TOURISM DESTINATION MODELLING

Building a sustainable planning tool for Australian tourism destinations

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SUSTAINABLE TOURISM CRC

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National Library of Australia Cataloguing-in-Publication Entry

Title: Tourism destination modelling : building a sustainable planning tool for Australian tourism destinations / Tod Jones ... [et al.]

ISBNs: 9781921658495 (pbk.) 9781921658990 (pdf).

Subjects: Tourism--Economic aspects--Australia. Tourism--Australia--Planning

Other Authors/Contributors: Jones, Tod. CRC for Sustainable Tourism.

Dewey Number: 338.479194

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First published in Australia in 2010 by CRC for Sustainable Tourism Pty Ltd

Cover images courtesy of Tourism Australia, Tourism WA (Margaret River), Tourism NT and SATC

Printed in Australia (Gold Coast, Queensland)

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List of Acronyms and Terms

ABS	Australian Bureau of Statistics
AIMS	Australian Institute of Marine Science
CSIRO	Commonwealth Science and Industry Research Organisation
DEC	Western Australian Department of Environment and Conservation
DPI	Western Australian Department of Planning and Infrastructure (now Department of Planning)
EC3 Global	STCRC's subsidiary commercialisation and consulting company for the development and delivery of commercial research outcomes to industry
EwE	Ecopath with Ecosim is ecological modelling software
NCC	Ningaloo Collaboration Cluster (part of the CSIRO's Wealth from Oceans Flagship)
Regional Strategy	Ningaloo Coast Regional Strategy
NDM	Ningaloo Destination Model (also referred to as *the model* in this report)
NSDO	Ningaloo Sustainable Development Office
STCRC	Sustainable Tourism Cooperative Research Centre
TERM	The Enormous Regional Model (an economic model of Australia that breaks down to local government areas)
TRA	Tourism Research Australia
TWA	Tourism Western Australia
Vensim	Modelling software used to create the Ningaloo Destination Model
WAMSI	Western Australia Marine Science Institute
WAPC	Western Australia Planning Commission
WfO	Wealth from Oceans Flagship (in the CSIRO)

Abstract

The Ningaloo Destination Model is a tourism planning tool for the Ningaloo Coast region of Western Australia that assesses the economic, social and environmental impacts of different planning decisions and events. This report describes the features of the tourism destination model, and analyses its application in the region and to other parts of Australia. Destination modelling integrates a number of research methodologies developed through past STCRC projects (on visitor spending and characteristics, social impacts and economic impacts), secondary data and ecological research. The key to this process is a model development technique that uses scenario planning methodologies to facilitate stakeholder engagement and conceptual modelling techniques to facilitate research integration. The report describes the methodologies used for model development and for data collection, provides two case studies demonstrating outputs, and explores applications of the Ningaloo Destination Model to the region, to other locations and to other sectors.

Visit http://cstc.curtin.edu.au/ningaloo/ningaloo.swf to view the interactive application of the model.

The Ningaloo Destination Model provides estimates of the impacts of plans and events related to tourism in four dimensions: tourism specific; economy; social; and environmental (both resource use and ecological). These outputs are explored through two case studies: a nodal coastal development; and a large resort development. The model can be used for four broad (oftentimes overlapping) categories of assessment: operational planning and decision making for specific organisations and groups (such as local government or agencies that manage land or sea use), regional planning, participatory planning and collaborations and to assist monitoring and evaluation. The Ningaloo Destination Model will be available to the general public (in a limited format) through websites; to agencies through a desktop version; and through integration into a larger model of the region being developed by the CSIRO.

Destination modelling is relevant for other tourism destinations and a process for the rapid and cost-effective application of destination modelling is feasible. While much of the data is available, a broader roll-out would require benchmarking of water, electricity and waste data, and developing a wireframe for all tourism destinations. Making destination modelling tools broadly available would significantly broaden the impacts

considered in tourism planning and lead to enhancement of desirable effects of tourism development, and early mitigation of negative impacts across Australia. The techniques developed for destination modelling were also found to be applicable to other sectors.

Acknowledgements

We acknowledge the generosity of the many groups and organisations that donated their information and time to the project. These include the Shires of Exmouth and Carnarvon, the WA Department of Environment and Conservation, in particular the Exmouth Office, Tourism WA, Tourism Australia, the Water Corporation and Horizon Power, the Visitor Centres for Exmouth and Carnarvon, the accommodation providers in the region and the station owners for access to the tourists staying on their properties. Special thanks go to Ronnie Fleah, and Rogé Kempe from the Shire of Exmouth, Jennie Cary, Roland Mau, Ray De Jong and Kelly Waples from DEC, David Nunn, David Temple-Smith and Colleen Henry who were working in the Ningaloo Sustainable Development Office, and Alison Mills and Graham Wilks from the Shire of Carnarvon. EC3 Global also provided us with data on the resource use of different accommodation types, which was a valuable check on our data.

We also acknowledge the hard work of many researchers, including Paul Walker, Karin Schianetz, Jean-Paul Orsini, Lindsay Collins, Zac Whitely, and Geoff West. The CSIRO and STCRC have both played an active part in the research process, particularly through our collaborations with the marvellous Beth Fulton, Jeff Dambacher and David Simmons.

Students played an important role in this research with Curtin multimedia design students under the supervision of Gonnie Bruekers and later with Geoff West providing visualisations of the modelling results. Tania Morris, Jonathon Mann and Andy Jelinek made special contributions to this project. In particular, we acknowledge the hard work of our PhD students Philippa Chandler, Anna Lewis and Kelly Chapman whose own research substantially enhanced both the tourism modelling and our engagement in the region.

SUMMARY

The Ningaloo Destination Model is a dynamic model of the Ningaloo Coast that incorporates the socio-economic, load and ecological impacts of tourism that is relevant to, and trusted by, a broad range of stakeholder groups. It integrates a number of methodologies developed through STCRC research projects to assess tourism characteristics and expenditure (Carlsen & Wood, 2004), social impacts (Fredline, 2002; Fredline, Deery, & Jago, 2006), and makes use of tourism economics expertise that has formed through STCRC research (Dwyer, Forsyth, Spurr & Ho, 2005). It also integrates data from other bodies, including EC3 Global, Horizon Power and the Water Corporation to provide projections of resource use. It links the tourism impacts calculated through these methods and data sources to the ecology of the region, which has been the focus of a research investment of over $30 million by the state and federal governments and research institutions. Most importantly, the model organises the data to answer important management and planning questions.

Visit http://cstc.curtin.edu.au/ningaloo/ningaloo.swf to view the interactive application of the model.

The Ningaloo Destination Modelling project was co-funded by STCRC and the CSIRO's Wealth from Oceans Flagship. It was one of five projects in the CSIRO's Ningaloo Collaboration Cluster, and was the only project to collect primary socio-economic data. While much of the research on the Ningaloo Coast has focused on marine ecology and on human interaction with the marine environment, the Ningaloo Destination Modelling project has focused on developments on the land including economic and social impacts, and their subsequent links to the marine ecology. Its primary deliverable is a scenario planning tool that estimates the social, economic and environmental impacts of plans, management decisions and events. This report describes the methodology, the features of the scenario planning tool, and explores the application of destination modelling to other locations and sectors.

Objectives of Study

The objective of the research was: **to develop a dynamic model of Ningaloo incorporating socio-economic, and load implications of tourism that can be integrated with an ecological model of the region**.

Achieving this objective required extensive work at the beginning and across the project to engage stakeholders in order to ensure that the model was relevant to businesses, managers and communities and had sufficient trust to be considered for ongoing use. Researcher engagement was required in order to bring in the necessary expertise to ensure that the model was accurately capturing how tourism operates in the region. We also address another objective in this report, which is central to the broader relevance of the model to tourism in Australia and in other sectors—the application of the model building process to other regions and sectors.

Outline of this Report

The chapter structure of this report addresses the elements of the research objective.

- Chapter 2 describes the modelling approach and methodology, including the data used to power the Model;
- Chapter 3 analyses the processes of engagement with stakeholders and researchers, the outcomes of these processes and how they contributed to the development of the Ningaloo Destination Model.
- Chapter 4 describes the economic, social and environmental outputs from the destination model with an example comparing the Ningaloo Coast Regional Strategy to a theoretical large resort development.
- Chapter 5 assesses the applications of the model to tourism planning and decision making, and the data and resource requirements of applying the model to other regions in Australia and to other sectors.

Methodology

The methodology for developing the Ningaloo Destination Model addresses two areas: the process of model development and the methods for collecting the data that populates the Model.

Model Development

Drawing from van den Belt's modelling methodology (2004), the process of model development followed five broad, overlapping stages:

- stakeholder assessment
- stakeholder modelling workshops—scenario development
- formal and informal meetings and communications with stakeholders
- data collection and dissemination
- model development .

Engagement and Collaboration with Stakeholders

The first three stages address engagement and collaboration with stakeholders. Stakeholders need to be engaged in model development to ensure that the model is relevant to them, and to build trust in the model so that they will use it and trust the results it produces. The first step in the process was an assessment of stakeholders' interests and their capacity to participate in the modelling process. The stakeholder assessment fed into a series of modelling workshops with a diverse stakeholder group that drew on scenario planning methodologies to develop four scenarios for the future of tourism in the region. The scenarios were used in workshops by stakeholders to comment on and assess model development across the course of the project. The process of continued stakeholder involvement throughout model development was achieved using a number of initiatives. Four rounds of workshops were held in all three towns and in Perth where the scenarios were further refined and early prototypes of the model demonstrated, commented on and results discussed. There was also an ongoing process of individual meetings with tourism industry members, government agency representatives, local groups, and interested tourists and community members that facilitated input into the Model.

Model Development

Model development consisted of two key steps: the development of conceptual diagrams; and the process of transforming the diagrams into a model through quantifying the relationships between variables. In an interdisciplinary project, communication between researchers and research integration can be challenging. Conceptual models of different parts of the tourism system provided a language for ensuring that all of the important aspects of the tourism system were being captured. It also gave people from a wide variety of groups the opportunity to articulate their understanding of the tourism system through diagrams. Nine conceptual models were developed in the workshops, which were refined to seven. Links were identified between the seven conceptual models. Together, they constituted a complete conceptual model of the tourism system for the Ningaloo Coast (see Figure 4 for a representation of the links between the seven conceptual models).

The second step was putting data behind the conceptual diagrams. This involved refinement of the conceptual diagrams to identify the key feedback loops. The model needs to capture the system dynamics while remaining as simple as possible. The more complex the Model, the harder it is to capture and understand its behaviour. While data were collected to address the four scenarios, it was also necessary to recognise where the model could be improved with additional data. Inputs also required the assessment of currently available plans for the region in order to address the uncertainties around future development. Model development included model testing through sensitivity analysis and validation using historical data. Modelling results were also discussed with members of the tourism industry and agency managers. Modelling results were presented in the region and in Perth every six months and the results of the workshops informed model refinement. The four scenarios were used throughout the process of model development to ensure that the Ningaloo Destination Model addressed the most relevant questions for the region.

