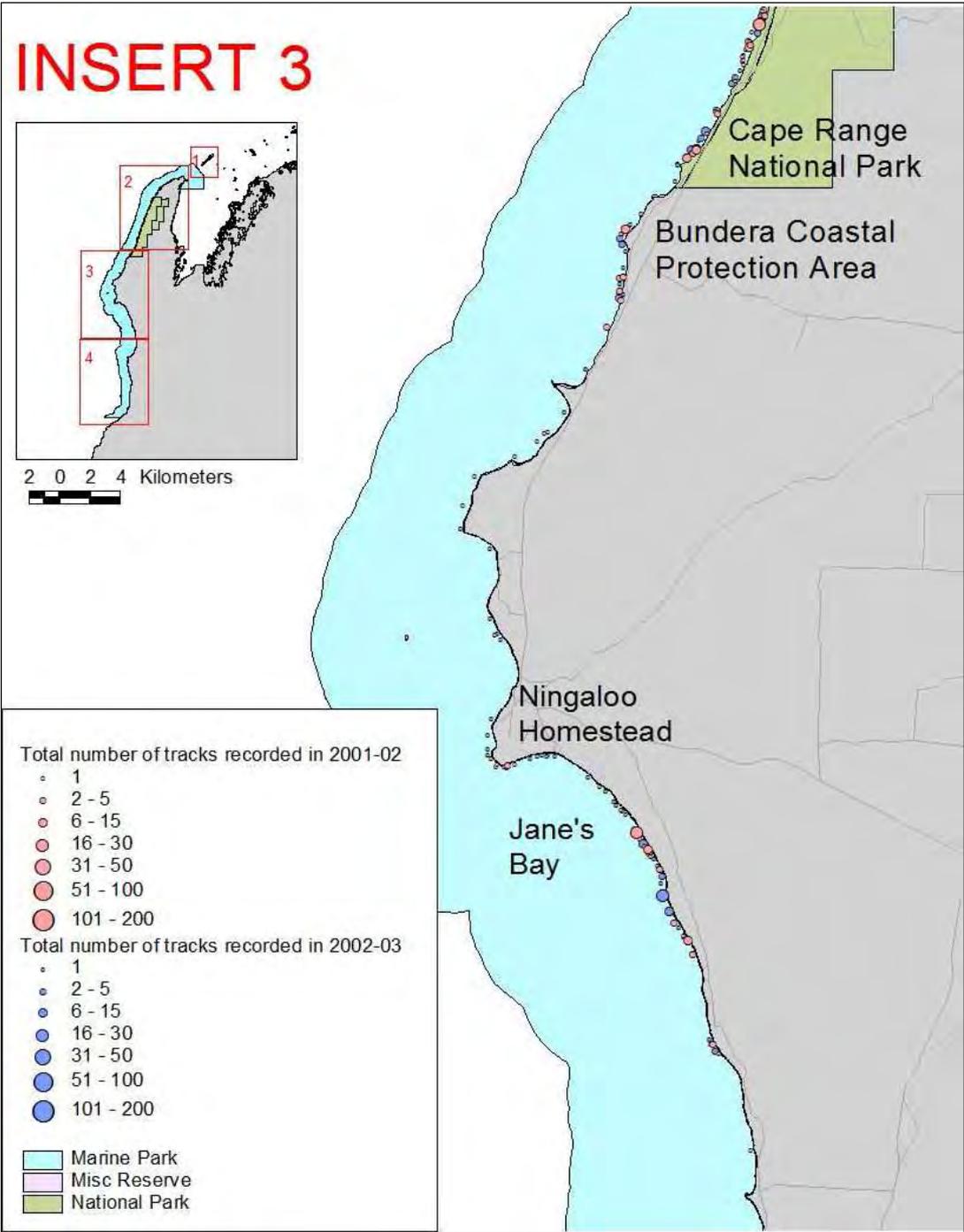


Figure 5.16 Spatial distribution of turtle tracks from Yardie Creek to Bateman's Bay, 2001-02 and 2002-03

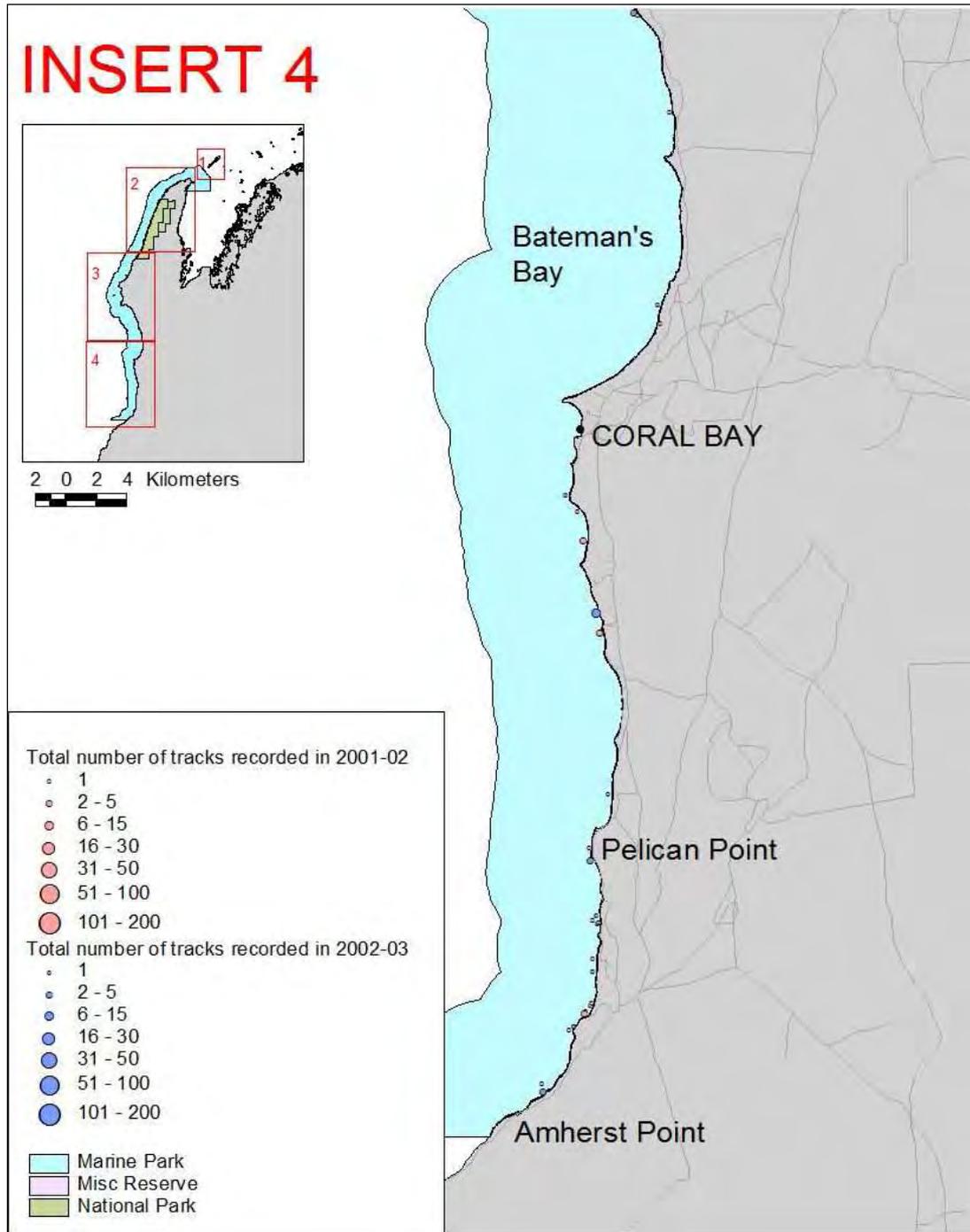


Figure 5.17 Spatial distribution of turtle tracks between Bateman's Bay and Amherst Point, 2001-02 and 2002-03

5.4.1.1 Species composition

The species composition was not analysed in 2001-02 because a high proportion of tracks were not positively identified (Figure 5.18). However, in 2002-03, most of the symmetrical tracks, representing green turtles, were found at the North Muiron Island, South Muiron Island and Hunters with low densities found at Lighthouse, Five Mile and Graveyards (Figure 5.19). No green turtle tracks were recorded south of Jane's Bay. Densities of asymmetrical tracks, representing loggerhead and hawksbill turtles, were greatest at North Muiron Island, South Muiron Island, Lighthouse, Bungelup and Jane's Bay (Figure 5.19). Asymmetrical tracks were also recorded in the southern areas between Jane's Bay and Pelican, where green turtles were not recorded.

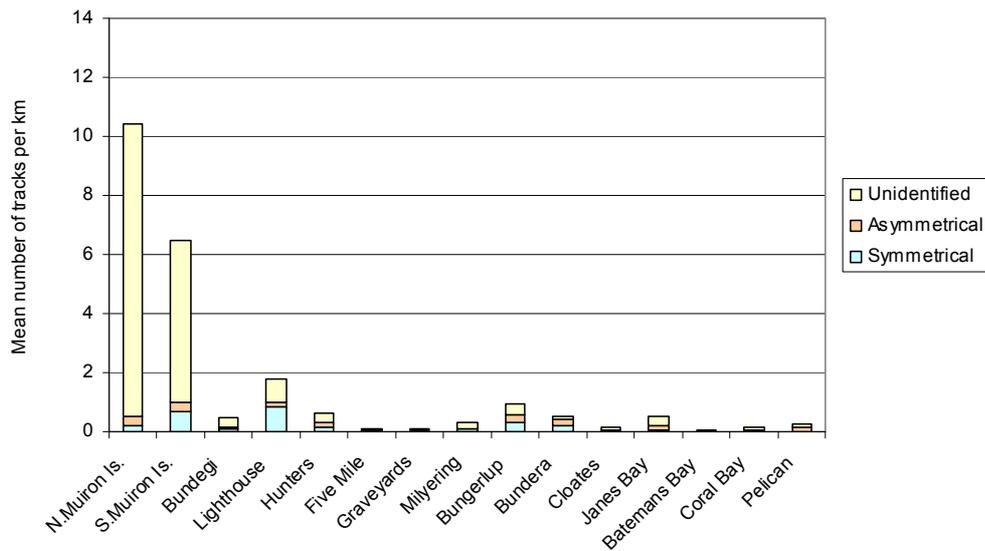


Figure 5.18 Mean density of asymmetrical, symmetrical and unidentified tracks/km in each section in the 2001-02 aerial surveys (refer to Table 5.3. for lengths of each section)

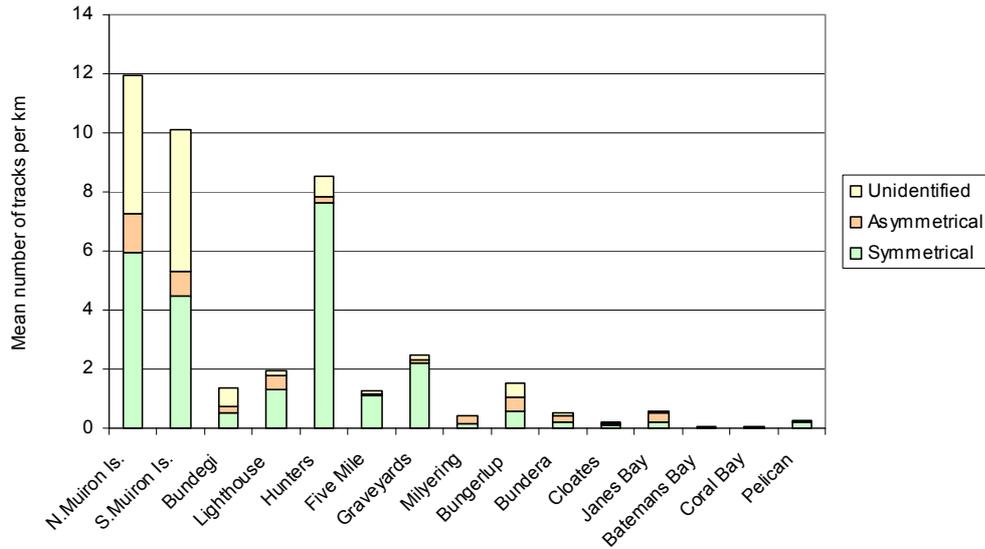


Figure 5.19 Mean density of asymmetrical, symmetrical and unidentified tracks/km in each section in the 2002-03 aerial surveys (refer to Table 5.3. for lengths of each section)

5.4.1.2 Validity of aerial data

The numbers of symmetrical, asymmetrical and unidentified tracks are presented in Table 5.7 for both 2001-02 and 2002-03 seasons. The accuracy of the surveys increased considerably between seasons with 61 – 84% tracks positively identified in 2002-03 (Table 5.7). The increase in accuracy may be attributed to a refinement of aerial techniques and increased experience of the pilot and observer in the 2002-03 surveys. Pearson's Correlation indicated that as track densities increase, the number of species identified decreases in 2001-02 ($r = -0.68$, $F = 10.05$, $p = 0.008$) and in 2002-03 ($r = -0.63$, $F = 8.06$, $p = 0.014$).

Table 5.7 Number of symmetrical, asymmetrical and unidentified tracks for each aerial survey, 2001-02 and 2002-03

Survey dates	Symmetrical tracks	Asymmetrical tracks	Unidentified tracks	Total No. tracks	% positively identified
2-Dec 2001	28	14	59	101	41.58
15-Dec 2001	21	24	297	342	13.16
14-Jan 2002	78	59	383	520	26.35
14-Dec 2002	477	71	124	672	81.55
15-Jan 2003	171	134	197	502	60.76
12-Feb 2003	329	114	87	530	83.58

To determine the accuracy of aerial surveys, the number of turtle tracks within Hunters Section was compared with ground survey data, which were considered to be accurate. A Students t-test found no significant difference ($p > 0.05$) in total tracks recorded in aerial and ground track counts (Students t-test: $df = 10$; $p = 0.9$; $n = 6$). Table 5.8 shows that surveys conducted on 14 January 2002 and 15 December 2002 recorded the same number of tracks, with less accurate results from the other aerial surveys. Aerial surveys conducted on 15 December 2001 and 12 February 2003 showed greater number of tracks compared to ground surveys suggesting that some tracks from previous days were also recorded.

Table 5.8 Comparing track counts from ground and aerial surveys

Survey Date	Survey Type	Symmetrical	Asymmetrical	Unidentified	Total
2-Dec-01	Aerial	0	0	11	11
	Ground	11	1	1	13
15-Dec-01	Aerial	3	9	14	26
	Ground	3	7	1	11
14-Jan-02	Aerial	6	16	14	36
	Ground	7	29	0	36
15-Dec-02	Aerial	50	2	2	54
	Ground	50	2	2	54
15-Jan-03	Aerial	101	5	9	115
	Ground	141	15	1	157
12-Feb-03	Aerial	116	9	4	129
	Ground	90	30	0	120

5.4.2 Track counts - Ground

Data collected in the ground track counts indicated a strong summer nesting seasonality of all species, with the majority of nesting of all species occurring from November to March. Low numbers of turtle tracks were also observed at the commencement of the surveys in November indicating that some nesting may have occurred prior to the survey period. In the Jurabi Coastal Park, green turtles were the predominant species making up 54% of the nesting attempts in 2001-02, followed by loggerhead turtles (42%) and hawksbill turtles (4%).

Similarly, a higher proportion of green turtle tracks were recorded in 2002-03 (92%) followed by loggerhead turtle tracks (7%) and hawksbill turtle tracks (1%). The nesting success of all species was consistent in both years, with a quarter of tracks resulting in nests in 2001-02 (213 nests) and 2002-03 (1587 nests).

Beach location

Overall, the majority of nests were recorded within 5m landward from the fringe of the vegetation (61%), followed by between the spring high tide and the fringe of the vegetation (21%), between 5 m from the fringe of the vegetation to the base of the primary dune (10%) and behind the primary dune (6%) (Figure 5.20). Although all species preferred to nest within 5m landward from the fringe of the vegetation, hawksbill and loggerhead turtles were less averse to nesting between the spring high tide and the fringe of the vegetation, potentially making their clutches more vulnerable to inundation during storm surges resulting from infrequent cyclonic events.

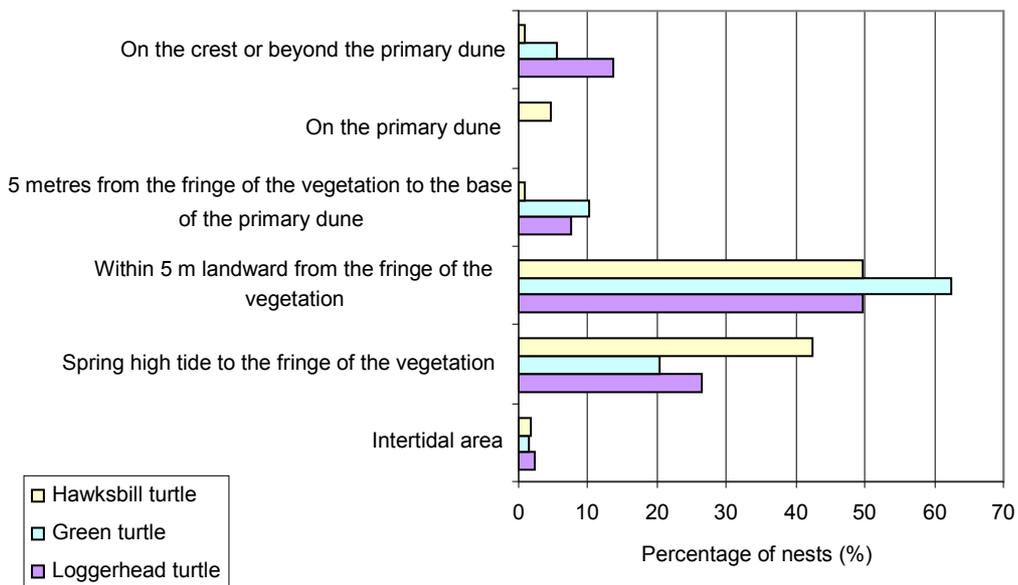


Figure 5.20 Percentage of turtle species nesting at various cross-sections of the beach (n = 8582 tracks)

5.4.2.1 Green turtles

The mean nesting frequency of green turtles was significantly higher in 2002-03 compared to the previous year (One-way ANOVA: $F = 13.98$; $p < 0.001$). There was a 6-fold increase in green turtle nests in 2002-03. Due to the low number of green turtles in 2001-02, the extent of the peak nesting period was not well defined. However, the data collected in 2002-03 showed a main peak period between December and February (Figure 5.21). The number of nests gradually increased in early November and December 2002, peaking in January and then decreased considerably in mid-February and March 2003.

Based on the mean nests per day in January and ACF for green turtles (Limpus 2005), the estimated female population of green turtles in the Jurabi Coastal Park was 40 – 50 turtles in 2001-02 and 540 – 630 turtles in 2002-03. Based on a five year remigration period, the female green turtle population along the Jurabi Coastal Park was estimated to be between 200 – 3,150 individuals.

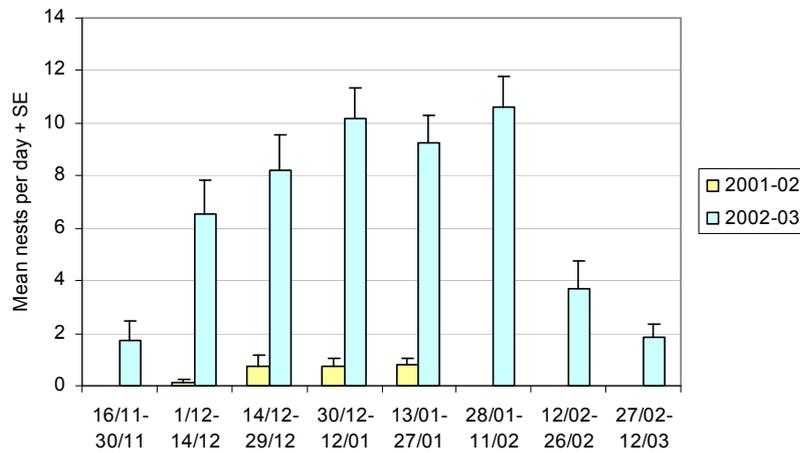


Figure 5.21 Mean nesting frequency of green turtles in 14-day intervals at Index sites (Hunters – Wobiri beaches), 2001-02 and 2002-03

The mean nests/km/day of green turtles was greatest at Trisel, Brooke, Five Mile and Mauritius in 2001-02 (Figure 5.22). The data collected in 2002-03 showed greater variation between sites with the highest densities at Brooke, North Graveyards, Trisel and Five Mile beaches (Figure 5.22). Beaches with low nesting frequencies were Tantabiddi, South Graveyards, Dunes and Mildura Wreck beaches.

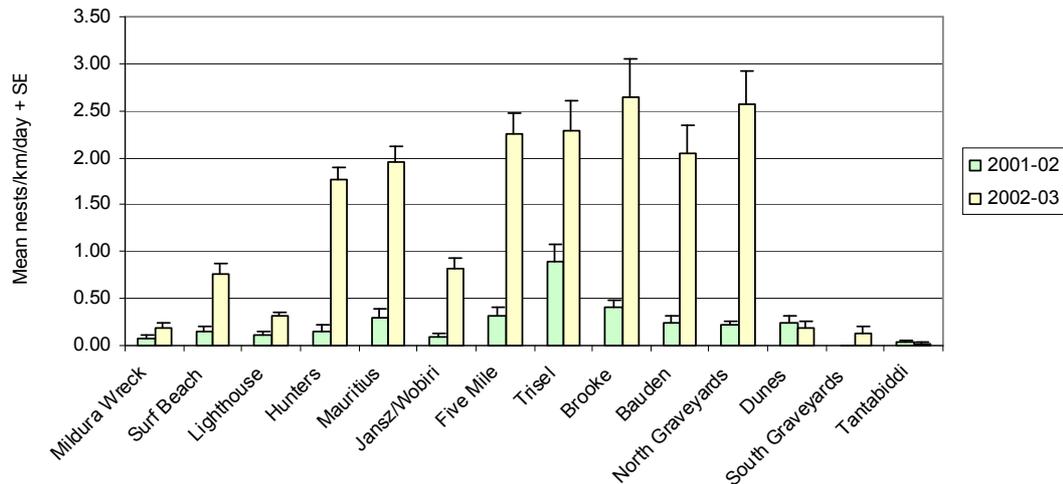


Figure 5.22 Mean nests/km/day of green turtles at all sites in the Jurabi Coastal Park, 2001-02 and 2002-03 (refer to Table 5.4 for length of each site)

The ANOVA test showed no significant difference ($p > 0.05$) in nesting success between the sites. The average nesting success of green turtles over all surveyed beaches was slightly higher in 2001-02 (26%; $n = 442$ tracks) than 2002-03 (22%; $n = 5615$ tracks). The highest nesting success for green turtles was recorded at North Graveyards and Brooke beaches in both nesting seasons (Figure 5.23). Bauden Beach also had a high nesting success in 2002-03. These three beaches were identified as reference sites that had no turtle watchers. There was no significant difference ($p > 0.05$) between tourist sites and reference sites in 2001-02, but there was a difference in 2002-03 (One-way ANOVA: $F = 18.95$; $p < 0.01$; $n = 8$ sites). Although the results indicate that Mildura Wreck Beach had a high nesting success in 2001-02, this data was derived from low track counts that bias these data. The 2002-03 data is more representative of the nesting success at Mildura Wreck Beach.

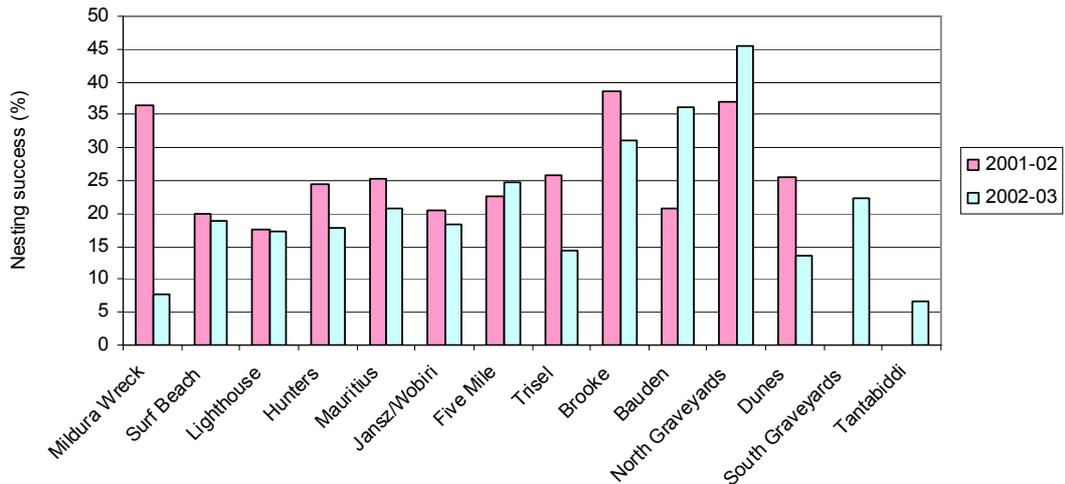


Figure 5.23 Nesting success of green turtles at sites at the Jurabi Coastal Park, 2001-02 (n = 442 tracks) and 2002-03 (n = 5615 tracks)

5.4.2.2 Loggerhead turtles

The mean nesting frequency of loggerhead turtles was similar in the 2001-02 and 2002-03 seasons. The peak nesting period for loggerhead turtles was in January in both 2001-02 and 2002-03 (Figure 5.24). The data collected in 2002-03 shows a gradual increase in mean nesting frequencies from November to late January and then a gradual decrease in February, with intermittent nesting occurring in late February and March. The estimated female turtle population of loggerhead turtles in the Jurabi Coastal Park was about 30 turtles in 2001-02 and up to 70 turtles in 2002-03. Based on a four year remigration interval, the total female loggerhead turtle population equates to approximately 120 – 280 individuals.

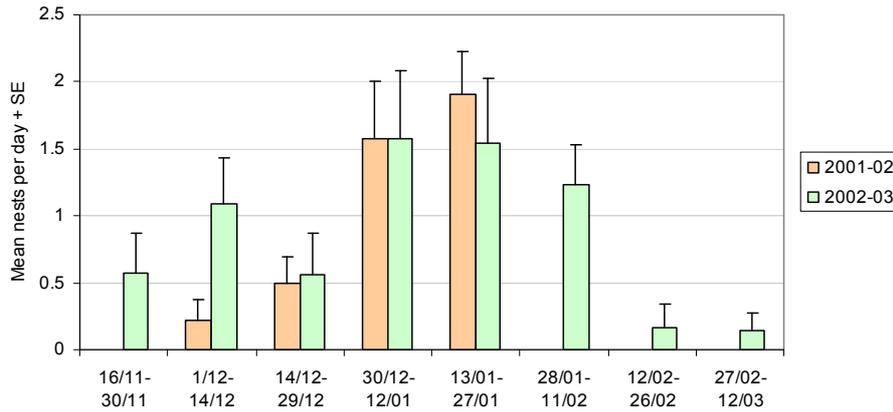


Figure 5.24 Mean nesting frequency of loggerhead turtles in 14-day intervals at Index sites (Hunters – Wobiri beaches), 2001-02 and 2002-03

The mean nests/km/day of loggerhead turtles in 2001-02 showed a high proportion of nests recorded at Mauritius Beach and Trisel beaches (Figure 5.25). In 2002-03, high densities of nests of loggerhead turtle nests were recorded at Hunters, Trisel and Mauritius beaches. As with green turtles, sites with low nesting frequencies were Tantabiddi, South and Graveyard beaches.

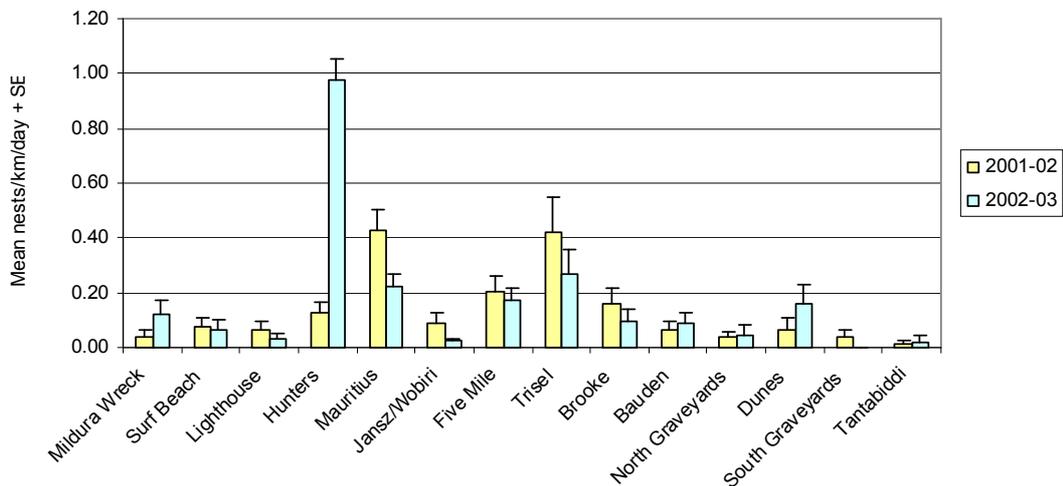


Figure 5.25 Mean nest/km/day of loggerhead turtles at all sites at the Jurabi Coastal Park, 2001-02 and 2002-03 (refer to Table 5.4 for length of each site)

The nesting success of loggerhead turtles was similar between sites in the Jurabi Coastal Park ($p > 0.05$). As with green turtles, the average nesting success of loggerhead turtles over all surveyed beaches was slightly higher in 2001-02 (33%; $n = 273$ tracks) than 2002-03 (28%; $n = 396$ tracks). The highest nesting success for loggerhead turtles was recorded at North Graveyards, Brooke and Trisel beaches (Figure 5.26). Low nesting success was recorded at Surf, Lighthouse and Five Mile beaches. Sites with no data were excluded from the analysis due to the lack of data collected at these sites. There was no significant difference ($p > 0.05$) in the nesting success between turtle watching sites (i.e. Hunters to Janz/Wobiri) and reference sites (i.e. Brooke to Graveyards) in both nesting seasons.

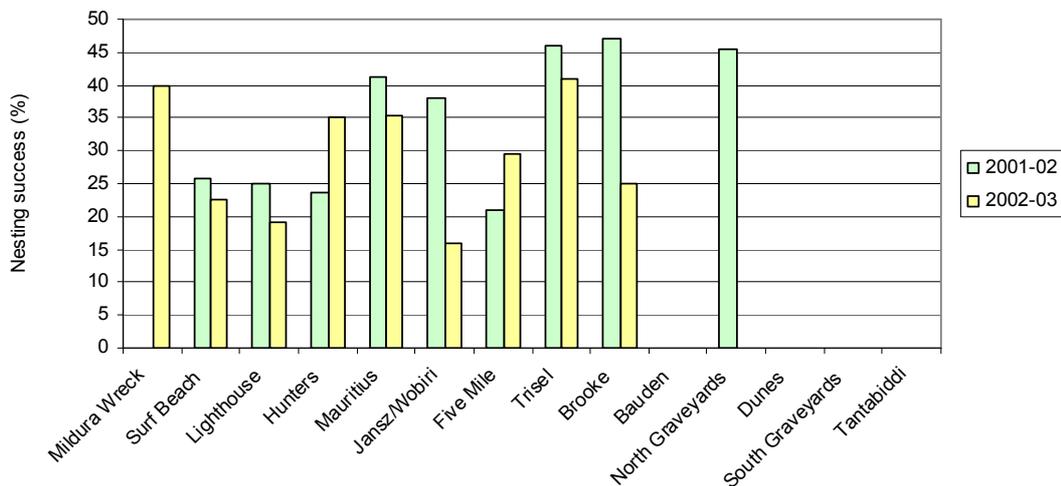


Figure 5.26 Nesting success of loggerhead turtles at sites at the Jurabi Coastal Park, 2001-02 ($n = 273$ tracks) and 2002-03 ($n = 396$ tracks).

5.4.2.3 Hawksbill turtles

The mean nesting frequency of hawksbill turtles was similar in the 2001-02 and 2002-03 seasons. As with green and loggerhead turtles, most of the hawksbill turtles were recorded in January (Figure 5.27). Although low numbers of hawksbill turtles were recorded, the results show a summer nesting peak.

Based on the maximum number of hawksbill turtle nests recorded within single re-nesting intervals, the estimated number of hawksbill turtles in the Jurabi Coastal Park was 4 turtles in 2001-02 and 13 turtles in 2002-03. Based on a four year remigration interval, the female population of hawksbill turtles in the Jurabi Coastal Park was calculated to be between 16 – 52 individuals.

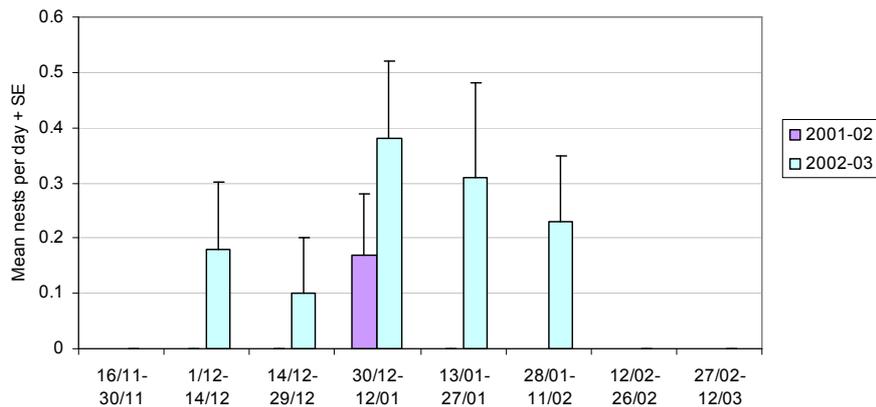


Figure 5.27 Mean nesting frequency of hawksbill turtles in 14-day intervals at Index sites (Hunters – Wobiri beaches), 2001-02 and 2002-03

The mean nest/km/day of hawksbill turtles in 2001-02 was low with nests recorded at Mauritius Beach, with fewer recorded at Five Mile and Trisel beaches (Figure 5.25). In 2002-03, relatively high mean nesting frequencies of loggerhead turtle nests were recorded at Hunters Beach with fewer at Dunes Beach. As with green turtles, sites with low nesting frequencies were Tantabiddi, South Graveyards and Mildura Wreck beaches.

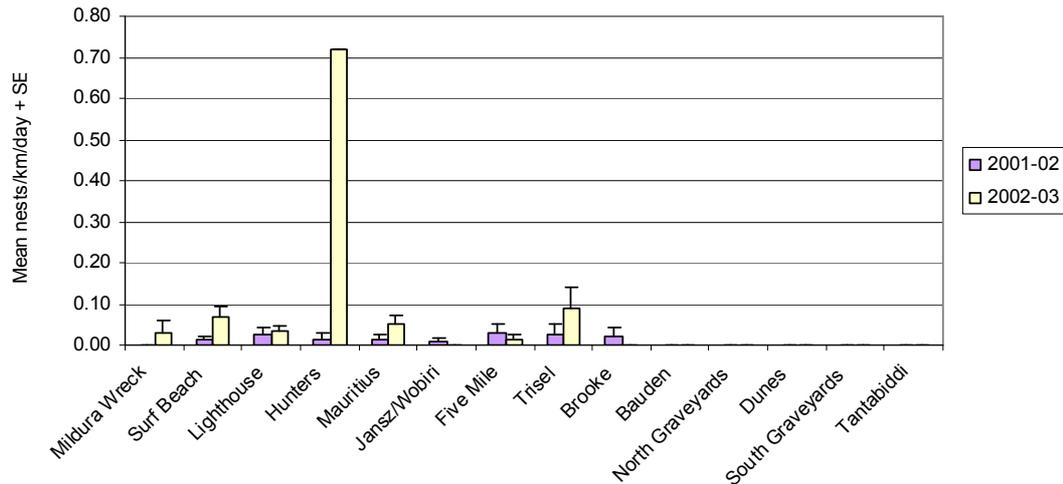


Figure 5.28 Mean nest/km/day of hawksbill turtles in the Jurabi Coastal Park, 2001-02 and 2002-03 (refer to Table 5.4 for length of each site)

Due to the low number of tracks recorded in the 2001-02, no sites provided nesting success data. The average nesting success of hawksbill turtles in 2002-03 was 53% ($n = 32$ tracks). This value was based on data collected from Lighthouse, Hunters and Mauritius beaches. Analysis of nesting success at tourist sites and reference sites was not carried out due to limited data collected for hawksbill turtles.

5.5 Discussion

5.5.1 Seasonal variation of turtles in the NMP

Most marine turtle species found in Western Australia nest throughout the year in very low numbers, with peak nesting seasons occurring during summer months (Prince, 2000; Baldwin *et al.*, 2003; Pendoley, 2005; DEWHA, 2009), which is also the case in the Ningaloo Marine Park and Muiron Islands. Further studies conducted in the Ningaloo region are consistent with the results of the current study (Carter *et al.*, 2004; Richards *et al.*, 2005; Markovina, 2008). Hawksbill turtles in Western Australia are thought to peak from August to December (Morris, *pers. comm.*, 2002). Generally, the incubation period for most species is usually 50 –

90 days depending on the sand temperature (Limpus, 1989). Therefore, the hatching period of turtles laying eggs in the NMP is expected to occur between January and May.

Although the abundance of loggerhead and hawksbill turtles did not differ between seasons, there was a large variation in nesting activity between seasons for green turtles (40 – 50 in 2001-02; 540 – 630 in 2002-03). Fluctuations in green turtle nesting abundances is common at other rookeries in Australia (Limpus and Nichols 1988; Limpus, 2009) and at the Jurabi Coastal Park (Prince, 2000, Carter *et al.*, 2004; Richards *et al.*, 2005; Markovina, 2008). Prince (2000) reported tagging 200 green turtles in 1995 and 1,000 the following year along the Jurabi Coastal Park (see Figure 5.2). Ongoing studies by the NTP have estimated 330 – 650 turtles in 2003-04 (Carter *et al.*, 2004), 175 - 350 turtles in 2004-05 (Richards *et al.*, 2005) and 2,000 – 3,000 nesting female turtles on the North West Cape during the 2007-08 season (Markovina, 2008). The estimated annual female nesting population of green turtles in the Jurabi Coastal Park, based on data taken over the past 20 years (1988 to 2008), is up to 3,000 turtles.

The most likely natural factor influencing green turtle annual nesting variability is the change in the Southern Oscillation Index (SOI) (i.e. El Niño and La Niña), which is thought to affect seagrass and algae production, which are both primary food sources for pre-nesting female turtles (Limpus and Nichols, 1988; Chaloupka, 2001; Troeng and Rankin, 2005). Given that the green turtle population of the North West Shelf Management Unit (see Section 5.2.1) is likely to be influenced by the patterns shown by SOI, as in north-eastern Australia (Limpus and Nichols, 1988), it is impossible to detect tourism-related impacts solely based on annual nesting activity. Therefore, localised and short-term studies specifically designed to investigate nesting behaviour need to be established. Chapter 7 of this thesis presents such a study.

While annual nesting variation may not accurately detect tourism-related impacts, it may be possible to predict the magnitude of nesting activity in future nesting seasons, which would allow operators and coordinators to plan well in advance. The ENSO theory developed by Limpus and Nichols (1988), based on 30 years of annual SOI and green turtle nesting activity data states that the relative abundance of nesting green turtles can be predicted two years in advance. While this theory is evident at eastern Australian islands, further research is required to determine if the same is true for green turtle populations in Western Australia. Another way of predicting the size of the annual nesting populations is by observing the relative abundance of mating turtles in the nearshore areas one to two months prior to the commencement of the nesting period (e.g. November - December).

5.5.2 Spatial distribution of turtles in the NMP

Numerous researchers support the use of aerial surveys to assess the distribution of turtles for the purpose of covering large areas in remote areas where vehicle access is often limited (Crouse, 1984; Shoop *et al.*, 1985; Schroeder and Murphy, 1999; Hopkins-Murphy *et al.*, 2001). However, aerial surveys have their limitations. An issue raised by Shoop *et al.* (1985) was the retention of turtle tracks in windy conditions and the repetitive nature of surveys over high density nesting areas. As a means of dealing with these issues, the aerial surveys in the current study used digital video footage to capture all tracks on film and analysed them in detail in a laboratory. This method therefore provided a more affective and cost efficient way of recording track densities because the area only needs to be covered once.

Comparisons between the aerial and ground surveys at Hunters Section showed that while aerial surveys can provide valuable information relating to total number of tracks and general distribution of species, limitations remain in recording species composition, particularly at high nesting density areas. A high proportion of species were identified in areas of low to medium track densities, but the accuracy of identifying species was compromised in high

density areas (e.g. North Muiron and South Muiron Islands) due to the overlapping of tracks. Aerial surveys conducted by Schroeder and Murphy (1999) also showed that counting turtle tracks by direct visual observation was difficult when tracks are overlapping each other. The abundance of tracks in such areas should be measured using ground surveys.

The aerial surveys confirmed previous reports that the Muiron Islands supported greater numbers of turtles than the western Northwest Cape Peninsula (Limpus, 1988; Prince, 2000; Limpus, 2002; Limpus and Chatto, 2004). The aerial survey also identified new rookeries that had not been reported prior to this study, including the north-east beaches of the North Muiron Island, Bungelup and Jane's Bay. While studies conducted in the Gascoyne region show green turtles attempting to nest as far south as Red Bluff and Bernier Island (Waayers, 2003) and Shark Bay (Limpus, 1982), the results from the current study showed a marked decrease in nesting density south of Jane's Bay (< 1 track/km), suggesting that this area could be the largest southern rookery in Western Australia. This marked decrease in nesting green turtles could be explained by the colder waters of the Ningaloo current that are moving north during the peak nesting period (Pearce and Pattiaratchi, 1999; Taylor and Pearce, 1999) provide a signal to green turtles the nesting conditions further south are less suitable.

The spatial information provided by aerial surveys provides a broader view of nesting distribution of turtles in the Ningaloo region. This baseline information helps managers identify key management areas for general turtle conservation and specific issues, such as impacts from tourist-turtle interactions, which relate to tourism development in the region. It also provides data that can be compared over time as a means of detecting changes in nesting distributions and potential impacts from human activities, such as unguided turtle watching. Chapter 6 explores the spatial distribution of human activities along the Ningaloo coast and cross references this data with the data gathered in this chapter to identify human-turtle interaction "hotspots".

5.5.3 Estimates of the turtle population in the NMP

Dethmers *et al.* (2006) estimated the population size of female green turtles in the North West Shelf Management Unit (Figure 5.1) to be approximately 125,300 individuals. The Lacepede Islands, in the southern Kimberley region, is known to support the greatest density and abundance of nesting green turtles (~ 1000 beach emergences per night) in Western Australia (Prince, 1994c). Available census data from Western Australian rookeries suggest that up to 40,000 green turtles occur in the Gascoyne region (Carnarvon–Muiron Islands) (Prince, 1994b; Waayers, 2003; UNEP/CMS, 2007). Based on aerial and ground surveys conducted in 2002-03, the number of female green turtles in the NMP and Muiron Islands could be up to 7,500 turtles. Given the average remigration interval of green turtles is 5 years (Limpus, 2009), the total female green turtle population could be up to 35,000 female turtles, which is consistent with the estimates of the Gascoyne region (~40,000 turtles). Based on these calculations, about one third of female green turtles on the North West Shelf are likely to be in the Ningaloo region during the breeding season.

The population estimates for green turtles in the Jurabi Coastal Park in the 2001-02 (200 female turtles) and 2002-03 (3,150 female turtles) nesting seasons were similar to those reported by WAMTP (Prince, 2000). In comparison with previous population estimates in the Jurabi Coastal Park, the number of green turtles calculated for 2001-02 was considered low, whilst 2002-03 was considered an average nesting season.

Previously, population estimates of loggerhead turtles suggest that about 3,000 female turtles nest along the Western Australia coast (Baldwin *et al.*, 2003). According to Prince (1994a), Dirk Hartog Island in Shark Bay makes up 75% of the nesting loggerhead turtles in Western Australia. The estimated annual number of loggerhead turtles nesting at Dirk Hartog is estimated at 800 – 1,000 individuals, which is considerably less than the annual population in the Ningaloo region that was calculated in this study (up to 5,000 female turtles). In fact, this

study has shown that the Ningaloo region probably supports the largest breeding population in Western Australia. Based on the average remigration interval for loggerhead turtles, the total female population could be expected to be as many as 20,000 turtles. In the Jurabi Coastal Park, where low densities of loggerhead turtles nest, the annual female loggerhead turtle population was estimated to be between 120 – 280 turtles, which was also considerably higher than the estimates calculated by WAMTP in the 1990's (5 – 25 turtles) (Prince, 2000).

The major rookeries for hawksbill turtles in Western Australia are in the Dampier Archipelago, the Montebello Islands and the Lowendal Islands (Limpus 2009). However, little is known about the size of these breeding populations. The annual female hawksbill turtle population in the NMP was estimated to be between 20 – 700 individuals, which equated to 80 – 2,800 turtles based on a 4 year remigration period. In the Jurabi Coastal Park, 20 – 50 female hawksbill turtles were estimated to be nesting. Although flatback turtles are known to nest in large numbers at Barrow Island (approximately 300km north of the Muiron Islands), no flatback turtles were recorded in the Jurabi Coastal Park.

While these population estimates provide an indication of the size of the Ningaloo Marine Park and Muiron Islands turtle populations relative to the Western Australian breeding populations, they are based on a two year data set and numerous assumptions drawn from other published population studies (Limpus *et al.*, 2001; Limpus *et al.*, 2003; Limpus, 2009). The amount of variation between years and sites in life history parameters, especially for green turtles (Broderick *et al.*, 2001), necessitates caution in interpreting these numbers. Additional ecological data, such as inter-nesting and remigration intervals, and at least 5 years of data is required to improve the accuracy of the population estimates.

The deployment of satellite trackers, known as Platform Terminal Transmitters (PTT's), can provide valuable information relating to inter-nesting habitat, re-nesting intervals (i.e. time taken between nesting events), number of clutches per season, movements between nesting

sites and post-nesting migration paths (Dobbs, 2001). Although PTT's accurately measure turtle movements and provide important information for estimating local female turtle populations, they are expensive, and depending on the research budget, will only provide a small sample size. The conventional technique of tagging turtles with a titanium tags can also provide this type of data. However, tagging requires large amounts of survey effort (e.g. working all night and every day during the season). The recovery of tags from turtles is often low unless the sampling effort is high during the season and over consecutive years at a relatively confined beach where there is high nesting activity (Limpus, 2002).

While population estimates of turtles are often derived from census data, this information can provide an indicative measure of relative abundance and the extent to which a population may be declining. Not only are population estimates essential for determining the conservation status of each species at various policy levels, but are also important in informing the planning process for turtle tourism and other coastal and offshore developments.

5.5.4 Nesting success in the Jurabi Coastal Park

Nesting success is a measure of the ratio of adult turtle tracks resulting in a nest, which differs from clutch success, which measures the ratio of hatchlings emerging from a nest. Nesting success is considered a indicator that determines the suitability of nesting habitat (Miller, 1999) and could potentially help to detect impacts from turtle watchers. The current study found that the average nesting success of green turtles in the Jurabi Coastal Park (24%) was considerably less compared to offshore islands in Western Australia, such as Barrow Island (49%) (Pendoley Environmental, 2005). This could suggest that mainland beaches are less suitable as nesting habitat compared with island beaches because they are often subject to higher levels of direct and indirect human disturbances, including turtle tourism activities (see Chapter 7).

A preliminary study undertaken by DEC found that, on average, about one third of all turtle species successfully nested along the Jurabi Coastal Park (CALM, 1995). The current study showed similar proportions of nesting success along the Jurabi Coastal Park however there was some variation between years. Nesting success was generally higher in 2001-02 compared to 2002-03 which could be related to lower nesting densities and therefore less competition for nesting space and/or disturbance from other turtles crawling on the beach.

The results also indicate that green turtles generally had lower nesting success (22%) compared with loggerhead (28%) and hawksbill turtles (53%), suggesting green turtles either are more fastidious about selecting an appropriate nesting area to lay eggs or more susceptible to disturbance. Although its likely that both inferences are occurring simultaneously, the disturbance to green turtles may be a key factor given green turtles are the predominant species in the Jurabi Coastal Park and are encountered by turtle watchers more regularly (see Chapter 7).

Little research has been conducted that investigates the relationship between turtle nesting success and human disturbance. The nesting success of turtles can reflect the suitability of a nesting habitat for adult turtles, which relies on sand characteristics, dune system stability, good beach access and sheltering of the beach (Lutz and Musick, 1997; Stoneburner and Richardson, 1981; Johannes and Rimmer, 1984; Fangman and Rittmaster, 1993). Anecdotal evidence suggests that low nesting success may also be attributed to disturbances from turtle watchers. The data collected in the Jurabi Coastal Park (see Section 5.4.2) showed that the nesting success was generally lower at beaches used by turtle watchers (e.g. Hunters, Mauritius and Jacobsz beaches). The highest nesting success for green and loggerhead turtles was recorded at beaches not used by turtle watchers (e.g. North Graveyards, Brooke and Trisel beaches) (see Figure 5.26). An argument in favour of this assertion is that nesting habitat characteristics are similar between the beaches of the Jurabi Coastal Park. On the

other hand, the low nesting success at South Graveyards and Tatabiddi could be related to the distribution of large algal mats on the shore and increased sand particle size and coral rubble, which can impede turtles from successfully nesting (Bustard, 1972). Although some inference can be made that turtle watchers are impacting the nesting success of turtles on the beaches of the Jurabi Coastal Park (also see Chapter 7), further research is necessary to determine whether nesting success can be used as an indicator of tourism-related impact.

5.5.5 Benefits of using volunteers in monitoring

As shown in this research, the involvement of volunteers is an important component in collecting data and creating opportunities for capacity building within the local community. The integration of conservation biology, ecotourism and volunteer tourism has emerged as having great potential benefits to aid the conservation of ecosystems worldwide (Clifton and Benson, 2006; Brightsmith *et al.*, 2008). Conservation biology can provide the scientific expertise for sound data collection, ecotourism can provide benefits to local communities and build local and international support for protected areas (Fennell and Weaver, 2004) and volunteer tourism can provide funding and labour (Campbell and Smith, 2006).

Increasingly conservation biologists are partnering with companies who specialise in volunteer tourism to raise funds and labour to implement field projects. Volunteer tourism also provides a captive audience for environmental messages and helps build the global conservation constituency (Campbell and Smith, 2006). The Earthwatch Institute is perhaps the best-known volunteer tourism organisation and has worked with about 1350 scientists and placed 90,000 volunteers since its founding in 1971 (Earthwatch Institute, 2008). Although volunteer tourism opportunities are diverse, Ellis (2003) found marine turtle projects to be the third most popular opportunity (17%) to work with flora or fauna, behind marine mammals (29%) and terrestrial fauna (22%). The use of volunteers to undertake turtle studies is essential for long-term monitoring. This is evident in this research and many other turtle

conservation programs throughout the world such as the Florida Marine Turtle Program (FWC, 2009), various turtle conservation programs in Malaysia (WWF, 2009), Projecto TAMAR IBAMA in Brazil (Projecto TAMAR IBAMA, 2009), Guyana, Suriname and French Guiana in South America, with patrols and tours organised by WWF (Zeppel, 2006) and Caribbean Conservation Corporation in Costa Rica (Campbell and Smith, 2006; CCC, 2009).

This thesis also contributes to this line of thought by showing how community monitoring provided biological information that informed decisions as part of the stakeholder workshops and provided feedback to local residents and the wider community about the nesting activities and impacts to turtles in the local area (refer to Chapter 4, Section 4.5). The active participation and coordination of local residents in the collection of baseline data communicates a community-focused project, possibly evoking acceptance amongst the wider local community. It is also thought to act as a way of subtly injecting awareness into the wider local community and empowering participants to inform others within the community of their potential impact on turtles. In a sense, the participants become the custodians of the resource and help educate their families and friends about turtle conservation. In principle, this form of broad-based education should reduce the pressure on managers to enforce regulations.

Most scholarly works conducted on volunteer tourism have focused on the quality of the data produced by volunteers, or the volunteers themselves (e.g. Markus and Blackshaw, 1998). The value of volunteer labour is greatly reduced if volunteer-collected data are not accurate enough to be used in scientific reports, and studies of data quality have led to some authors to express concern over the use of volunteer-collected data (Foster-Smith and Evans, 2003). However, when appropriate tasks are chosen and sufficient training given, many studies show volunteers are able to collect high quality data useful for scientific publications and resource management planning (Darwall and Dulvy, 1996; Schmitt and Sullivan, 1996; Newman *et*

al., 2003; Pattengill-Semmens and Semmens, 2003). The quality of data collected in this thesis matches these studies. The accuracy of the data collected as part of this thesis was maintained through comprehensive training, the development of an on-site training manual and regular competency assessments of volunteers during the nesting season.

5.6 Conclusion

The aerial and ground surveys provide information relating to the distribution and abundance of turtles attempting to nest, subsequently identifying significant nesting habitats in the Ningaloo region. The aerial surveys proved to be a cost-effective method for collecting spatial data over a broad area. However, this method is limited by some difficulties in identifying tracks and should be considered an indicative measure of the distribution of species within the area, rather than an exact measure. Nevertheless, ground-truthing of those areas identified as significant habitat by the aerial surveys can clarify what species are present. Track counts provide useful baseline data that reflect the temporal variation of nesting activity and nesting abundance within the season.

Green turtles are the predominant species in the Ningaloo region with up to 35,000 female turtles within the nesting population, which constitutes about one third of female green turtles on the North West Shelf. The other two species that nested in the Ningaloo Marine Park were less abundant, with an estimate of up to 20,000 loggerhead turtles and 3,000 hawksbill turtles comprising the total female nesting population. However, given that turtles are long-lived animals that reach sexual maturity between 20 - 40 years and have a remigration interval ranging between 2 - 9 years, two consecutive seasons of data is not sufficient to make judgements about population changes or long-term patterns in nesting activity.

As indicated in the preliminary data derived from the track count surveys, the annual nesting activities of green turtles can fluctuate considerably between years. Every year a different cohort of nesting female turtles will arrive at the shores of the Ningaloo coast and the size of

the nesting population will depend on numerous environmental factors, such as El Niño movements, water temperature, seagrass production and the health of other food sources (Limpus and Nichols, 1988; Eckert *et al.*, 1999). Therefore, ongoing long-term monitoring is essential to understand these patterns in nesting activity. Long-term monitoring, however, requires substantial resources and volunteers to achieve accurate and useful information. The current study provided the resources and personnel to undertake two months of baseline data collection between 2001 and 2003, covering most of the beaches within the Jurabi Coastal Park area. Track count monitoring has continued since then, however financial support may not be available in the subsequent years. Not only does this emphasize the importance of facilitating collaboration among stakeholders (see Chapter 4), but also has ramifications for the development of long-term monitoring programme.

The distribution and abundance of nesting female turtles are measures used to understand the dynamics of the population. To understand the population in its entirety, other variables need to be considered, such as productivity and survivorship of hatchlings, adult mortality, inter-nesting characteristics (i.e. inter-nesting habitats, number of clutches per season and inter-nesting interval for each species), post-nesting migration movements, interannual variability (i.e. years between nesting seasons) and the male population (Eckert *et al.*, 1999; Limpus, 2009). There are also other habitats that support turtles at different life stages, such as during mating aggregations, inter-nesting habitats, post-hatching nearshore areas, open oceans and pelagic zones, and foraging areas. Other aspects of a nesting population can be measured through clutch surveys, recording stranded or dead turtles, deployment of satellite trackers, tagging and male turtle capture techniques.

Although the distribution and abundance of turtle nests can provide a generic indicator of nesting activity, using this data to measure tourism-related impacts would be erroneous given the numerous natural and non tourism-related influences (e.g. long-line fishing, oil and gas developments, coastal development) occurring in the Ningaloo region and abroad. It is

therefore imperative to identify measurable indicators that will determine tourism-related impacts, whilst minimising the external environmental influences. The data on nesting success of turtles, particularly green turtles along the Jurabi coast, showed that there were differences between turtle watching sites and reference sites suggesting that management is required. The following chapter presents baseline data relating to the distribution and abundance of turtles and visitors along the Jurabi Coastal Park, where interactions were identified by the aerial survey.

**CHAPTER 6 ESTABLISHING BASELINE DATA ON TOURISTS: A
PRELIMINARY INVESTIGATION OF INDEPENDENT TURTLE
WATCHING GROUPS IN THE NINGALOO MARINE PARK**

6.1 Introduction

A further important consideration when developing wildlife tourism is identifying areas where visitors are interacting with animals. Designated management areas need to be established to control access and tourist behaviour. Research of human uses and perceptions of natural areas is only recently, and often reluctantly, being used in natural resource management and planning (Higginbottom, 2004b; Newsome, 2005). Therefore, sustainable management of wildlife tourist experiences need to be guided by information related to the distribution, characteristics and behaviour of visitors within the natural environment.

The following chapter presents baseline data relating to the distribution of independent tourists along the NMP and the characteristics of independent turtle watching groups in the Jurabi Coastal Park. The research questions associated with this study are:

- Where are the key management areas for turtle tourism in the NMP?
- What are the spatial-temporal distribution and demographic characteristics of turtle watchers seeking turtles in the Jurabi Coastal Park during the nesting season?
- How knowledgeable are turtle watchers of DEC's code of conduct and how does this relate to visitor behaviour?

This chapter first describes what is currently known about tourist activity and tourist profiles in the Ningaloo region. The chapter then describes the methods used to record the distribution of human activity including the use of aerial surveys, on-site surveys and a questionnaire. The results present the distribution of human activity along the NMP coast and identify areas

where turtle tourism exists. The on-site surveys provide baseline data on the abundance of turtle watchers in the Jurabi Coastal Park, whilst the questionnaire provides information relating to independent turtle watchers' characteristics, knowledge and experience, satisfaction and perceptions of existing management conditions.

6.2 Relevant literature

6.2.1 Identification of tourist activities

Although independent travellers have been watching nesting turtles incidentally for decades, there has been little management or guidance to prevent impacts from tourism. The main impacts from tourist activities include the use of artificial lighting on nesting beaches, which disrupts critical behaviours, including nest-site choice and nocturnal nesting behaviour (Lutcavage *et al.*, 1997) and off-road beach traffic, which can destroy nests, crush hatchlings as they transverse the beach and create deep wheel ruts that present a barrier to hatchlings attempting to reach the ocean (Hosier *et al.*, 1981; Cox *et al.*, 1994). As tourist activity in the Ningaloo region increases (CALM, 2005), there is concern among the Department of Environment and Conservation (DEC) managers, scientists and wildlife conservation NGOs that human-turtle interactions will impact on the ecological integrity of nesting marine turtle species.

Fundamental to achieving sustainable wildlife tourism is ensuring that the wildlife is not adversely impacted by tourism. Monitoring is essential for managers who are increasingly required to report on the outcomes of their activities, which includes collecting data on the target species and visitors seeking wildlife (Pitts and Smith 1993; Newsome *et al.*, 2002). In the case of turtle tourism in the Ningaloo region, there remains inadequate baseline data on marine turtles and visitor distribution for controlling access and tourist behaviour at important turtle nesting sites.

Smith (2004) describes four distinct components of visitor monitoring including counting visitors, questionnaires and personal interviews, site-based surveying and observing visitors. Counting visitors often involves compiling information about visitor use levels and patterns of use. There is a range of techniques used to collect data on visitors, from traffic counters (Watson *et al.*, 2000) to visitor books, entry passes purchased or revenue returns from licensed commercial tour operators (Roggenbuck and Lucas, 1987; Watson *et al.*, 2000). Aerial surveys were used to record the spatial distribution of visitor activity (including vehicle activity and human presence) along the NMP coast.

In wildlife management applications, a central role of Geographical Information System (GIS) techniques has been to associate landscape features with ecological-spatial attributes to identify suitable habitat that may be threatened by human activities (Congalton and Green, 1995; Griffiths *et al.*, 2002). GIS applications in wildlife management include recording the distribution of animals, such as whales, dugongs and turtles using aerial surveys (Preen *et al.*, 1997). The data collected in aerial surveys can then be used as a geographical layer over other resource areas, such as tourism facilities and activity. GIS applications for tourism are often related to tourism marketing and information technology linked with mass tourism (McAdam, 1999; Van der Knaap, 1999) and destination-based tourism information management systems (e.g. maps and websites) (Porter and Tarrant, 2001). However, there is a paucity of studies that use aerial surveys to quantify tourist and wildlife distributions for the purpose of identifying potential impact sites or “interaction hotspots”.

Once the key management areas are identified by the aerial surveys, site-based surveys were undertaken using semi-structured interviews to obtain detailed information on visitor characteristics, preference, satisfaction and perceptions of existing management (Watson *et al.*, 2000).

Successful management of tourism in natural areas depends on knowledge of both visitor-use and characteristics of visitors (Buckley and Pannell, 1990; Morin *et al.*, 1997). Although studies have recorded the abundance of visitors in the Cape Range National Park (see Section 3.4.2), little is known about the distribution and abundance of independent turtle watchers in the Jurabi Coastal Park. A preliminary investigation of independent turtle watchers was conducted at access points along the Jurabi Coastal Park in 1995 (CALM, 1995). A total of 92 questionnaires were distributed amongst independent turtle watchers after their experience on the beach at night. The study showed that most of the respondents were from Perth or overseas travellers.

6.2.2 Tourists ability to retain educational information

Education of wildlife visitors can occur through changes in attitudes and/or knowledge, which in turn, may promote more responsible behavior towards wildlife in terms of minimizing negative impacts, subsequent involvement in wildlife conservation or research, increase the number of advocates of conservation and more satisfied customers (Higginbottom *et al.*, 2003; Zeppel and Muloin, 2008c; Zeppel, 2008). Studies at the Mon Repos Conservation Park have shown that interpretation resulted in changes in attitude about supporting conserving marine turtles (Howard, 2000; Tisdell and Wilson, 2001; Ballantyne *et al.*, 2007; Hughes, 2009). A study conducted by Woodson (1996) at the Mon Repos Conservation Park also revealed that there is a cyclical relationship between education, concern and behaviour change and a strong interdependence between education and behaviour change. The study found that once a person gains awareness through education, they then become interested and potentially concerned about the turtle populations. Once this concern becomes important enough to the person, it will lead to a desire to change their behaviour.

As a means of managing the interactions between independent turtle watchers and turtles in the Jurabi Coastal Park, a code of conduct (the code) was developed by DEC based on the guidelines set at Mon Repos Conservation Park, Queensland (Mau, 2003). The code was presented in two forms: a pamphlet which was available at the DEC office in Exmouth, Milyering Visitor Centre and Exmouth Tourism Bureau (Shire of Exmouth and CALM, 2004); and signs which were positioned at the trailhead at selected access paths along the Jurabi Coastal Park, including Hunters, Mauritius, Jacobsz, Jansz, Wobiri, Five Mile, Trisel, and Bauden beaches (Figure 3.3). The code comprised seven general guidelines that relate to how visitors should behave whilst seeking turtles on the beach at night. The guidelines presented in the DEC brochure and at beach signs are compared in Table 6.1. The DEC has also installed signs at beach access areas where there is evidence of off-road driving activity.

6.2.1 Management and visitor satisfaction

The satisfaction levels are often high in wildlife tourism (Orams, 2001; Higinbottom, 2004b; Newsome *et al.*, 2005). Specific elements of visitors experience that enhance satisfaction include the variety of animals seen, particular features of animals, closeness to the wildlife, seeing large, rare or new species, natural settings and being able to learn about the wildlife (Higinbottom, 2004b). Orams (2001) revealed that a range of factors influence tourist enjoyment of whale watching including the number of whales sighted, the whale behaviour, the number of fellow passengers, cruise duration, boat construction and seasickness. The major finding was that the proximity of the whales was not a major influence on the tourist's level of satisfaction (Finkler and Higham, 2004; Muloin, 1998; Peake *et al.*, 2009; Valentine *et al.*, 2004).

Managers often seek visitors' preferences for proposed management actions to ensure that such actions do not affect the quality of the visitor experience or satisfaction (Chin *et al.*, 2000). Most studies that have investigated visitor preferences found that respondents

supported regulatory actions such as limiting access (Shindler and Shelby, 1993), limiting the number of visitors (Chin *et al.*, 2000) and management through the provision of educational material (Morin *et al.*, 1997; Chin *et al.*, 2000).

Table 6.1 Guidelines presented on DEC pamphlets and beach signs

General guideline	Guidelines in DEC pamphlet	Guidelines on signs at car parks along the Jurabi Coastal Park
1. Walk along high tide	Walk along the beach at the high tide mark (near the water) looking for tracks or turtles emerging from the water	Not stated
2. Minimise use of lights (e.g. torches and flash photography)	Do not approach or shine lights on turtles leaving the water or moving up the beach. If a turtle encountered, calmly stop where you are, sit down, and wait for her to start digging.	Let your eyes adjust to the dark. Use small torches to observe egg laying. Avoid shining lights out to the sea or at turtles coming up the beach
	Only use the camera flash after turtle commences egg laying	Not stated
3. Avoid sudden movements	Avoid excess noise and sudden movement at all times	Avoid making sudden movements
4. Stay behind turtles as much as possible	Always position yourself behind the turtle and stay low (sit, crouch or lie on the sand). If you are getting covered in sand as she digs you are too close!	Not stated
	When approaching a nesting turtle crawl up behind her on your stomach	Not stated
5. Be patient and wait	Be patient. She may abandon the nest and dig another one for a variety of reasons including hitting an obstacle or the sand being too dry.	Sit patiently
6. Be quiet	Not stated	Avoid making any noise
7. Keep your distance	Wait until she is laying before moving closer. She will be quite still when laying her eggs – if sand spraying or she is using her flippers, she is not laying	Approach turtle with caution. Close contact (within 3 m) should not be attempted until nesting is complete and the eggs are being laid.
	Give her enough space to camouflage the nest	Not stated
	Let her return to the ocean without interruption getting between her and the ocean	Not stated
8. Depart before 11pm	Depart all beaches by 11pm	Not stated

6.3 Methods

6.3.1 Aerial surveys - tourist activity

6.3.1.1 Survey Area

Tourist activity was recorded in conjunction with the six aerial surveys that collected data on turtle tracks during the peak nesting period along the Ningaloo Marine Park coast (see Chapter 5, Section 5.3.1).

6.3.1.2 Distribution of off-road vehicle activity

Off-road vehicle tracks on beaches along the Ningaloo coast were recorded during aerial surveys to measure the extent of beach used by off-road vehicles. The length of beach and density of tracks were used to measure the extent of beach used by off-road vehicles. Off-road vehicles include four-wheel-drives (4WD's), motorbikes and quad-bikes (which are often used in Coral Bay as a common form of transportation). Indentations in the sand left by vehicles (Figure 6.1) were recorded on digital video tape and later examined using video editing software.



Figure 6.1 Off-road vehicle traffic at Bateman's Bay, 2002-03

6.3.1.3 Distribution of human footprints

The spatial distribution of human footprints was recorded as a surrogate measure of human presence on beaches (Figure 6.2). The length of beach with human prints was recorded and examined using video editing software. Areas of high densities of footprints were identified and the proportion of footprints recorded over the entire survey area was calculated to identify areas of human activity. Although the length and density of footprints does not provide data on turtle watcher activity exclusively, it does isolate specific areas where turtle tourism activity may be occurring. Areas containing high densities of footprints were ground-truthed to confirm the presence of turtle watchers (see Section 5.3.2).

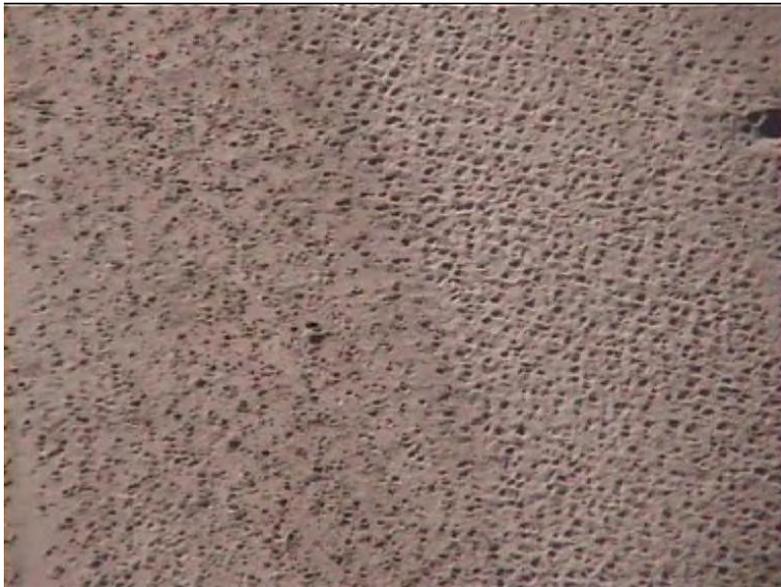


Figure 6.2 High density of human footprints at Hunters Beach, 2001-02

6.3.1.4 Data analysis

The retention of vehicle and human prints depended on weather conditions during and before the aerial surveys. However, given the prevailing southeasterly winds during the summer period in the Ningaloo region, the retention of tracks was between 1 – 5 days. Therefore, the spatial extent and densities of vehicle and human prints on the beach are considered an indicative measure of activity. These indicative measures were tabulated to show the length

of beach with evidence of tracks and associated densities for each section. The length of beach with vehicle tracks and footprints on the beach were estimated by recording the GPS positions at either end of the imprints. The proportion of the length of the beach with vehicle tracks and footprints was calculated and the locations of off-road vehicle access to the beach were recorded. The densities of vehicle tracks were recorded by observing the closeness and overlap of tracks. The following categories were developed to represent the varying density of vehicle tracks:

- High density: tracks overlapping and covering the beach (>10 tracks) (Figure 6.1);
- Medium density: tracks that do not overlap but cover some of the beach (3–10 tracks); and,
- Low density: evidence of one or two vehicle tracks along the beach

The densities of footprints were estimated using the following categories:

- High density: areas were characterised by overlapping footprints covering the area between the high tide mark and the fringing vegetation (Figure 6.2);
- Medium density: areas were not overlapping but covered the beach area; and
- Low density: areas were characterised by sparsely spaced footprints in the sand (i.e. no more than three people walked along the beach).

6.3.2 On-site visitor surveys and questionnaire

6.3.2.1 Study period

On-site visitor surveys and questionnaires were undertaken during the 2001-02 nesting season over 35 nights between 3 December 2001 and 21 January and the 2002-03 nesting season over 33 nights between 3 December 2002 and 22 January 2003.

6.3.2.2 Study area

On-site visitor surveys and questionnaires were undertaken at six sites in the Jurabi Coastal Park: Hunters, Mauritius, Jacobsz, Jansz, Wobiri and Five Mile (Figure 6.3). Due to limited resources in the 2002-03 nesting season, the latter three sites were excluded from the study and only Hunters, Mauritius and Jacobsz were surveyed as they represented more popular turtle watching beaches. Each site comprised car parking areas with access paths leading to the beach. The trailhead of each path comprised signs that informed visitors how to behave around nesting turtles at night.

Hunters Access comprised two car park areas, one located behind the dune and the other on the beach. The car park area behind the dune had a designated pathway leading from the car park to the beach. Mauritius Access comprised a car park behind the primary dune, which prevented the light emitted from the car headlights from reaching the beach, and a designated pathway to the beach. Jacobsz Access comprised a car park on the beach with low-lying bollards which acted as a barrier between the car park and the beach. Jansz and Wobiri Accesses were separate car parks that provided access to the same beach area. Five Mile Access comprised a car park on the beach that was contained within low-lying bollards similar to Jacobsz Access.

6.3.2.3 On-site visitor surveys

The number of independent turtle watchers and their group sizes were recorded at each carpark. The time of arrival and departure of each group was recorded to estimate the duration of their time spent on the beach.

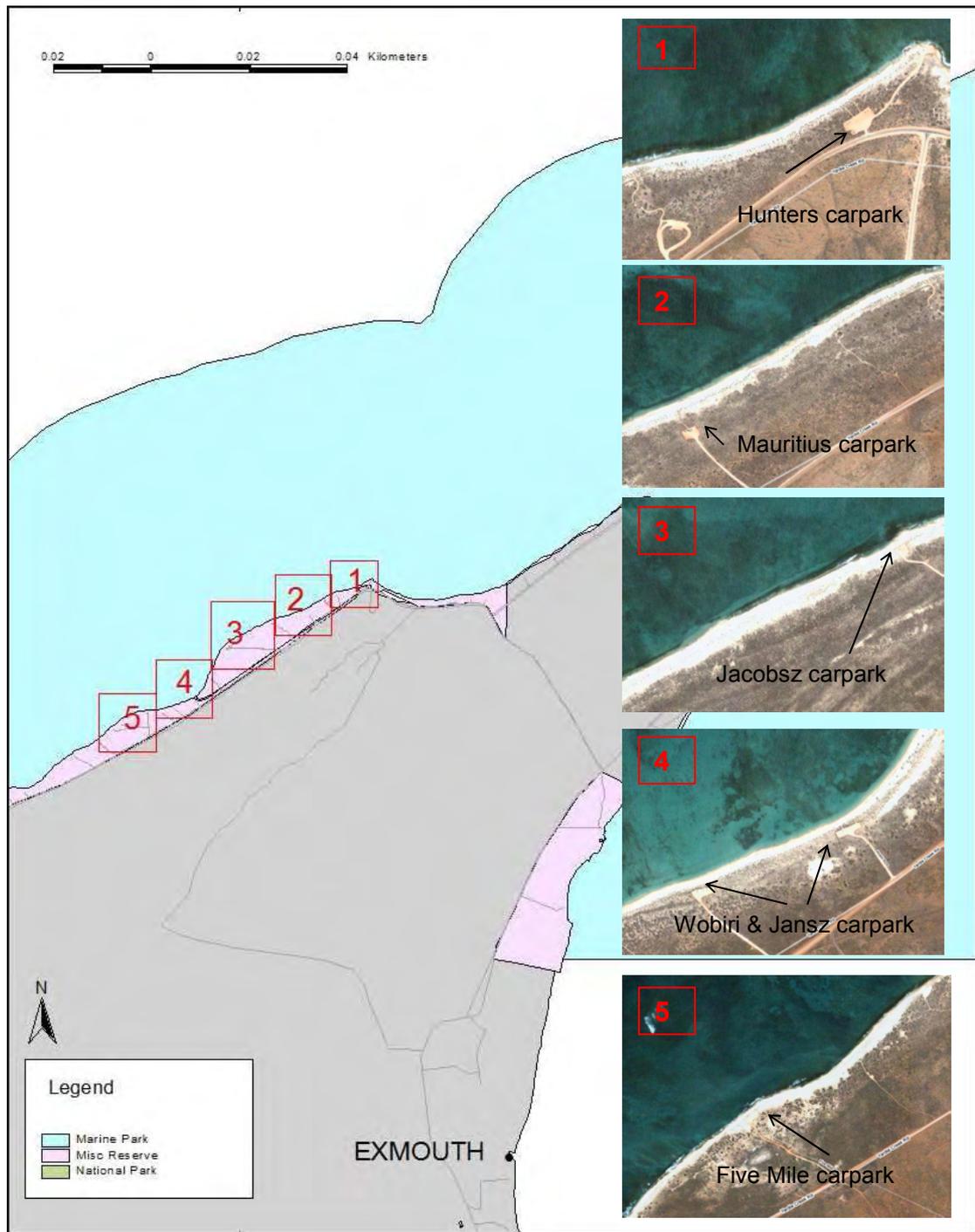


Figure 6.3 On-site survey carpark areas in the Jurabi Coastal Park (Note: Satellite maps from Google Earth, 2008)

6.3.2.4 Visitor questionnaire

A total of 175 questionnaires were opportunistically administered to visitors at car parking areas in the 2001-02 and 2002-03 nesting seasons between 8pm and midnight as turtle watchers returned from the beach. The response rate from independent turtle watching groups was 51% (N = 340). One person from each visitor group was asked to take part in the questionnaire. An interviewer-completed technique (Jennings, 2001) was used to assist respondents in answering questions. The sample size of some questions varies due to modifications of the questionnaire in 2002-03 and incompleteness of some questionnaires. The majority of visitors were aged between 26 - 40 years and the gender ratio of respondents was equal. The survey used a variety of questioning instruments to gauge visitor's responses including a Five Point Likert Scale, single and multiple response questions and open answer questions (Jennings, 2001) (Appendix 2).