Data Collection

High quality data are crucial to the accuracy of the Model. Following a methodology developed through past STCRC projects (Carlsen & Wood, 2004; Wood et al., 2006), visitor surveys were distributed in the region between July 2007 and September 2008, resulting in a dataset of 1574 surveys, and a response rate of 50.8 percent. Using another methodology developed through STCRC research (Fredline, 2002), three resident communities on the Ningaloo Coast—Exmouth, Coral Bay and Carnarvon—were surveyed to ascertain perceptions of local residents regarding the impact of tourism on their quality of life using face to face administration (Exmouth and Coral Bay) and telephone interviews (Carnarvon). There were 287 completed questionnaires collected with 122 coming from Exmouth, 26 from Coral Bay, and 139 from Carnarvon. The survey data were analysed separately for each location.

Utilising expertise within the STCRC's Centre for Economic Policy, expenditure data from the visitor surveys was used in conjunction with The Enormous Regional Model (TERM), information from the Western Australian Tourism Satellite Account, Australian Bureau of Statistics data, and the database of the Monash Multi-Regional Forecasting (MMRF) model to develop more meaningful economic outputs. These are Tourism Value Added, and Tourism Gross Regional Product. Other data were collected from existing data sources. This included data on tourists from Tourism Research Australia and the Australian Bureau of Statistics, and information on resource use from Horizon Power, the Water Corporation and waste generation from the Gascoyne Development Commission.

There has been a massive investment in marine ecology data in the region from the Western Australian Marine Science Institute (WAMSI) and the Australian Institute of Marine Science (AIMS), along with Australian Universities. This data has been integrated in an ecological model of the region developed by Beth Fulton from the CSIRO's Marine and Atmospheric Research Division using Ecopath software, which has been integrated with the Ningaloo Destination Model, allowing for the calculation of a broad range of ecological impacts.

Key Findings

Techniques for Destination Model Development

The Ningaloo Destination Modelling project has identified techniques that have successfully engaged a variety of different groups, integrated a wide variety of data types and utilised an interdisciplinary research team. The series of workshops that began with a scenario-setting workshop proved successful at introducing a variety of groups to the project and encouraging their involvement. The workshop outcomes (four scenarios that captured the concerns and goals of a variety of stakeholders) provided an important focus for model development and a means of ensuring the relevance of the finished model. The modelling process, in particular through the use of conceptual modelling, proved sufficiently flexible to incorporate a wide variety of data sets and disciplinary expertise.

The Ningaloo Destination Model Prototype

A key outcome for the project is the Ningaloo Destination Model itself, which is a template for the relationships that are found within tourism systems. In addition to providing a basis for future destination models, the Ningaloo Destination Model has developed a triple bottom line approach to assess management decisions and future plans in across the following areas:

Tourism Impacts

- Visitors
- Visitor Nights
- Visitor Load*
- Accommodation Amount (beds)
- Accommodation Used/Vacant (beds)
- Activities (hours undertaken)

Social Impacts

- Employment (jobs)
- Cultural Diversity
- Showcase the Region
- Environmental Impact
- Delinquent Behaviour and Disturbances
- Overcrowding
- Residential Housing Available/Demand

Economic Impacts

- Visitor Expenditure ($AU)
- Employment from Tourism (jobs)
- Net Taxes on Tourism
- Tourism Value Added
- Tourism Gross Regional Product

Environmental Impacts (Resources and Ecological)

- Water (GL)
- Electricity (KWH)
- Landfill (M3)
- Human Waste (L)
- Impact of Sustainable Technologies
- Fish Stocks (biomass)
- Catch Rates (biomass)
- Coral (biomass)
- Spangled Emperor (biomass)
- Whale Sharks (biomass)
- Marsupials (biomass)

Applications of the Ningaloo Destination Model on the Ningaloo Coast and Beyond

In the region, the model can be applied in four different kinds of exercises: operational planning and decision making for specific organisations and groups (such as local government or agencies that manage land or sea use), regional planning, participatory planning and collaborations and to assist monitoring and evaluation. Integrating destination modelling with adaptive management methodologies is recommended as the most effective use of the model and a way of ensuring its continued relevance.

The structure of the model is applicable to other regions in Australia, and the data exists to quickly build simple models (5–8 days) if it was accompanied by the development of a generic modelling framework. However, more comprehensive models are likely to require further data collection and more time (10–15 days). Visitor and resident surveys provide the most comprehensive data, but would take much longer (4–6 months) to organise, run, enter the data and produce results to inform the modelling. The extent of data collection should be linked to the intended use of the destination model. If the model is intended to be a general tool to broadly inform a tourism planning exercise, then a quick and inexpensive approach may be acceptable. If the intention is to make use of the model to monitor and assess tourism development, then we recommend a greater investment in data collection. Additionally, modelling software and modelling expertise are required. We provide links to the key data sources in Appendix A, and the specific sources for a data collection trial for the Margaret River – Augusta region are summarised in Appendix B, along with a discussion of issues for specific information sources.

Turning to the question of applying the modelling technique to other sectors, the process of model development has proved successful at community engagement, conceptual modelling, data gathering and working with an interdisciplinary research team. The lessons learnt from these processes are applicable to other sectors.

Future Action

Future actions need to address the use of the Ningaloo Destination Model on the Ningaloo Coast, and the possibilities for the broader application of Destination Modelling. We have met with a number of different agencies to discuss how they would like to access the model and if they require training, with positive responses from agencies in the region. Discussions with agencies in Perth are ongoing.

The Ningaloo Destination Model will be made available through a variety of avenues. First, two online versions of the Ningaloo Destination Model are nearing the end of development that will allow all stakeholders and the general public to access particular model results. Second, an easy to use desktop version of the model has been developed that will be provided to the Shires and agencies so that they can run their own scenarios with a half day training in model use. Third, the Ningaloo Destination Model will be incorporated into a more detailed model of the Ningaloo Coast region that is being developed by Beth Fulton at the CSIRO's Marine and Atmospheric Research Division. We are also exploring the option of using other funding sources to create a regional position whose job is to promote research including the model and to ensure that it is being considered for important decision making processes.

Destination modelling is relevant for other tourism destinations and a process for the rapid and cost-effective application of destination modelling is feasible. This would require research funding to develop a wireframe that is relevant for all tourism destinations. Most of the data that would be required is already available, and it would be possible to enhance this data further through establishing benchmarks for a range of region types—the information that would make this possible could be available through EC3 Global and literature searches. Making destination modelling tools broadly available would significantly broaden the impacts considered when undertaking tourism planning and lead to a more comprehensive understanding of how tourism functions as a system across Australia. Given the changing attitudes of people that have engaged with the Ningaloo Destination Model, a broad roll-out of destination modelling could lead to some of the detrimental effects of tourism development being identified and proactively addressed at the early stages of planning across Australia.

The techniques developed for destination modelling are applicable to other sectors, and have already been applied to issues such as water catchments and environmental management in other countries (see, for instance, van Den Belt, 2004). It is possible, for instance, to build a model for a regional town that would assess the implications of resource sector expansion on that site. The investment required for such model development depends on data availability, and the availability of expertise on issues specific to that sector.

Chapter 1

INTRODUCTION

The Ningaloo Destination Model is a world-leading tourism planning tool for the Ningaloo Coast region of Western Australia that assesses the economic, social and environmental impacts of different planning decisions and events. This report describes the features of the tourism destination model, and analyses its application in the region and to other parts of Australia.

Tourism is a complex system. Consequently, tourism development in a region has implications for jobs and economic growth, lifestyles and community attitudes, availability and cost of resources like water and electricity, and regional ecology among other things. Understanding the implications of development across these fields can be extremely difficult. However, there are now tools that help us to understand tourism using models that can indicate the potential economic, social and environmental impacts of different future scenarios. Models such as the Ningaloo Destination Model can capture the dynamics of complex systems. The Ningaloo Destination Model uses methods developed to assist management of complex systems to assess possible economic, social and environmental impacts of tourism. These methods, and the methods used to collect the data required to run the Model, are discussed in Chapter 2.

A collaborative process of model development is important to ensuring that the model will be used. Involvement of a range of different interest groups in its development facilitated the regional community's understanding of tourism, ensured representation of different stakeholder perspectives and encouraged trust in the Model. Building trust in the model aids acceptance of model results by a variety of stakeholders with differing perspectives and priorities. This in turn helps the various interest groups work together in planning and development of tourism in the region. Chapter 3 describes the processes of engagement, the outcomes of these processes and how they contributed to model development.

The Ningaloo Destination Model has also drawn on national expertise in the social, economic and environmental fields enabling access to techniques developed through previous STCRC research projects. This has ensured a rigorous approach that also provides a comprehensive and holistic assessment of the possible impacts of different planning decisions. Chapter 4 describes the social, economic and environmental outputs from the model using the example of the development of two possible futures for the region—the current plans for the region as expressed in the Ningaloo Coast Regional Strategy, and a hypothetical large resort development.

The uses of the Ningaloo Destination Model extend beyond the regional planning issues explored through the case study. It contributes to four overlapping dimensions of tourism policy and decision making: operational planning; regional planning; participatory planning; and monitoring. While contributing to exercises in these fields is important, the broader relevance of destination modelling rests on its capacity to be applied to other regions. The structure of the model is applicable to other regions in Australia, and the data exists to quickly build simple models (5–8 days) if it was accompanied by the development of a generic modelling framework. However, more comprehensive models are likely to require further data collection and more time. The most comprehensive data would be through visitor and resident surveys (which have already been developed through STCRC research), but would require a larger investment and a longer time period. Chapter 5 discusses the application of the model in the fields of operational planning, regional planning, participatory planning, and monitoring, and explores the data requirements, time and resources that would be needed to apply the model to other regions in Australia. It also briefly discusses the possibility of applying the modelling techniques to other sectors.

Chapters 2 and 3 describe the methodology and development of the Ningaloo Destination Model, while Chapters 4 and 5 describe outputs and applications. For readers who are primarily interested in the kinds of outputs the model produces and its applications, we have written this report so that Chapters 4 and 5 can be read without knowledge of the previous chapters with the exception of this introduction.

What is a Computer Model?

The terms 'modelling' and 'model' refer to a wide variety of tools and techniques. In this project, modelling refers to computer based modelling that simulates the dynamics of a system through quantifying the interconnections and time delays. The main value of this modelling is not its capacity to predict the future. Instead, modelling allows for decisions to be tested and scoped in a simulated environment before they are applied to the real world. In a flight simulator, pilots get to test their decision making in an environment where they are protected from bad decisions. The Ningaloo Destination Model does the same thing for tourism planning and management. It allows stakeholders to test decisions in an environment where they cannot 'crash' in the real world.

Background

The Ningaloo Destination Modelling Project

The Ningaloo Destination Modelling project flows from earlier work by Carlsen and Wood (2004), conducted under the auspices of the Sustainable Tourism Cooperative Research Centre and the Department of Conservation and Land Management that established an economic value for Ningaloo reef. The Destination Model was designed to produce a sustainability model that could augment earlier work on economic values to include social, environmental and ecological components. The model would enable the examination of scenarios to guide future land-use planning of the terrestrial environment that would also influence the marine environments of Ningaloo. It was intended to explore scenarios that related to development driven by changes in tourism numbers and tourism segments. For example; what would be the impacts if tourism numbers doubled over a twenty-year period or what if tourism growth was predominantly in one market segment such as international tourists? It was intended that the scenarios would examine issues such as economic impacts and use of particular resources such as land, coral, beaches, fish or water. The scenarios could also provide a lens to extrapolate the impact of changes to tourism on service delivery, energy consumption or waste generation.

At a more complex and more immediate level, it was intended that the model provide the means of assessing the impacts of shocks such as cyclones or pandemics or the loss of a significant tourism asset through events like coral bleaching or changing patterns of wildlife visitation such as whale sharks. At a very practical level, the model would enable the examination of scenarios driven by policy decisions; providing a tool through which to gaze into different futures shaped by land-use planning. This latter point is particularly important in a region whose development is controlled by a very prescriptive regional plan; the Ningaloo Coastal Strategy, which was given statutory power through a Statement of Planning Policy and an Interim Development Order. Specifically, the model would provide a lens through which to view the impacts of slow, planned development as opposed to large scale developments outside a rational planning framework such as that proposed for Maud's Landing during the 1990s, the very development proposal that led to the preparation of the Ningaloo Coastal Strategy.

Finally and perhaps most significantly, the Ningaloo Destination Model was intended to be a tool to synthesise the findings of other research conducted through the Ningaloo Collaboration Cluster of the Wealth from the Oceans CSIRO Flagship. The Ningaloo Collaboration Cluster would provide a wealth of data on the ecology and use of the Ningaloo Marine Park, which, in isolation, would not be linked to other factors such as the economy, local communities and the decision-making processes that guide development.

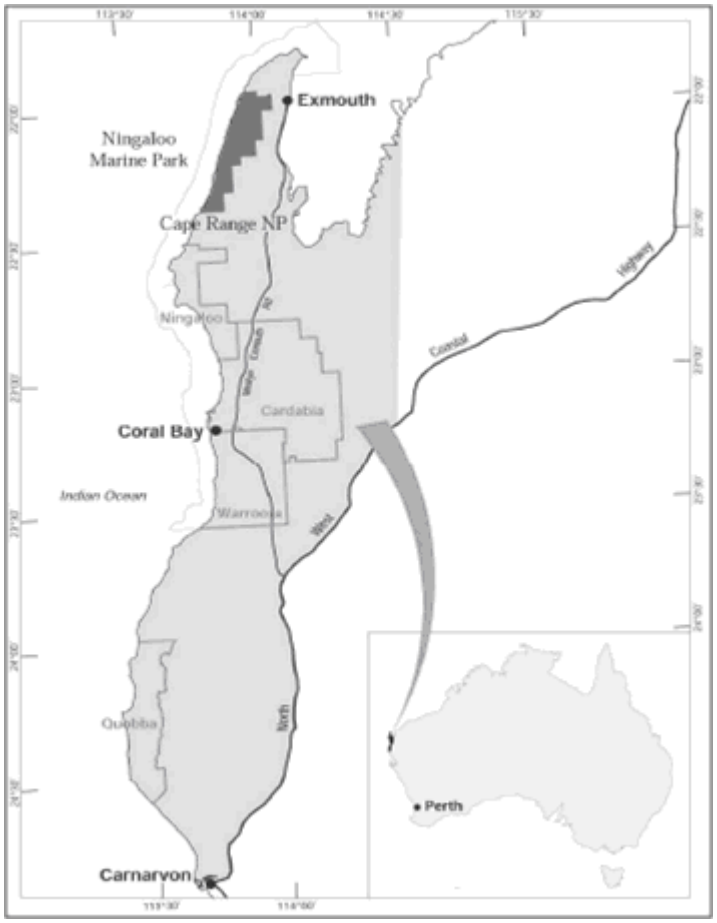
This project has already influenced tourism planning for the Ningaloo Coast. Data from the project has been used in developing a marketing strategy for Exmouth and in planning for Cape Range National Park. Modelling results have been used in developing a Strategic Tourism Plan for Carnarvon. Access to the model will be provided free for local and state agencies that operate in the region and training in both Model use and adaptive management have been arranged with the Shire of Exmouth and the Exmouth Office of the Department of Environment and Conservation. The model would greatly enhance the review of the current regional plan (discussed in the next section), town planning in Exmouth and Carnarvon, and future proofing resource management, in particular Fisheries, ground water management and electricity supply, where tourism planning is likely to have a large impact over future resource use.

The Ningaloo Coast

The Ningaloo Reef is the largest fringing coral reef in Australia stretching over 300 km along the remote

northwest coast between the Carnarvon and Exmouth townships (Figure 1). The exceptional conservation values of the region include marine and terrestrial flora and fauna, karst formations and subterranean fauna, and remoteness values. This coastal region is sparsely populated and its approximately 8000 residents live mainly in the towns of Carnarvon (71 percent), Exmouth (26 percent) and Coral Bay (2 percent). The region's economy is based on tourism, fishing, mining, horticulture and livestock, while nature-based and wilderness tourism is the main source of income in Exmouth and Coral Bay, and is marketed nationally and internationally as a premier tourism destination (Western Australian Tourism Commission, 2003). The primary attraction of the region is the accessible Cape Range National Park and the Ningaloo Marine Park, which Western Australia's Department of Environment and Conservation labelled the state's 'premier marine conservation icon' (Department of Conservation and Land Management, 2005b, p. vii)

Figure 1: The Ningaloo coastal region of Western Australia



Department of Conservation and Land Management (2005b)

The number of tourists to the Ningaloo Coast in 2008 was 176 000,[1] which was lower than previous years most likely due to high petrol prices early in the year and the advent of the global financial crisis. The highest recorded number of visitors was 2004 when 208 000 people visited the region. Although reliable statistics are not available for the early 1990s, it is thought that visitor numbers have increased markedly (Wood & Dowling, 2002).

Planning in the region has been an issue of state and national interest, particularly since the mid-1990s with the advent of a proposal for a large marina development at Maud's Landing in the middle of the reef, just north of Coral Bay (Pforr, Macbeth, Clark, Fountain, & Wood, 2007). The Maud's Landing proposal evoked widespread protest in Western Australia through the 'Save Ningaloo' campaign and contributed to a change in government in Western Australia in 2001. The new Gallop Labour Government rejected the marina proposal in 2003 and began preparation of the 'Ningaloo Coast Regional Strategy Carnarvon to Exmouth' (henceforth, the

[1] This figure is a four year average (due to small sample size) of statistics from Tourism Research Australia's International Visitors Survey and Domestic Visitors Survey.

Regional Strategy). This strategy was overseen by the Ningaloo Sustainable Development Office (NSDO), a regionally based office of the Western Australian Department of Planning and Infrastructure. The Regional Strategy provides a comprehensive framework for sustainable tourism development in the region, limiting the construction of high impact developments, such as marinas and canals, to the towns of Carnarvon and Exmouth (see Figure 2). While this plan covers the coastal strip, the region is subject to a variety of planning processes that are largely uncoordinated. The Department of Environment and Conservation has separate management plans for Ningaloo Marine Park (Department of Conservation and Land Management, 2005b) and Cape Range National Park (Department of Conservation and Land Management, 2005a), and the Shire of Exmouth is undertaking a Structure Plan and Local Tourism Planning Strategy to assist coordination of a new marina development and future town growth.

Research Objectives

The objective of the research was: **to develop a dynamic model of Ningaloo incorporating socio-economic, and load implications of tourism that can be integrated with an ecological model of the region.**

Achieving this objective required extensive work at the beginning and across the project to engage stakeholders in order to ensure that the model was relevant to businesses, managers and communities and had sufficient trust to be considered for ongoing use. This is an important aspect of the modelling that is discussed alongside a description of the outputs of the model and how these assess the economic, environmental and social impacts of tourism. Additionally, researcher engagement was required in order to bring in the necessary expertise to ensure that the model was accurately capturing how tourism operates in the region. We also address a secondary objective in this report, which is central to the broader relevance of the model to tourism in Australia and in other sectors—the application of the model building process other regions and sectors—in Chapter 5.

Chapter 2

DESTINATION MODELLING METHODOLOGY AND DATA COLLECTION

The purpose of this chapter is to provide a brief overview of the technical issues addressed to build the Ningaloo Destination Model. There are two broad sets of issues: the methods for developing the model and the methods for collecting the data on which the model relies. It should be noted that this report focuses on the process of model development and uptake. However, data collection methodologies are also addressed and the report includes a description of the data that was collected.

Building the Model

Building a tourism model requires both long term engagement with managers, community groups and researchers, as well as the technical expertise to capture their knowledge and concerns. Without engagement, even the most accurate model will not be trusted by the community or used in planning. Without adequate technical expertise, the model runs the risk of generating misleading results, potentially leading to bad policy decisions.

Past Tourism Modelling Projects

Modelling techniques have been used in a number of locations to assist tourism destination planning with a variety of levels of success (for an extensive appraisal, see Schianetz, Kavanagh, & Lockington, 2007). The modelling work that has been successful in achieving sustained change in planning processes focused on participation and consensus building, as demonstrated by modelling work undertaken in the Alpine village of Obergurgl, Austria (Holling, 1978; Moser & Moser, 1986), Bali, Indonesia (Wirinatha, 2001), the Douglas Shire, Australia (Walker, Greiner, McDonald, & Lyne, 1999) and Ping Ding, Taiwan (Chan & Huang, 2004). Obergurgl has been described as an ideal environment for such a project as the village had only 80 families and required the study of only a few dynamics which limited complexity (Holling, 1978). However, most tourism destinations and regional planning processes are larger and more complex. The other studies have not provided the same level of detail, although all indicate that modelling can foster group learning, participation and consensus building. Other applications of modelling, such as in the Sporades Islands, Greece (Giaoutzi & Nijkamp, 1993), Guilin, Mainland China (Xu & Bao, 2000) and for natural-resource-based tourism more broadly (Chen, 2004) have focused on model development rather than participation and as a result had little impact on tourism planning. A major problem with land-use modelling, in addition to the time and cost of development, is that the models are often not taken up by stakeholders. This is a major issue for research more broadly despite the capacity to address issues that directly concern the stakeholders. This reinforces the importance of engagement at the beginning of a modelling project, which is discussed in Chapter 3.