Visitors were asked questions relating to their demographic characteristics, including their age, place of origin, gender, number of people in their group and their length of stay in Exmouth. Respondents were given a list of reasons for visiting the Ningaloo region and asked to rate, on a Five Point Likert Scale, the importance of the reason for their visit. This question was designed to gauge how important shore-based turtle tourism was in their decision to visit the region compared to other tourism and recreational activities, such as diving and/or snorkelling on the reef, visiting the Cape Range National Park, visiting Coral Bay, seeing manta rays, visiting aboriginal sites, watching whale sharks, taking a boat cruise, fishing, bush walking and four wheel driving.

Visitors were asked about any previous experience relating to viewing turtles at night. Their experience was gauged by asking how many times they had seen marine turtles and where they had encountered them. Visitors were then asked questions relating their knowledge of the code of conduct. At the same time guidelines of the code were available on the signs at each site and in DEC pamphlets. Those visitors that were aware of the code of conduct were

asked to recall at least four guidelines. Visitor responses were compared against eight guidelines of the code: walk along high tide, minimise use of lights (e.g. torches), avoid sudden movements, stay behind turtles as much as possible, be patient and wait, be quiet, keep your distance and depart before 2300 hours. This question generated multiple responses which were coded to identify main themes (Jennings, 2001). Although this question did not necessarily measure their knowledge or understanding of the code, it did reflect whether they were able to remember details of the code that should influence their behaviour.

Visitors were also asked how they were informed of the code. Respondents were provided multiple sources including a previous visit, friends or relatives, tourist brochures, tour guide, visitor's bureau or travel agent, existing beach signs, documentary or word of mouth.

Visitor's expectation of encountering a turtle was gauged to understand how this might affect visitor satisfaction. Visitors were asked to rate their overall experience on a 10-Point Rating Scale with 1 representing a very poor experience and 10 representing an excellent experience. Visitors were also asked more specific questions relating to their satisfaction with various aspects of their experience including the number of turtles they encountered, how close they could get to the turtle, the elements of the code of conduct, the number of people on the beach, opportunities to learn new information, and the facilities available. The respondent's level of satisfaction was elucidated using a Five Point Likert Scale from very unsatisfied to very satisfied.

Visitors were asked questions relating to their perception of the existing management and whether they believed it was adequate. Using a Five Point Likert Scale from strongly agree to strongly disagree, respondents were asked to rate their level of agreement with statements relating to information available, preference of an interpreter, signage and the usefulness of the code of conduct in deterring inappropriate behaviour.

6.3.2.5 Data analysis

The average number of turtle watchers per night and the size of each group were calculated. The time of arrival and departure for each group were recorded to calculate the duration on the beach and determine the temporal distribution of groups during the night.

Several statistical analyses were used to present the data from the questionnaire. Frequency distributions and percentages were mainly used to present socio-demographic data (e.g. place of origin, where and for how long were respondents staying in the Ningaloo region, previous experience, ability to recall guidelines from the code and local sources of information that include the code). Mean importance scores were calculated for each statement relating to respondents reasons for visiting the region.

Kruskal Wallis Tests were used to compare respondents' level of experience based on the number of turtle watching experiences (Scale: 0 – 10, where 0 = no turtle watching experiences and 10 = >10 turtle watching experiences) and their ability to recall the guidelines based on the number of correct guidelines recalled. This type of statistical test was also used to test whether respondents' ability to recall guidelines was influenced by various sources of information available.

Mann-Whitney (U) Test used to test the significant differences in levels of visitor satisfaction depending on whether respondents encountered a turtle. Satisfaction levels were also analysed using mean satisfaction scores (1 very unsatisfied – 5 very satisfied) for the various statements relating to the respondents' experience on the beach. Mean scores were also used to analyse respondents' perception of existing management. Mean agreement scores (1 strongly disagree – 5 strong agree) were calculated for statements relating to the existing management of turtle tourism in the Jurabi Coastal Park. All data analysis was undertaken using SPSS Version 15 for Windows.

6.4 Results

6.4.1 Aerial surveys - Tourist activity

Fifty kilometres of beach (17%) along the Ningaloo Marine Park had evidence of off-road vehicle activity. The greatest length of beach used by off-road vehicles was recorded at Graveyards, Bateman's Bay, Cloates and Bundera (Table 6.2). The highest density of vehicle tracks was recorded at Bateman's Bay, with Bundegi, Jane's Bay and Coral Bay comprising medium densities. The vehicle tracks were mostly located in the critical nesting area on the beach, which is generally along the higher portion of the beach near the vegetation.

Twenty-four kilometres of beach (10%) had evidence of human footprints. The greatest lengths of beach with footprints were recorded Bungelup, Jurabi, and Lighthouse (Table 6.3). The density of footprints was greatest at Jurabi, Bundegi and Coral Bay. The footprints recorded at Bundegi and Coral Bay are likely to be from daytime users (e.g. snorkelers and bathers), while the majority of footprints are likely to be from turtle watchers at the Jurabi Coastal Park, which does not attract many tourists during the day.

Table 6.2 Indicative measures of vehicle tracks on the Ningaloo coast from the aerial surveys conducted in 2001-02

Section	Length of beach (km)	Length of beach with off-road vehicle tracks (km)	Proportion of beach with vehicle tracks (%)	Density of vehicle tracks ¹
North Muiron	10	0.00	0	None
South Muiron	17	0.00	0	None
Bundegi	18	1.43	8	Medium
Lighthouse	7	4.09	63	Low
Jurabi	9	0.00	0	None
Graveyards	14	9.44	67	Low
Milyering	24	2.07	9	Low
Bungelup	32	0.00	0	Low
Bundera	15	6.70	43	Low
Cloates	31	8.30	26	Low
Janes Bay	36	0.00	0	Medium
Bateman's Bay	27	8.31	31	High
Coral Bay	23	3.20	14	Medium
Pelican	24	4.26	18	Low
Total	289	47.80	17	Low/Medium

¹ Density of vehicle tracks are based on the number of tracks across the beach (high tide to fringe of vegetation): Low (1 – 2 tracks); Medium (3 – 10 tracks); High (>10 tracks)

Table 6.3 Indicative measures of human footprints on the Ningaloo coast from aerial surveys conducted in 2001-02

Section	Length of beach (km)	Length of beach with human footprints (km)	Proportion of beach with footprints (%)	Density of vehicle tracks ¹
North Muiron	10	0.00	0	None
South Muiron	17	0.00	0	None
Bundegi	18	1.94	11	High
Lighthouse	7	5.92	91	Low
Jurabi	9	6.02	66	High
Graveyards	14	0.00	0	Low
Milyering	24	1.77	7	Medium
Bungelup	32	8.70	27	Medium
Bundera	15	0.00	0	None
Cloates	31	0.00	0	Low
Janes Bay	36	0.00	0	None
Bateman's Bay	27	0.00	0	Low
Coral Bay	23	0.00	0	High
Pelican	24	0.00	0	None
Total	289	24.35	10	Medium

¹ Density of footprints are based on the number of tracks across the beach (see Section 5.3.1.3)

6.4.2 On-site surveys - turtle watching groups

A total of 944 turtle watchers (340 turtle watching groups) were recorded at the Hunters, Mauritius and Jacobsz car parks during the night in 2001-02 and 2002-03 survey periods. On average, three people were in each group (SE = 0.098, range = 1 – 16; n = 340). Figure 6.5 shows the total number of visitors at Hunters, Mauritius and Jacobsz beaches was generally higher in 2002-03 compared with in 2001-02. Data collected in 2001-02 indicates that the most popular beaches for turtle watching were Hunters, Mauritius and Jacobsz beaches and were subsequently selected as focus sites in 2002-03.

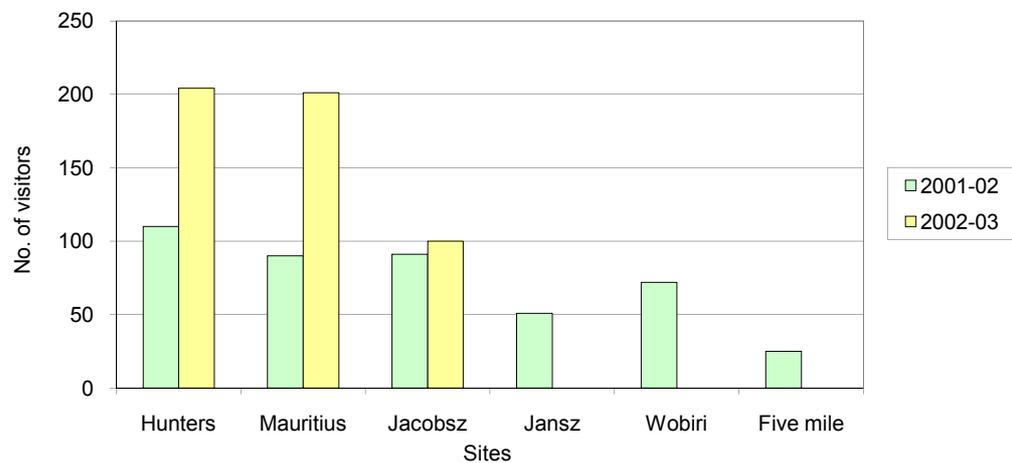


Figure 6.4 Number of turtle watchers at beaches in the Jurabi Coastal Park, 2001-02 and 2002-03

Most of the visitors were recorded in January in 2001-02 and 2002-03. The average number of turtle watchers visiting the Jurabi Coastal Park per night was 13 (SE = 1.47; range 0 – 44; n = 35 nights) in 2001-02. Although fewer beaches were surveyed in 2002-03, the average number of turtle watchers present at night between Hunters and Jacobsz beaches was also 13 (SE = 1.75; range 2 – 44; n = 36 nights).

The majority of turtle watchers (63%; $n = 129$) arrived at beaches between 2000 and 2130h and departed between 2130 and 2300h (71%; $n = 129$). Visitors commenced arriving as early as 1730h with the majority of them on the beaches between 2100 and 2230h (Figure 6.5).

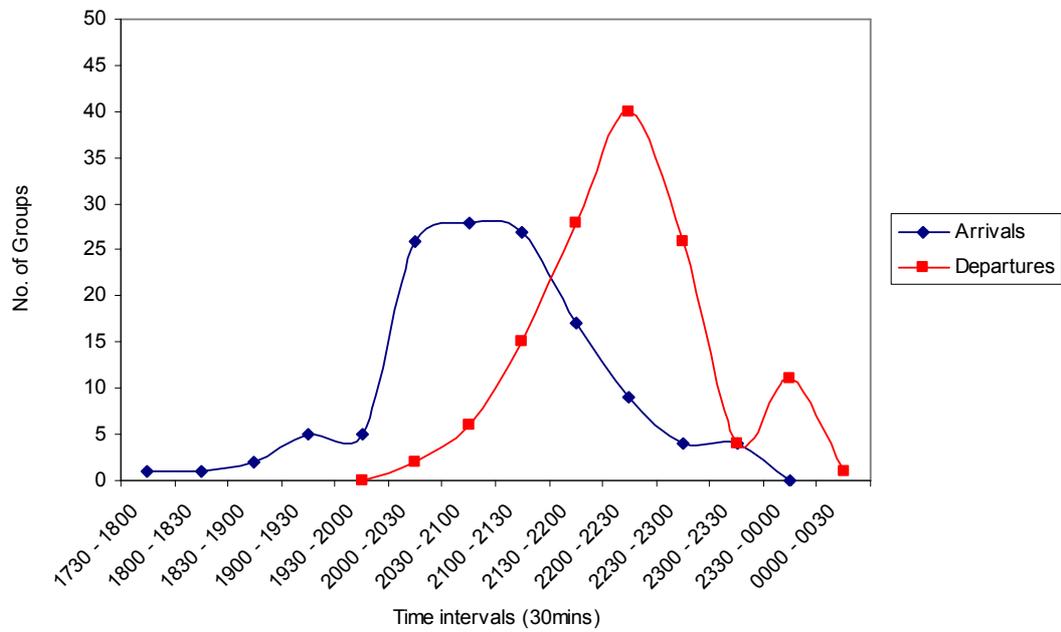


Figure 6.5 Arrival and departure times of turtle watchers at all sites, 2001-02 and 2002-03 ($n = 129$)

Almost a third of the visitor groups (31%) stayed on the beach for less than 30 minutes, whilst 24% were present on the beach between 31 – 60 minutes (Figure 6.6). Although the majority of visitor groups left after 60 minutes, there was 21% who remained on the beach for more than two hours.

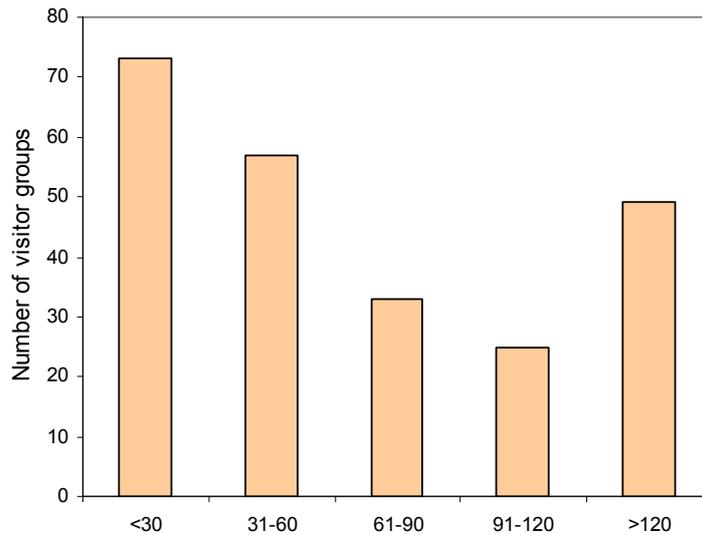


Figure 6.6 Time spent (minutes) on the beaches in the Jurabi Coastal Park

6.4.3 Visitor questionnaire

6.4.3.1 Socio-demographics

The data collected in 2001-02 and 2002-03 was collated as no significant difference ($p > 0.05$) was detected between socio-demographic variables. The majority of respondents were international visitors (54%), followed by people from Western Australia (26%) and interstate travellers (14%). Only 6% of people were from Exmouth (Figure 6.7). On average, respondents spent six days in the region (SE = 0.35; Range = 1 – 30; $n = 173$). Most respondents stayed at caravan parks (39%), hotels (26%) and backpacker accommodation (17%). Respondents were mainly influenced by friends and relatives (28%) and local brochures produced by the DEC (27%) to watch turtles at the Jurabi Coastal Park.

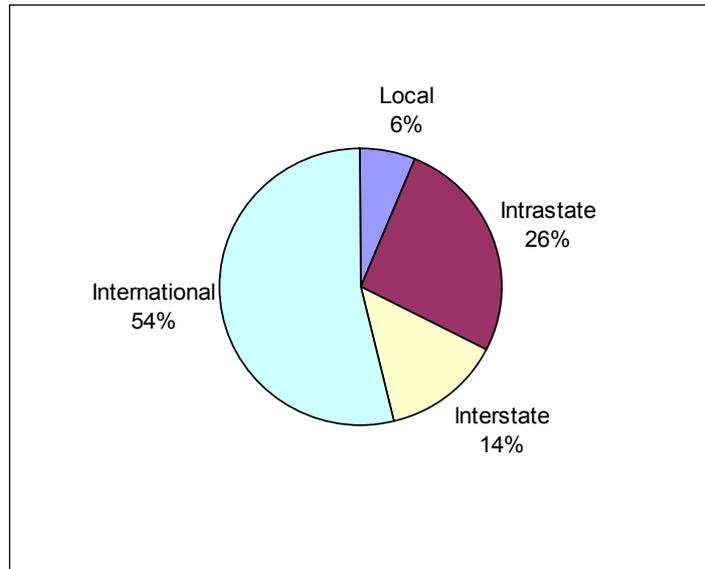


Figure 6.7 Origin of turtle watchers visiting the Northwest Cape (n = 175)

The respondents were asked about their reasons for visiting the Ningaloo region. The most important reason for visiting Exmouth was diving and snorkelling (mean = 4.83; SE = 0.59; n = 88), getting out of the city (mean = 4.14; SE = 0.60; n = 88) and watching adult turtles nesting (mean = 3.39; SE = 0.14; n = 88) (Figure 6.8). The results also showed that respondents viewed watching turtle hatchings (mean = 2.78; SE = 0.15; n = 88) less important than adult turtles nesting.

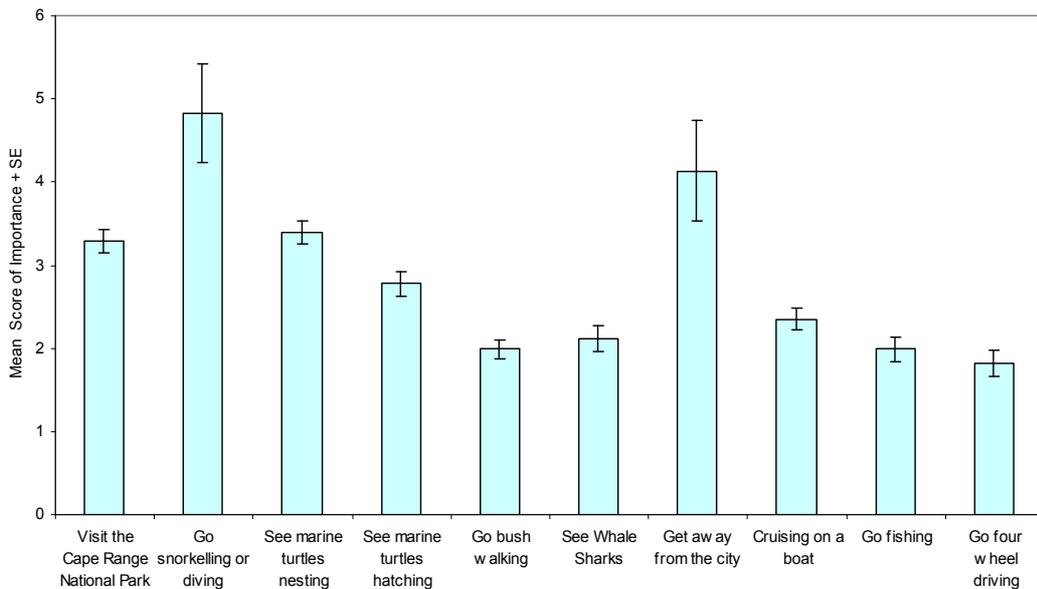


Figure 6.8 Mean scores of importance (+SE) of respondents' reasons for visiting the Ningaloo region (n = 88)

6.4.3.2 Previous experience and retention of information

A total of 63% of respondents were looking for turtles for the first time, while 29% had seen turtles once or twice before and 9% had seen turtles three times or more ($n = 175$). Most respondents had seen nesting turtles in Western Australia (72%), while other visitors had viewed turtles in Asia, America and Europe (Figure 6.9).

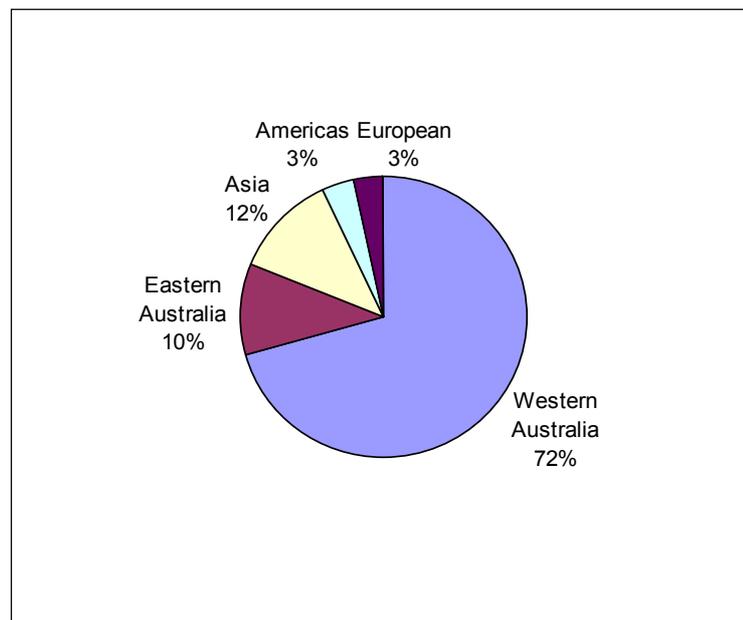


Figure 6.9 Locations of previous experience in turtle-viewing ($n = 175$)

Respondents were asked about how many times they had been turtle watching, which was used to measure their level of experience (see Section 6.3.2.5). The respondents' level of experience was then compared with their ability to recall guidelines from the code of conduct. A Kruskal Wallis Test indicated no significant difference between the level of tourists experience and their ability to recall the guidelines ($p > 0.05$). Respondents were also asked to state as many of the guidelines from the code of conduct as possible. The results showed that 113 (70%) respondents managed to recall at least three guidelines listed in the code of conduct, yet 51 (30%) respondents could not recall more than two guidelines (Figure 6.10).

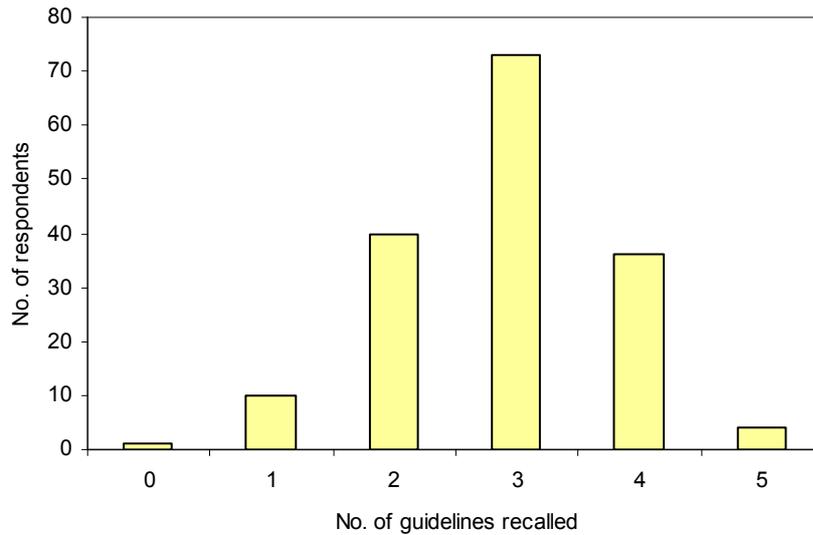


Figure 6.10 Number guidelines recalled by respondents (n = 164)

Respondents were asked about the guidelines within the code of conduct for interacting with nesting turtles in the Ningaloo region. All guidelines were stated except for “be patient” and “depart before 11pm”. The most common guidelines recalled by respondents were “do not use your torch”, “minimise noise” and “keep distance from the turtle” (Table 6.4). Guidelines that were not recalled as much were “stay behind the turtle”, “minimise sudden movements” and “walk along the high tide”. The guidelines that were commonly recalled were presented on beach signs suggesting that visitors’ knowledge of the code was derived from on-site educational material. Generic responses were also provided including “do not disturb turtle or nest” and “do not interact with turtle”. Some of the responses from respondents could also be seen as variations of the actual guidelines. Responses such as “do not cross turtle path”, “watch where you walk” and “do not touch turtle” could all be relevant to “keep your distance” or “stay behind the turtle”.

Table 6.4 Recalling the guidelines of the code of conduct (n = 175)

Responses	Frequency	Percent (%)
Do not use your torch*	152	86
Minimise noise*	114	65
Keep distance from turtle*	98	56
Do not touch the turtle*	51	29
Stay behind the turtle*	24	13
No flash photography*	22	12
Minimise sudden movements*	20	11
Do not disturb turtle	20	11
Do not disturb the nest	12	6
Watch where you walk	7	4
Do not interact with turtle	5	2
No crowding on the beach	5	2
Do not dig holes	3	1
Do not cross turtle's path	2	1
Walk along high tide*	2	1
Do not bring dogs	1	1
Leave after she lays	1	1

* Guidelines in the code of conduct for interacting with turtles

The majority of respondents were informed about the code (162 respondents; 93%). A Mann-Whitney (U) Test showed no significant difference ($p > 0.05$) in respondents' ability to retain guidelines of the code of conduct between those respondents that were informed or not informed. Of the respondents that were informed of the guidelines, 84 (55%) were informed by beach signs, 26 (17%) by the DEC pamphlet and 19 (12%) by the Exmouth Tourist Bureau (Figure 6.11).

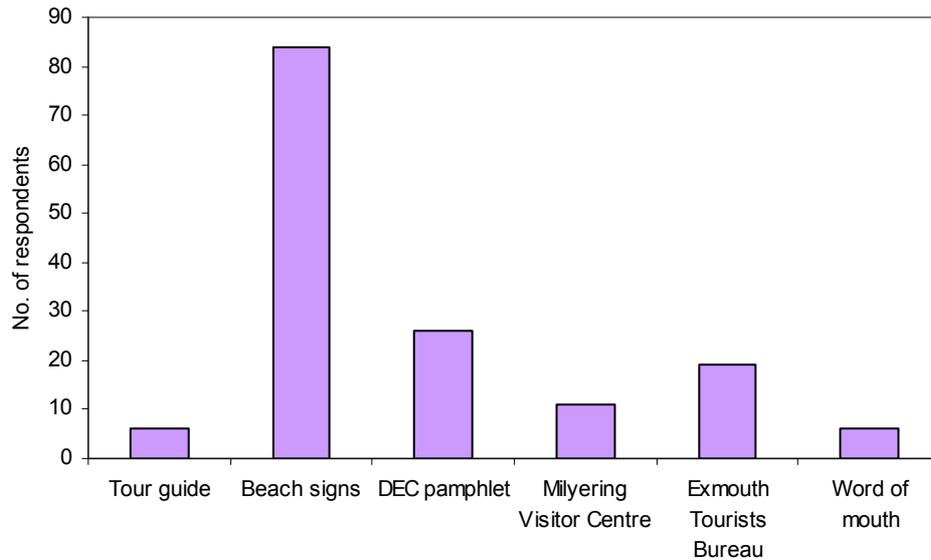


Figure 6.11 Number of respondents informed by various information sources of the code (n = 175)

6.4.3.3 Visitor satisfaction

The majority of respondents (62%) ranked the overall experience as being satisfied and very satisfied (mean = 6.8; SE = 0.244; n = 165). Visitor satisfaction was also compared between tourists that were informed of the code of conduct and whether or not they encountered a turtle. A Mann-Whitney (U) Test indicated that there was no significant difference ($p > 0.05$) in overall satisfaction between those respondents whom were informed and not informed of the code. Respondents' ability to retain information from the various information sources was also compared to ascertain whether some modes of interpretation were more effective. A Kruskal Wallis Test showed no significant difference ($p > 0.05$) in respondents' ability to recall the guidelines from the various information sources.

An important finding of this study was that the overall level of satisfaction decreased significantly when turtle watchers did not encounter a turtle (Mann-Whitney U = 1030; $z = -7.491$; n = 162; $p < 0.001$). This result was confirmed by comparing the direct statements relating to respondents satisfaction in encountering turtles and the actual number of turtles

seen by respondents (Mann-Whitney $U = 186$; $z = -5.336$; $n = 93$; $p < 0.001$). Since the majority of respondents (84%) expected to encounter a turtle during their visit to the beach, this has implications for the viability of turtle tourism during seasons when nesting turtles are scarce.

In order to understand the level of satisfaction of turtle watchers, respondents rated their level of satisfaction against a number of statements relating to their experience. Figure 6.12 shows that the majority of respondents were satisfied with “the guidelines that they had to follow” (mean = 4.10; SE = 0.12; $n = 96$), “the crowds on the beach” (mean = 4.00; SE = 0.10; $n = 96$) and “how close they could get to turtles” (mean = 3.9; SE = 0.13; $n = 96$). The lowest mean satisfaction score related to opportunities for learning (mean = 3.5; SE = 0.11; $n = 96$) and the lack of facilities (mean = 3.64; SE = 0.09; $n = 96$).

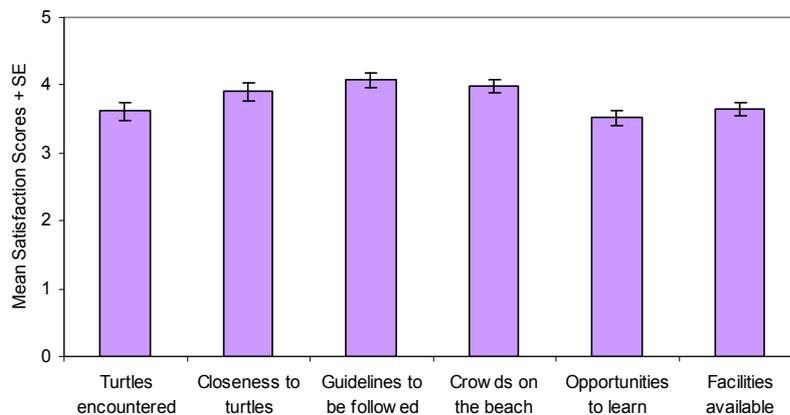


Figure 6.12 Mean satisfaction scores (+ SE) of turtle watchers in response to statements relating to their experience ($n = 96$).

6.4.3.4 Perception of existing management

Respondents were also asked to rate various statements relating to the management of turtle tourism in the Jurabi Coastal Park. Figure 6.13 shows that respondents believed that the code of conduct was useful (mean = 4.02; SE = 0.09; $n = 96$), but more signs

were required (mean = 3.3; SE = 0.11; n = 96). The results also show that less respondents agreed that an interpreter was required (mean = 2.76; SE = 0.13; n = 96), possibly indicating that there was sufficient information available to satisfy visitors (Figure 6.13).

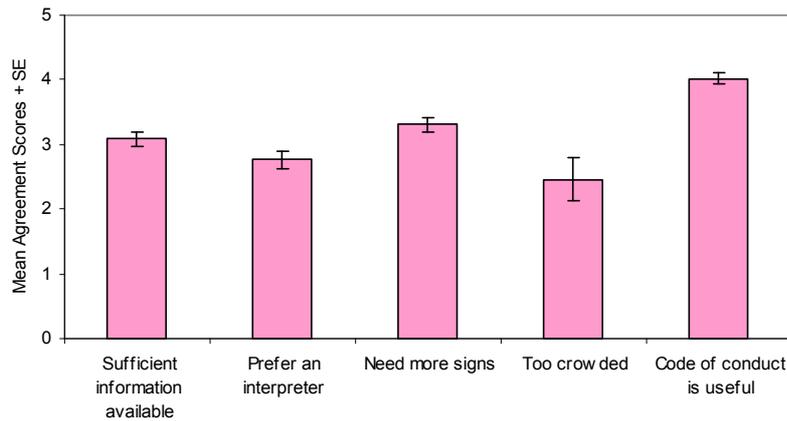


Figure 6.13 Mean agreement scores (+ SE) of turtle watchers in response to statement relating to the existing management of turtle tourism in the Jurabi Coastal Park (n = 96)

6.5 Discussion

6.5.1 Identifying "interaction hotspots"

Fundamental to achieving sustainable wildlife tourism is ensuring that the wildlife is not adversely impacted by tourism. However, in order to understand the characteristics of potential impacts, baseline monitoring of both focal species and tourist activities are essential (Pitts and Smith 1993; Newsome *et al.*, 2002). The current thesis combines aerial survey data from Chapter 5 and this chapter to identify key management areas or "interaction hotspots". This information identifies potential interaction hotspots along the Jurabi Coastal Park, Bungelup/Bundera, Jane's Bay and Bateman's Bay (Figure 6.14). The Jurabi Coastal Park and Bateman's Bay were identified as interaction hotspots for turtle watchers and off-road vehicle beach traffic. The Jurabi Coastal Park was then ground truthed to establish the extent and nature

of tourist activity (this Chapter) and to determine the nature of impacts and whether they related to turtle tourism activities (see Chapter 7 for studies relating to tourist-turtle interactions). This information was used to establish on-site surveys at beaches along the Jurabi Coastal Park, which helps to form the basis for a long term monitoring programme that has been running for six years by the Community Turtle Monitoring Program (see <http://www.ningalooturtles.org.au/>). This information also provided evidence that off-road vehicle access to the beach needed to be managed. Consequently, funding was secured for the installation of additional signs and the implementation of a community education programme that encouraged local residents in Coral Bay to avoid driving on the beach during the turtle nesting season (R. Mau, pers. comm., 2004).

6.5.1 Tourist activity and characteristics of turtle watchers

Turtle tourism has become a popular attraction in some parts of Australia including Mon Repos, which receives approximately 30,000 visitors per year (Wilson and Tisdell, 2001). The visitation of turtle watchers along the Jurabi Coastal Park within the nesting season was significantly less with about 500 people (~170 visitor groups) visiting each year. Despite an increase in tourism development in the Ningaloo region (Wood and Dowling, 2002) and an increased shift in arrivals during the summer months, the growth of turtle tourism has been relatively stable since 1995⁴ (CALM, 1995).

Most turtle watchers visiting the Jurabi Coastal Park were European travellers staying in Exmouth, which corresponds with the visitor database from the Cape Range National Park (CALM, 1995; CALM, 2001). Similar surveys conducted at Mon Repos also revealed that the majority of overseas visitors were from Europe (Tisdell and Wilson, 2001).

⁴ Based on comparisons between the number of turtle watchers visiting the Jurabi Coastal Park in January 1995, 2001 and 2002.

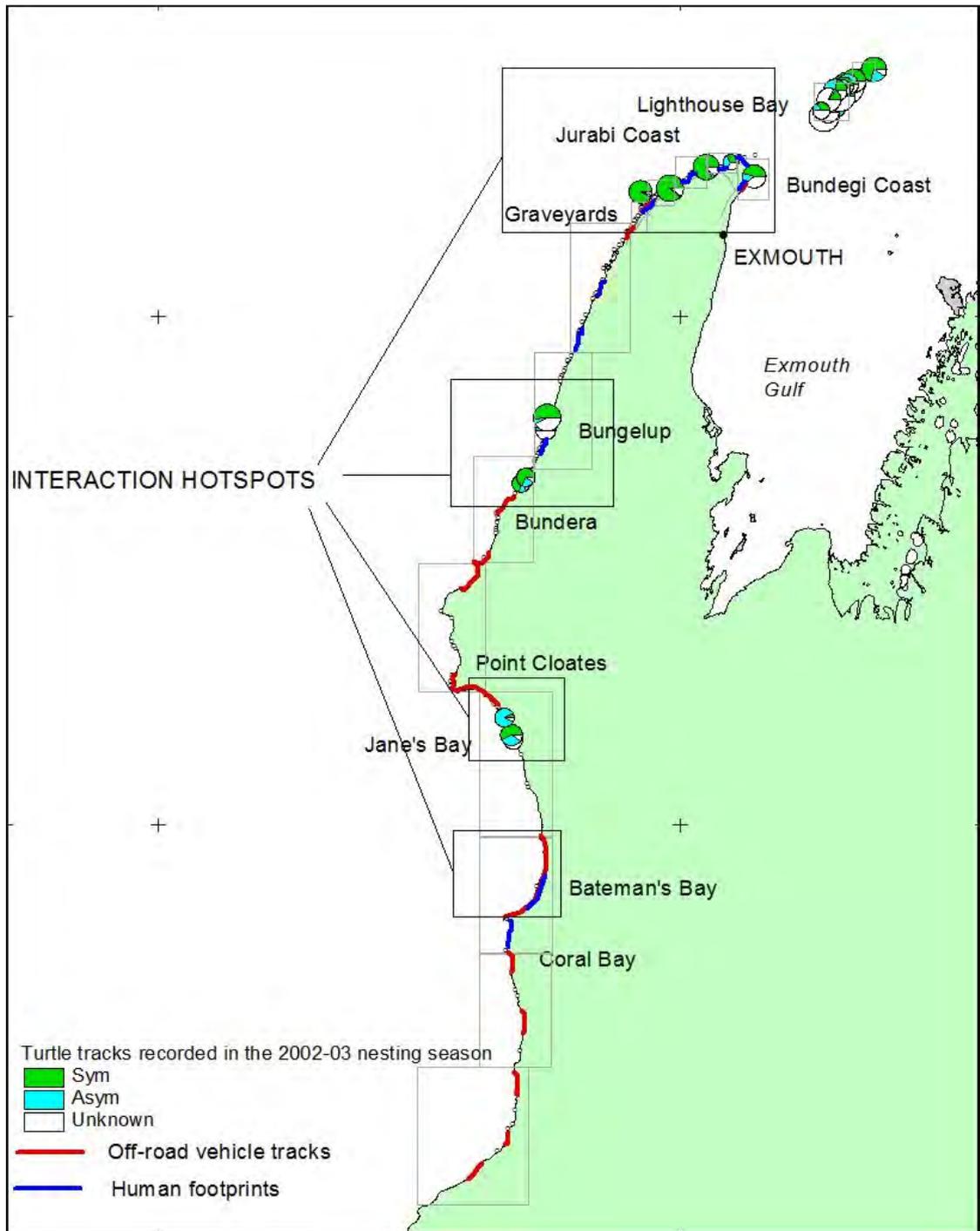


Figure 6.14 Human-turtle interaction hotspots in the Ningaloo region.

As with other studies in the Ningaloo region, visitors generally stay for short periods of time (Wood and Dowling, 2005; Moore and Polley, 2007). Most of the respondents were self-sufficient independent travellers that were passing through Exmouth from Perth to other destinations in northern Australia, such as Broome and Darwin. Respondents were most likely to visit the beaches at night with a spouse or partner or with friends in groups of two to four, which is often reported by other authors studying nature-based tourists (Polley, 2002; Smith, 2004).