Engagement and Collaboration with Stakeholders

Collaboration has a range of practical benefits. These include avoiding the costs of resolving conflicts in the longer term, greater political legitimacy, improved coordination, and a greater knowledge base for making decisions (Aas, Ladkin, & Fletcher, 2005; Bramwell & Sharman, 1999). In addition to achieving better outcomes, collaboration can ideally provide a ‘democratising and more inclusive and equitable set of processes than conventional approaches’ (Bramwell & Lane, 1999, p. 180). Meaningful collaboration is therefore one of the key elements in sustainable tourism planning, in particular for its contribution to inclusive development that seeks to avoid protracted conflicts.

Review of past tourism modelling projects show a common major failing is lack of stakeholder engagement. This is despite a general emphasis on the need for meaningful engagement in areas of research that use modelling. Ideally, participation should be early in the modelling process, and should provide stakeholders with the opportunity to ask questions and learn as the model develops (van den Belt, 2004). Good collaboration and modelling research require an initial stakeholder assessment including interviews with key stakeholders. This

can contribute to a better understanding of the different groups involved and their perspectives on the main issues. Building on techniques from organisational learning (Senge, 1990) and adaptive management (Holling & Gunderson, 2002), van den Belt's method of model development uses a logical sequence of workshops:

- Introduction
- Problem definition
- Conceptual model building
- Quantitative model building
- Testing, scenarios and conclusion

The initial workshop is crucial to the process of model development. In this workshop, stakeholders have the modelling process explained to them and set the scope of the models. The model building workshops capture stakeholder knowledge and ideas through the development of conceptual models. A conceptual model is a diagram that expresses how the world works (for an example, see Figure 2). Subsequent workshops assess model development. This helps to facilitate learning about the issues that the model addresses through increasing the model's accuracy. Quantitative model building is where data is put behind the conceptual models and the results are discussed with a group of stakeholders. The fifth and final stage presents the results to stakeholders and draws conclusions based on model simulations. This should not be the final use of the model. An iterative process of refinement and use can ensure that the model is updated and continues to inform management and planning in the region into the future. Engagement is potentially a transformative process where different groups learn about each other's perspectives and about tourism to their region.

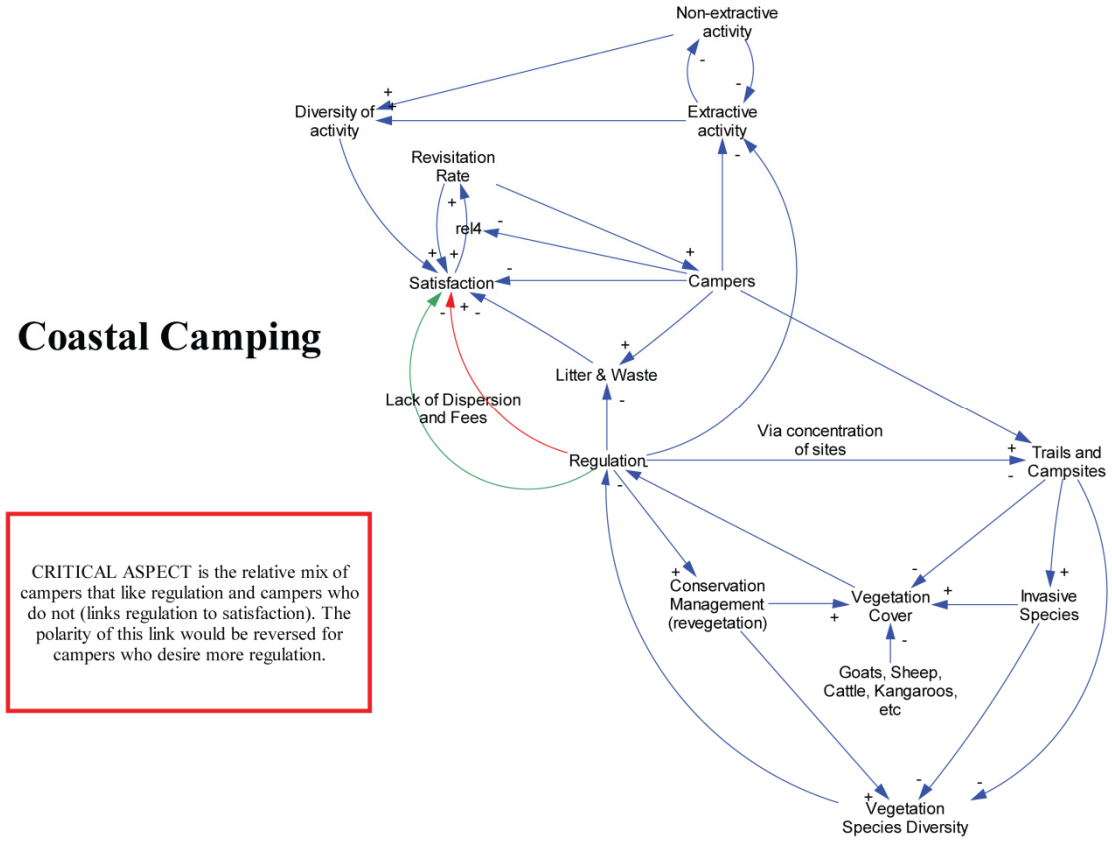
Model Development

The process of conceptual model building and quantitative model building is a crucial step in developing computer models. For this reason, it is worthwhile reflecting on this process in more depth. In an interdisciplinary project, communication between researchers and research integration can be challenging. Conceptual models of different aspects of the tourism system, such as the coastal camping diagram in Figure 2, provided a language for ensuring that all of the important aspects of the tourism system were being captured (Jones & Wood, 2008). It also provides people from a wide variety of groups the opportunity to articulate their understanding of tourism, and to comment on other people's views. While best undertaken in a group setting so that collaborative learning can occur, it is also beneficial in individual meetings, particularly with participants with unique perspectives who are not comfortable expressing their opinions in a group environment. A central element of this process is identifying the feedback loops and thresholds of impacts that determine the dynamics of a system.[2]

The second method is putting data behind the conceptual diagrams. This involves firstly refinement of the conceptual diagrams to identify the key feedback loops in order that the model captured the important system dynamics while remaining as simple as possible. The more complex the model, the harder it is to capture and understand its behaviour. The conceptual diagrams are simplified to exclude variables that only had a small influence on tourism. Data needs are then identified. Model development also includes model testing through sensitivity analysis and against historical data. Modelling results need to be discussed with managers and industry members who are familiar with different aspects of the region, in particular tourism and the region's ecology.

[2] The technique employed in the NDM project for integrating research from different disciplines is described in more detail in Jones and Wood Jones T, Wood D, 2008, 'Researching tourism to the Ningaloo Reef, Western Australia, or how the social sciences can collaborate in researching complex problems' *Interdisciplinary Journal of the Social Sciences* **3**(6) 137-144.

Figure 2: A conceptual model of coastal camping (developed with Jeff Dambacher, CSIRO)



Data Collection

High quality data is a crucial to the accuracy of the model. Researchers in the Ningaloo Destination Modelling project undertook surveys of residents and visitors to the Ningaloo Coast, and collected data from accommodation providers about water and electricity use. Other data was collected from existing data sources. This included data on tourists from Tourism Research Australia and the Australian Bureau of Statistics, and information on resource use from Horizon Power and the Water Corporation.

Visitor Surveys

The visitor survey methodology adopted in this report was developed through a series of previous STCRC projects examining cost-effective ways of measuring and explaining visitor characteristics and expenditure. The methodology is explained in detail in the STCRC technical reports *Assessment of the Economic Value of Recreation and Tourism in Western Australia's National Parks, Marine Parks and Forests* (Carlsen & Wood, 2004) and *Economic Evaluation of Tourism for Natural Areas: Development of a 'Toolkit Approach'* (Wood et al., 2006). Questions about details of expenditure on categorised items and length of stay in the region were central components of the survey. Questions assessing the characteristics and motivations of visitors to the region and the location of activities and accommodation were also important.

The survey collected information on a number of visitor characteristics common to many visitor surveys and considered appropriate for assessing the features of tourism to a destination (Cooper, 2005). This included: place of residence; age; gender; travel group; household income; activities; information sources; expenditure; accommodation type and location; travel method; and trip expectations and satisfaction. The survey also focused on information relevant to the modelling. This included information on the length of time spent doing different activities, more detailed information about length and location of stay and accommodation types.

Resident Surveys

Planners and decision makers encourage tourism because of a common perception it brings benefits to the community. To verify this, a recent focus for government agencies has included measurement of the social and

environmental impacts of tourism on communities. Monitoring tourism impacts can help to protect community wellbeing, and ensure tourism's long term viability, particularly if it is reliant on a natural area (Faulkner & Tideswell, 1997). The community, as hosts to the tourists, are vital to the visitor experience and may affect tourism development by their willingness—or otherwise—to be involved in tourism development (Pearce, 1998). Research suggests that it would be impossible to sustain tourism to a destination without the support of the local people (Ahn, Lee, & Shafer, 2002).

A computer model of a destination thus needs the ability to indicate how different tourism developments are likely to impact on communities. To identify the impacts most relevant to communities in the Ningaloo Reef region, researchers surveyed residents to assess their perceptions of how tourism affects their lives and their communities. The questionnaire used in this study was developed based on previous work undertaken in assessing host community perceptions of tourism impacts on the Gold Coast, Queensland (Fredline, 2002) and in Byron Bay, New South Wales (Fredline et al., 2006). In these two studies, a much longer questionnaire was used. For this current study however, the aim was to test a reduced scale with the objective of developing a quicker and easier to administer indicator of the social impacts of tourism on the host community. Thus, the items used in previous research were summarised with the aid of principal components analysis to produce a 16-item scale and tested in other locations (Hughes, Jones, Deery, Wood, Fredline, Whitely, 2008). Principal components analysis is a statistical method of reducing a large number of variables to a more manageable set based on correlations between the variables. The benefit in undertaking this analysis is that the length of the questionnaire is reduced while retaining the original properties of the scale.

Secondary Data

The model also relies on secondary data sourced from three key agencies and the utility providers for the Ningaloo Coast region. Secondary data was sourced from Tourism Research Australia's (TRA) National Visitor Survey, and International Visitor Survey, the WA Department of Environment and Conservation, and the Australian Bureau of Statistics' (ABS) visitor accommodation surveys and census data on Exmouth and Carnarvon. Information on water use was provided by the Water Corporation. Data on electricity use was collected from tourism accommodation providers through an agreement with Horizon Power. A recent survey and report by the Gascoyne Development Commission (GDC) assessed the level of waste in the region and the potential savings that recycling could have for the region (A Prince Consulting, 2008; Gascoyne Development Commission, 2009). We also obtained very useful data from EC3 Global on the water, waste and electricity use of different accommodation types from comparable regions, which was a valuable for checking data accuracy. The EC3 Global data is relevant to discussions of the application of the model to other regions discussed in Chapter 5.

Economic Indicators

Regional tourism economic contribution is derived from the expenditure data collected as part of the project's visitor survey. Tourists' expenditure is a way of measuring the consumption of goods and services by visitors to the region.[3] However, expenditure (also referred to as consumption) also includes goods and services that are not actually produced within the region. For instance, expenditure includes imports and other mark-up costs such as net commodity taxes and any transportation to move goods and services from producers to consumers. These mark-up costs are often defined as margins.

The shares of imports and all margins are contained in regional Input–Output tables. Using a regional Input-Output (I–O) table, the amounts of consumption of goods and services (the expenditure) are used to calculate the value that tourism contributes to different producing industries, as well as the commodity taxes that are paid by tourists. The sum of these outputs across all goods and services is defined as tourism output. Regional I–O tables can also be used to calculate tourism value added and employment. Tourism gross value added (TGVA) measures the value of tourism gross output at basic prices by all industries which supply tourism products, less the value of the inputs used in producing these tourism products. Value added is the most widely accepted measure of the contribution of an industry to the economy.

Finally, tourism gross regional product is derived by adding tourism value added with all commodity taxes associated with tourism consumption. Tourism gross regional product is therefore a more accurate measure of

[3] This is consumption from the demand side

the size of the tourism industry in the Ningaloo Coast region as it excludes all of the imports and other costs (such as transportation) that do not contribute to production in the regional economy. Visitor survey expenditure data in this project and expenditure data from Tourism Research Australia were compared and reconciled to ensure consistency.

Ecology Data

The data on the marine ecology of the region was drawn from a series of marine science projects from the Western Australian Marine Science Institute (WAMSI) and the Australian Institute of Marine Science (AIMS). WAMSI has over 250 scientists working on 86 projects across a wide range of fields. WAMSI research on the Ningaloo Coast has focused on collecting information to inform the Department of Environment and Conservation management planning process. This includes assessing deep water fish communities and habitats; assessing the health of key target species for recreational fishers; understanding the ecosystem and the level of impact by humans (particularly tourists); and assessing the groundwater system and its links to Ningaloo Reef. This information is being collated by Dr Beth Fulton from the CSIRO's Marine and Atmospheric Research Division who has developed an ecological model of the region in a program called Ecopath with Ecospace (EwE). This ecological model has been integrated with the Ningaloo Destination Model, including a range of ecological indicators alongside the tourism, economic, resource-use and social indicators already in the model.

Reliable data on the ecology of land areas in the region was not available due to a lack of recent research. Consequently, data based on comparable regions, coupled with a qualitative modelling exercise to define possible dynamics between tourism, management and land ecology was used to inform the model.

Chapter 3

STAKEHOLDER AND RESEARCHER ENGAGEMENT TECHNIQUES AND OUTCOMES

Engaged model development is essential to the success of a modelling project. Stakeholders need to be engaged in model development to ensure that the model is relevant to them, and to build trust in the model so that they will use it and trust the results it produces. Researchers also need to be engaged in the process of incorporating their information and insights into the model. While the features and capacities of the Ningaloo Destination Model are described in Chapter 4, this chapter explains why these features were chosen through a process of engagement that underpinned model development.

Table 1 provides an overview of the key stages used in developing the model, derived from van den Belt's methodology (2004) discussed in Chapter 2. This chapter describes the results of each of these stages and explains how they contributed to model development.

Table 1: Stages of Model Development

Stage	Description
1	Stakeholder assessment
2	Stakeholder modelling workshops – Scenario Development
3	Formal and informal meetings and communications with stakeholders
4	Data collection and dissemination
5	Model development

Stakeholder Assessment

The first step undertaken in the Ningaloo Destination Modelling project was an assessment of stakeholder interests and their capacity to participate in the modelling process. This helped identify groups that might struggle to participate (summarised in Table 2). Factors inhibiting participation included the absence of familiarity with a workshop environment and the technical outputs of modelling, not being paid to attend (as was the case for government agencies) or involvement with an organisation that would facilitate participation, distance from the workshop venues (which were held in three locations to facilitate attendance), and relative power to influence decision making in the region or in Perth. Those with the most capacity to participate were government agencies, the local Shires, researchers and large companies. Local groups and committees were in the mid-range group as they had the capacity to send a representative. Individual members of the tourism industry, residents, indigenous groups and tourists were the least likely to sustain participation and effectively express their point of view in a multi-stakeholder setting. This was addressed through providing opportunities to voice opinions and play roles, particularly in the small group activities. Views from these groups were also obtained through individual meetings.

Information was distributed before the workshop and meetings were held with key stakeholders. The research was not driven by a specific outcome (for instance developing a plan or a specific concern). Instead, it was driven by research organisations seeking to supplement research programs focused on the ecology of Ningaloo (in particular marine science) with research on the social and economic systems that are linked to the region's ecology. While the research was not initiated by stakeholders, there was strong support from key stakeholders, particularly in the two Shires, the Ningaloo Sustainable Development Office, the planning body that oversaw land-use planning for the coastline between Carnarvon and Exmouth, and from the Department of Environment and Conservation (DEC), the agency responsible for protected area management in Western Australia. There was also existing relationships with owners of the coastal pastoral stations, the areas likely to experience the greatest change from future tourism development.

Table 2: Stakeholder Assessment

	Surveys	Public workshop	Modelling workshops	Data collection	Capacity to participate
1. Government authorities					
Shire of Exmouth Employees	√	√√√	√√√	√√ √	H
Water Corporation*	√√	-	-	√√	H
Dept. of Environment and Conservation	-	√√√	√√√	√√ √	H
Dept. of Fisheries*	-	-	-	-	H
Horizon Power*	-	√√	-	√√	M
Dept. of Planning and Infrastructure	-	√√	√√	√√	H
Gascoyne Development Commission	√	√√√	√	√√	H
2. Tourism associations					
Exmouth Visitors Centre	√	√√√	√√	√√	M
Tourism Western Australia	-	√√√	√√√	√√ √	H
Carnarvon Visitors Centre					M
3. Local tourism operators					
Dive/Whale Shark Tour Operators	√√√	√√√	√√√	-	L
Other Tour Operators	√√√	√√√	√√√	-	L
4. Local accommodation providers					
Caravan Parks	√√√	√√√	√	√	L
Hotels	√√√	√√√	√	√	L
5. NGOs and non tourism associations					
Recreational Fishing Advisory Committee	-	√√√	-	√√	M
Cape Conservation Group	-	√√√	-	√√	M
6. Research institutions/projects					
Terrestrial impact studies	-	√√	√√√	√√ √	M
Social tourism impact studies	-	√√	√√√	√√ √	H
Economic yield of tourism	-	√√	√√√	√√ √	H
Indigenous studies	-	√√	√√√	√√ √	M
Geology (groundwater)	-	√√	√√√	√√ √	M
Tourism benchmarking/ecotourism	-	√√	√√√	√	H
Modelling experts	-	√√	√√√	√√ √	H

	Surveys	Public workshop	Modelling workshops	Data collection	Capacity to participate
7. Others					
Shire of Exmouth Councillors	-	√√√	-	√	M
Tourists	√√√	-	-	-	L
Residents**	√√√	√√√	√√	√	L
Local industry	√√	√√	√√	√√	L
Indigenous groups***	√√	√√√	√√	√√	L
Military/Airbase	-	√√	√	√√	M

Rating of importance for participation: √√√ very important, √√ important, √ of minor importance, - not considered as important.

Rating of Capacity to Participate: H high, M medium, L low.

* The organisation was invited to participate but did not do so. However, follow-up contact has led to the organisation becoming involved in the project.

** While only three attendees listed themselves as 'residents', 30 of the participants actually reside in the region.

*** An indigenous tourism workshop is being planned and will involve this stakeholder group.

Stakeholder Modelling Workshops — Scenario Development

The background to the project was provided at the beginning of the workshop, along with an explanation of the possibilities and limitations of destination modelling. The workshop was facilitated by Paul Walker, an experienced modeller who had conducted similar projects in a number of other locations in Australia including the Tapestry region in the southwest of Western Australia and Port Douglas in Queensland. The organisations running and funding the project were also perceived as fair and neutral by participants, which was important given past dissatisfaction with planning processes.

The first step in the workshop was to identify hopes and concerns regarding tourism in Exmouth. This discussion began with participants discussing the possibilities for tourism in the next 2–5 years. The results of the session are listed in Table 3. Most of the suggestions came from community members rather than agency or Shire employees. The opportunities and concerns were then moved into four clusters based on common themes. The themes identified were future growth, governance, shocks to growth and sustainable technologies to reduce resource use in the town centres.

Table 3: Opportunities, Concerns and Attractions Relating to Tourism

Opportunities	Concerns	Attractions
Health infrastructure	Housing (especially staff)	Climate
Employment	Transport (especially air)	Lifestyle (can become a concern)
Prosperity	Getting Staff	Restaurants and Leisure
Education	Overuse of resources	Wilderness
Research centre	Environmental	Hinterland
Sustainability	Water availability	
Facilities	Lifestyle	
Diversity of services	Best use of resources	
Availability of services	Different calibre of tourists	
Water recycling	Over regulation	
Waste	Tourist volumes	
Recycling on the whole (critical mass)	Nature of development	
Restaurants and entertainment	Small rate base	
People who come here are environmentally conscious	Tenure	
Wildlife/ecotourism		
Access to the hinterland		

Workshop attendees then divided into small groups, one for each scenario. Each group set out to identify the degree of importance and control for their given scenario. Participants were asked to choose the scenario that most interested them and join the relevant group. As part of the process, any scenarios chosen by only a small number of participants were excluded from further consideration. However, participants divided fairly evenly in numbers amongst the four scenarios. Different groups of stakeholders gravitated to different scenarios. The tourism operators and the Shires were most interested in the Governance scenario, which was focused on licensing and planning issues. The environmental groups were interested in the Sustainable Technologies scenario, where resource savings through new technologies and recycling were explored. Accommodation providers and business owners were split between the growth and shocks scenarios, which explored different aspects of tourism growth in the region. Shocks refer to external shocks to tourism, such as a cyclone, an epidemic that disturbs travel patterns, cheap flights, amongst other things (described in Chapter 4). The groups were led by tourism researchers who had received training the previous day in the goals of the small groups for both discussion and interactions. Participants used a series of activities to explore the issues within the scenarios, and how they could affect the economy, environment and communities in the region. They also identified uncertainties, or things that could prevent or facilitate the occurrence of a particular hope or issue. The final activity was for each of the groups to present their scenario to all of the participants.