The Ningaloo region is regarded as one of Western Australia's iconic tourist destinations (Tourism WA, 2004). A survey conducted in the Cape Range National Park also found that visitors ranked wildlife and the beach and ocean as extremely important in their decision to visit the Ningaloo region (Moore and Polley, 2007). This was also the case for independent turtle watchers in this study. A high proportion of respondents were mainly interested in diving and snorkelling, getting out of the city and watching adult turtles nesting whilst visiting the Ningaloo region (see Figure 6.8). Although visitors indicated that watching adult turtles was one of the main reasons for visiting the Ningaloo region, further discussions with turtle watchers suggested that turtle tourism is a nightly activity that compliments other marine oriented activities such as diving and snorkelling in the Ningaloo region.

The results of the current study showed that respondents referred watching adult turtles nesting than hatchlings crawling down the beach (Figure 6.8), suggesting this form of turtle tourism is more attractive to visitors and likely to be more marketable. Given that hatchlings generally emerge from the nest at random times between sunset and midnight and take less than 10 minutes to reach the water, the probability of seeing hatchlings is low compared to encountering adult turtles, which can take up to three hours to successfully complete the nesting process.

6.5.2 Experience and knowledge of turtle watchers

Although most of the respondents were participating in turtle tourism for the first time, about a third of respondents had seen nesting turtles in Western Australia, particularly in the Ningaloo region. Given most popular nesting sites in the Ningaloo region have signage outlining how to behave around nesting turtles, it is expected that repeated visitors would have some knowledge of the code of conduct. The results indicate that turtle watchers recalled most of the guidelines of the code. Although turtle watchers did not state that they were required to leave the beach before 11 pm, the majority of them had departed the beach at this time (see Figure 6.5). This guidance statement allows time during the night for turtles to nest without being disturbed. Repeated disturbance through out the night over consecutive days could potentially displace adult turtles, causing other problems such as overcrowding at other sites and decrease in clutch success. The most common guidelines recalled by turtle watchers were “avoid using lights”, “not making noise” and “keep your distance” (see Table 6.4). Respondents’ ability to recall these three statements coincided with the statements featured on the signs at access paths at each of the survey sites, which was also where most respondents were informed of the code. A guidance statement that exists in most codes for interacting with turtles suggest people should be quiet whilst watching despite the fact that turtles have very limited hearing capacity on land (Lenhardt, 1994; Moein-Bartol *et al.*, 1999). However, people talking and making noise may impact on the ambience of the experience, potentially impacting on visitor satisfaction (Musa, 2003). However, the most important guidance statement is “avoid using your torch” because light can prevent adults from emerging from the water to nest and can attract hatchlings attempting to reach the water (Witherington and Martin, 1996). Other important guidelines are “keep your distance”, “stay behind the turtle” and “walk along the high tide”. These guidelines refer to positioning people in the presence of a turtle on the beach. Walking along the high tide or along the waters edge looking for tracks leading up the beach is a strategy used to find nesting turtles. Not only does this strategy increase the chance of finding turtles, but immediately positions people behind

the turtle as the turtle crawls up the beach towards the dune. This phase of the nesting process is when turtles are considered to be most vulnerable to disturbance as they scan the beach to ensure their safety (Johnson *et al.*, 1996; Bustard, 1972). The interactions between turtle watchers and turtles are investigated further in Chapter 7.

6.5.3 Visitor satisfaction

The satisfaction levels in this study were relatively high, which is often the case in most wildlife tourism situations (Orams, 2001; Higginbottom, 2004b; Newsome *et al.*, 2005). Factors that contributed to high satisfaction levels of turtle watchers in the current study were low numbers of other people on the beach, the freedom to experience nesting turtles alone and the closeness of the encounter. Other factors that were not measured but may have contributed to a high level of satisfaction included viewing a large endangered species, viewing particular feature of the animals' behaviours (i.e. laying eggs) and the natural setting of the beach at night (Higginbottom, 2004b). Previous studies at the Jurabi Coastal Park found that turtle watchers were satisfied with walking the beaches and gazing at the stars without seeing a turtle (CALM, 1995). In contrast, the results from the current study showed that turtle watchers were less satisfied when they failed to see a turtle.

Satisfaction is dependent on meeting or exceeding expectations (Akama, 2003; O'Neill *et al.*, 2004). Therefore, if turtle watchers' expectations for the turtle-watching experience were met or exceeded by their actual experiences, it is likely that they would be satisfied. The results in the current study showed that 84% of turtle watchers at the Jurabi Coastal Park expected to see a turtle but only half of the groups encountered a turtle. Given that only 62% of turtle watchers were satisfied with the experience, these results suggest that encountering turtles is an essential requirement for developing turtle tourism. A study conducted at Mon Repos also found that visitors that encountered turtles and considered their experience educational were more likely to contribute to protecting turtles than those who did not encounter turtles

(Tisdell and Wilson, 2005). Whether turtle watchers encounter a turtle is therefore essential for increasing visitor satisfaction and encouraging conservation amongst tourists. Ensuring that independent turtle watchers find turtles during low nesting seasons can be achieved by employing scouts who regularly patrol beaches at night and contact guides once a turtles is located. This process is known to be effective at Mon Repos where the majority of visitors are satisfied with their experience (Tisdell and Wilson, 2005).

6.5.4 Managing turtle watchers

Various strategies are used to manage human-turtle interactions including the implementation of a code of conduct, employment of tour guides, interpretative signage and documentaries (Newsome, 2002; Bauer and Dowling, 2003; Birtles *et al.*, 2004). Tour guides provide a more regulatory way of controlling visitors and often increase the satisfaction of tourists through the provision of information and interpretation (Newsome *et al.*, 2005; Higginbottom, 2004b; Lück, 2007; Zeppel and Muloin, 2008c). At Mon Repos where turtle tourism is well established, code of conducts are implemented through the employment of tour guides and interpretative signs. While these strategies are considered affective in reducing disturbances from tourist-turtle interactions, respondents surveyed at the Jurabi Coastal Park reported there was sufficient information and that they would rather not be on a guided turtle tour. Respondents preferred to have a “natural” experience, where they find a turtle on their own, enhancing their sense of isolation and their ambient experience as discussed earlier in Section 6.5.3. The challenge for managers and tour operators is to therefore provide a natural experience without disturbing turtles.

In 2003, DEC and Shire of Exmouth constructed a visitor centre specifically to cater for managing turtle watchers (see Section 3.5.1 for background to the JTC). The purpose of the JTC was to provide a natural experience whilst managing visitor behaviour. The idea was to manage visitor behaviour at a single location, as opposed to the current situation, where

visitors are distributed along all the beaches of the Jurabi Coastal Park. The JTC provides various static interpretative displays that describe the life-cycle, nesting process and threats to turtles in the NMP. More recently designed signs that present the code are positioned along the pathway from the carpark to the centre (Smith, 2005).

6.6 Conclusion

Planning models need to be guided by baseline information related to the distribution, characteristics and behaviour of visitors within the natural environment, particularly in remote areas. This chapter shows that the annual growth of turtle tourism in the Ningaloo region appears to be relatively consistent. While turtle tourism in the Ningaloo region remains undeveloped, the sector is expected to grow with the construction of the JTC and additional marketing to visitors of Western Australia. With the expected growth in tourist numbers within the Ningaloo region, particularly during the nesting season, appropriate management strategies need to be developed and implemented before significant impacts to turtles occur.

This chapter used aerial surveys to identify key management areas where human-turtle interactions are likely to occur. The aerial surveys also identified key on-site monitoring areas for conducting questionnaires. The on-site investigations revealed that most turtle watchers were independent international travellers passing through Exmouth on their way to northern Australia. Most of the respondents were participating in turtle tourism for the first time suggesting that education of turtle watchers is critical. Although respondents recalled the most critical elements of the code, such as minimising torch use, other guidelines such as walking along the high tide were not recalled highlighting the need for further information signs and tour guiding.

A key finding from this chapter is that encountering a turtle is imperative for providing a satisfactory experience for turtle watchers. Therefore, those years that have few turtles

emerging from the water may require trained personnel to find turtles before turtle watchers enter the beach. The following chapter explores whether turtle watchers comply with the code guidelines and how non-compliance behaviour of turtle watchers can impact the behaviour of turtles whilst attempting to nest.

CHAPTER 7 QUANTIFYING DISTURBANCES TO TURTLES FROM NON-COMPLIANT BEHAVIOUR OF INDEPENDENT TURTLE WATCHERS IN THE JURABI COASTAL PARK

7.1 Introduction

The previous two chapters provided baseline data relating to the temporal and spatial distribution of turtles and turtle watchers. The previous chapters also confirmed that the beaches of the Jurabi Coastal Park comprise critical areas where independent turtle watchers (i.e. unguided tourists seeking turtles) and marine turtles interact. This chapter focuses on investigating the behaviors of tourists and turtles during the period at which the interactions take place. This chapter aims to explore the impact of these interactions on the turtle nesting populations. In order to address the following research questions will be explored:

- How do guidance statements within DEC's code of conduct for interacting with marine turtles influence the behaviour of turtle watchers?
- How is the behaviour of nesting turtles affected by non-compliant behaviour of turtle watchers?

Initially, this chapter presents literature relevant to the potential impacts from turtle watchers, the application of a voluntary code of conduct in turtle tourism and how to measure disturbance to turtles from non-compliance behaviour of turtle-watchers. Secondly, the methods section describes the development of wildlife interaction surveys, which were aimed at observing non-compliant behaviour of independent turtle watching groups and quantifying the responses of turtles to this behaviour.

7.2 Relevant Literature

7.2.1 Potential impacts from turtle watchers

Although some studies have focused on general impacts from tourist activities (Mortimer, 1979; Hosier *et al.* 1981; Arianoutsou, 1988; Raymond, 1984; Lutcavage *et al.*, 1997), there remains a paucity of knowledge about how turtle watchers impact on nesting turtles. Artificial lighting on nesting beaches is detrimental to all marine turtle species because it disrupts critical behaviours, including nest-site choice and nocturnal nesting behaviour (Lutcavage *et al.*, 1997). Turtles select a nest site by deciding where to emerge from the water and where on the beach to lay their eggs (Witherington and Martin, 1996). The most clearly demonstrated effect of artificial light on nesting is to deter turtles from emerging from the water. Evidence for this has been given by Raymond (1984) who reported on a dramatic reduction in nesting attempts by loggerhead turtles at a brightly illuminated beach site in Florida. Elsewhere in Florida, Mattison *et al.* (1993) showed that there were reductions in nesting emergences where illuminated piers and roadways were close to beaches.

Turtles are sensitive to different types of artificial light, particularly light sources that emit comparatively short wavelength (400 – 640nm) which is the blue/green spectrum (Arianoutsou, 1988; Witherington, 1992). Flashlights or light from torches are generally within this spectrum and are known to affect adult and hatchling turtle at night, particularly during the initial phases of nesting (Mortimer, 1979; Hirth and Samson, 1987). According to Mrosovsky (1978), intermittent flashes of light do not cause disturbance to turtles, but constant use of light can influence turtle orientation. Campfires on nesting beaches have also been identified as a source of light that can misorient hatchlings and can deter nesting females (Mortimer, 1979). Heavy utilization of nesting beaches by humans may result in lowered hatchling emerging success rates due to compaction of sand above nests (Mann, 1977), and

pedestrian and vehicle tracks can interfere with the ability of hatchlings to reach the ocean (Hosier *et al.* 1981).

According to Witherington and Martin (1996) people moving within the view of a turtle is as disruptive to nesting turtles as the use of a torch. The eyesight of all marine turtle species is myopic out of the water, which means they can only see shadows or silhouettes on the beach (Ehrenfeld and Koch, 1967; Witherington and Martin, 1996). Therefore, the potential for disturbing nesting turtles at night is considered inevitable unless management measures are developed and implemented.

7.2.2 Code of conduct for turtle tourism

In most cases, strategies to manage impacts of wildlife tourism activities on wildlife involve attempts to change or limit visitor behaviour, often by restricting access to wildlife (Newsome *et al.*, 2002; Higginbottom, 2004b). There are a variety of strategies currently being applied in an attempt to change visitor behaviour including implementation of a code of conduct, employment of tour guides and installation of interpretative signage (Newsome *et al.*, 2002; Bauer and Dowling, 2003; Birtles *et al.*, 2004). A code of conduct often includes a set of guidance statements that instruct how people should behave during their encounter with wildlife. Several authors support the theory that a code of conduct has the ability to change visitor behaviour (Frost and McCool, 1988; Roggenbuck, 1992; Harris *et al.*, 1995).

A code of conduct, however, is designed to act as a form of self-regulation, which is ultimately self-imposed and voluntary (Mason and Mowforth, 1996). Self-regulation or voluntary codes of conducts may be targeted at the industry (operators and guides) or at individual/groups of independent travellers. Research shows that voluntary codes are seldom adhered to by tourists that are not participating in a tour (Waayers *et al.*, 2006), that have

joined a tour (Sirakaya and Uysal, 1997; Scarpaci *et al.*, 2003) and tourists that have completed a tour (O'Neil *et al.*, 2006).

Code of conducts for tourist-turtle interactions are considered to be well established for nesting beaches at popular turtle tourism destinations such as in Australia, Costa Rica, Florida, and Greece (Waayers, 2003). However, the guidelines established for influencing turtle watchers behaviour are not based on quantitative research. As described in Section 6.2.3, the code of conduct used in the Ningaloo region comprised seven general guidelines that relate to how visitors should behave whilst seeking turtles on the beach at night (see Table 6.1). These general guidelines are used in this chapter to examine non-compliance behaviour of turtle watchers.

7.2.3 Measuring disturbance to nesting turtles

In order to determine how turtles might be affected by independent turtle watchers an understanding of turtle senses and their behavioural responses to various external stimuli is required. Bustard (1972) suggests that marine turtles do not have well developed hearing because there is no external ear to collect auditory stimuli. A turtles' ear drum is covered by ordinary skin which reduces sensitivity of sounds at medium to high frequencies, such as human voices. Turtles are however sensitive to ground borne vibrations and to touch, particularly on the soft parts of the flippers and the carapace (Bustard, 1972). Their sense of smell has been assumed to be effective based on the presence of well developed olfactory areas in the brain (Bustard, 1972). Little is known about the affects of human voices, touch and smell on nesting turtles.

Two indicators can be used to identify changes in turtle behavior in response to external stimuli: vigilance behavior and disturbance behavior. Vigilance can be defined as a behavior by which an animal scans its surroundings to interpret the situation prior to acting (Quenette,

1990), and is often associated with the detection of predators (Bertram, 1978; Terhune, 1985; Lima, 1995). Hailman and Elowson (1992) identified two key head postures that represent vigilance postures of all turtle species during the nesting process: head-horizontal pauses and head-raised pauses. The head-horizontal pause occurs when some of the body is supported by limbs and the neck is raised at a slight angle so that the head is off the sand and the chin is held parallel with the ground. During this posture, the head is often turned side to side and occurs frequently at the beginning and end of pauses. The head-raised pause occurs when the neck is at a strongly oblique angle or almost vertical so that the nostrils are at the highest point of the turtle. The head may also turn in this posture which usually occurs during the pause (Hailman and Elowson, 1992).

Disturbance behaviour is often in response to external stimuli that obstructs or deters an animal from pursuing a natural behavioral pattern and often follows vigilance behaviour. In order to quantify the disturbance behaviours of nesting turtles, it is essential to first understand the natural nesting process. Several studies have described the general nesting process of turtle species in a natural setting (Stoneburner and Richardson, 1981; Limpus and Reimer, 1990; Hailman and Elowson, 1992; Witherington, 1992; Fangman and Rittmaster, 1993; Jacobson and Lopez, 1994) and the potential impacts associated with each phase of the nesting process (Stoneburner and Richardson, 1981; Hailman and Elowson, 1992; Johnson *et al.*, 1996). Table 7.1 summarizes the estimated time taken, vigilance and disturbance behaviours and level of vulnerability to disturbance at various stages of the nesting process.

During the initial period of emergence all turtle species often raise their heads well above the sand as they ascend the beach (Hailman and Elowson, 1992). It appears that the turtles are making a visual inspection of the beach during this phase. They then commence traversing the beach no more than 20° perpendicular to the water line (Hailman and Elowson, 1992). This behaviour is similar in all marine turtle species and the movement of the turtle is usually direct unless debris or movements on the beach causes deviation. Once the turtle has reached

the higher section of the beach where the sand is warmer and drier, it may change direction several times before selecting a site to construct her nest (Stoneburner and Richardson, 1981). At this stage of the nesting process, turtles often crawl slightly faster than the initial ascent and continue to display head-raises and head-horizontal pauses. Once turtles reach the vegetation above the high tide, they commence digging a body pit (see Lutz and Musick, 1997). The time taken to find a suitable nesting site on the beach and dig a body pit can vary depending on the beach characteristics and species. Green turtles usually take longer to find a suitable nesting site on the beach as they are generally more selective and dig larger body pits compared to other marine turtle species (Miller, 1997).

Table 7.1 Summary of potential impacts to turtles during the various phases of the nesting process

Phase of the nesting process	Estimated time taken to complete phase	Vigilance behaviour	Disturbance behaviour	Vulnerability
Emerging from the water	10 mins	Head horizontal and raised pauses	Return to water	High
Ascend the beach	15 – 20 mins	Head horizontal and raised pauses	Redirection of crawl; return to the water	High
Excavating body pit	15 – 30 mins	Head raised pauses	Abort body pit; return to water	High
Excavating a egg chamber	10 – 15 mins	Head raised pauses	Abort egg chamber; return to the water	Medium
Egg laying	10 – 15 mins	Head raised pauses	Abort egg laying; return to the water	Low
Camouflaging egg chamber and body pit	15 – 30 mins	Head raised pauses	Abort camouflaging; return to the water	Medium
Returning to the water	5 – 10 mins	Head horizontal and raised pauses	Redirection of crawl; return to the water	Low

Source: Bustard, 1978; Stoneburner and Richardson, 1981; Hailman and Elowson, 1992

Studies have shown that turtles are highly susceptible to disturbance during these early phases of the nesting process (Limpus and Reimer, 1990; Witherington, 1992; Fangman and Rittmaster, 1993; Jacobson and Lopez, 1994; Johnson *et al.*, 1996). Hailman and Elowson (1992) noted that loggerhead turtles that are disturbed during excavation of the body pit will usually abandon nesting and return to the water. However, they did record a few instances where turtles attempted to dig another body pit after being disturbed.

The excavation of the egg chamber is signalled by a change of movements in the hind limb. The hind limbs are brought alternately to the mid-posterior position and then moved outward and forward with a rapid movement that flicks sand with the dorsal surface of the flipper (Limpus and Reimer, 1990, Miller, 1997). If a female is disturbed during excavation of the egg chamber, it usually abandons the nesting attempt, even if the egg chamber is almost complete, and returns to the water. Head-raised pauses are evident during the excavation of the egg chamber. Once it has successfully completed the egg chamber, egg laying will commence shortly after. During egg laying, all species of marine turtle are relatively tolerant of a modest level of external disturbance. As a general rule, the level of tolerance increases as the turtle lays more eggs (Limpus and Reimer, 1990). Once the turtle completes the egg laying phase, it begins to cover the egg chamber with her hind flippers, followed by covering the body pit area with her front flippers. The duration of this phase can vary considerably depending on the depth of the body pit and independent characteristics of a turtles' behaviour. Once the body pit is completely covered, all marine turtle species immediately return to the ocean and often pause a few times before re-entering the ocean. Turtles usually pause before crossing the beach, and then move directly towards the water from the nesting site. In cases where people are present, turtles usually display avoidance behaviours by crawling away, potentially increasing fatigue for the turtle, particularly if it is forced to crawl a further distance to reach the ocean (Johnson *et al.*, 1996). According to Lusseau (2007), the behaviour budget of a population is directly linked to its energetic budget. In the case of female turtles attempting to nest, this has huge adverse implications for turtle populations.

It should be noted that not all turtles successfully nest under optimal conditions (Bustard, 1972; Miller, 1997; Hailman and Elowson, 1992). Turtles that abandon a nesting attempt will return on the same or subsequent night to lay eggs (Davis and Whiting, 1977; Talbert *et al.*, 1980). However, if disturbed over consecutive nights, turtles will become displaced from their preferred nesting beach and potentially nest at a different beach which may be

suboptimal habitat and less favourable for a successful recruitment of hatchlings (Murphy, 1985b; Jacobson and Lopez, 1994). Additional nesting attempts also increase fatigue and affect the energy reserves required to last the entire nesting season (Lutz and Musick, 1997). In order to gauge the extent of disturbance to turtles from human-turtle interactions in the Ningaloo region, this chapter attempts to quantify the behaviour of both tourists and turtles. It also explores whether the voluntary code of conduct used by independent turtle watchers in the Ningaloo region is effective in encouraging appropriate behaviour.

7.3 Methods

7.3.1 Study Area

Tourist-turtle interaction observations were undertaken in conjunction with the on-site surveys at popular turtle watching areas, including Hunters, Mauritius and Jacobsz Access. (see Section 5.3.2). Surveys were conducted opportunistically between 8pm and midnight as turtle watchers arrived on site and entered the beach area. Ethics approval was provided for deployed two observers at each study site to record observations of non-compliant behaviour of independent visitor groups and the disturbance behaviour of green turtles. No interactions with other species were recorded due to the low numbers of loggerhead and hawksbill turtle emergences. The interaction observations involved regularly patrolling the beaches to detect tourist-turtle interactions and quantifying breaches of the guidelines within the code and the types of disturbance behaviour of green turtles in response to these breaches.

7.3.2 Ethical approvals

DEC licenses were granted to interact with turtles during the focused observations in 2002/03 (ref: SF004016) and 2003/04 (ref: CE000172). Approvals for interacting with turtles were also granted by the Murdoch University Ethics Committee and under the Prevention of Cruelty to Animals Act 1920. The Murdoch University Human Ethics

Committee also approved the method for gauging activities of visitors on the beach and conducting questionnaires (ref: W930/02).

7.3.3 Observation schedule

Two types of methods were used to quantify non-compliance behaviour and disturbance: “scanning observations” of torch-use and movement of groups on the beach and “focused observations” of specific behaviours of tourists and turtles simultaneously during an interaction. A total 271 scanning observations were undertaken during the 2001-02 nesting season over 35 nights between 3 December 2001 and 21 January (n = 121 independent turtle watching groups) and the 2002-03 nesting season over 33 nights between 3 December 2002 and 22 January 2003 (n = 150 independent turtle watching groups). A total of 108 focused observations were conducted on the same nights as the scanning observations during the 2002-03 nesting season (Table 7.2). Consent to use the visitor behaviour data from scanning and focused observation techniques was requested after the visitor group returned to the carpark area along with consent to complete a questionnaire (ref: W930/02). The data from both methods were cross-referenced to compare behaviour (without distraction from researchers) and their knowledge of the code of conduct.

Table 7.2 Sample sizes of the various methods used to measure disturbance from turtle watchers (Note: the methods are listed in chronological order)

Methods	Number of turtle watching groups (2001-02 and 2002-03)	Description of method
On-site Visitor Surveys (before experience)	340	Visitor counts, group sizes, time of arrival/departure and duration.
Scanning Observations (during experience)	171	Observing tourists behaviours (i.e. torch use and position on beach) from a vantage point.
Focused Observations (during experience)	108	Observing tourist and turtle behaviour simultaneously during an interaction.
Disturbance incidents (during experience)	63	All disturbances that were recorded during the Focused Observations. Specific disturbance behaviour was linked to non-compliant behaviour of turtle watchers
Questionnaires (after experience)	175	Opportunistic administration of questionnaire to turtle watchers after their experience.
Cross-reference with Questionnaire data (part of analysis)	108	Comparing turtle watchers behaviour (Focused Observations) and their knowledge of the code of conduct (Questionnaire).

7.3.4 Training observers

A total of 30 second-year environmental science students from Murdoch University were recruited and trained to undertake scanning and focused observations. The training involved one week of intensive fieldwork and education before volunteers were ready to undertake interaction surveys. Volunteers were educated about the methods of this study including the process of observing a visitor group discretely and how to avoid being noticed by visitor groups. Volunteers were trained in how to record torch-use to ensure the standard of data collection was consistent between different observers. In order to differentiate between these categories, observers were given a demonstration of the different frequencies of torch-use prior to undertaking sample sessions. Volunteers were given theoretical and practical experience of the nesting process including identifying the commencement and termination of phases of the nesting process, identifying vigilance behaviour (e.g. head postures and body movements) and disturbance behaviours of marine turtles (e.g. turn back to the ocean during emergence). The performance of volunteers was regularly monitored to ensure the standard of sampling was maintained.

7.3.5 Scanning Observations

A scanning approach was used to observe turtle watchers behaviour before encountering a turtle. Visitor groups were observed for approximately 10 minutes after they entered the beach. Scanning observations involved observing group behaviours on the beach from a vantage point on the dune and on the beach as they searched for turtles.

Initially, observers described the use of torch light and movements of groups on the beach to develop a quantitative method for measuring potential impacts from tourist activities. From these preliminary observations, torch-use was categorised into three distinct levels: no torch-use (no torchlight was visible); occasional torch-use (groups turned the torch on at intermittent time intervals) and constant torch-use (groups did not turn the torch off at all). General observations of non-compliant behaviour of groups were also recorded to develop categories that were directly linked to the guidelines stated in the code of conduct. These categories were then applied to the focused observation surveys.

7.3.6 Focused Observations

7.3.6.1 Quantifying non-compliant tourist behaviour

Focused observations were conducted while groups encountered a turtle. Once an encounter was detected, a single observer accompanied the group to directly observe any multiple non-compliance behaviours by people within the group (Table 7.3). Seven guidelines from the code of conduct were used to quantify non-compliance behaviour of independent turtle watching groups, including shining torch light on turtles during the nesting process, using flash photography, making loud noises, no touching, sudden movements, not staying behind the turtle and not staying within 3m from the turtle (Table 7.3).

7.3.6.2 Quantifying turtle behaviour

A focal-animal sampling approach was used in combination with sequence sampling (Altman, 1974; Lehner, 1996) in order to detect a disturbance associated with non-compliance behaviour. Although green turtles naturally show a variety of behaviours during the nesting process and do not always lay eggs on every emergence, these methods focus disturbance behaviour at the site and do not consider reference sites. To detect a disturbance in response to non-compliant tourist behaviour, “animal behavioural patterns” (which are defined as linking two behavioural acts together into a reasonably predictable and stereotyped pattern) were identified for turtles (e.g. vigilance act followed by a disturbance behavioural response) (Delgado and Delgado, 1962; Lehner, 1996). The categories used to record the pattern were based on “agonistic behaviour types”, which are defined as behaviours associated with conflict, escaping and disturbance (Lehner, 1996).

Table 7.3 Definitions of non-compliance behaviour by tourists

Guidelines in Code of Conduct	Non-compliant behaviours observed and recorded	Definition of non-compliant behaviour
<u>Scanning observations</u>		
Minimise use of lights	Frequency of torch-use	Groups using their torch light (occasionally, not at all or consistently) whilst seeking turtles
Walk along high tide line	Not walking along the high tide mark	Groups walking within 5m of the high tide line
<u>Focused observations</u>		
Minimise use of lights	Shining torch on turtle during nesting process	People or a person within a group directing the light of the torch onto the turtle during any stage of the nesting process
	Using flash photography	People or person within the group using flash photography whilst viewing the turtle
No touching	Touching turtles	People or a person within a group touching the turtle
Do not make loud noises	Making loud noise	People or a person within a group speaking above the normal volume (i.e. talking loudly or making loud noises)
Avoid sudden movements	Sudden movements	People or a person within a group exhibiting rapid movements (e.g. running, approaching turtle quickly)
Stay behind turtle as much as possible	Not staying behind the turtle	People or a person within a group positioned on the sides or in front of the turtle
Keep your distance (refers to guidelines on the car park signs)	Not staying 3 metres from the turtle	People or a person within a group moving within a 3 m radius of the turtle

In order to associate non-compliant behaviour by tourist groups with the corresponding disturbance, bouts of vigilance behaviour were initially observed. These vigilance behaviours as described by Hailman and Elowson's (1992) ethnogram of nesting female loggerhead turtles under natural conditions was used to detect a potential disturbance reaction. The vigilance behaviours described in Section 7.2.3 were primarily used to indicate the onset of a disturbance response (Table 7.4).

Table 7.4 Definitions of disturbance behaviours of marine turtles

Behaviour	Definition
Turning back to the ocean	Turtle makes a 180° turn and returns to the water
Redirection of crawl	Turtle diverts from its original direction away from tourist group
Crawling faster	Turtle begins to move across the sand quicker
Aborting the body pit	Turtle terminates excavation of the body pit and crawls from the digging site
Aborting the egg chamber	Turtle terminates excavation of the egg chamber and crawls from the digging site
Aborting laying her eggs.	Turtle terminates egg laying and crawls from the nesting site

Data collection occurred as a series sequential events. Non-compliant behaviours of visitor groups were recorded based on guidelines from the code, then if the turtle showed vigilance behaviour followed by disturbance behaviour, this was also recorded in association with the non-compliant behaviour. This occurred in instances where the disturbance could potentially have been caused by more than one non-compliant behaviour.

7.3.7 Data analysis

Observational data were recorded on data sheets that were designed to cross-reference tourist non-compliant behaviour and turtle behavioural responses (Appendix 3). These data were coded, entered and analysed in SPSS 15.0 for Windows. The data from scanning and focused observations were analysed separately. Scanning observations from 2001-02 and 2002-03 seasons were analysed using percentages and cross-tabulations to examine the likelihood of

encountering turtles using three different levels of torch-use (constant, occasional and no use) and whether groups were walking along the high tide line on the beach. Pearson's Chi-Square test was used to gauge whether the level of torch-use affected tourists ability to encounter turtles. The Haberman (1973) evaluation of adjusted residuals was used to gauge whether constant torch-use reduced the chance of encountering turtles.

Multiple behaviours of tourist groups and turtles during the focused observations were recorded. To determine which guideline was breached the most, the cumulative total non-compliant behaviour over all interactions were calculated.

7.4 Results

7.4.1 Scanning Observations

Scanning observations of torch-use showed that 39 (32%) groups in 2001-02 and 62 (41%) groups in 2002-03 did not use their torch light within the first 10 minutes of entering the beach (Table 7.5). When combining data from both seasons, 101 (37%) groups did not use their torch at all, 103 (38%) groups used their torch occasionally, and 67 (25%) groups used their torch constantly (n = 271).

Table 7.5 Levels of torch-use from indirect observations in 2001-02 and 2002-03

Season	No torch-use		Occasional torch-use		Constant torch-use	
	No.	%	No.	%	No.	%
2001-02	39	32	41	34	41	34
2002-03	62	41	62	41	26	17
Total	101	37	103	38	67	25

The proportion of groups that encountered a turtle was less in 2001-02 (28 groups; 32%) compared with 2002-03 (101 groups; 80%). This is likely to be attributed to the 6-fold increase in the number of green turtles emerging onto the beach to nest in 2002-03 (see Chapter 5). A Pearson's Chi-Square test detected significance when cross-tabulating levels of

torch-use and whether visitor groups encountered a turtle ($\chi^2 = 6.43$; $p = 0.04$). This significance was further investigated through an evaluation of adjusted residuals of each intersection (Haberman, 1973). The high negative adjusted residual value of -2.4 between constant torch-use and encounter suggests it less likely that visitor groups would encounter a turtle when constantly using their torch light.

During the scanning observations, observers also recorded the position of turtle watchers on the beach. The results showed that about half of the groups walked along the high tide line in both 2001-02 and 2002-03. Chi-Square Test showed that groups were equally likely to encounter turtles near the high tide line or elsewhere on the beach ($\chi^2 = 30.12$; $p < 0.001$).

7.4.2 Focused Observations

Focused observations of tourist-turtle interactions showed that 44 (41%) groups did not breach any of the guidelines, 22 (20%) groups breached one guideline and 19 (17%) groups breached two guidelines (Figure 7.1). The most common non-compliant behaviour during an interaction was getting within 3m of the turtle (37 groups; 23%), shining torch light on the turtle (31 groups; 19%), not staying behind the turtle (31 groups; 19%) and sudden movement (20 groups; 12%)(Figure 7.2).

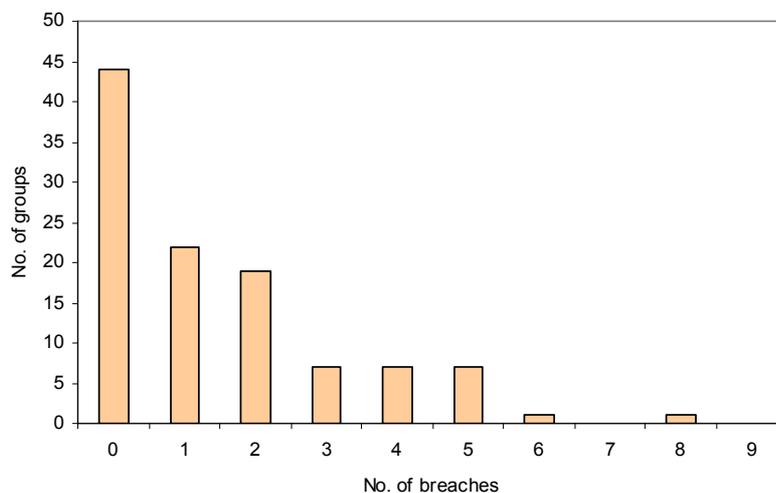


Figure 7.1 Percentage of groups breaching guidelines of the code of conduct (n = 108)

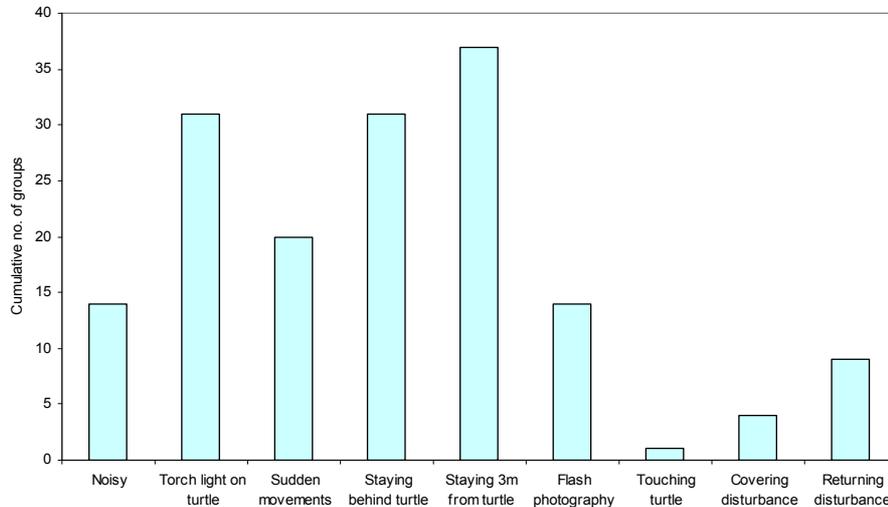


Figure 7.2 Total number of breaches recorded for each guideline of the code (n = 108)

These results were cross-referenced with turtle watchers' knowledge of guidelines presented in Chapter 6. The results showed that all turtle watchers who recalled the code "shining a torch on the turtle" shone their torch on the turtle they were watching. Similarly, 43 (43%) groups that made loud noises recalled noise as a guidance statement and 36 (36%) groups closer than 3m from the turtles recalled this as a guidance statement. None of the turtle watchers who were observed using flash photography recalled this as a breach of the code.

Of the 108 interaction surveys, a total of 34 (31%) encounters resulted in a disturbance caused by non-compliant behaviour of groups. Given that each disturbance may have been attributed to multiple breaches of the code, the following analysis represents all potential incidents of disturbance (n = 63). The majority of these disturbances (82%; n = 63) occurred during the initial phases of the nesting process (i.e. ascending the beach, excavating a body pit and egg chamber). Almost half of disturbances resulted in turtles turning around as they ascended the beach and eventually returning to the water (31 incidents; 49%) followed by turtles aborting the body pit phase (14 incidents; 22%). The majority of these disturbances

were caused from groups getting closer than 3m and/or shining their torch on the turtle (Figure 7.3). Sudden movements and not staying behind the turtle mostly caused turtles to turn back as they ascended the beach. No turtle disturbance behaviour was recorded as a result of loud noises or tourist activities during the covering phase or during the egg-laying phase (Figure 7.3).

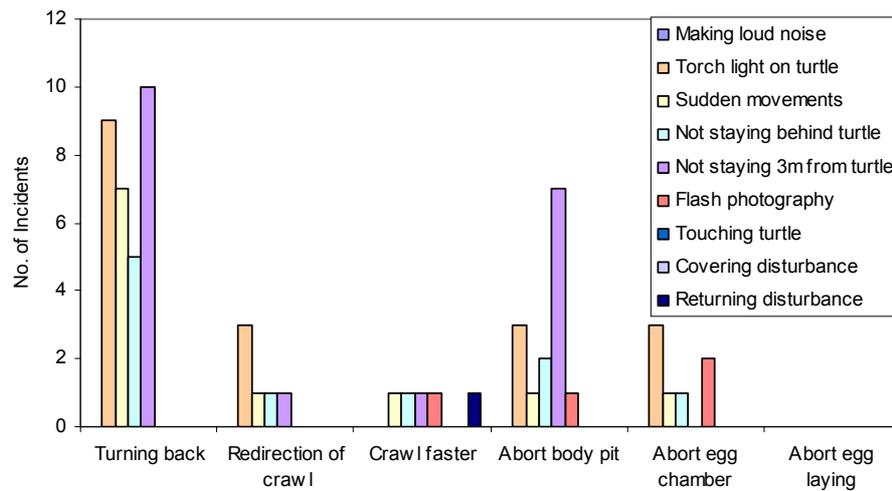


Figure 7.3 Number of incidents of disturbances from non-compliant behaviour (note some of the disturbances were caused by multiple breaches) (n = 63 incidents)

7.4.3 Comparing turtle watchers retention of information and behaviour

The present study is consistent with other research that indicate visitors knowledge of voluntary code of conduct is not necessary reflected in behaviour (Howard, 2000; O'Neill *et al.*, 2004). As a means of exploring this quandary, the turtle watchers' ability to recall guidelines from the code (see Chapter 6) and non-compliance behaviour (this Chapter) are compared. The guidelines that were ignored the most by turtle watchers were avoid shining torch light on turtles (68%; n = 76), being noisy (43%; n = 76) and staying 3m from the turtle (35%; n = 76) (Table 7.6). Lights and distance from the turtle have also been identified as resulting in the greatest disturbance (Figure 7.2). It also questions the effectiveness of the

self-regulated code of conduct for watching turtles and again lends support for better interpretation and the employment of trained guides as discussed in Chapter 6.

Table 7.6 Percentage of respondents that recalled and breached various guidelines of the code (n = 76)

Breaches of the code	Total no. of breaches	Number of respondents that recalled this guideline	Percentage of respondents that recalled this guideline (%)
Noisy	14	6	43
Torch light on turtle	31	21	68
Sudden movements	20	3	15
Staying behind turtle	31	2	6
Staying 3m from turtle	37	13	35
Flash photography	14	0	0
Touching a turtle	1	0	0

7.5 Discussion

7.5.1 Disturbances to turtles from turtle watchers

While several authors have discussed the potential impacts of independent and guided turtle watchers (Mortimer, 1979; Hosier *et al.* 1981; Arianoutsou, 1988; Raymond, 1984; Lutcavage *et al.*, 1997), little research has specifically detailed the disturbances to turtles based on non-compliance behaviour. Studies that attempt to measure disturbance to turtles from turtle watchers often relied on feedback from tourists (CALM, 1995; Curnock *et al.*, 2005) rather than observing actual interaction. A questionnaire conducted at Mon Repos in 2004 revealed that almost 25% of visitors surveyed (n = 350) felt that their tour group had disturbed a turtle (Curnock *et al.*, 2005). A study that attempted to detect disturbance from independent turtle watchers, which was also carried out on the beaches of the Jurabi Coastal Park, found 33% of turtles were disturbed (CALM, 1995). The results presented in the current study provide a more detailed investigation of the interactions between independent turtle watching groups and turtles attempting to nest. The study found that 31% of interactions resulted in a disturbance. This extrapolates to 20% of all turtles on the beach being disturbed, which is consistent with previous studies (CALM, 1995).

It should be noted that the percentage of turtles disturbed in the current study only considers turtles as they emerge from the water and does not include the disturbance to turtles before entering the beach. The estimates presented in this research should therefore be considered a conservative estimate of disturbance since turtles often select a nest site before they emerge from the water (Witherington and Martin, 1996; Miller, 1999)

7.5.2 Biological implications of disturbing nesting turtles

In line with other studies (Limpus and Reimer, 1990; Witherington, 1992; Fangman and Rittmaster, 1993; Jacobson and Lopez, 1994; Johnson *et al.*, 1996), the current study confirms that most disturbances occur in the earlier phases of the nesting process with little disturbance during egg-laying (Figure 7.3). All of these disturbances, which occurred at the emergence phase, resulted in the turtle turning around and returning to the ocean without laying eggs. According to Murphy (1985b), repeated disturbance to turtles can result in poor nest-site selection and may cause some females to forego a nesting opportunity, in turn reducing the number of clutches laid per season. Given that Miller (1997) noted that turtles only breed every 2 – 9 years, such a reduction has potential to decrease the nesting population. Furthermore, turtles are known to rely on fat reserves for energy during the nesting period, therefore increased nesting activity for individuals may have a pervasive impact on their breeding productivity (Houghton *et al.*, 2002). While the study presented in this thesis did not use mark-recapture tagging methods to gauge the effects of repetitive pressure on emerging turtles from turtle watchers, the potential risk of increased fatigue, which diminishes fat reserves and/or failure to lay eggs is possible and requires further research.

7.5.2.1 Impacts from light

Artificial lighting on nesting beaches can impact on turtle populations because it disrupts critical behaviours, including hatchling disorientation, nest-site choice and nocturnal nesting behaviour (Salmon *et al.*, 1992; Witherington, 1992; Lutcavage *et al.*, 1997). Although the present study focused on the disturbance from torch light on adult female turtles, it should be noted that hatchling would have also been impacted by torch-use in the Jurabi Coastal Park. The scanning observations inferred that constant torch-use reduced a group's chances of encountering a turtle, possibly because they are frightening a turtles off the beach or preventing turtles from exiting the water to commence the nesting process (Waayers *et al.*,

2006). While it is possible that constant torch-use caused turtles to return to the water before the group reached the location where the turtle emerged, further research is required to verify whether constant torch-use limits tourist's ability to encounter turtles. Nevertheless, this study showed that turtle watchers were less likely to encounter a turtle when constantly using a torch compared to only using it intermittently or not at all. These results support other studies that suggest slow repetitive flashes of light (< 40 flashes/min) do not affect turtles (Carr and Giovannoli, 1957; Murphy, 1985b; Witherington, 1992; Lutcavage *et al.*, 1997).

The focused observations also confirm that light sources disturb adult turtles on the beach. The main disturbances from shining light onto the turtle were causing the turtle to return to the water, abort the body pit and redirecting the turtles crawl path. All of these disturbances occur in the early phases of the nesting processes and are often when turtles are most susceptible to disturbance (Jacobson and Lopez, 1994; Johnson *et al.*, 1996). Furthermore, the impact from light on turtles, particularly hatchlings, is often related to the intensity of ambient light generated by the moon (i.e. less impact during full moon periods)(Salmon *et al.*, 1992). The influence of the moon on site selection and nesting success of adult turtles was not examined in this thesis and requires further investigation.

7.5.2.2 Impacts from shadows

Witherington and Martin (1996) suggest that the presence of people within the field of view of a turtle may cause abandonment just as often as, and perhaps more often than torch light. Studies have suggested that marine turtles, particularly green turtles, can be alarmed by moving shadows resulting in the abandonment of a nesting attempt (Bustard, 1972; Hailman and Elowson, 1992; Witherington, 1992). This study showed that turtle watchers that were within three metres of turtle, as it crawled up the beach, caused most of the disturbances (Figure 7.2). Although enforcing the distance from a turtle may be useful for guiding, restricting independent turtle watchers from approaching turtle is a difficult condition to enforce or regulate. Keeping visitors within a specified distance from a focal mobile animal is

a challenge, particularly if the animal is moving in people's direction. It is therefore argued that the application of a restricted distance is ambiguous due to the uncertainty associated with the natural behaviour of animals in the wild. It may be more appropriate to emphasise the importance of strategically positioning turtle watchers on the beach or use guides to enforce the code.

7.5.2.3 Impacts from walking above the high tide and noise

The current study showed that most groups (57%) were observed walking above the high tide. Walking along the high tide, preferably close to the water's edge, is an important guideline in that it enables turtle watchers to detect the location of turtles without disturbing them as they crawl up the beach and positions turtle watchers behind a turtle and out of the turtle's line of sight.

This study found no support for the notion that human voices affect turtle behaviour during the nesting process. For turtles, auditory perception occurs through a combination of bone and water conduction, rather than air conduction (Lenhardt, 1994; Moein-Bartol *et al.*, 1999). It is important to note that whilst noise may not affect turtles, it may disrupt the experience for other surrounding turtle watchers.

7.5.3 Implications for management

In wildlife tourism operations, appropriate interpretation can enhance tourist enjoyment, promote wildlife conservation and local employment, and influence on-site behaviour of tourists (Ham and Weiler, 2002) and enhance better appreciation and concern for conservation (Staiff and Bushell, 2003). The present study indicates that constant torch-use reduced the chance of encountering a turtle, which in turn was found to consequently reduce visitor satisfaction (see Chapter 5). This finding suggests that compliance with DEC's code of conduct may also increase the level of satisfaction of visitors. It is widely accepted that

interpretation should go beyond outlining the “do’s and don’ts”, but give explicit rationale for why people should act in a particular way (Moscardo, 1998; O’Neill *et al.*, 2004). Therefore, compliance with the code may be more effective if turtle watchers know that constant torch-use will reduce their likelihood of encountering a turtle and therefore affect their experience.

Guiding is an essential ingredient for reducing the frequency of non-compliant behaviour by tourists (Newsome *et al.*, 2002; Bauer and Dowling, 2003; Birtles *et al.*, 2004). Guiding turtle watchers during the night has been identified, in this chapter and previous chapters, as being critical tool in reducing disturbance to turtles and enhancing the experience of watching turtles. As discussed in Chapter 6, “guiding” provides a means of controlling visitors and often increases the satisfaction of tourists through the provision of information and interpretation (Newsome, 2004; Higginbottom, 2005). In the current study, the distance and position of turtle watchers from turtles were identified as a factor that causes significant disturbance because turtles can respond to moving shadows. This study suggests that walking below the high tide, preferably close to the water’s edge, is essential for positioning turtle watchers behind the turtle and out of the turtle’s line of sight during the earlier phases of the nesting process. However, this may have implications for adult turtles wading in the intertidal area prior to entering the beach. Although controlling the distance and position of turtle watchers from a turtle may be possible by employing tour guides, restricting independent turtle watchers from approaching turtles is difficult to regulate as demonstrated in the current study.

Work which forms the basis of this thesis has influenced further development and research in turtle tourism in the Ningaloo region. The development of the JTC in 2003 provided an initial starting point for turtle watchers and a facility that employs trained tour guides and interactive interpretative material necessary to manage the impacts described in this chapter. The JTC operates in a similar way to the visitor centre at Mon Repos Conservation Park. Visitors are led onto the beach by a trained guide, once a nesting turtle has been located by

other personnel patrolling the beach. The tour group, containing up to 15 people (as opposed to 70 people at Mon Repos), are called onto the beach once the turtle has commenced egg-laying. This avoids disturbance during the earlier stages of the nesting process. Tour guides then describe the nesting process whilst the group gathers around the turtle. In these situations the guide provides guidance to the groups as they watch the nesting process and provides interpretation of the viewing experience.

Further research has also been undertaken in response to the development of the JTC. A recent study that reviewed the methods developed in this thesis and investigated the effectiveness of the JTC, revealed that 15% of visitors ($n = 34$) felt that they had personally disturbed a nesting turtle (Smith, 2006). Although the methods used to reach this result were different to the current study, it indicates a significant reduction in the proportion of turtles being disturbed by visitor groups in the Jurabi Coastal Park, which can be mainly attributed to the implementation of guiding and interpretation (Smith, 2006).

7.6 Conclusion

To address the objectives presented earlier in this chapter, the group behavioral characteristics of turtle watchers and turtles were investigated. Firstly, less than half of groups that encountered a turtle did not breach any guidelines of the code, which suggests that further management of tourist behavior is necessary. The second question relates to whether turtles were disturbed by non-compliant behavior. This study indicates a third of groups that encountered a turtle resulted in a disturbance, which equated to about 20% of turtles being disturbed. While the disturbances at Jurabi Coastal Park appear to be less than estimates from DEC's study in 1995 and at Mon Repos Conservation Park, this level of disturbance is still considered unacceptable and further education and guiding is needed. A more recent study based on the research reported in this chapter (Smith, 2006) has found that the development and operation of the JTC has provided a focal point to independent turtle

watchers, additional interpretation material and employment of guides, which has consequently reduced the disturbance to turtles.

The following chapter brings together previous chapters into a holistic approach to planning and managing turtle tourism in the Ningaloo region. Chapter 8 also explains how this information can inform the development of a planning model specifically for wildlife tourism operations.

PART 3

DEVELOPING A PLANNING MODEL FOR WILDLIFE TOURISM

CHAPTER 8 DEVELOPING A PLANNING MODEL FOR TURTLE TOURISM IN THE NINGALOO REGION

8.1 Introduction

As described in Chapter 2, planning models are useful for integrating numerous aspects inherently contained within tourism development. Planning models identified as having a holistic planning structure for integrating multiple aspects of wildlife tourism are the Tourism Optimisation Management Model (TOMM) and the adaptive management approach (Higginbottom, 2003; Newsome *et al.*, 2005; Higham *et al.*, 2008). This thesis attempts to fuse TOMM and adaptive management to provide a more holistic, flexible, simplified and self-reliant model for achieving sustainable wildlife tourism. The structure of TOMM (Figure 2.1) will provide the basis for involving stakeholders in decision-making, integrating baseline data and the development of indicators, standards and benchmarks, which were highlighted as being critical components in the case of turtle tourism in the Ningaloo region. The adaptive management approach will provide a vehicle for addressing the uncertainties associated with natural variation and provide feedback to stakeholders and the local community, which were also important components in this case study. Both models comprise mechanisms for generating funds for ensuring the longevity of the planning process and sustainable management practices.

The studies presented in the previous chapters provide important baseline data for developing turtle tourism in the Ningaloo area. In particular, the work provides information relating to stakeholder collaboration, marine turtle populations, visitor distribution and characteristics and identifies potential impacts on turtles from turtle watchers in the Ningaloo area. These studies also identify gaps regarding knowledge of turtles and turtle tourism in the study area. The purpose of this chapter is to discuss aspects of two visitor planning models, TOMM and

Adaptive Management, which complement the requirements of wildlife tourism drawing on the outcomes of the studies in this thesis to inform the development of a Wildlife Tourism Optimisation Management Model (WTOMM) for the Ningaloo region of Western Australia.

8.2 TOMM and Adaptive Management

As discussed in Section 2.3.1, TOMM provides a regional and adaptive approach to turtle tourism however it possesses some limitations. Its greatest limitation is that it requires a large amount of professional expertise and logistical support to facilitate workshops and reporting. Because TOMM works at the regional level, covering the wide range of environments, tenures, land-uses and stakeholders, it can lack the intricacy needed to identify and measure more detailed aspects of tourism. The broad application of TOMM would also generate a large amount of information and consequently more work to manage data. TOMM also shares, with other models described in Chapter 2, a level of societal subjectivity when choosing an acceptable range and benchmark for each indicator. While acceptable ranges provide more flexibility than a limit (as with LAC), the benchmark remains a fixed value which is usually the average of the first year of data collection (McArthur, 2000). To facilitate the implementation of TOMM would therefore require a significant amount of funding. The average annual cost for running TOMM at Kangaroo Island is between \$60,000 - 80,000, which mainly covers the wages of the facilitator (Duka and Jack, 2005). Without ongoing financial support, the objectives set as part of TOMM at Kangaroo Island would not be achievable.

Successful management of turtle tourism depends, not only upon the development of indicators, collection of data and strategic planning, but also upon the personality of the stakeholders and their willingness to collaborate (Duka and Jack, 2005). Through the implementation of TOMM at Kangaroo Island, Duka (2005) identified several key lessons learnt when dealing with stakeholders. These lessons included:

- Attitude change will not occur without collaboration;

- Collective responsibility is essential in incorporating TOMM into management;
- Stakeholder empowerment is critical to success;
- Education is essential to evoke a sense of responsibility for the natural resources;
and,
- Results take time and require at least five years investment.

8.3 Developing the Wildlife Tourism Optimisation Model (WTOMM)

As discussed throughout this thesis, wildlife tourism has specific requirements that are essential for achieving sustainability. The development of tourism planning models has been an evolutionary process where models have been modified as ideas manifest and policies change (Stankey *et al.*, 1985; Graefe *et al.*, 1990; Manidis Roberts Consultants, 1997; Boyd and Butler, 1996). In this way, WTOMM can be seen to have evolved from TOMM and the concepts of adaptive management, which have taken into account the problems identified in previous planning models. As with TOMM, WTOMM covers regional areas to allow for the distribution of highly mobile and migratory animals, such as marine turtles, seals, cetaceans, and birds. The marine habitats that these animals utilise often include multiple tenures, environments and stakeholders, hence requiring a structured but flexible planning framework.

The following section describes how WTOMM addresses some of the problems found in previously described models (see Chapter 2) through the example of turtle tourism in the Ningaloo region. This thesis describes the structure of WTOMM in three components: Context Description; Workshops and Baseline Studies; and Implementation (Monitoring and Management) (Figure 8.1). For reasons outlined in Chapter 4, a coordinator needs to be employed to organise the various aspects of the process including conducting literature reviews, facilitating workshops, organising data collection and report writing.

8.3.1 WTOMM Context Description

As described in TOMM, the Context Description sets the scene by identifying and documenting available information relevant to the tourism industry. This information includes strategic imperatives or policies, community values, product characteristics, growth trends, market trends and opportunities, positioning and branding. These aspects of turtle tourism in the Ningaloo region were outlined in Chapter 3. Alternative management scenarios are then generated to identify potential solutions in the event of a crisis situation or dramatic change due to external influences. In adaptive management, alternative models or scenarios may be used to illustrate different assumptions, values and implications and help to address power differentials. In the case of NTAG, future projections, rather than scenarios were discussed prior to establishing a vision and broad objectives. This process of discussing future projections promoted thoughts amongst stakeholders relating to the future of turtle conservation and tourism in the region and helped identify the values of each interest group.

Adaptive management also takes into account the need for predictive capacity and embraces opportunities to learn from variations in nature. This approach is particularly important when dealing with fluctuating seasonal populations of green turtles. A strategy for addressing the issue of low tourist-turtle interactions resulting from low densities of nesting green turtles is to employ scouts that are used to find turtles. Once a turtle is located, the scout informs a tour guide that a turtle is on the beach and to bring a group of tourists onto the beach to watch the turtle nesting.

The Context Description of WTOMM comprises two similar aspects of TOMM: design of the process for engaging potential stakeholders and the development of the WTOMM; and a compilation of relevant documentation and description of the area (Figure 8.1). Stakeholder collaboration has recently become an important part of any planning process and is becoming more frequently used in government processes (Newsome *et al.*, 2005; Higginbottom, 2004a).

As with other studies (e.g. Jamal and Getz, 1995; Healey, 1997; Bramwell and Sharman, 1999), this research shows that the success of collaboration relies on building partnerships and trust, recognising interdependence, generating a collective vision and objectives and commitment amongst stakeholders. The establishment of NTAG and associated efforts to collaborate indicate that turtle tourism and conservation is well within the process of developing a collaborative and strategic planning process in the Ningaloo region. Nevertheless, the continuation of this process depends on stakeholder commitment to the process and above all on the capacity of institutions and interest groups to transform collaboration into an ongoing learning process.

The initial stages of WTOMM contain strategies for avoiding potential conflict among stakeholders. Firstly, more focus and effort is given to engaging and appropriately selecting stakeholders that will contribute positively to the process and workshop dialogue. WTOMM uses snowball techniques (as described in Chapter 3) for selecting a range of people from different backgrounds and then evaluates individual status and relationships within the community. Whilst being mindful of existing partnerships within the community, the criteria for selecting individuals should include, and not be restricted to, selecting potential “drivers” in the community, indigenous groups, appropriate government agencies and private industries. Eventually, the selection process will identify a single representative from each interest group. Once the stakeholders have agreed to participate, an initial meeting is arranged to introduce the process and outline the requirements and commitments of each participant (e.g. frequent workshops followed by bi-annual meetings). Engagement strategies then need to be established to ensure all stakeholders and associated agencies or organisations are aware of their responsibility and commitment to the process. Their participation in the workshops should become part of their job criteria as an employer of a particular interest group.

The Context Description also requires the facilitator to compile relevant documentation (e.g. policy and plans) and describe what is known about the natural area, human use and potential

impacts. Documentation may include legislation, policy and management plans relevant to the conservation status of focal species, scientific reports or papers relating to the ecology and important habitats that support focal species and plans relating to tourism development in the region. A description of historical and existing impacts to the focal species should also be identified to understand cumulative effects and the establishment of reliable indicators.

8.3.1 Workshops and baseline studies

8.3.1.1 Conduct workshops

This section of WTOMM was modified from TOMM to emphasise the importance of generating a broad vision, objectives and future outcomes and the collection of baseline data (Figure 8.1). The initial workshops are critical to the collaborative process as the outcomes provide the foundation for future planning. As discussed in Chapter 3, the generation of a broad vision, objectives and future outcomes are essential for guiding the planning process. WTOMM also includes provision for defining the management area to be considered and determining how the group will function within the Ningaloo region. Another addition to WTOMM was provision for discussing joint funding opportunities and resourcing, which often appears to “plague” the planning processes. Dialogue should be encouraged among stakeholders regarding funding opportunities and the application of joint funding arrangements. Since the establishment of NTP, some stakeholders have collaborated to generate community-based funds (e.g. Coastcare, Natural Heritage Trust, World Wildlife Fund for Nature, Australian Defence Force) for the turtle monitoring programme and guiding at the JTC (Richards *et al.*, 2005; Markovina, 2008). The attendance of stakeholders at workshops and meetings should be seen as a formal commitment and in-kind contribution by each stakeholder.

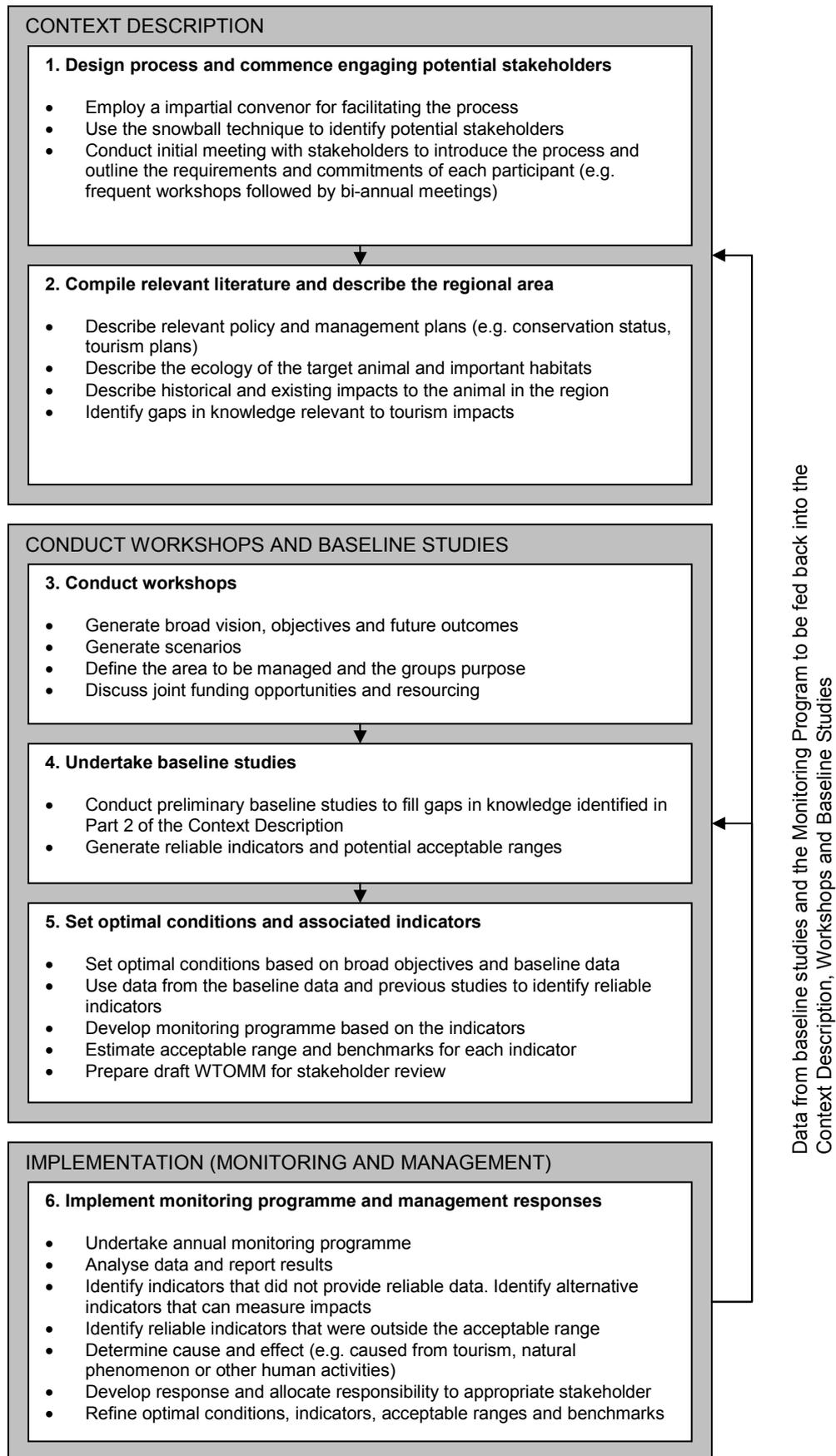


Figure 8.1 Structure of the Wildlife Tourism Optimisation Management Model

A professional convenor's role is to facilitate the proceedings of workshops and maintain equality of dialogue amongst stakeholders, which brings a sense of professionalism and seriousness to the process (Refer to Chapter 3). Nevertheless, it is important to allow stakeholders to take more leading roles over time in order to maintain a sense of stewardship within the group. Experience gained in the research for this thesis supports the notion that rotating people representing interest groups could be useful as a means of maintaining motivation within the group and evoking new ideas for discussion (Chapter 3). For this to happen, comprehensive handovers would need to be encouraged to ensure new individual's representing a stakeholder group do not revisit issues previously discussed.

The experience gained from this research also supports the development of incentives that encourage stakeholders to participate in the workshops, such as providing opportunities to stakeholders in influencing how the industry operates at a local level and/or financial or promotional advantages. Financial or promotional incentives for government agencies and NGOs could be in the form of securing grants based on their involvement in a broader conservation project. For tour operators, promotional incentives would include environmentally friendly branding, which could potentially attract the environmentally conscious tourism market. In addition, communicating the collaborative process to the public will provide each interest group involved positive environmental exposure within the community, which may in turn encourage stakeholders to continue participating in workshops and meetings. Workshops should also be held during working hours to show that the collaborative process is a key component of each stakeholders' work requirements, not just an afterhours voluntary service.

8.3.1.2 Baseline studies

The development of a monitoring programme is potentially large a complex component of the planning process as discussed in Section 2.5. Monitoring programs that are designed for sustainable tourism, addressing biological, social and economic issues, often require complex

and comprehensive baseline studies. The baseline studies are often undertaken to provide background information that can inform decision making as well as the development of long-term monitoring programs. While TOMM provides the capacity to measure predetermined indicators, there is little focus on collecting baseline data, which would add value to selecting suitable indicators.

There is a dearth of “hard data” on the nature and significance of tourism impact situations (Knight and Cole, 1995; Hammit and Cole, 1998; Valentine and Birtles, 2004) mainly due to the lack of systematic and quantitative monitoring of impacts of tourism on wildlife (Manfredo *et al.*, 1995; Hockings *et al.*, 2000; Green and Higginbottom, 2001; Newsome *et al.*, 2005). The collection of baseline data on focal species provides the basis from which to investigate wildlife and understand the effects of tourism on wildlife (Gilbert and Dodds, 1992; Higginbottom, 2004a; Newsome *et al.*, 2005; Bejder *et al.*, 2006). Baseline studies were included in WTOMM primarily as a means of filling the gaps of information identified in the Context Description and to provide information that can inform decisions relating to selecting reliable indicators.

This research has shown how baseline data plays a vital role in the development of turtle tourism in the Ningaloo region. The action research approach has also provided an insight in to how partnerships can be established through well planned workshops, aerial surveys identified “interaction hotspots” that have established key management areas and visitor surveys and interaction observations provided an understanding of tourist characteristics and how to better manage turtle-tourist interactions. This information can also help to investigate which variables provide the most reliable indicators for detecting changes in natural variation or changes derived from tourism-related impacts.

8.3.1.3 Set optimal conditions and associated indicators

The setting optimal conditions is often generated through the initial stakeholder consultation at workshops, while the associated indicators require expertise to advise on appropriate and reliable indicators (i.e. sampling design and studies that detect tourism-related impacts) (see Appendix 4 for examples of optimal conditions and indicators based on the findings of the current research). Once the optimal conditions and associated indicators are determined, stakeholders are given an opportunity to review a draft of WTOMM and provide feedback. Based on the objectives identified in the workshops (see Chapter 4), optimal conditions were divided into the five categories:

- Environmental;
- Social and cultural;
- Educational;
- Economic; and,
- Planning.

These categories were modified from TOMM to account for an indigenous involvement, a holistic view of tourism development and the importance of measuring the performance of the planning process itself, which are elements that have been previous been poorly integrated in planning structures. Indigenous input into ecotourism policies and organisations is limited in Australia (Zeppel, 2003). Most public land and tourism policies in Australia focus on native title, cultural heritage and environmental relationships, but have limited means for indigenous participation in the control and management of ecotourism (Zeppel, 2003).

Establishing reliable indicators is often a complex task requiring expert advice and careful contemplation given resource limitations. Behavioural studies that observe human-animal interactions that explicitly investigate tourism-related impacts require complex experimental design and substantial statistical analysis and interpretation (Newsome *et al.*, 2005).

Considerations for impact studies are often the varying degree of tolerance in individual animals to human intrusion and natural disturbance (Hammit and Cole, 1998). In order to establish indicators that distinguish between natural influence and human-related impact, studies need to focus on the interaction as it occurs. In this thesis, the track counts showed that nesting success was generally lower at sites where turtle watchers were present, inferring that turtles are being disturbed. Yet it was the interaction observations described in Chapter 7 that provided a more accurate depiction of disturbance from turtle watchers with this work providing data on the formulation of reliable indicators of disturbance.

8.3.2 Implementation (Monitoring and Management)

The final stage of WTOMM involves implementing the monitoring programme and generating management responses. This phase is different to TOMM as it includes monitoring as part of the implementation phase rather than having an explicit monitoring section. The rationale for including monitoring in the implementation phases is because monitoring relates to ongoing long-term data collection and is usually modified based on management decisions.

8.3.2.1 Monitoring

Fundamental to developing sustainable wildlife tourism is the collection of long-term biological data on focal species, as it provides the basis from which to investigate wildlife (Gilbert and Dodds, 1992) and understand the effects of tourism on wildlife (Higginbottom, 2004a; Newsome *et al.*, 2005). Annual monitoring of indicators is critical for learning about the ecology of turtle populations, how tourists interact with turtles, assessing the effectiveness of management actions and evaluating the sustainability of marine turtle tourism. The information generated from these data satisfies reporting requirements, allows marine park managers to make informed management decisions and provides a mechanism for generating future funding.

Understanding the ecological characteristics of animals and how they interact within their habitats is essential to determine the extent of disturbance in the short-term as well as wider effects on the regional population (Higham *et al.*, 2008). For example, the amount of energy lost by disturbed turtles on the beach could potentially reduce the number of eggs laid in a clutch in that season. Given that green turtles breed on average every five years (Limpus, 2009), this can have significant adverse effects on the size of the population. While this thesis determined the temporal and spatial distribution of turtle species in the NMP, there remains a paucity of data relating to the breeding characteristics of turtles, such as inter-nesting activities, remigration intervals or clutches per season, which help to understand how the dynamics of nesting female turtles are affected by tourism and other cumulative influences.

The integration of conservation biology, ecotourism and volunteer tourism emerged as having great benefits to aid the conservation of ecosystems worldwide (Clifton and Benson, 2006; Brightsmith *et al.*, 2008). Conservation biology can provide the scientific expertise for sound data collection, ecotourism can provide benefits to local communities and build local and international support for protected areas (Fennell and Weaver, 2005) and volunteer tourism can provide funding and labour (Campbell and Smith, 2006). WTOMM embraces the integration of conservation biology, ecotourism and volunteer involvement and encourages capacity building within communities by providing opportunities for training local residents, university students and tour operators in collecting baseline data and participating in ongoing monitoring. The involvement of these groups in monitoring has many benefits to achieving the objectives of WTOMM, including the reduction of costs by using volunteers to undertake monitoring; creating awareness about impacts in the local community and providing opportunities for employment in the local community. The use of volunteers, particularly local residents and students, can significantly reduce the costs of travelling to monitoring sites and undertaking the fieldwork. This research also argues that the involvement of local communities in monitoring can potentially have greater management outcomes than simply

collecting data. Monitoring programs that involve local communities can encourage a sense of stewardship for the focal species, which acts to develop ambassadors within the community. In this way, community involvement in monitoring can provide an important mechanism for a community-based management approach, which may complement the objectives of government agencies and contribute to capacity building within the local community. For this approach to be effective, it is essential to maintain a balance of collecting useful data, maintaining scientific integrity and provide opportunities for local people to become involved in monitoring activities.

Although this research did not specifically explore the nature and extent to which local residents became empowered or become ambassadors of turtle conservation through NTP, the feedback from volunteers suggests that their involvement is an important component of raising awareness and support for wildlife conservation and wildlife tourism development in the Ningaloo region. The involvement of the community in wildlife conservation was also an important factor in the development of TOMM at Kangaroo Island (see Section 8.2.3).

8.3.2.2 Management Responses

A criticism of previous planning models has been the subjectivity associated with measuring indicators and estimating acceptable ranges and benchmarks (McArthur, 2000). To address this subjectivity, which mainly stems from the inherent variation in natural processes, WTOMM applies elements of adaptive management that embrace learning and adaption approaches. As with TOMM, WTOMM has the capacity to assess the reliability of indicators, acceptable ranges and benchmarks as seasonal data becomes available. In this way, the models ability to adapt to changes allows for natural variation inherent in animal behaviour and biology. A conservative and precautionary approach should also be taken to avoid any unforeseen adverse impacts.

If an indicator is outside the acceptable range, then the cause of impact (e.g. caused from tourism, natural phenomenon or other human activities) and the likely effect this impact has on the focal animal needs to be determined. Understanding the nature of impacts will contribute to accurately diagnosing the cause of impacts by other industries or human use, such as fisheries (e.g. prawn trawling and long line fishing), recreational boating, pollution and aboriginal hunting. Subsequently, responsibility can be placed on the appropriate agency or organisation. Following this, an appropriate management response to the impact needs to be developed (see Appendix 5 for examples of management responses based on the outcomes of the research presented in this thesis).

An important part of WTOMM, which is absent in other planning models (i.e. LAC and TOMM), is its capacity to measure and assess the success of the model and its components. However, to evaluate the effectiveness of a planning process, long-term monitoring of stakeholder collaboration, biological aspects, tourist activity and human-wildlife interactions need to be undertaken. This thesis collected two years of data in 2001 and 2002 relating to these aspects, which provided the foundation for continuing such research. The focus of this present research was primarily on collecting baseline data that may be used to develop indicators of tourism-related impacts on turtles (see Appendix 4). A fundamental issue that arose from this research was the difficulty in isolating tourism-related impacts from natural changes in the distribution and behaviour of turtles. For example, nesting success as an indicator of turtle disturbance from tourist behaviour does not take into account that nesting success can depend on a several localised factors, such as sand temperature, debris on the beach or the variation in tolerance levels of individual turtles.

The final step in the implementation stage is to refine optimal conditions, indicators, acceptable ranges and benchmarks based on data from previous years and to feed this information back into the Context Description and decision making process with stakeholders. Equally important is providing feedback of the results to participants involved

in the Monitoring Program. Compared to TOMM, WTOMM puts greater emphasis on communicating the results of monitoring and key outcomes of the planning process as a means of learning and adapting to natural and anthropogenic change. It is the coordinator's responsibility to communicate the progress of WTOMM to stakeholders, local residents and broader interest group to encourage ongoing support for the model and interest from potential funding bodies. It is also the coordinator's role to prepare annual reports to document the results of the monitoring programme and detail how the objectives are being achieved.

8.4 Conclusion

TOMM and adaptive management were identified as having the prerequisites for addressing problems with planning for wildlife tourism. These attributes include their ability to cover large areas, which is necessary for addressing the fugitive nature of most target animals and include: a provision for involving stakeholders in workshops; a provision for developing monitoring programs; a provision for giving feedback and reporting results; and a provision for dealing with the uncertainty in animal behaviour and population dynamics.

Although these models provide provisions for undertaking the various requirements of wildlife tourism, the objectives within each component are not always achieved. Several authors, who have explored the implementation of TOMM, suggest that because of its enormity and sophisticated nature, it requires a large amount of data for measuring a diverse range of indicators from multidisciplinary disciplines including biology, sociology and economics (Manidis Roberts Consultants, 1997; McArthur, 2000). This large amount of data requires a significant amount of resources and consequently has high operation costs. Studies have also shown that TOMM is difficult to implement due to the lack of collaboration, stakeholder empowerment, education, feedback and long term commitment (McArthur, 2000; Newsome *et al.*, 2002; Higginbottom, 2004a; Duka and Jack, 2005; Miller and Twining-Ward, 2005).

The development of a monitoring programme and management response tables (Appendix 4 and 5) have provided direction and guidance for managers currently responsible for turtle tourism development in the NMP. Some components of the implementation stage have been undertaken since this research, such as the Community-based Turtle Monitoring Program, the construction and operation of the JTC and the employment of trained guides that lead turtle watchers on the beaches at night. WTOMM has become a useful guiding document for managers and stakeholders, however, to fully realise the potential of WTOMM, further research is required to explore its components and how they are currently being applied in the NTP and how they can be applied to other wildlife tourism settings.

The following chapter concludes this thesis by addressing the research questions presented in Chapter 1 by drawing on the key findings of this case study. It also describes how this research has contributed to new knowledge in the field of sustainable wildlife tourism generally and turtle tourism specifically.

CHAPTER 9 CONCLUSION

The purpose of this research was to explore three essential elements that contribute to achieving sustainable wildlife tourism, including: the nature and extent of collaborative relationships amongst stakeholders; the importance of collecting baseline data to inform decisions; and detecting tourism-related impacts on wildlife. It also explored the planning requirements specific for wildlife tourism and proposed a model based on TOMM and adaptive management approaches. This final chapter brings this thesis to a close by revisiting the research questions and objectives associated with these elements presented in Chapter 1. It describes the key findings of this research and how this thesis contributes to new knowledge in the field of wildlife tourism, marine turtle research and sustainable planning in turn providing the foundation for future research.

Research Objective 1:

To explore the nature and extent of collaboration between stakeholders relevant to turtle tourism in the Ningaloo region.