Feedback from the workshops using a five point Likert-type rating scale indicated that the forum increased understanding of the project ($x = 4.3$ from a possible 5) and that stakeholders gained a better understanding of the perspectives of other groups ($x = 3.9$). The lowest score was in increasing understanding of people's own objectives in relation to tourism ($x = 3.1$). All participants indicated that they were keen to be involved in future workshops and wanted to receive information about the project.

After discussion amongst the research team, the best way to communicate the scenarios was thought to be through a narrative about how this scenario would affect life in the future, based on the factors identified in the workshop. All four of the scenarios were written up as narratives. As an example, the scenario for our workshop in Exmouth addressing control over access to the region and resources is provided below.

What would life be like if there was control over access to the region and attractions within the region?

If there was an open door to development coupled with easier access to the beach (beach frontage) and Ningaloo Reef (for instance, a sealed road over the range) and more flights, a number of tensions would arise. The 'wilderness experience' would end due to the degradation of the marine environment and there would be a change in the character of tourists due to a move towards mass tourism. The growing numbers of tourists would create tensions with traditional owners and locals. However, there would be quick growth in infrastructure to cope with the increasing numbers. Prices would be driven up by demand, although operators would benefit in the short term. Mass tourism would bring a low-yield (low-spending) group of visitors, but in much greater numbers, initially bringing a greater return to the local community but impacting on the attractiveness of the area and the lifestyle of locals. The natural environment and in particular Ningaloo Reef come under greater pressure, which would then impact on visitor numbers. Water use and waste generation would increase, putting pressure on resources and infrastructure. International events (such as terrorism, avian flu) and extreme events (cyclones, fire) could prevent this scenario from occurring.

The alternative is to control numbers in the national parks and the amount of people who can stay in the region (cap on accommodation). Some visitors would be turned away. Greater control could be exerted over where people go and what they do, with an emphasis on high-quality nature experiences. The local lifestyle would be impacted less due to smaller numbers and a focus on high-yield tourists. Economically, growth would be slower but also would be sustainable for a longer period. There would be less employment, although the employment generated would be longer lasting as the region would have greater longevity. The reason for this is the minimisation of environmental impacts. There would be a focus on maintaining the integrity of the environment, which would lead to an emphasis on ecotourism and 'nature-based' experiences. Exerting control over access to the region and attractions within the region would also lead to greater collaboration with traditional owners and possibly an extended season as visitors would be unable to all come at the same time. This kind of control is only possible if a strategic management plan is developed and is committed to by both sides of politics, the shires and local communities.

Model Run: The scenario could be tested by changing the levers for development of access roads (to destination and within destination), budget flight availability, access control (to Cape Range National Park), accommodation caps, and shocks (international events, extreme events).

Links to be explored: The model should allow us to test the potential implications of these levers on environmental and social impacts, economic yield and the attractiveness of the region. This should give us a better understanding of what influence controlling access to the region and attractions could have on the long-term future of the region's tourism industry.

This exercise identified key questions for the modelling and the most important variables that needed to be included to address change and uncertainty around those questions. The four scenarios were sent to all participants in a newsletter that became a regular feature of the project. The workshop was repeated in Carnarvon and Coral Bay and 10 scenarios were identified: 4 from Exmouth, 3 from Carnarvon and 3 from Coral Bay. The scenarios were then consolidated in order to eliminate overlaps between regions into four final scenarios. These scenarios addressed four distinct sets of issues:

- questions of uncontrolled and controlled growth
- changes to governance, particularly over land release for residential and visitor accommodation and licence tenure for tourism operations
- varied rates and uncertainties of growth, which includes events both internal to the region (cyclones, changes to the cost of air traffic) and external to the region (peak oil, a terrorist attack, a financial crisis, an epidemic).
- the capacity of green technologies and sustainable development strategies to conserve water and electricity capacities and to reduce waste.

The four scenarios are summarised in Table 4.

Formal and informal meetings and communications with stakeholders

The process of stakeholder engagement continued throughout the project. A second round of workshops presented the consolidated scenarios and sought feedback on their relevance. They were considered to have captured the important questions facing the region. This was indicated by stakeholders in Carnarvon, Coral Bay, Exmouth and Perth giving combined relevance ratings for the scenarios of more than 4.3 out of a possible 5. The lowest rating was the varied rates and uncertainties of growth scenario (Scenario 3) and the highest was the governance scenario (Scenario 2).

Table 4: The Four Consolidated Scenarios for the Ningaloo Coast

Scenario	Relevance
Scenario 1: A large increase in visitor numbers versus a controlled increase: This scenario addresses questions for increased growth—if you can control growth in particular segments (in particular those who prefer a particular accommodation type and activities with differing environmental impacts) and for particular activities, what will be the costs and benefits to the environment, community and economy?	4.3
Scenario 2: Changes to Governance This scenario addresses questions about governance raised in particular in Exmouth and Coral Bay. If there are changes in governance over accommodation and activities, what will be the impacts on tourism? Will they be substantial or minor? Particular concerns were over tourism license tenure and land release (zoning).	4.5
Scenario 3: Varied rates and uncertainties of growth This scenario addresses a second aspect of growth. What if there are unexpected interruptions? What are the best strategies for a fast recovery following an unexpected event or variations in visitor numbers to the region? The view also addresses the issue of capacity constraints by testing a variety of land release policies.	4.3
Scenario 4: Green technologies and development strategies The fourth scenario addresses how adoption of green technologies could affect the capacities of the town sites to expand in the short, medium and long term, given current constraints on water, electricity and waste water, and the spatial allocation of tourists. It also addresses the costs and savings over different time periods.	4.4

The process of continued stakeholder involvement throughout model development was achieved using a number of initiatives. Four rounds of workshops were held in all three towns and in Perth where the scenarios were further refined and early prototypes of the model demonstrated, commented on and results discussed. There was also an ongoing process of individual meetings with tourism industry members, government agency representatives, local groups, and interested tourists and community members. These meetings enabled ongoing opportunities for input into the model development.

Data

Data collection was an important activity for both developing the model and building relationships with stakeholders. Three surveys were used to gather data: a visitor survey, a resident survey, and an accommodation provider survey that addressed resource use. The methodologies for these surveys are discussed in Chapter 2.

In addition to keeping communication channels open with stakeholders, collected data was regularly disseminated to stakeholders. This contributed to planning processes in the region that were underway simultaneously with the NDM project. These include preparation of Department of Environment and Conservation landscape plans, preparation of site master plans for the Department of Planning, and tourism strategies for the Shires of Carnarvon and Exmouth.

Visitor and Resident Surveys

The largest and most important dataset for developing the Ningaloo Destination Model included a survey of

1574 visitors distributed in the region between July 2007 and September 2008. In total 3100 visitor questionnaires were distributed with a response rate of 50.8 percent. An STCRC technical report was written to address a number of requests for tourism data from a wide variety of groups in the region and in Perth. The report, *Ningaloo Coast Region Visitor Statistics* (2009) is available from the STCRC website in the bookshop section. It includes a summary of the survey data for different areas in the Ningaloo Coast region, and a discussion of visitor motivations.

Three resident communities on the Ningaloo Coast, Exmouth, Coral Bay and Carnarvon, were surveyed to ascertain perceptions of local residents regarding the impact of tourism on their quality of life. The survey sample included all permanent town residents. Owing to the small size of the communities, a high proportion of households in the three towns were approached and asked to participate in the survey. This was made possible in Exmouth by the use of Curtin University of Technology planning students, who were provided with a half-day of training and were provided with a small quota of households to survey. The entire town was surveyed in two afternoons. In Carnarvon, a phone survey included all households with publicly listed telephone numbers. Coral Bay residents were approached at work, asked to fill out the survey overnight, and the survey was picked up the next day. In total, 287 completed questionnaires were collected with 122 coming from Exmouth, 26 from Coral Bay, and 139 from Carnarvon. Coral Bay is a resort town with a small resident population of approximately 120 adults. Exmouth (pop. 2063) and Carnarvon (pop. 5682) are larger towns, reflected in their domination of the sample size (43 percent and 48 percent respectively). The survey data were analysed separately for each location. This was due to the distinctly different relationships that each community has with tourism. Carnarvon is an older agricultural town with a low ratio of tourists to residents. Coral Bay is a resort town that at times attracts more than 2000 tourists. Exmouth began as a military defence town and is transitioning to a tourist town, with more tourists than residents staying in the town during the school holiday periods in April and July.

As mentioned previously, expenditure from the visitor surveys represents the consumption associated with tourism. Values of consumption are often greater than the values of the associate output of the corresponding producing industry due to imports and margin values (net commodity taxes and all transport costs). Tourism output is derived through a technical procedure to remove imports and margin values using information from the regional I–O table. Subsequently, value added and employment are derived using employment to output ratios and value added to output ratios, which are implied by the cost structure in the regional I–O tables. In this project, the regional I–O data for Ningaloo are extracted from the I–O database of The Enormous Regional Model (TERM).[4] The calculation of tourism contribution was also based on supplementary data such as Tourism Satellite Accounts at the state and territory level (Pambudi et al., 2009), ABS industry employment at the local government area level[5], and the database of the Monash Multi-Regional Forecasting (MMRF)[6] model. The economic analysis was carried out by the STCRC Centre for Economic Policy.

Secondary Data

Secondary data is important to the functioning of the model. Information from Tourism Research Australia (TRA) based on the National Visitor Survey and the International Visitor Survey provided a figure for the total number of visitors to the region. A four year average was used to calculate this figure due to small sample size for the Ningaloo Coast region. Other results from these surveys were used to verify information from our visitor surveys. Information from the Australian Bureau of Statistics (ABS) was used to verify occupancy rates from their visitor accommodation surveys. This information was supplemented with interviews with accommodation providers in the region. ABS data on the resident population and local industry was important to defining the local economy and the size and characteristics of the resident populations in the model and the occupancy rates for residential housing.

Information on water use was provided through data from the Water Corporation. Data on electricity use was collected through an agreement with Horizon Power, where accommodation providers would give their permission for their electricity use data to be provided to Curtin University by Horizon power. Both electricity and water data were supplemented with a survey of accommodation providers that assessed resource use and their current water and electricity saving measures. A recent survey and report by the Gascoyne Development

[4] TERM Multi-regional CGE model of Australia as at November 2006 http://www.monash.edu.au/policy/archivep.htm#tpmh0074

[5] Industry of Employment (ANZSIC06) (IND06P), Local Government Area, ABS (https://www.censusdata.abs.gov.au/CDATAOnline/user/?page=Login&javascript=true)

[6] The MMRF model (2007), Centre of Policy Studies http://www.monash.edu.au/policy/archivep.htm#tppa0080

Commission (GDC) assessed the level of waste in the region and the potential savings that recycling could have for the region (A Prince Consulting, 2008; Gascoyne Development Commission, 2009). EC3 Global provided data on electricity usage, water usage and waste generation by different hotel types in similar climatic regions. Given the difficulty in obtaining this data and the small sample sizes, the EC3 Global data proved an easier route to obtain reliable data.