The associated questions are:

- *What stakeholders are relevant to turtle tourism in the Ningaloo region?*
- *What is the nature and extent of collaboration amongst stakeholders participating in workshops for the development of turtle tourism in the Ningaloo region?*

This thesis showed that careful selection of stakeholders and active participation of stakeholders in the planning process can lead to collaboration and partnerships that may have been potentially indifferent in the past. It proposes several ways of selecting stakeholders and avoiding conflicts among stakeholders. These strategies have been incorporated into WTOMM and include using the snowball technique for selecting a range of people from different backgrounds, selecting only one representative from each interest group based on

specific criteria, a Stakeholder Engagement Strategy should be prepared to formalise stakeholder responsibilities and commitments and most importantly employ an external coordinator/convenor to help drive the process and facilitate workshops. While this case study identified evidence of collaboration in the initial stages of the NTP, longitudinal studies should be undertaken to explore the elements that contribute to the longevity or failure of collaboration.

Research Objective 2:

To determine the distribution and abundance of nesting turtles along the Ningaloo Marine Park coast.

The associated questions are:

- *Where are the key turtle rookeries along the Ningaloo Marine Park coast?*
- *What is the size of the annual nesting population of female turtles in the Ningaloo Marine Park and Muiron Islands?*
- *What is the extent of the peak nesting season in the Ningaloo region?*
- *Can the nesting success of turtles be used as an indicator for detecting impacts from turtle watchers at the Jurabi Coastal Park?*

The baseline data on turtles provided essential information for making informed decisions about turtle tourism management in the Ningaloo region. The peak nesting period for green, and loggerhead turtles in the Ningaloo Marine Park occurs between November and March with the peak of the season in mid-January, which is consistent with peak nesting time in other nesting areas in Western Australia. The peak nesting period for hawksbill turtles is unknown given the low nesting activity during the survey period.

The use of digital video aerial surveys proved to be an effective tool in identifying indicative nesting rookeries for turtles, however further refinement of this technique is needed in order

to differentiate between species. Green turtles are the predominant species in the Ningaloo region with up to 35,000 female turtles within the nesting population, which constitutes about one third of female green turtles on the North West Shelf. The majority of the green turtles nest in the northern parts of the Ningaloo Marine Park with few nesting south of Jane's Bay, which was identified as the southern extent of nesting green turtles in Western Australia. The other two species that nested in the Ningaloo Marine Park were less abundant, with up to 20,000 loggerhead turtles and 3,000 hawksbill turtles within the entire nesting population.

The low nesting success of green turtles in the Jurabi Coastal Park compared to other rookeries in Australia suggests that there may be some disturbance to their natural nesting behaviour. The results of this study also indicate that the nesting success was significantly lower at turtle watching beaches. While this suggests disturbance is occurring at turtle watching beaches, further investigation of natural influences, such as sand temperature and beach topography, need to be measured to confidently conclude that disturbances are tourism related. Although nesting success could potentially be an effective way of detecting impact, a more reliable measure is observing the actual interactions between turtle watchers and turtles as explored in Chapter 7.

Research Objective 3:

To determine the distribution and characteristics of visitors along the Ningaloo Marine Park coast during the turtle nesting period.

The associated questions are:

- *Where are the key management areas for turtle tourism in the NMP?*
- *What are the spatial and temporal distribution and demographic characteristics of turtle watchers seeking turtles in the Jurabi Coastal Park during the nesting season?*
- *How knowledgeable are turtle watchers of DEC's code of conduct and how does this relate to visitor behaviour?*

Key management areas or interaction hotspots were identified by comparing the spatial distribution of human activities and turtle tracks. This information is valuable to wildlife managers as they often have limited budgets which restrict the amount of areas that require management.

Turtle tourism was underdeveloped at the time of this study, requiring additional management and infrastructure to mitigate impacts from increased visitation to the NMP. On-site investigations showed that the majority of independent turtle watchers were inexperienced with little knowledge of marine turtles, highlighting the need to provide guided tours and interpretation. The JTC, which was constructed after this study was undertaken, now provides a focal point for turtle tourism in the Ningaloo region. A recent study, which followed the research presented here, found that the JTC was effective in reducing disturbances to turtle as well as increasing visitor awareness and knowledge of turtles in the region (Smith, 2006).

Research Objective 4:

To explore and quantify the impacts of human-turtle interactions during the nesting process.

The associated questions are:

- *How do the guidance statements within DEC's code of conduct for interacting with marine turtles influence the behaviour of turtle watchers?*
- *How is the behaviour of nesting turtles affected by non-compliant behaviour of turtle watchers?*

Behavioural observations indicated that 60% of independent turtle watching groups breached the code of conduct and one third of group's disturbed turtles (see Chapter 7). A study by Smith (2006) reported that disturbance to turtles decreased as a result of the JTC. Smith's results reinforce the importance of using guides and interpretation to provide a more satisfying experience and to reduce the impact on turtles attempting to nest at night.

Given the complexities and uncertainties inherent in the biophysical and social systems that make up ecosystems, sustainable management can only be achieved if management institutions have strong learning capacities. While constructive approaches to conflict amongst stakeholders requires good civic dialogue, treating management as a learning experience wherein management practices are considered to be a series of experiments from which new knowledge leads to continuous adjustments and modifications is an emerging concept in tourism management.

In order to integrate the often complex aspects of sustainable wildlife tourism (i.e. stakeholder involvement, collecting social and biological data and detecting tourism-related impacts), a planning model needs to be developed. This thesis fused the structure of TOMM and concepts of adaptive management to develop a more advanced planning model that attempts to address some of the issues that continue to hinder the wildlife tourism planning process. The key structural modifications within WTOMM provide a more structured process for selecting representative stakeholders and ensuring stakeholder commitment as well as provision for baseline studies that can inform optimal conditions and indicators. While these modifications appeared to have had an immediate positive benefit for turtle tourism in the Ningaloo region, further studies are needed to explore how the NTP has evolved. Although WTOMM has not been formally adopted for the NTP, this thesis has applied the initial stages of the model through stakeholder involvement and developing a monitoring programme. Given the NTP continues to operate and has been recognised as a successful conservation programme within Australia, the potential for WTOMM as a useful planning model in other wildlife tourism situations is evident.

REFERENCES

- Akama, J.S. (2003) Measuring tourist satisfaction with Kenya's wildlife safari: a case study of Tsavo West National Park. *Tourism Management* 24 (1), 73
- Altman, J. (1974) Observational study of behaviour: sampling methods. *Behaviour* 49, 227-267.
- Andersen, M.S. and Miller, M.L. (2006) Onboard marine environmental education: whale watching in the San Juan islands, Washington. *Tourism in Marine Environments* 2 (2), 111-18
- Arapis, T. and Margaritoulis, D. (1994) Sea turtle conservation and sustainable tourism for the proposed marine park on Zakynthos Island, Greece. In *Proceedings of the Thirteenth Annual Symposium on Sea Turtle Biology and Conservation*. (eds B. A. Schroeder and B. E. Witherington). US Department of Commerce, National Oceanographic and Atmospheric Administration, National Marine Fisheries Service, Southeast Fisheries Science Centre, Jekyll Island, Georgia
- Arbec Turtle Conservation (ATC) (2002) *Development of management, research & education programmes at the world's first trans-boundary marine park between Sabah, Malaysia and the Philippines*. Online at www.arbec.com.my/sea-turtles/ [Accessed: 7 May 2004]
- Arianoutsou, M. (1988) Assessing the impacts of human activities on nesting of loggerhead sea turtles (*Caretta caretta*) on Zakynthos Island, Western Greece. *Environmental Conservation* 15 (4), 327-334.
- Ashley, C. and Roe, D. (1998) *Enhancing Community Involvement in Wildlife Tourism: Issues and Challenges*. IIED Wildlife and Development Series No. 11. International Institute for Environment and Development, London

- Baldwin, R., Hughes, G.R. and Prince, R.I.T (eds.) (2004) Distribution and abundance of nesting and foraging populations of loggerhead turtles in the Indian Ocean. In *Loggerhead Sea Turtles*. Smithsonian Books Washington, D.C.
- Ballantyne, R., Packer, J. and Bond, N. (2007) The impacts of a wildlife tourism experience on visitors' conservation knowledge, attitudes and behaviour: Preliminary results from Mon Repos turtle rookery, Queensland. In *Proceedings of the CAUTHE 2007 Conference: Tourism-Past Achievements, Future Challenges* (eds. I. McDonnell, S. Grabowski and R. March). University of Technology, Sydney.
- Bauer, T. and Dowling, R.K. (2003) Ecotourism policies and issues in Antarctica. In *Ecotourism Policy and Planning*. (eds. D.A. Fennel and R.K. Dowling), pp. 309-329. CABI Publishing, Wallingford, UK.
- Bejder, L., Samuels, A., Whitehead, H. and Gales, N. (2006) Interpreting short-term behavioural responses to disturbance within a longitudinal perspective. *Animal Behaviour*. 72 (5), 1149-1158.
- Berkes, F. and Folke, C. (1998) *Linking Social and Ecological Systems: Management Practises and Social Mechanisms for Building Resilience*. Cambridge University Press, Cambridge.
- Berrow, S.D. (2003) An assessment of the framework, legislation and monitoring required to develop genuinely sustainable whalewatching. In *Marine Ecotourism: Issues and Experiences* (eds B. Garrod and J. C. Wilson). Channel View Publication, Clevedon.
- Bertram, B. (1978) Living in groups: predators and prey. In *Behavioural Ecology* (eds J.R. Krebs and N.B. Davies) pp. 64-96. Blackwell Scientific Publications, Oxford, UK.

- Berwick, S.H. and Saharia, V.B. (eds.) (1995) *The Development of International Principles and Practises of Wildlife Research and Management: Asian and American Approaches*. Oxford University Press, Oxford.
- Birtles, A., Curnock, M., Dobbs, K., Smyth, D., Arnold, P. Marsh, H., Arnold, P., Valentine, P., Limpus, C. J., Hyams, W., Dunstan, A., Charles, D., Gatley, C., Mangott, A., Miller, D., Hodgson, A., Emerick, S. and Kendrick, A. (2005) *Towards sustainable dugong and turtle tourism. Final report to the Commonwealth Department of the Environment and Heritage – Phase II*. James Cook University and Natural Heritage Trust, Australia
- Birtles, A., Valentine, P. and Curnock, M. (2001) Tourism based on free-ranging marine wildlife: opportunities and responsibilities. Wildlife Tourism Research Report Series No. 11. Cooperative Research Centre for Sustainable Tourism, Gold Coast
- Birtles, A., Valentine, P., Curnock, M., Arnold, P. and Dunstan, A. (2002) *Incorporating visitor experiences into ecologically sustainable Dwarf Minke Whale tourism in Northern Great Barrier Reef*. Technical Report No. 42. CRC Reef Research Centre, Townsville, Australia
- Bodmer, R.E., Penn, J., Puertas, P., Moya, I. and Fang, T. (1997) Linking conservation and local people through sustainable use of natural resources: community-based management in the Peruvian Amazon. In *Harvesting Wild Species: Implications for Biodiversity Conservation*. (eds C. H. Fresse). Johns Hopkins University Press, Baltimore, Maryland.
- Boiko, P.E., Morrill, R.L., Flynn, J., Faustman, E.M., Van Belle, G. and Omenn, G.S. (1996) Who holds the stakes? A case study of stakeholder identification at two nuclear weapons production sites. *Risk Analysis* 16 (2), 237-249.
- Bolten, A.B. and Witherington, B.E. (eds.) (2003) *Loggerhead sea turtles*. Smithsonian Books Washington, D.C.

- Bookhout, T.A. (ed.) (1996) *Research and Management Techniques for Wildlife and Habitats*. The Wildlife Society, Bethesda, MD.
- Boyd, S.W. and Butler, R.W. (1996) Managing ecotourism: An opportunity spectrum approach. *Tourism Management* 17 (8), 557-66.
- Bramwell, B. and Lane, B (1993) Sustainable tourism: an evolving global approach. *Journal of Sustainable Tourism* 1 (1), 1-5.
- Bramwell, B. and Lane, B. (2000a) Collaboration and partnership in tourism planning. In *Tourism, Collaboration and Partnerships: Politics, Practice and Sustainability*. (eds B. Bramwell and B. Lane), pp. 1-19. Channel View Publications, Clevedon.
- Bramwell, B. and Lane, B (eds.) (2000b) *Tourism Collaboration and Partnerships: Politics, Practise and Sustainability*. Channel View, Clevedon.
- Bramwell, B. and Sharman, A. (1999) Collaboration in local tourism policy making. *Annals of Tourism Research* 26 (2), 392-415.
- Briassoulis, H. (2002) Sustainable tourism and the question of the commons. *Annals of Tourism Research* 29 (4), 1065-85.
- Broderick, A.C., Godley, B.J. and Hays, G.C. (2001) Trophic status drives interannual variability in nesting numbers of marine turtles. *Proceeding of the Royal Society of London B*, vol. 268, pp. 1481-1487.
- Brightsmith, D.J., Stronza, A. and Holle, K. (2008) Ecotourism, conservation biology, and volunteer tourism: A mutually beneficial triumvirate. *Biological Conservation* 141: 2832-2842
- Brown, D.W. (1996) *Strategic Land Use Planning Source Book*. Commission on Resources and Environment, Victoria.

- Bryan, H. (1977) Leisure value system and recreational specialization: The case of trout fishermen. *Journal of Leisure Research* 9, 174-187.
- Bryson, J.M. and Crosby, B.C. (1992) *Leadership for the Common Good. Tackling Public Problems in a Shared-Power World*. Jossey-Bass, San Francisco.
- Buckley, R. (1999) Tools and indicators for managing tourism in parks. *Annals of Tourism Research* 26 (1), 207-209.
- Buckley, R.C. and Pannell, J. (1990) Environmental impacts of tourism and recreation in national parks and conservation reserves. *Journal of Tourism Studies* 1: 24-32.
- Bureau of Meteorology (2005) Climate and history in Learmonth. Online at: http://www.bom.gov.au/weather/wa/learmonth/climate_and_history.shtml [Accessed: 2 April 2005]
- Burns, G.L. (2004) The host community and wildlife tourism. In *Wildlife Tourism: Impacts, Management and Planning*. (eds. K. Higginbottom), pp. 125-144. Common Ground, Altona.
- Burns, G.L. and Howard, P. (2003) When wildlife goes wrong: A case study of stakeholder and management issues regarding dingoes on Frazer Island, Australia. *Tourism Management* 24 (6), 699-712.
- Bustard, R (1972) *Australian sea turtles: Their natural history and conservation*. William Collins Sons and Co. Ltd., Glasgow.
- Butler, R.W. (1980) The concept of a tourist area cycle of evolution implications for the management of resources. *Canadian Geographer* 24, 5-12.

- Butler, R.W. (1993) Tourism - an evolutionary perspective. In *Tourism and sustainable development: monitoring, planning, management*. (eds. L. G. Nelson, R. W. Butler and G. Wall), pp. 27-43. University of Pennsylvania Press, Philadelphia, USA.
- Caffyn, A. (2000) Is there a tourism partnership life cycle? In *Tourism Collaboration and Partnership: Politics, Practice and Sustainability*. (eds. B.Bramwell and B.Lane), pp. 200-219. Channel View Publications, Clevedon.
- CALM (1987) Cape Range National Park. No. 8. Department of Conservation and Land Management, Perth, Western Australia
- CALM (1989) *Ningaloo Marine Park (State Waters) Management Plan 1989-1999*. Department of Conservation and Land Management, Perth
- CALM (1995) *Preliminary summary of turtle tourism monitoring of mainland North West Cape rookery beaches*. Department of Conservation of Land Management, Perth
- CALM (1999) *Jurabi and Bundegi Coastal Parks and Muiron Islands Management Plan 1999-2009*. Department of Conservation and Land Management, Perth
- CALM (2001a) *Summary of Visitor Statistics. Milyering Bicentennial Visitor Centre, Cape Range National Range, 1989-2001. Summary of Visitor Statistics*. Department of Conservation and Land Management, Exmouth, WA
- CALM (2001b) *VISTAT 2000: Guidelines for the collection of visitor information data on CALM-Managed lands and waters*. Department of Conservation and Land Management, Como, WA
- CALM (2004) *Ningaloo Marine Park Draft Management Plan and Indicative Management Plan for the Extension to the Existing Park and Muiron Islands Marine Management Area*. CALM and Marine Parks and Reserves Authority, Perth, Western Australia

- CALM and AMCS (2000) *Marine Community Monitoring Manual*. Department of Conservation and Land Management, Fremantle, WA
- Campbell, L.M. and Smith, C. (2006) What makes them pay? Values of volunteer tourists working for sea turtle conservation. *Environmental Management* 38: 84-98
- Cape Conservation Group (2007) *Turtle Monitoring Field Guide (Edition 6)*. Ningaloo Turtle Program, Exmouth, WA.
- Caribbean Conservation Corporation (CCC) (2009) Available at: <http://cccturtle.org/> [Accessed on 20 April 2009].
- Carr, A and Giovannoli, L. (1957) The ecology and migrations of sea turtles. *American Museum Novitates* 1835, Costa Rica
- Carter, R., Mau, R., McGrath, K. and Waayers, D. (2004) *Ningaloo Community Turtle Monitoring Interim Annual Report 2003-2004*. Written and prepared for the Commonwealth Department of Defence and Coastwest Coastcare. Ningaloo Community Monitoring Programme. Collaboration of DEC, Murdoch University, Cape Conservation Group and World Wide Fund for Nature, Western Australia
- Cassidy, A. J. (1998) Transcript of interview. In *Battye Library Oral History Collection*. (eds pp. 1-36. Edith Cowan University, Perth.
- Ceballos-Lascurain, H. (1998) Birdwatching and ecotourism. *The Ecotourism Society Newsletter* 1, 1-3.
- Chaloupka, M. (2001) Historical trends, seasonality and spatial synchrony in green sea turtle egg production. *Biological Conservation* 101, 263-279.
- Chatto, R. (1997) A Preliminary Overview of the Locations of Marine Turtle Nesting in the Northern Territory. In *Marine Turtle Conservation and Management in Northern*

- Australia*. (eds R.Kennett, A.Webb, G.Duff, M.Guinea and G.Hill),pp. 33-40. Centre for Indigenous Natural and Cultural Resource Management and Centre for Tropical Wetlands Management, Northern Territory University
- Chin, C.L.M., More, S.A. Dowling, R.K. and Wallington, T.J. (2000) Ecotourism in Bako National Park, Borneo: Visitors' perspectives on environmental impacts and their management. *Journal of Sustainable Tourism* 8(1), 20-35.
- Ciriacy-Wantrup, S.V. and Bishop, R.C. (1975) "Common property" as a concept in natural resources policy. *Natural Resources Journal* 15, 713-27.
- Clark, R.N. and Stankey, G.H. (1979) *The Recreation Opportunity Spectrum: A Framework for Planning, Management and Research. (General Technical Report PNW-98)*. Department of Agriculture, Forest Service, Pacific Northwest Forest and Range Experiment Station, Portland, Oregon
- Clifton, J. and Benson, A. (2006) Planning for sustainable ecotourism: the case of research ecotourism in developing country destinations. *Journal of Sustainable Tourism* 14: 238-254
- Cole, D.N. (2001). *Day users in wilderness: How different are they?* Research Paper RMRS-RP-31. USDA Forest Service, Rocky Mountain Research Station, Fort Collins, CO, USA
- Cole, D.N. and McCool, S.F. (2000). Wilderness visitors, experiences and visitor management. In: *Wilderness Science in a Time of Change Conference. Missoula. MT. 23-27 May 1999*. (eds. Cole, D.N., McCool, S.F., Freimund, W.A., Borrie, W.T. and O'Loughlin, J.) Proceedings RMRS-P-15-VOL-4. Vol. 4, USDA Forest Service, Ogden UT, USA

- Congalton, R. G. and Green, K. (1995). The ABCs of GIS: an introduction to geographic information systems. In *Wetland and Environmental Applications of GIS* (eds. J.G. Lyons & J. McCarthy) pp. 9-24. Lewis Publishers, Boca Baton, Florida.
- Commonwealth of Australia (2002) Ningaloo Marine Park (Commonwealth Waters) Management Plan. Environment Australia and National Heritage Trust, Canberra
- Commonwealth of Australia (2004) *National Native Title Tribunal: Gnulli Claimant Application*. Online at http://www.nntt.gov.au/applications/claimant/WC97_28.html [Accessed: 7 December 2004]
- Cosgriff, K. (1997) *Wildlife tourism in Royal Chitwan National Park, Nepal*. Honours Thesis. Charles Sturt University
- Cox, J. H., Percival, H. F. and Colwell, S. V. (1994) *Impact of vehicular traffic on beach habitat and wildlife at Cape San Blas, Florida*. Cooperative Fish and Wildlife Research Unit, U.S. Biological Survey, Technical Report Number 50; 1994. p. 44
- Crouse, D.T. (1984) Loggerhead sea turtle nesting in North Carolina: applications of an aerial survey. *Biological Conservation* 29, 143-155.
- Curnock, M., Birtles, A., Gatley, C., and Valentine, P. (2005) *Mon Repos Visitor Survey 2004–05 Preliminary Results*. James Cook University and Queensland Parks and Wildlife Service.
- Darwall, W.R.T. and Dulvy, N.T. (1996) An evaluation of the suitability of non-specialist volunteer researchers for coral reef fish surveys. Mafia Island, Tanzania: a case study. *Biological Conservation* 78: 223-231

- Davis, D., and Tisdell, C. A. (1998). Tourist levies and willingness to pay for a whale shark experience. *Tourism Economics*, 5, 161-174.
- Davis, G.E. and Whiting, M.C. (1977) Loggerhead sea turtle nesting in Everglades National Park, Florida, USA. *Herpetologica* 33, 18-28.
- Dearden, P and Mitchell, B. (1998) *Environmental Change and Challenge: A Canadian Perspective*. Oxford University Press, Toronto.
- De Kadt, E. (1979) *Tourism: Passport to Development?* Oxford University Press, World Bank, UNESCO. Oxford
- Delgado, R.R. and Delgado, J.M.R (1962) An objective approach to measurement of behaviour. *Philosophy Science* 29, 253-268.
- Dethmers, K.M., Broderick, D., Moritz, C. Fitzsimmons, N.N., Limpus, C.J., Lavery, S., Whiting, S., Guinea, M., Prince, R.I.T. and Kennett, R. (2006) The genetic structure of Australasian green turtles (*Chelonia mydas*): exploring the geographical scale of genetic exchange. *Molecular Ecology* 15: 3931–3946.
- Department of Environment and Conservation (DEC) (2008) Wildlife Conservation Act (1950). Online at <http://www.dec.wa.gov.au/management-and-protection/threatened-species/listing-of-species-and-ecological-communities.html> [Accessed on 20 November 2008]
- Department of Environment, Water, Heritage and Arts (DEWHA) (2008) *Marine turtles in Australia*. Online at <http://www.environment.gov.au/coasts/species/turtles/index.html> [Accessed on 20 November 2008]
- Department for Planning and Infrastructure (2005) Tide Predictions. Online at <http://www.dpi.wa.gov.au/coastaldata/tidesandwaves/predictions.html> [Accessed: 24 January 2005]

- Department of Environment and Heritage (DEH) (2003) *Recovery Plan for Marine Turtles in Australia*. Commonwealth of Australia, Canberra
- Department of Local Government and Regional Development (2003) Regional trends and indicators: Shire of Exmouth June 2002. Online at [Accessed: 23 June]
- Dobbs, K. (2001) *Marine turtles in the Great Barrier Reef World Heritage Area: A compendium of information and basis for the development of policies and strategies for the conservation of marine turtles*. Great Barrier Reef Marine Park Authority, Townsville
- Douglas, T. (ed.) (2000) *Pilbara Journey through the 20th Century*. Robe River Iron Associates, Karratha, Western Australia.
- Dowling, R.K. (1993) An environmentally-based planning model for regional tourism development. *Journal of Sustainable Tourism* 1 (1), 17-37.
- Dowling, R.K. and Sharp, J. (1996) Conservation-tourism partnerships in Western Australia. *Tourism Recreation Research* 22(1):55-60
- Drumm, A. (1998) New approaches to community-based ecotourism management. In *Ecotourism: A Guide for Planners and Managers*. (eds. K. Lindberg, M. E. Wood and D. Engeldgrum), pp. 197-213. The Ecotourism Society, Vermont.
- Duffus, D.A. and Dearden, P. (1990) Non-consumptive wildlife-oriented recreation: A conceptual framework. *Biological Conservation* 53, 213-231.
- Duka, T. (2005) *Kangaroo Island Tourism Optimisation Management Model Annual Report (2004-05)*. In partnership with Kangaroo Island Council, Tourism Kangaroo Island, Kangaroo Island Natural Resource Management Board, Kangaroo Island Development Board, Department for Environment and Heritage, South Australian Tourism Commission, Kangaroo Island Community and Kangaroo Island Tourism Industry

- Duka, T. and Jack, E. (2005) *Kangaroo Island Tourism Optimisation Management Model (TOMM)*. TOMM Management Committee, Adelaide, South Australia
- Dutton, P., Brodrick, D. and Fitzsimmons, N. (2002) Defining management units: molecular genetics. In *Proceedings of the Western Pacific Sea Turtle Cooperative Research and Management Workshop*. (eds I.Kinan). Western Pacific Regional Fishery Management Council, Honolulu
- Earthwatch Institute (2008) Earthwatch expeditions - Earthwatch. Available online at: <http://www.earthwatch.org/expeditions> [Accessed on 2 August 2008]
- Eckert, KL, Bjorndal, KA, Abreu-Grobois, FA & Donnelly, M (1999) *Research and Management Techniques for the Conservation of Sea Turtles*. IUCN/SSC Marine Turtle Specialist Group Publication 4.
- Ehrenfeld, D.W. and Koch, A.L. (1967) Visual accommodation in the green turtle. *Science* 155, 827-828.
- Fangman, M.S. and Rittmaster, K.A. (1993) Effects of human usage on the temporal distribution of loggerhead nesting activities. In *Proceedings of the 13th Annual Sea Turtle Biology and Conservation*. (eds B. E. Schroeder and B. E. Witherington), pp. 222. NOAA Tech. Memo. NMFS-SEFC-341, Miami
- Fennell, D. (1999) *Ecotourism: An Introduction*. Routledge, London.
- Fennell, D. and Ebert, K. (2004) Tourism and the precautionary principle. *Journal of Sustainable Tourism* 12 (6), 461-479.
- Fillion, F.L., Foley, J.P. and Jaquermot, A.J. (1992) The economics of global tourism. In *Fourth World Congress on National Parks and Protected Areas*, pp. 10-21. Caracas, Venezuela

- Finkler, W. and Higham, J. (2004) The human dimension of whale watching: An analysis based on viewing platforms. *Human Dimensions of Wildlife*, 2, pp.103-117.
- Finn, C.B. (1996) Utilising stakeholder strategies for positive collaborative outcomes. In *Creating Collaborative Advantage*. (ed C. Huxham), pp. 44-56. Sage, London.
- Fitzsimmons, N.N., Moritz, C., Limpus, C., Miller, J.D., Parameter, C.J. and Prince, R. (1996) *Comparative genetic structure of green, loggerhead and flatback populations in Australia based on variable mtDNA and nDNA regions*. National Oceanic and Atmospheric Administration Technical Memorandum National Marine Fisheries Service. Southeast Fisheries Centre,
- Fitzsimmons, N.N., Moritz, C., Limpus, C., Pope, L. and Prince, R. (1997) Geographical structure of mitochondrial and nuclear gene polymorphisms in Australian green turtle populations and male-biased gene flow. *Genetics* 147, 25-32.
- Florida Fish and Wildlife Conservation Commission (FWC) (2009) Florida Marine Turtle Program. Available online at: http://myfwc.com/WILDLIFEHABITATS/SeaTurtle_index.htm [Accessed on 20 April 2009]
- Foster-Smith, J. and Evans, S.M. (2003) The value of marine ecological data collected by volunteers. *Biological Conservation* 113: 199-213
- Frost, J.E. and McCool, S.F. (1988) Can visitor regulations enhance recreational experiences? *Environmental Management* 12 (1), 5-9.
- Garrod, B. (2003) Defining marine ecotourism: a delphi study. In *Marine Ecotourism: Issues and Experiences*. *Aspects of Tourism* (eds B. Garrod and J. C. Wilson), pp. 17-36. Channel View Publications, Clevedon.

- Gauthier, D.A. (1993) Sustainable development, tourism and wildlife. In *Tourism and Sustainable Development: Monitoring , Planning, Managing*. (eds R. Bulter, J. G. Nelson and G. Wall). Department of Geography, University of Waterloo, Waterloo.
- Gilbert, F.F. and Dodds, D.G. (1992) *The Philosophy and Practise of Wildlife Management*. Krieger Publishing Company, Florida.
- Gerber, L.R., Wielgus, J. and Sala, E. (2007) A decision framework for the adaptive management of an exploited species with implications for marine reserves. *Conservation Biology* 21, 1594-1602.
- Gnulli Working Group (2004) *Cultural history of the Baiyungu people and their turtle hunting*. Email message 10 October 2004.
- Gourlay, T. and DeJong, R. (2008) *Jurabi Turtle Centre 2007- 2008 Report*. The Department of Environment and Conservation, Exmouth.
- Gossling, S. (2002) Human-environmental relations with tourism. *Annals of Tourism Research* 29 (2), 539-556.
- Govan, H. (1998) Community turtle conservation at Rio Oro on the Pacific coast of Costa Rica. *Marine Turtle Newsletter* 80, 10-11.
- Graefe, A.R., Kuss, F.R. and Vaske, J.J. (1990) *Visitor Impact Management: The Planning Framework. Vol. 2*. National Parks and Conservation Association, Washington, DC.
- Grafton, R.Q. and Kompas, T. (2005) Uncertainty and the active adaptive management of marine reserves. *Marine Policy* 29, 471–479.
- Gray, B. (1989) *Collaborating. Finding Common Ground for Multi-Party Problems*. Jossey-Bass, San Francisco.

- Graham, R.T. (2005) *Unofficial proceedings of the first international Whale Shark conference, Perth Australia.* Available online at: http://www.mcass.sc/iws_presentation_summary.pdf [Accessed 20 April 2005]
- Green, R. and Higginbottom, K. (2001) *The negative effects of wildlife tourism on wildlife. (Wildlife Tourism Research Report No. 5).* Status assessment of wildlife tourism in Australia series. CRC for Sustainable Tourism, Gold Coast, Queensland
- Griffiths, G. H., Lee, J. and Eversham, B. C. (2002) Landscape pattern and species richness; regional scale analysis from remote sensing. *International Journal of Remote Sensing* 21 (13 & 14): 2685-2704
- Haberman, S.J. (1973) The analysis of residuals in cross-classified data. *Biometrics* 29, 205–220.
- Hailman, J.P. and Elowson, A.M. (1992) Ethogram of the nesting female loggerhead turtles(*Caretta caretta*). *Herpetologica* 48, 1-30.
- Hall, C.M. (1995) *An Introduction to Tourism in Australia: Impacts, Planning and Development.* Longman Australia, Melbourne.
- Hall, C.M. (2000) Rethinking collaboration and partnership: a public policy perspective. In *Tourism Collaboration and Partnerships: Politics, Practice and Sustainability.* (eds B.Bramwell and B.Lane), pp. 143-158. Channel View Publications, Clevedon.
- Hall, C. and Jenkins, J. (1995) *Tourism and Public Policy.* Sage, London.
- Hall, C.M. and McArthur, S. (1998) *Integrated Heritage Management: Principles and Practice.* The Stationery Office, London.
- Hall, C.M. and Boyd, S. (2003) *Ecotourism in Peripheral Areas.* Channel View Publishing. Clevedon UK

- Hall, T.E. and Shelby, B. (1998). Changes in use of three Oregon, USA wildernesses. *Environmental Management* 22 (1): 89-98
- Ham, S.H. and Weiler, B. (2002) Interpretation as a Centrepiece in Sustainable Wildlife Tourism. In *Sustainable Tourism: A Global Perspective* (eds. Harris, R., Griffin, T. & Williams, P.), pp. 35-44. Butterworth-Heinemann, London.
- Hammit, W.E. and Cole, D.N. (1998) *Wildland Recreation: Ecology and Management*. John Wiley, New York.
- Hara, M., Maharaj, I. and Pithers, L. (2003) *Marine-based tourism in Gansbaai: A socio-economic study*. Department of Environmental Affairs, Cape Town
- Harris, L.K., Krausman, P.R. and Shaw, W.W. (1995) Human attitudes and mountain sheep in a wilderness setting. *Wildlife Society Bulletin* 23 (1), 66-72.
- Harrison, D. (1997) Ecotourism in the South Pacific: the case of Fiji. In *World Ecotour '97*. p. 75. BIOSFERA, Rio de Janeiro, Brazil.
- Harrison, E. and Troeng, S. (2003) *Report on the 2002 green turtle programme at Tortuguero, Costa Rica*. Caribbean Conservation Corporation, Costa Rica
- Healey, P. (1997) *Collaborative Planning: Shaping Places in Fragmented Societies*. MacMillan Press, London.
- Herath, G. (2002) Research methodologies for planning ecotourism and nature conservation. *Tourism Economics* 8 (1), 77-101.
- Higginbottom, K. (2004a) Managing impacts of wildlife tourism on wildlife. In *Wildlife Tourism: Impacts, Management and Planning*. (ed. K. Higginbottom), pp. 211-230. Cooperative Research Centre for Sustainable Tourism and Common Ground, Altona, Victoria.

- Higginbottom, K. (ed.) (2004b) *Wildlife Tourism: Impacts, Management and Planning*.
Common Ground, Altona, Victoria.
- Higginbottom, K., Green, R and Northrope, C. (2003) A framework for managing the negative impacts of wildlife tourism on wildlife. *Human Dimensions of Wildlife* 8 (1), 1-24.
- Higham, J. E. S. (1998). Tourists and albatrosses: The dynamics of tourism at the Northern Royal albatross colony, Taiaroa Head, New Zealand. *Tourism Management*, 19(6), 521 - 531.
- Higham, J.E.S. and Carr, A. (2003) Wildlife tourism and the protection of rare and endangered endemic species in New Zealand: an analysis of visitor experience. *Human Dimension of Wildlife* 8(1), 23 - 36
- Higham, J. and Lusseau, D. (2004) Ecological impacts and management of tourist engagements with marine mammals. In *Environmental Impacts of Ecotourism* (ed. R. Buckley). CAB International, Wallingford UK, pp. 171-186
- Higham, J.E.S. and Lück, M. (2007) Marine wildlife and tourism management: in search of scientific approaches to sustainability. In *Marine Wildlife and Tourism Management: Insights from the natural and social sciences* (eds. J.E.S. Higham and M. Lück). CAB International, Wallingford UK, pp. 1 - 18
- Higham J.E.S., Bejder, L. and Lusseau D. (2008) An integrated and adaptive management model to address the long term sustainability of tourist interactions with cetaceans. *Environmental Conservation* 35 (4), 294-302
- Hirth, H.F. and Samson, F.B. (1987) Nesting behaviour of green turtles (*Chelonia mydas*) at Tortuguero, Costa Rica. *Caribbean Journal of Science* 23, 374-379.

- Hockings, M., Stolton, S. and Dudley, N. (2000) *Evaluating effectiveness: A framework for assessing the management of protected areas*. IUCN, Gland, Switzerland and Cambridge, UK
- Hodgson, G. (1999) A global assessment of human effects on coral reefs. *Marine Pollution Bulletin* 38 (5), 345-55.
- Hopkins-Murphy, S.R., Murphy, T.M., Hope, C.P., Coker, J.W. and Hoyle, M.E. (2001) *Population trends and nesting distribution of loggerhead turtle (Caretta caretta) in South Carolina 1980-1997*. Final Report to the US Fish and Wildlife Services. Department of Natural Resources, South Carolina.
- Hosier, P.E., Kochhar, M. and Thayer, V. (1981) Off-road vehicle and pedestrian track effects on the sea-approach of hatchling loggerhead turtles. *Environmental Conservation* 8:158-161.
- Houghton, J.D.R., Broderick, A.C., Godley, B.J., Metcalfe, J.D. and Hays, G.C. (2002) Diving behaviour during the inter-nesting interval for loggerhead turtles *Caretta caretta* nesting in Cyprus. *Marine Ecology Progress Series* 227, 63-70
- Howard, J. (2000) Research in Progress: Does Environmental Interpretation Influence Behaviour through Knowledge or Affect? *Journal of Environmental Education* 15/16, 153-156.
- Hoyt, E. (2001) *Whale Watching 2001: World-wide Tourism Numbers, Expenditures, and Expanding Socio-economic Benefits*. International Fund for Animal Welfare, Crowborough, UK
- Hughes, P. (2001) Animals, values and tourism: structural shifts in UK dolphin tourism provision. *Tourism Management* 22, 321-329.

- Hughes, K. (2009) Using wildlife tourism to enhance conservation learning: A case of Mon Repos turtle rookery. In The 6th international Congress on Coastal and Marine Tourism (eds. A. Albers and P.B. Myles). Kyle Business Projects, Port Elizabeth, p. 270.
- Hunter, C. (2002) Aspects of the sustainable tourism debate from a natural resources perspective. In *Sustainable Tourism: A Global Perspective*. (eds R. Harris, T. Griffin and P. Williams). Butterworth-Heinemann, Oxford.
- Interim Marine and Coastal Regionalisation for Australia (1997) *An ecosystem-based Classification for Marine and Coastal Environments (Version 3.2)*. Environment Australia, Commonwealth Department of the Environment, Canberra
- Jacobson, S.K. and Lopez, A.F. (1994) Biological impacts of ecotourism: tourists and marine turtles of Tortuguero National Park, Costa Rica. *Wildlife Society Bulletin* 22, 414-419.
- Jamal, T. and Getz, D. (2000) Community roundtables for tourism-related conflicts: the dialectics of consensus and process structures. In *Tourism Collaboration and Partnerships: Politics, Practice and Sustainability*. (eds B. Bramwell and B. Lane), pp. 159-182. Channel View Publications, Clevedon.
- Jamal, T.B. and Getz, D. (1995) Collaboration theory and community tourism planning. *Annals of Tourism Research* 22 (1), 186-204.
- James Scheerer Research Charter (2004) *Turtle Tagging Expeditions*. Available online at <http://www.jamesscheerer.com.au/TTagging.htm> [Accessed: 30 July 2004]
- Jennings, G. (2001) *Tourism Research*. John Wiley and Sons Australia, Ltd, Queensland.
- Johannes, R.E. and Rimmer, D.W. (1984) Some distinguishing characteristics of nesting beaches of the green turtle (*Chelonia mydas*) on the North West Cape Peninsula, Western Australia. *Marine Biology* 83, 149-54.

- Johnson, S.A., Bjorndal, K.A. and Bolten, A.B (1996) Effects of organized turtle watches on loggerhead (*Caretta caretta*) nesting behaviour and hatchling production in Florida. *Conservation Biology* 10 (2), 570-577.
- Kay, A. (1995) Sea turtle encounters: Mon Repos Conservation Park. Queensland Department of Environment and Heritage, Brisbane, Australia.
- Kulczycki, C. and Lück, M. (2009) Outdoor Adventure Tourism and Wellness. In *Wellness and Tourism: Mind, Body, Spirit, Place* (eds. R. Bushell and P. Sheldon), pp. 165-176. Cognizant Communication Corp. Elmsford, NY.
- Kennett, R.M., Yunupingu, D., Wunungmurra, B., Munungurritj, N. and Marika, R. (1997) Nhaltjan Nguli Miwatj Yolngu Djaka Miyapunuwu: Sea turtle conservation and the Yolngu People of north east Arnhem Land, Australia. In *Principles of Conservation Biology* (ed. G.Meffe) pp. 426-432. Sinauer Associates, Sunderland, MA.
- Kirkwood, R., Boren, L. Shaughnessy, P., Szteren, D., Mawson, P. Hückstädt, L., Hofmeyr, G., Oostuizen. H., Schiavini, A., Campagna, C. and Berris, M. (2003) Pinniped-focused tourism in the Southern Hemisphere: a review of the industry. In *Marine Mammals: fisheries, Tourism and Management Issues* (eds. N. Gales, M. Hindell, and Kirkwood, R.). CSIRO Publishing, Collingwood Victoria, pp. 245-64
- Kleinschmidt, F. (1996). Tourism and whale watching a local government perspective. In *Encounters with whales* (eds. K. Colgan, S. Prasser, A. Jemery). pp 97-100. Prepared for the Australian Nature Conservation Agency, Canberra, Australia
- Knight, R.L. and Cole, D.N. (1995) Factors that influence wildlife responses to recreationists. In *Wildlife and Recreationists: Coexistence Through Management and Research*. (eds. R. L. Knight and L. J. Gutzwiller), pp. 71-80. Island Press, Washington, DC.

- Ladkin, A. and Bertramini, A. M., (2002) Collaborative tourism planning: a case study of Cusco, Peru. *Current Issues in Tourism*, 5 (2), pp. 71-93
- Laing, J., Wegner, A., Moore, S.A. and Weiler, B. (2008) Identifying success factors behind partnerships for managing recreation and tourism in urban fringe parks. *Annals of Leisure Research* 11, 101-122.
- Laing, J. Lee, D. Moore, S.A, Weiler, B. and Wegner, A. (2009) Advancing conceptual understanding of partnerships between protected area agencies and tourism industry: A post-disciplinary and multi-theoretical approach. *Journal of Sustainable Tourism*. 17 (2), 207-229.
- LeBuff, C.R. Jr. and Hagan, P.D. (1978) The role of aerial surveys in estimating nesting populations of the loggerhead turtle. In *Proceedings of the Florida and Interregional Conference on Sea Turtles*. (eds. G. E. Henderson), pp. 33. Florida Marine Research Publications, Jensen Beach
- Lee, K.N. (1993) *Compass and Gyroscope: Integrating Science and Politics for the Environment*. Island Press, Washington DC.
- Lehner, P.N. (1996) *Handbook of Ethological Methods*. Second Edition. University Press, Cambridge.
- Lenhardt, M.L. (1994) Seismic and very low frequency sound induced behaviours in captive loggerhead marine turtles (*Caretta caretta*). In *Proceedings of the Fourteenth Annual Symposium on Sea Turtle Biology and Conservation*. (eds. K. A. Bjorndal, A. B. Bolten, D. A. Johnson and P. J. Eliazar). National Technical Information Service, Springfield, Virginia
- Lima, S.L. (1995) Back to the basics of anti-predatory vigilance: the group-size effect. *Animal Behaviour* 49, 11-20.

- Limpus, C. J. (1982) The status of Australian sea turtle populations. In *Biology and Conservation of Sea Turtles*. (ed. K. Bjorndal), pp. 297-303. Smithsonian Press, Washington D.C.
- Limpus, C.J. (1988) The marine turtles in Australia, 1988 review. In *International Symposium on Sea Turtles*. Hiwasa Community Centre, Tokushima Prefecture
- Limpus, C.J. (1992) Estimation of tag loss in marine turtle research. *Wildlife Research* 19(4), 457 – 469
- Limpus, C.J. (1994) Marine turtles: Ancient mariners in distress. *Air Sea Rescue Journal* 12 (2), 99-100, 103, 105, 106-113
- Limpus, C.J. (2002) *Western Australian Marine Turtle Review*. Queensland Environment Protection Agency, Brisbane.
- Limpus, C. (2009) *A review of Marine Turtles in Australia: Green Turtle (Chelonia mydas)*. EPA, Brisbane, Australia
- Limpus, C. J. and Limpus, D.J (2002) *Queensland turtle conservation project: Raine Island study 2001-2002*. Queensland Parks and Wildlife Service, Queensland
- Limpus, C.J. and Chatto, R. (2004) Marine turtles. In *National Oceans Office: Description of Key Species Groups in the Northern Planning Area*, National Oceans Office, Hobart, Australia.
- Limpus, C. J. and Nicholls, N. (1988) The southern oscillation regulates the annual numbers of green turtles (*Chelonia mydas*) breeding around Northern Australia. *Australian Journal of Wildlife Research* 15, 157-161.

- Limpus, C.J., Miller, J.D., Parmenter, C.J. and Limpus, D.J. (2003) The green turtle, *Chelonia mydas*, population of Raine Island and the northern Great Barrier Reef: 1843–2001. *Memoirs of the Queensland Museum* 49(1): 349–440.
- Lindberg, K. (1997) Economic aspects of ecotourism. In *Ecotourism: A Guide for Planners and Managers*. (eds. K.Lindberg, M. E. Wood and D.Engeldgrum), pp. 87-117. The Ecotourism Society, Vermont.
- Long, P. (2000) Tourism development regimes in the inner city fringe: the case of discover Islington, London. In *Tourism Collaboration and Partnership: Politics, Practice and Sustainability*. (eds. B.Bramwell and B.Lane). Channel View Publications, Clevedon.
- Lück, M. (2003) Education on marine mammal tours as agent for conservation – but do tourists want be educated? *Ocean and Coastal Management* 46(9), 943-56
- Lück, M. (2007) Managing Marine Wildlife Experiences: The Role of Visitor Interpretation Programmes. In *Marine Wildlife and Tourism Management: Insights from the natural and social sciences* (eds. Higham, J. and M. Lück), pp. 334-346. CABI, Wallingford, UK.
- Lusseau, D., Williams, R., Bejder, L., Stockin, K.A., Bain, D., Methe, M.A., Christiansen, F., Martinez, E. and Berggren, P. (In Review). The resilience of animal behavior to disturbance. *American Naturalist*.
- Lutcavage, M.E., Plotkin, P., Witherington, B. and Lutz, P.L. (1997) Human impacts on sea turtle survival. In *The Biology of Sea Turtles*. (eds P. L. Lutz and J. A. Musick), pp. 387-404. CRC Press, Boca Raton, Florida.
- Lutz, P.L. and Musick, J.A. (eds.) (1997) *The Biology of Sea Turtles*. CRC Press, Boca Raton.
- Lutz, P.L., Musick, J. and Wyneken, J. (eds) (2003) *The Biology and Conservation of Sea Turtles, Volume II*. CRC Press, Boca Raton, Florida, USA. pp. 496

- Macbeth, J. (2005) Towards an ethics platform for tourism. *Annals of Tourism Research* 32 (4), 962-984
- Mack, P. (1994) *Turtles at Coral Bay: A study of turtle breeding summer 1994/95*. Annual Report. Peter Mack Foundation, Coral Bay WA
- MacLellan, L.R. (1999) An examination of wildlife tourism as a sustainable form of tourism development in north west Scotland. *International Journal of Tourism Research* 5, 375-387.
- Mandell, M.P. (1999) The impact of collaborative efforts: changing the face of public policy through networks and network structures. *Policy Studies Review* 16:4-17.
- Manfredo, M.J., Vaske, J.J. and Decker, D.J. (1995) Human dimensions of wildlife management: basic concepts. In *Wildlife and Recreationalists: Coexistence Through Management and Research*. (eds. R. L. Knight and K. J. Gutzwiller), pp. 17-32. Island Press, Washington, DC.
- Manidis Roberts Consultants (1997) *Developing a Tourism Optimisation Model (TOMM), a model to monitor and manage tourism on Kangaroo Island, South Australia: Final Report*. South Australian Tourism Commission, Adelaide
- Mann, T.M. (1977) Impact of developed coastline on nesting and hatchling sea turtles in southern Florida. *Florida Marine Research Publications* 33, 53-54.
- Lawson, S. and Manning, R. (2000) Crowding Versus Access at Delicate Arch, Arches National Park: An Indifference Curve Analysis. *Proceedings of the Third Symposium on Social Aspects and Recreation Research*, Tempe, AZ, Arizona State University, pp. 135-143.
- Markovina, K. (2008) *Ningaloo Turtle Program Annual Report 2007-2008*. Ningaloo Turtle Program, Exmouth, Western Australia.

- Markus, N. and Blackshaw, J.K. (1998) Motivation and characteristics of volunteer flying-fox rehabilitators in Australia. *Anthrozoos* 11, 203-209
- Mason, P. and Mowforth, M (1996) Codes of conduct in tourism. *Progress in Tourism and Hospitality Research* 2 (2), 151-64.
- Mason, P. and Cheyne, J. (2000) Residents' attitudes to proposed tourism development. *Annals of Tourism Research* 27 (2), 391-411.
- Mason, P., Johnston, M. and Twyman, D. (2000) The World Wide Fund for Nature Arctic Tourism Project. In *Tourism Collaboration and Partnership: Politics, Practice and Sustainability*. (eds B.Bramwell and B.Lane). Channel View Publications, Clevedon.
- Mau, R. (2003) *Lessons from Mon Repos Conservation Park (unpublished report)*. CALM, Exmouth
- McAdam, D. (1999) The value and scope of geographical information systems in tourism management. *Journal of Sustainable Tourism* 7 (1), 77-92
- Matt, C. and Aumiller, L. (2002) A win-win situation: managing to protect Brown Bears yields high viewer satisfaction at McNeil River State Game Sanctuary. In *Wildlife viewing: A Management Planning Handbook*. (eds M.Manfredo), pp. 70-92. Oregon State University press, Corvallis.
- Mattison, C., Burney, C. and Fisher, L. (1993) Trends in the spatial distribution of sea turtle activity on an urban beach (1981-1992). In *Proceedings of the Thirteenth Annual Symposium of Sea Turtle Biology and Conservation*. (eds B.A.Schroeder and B.Witherington), pp. 102-104. NOAA Technical Memorandum NMFS-SEFC-341,
- Markovina, K. (2008) *Ningaloo Turtle Program Annual Report 2007-2008*. Ningaloo Turtle Program, Exmouth Western Australia.

- McArthur, Hall and (1996) *Integrated management in Australia and New Zealand-the human dimension*. Oxford University Press, Sydney.
- McArthur, S. (2000) Visitor management in action: An analysis of the development and implementation of visitor management models at Jenolan Caves and Kangaroo Island. *PhD Thesis*. University of Canberra, Canberra, ACT
- Medeiros de Araujo, L. and Bramwell, B. (2000) Stakeholder assessment and collaborative tourism planning: The case of Brazil's Costa Dourada project. In *Tourism Collaboration and Partnerships: Politics, Practise and Sustainability*. (eds B.Bramwell and B.Lane), pp. 272-294. Channel View Publications, Clevedon.
- Miles, M. and Huberman, M.A. (1994) *Qualitative Analysis: An Expanded Sourcebook. Second Edition*. Sage, Thousand Oaks, CA.
- Miller, J.D. (1997) Reproduction in sea turtles. In *The Biology of Sea Turtles*. (eds P.L.Lutz and J.A.Musick), pp. 51-82. CRC Press, Boca Raton, Boston, London, New York, Washington DC.
- Miller, G. and Twining-Ward, L. (2005) *Monitoring for a Sustainable Tourism Transition: the Challenge of Developing and Using Indicators*. Oxon: CAB International.
- Moein-Bartol, S., Musick, J.A. and Lenhardt, M.L. (1999) Auditory evoked potentials of loggerhead sea turtle (*Caretta caretta*). *Copeia*, 836-940.
- Moncrieff, D. (1997) *A Tourism Optimisation Model for Dryandra Woodland* (unpublished report). Department of Conservation and Land Management, Perth
- Moore, S.A. and Polley, A. (2007). Defining indicators and standards for tourism impacts in protected areas: Cape Range National Park, Australia. *Environmental Management*. 39:291–300

- Moore, S., Smith, A.J. and Newsome, D. (2003) Environmental performance reporting for natural area tourism: contributions by visitor impact management frameworks and their indicators, *Journal of Sustainable Tourism* 11(4), 348-375.
- Morin, S. L., Moore, S. A., & Schmidt, W. (1997) Defining indicators and standards for recreational impacts in Nuyts Wilderness, Walpole–Nornalup National Park, Western Australia. *CALM Science*, 2(3), 247–266.
- Morris, K. and Lapwood, M. (2001) *Development of a joint management strategy between Aboriginal communities and CALM for the conservation of marine turtles in the Campier Peninsula region of Western Australia*. CALM, Perth
- Mortimer, J.A. (1979) Ascension Island: British jeopardize 45 years of conservation. *Marine Turtle News* 10:7- 8.
- Mortimer, J.A. (1990) The influence of beach sand characteristics on the nesting behaviour and clutch survival of green turtles (*Chelonia mydas*). *Copeia*, 802.
- Moritz, C., Broderick, D., Dethmers, K., Fitzsimmons, N. and Limpus, C. (2002) Population genetics of Southeast Asian and Western Pacific green turtles, *Chelonia mydas*. Report for *Convention on the Conservation of Migratory Species of Wild Animals: Bonn 20th June*.
- Moscardo, G. (1998) Interpretation and sustainable tourism: functions, examples and principles. *Journal of Tourism Studies* 9 (1), 2-13.
- Moscovici, S. (1988) Notes towards a description of social representations. *Journal of European Social Psychology* 18, 211–250
- Mowforth, M. and Munt, I. (1998) *Tourism and Sustainability: New Tourism in the Third World*. Routledge, London.

- Mrosovsky, N. (1978) Orientation mechanisms of marine turtles. In *Animal Migration, Navigation, and Homing* (ed. K. Schmidt-Koenig and W. T. Keeton), pp. 413-419. New York: Springer-Verlag.
- Mulford, C.L. and Rogers, D.L. (1982) Definitions and models. In *Interorganizational Coordination: Theory, Research and Implementation* (eds. Rogers, D.L. and Whetten, D.A.), pp. 9-31. Iowa State University Press, Ames, IA.
- Muloin, S. (1998) Wildlife tourism: The psychological benefits of whale-watching. *Pacific Tourism Review*, 1, pp.199-213.
- Murphy, P.E. (1985a) *A Community Approach*. Methuen, New York.
- Murphy, T.E. (1985b) Telemetric monitoring of nesting loggerhead sea turtles subjected to disturbance on the beach. In *Fifth Annual Workshop on Sea Turtle Biology and Conservation*. Waverly, Georgia
- Murphy, P.E. (1994) Tourism and sustainable development. In *Global Tourism the Next Decade*. (ed. W. Theobald). Butterworth-Heinemann, Oxford.
- Musa, G. (2003) Sipadan: An over-exploited scuba-diving paradise? An analysis of tourism impact, diver satisfaction and management priorities. In *Marine Ecotourism Issues and Experience* (eds. B. Garrod and J. Wilson), pp. 122-38. Aspects of Tourism, Channel View Publications, Cleveland
- Mustonen, P. (2007) Volunteer tourism – altruism or mere tourism. *Anatolia: An International Journal of Tourism and Hospitality Research* 18(1), 97-115
- Newman, C., Buesching, C.D. and Macdonald, D.W. (2003) Validating mammal monitoring methods and assessing the performance of volunteers in wildlife conservation - Sed quis custodiet ipos custodies? *Biological Conservation* 113, 189-197

- Nichols, W.J., Bird, K.E. and Garcia, S. (2000) Community-based research and its application to sea turtle conservation in Bahia Magdalena, BCS, Mexico. *Marine Turtle Newsletter* 89, 4-7.
- Newsome, D. and Rodger, K. (2008) To feed or not to feed: a contentious issue in wildlife tourism. In *Too Close for Comfort* (eds. D. Lunney, A. Munn and W. Meikle). pp. 255-270. Royal Zoological Society of New South Wales, Mosman, Australia,
- Newsome, D., Moore, S.A. and Dowling, R.K. (2002) *Natural Area Tourism: Ecology, Impacts and Management. Aspects of tourism*. Channel View Publications, Clevedon.
- Newsome, D., Dowling, R.K. and Moore, S. A. (2005) *Wildlife tourism. Aspects of Tourism*. Channel View Publications, Clevedon.
- Nilsen, P. and Tayler, G. (1997) A comparative analysis of protected area planning and management frameworks. In *Proceedings of a Workshop on Limits of Acceptable Change and Related Planning Processes: Progress and Future Directions*. (eds. S.F. McCool and D.N. Cole). US Department of Agriculture Forest Service, Rocky Mountain Research Station, Ogden UT.
- NTP (2009) Ningaloo Turtle Program. Online at <http://www.ningalooturtles.org.au/> [Accessed on: 25 July 2009].
- Oliver, J. (1995) Is the "Limits of Acceptable Change" concept useful for environmental managers? A case study from the Great Barrier Reef Marine Park. In *Conservation Through Sustainable Use of Wildlife*. (eds. G. Grigg, P. Hale and D. Lunney), pp. 131-139. Centre for Conservation Biology, Brisbane.
- O'Neill, F., Barnard, S. and Lee, D. (2004) *Best Practise and Interpretation in Tourist/Wildlife Interactions: A Dolphin Swim Tour Example. Wildlife Tourism Research Report No. 25*. CRC for Sustainable Tourism, Gold Coast

- Orams, M.B. (1996) A conceptual model of tourist-wildlife interaction: the case for education as a management strategy. *Australian Geographer* 27 (1), 39-51.
- Orams, M.B. (1997) The effectiveness of environmental education: can we turn tourists into greenies? *Progress in Tourism and Hospitality Research* 3:295 - 306
- Orams, M.B. (2000) Tourists getting close to whales, is it what whale watching is all about? *Tourism Management* 21, 561-569
- Orams, M.B. (2001) Types of ecotourism. In *The Encyclopaedia of Ecotourism*. (ed. D. B. Weaver). CAB International, Wallingford.
- Ostrom, E., Burger, J., Field, C.B., Norgaard, R.B. and Policansky, D. (1999) Revisiting the commons: Local lessons, global challenges. *Science* 284, 278-82.
- Page, S.J. and Dowling, R.K. (2006) *Ecotourism*. Wu-Nan Books, China.
- Parker, S (2000) Collaboration on tourism policy making: environmental and commercial sustainability on Bonaire, NA. In *Tourism Collaboration and Partnerships: Politics, Practice and Sustainability*. (eds. B. Bramwell and B. Lane), pp. 78-97. Channel View Publications, Clevedon.
- Pattengill-Semmens, C.V. and Semmens, B.X. (2003) Conservation and management applications of the REEF volunteer fish monitoring programme. *Environmental Monitoring and Assessment* 81, 43-50
- Peake, S. Innes, P. and Dyer, P. (2009) Ecotourism and conservation: Factors influencing effective conservation messages. *Journal of Sustainable Tourism*. 17(1), 107-127
- Pearce, A.F. and Pattiaratchi, C.B. (1999) The Capes Current: A Summer Counter-current Flowing Past Cape Leeuwin and Cape Naturaliste, Western Australia. *Continental Shelf Research* 19, 401-420.

- Pearson, M. and Sullivan, S. (1995) *Looking after heritage places: the basics of heritage planning for managers, landowners, and administration*. Melbourne University Press, Carlton.
- Pendoley, K. (2005) Sea turtles and the environmental management of industrial activities in north west Western Australia. *PhD thesis*. Murdoch University, Perth.
- Pigram, J.J. and Jenkins, J.M. (1999) *Outdoor Recreation Management*. Routledge, London.
- Pitts, D. and Smith, J. (1993) *A visitor monitoring strategy for Kakadu National Park*. In *Track to the Future: Managing Change in Parks and Recreation*. National Conference of the Royal Australian Institute of Parks and Recreation. RAIPR, Cairns
- Porter, R. and Tarrant, M.A. (2001) A case study of environmental justice and federal tourism sites in southern Appalachia: a GIS application. *Journal of Travel Research* 40 (1): 27-41
- Preen, A.R., Marsh, H., Lawler, I.R., Prince, R.I.T. and Shepherd, R. (1997) Distribution and abundance of dugongs, turtles, dolphins and other megafauna in Shark Bay, Ningaloo Reef and Exmouth Gulf, Western Australia. *Wildlife Research*, vol. 24, pp. 185 - 208
- Prince, R.I.T. (1993) Western Australia Marine Turtle Conservation Project: An outline of scope and an invitation to participate. *Marine Turtle Newsletter* 60, 8-14.
- Prince, R.I.T. (1994a) Shark Bay World Heritage Area: An important loggerhead nesting site. *Marine Turtle Newsletter* 67, 5-6.
- Prince, R.I.T. (1994b) Status of the Western Australian marine turtle population: The Western Australian Marine Turtle Project 1986-1990. In *Proceedings of the Australian Marine Turtle Conservation Workshop*. (eds R. James), pp. 1-14. ANCA, Canberra, Australia

- Prince, R.I.T. (1994c) Update: Sea Turtle of Western Australia. *Marine Turtle Newsletter* 64, 18-19
- Prince, R.I.T. (1997) The Western Australian Marine Turtle Project. In *Sea Turtles of the Indo-Pacific: Research Management and Conservation*. (ed. Pilcher, G.), pp. 94-99. Asean Academic Press, London.
- Prince, R.I.T. (1998) *North West Cape and Muiron Islands marine turtle nesting population study*. Department of Conservation and Land Management, Perth, Western Australia
- Prince, R.I.T. (2000) *North West Cape and Muiron Islands marine turtle nesting population study*. CALM, Perth
- Projeto TAMAR IBAMA (2009) *Homepage of Projeto TAMAR IBAMA* Available at: <http://ospiti.peacelink.it/zumbi/org/tamar/eng/main.html> [Accessed on 20 April 2009]
- Quenette, P.Y. (1990) Functions of vigilance in mammals: A review. *Acta Oecologica* 11, 801-818.
- Raymond, P.W. (1984) *Sea turtle hatchling disorientation and artificial beachfront lighting*. Center for Environmental Education, Washington, D.C.
- Reed, M. (1997a) Power relations and community-based tourism planning. *Annals of Tourism Research* 24 (3), 566-91.
- Reed, M.G. (2000) Collaborative tourism planning as adaptive experiments in emergent tourism settings. In *Tourism Collaboration and Partnerships: Politics, Practice and Sustainability*. (eds. B. Bramwell and B. Lane), pp. 247-271. Channel View Publications, Clevedon.
- Reynolds, P.C. and Braithwaite, D. (2001) Towards a conceptual framework for wildlife tourism. *Tourism Management* 22, 31-42.

- Richards, G. and Hall, D. (eds.) (2000) *Tourism and Sustainable Community Development*. Routledge, London.
- Richards, A., Mau, R., Macgregor, K. and Bedford, S. (2005) Ningaloo Turtle Program: (Annual Report). NTP, Western Australia
- Ripple, J. (1996) *Sea turtles*. Voyager Press, Inc. Stillwater, USA. p 10
- Riveria, J. (2002) Assessing a voluntary environmental initiative in the developing world: The Costa Rica certification for sustainable tourism. *Policy Science* 35, 333-60.
- Roberts, L. and Simpson, F. (2000) Developing partnership approaches to tourism in central and eastern Europe. In *Tourism Collaboration and Partnerships: Politics, Practice and Sustainability*. (eds. B. Bramwell and B. Lane). Channel View Publications, Clevedon.
- Robinson, J. G. and Bodmer, R.E. (1999) Towards wildlife management in tropical forests. *Journal of Wildlife Management* 63 (1), 1-13.
- Rodger, K., Moore, S.A. and Newsome, D. (2007) Wildlife Tours in Australia: characteristics, the place of science and sustainable futures. *Journal of Sustainable Tourism* 15(2), 160-179
- Roggenbuck, J.W. (1992) Use of persuasion to reduce resource impacts and visitor conflicts. In *Influencing Human Behaviour: Theory and Applications in Recreation, Tourism, and Natural Resources Management*. (ed. M.J. Manfredi), pp. 149-208. Sagamore Publishing Co., USA.
- Roggenbuck, J.W. and Lucas, R.C. (1987) Wilderness use and user characteristics: A state-of-knowledge review. In *National wilderness research conference: Issues, state of knowledge, future directions* (ed. R.C. Lucas). General Technical Report INT-220. USDA Forest Service, Intermountain Research Station.

- Rowley, T.J. (1997) Moving beyond dyadic ties: A network of stakeholder influences. *Academy of Management Review* 22 (4), 887-910.
- Salmon, M., Wyneken, J., Fritz, E. and Lucas, M. 1992. Sea finding by hatchling sea turtles: roles of brightness, silhouette and beach slope orientation cues. *Behavior* 122, 56.
- Scarpaci, C., Dayanthi, N. and Corkeron, P.J. (2003) Compliance with regulations by "swim-with-dolphins" operations in Port Phillip Bay, Victoria, Australia. *Environmental Management* 31 (3), 342-47.
- Scheyvens, R. (2002) *Tourism Development: Empowering Communities*. Prentice Hall, Harlow, England.
- Schmitt, E.F. and Sullivan, K.M. (1996) Analysis of a volunteer method for collecting fish presence and abundance data in Florida Keys. *Bulletin of Marine Sciences* 59: 404-416
- Schroeder, B. and Murphy, S. (1999) Population surveys (ground and aerial) on nesting beaches. In *Research and Management Techniques for the Conservation of Sea Turtles*. (eds. K. L. Eckert, K. A. Bjorndal, F. A. Abreu-Grobois and M. Donnelly), pp. 45-56. IUCN/SSC Marine Turtle Specialist Group, Washington.
- Seddon, P. J. and Ellenberg, U. (2008) Effects of human disturbance on penguins: the need for site and species-specific visitor management guidelines.
- Selman, P.H. (1992) *Environmental planning: the conservation and development of biophysical resources*. Paul Chapman Publishing, London.
- Shindler, B. and Shelby, B. (1995) Product shift in recreation settings: Findings and implications from panel research. *Leisure Sciences* 17, 91-107.

- Shire of Exmouth and CALM (1999) *Jurabi and Bundegi Coastal Parks and Muiron Islands Management Plan 1999-2009*. National Parks and Nature Conservation Authority, Perth
- Shoop, C.R., Ruckdeschel, C.A. and Thompson, N.B. (1985) Sea turtles in the southeast United States: Nesting activity as derived from aerial and ground surveys, 1982. *Herpetologica* 41 (3), 252-259.
- Sirakaya, E. and Uysal, M. (1997) Can sanctions and rewards explain conformance behaviour of tour operators with ecotourism guidelines. *Journal of Sustainable Tourism* 5 (4), 322-32.
- Sloan, N.A., Wicaksono, A, Tomascik, T., and Uktolseya, H. (1994) Pangumbahan sea turtle rookery, Java, Indonesia: towards protection in a complex regulatory regime. *Coastal Management* 22, 251-264.
- Smith, A. (2004) Campsite impact monitoring and assessment in the temperate eucalypt forests of Western Australia: An integrated approach. *PhD Thesis*. Murdoch University, Perth
- Smith, L. (2006) Management of tourism based on viewing nesting marine turtles in the Jurabi Coastal Park, Western Australia: an evaluation of the effectiveness of the Jurabi Turtle Experience. *Honours Thesis*. Murdoch University, Perth.
- Smith, A. and Newsome, D. (2002) An integrated approach to assessing, managing and monitoring campsite impacts in Warren National Park, Western Australia. *Journal of Sustainable Tourism* 10 (4), 343-359.
- Spencer, D.M., Kim, D.K., Nelson, C.M. and Holecek, D.F. (1999). Characteristics and behaviour of tourists who use trails. *Current Issues in Tourism* 2 (2 & 3), 174-196
- Staiff, R and Bushell, R (2003) Travel Knowledgeably: The Question of Content in Heritage Interpretation. In *Interpreting the Land Down Under: Australian Heritage*

- Interpretation and Tour Guiding* (eds. Black, R and Weiler, B.), pp 92-108. Fulcrum Publishing, Golden, Colorado, USA.
- Stankey, G.H., Cole, D.N., Lucas, R.C., Peterson, M.E. and Frissell, S.S. (1985) *The limits of acceptable change (LAC) system for wilderness planning, General Technical Report INT-176*. Forest Service US Department of Agriculture, Washington, DC.
- Stoneburner, D.L. and Richardson, J.I. (1981) Observations on the role of temperature in loggerhead turtle nest site selection. *Copeia*, 238.
- Strauss, A. (1987) *Qualitative Analysis for Social Scientists*. Cambridge University Press, Cambridge, UK.
- Talbert, O.R., Stancyk, S.E., Dean, J.M. and Will, J.M. (1980) Nesting activity of the loggerhead turtle (*Caretta caretta*) in South Carolina: A rookery in transition. *Copeia*, 709-18.
- Taylor, J.G. and A.F. Pearce (1999). Ningaloo Reef Currents: Implications for Coral Spawn Dispersal, Zooplankton and Whale Shark Abundance. *Journal of the Royal Society of Western Australia* 82, 57-65.
- Terhune, J.M. (1985) Scanning behaviour of harbour seals on haul-out sites. *Journal of Mammalogy* 66, 392-395.
- Timothy, D.J. (1998) Co-operative tourism planning in a developing destination. *Journal of Sustainable Tourism* 6(1), 52-68
- Tisdell, C. (1996) Ecotourism, economics and the environment: observations from China. *Journal of Travel Research* 34 (4), 11-19.

- Tisdell, C. and Wilson, C. (2001) Wildlife-based tourism and increased support for nature conservation financially and otherwise: evidence from sea turtle ecotourism at Mon Repos. *Tourism Economics* 7 (3), 233-249.
- Tisdell, C. and Wilson, C. (2002) Ecotourism for the survival of sea turtles and other wildlife. *Biodiversity and Conservation* 11 (9), 1511-1520.
- Tisdell, C. and Wilson, C. (2005) Perceived impacts of ecotourism on environmental learning and conservation: turtle watching as a case study. *Environment, Development and Sustainability* 7(3): 291-302
- Tourism WA (2004) Nature Based Tourism Strategy for Western Australia. Government of Western Australia, Perth
- Tremblay, P. (2000) An evolutionary interpretation of the role of collaborative partnerships in sustainable tourism. In *Tourism collaboration and partnerships - politics, practice and sustainability* (eds. B. Bramwell and B. Lane), pp. 314-332. Clevedon, UK, Channel View Publications.
- Tremblay, P. (2001) Wildlife tourism consumption: Consumptive or non-consumptive? *International Journal of Tourism Research* 3, 81-86.
- Troëng, S. and Rankin, E. (2005) Long-term conservation of the green turtle *Chelonia mydas* nesting population at Tortuguero, Costa. Rica. *Biological Conservation* 121, 111–116
- UNEP/CMS (2007) United Nations Environment Programme - World Conservation Monitoring Centre: Interactive Mapping IMAPS. Online at http://www.unep-wcmc.org/imaps/imaps_index.aspx [Accessed on 12 December 2007]
- Valentine, P., Birtles, A., Curnock, M., Arnold, P. and Dunstan, A. (2004) Getting closer to whales: Passenger expectations and experiences and the management of swim with

- dwarf minke whales interactions in the Great Barrier Reef. *Tourism Management*, 25, 647-655.
- Valentine, P. and Birtles, A. (2004) Wildlife watching. In *Wildlife Tourism: Impacts, Management and Planning*. (ed. K. Higginbottom), pp. 16-34. Common Ground Publishing and CRC Sustainable Tourism, Altona, VIC.
- Van der Knapp, W.G.M. (1999) Research Report: GIS orientated analysis of tourist time-space patterns to support sustainable tourism. *Tourism Geographies* 1 (1), 59-69
- Vaske, J.J., Decker, D.J. and Manfredi, M.J. (1995) Human dimensions of wildlife: an integrated framework for coexistence. In *Wildlife and Recreationalists Coexistence Through Management and Research*. (eds. R. L. Knight and L. J. Gutzwiller), pp. Island Press, Washington, DC.
- Waayers, D. (2001) Conservation of marine turtles in Indonesia: an investigation into the role of turtle-based tourism. *Masters Thesis*, Murdoch University, Perth.
- Waayers, D. (2003) *Distribution of green and loggerhead turtles between Carnarvon and Exmouth*. Report prepared for CALM. Ecowaays Australia.
- Waayers, D., Newsome, D. and Lee, D. (2006) Observations of non-compliance behaviour by tourists to a voluntary code of conduct: A pilot study of turtle tourism in the Exmouth region, Western Australia. *Journal of Ecotourism*, 5 (3), 211-222
- Wagar, J. A. (1969). Non-consumptive uses of the coniferous forest, with special relation to consumptive uses. In *Coniferous forest of the northern rock mountains: proceedings of the 1968 symposium* (ed. R. D. Taber). University of Montana Foundation, Missoula, Montana.
- Walters, C.J. (1997) Challenges in adaptive management of riparian and coastal ecosystems. *Conservation Ecology* 1 (2), 1

- Ward, J., Hughey, K. and Ulrich, S. (2002) A framework for managing the biophysical effects of tourism on the natural environment in New Zealand. *Journal of Sustainable Tourism* 10 (3), 239-259.
- Watson, A.E., Cole, D.N., Turner, D.L., Reynolds, P.S. (2000) *Wilderness recreation use estimation: a handbook of methods and systems*. General Technical Report RMRS-GTR-56. Rocky Mountain Research Station, Forest Service, USDA, Ogden, UT.
- Wearing, S. and Neil, J. (1999) *Ecotourism: Impacts, Potentials and Possibilities*. Butterworth-Heinemann, Oxford.
- Wearing, S. (2003) Volunteer tourism. *Tourism Recreation Research* 28 (3): 3 - 4
- Western Australian Planning Commission (WAPC) (1999) *Environmental and Planning Guidelines for Tourism Development on the North West Cape*. Department of Environmental Protection and Ministry of Planning, Perth, Western Australia
- Western Australian Planning Commission (WAPC) (2004) *Carnarvon-Ningaloo Coast: Planning for Sustainable Tourism and Land Use*. Document for public comment. Department for Planning and Infrastructure, Perth
- Williams, R. and Wood, D.S. (2000) *Tourism activities on the Exmouth Peninsula and the Ningaloo Marine Park from 1991-2000: A review of tourism activity survey data in the Exmouth, Cape Range National Park and Ningaloo Marine Park areas 1991-2000*. School of Architecture Construction and Coastal Planning, Curtin University, Perth, Western Australia
- Wilson, J.C. (2003) Planning policy issues for marine ecotourism. In *Marine Ecotourism: Issues and Experiences. Aspects of Tourism* (eds. B. Garrod and J. Wilson), pp. 48-65. Channel View Publications, Clevedon.

- Wilson, C. and Tisdell, C. (2001) Sea turtles as a non-consumptive tourism resource especially in Australia. *Tourism Management* 22, 279-288.
- Witherington, B.E. (1992) Behavioural responses of nesting sea turtles to artificial lighting. *Herpetologica* 48, 31.
- Witherington, B.E. and Martin, R.E. (1996) *Understanding, assessing and resolving light-pollution problems on sea turtle nesting beaches*. FMRI Technical Report TR-2. Florida Department of Environment Protection, Florida, USA
- Wood, D.S. and Dowling, R.K. (2002) *Tourism surveys in the North West Cape region 1989-2002*. Curtin University of Technology and Edith Cowan University, Perth, Western Australia
- Wood, D. and Glasson, J. (2005) Giving the Environment a Voice: the Transformational Potential of Valuing Tourism in Sensitive Natural Environments: The Case of the The Ningaloo Coastal Region, Western Australia. *Planning Practice and Research* 20(4), 391-407.
- Woodson, A. (1996) *How peoples behaviours change with effective sea turtle education: Perceptions and realities*. Unpublished Report for the Mon Repos Conservation Park, Cairns, Australia
- World Commission on Environment and Development/World Tourist and Travel Corporation/Earth Council (1995) *Agenda 21 for the travel and tourism industry: towards environmentally sustainable development*. Madrid
- World Wildlife Fund for Nature (WWF) (2009) Available at: http://www.panda.org/who_we_are/wwf_offices/malaysia/wwf_malaysia_conservation/projects/index.cfm?uProjectID=MY0207 [Accessed on 20 April 2009]

- Yin, R.K (1994) *Case Study Research, Design and Methods. Second Edition*. Applied Social Research Methods Series. Volume 5. Sage, Thousand Oaks.
- Zeppel, H. (2003) Sharing the Country: Ecotourism Policy and Indigenous Peoples in Australia. In *Ecotourism Policy and Planning* (D.A. Fennell and R.K. Dowling), pp. 55-76. CABI Publishing, Wallingford
- Zeppel, H. (2006) Indigenous ecotourism: Sustainable development and management . Wallingford, CABI, pp. 86-88.
- Zeppel, H. (2008) Education and conservation benefits of marine wildlife tours: developing free-choice learning experiences. *The Journal of Environmental Education*. 39(3), p. 3-17.
- Zeppel, H. and Muloin, S. (2008a) Aboriginal Interpretation in Australian Wildlife Tourism. *Journal of Ecotourism*. 7 (2&3), 116 – 136
- Zeppel, H. and Muloin, S. (2008b) Marine Wildlife Tours: Benefits for Participants. In *Marine Wildlife and Tourism Management: Insights from the Natural and Social Sciences* (eds. J. Higham and M. Luck), pp. 19-48. CABI, Wallingford
- Zeppel, H. and Muloin, S. (2008c) Conservation benefits of interpretation on marine wildlife tours. *Human Dimensions of Wildlife* 13, 280-294.
- Zeppel, H. (2009) National Parks as Cultural Landscapes: Indigenous Peoples, Conservation and Tourism. In: *Tourism and National Parks: International Perspectives on Development, Histories and Change* (eds. W. Frost and C.M. Hall). Taylor & Francis, UK.