Another research project provided a model of ecological impacts (CSIRO Marine and Atmospheric Research). A key element of this project was the close links to the CSIRO and the exchange of information from the Ningaloo Destination Model with its attention to land-use planning and the CSIRO's ecological modelling.

Model Development

The two key steps for model development were the development of conceptual diagrams and the process of transforming the diagrams into a model through quantifying the relationships between variables. While the scenarios provided guidance about the kinds of questions that the model would be able to answer, these two steps determined the relationships within the model, and put data behind these relationships. These two processes are discussed separately below. This section addresses how researchers from different disciplines can integrate their knowledge and expertise, as well as how to integrate the views and knowledge of stakeholders.

Conceptual Model Development

In an interdisciplinary project, communication between researchers and research integration can be challenging. Conceptual models of different aspects of the tourism system, such as the coastal camping diagram in Figure 2, provided a language for ensuring that all of the important aspects of the tourism system were being captured (Jones & Wood, 2008). It also gave people from a wide variety of groups the opportunity to both articulate their understanding of the tourism system, and to comment on other people's views.

Two elements of conceptual modelling are crucial to integrating a different disciplines and perspectives related to tourism (Jones & Wood, 2008). First, tourism itself needed to be broadly formulated as a system, incorporating linkages between visitation, economic, social and ecological systems. Second, researchers in the NDM project needed to become familiar with the terminology and concepts applied to systems, most notably in the fields of adaptive management and organisational learning. The language of systems reflects key concepts. Feedback loops are an important concept. This occurs where one part of a system affects another part, which in turn feeds back to either limit (negative feedback) or increase (positive feedback) the first variable in the system. Conceptual modelling is particularly useful for identifying feedback loops that determine the behaviour of the tourism system. These are concepts that focus attention on the key information in different fields and are broadly applicable.

The conceptual modelling method was used in a two day workshop in June 2007 that immediately followed the scenario workshop in Exmouth. This was a smaller workshop involving key local stakeholders from the tourism industry, the Shires, government agencies and researchers. The aim of the workshop was to address nine areas that were thought to capture the key elements of the tourism system (see Table 5). Participants collaboratively designed sub-models that identified the economic, social and environmental drivers and impacts, as well as critical relationships. The conceptual modelling workshop provided an opportunity for discussion regarding the key elements and structure of tourism through which diverging views of the tourism system could be resolved through debate and a broader view of the tourism system.

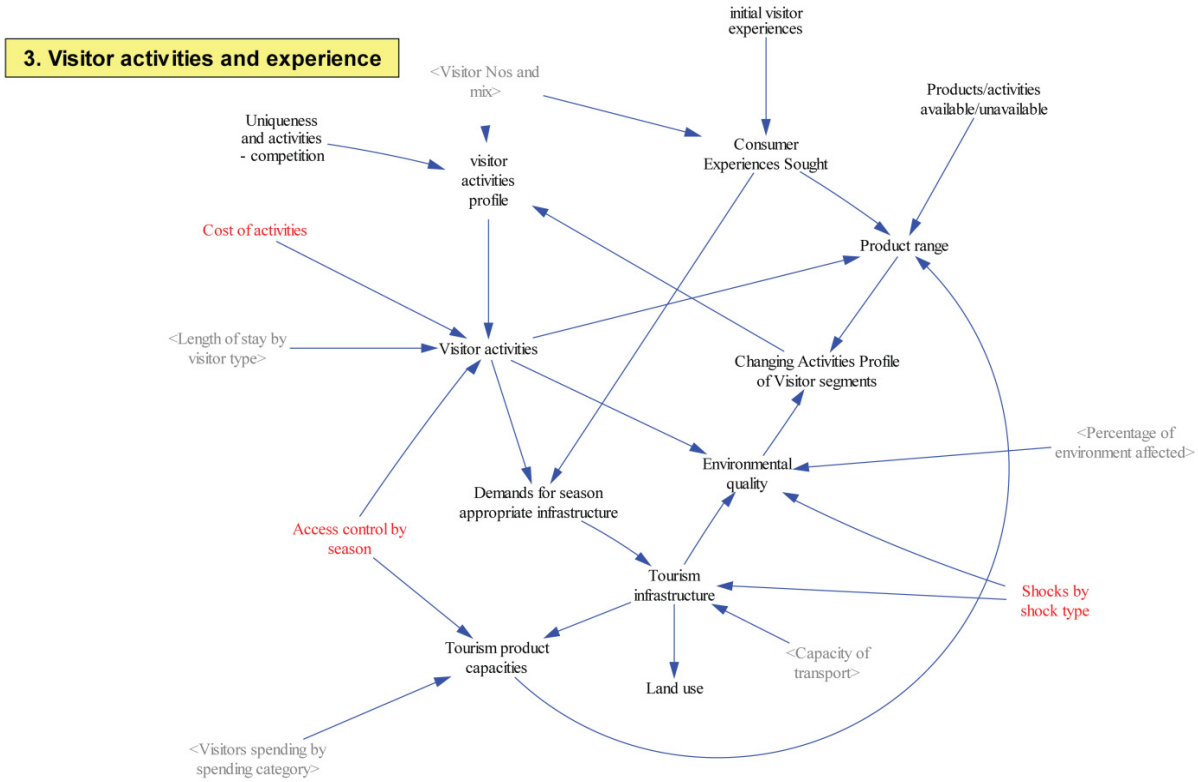
Table 5: The Nine Submodels Addressed in the Conceptual Modelling Workshop

Visitor numbers and mix	Visitor spending	Length of peak season
Visitor activities	Environmental loads	Transport linkages/options
Accommodation sector	Environmental impacts	Socio-cultural impacts of tourism

Each submodel was addressed in a separate session, and was discussed by people with experience in the region and by researchers with expertise in that area. The process began by identifying key elements in the tourism system. For instance, in the conceptual model of visitor activities and preferences, the model began with

a blank whiteboard and one element of the system—visitor activities and preferences. Participants were then asked to identify the key things that influenced visitor activities and how they related to each other, producing the diagram reproduced in Figure 3. This was the beginning of the process of asking a wide variety of people to explain their understanding of the tourism system and to begin to assess and integrate these worldviews. The outcomes of the workshop were conceptual diagrams of key tourism systems that formed the initial basis and a reference point for future model development. The submodels together formed a conceptual model of the entire tourism system for the Ningaloo Coast.

Figure 3: Conceptual Model of Visitor Activities and Preferences



Conceptual modelling was also used in smaller meetings in order to refine different elements of the tourism system and to further clarify relationships in the model. For instance, a meeting with DEC staff and researchers developed a conceptual model that represented the dynamics of coastal camping impacts and regulations. Further meetings and research led to refinement of the diagram which neatly and elegantly captures the key elements of coastal camping and regulation (see Figure 2). While best undertaken in a group setting so that collaborative learning can occur, it is also beneficial in individual meetings, particularly with participants with unique perspectives who are not comfortable expressing their opinions in a group environment.

The use of conceptual models was important because it facilitated research integration through identifying linkages between different aspects of the system. Conceptual models were important guides for the process of model development, which went beyond identifying the key elements of the system. A central element of this process is identifying the feedback loops and thresholds of impacts that determine the dynamics of the system.

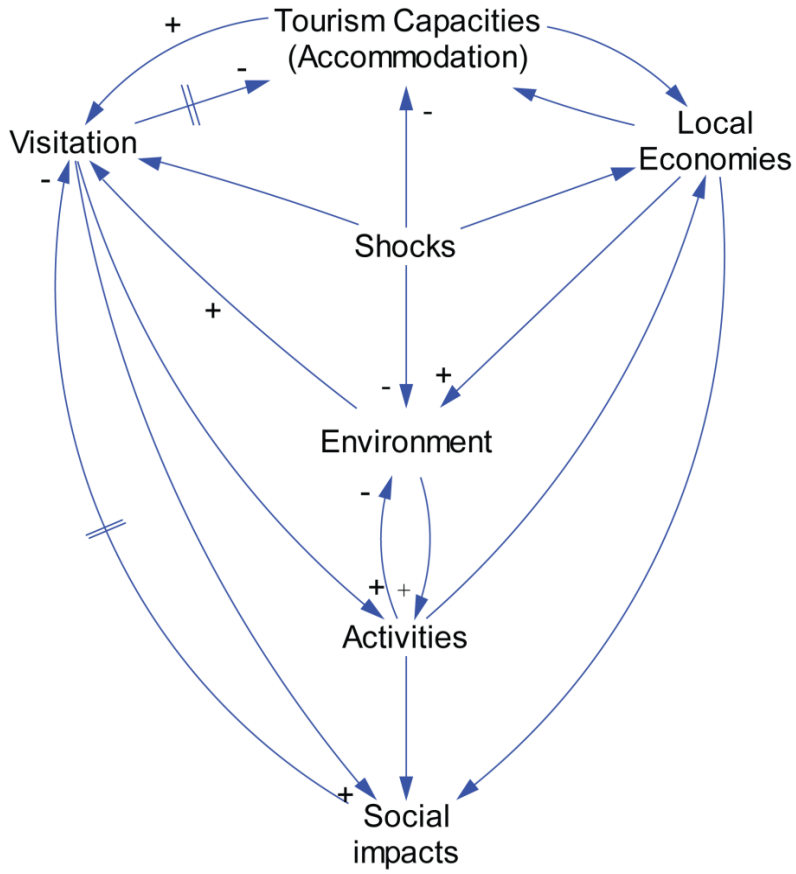
Building the Ningaloo Destination Model—Putting Data into the Diagrams

The second step was putting data behind the conceptual diagrams. This involved refinement of the conceptual diagrams to identify the key feedback loops. The model needs to capture the system dynamics while remaining as simple as possible. The more complex the model, the harder it is to capture and understand its behaviour. While data was collected to address the four scenarios, it was also necessary to recognise where the model could be improved with additional data. Inputs also required the assessment of currently available plans for the region in order to address the uncertainties around future development.

Model development also included model testing through sensitivity analysis and validation using historical data. Modelling results were discussed with members of the tourism industry and agency managers. The model was tested through examination of its behaviour in extreme situations (extreme rates of growth and changes in accommodation). Historical changes in other locations were also entered into the model to test its ability to accurately represent future changes. For instance, large resort developments were entered into the model to look at its capacity to predict future resource use and activity use. When required, the model was modified to address these changes. Modelling results were also presented in the region and in Perth every six months, through both regional forums and in meetings with individual stakeholders. These meetings identified areas where the model needed improvement, and refined how the data was presented. Communication became an important focus across the course of the project.

Putting data behind the diagrams also incorporated connecting the submodels together. The final model does not include all of the submodels from the conceptual modelling workshop as some were combined or excluded. This process was guided by the four scenarios. Figure 4 provides a conceptual diagram of the finished model that captures the submodels.