Appendix 1 Training and Competency Assessment Protocol

Ningaloo Turtle Program

Volunteer Trainers' Guide

NINGALOO TURTLE PROGRAM – COMMUNITY MONITORING VOLUNTEER TRAINING

Methods and Procedures for Training Volunteers for Turtle Monitoring.

Induction and Occupational Health and Safety (OH & S) issues (to be conducted by Volunteer Coordinator/Team Leader or other designated person):

This includes watching a training video. Volunteers should have read Field Manual **before** training starts – although not expected to know it inside-out.

Learning the monitoring methods involves 3 ways:

1. **reading** manual prior to beach training
2. **watching** the training DVD and
3. **practical** field training with a competent trainer.

FIELD TRAINING

TRAINERS SHOULD:

1. Have the Rucksack for the relevant section of beach where training is to be conducted. The Rucksack should contain:
 - a) Folder for the particular section.
 - b) Trainer File with all relevant paperwork including this guide.
 - c) Name tag stickers & black texta
 - d) Monitoring kit containing disposable camera, tape measure, GPS, spare batteries, spare pencil & disposable gloves.
 - e) First Aid Kit
 - f) 2-way radio
2. Wear appropriate footwear & carry drinking water.
3. Carry a copy of the **Field Guide (FG)** for **all** training activities as a reference and have a good working knowledge of the layout and content of the **FG**.
4. Conduct a quick “Everyone introduce yourself” activity at the beach before starting the training. This helps to find out their names and gives an idea of the background of their trainees.
5. Put the trainees at ease – a lot get quite nervous about the training and the assessment.
6. Cater for people who don’t have a good command of English or whose written skills are lacking. Speak clearly and avoid getting impatient with them, however speaking very slowly and very loudly doesn’t help!
7. Give trainees time – don’t pressure them, but at the same time do not let the session run for too long.
8. Ensure that all trainees get involved during the training sessions – some will stay in the background and rely on others to answer questions. Getting them to take turns doing things and answering questions during the training session ensures everyone learns.
9. Explain that training usually involves 3 mornings, after which they can “shadow” competent volunteers for a few mornings, before being assessed. However if a trainee obviously grasps everything quickly or has had previous turtle experience, then the trainer can use their discretion to cut that particular volunteer’s training to 2 days.

10. Ensure each volunteer has filled out a DEC volunteer sheet and they have had an OH&S induction. If not, hand out the volunteer sheet for the relevant volunteers to fill out before starting training and give brief OH & S talk – mainly hat, sunscreen, drinking water/dehydration, suitable footwear, use of the 2-way radios if necessary.
11. Explain that the Competency Assessment is all practical field assessment, based on performance of all the procedures/methods they will have covered in training, with no written exams or tests. They will be able to experience a “dummy” assessment during the last day of training.
12. Emphasise there is no such thing as a failure and that sometimes there may not be enough tracks or nests of to able to award competency. In such a case each trainee will be given further opportunities, as soon as possible, to gain their competency.

Each TRAINEE volunteer should be given:

1. a clip-board with training data sheet and other sheets/reports that may need to be filled in;
2. have access to a kit, containing GPS, disposable camera, tape-measure, spare batteries, spare pencil & disposable gloves; and
3. a 2-way radio or if not enough to go around, have access to one.

IMPORTANT POINTS FOR TRAINERS

1. Making everyone feel comfortable before starting any training session is worth the effort. Lots of people feel nervous learning in a group situation, particularly the first session before getting to know anyone.

People’s brains go into “lock down/can’t learn” mode if they are really uncomfortable.

SOLUTION: Quick group intro – trainer first then each volunteer eg name, where from, why they are volunteering. Humour goes a long way to relaxing the group, but not every trainer will be comfortable with that.

2. Once the first session is underway, it is important that the trainer monitors the group dynamics – e.g .if they are all young Uni students and there is an “outsider” in their 60s. Between finding tracks, the trainer can walk with people they think are feeling uncomfortable find out more about them & get to know them better.
3. Important not to let ONE trainee volunteer dominate the group. Ensure everyone in the group has a turn. Use of the Trainer’s Checklist will ensure that every part of the training is covered and that everyone gets a turn at using the GPS, 2-way etc.

TRAINING PROCEDURES

Training/Knowledge Required	Explanations
Hierarchical classification of monitoring locations (Induction)	Explain the hierarchical division of the monitoring section of the coast – e.g. Ningaloo Region, NW Cape Division, Graveyards section, the Five Mile – Five Mile North sub-section (FG p 3 & 4) – REFER TO DIAGRAMS IN THE FIELD GUIDE
Monitoring kit	Go through the contents and emphasise the need for volunteers to report any missing/faulty equipment to the team leaders via communications log, which is in every clip-board for each section (FG p7)
Monitoring methods	Explain flow chart of monitoring methods (FG p 8 & 9)
Correct use of 2-way radios	<ul style="list-style-type: none"> • Demonstrate correct use of 2-way radios – CORRECT RADIO ETIQUETTE – not to be used for chit-chat . Use Channel 1 • Emphasise use of the transmit button – must be pressed to talk, not pressed to receive • Allow trainees to practice • EMPHASISE THE NEED TO HAVE RADIO ON AT ALL TIMES DURING MONITORING A SECTION OF BEACH.
Locating sub-section totem marker (FG p5)	<ul style="list-style-type: none"> • Locate & show volunteers the TOTEM MARKER FOR START OF and AT END OF start of training sub-section. • Show where to find GPS locations of start and end markers of the section on laminated sheet in folder. • Emphasise using GPS and the locations given for verification of end of section, when monitoring section new to the volunteer. • Start at imaginary line from totem to water –NB if heading north don't include tracks south of the line – if heading south don't include tracks north of this line
Filling in data sheet header	<ul style="list-style-type: none"> • Use pencil and block letters when filling out data sheet • Ensure all trainees fill in data sheet header – eg date, start time, start sub-section, recorder, GPS no & camera number • Explain that recorder's name should be first and last name, no nicknames or just first names (in case problem with data sheet and they have to be contacted) • Show how to get date & time from GPS if no watch
Locating high tide mark	<ul style="list-style-type: none"> • Ensure volunteers can locate high tide mark <p>(Signs are flattening of wet sand and the obvious flotsam line – wherever possible ask trainees to demonstrate/show you before telling them the signs)</p> <ul style="list-style-type: none"> • For monitoring ensure people walk just below this line.
Identifying emerge & return tracks	On encountering first track on a beach list the signs which indicate direction of track – eg which way sand pushed

	<ul style="list-style-type: none"> • FOR GREEN TURTLES: trace front flipper marks to centre to make an arrow in direction of travel and emphasise the tail mark is pushed into the sand pointing in the opposite direction of travel (actually putting your finger into some of the tail marks is a good idea!) Get the trainees to do the same. • FOR LOGGERHEAD AND HAWKSBILL TURTLES indicate the way the sand is pushed and draw the J shape of the back flipper marks – emphasise the top of the J points in direction of travel. <p>For all types of tracks It is advisable to get all the trainees to trace the arrows, and Js in the sand on a part of the track – this ensures they know the direction & understand what you are talking about, if they are INITIALLY a bit confused.</p>
<p>Identifying species by track</p>	<ul style="list-style-type: none"> • When the first track of the first training session (in Jurabi Coast Division this is often a green turtle track) ask if any trainee knows what it is – some have read the manual thoroughly – gives everyone a confidence boost if they get it right without being told! • Point out the distinguishing characteristics of tracks for each species, explain how the turtle moves(eg alternate or simultaneous flipper movement) and makes the track – demonstrating on the sand is effective (especially for visual learners). Also refer to diagrams in the FG (pages 13 – 16). <p>Greens:</p> <ul style="list-style-type: none"> • opposite flipper marks (front and back) • tail mark and • plastron drag <p>Loggerheads</p> <ul style="list-style-type: none"> • alternate pattern – with J shape • generally no tail mark <p>Hawksbills</p> <ul style="list-style-type: none"> • alternate pattern with J shape • squiggly tail mark <p>Draw lines that clearly show the opposite/alternate pattern on the track. Get all trainees to do the same on the track – this ensures they all know what you mean.</p> <ul style="list-style-type: none"> • Emphasis that hawksbills are a lot smaller and often have wiggly tail mark, plastron drag narrower • Mention size of track for the species (eg 95 – 144cm for greens, size overlap from 70-85 for hawksbills and loggerheads) FG p 11 or laminated sheet in folder

	<ul style="list-style-type: none"> • Encourage trainees to measure track when determining whether hawksbill or loggerhead, although reiterate that there is an overlap in size between the 2 species • When measuring tracks – go from outer edge to outer edge (FG p 11) – get out tape measure and demonstrate how to measure a track. <p style="text-align: center;">NB</p> <p style="text-align: center;">DON'T OVERLOAD THE TRAINEES WITH INFORMATION ABOUT ALL 3 TYPES OF TURTLETRACKS AT ONCE!</p> <p>Usually, along the Jurabi Coast, the first track will be a green and often the only type of track encountered in a training session. Trainees will become comfortable with this track and then can often spot the difference if/when loggerhead or hawksbill track located.</p> <ul style="list-style-type: none"> • When a track from a different species is located go through characteristics of that particular track.
Taking photos for identification	<ul style="list-style-type: none"> • Emphasise that every kit has a disposable camera for use when unsure of whether there is a nest or unsure of species' track – <p style="text-align: center;">HOWEVER WOULD EXPECT THAT COMPETENT TRACKERS WOULD ONLY TAKE A PHOTOGRAPH ON LIMITED OCCASIONS.</p> <ul style="list-style-type: none"> • Demonstrate how to photograph the track (FG p 17 & 18). • NB - if photo taken reiterate that photo number must be recorded on data sheet, in relevant column.
Determination of false crawls & nesting - characteristics and field signs	<ul style="list-style-type: none"> • Follow a track to determine whether false crawl or successful nest – emphasise OFTEN better to follow return track than emerge track. • If follow return track and find obvious body pit then regard as false crawl (RECORD ON DATA SHEET) – no need to check further along track as turtles don't tend to nest then make body pit afterwards. • If nest go through characteristics of nest – identify escarpment, sand misting over emerge track, sand mound fill-in over successful nest, damp & well aerated sand, primary body pit filled in, shallow secondary body pit, vegetation dug up • Correlate the different parts of the nest with the different phase of nesting – explaining: <ol style="list-style-type: none"> 1. how turtles dig the primary body pit, egg chamber, fill-in and 2. which flippers do what (eg front flippers body pit, back flippers egg chamber, both flippers fill-in, but back flippers doing the mounding. (Trainees find it much easier to understand nests when they have seen the complete nesting process.)

	<p>3. Point out the approximate location of the egg chamber – they need to imagine or see where the primary pit was dug and where the back of the turtle’s carapace would be positioned.</p> <ul style="list-style-type: none"> • False crawl – no sign of nest, may just be simple U-turn with no digging, or just body pits with lots of sand moved but no evidence of covering/filling in.
Tallying false crawls	<ul style="list-style-type: none"> • Demonstrate the tally method in the false crawls table – most people know but the occasional person has not used this method eg IIII = 5 • Throughout training session check trainees data sheets to ensure correct procedures for recording data are being followed.
Position of nest on beach	<ul style="list-style-type: none"> • Refer trainees to diagram on data sheet • Go through the different positions I, H, E and D <p>I = intertidal – from water’s edge to high tide mark H = between high tide mark and edge of vegetation E = between edge of vegetation and base of dune D = base of dune and beyond</p>
How to use GPS	<p>Should have been covered in Induction – if not then:</p> <ul style="list-style-type: none"> • Show how to: <ul style="list-style-type: none"> a) turn on and off (to power-off the button needs to be held down) b) determine when ready to use c) page (quit) from screens d) check battery level e) read time and date from GPS f) read latitude and longitude • When demonstrating make sure everyone is paying attention and can see the screen of a GPS. <p>If only 1 GPS, do a demo making sure everyone can see the screen and what buttons to press, then ensure every trainee uses the GPS during the training session.</p>
Recording data in Table B: Nests	<ul style="list-style-type: none"> • Record species type (G/L/H/U) • GPS the nest – turn GPS on and allow time to acquire satellites • Indicate where nest would be – get trainee to put GPS over nest location and wait for approximately 1 minute until the Lat & Long readouts stable • Get one trainee to read out coordinates – all trainees record lat & long coordinates of nest • Ask one trainee to read back coordinates to eliminate errors in

	<p>recording coordinates</p> <ul style="list-style-type: none"> • For every nest encountered – get every trainee to locate nest, place GPS on nest and call out coordinates • Ask the trainees to determine position of nest on beach – get them to write this on the data sheet – discuss the answers
Determination of nest damage & print identification	<ul style="list-style-type: none"> • Discuss difference between new nest & old nest • Record all the other data needed for each nest – check each trainee sheet to ensure recording data correctly • Tell trainees to look for prints within a 5 metre radius of the nest – if footprints found – identify the prints – use the laminated sheet
Correct marking of tracks & nest	<ul style="list-style-type: none"> • Emphasise the need to mark the both the emerge & return tracks - demonstrate how to mark the tracks – emphasise to mark track away from the high tide mark to avoid it getting washed away • During training ensure every trainee gets a turn at marking tracks well above the high tide mark • Demonstrate how to mark the nests and ensure each trainee gets a chance to mark a nest – DO NOT TRASH THE ESCARPMENT – JUST A LINE ACROSS THE NEST AT THE OPPOSITE END FROM THE EGG CHAMBER
Location of finishing totem marker & recording of finish time	<ul style="list-style-type: none"> • At then end of the training session find the finishing totem marker • Emphasise if monitoring on beach and cannot locate marker – use the GPS and coordinates given in the file to find marker or end of section • Record finish time on the data sheet
Marking of page numbers & totalling false crawls	<ul style="list-style-type: none"> • At end of section ensure trainees total the false crawl tallies • Emphasise the need write in correct page numbers eg P 1 of 1, or if 2 sheets used P 1 of 2 & P 2 of 2
Marine Turtle Rescue Report	<ul style="list-style-type: none"> • Go through “How to Determine a Stranded Turtle” flowchart to determine if turtle really needs to be rescues. • If there is a stranded turtle during training – use this as an opportunity to fill in Marine Turtle Rescue Report • If no stranded turtle encountered during training, show how to fill in the report – possibly Day 3 of training – can get all the trainees to fill in Rescue Report for a “mock” rescue • Important to stress that turtles resting on the reef flat or the beach, and which are obviously not stuck, are not regarded as stranded turtles! • If stranded turtles are freed – just let them make their own way the water – guiding them if necessary.

	DO NOT PUSH THEM ACROSS THE REEF FLAT TO THE WATER
Mortality report	<ul style="list-style-type: none"> • Go through the Stranding & Mortality Sheet – how to fill it in • During the training, if possible use live resting turtle to demonstrate how to measure carapace length, tail and head measurements (but not if it seems to disturb the turtle) – emphasise must use gloves if touching dead turtle • If cannot no turtle available as a model use diagrams on the mortality sheet to show where to take the measurements
Filling in communications log	<ul style="list-style-type: none"> • Emphasise the need to fill in the communications log if filled in mortality report, rescue report or have any else to communicate – eg no spare batteries in GPS, no ruler etc
Tagged turtle resighting report	<ul style="list-style-type: none"> • Indicate where tags are located – on rear edge of the 2 front flippers and some have more than 1 tag • Check turtles still on beach and on reef flat for tags and if tags found then record the relevant tag numbers on the Tagged Turtles Resighting Sheet • Emphasise the need to CORRECTLY IDENTIFY THE TURTLE – if unsure take photo or if monitoring with someone else get the other person to identify the turtle if possible – ALWAYS USE THE KEY
Turtle & Hatchling identification	<ul style="list-style-type: none"> • Go through the KEY FOR TURTLE IDENTIFICATION – wherever possible use a resting turtle on the beach as a model - obviously only if it can be done without disturbing the turtle! • Point out the costal scales (don't call them scutes) – 5 pairs for loggerheads and 4 pairs for greens, hawksbills & flatbacks. • If 4 pairs evident – size is a big factor between greens and hawksbills, but also difference in the pre-frontal scales (Greens 1 pair, Hawksbills 2 pairs) – also hawksbill has obvious “beak”. • Hawksbills have overlapping scales – Greens don't. • Difference between greens and flatbacks – dome of the carapace and flatbacks have a pair of pre-ocular scales but Greens don't. <p>• For identification of hatchlings – refer to photos of hatchlings in monitoring folders.</p> <p>Point out distinguishing features:</p>

	<p>Loggerhead hatchlings: 3 distinct ridges on back & 5 pairs costal scales</p> <p>Green hatchlings: distinct white edging on flippers and carapace, 4 pairs of costal scales.</p> <p>Hawksbill hatchlings: 4 pairs of costal scales and unlike greens no white edgings</p> <p>Use the photos in the FG to emphasise the differences.</p>
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BEACH MONITORING VOLUNTEER ASSESSMENT

The assessment is used to determine the trainee volunteer's ability to use the Beach Monitoring Method as accurately as possible. The assessment ensures the trainee volunteer can correctly fill in the data sheet, identify turtle species according to beach tracks, identify false crawls or successful nesting and all the other procedures which are part of the beach monitoring method. Trainee volunteers need to be able to correctly use a GPS to determine and record the location of successful nests. They also need to be able to identify any turtles which have tags and identify hatchlings which might be seen.

METHOD FOR ASSESSMENT

1. The assessor should use the **Volunteer Competency Assessment Sheet** to record the competencies of the trainee volunteers. Refer to the Appendix 1: Example Assessment Sheet. Only 1 assessment sheet is required for each group being assessed.
2. Each volunteer should have a copy of the **Volunteer Competency Assessment Answer Sheet** (refer to Appendix 2: Example Volunteer Competency Assessment Answer Sheet). This allows the trainer to assess all the volunteers for each track encountered, allowing for a more efficient the assessment session, which takes up less time. The volunteers record their answers on the answer sheet, which is shown to the assessor, who marks ✓ or X for each of the categories listed on the Volunteer's for each track encountered. The assessor should record the results on the assessment sheet as the assessment session progresses.
3. When volunteers are being assessed using this method, it is essential that the assessor tells the group that each person is to work individually and that there should be no collaboration in deducing the type of track and whether there is a nest or false crawl.
4. For each nest encountered, the assessor should ensure that every volunteer being assessed has a turn at determining using a GPS to record the approximate location of the nest.
5. For turtle identification, an assessor could use a resting turtle for students to identify, providing the turtle is comfortable with having people looking t it.

The group should approach from behind to look at the turtle. The trainee volunteers would determine the species and write on their answers of the back of their answer sheet, along with the determining characteristics. If not turtles are encountered during the assessment session or an encountered turtle is too "flighty", the assessor can ask the trainees to write the distinguishing characteristics of the 3 species of turtle encountered along the Jurabi Coast.

6. It is not necessary for a trainee volunteer to get absolutely everything right to gain Competency. See Appendix 1: Example Assessment Sheet for 3 hypothetical trainees.

J Bloggs attained did not get anything wrong so is classed as Competent.

B Simpson made a few mistakes made a few more mistakes than J Bloggs but still demonstrated a level that overall would be deemed Competent.

F Bat would definitely not be deemed competent – even a 50% nest accuracy would be too low.

Appendix 1: Beach Monitoring Volunteer Competency Assessment Sheet

Date:

Assessor Name:

Volunteer Name	Arrives on time	Fills in data sheet header correctly	Correctly identifies emerging and returning tracks	Identifies turtle species from tracks	Determines successful nesting & identifies the different parts of the nest	Correctly identifies false crawls	Identifies nest location on beach I/H/E/D	Identifies disturbance and tracks	Data sheet completed and filled in correctly	Correctly uses GPS	Correctly marks tracks & nests	Correctly identifies turtle species/ knows the features	Final Assessment & Comment
J Bloggs	✓	✓	✓✓✓✓✓	G ✓✓✓ L ✓✓✓ H ✓	X✓✓✓✓✓✓ ✓	✓✓✓✓	✓✓✓✓	✓	✓	✓✓	✓✓	✓✓	C
B Simpson	✓	✓	X✓✓✓✓	X✓✓ ✓✓ ✓✓ ✓✓	XX✓✓✓✓✓✓ ✓	✓✓✓✓	✓✓✓✓	✓	✓	✓✓	✓✓	✓✓	C
F Bat	X	X	XX✓	X✓ X✓ X✓ ✓✓	XXXXXX✓✓ ✓	X✓✓	X✓✓✓	X	✓	✓✓	✓✓	X✓	FA or NFT

C = Competent FA = Further Assessment NFT = Needs further training

Assessor Signature:

Appendix 3: Turtle Identification Sheet

Type of Turtle	Distinguishing Characteristics

Appendix 2 Tourist Questionnaire

Tourist Questionnaire



The purpose of this questionnaire is to better understand the needs of visitor's to this region. By completing this questionnaire, you can provide valuable information that will contribute to the conservation of marine turtles

Thankyou for your participation

1 Are you a local to the Ningaloo Region or are you a visitor to the region?

(Please tick appropriate box)

- Local Go to 6
 Visitor Go to 2

2 Where are you staying in Exmouth? (please tick)

- a) Hotel
 b) Backpackers
 c) Resident's house
 d) Camping in Cape Range N.P.
 e) Caravan Park in Exmouth
 f) Caravan Park on west coast
 g) Other (please specify) _____

3 What kind of visit is this for you? (please tick)

- a) Recreation/holidays
 b) Business
 c) Combined recreation and business
 d) Research, education/school visit
 e) Other (please specify) _____

4 How important were the following features in your decision to visit the Ningaloo Region?

(Please circle the appropriate number in each row)

	Not at all important	Not very important	Somewhat important	Very important	Extremely important
Visit the Cape Range National Park	1	2	3	4	5
Go diving or snorkeling	1	2	3	4	5
See marine turtles nesting	1	2	3	4	5
See marine turtles hatching	1	2	3	4	5
Go bush walking	1	2	3	4	5
See whale sharks	1	2	3	4	5
Get away from the city	1	2	3	4	5
Cruising on a boat	1	2	3	4	5
Go fishing	1	2	3	4	5
Go four wheel driving	1	2	3	4	5

5 How long do you plan to stay in the Ningaloo Region on this visit?

Days _____

6 What influenced you to participate in viewing turtle nesting?
(please tick one or more box)

- a) Previous visit
- b) Friends/relatives
- c) Advertisements/tourist brochures
- d) Tour guide
- e) Tourist Bureau/travel agent
- f) Beach signs
- g) Documentary
- h) Other (please specify) _____

7 How many times have you been turtle-watching before?

- a) First time
- b) Once before
- c) Twice before
- d) Three times or more

If you have, please specify the location of previous turtle watching

8 Have you seen any turtles tonight? (please tick a box)

- Yes
- No

9 If yes, please enter the number of turtles seen at each phase

- a) Emerging
- b) Digging body pit
- c) Digging egg chamber
- d) Laying eggs
- e) Covering
- f) Camouflaging nest
- g) Returning to the sea
- h) Hatching

10 Did you expect to see a turtle tonight?

- Yes
- No

11 Were you informed about how to minimise disturbance to turtles on the beach?

- Yes
- No (go to Question14)

12 If yes, how were you informed (please tick)

- a) Tour guide
- b) Beach signs
- c) CALM pamphlet
- d) Milyering Visitor Centre
- e) Exmouth Tourist Bureau
- f) Other _____

13 Please list the activities you should not do when turtle-watching

- 1 _____
- 2 _____
- 3 _____
- 4 _____

14 How would you rate your turtle watching experience overall? (please circle)

Very poor 1...2...3...4...5...6...7...8...9...10 Excellent

15 How satisfied were you with the following statements of the turtle experience at this site. Please circle the appropriate number in each row.

	Very unsatisfied	Unsatisfied	Neither/nor satisfied	Satisfied	Very satisfied
The number of turtles that I saw	1	2	3	4	5
How close I could get to the turtles	1	2	3	4	5
The guidelines that I had to follow	1	2	3	4	5
The number of people on the beach	1	2	3	4	5
Opportunities learn new information	1	2	3	4	5
The facilities available for visitors	1	2	3	4	5

16 Would you recommend a trip to Exmouth to friends/family?

Yes
No

17 Would you recommend turtle-watching in Exmouth to friends/family?

Yes
No

18 Are you participating in a turtle nesting tour?

Yes
No Go to Question 20

Name of tour operator _____

If yes, could you please tell us how satisfied you were with the following features of your visit?
19 Please circle the number that best describes how you feel.

	Not at all satisfied	Somewhat satisfied	Very satisfied	Extremely satisfied	No opinion
Value for money	1	2	3	4	5
Staff friendliness	1	2	3	4	5
Staff knowledge	1	2	3	4	5
Amount of information	1	2	3	4	5
Quality of information	1	2	3	4	5

Below are some statements about how your turtle nesting experience can be improved. I would like to know how strongly you agree with each of these statements.
20 Please circle the number of your choice for each row.

	Strongly disagree	Disagree	Neither/nor disagree	Agree	Strongly agree
I believe that there is sufficient information	1	2	3	4	5
I would prefer to have an interpreter	1	2	3	4	5
I believe there should be more signs	1	2	3	4	5
I believe there are too many people on the beach	1	2	3	4	5
I think that the turtles are well managed	1	2	3	4	5
I believe the code of conduct is useful	1	2	3	4	5

Appendix 3 Turtle Interaction Survey

TURTLE INTERACTION SURVEY



Date: _____
 Name of Beach: _____
 Surveyor name(s): _____
 Survey Time _____
 Start: _____
 Finish: _____



Total number of vehicles: _____

Questionnaire Reference Number:

--	--	--	--	--	--	--	--	--	--

Number of people

Adults									
Children									

Length of stay

Arrival									
Departure									

Torch Use (tick)

No use									
Some use									
Constant									

Contact with turtle

Yes									
No									

Tick those codes of conduct that are not been followed

1. Not walking along high tide									
2. Noise									
3. Shining torch on turtle before she lays									
4. Sudden movements									
5. Not staying behind turtle									
6. Closer than 3m from turtle									
7. Flash photography									
8. Touching									
9. Disturbance whilst covering nest									
10. Disturbance whilst returning									

Disturbance indicators/corresponding code

1. Turning back to the ocean									
2. Redirection of crawl									
3. Crawling faster									
4. Aborting body pit									
5. Aborting egg chamber									
6. Aborting laying									

Additional comments:

**Appendix 4 Conceptual Monitoring Program for sustainable turtle tourism in the
Ningaloo region**

¹ This is a proposed figure and is subject to further consultation with the stakeholders

² This is a proposed figure that was generated from the TOMM at Kangaroo Island (Manidis Roberts Consultants 1997) and is subject to further consultation.

Optimal conditions	Indicator	Acceptable Range	Monitoring method	Details of monitoring
1. Environmental				
1.1 Nesting processes are maintained in areas where tourism activity occurs	The proportion of turtles disturbed by tourist activities	0 to 10% of turtles encountered ¹	Interaction Surveys	Volunteers on the beaches at night record disturbances.
1.2 The nesting success of marine turtles is maintained at popular turtle-viewing beaches	Compare the nesting success of marine turtles at beaches where tourists are present and at a number of control sites	No significant difference between beaches with human presence and control sites	Turtle Track Surveys	Annual monitoring of false and successful crawls.
2. Social and Cultural				
2.1 Residents participate in marine turtle conservation and marine turtle tourism	Number of residents actively involved in marine turtles conservation and marine turtle tourism	At least 20 people	Annual Report	Keep records of the number of local volunteers and local contributing to the NTP
2.2 Provide opportunities for indigenous people to participate in marine turtle conservation and marine turtle tourism	Number of indigenous people actively involved in marine turtles conservation and marine turtle tourism	At least 5 people	Annual Report	Keep records of the number of indigenous people involved in the NTP
2.3 Provide opportunities for students to participate in field work and other research	Number of students actively involved in marine turtle conservation and marine turtle tourism	At least 20 students	Annual Report	Keep records of the number of student volunteers involved in the NTP
2.4 Residents feel comfortable that tourism contributes to a peaceful, secure and attractive lifestyle	Proportion of the community who perceive positive benefits from their interaction with tourist	70 to 100% of residents ²	Resident survey	Ask residents whether they have issues with tourists in the Ningaloo region
3. Tourism Development				
3.1 Commercial operating guides are accredited for conducting turtle tours	Guides conducting marine turtle tours are accredited	All guides are accredited ¹	Annual Operator Report	DEC is responsible for distributing and assessing the Operator Report/ TAFE records
3.2 All turtle interaction tour operators have licences	Number of operators conducting turtle tours without a license	none ¹	Interaction survey	DEC is responsible for ensuring that no unauthorised activity is occurring

Optimal conditions	Indicator	Acceptable Range	Monitoring method	Details of monitoring
3.3 The majority of independent turtle-viewers watch turtles in designated visitor service locations	The proportion of visitors seeking to watch marine turtles visit the Jurabi Turtle Centre	At least 80% of visitors seeking marine turtles ¹	Interaction survey	Divide the number of people at the JTC with the total number of people visiting the beaches at night
3.4 The majority of visitors have a highly satisfying experience	Proportion of visitors who were very satisfied with their experience	At least 90% of respondents	Tourist questionnaire	Administered at the JTC. Refer to questions 14-17 in tourist questionnaire (Appendix 2)
3.5 There is integration of business and regional, state and national tourism marketing programs for the Ningaloo region	Number of co-operative marketing campaigns such as joint brochures and advertisements	At Least 50% of operators ²	Annual Operator Report	Estimate the average number of co-operative marketing campaigns. Administered by the WATC
3.6 The majority of turtle interaction tour operators are owned by residents of the Ningaloo region	The proportion of local businesses acquiring annual turtle interaction licenses	At least 80% of operators are local ¹	Annual Operator Report	Demographic information on licenses. DEC licensing information
4. Economic				
4.1 The majority of visitors to the Ningaloo region stay an extra night to see turtles	Number of extra nights to specifically see turtles	At least one night ¹	Tourist questionnaire	Administered at the JTC. Refer to question 5 in tourist questionnaire (Appendix 2)
4.2 The growth of the turtle-based tourism industry is maintained at a sustainable level	Annual growth in the visitation of independent turtle viewers to the North West Cape	3 % average growth for the next 5 years ²	Interaction Survey	Count the total number of visitors to the North West Cape
	Annual growth of visitors participating in commercial tours	3 % average growth for the next 5 years ²	Annual Operator Report	Count the total number of visitors participating in commercial tours
4.3 The turtle-based tourism industry contributes to the growth of tourism yield	Expenditure of visitors participating in marine turtle tourism related activities	At least 3 % of the total expenditure of tourism in the region ²	Tourist questionnaire	Expenditure question which estimates how much money marine turtle tourism contributes to the tourism industry (see Wilson & Tisdell, 2003)
4.4 The funds extracted from the JTC should be appropriately distributed.	Annual financial statement including proportions of money that were allocated to maintenance, operation and research	Annual JTC Report	Annual Report	CALM and/or the Shire of Exmouth to analyse data and create Report
4.5 The marine turtle tourism industry provides employment opportunities for local residents	Annual number of job opportunities for local residents related to marine turtle tourism	At least 5 local residents employed	Annual Report	DEC to administer survey and collate details

Optimal conditions	Indicator	Acceptable Range	Monitoring method	Details of monitoring
5. Planning process				
5.1 Integrating all stakeholders in the decision-making process	Number of stakeholders attending workshops	At least one representative from each interest group is present	Annual Report	Attendance at workshops is reported in the Annual Report
5.2 The growth of the marine turtle tourism industry is regulated by the level of impact on environmental and social factors	Proportion of indicators within their acceptable range	80% within the acceptable range	Annual report	Summarise the number of indicators within their acceptable range
5.3 NTAG continues to conduct annual workshops	Stakeholder workshops are held annually on set dates	Annual workshops conducted	Annual Report	Summarise the outcomes of the workshop
5.4 The monitoring programme continues to measure indicators	Number of indicators measured as part of the monitoring programme	All indicators are measured	Annual Report	Summarise the proportion of indicators measured and reasons why indicators were not measured

**Appendix 5 Indicative Management Response for turtle tourism in the Ningaloo
region**

Indicator	Result from 2002/03	Within acceptable range (AR)	Discrepancy from AR	Trend	Cause/effect	Response	Response options
1. Environmental							
1.1 The proportion of turtles disturbed by tourist activities	13% of disturbance from tourist activity	NO	3%		Limited guidance on the beaches at night	DEC and WATC response	Place volunteers at the proposed JTC to provide guidance to independent travellers at night
							Implement amended code of conduct at nesting beaches
							Develop a strategy for guiding tourists on the beaches
1.2 Compare the nesting success of green turtles at high-use areas and control sites	Low nesting success at high-use areas	NO	Significant difference between sites and controls for green turtles	High-use areas continue have a low nesting success	Visitors roaming the beaches with no control or guidance	NTP	Use certified tour guides to control the visitor groups
2. Social and Cultural							
2.1 Number of local residents actively involved in monitoring marine turtles	20 local residents	YES					No response required
2.2 Number of indigenous people actively involved in marine turtles conservation and marine turtle tourism	Three inactive members	NO	10 indigenous people	Increasing interest	Lack of incentives for the involvement indigenous people in the local area	NTP (in particular the Biayungu Corp)	Provide more opportunities for indigenous involvement through the development of relationships and respecting the cultural significance of marine turtles in the Aboriginal community
2.3 Number of students actively involved in marine turtle conservation and marine turtle tourism	30 students	YES					No response required

Indicator	Result from 2002/03	Within acceptable range (AR)	Discrepancy from AR	Trend	Cause/effect	Response	Response options
2.4 Proportion of the community who perceive positive benefits from their interaction with tourist	UNKNOWN						Conduct resident survey in 2003/04
3. Tourism Development							
3.1 Guides conducting marine turtle tours are accredited	Zero	NO	No certified guides	None	No certified course	DEC and WATC response	Develop a course that teaches best practise turtle tours and quality of service
3.2 Number of operators conducting turtle tours without a license	One operator conducted tours without a license (from Perth)	NO	one	Growing interest in turtle-based tourism	State issue, tourism related	DEC and WATC response	Investigate management tools: (1) Education & interpretation; and (2) Prosecuted illegal tours
3.3 The proportion of visitors seeking to watch marine turtles visit the JTC	31% of independent turtle-viewers visited the JTC site	NO	59% percent	Current turtle-viewing is not focuses at the JTC	Tourism related	DEC and WATC response	Promote the Jurabi Turtle Centre
							Closure of the car parks at other popular nesting sites
3.4 Proportion of visitors who were very satisfied with their experience	56% ranked their overall experience more than average	NO	34% of visitors	Consistent with 2001-02 season	Low proportion of encounters	NTP	Development of a guiding system which increases the number of encounters and opportunities to view the egg laying phase
3.5 Number of co-operative marketing campaigns such as joint brochures and advertisements	one	NO	Four operators	Same as previous years	Tourism related	WATC	Promote co-operative marketing between operators and other tourism related enterprises
3.6 The proportion of local businesses acquiring annual turtle interaction licenses	100% of licenses were issued to local tour operators	YES					No response required
4. Economics							

Indicator	Result from 2002/03	Within acceptable range (AR)	Discrepancy from AR	Trend	Cause/effect	Response	Response options
4.1 Number of extra nights to specifically see turtles	UNKNOWN				Tourism related	NCMP	Insert a series of question in the Visitor Questionnaire about whether visitors stayed extra nights to view turtles and whether turtle-viewing is a secondary activity
4.2 Annual growth in the visitation of independent turtle viewers to the Jurabi Coastal Park	12.5% increase in visitation	NO	9.50%	Increased growth of independent turtle-viewers	Tourism related	NTP	Regulate the number of independent turtle-viewers through the JTC. This may involve restricting the number of visitors per night using a ticket system similarity used at the Mon Repos.
4.3 Annual growth of visitors participating in commercial tours	UNKNOWN				Tourism related	DEC	Collect and analyse data from the Annual Operator Report
4.4 Expenditure of visitors participating in marine turtle tourism related activities	UNKNOWN				Tourism related	NCMP	Insert a series of questions in the Visitor Questionnaire
4.5 Annual financial statement including proportions of money that were allocated to the maintenance of the JTC, operations and research.	UNKNOWN				Tourism related	JTC Advisory Committee	Include a section of the Annual JTC Report for the itemisation of financial contributions and accumulated donations
4.6 Annual number of job opportunities for local residents related to marine turtle tourism	One programme manager, 3 turtle guides and various contributions from CALM, Exmouth Shire, CCG, WWF and Murdoch University.	YES					No response required
5. Planning							

Indicator	Result from 2002/03	Within acceptable range (AR)	Discrepancy from AR	Trend	Cause/effect	Response	Response options
5.1 Number of stakeholders attending workshops	No attendance by two representatives at meetings	NO	Two	The same two representatives continue to miss meetings	Remote area; distance between stakeholder and workshop location	NTP	Give plenty of notice of the location and time to representatives and vary the location to accommodation transport issues
5.2 The majority of indicators are within the acceptable range	4 YES; 11 NO (27% are within the acceptable range); 7 Unknown	NO	53%	Slight increase in the percentage of indicators falling within acceptable ranges	Model development	NTP	Implement management responses where the indicators fall outside the acceptable range.
5.3 Stakeholder workshops are held annually on set dates	YES						No response required
5.4 Number of indicators measured as part of the monitoring programme	16/25 indicators were measured	NO	9 indicators	None of these indicators have been measured before	Lack of funds and resources to undertake surveys	NTP and DEC	Gather funds to survey kangaroo road-kills, amend visitor questionnaire to include questions relating to visitor expenditure (see Wilson and Tisdell (2001) for examples)