Figure 4: A Conceptual Diagram of the Ningaloo Destination Model



Summary: From Engagement to a Finished Model

The process of engagement that ran throughout this project was crucial to building the Ningaloo Destination Model. Engagement was important for three reasons. First, it ensured that the Ningaloo Destination Model would have the capacity to address key questions from different sectors, including the community, businesses, and key agencies. Second, it ensured that different perspectives informed the process of model development and were able to be tested within the model. This includes integrating information from a variety of different sources including different academic disciplines. Conceptual modelling was central to this process. Third, engagement ensured that the finished model would have a high degree of trust across different stakeholder groups and sectors. This is crucial to ensuring that the Ningaloo Destination Model will have an impact on management processes and decision making at the regional and state levels.

Chapter 4

USING THE NINGALOO DESTINATION MODEL

ADDRESSING THE ECONOMIC, SOCIAL AND ENVIRONMENTAL IMPACTS OF DEVELOPMENT DECISIONS

> We would like to take this opportunity to congratulate the Department on its systematic and comprehensive community consultation process. Departmental staff has been committed and diligent in maintaining contact with key stakeholders and have provided a variety of well-promoted avenues through which community members can have input. As mentioned in our submission, however, [our group] has concerns that the value of this consultation process is severely limited by the absence of parameters and information to guide the community in its assessment of this project.
> *Except from letter regarding a consultation process on the Ningaloo Coast*

Early Assessment of Decisions and Plans

Planning would be much easier if the impacts of a decision could be known while the plans were being made. The above letter excerpt points to a major problem in a decision-making or planning process—there is often insufficient information about potential impacts due to the expense of assessment across a wide number of fields. Even where there are separate environmental, economic and social assessments, there is often no consideration of how these could interact with each other. For instance, environmental impacts could reduce tourist numbers. This is not just an issue for community consultation. All assessments suffer from the same lack of information and understanding about the potential consequences of decisions.

Destination modelling provides information about impacts during the planning phase of a project or decision. At its broadest level, it can be used to assess broad regional plans, or how planning new developments in one area will impact on other areas. The examples used in this chapter operate at the broad regional level. The Ningaloo Destination Model can also be used to assess more specific localities. For instance, it can address campsite developments in Cape Range National Park, or changing residential or holiday accommodation in any of the three town sites. In addition to assessing planned events, the Ningaloo Destination Model can also assess the implications of unplanned events over which there is little control, such as a cyclone, a terrorist attack outside the region, or changes to airfares. The model relies on both data undertaken by research programs in the region (from an investment in research of over $30 million) and data available from other sources. It takes complex data from a variety of fields and organises it to address planning and management decisions.

This chapter describes the outputs from the Ningaloo Destination Model, focussing on how it takes a triple bottom line approach to assessing impacts. After looking at the economic, environmental and social indicators in the Model, this chapter uses two examples to describe how the model can be used to assess and weigh different planning strategies. These are: the current plans for the region (the Ningaloo Coast Planning Strategy); and a large resort development on the reef. The chapter finishes with a more detailed discussion of where the model can assist decision making through explaining the model's key characteristics.

A Triple Bottom Line Approach

Best practice in tourism has moved beyond a 'booster' approach that focuses on visitor numbers and economic impacts. The paradigm for tourism planning is now a triple bottom line approach that requires economic, social and environmental impacts to be addressed. The Ningaloo Destination Model facilitates a holistic approach to planning by addressing issues in each of these categories, as well as the implications for tourism itself, of any scenario run through the model.

The triple bottom line approach is in certain circumstances is extended to a quadruple bottom line approach which includes cultural impacts as a separate dimension. Culture is included in the 'social impacts' here, in particular through the cultural diversity of the visitor dimension. Indigenous culture is not included as a separate dimension for two reasons. First, the Aboriginal corporation that is most involved in tourism is a key stakeholder group and their concerns related to the expansion of tourism in Coral Bay have been included. These are the growth of Coral Bay as they have the opportunity to develop an ecolodge and workers' accommodation in Coral Bay. Additionally, the Baiyungu Aboriginal Corporation owns Cardabai Station, and would be potentially severely impacted by a large coastal development due to its proximity to Coral Bay. Second, the complexity of Indigenous culture (particularly relations between different individuals and groups) would have extended the complexity of the model beyond the resources and time frame of the project. This is an area that could be incorporated through future research. Third, the concerns of Indigenous stakeholders were focused on the economic dimensions and partaking in future development rather than on issues of access and traditional hunting and gathering.[7]

Tourism Impacts

The starting point for understanding all scenarios is how that scenario affects tourism. The economic, social and environmental impacts predominantly flow from changes in tourism, in particular visitor nights and visitor activities. Monitoring the amount and type of accommodation used and available also provides explanations about where tourism growth is limited. Table 6 below provides a list of the tourism impacts in the model and the different ways the impacts can be viewed. For instance, visitors and visitor nights could be viewed by their location (comparing Exmouth to Carnarvon), by the kind of accommodation visitors are staying in (campgrounds, caravan parks, backpackers, hotels, holiday rentals or other—predominantly with friends or family), by the origin of the visitor, by the visitor segment, or by the time of year that they visit (season). Viewing the different visitor origin and visitor segments allows for a greater understanding of how different groups impact the region. It is possible to trace this division through to activities and expenditure in order to assess their desirability, and through to accommodation to look at where and when they stay in the region.

As the region is highly seasonal there are variations between different times of the year (what we call tourism seasons in the model). The model has six seasons. From most busy to least busy, the seasons are: low season (November to start of April school holidays), April school holidays, medium season (end of April holidays to July school holidays), July school holidays, peak season (July to early September), shoulder season (September to October). The seasons are essential to understanding tourism under different scenarios. Increasing accommodation types will increase visitor load in the school holidays, but will lead to lower occupancy rates in the low season.

Visitor accommodation impacts can be divided into two types. First, the model provides information on the amount of accommodation available. This is set by the user at the beginning of the model run. As accommodation is a key limiting factor on visitor numbers, it is important that users are able to view and assess how this changes. Second, the model provides data on the amount of accommodation used and left vacant. This allows for assessment of the kind of growth rate necessary to fill a particular development, or whether the goal of a particular growth rate is feasible or desirable given the existing infrastructure and the resulting environmental and socio-cultural impacts.

Visitor activities are a key element of the model. Visitor activities are linked to both expenditure and ecological impacts. Certain activities are high cost (snorkelling or swimming with whale sharks), while others have a greater ecological impact (in particular, recreational fishing). There are twelve activities in the model, which were chosen based on the responses to the visitor surveys. These are: beach activities (excluding snorkelling); fishing from the shore; fishing from a boat; snorkelling: scuba diving; shopping; eating out; sightseeing; safari tours; whale shark tours; surfing/windsurfing; and other activities.

[7] They do not want to draw attention to the current informal arrangements that they view as adequate for their activities (interview, 10 March 2010).

Table 6: Tourism Impacts in the Ningaloo Destination Model

Impact data	How the impact data can be divided
Visitors	Location, Accommodation Type, Origin, Visitor Segment, Season
Visitor Nights	Location, Accommodation Type, Origin, Visitor Segment, Season
Visitor Load*	Location, Accommodation Type, Origin, Visitor Segment, Season
Accommodation Amount (beds)	Location, Accommodation Type
Accommodation Used/Vacant (beds)	Location, Accommodation Type, Season
Activities (hours undertaken)	Location, Origin, Visitor Segment, Season, Activity Type (12 activities in model)

*Visitors present in the region at the same time.

Economic Impacts

Possibly the most important impact of tourism in regional Australia is that it is an economic driver that can generate jobs and support communities in rural Australia through tourists' consumption. Although the visitor surveys (chapters 2 and 3) can provide us with tourism expenditure in the region, there are other measures that can better represent the true contribution of tourism activity, as tourism expenditure tends to be larger than the actual output of goods and services produced locally. This is because the region imports goods and services from outside for local use including tourism and many other sectors in the region. As the region has to pay for the imports, it is only the locally produced goods and services that generate benefits to the region through tourists' expenditure. Thus, what matters most to the households in the region is the income they bring home from working in the tourism sector and any return to capital invested in the tourism sector (value added); and, what matters to the government is the total amount of taxes paid to the government. All in all, the sum of value added and the tax revenue is the true contribution of the tourism sector to the regional economy, and this is defined as tourism gross regional product.

In addition to the economic contribution derived from visitor expenditure, we also include employment from tourism in the model estimated as number of jobs generated. This includes both direct employment in the tourism industry (working in visitor accommodation, as a tour guide) and indirect employment derived from the presence of tourists (a job in the supermarket created by the larger size of the town due to the presence of tourists).

Table 7: Economic Impacts in the Ningaloo Destination Model

Impact	How the data can be divided
Visitor Expenditure ($AU)	Location, Visitor Origin, Visitor Segment, Season, Expenditure Category
Employment from Tourism (jobs)	Location
Net Taxes on Tourism	Industry Sector, Origin
Tourism Value Added	Industry Sector, Origin
Tourism Gross Regional Product	Industry Sector, Origin

Social Impacts

Public perception of tourism tends to emphasise the negative social impacts, such as crowding and increasing rental prices. However, a more thorough analysis demonstrates that tourism brings both positive and negative social impacts. The residents' survey of Carnarvon, Exmouth and Coral Bay that was run as part of this project (described in Chapters 2 and 3) assessed residents' perceptions of tourism on their lives and on their community. Residents identified three key positive and three key negative impacts.

The most positive impact was employment in the tourism industry. Residents therefore considered the economic impact of tourism to be the most positive benefit to their communities. This was followed by the cultural diversity brought by tourists, which was measured in the model through the presence of international visitors. The third impact was the way that tourism showcased the region, increasing the value that the community placed on where they lived. This was measured through the hours that visitors spent on activities that

showcased the region, including sightseeing, snorkelling, time on the beach, safari tours, swimming with whale sharks and scuba diving.

The greatest negative impact was perceived impacts on the environment. This result is consistent with other community consultations that have been held in the region, including the Exmouth Structure Plan and a recent public consultation about the expansion of the Exmouth Small Boat Harbour by the Department of Transport. The environmental impacts are linked to fish stocks as this is the greatest impact of tourism and impacts on popular resident activities (fishing and snorkelling). The second most negative impact was delinquent behaviour and disturbances. This relates to both the presence of holiday rentals amongst residential housing, where visitors' late nights can disturb locals' sleep, and to seasonal workers and visitors creating disturbances from public drunkenness or similar antisocial behaviour. Interviews with the police indicated that tourists carried out virtually no assaults or burglaries. Delinquent behaviour and disturbances was measured through the number of holiday rentals and the number of transient workers in Exmouth. The third negative impact was overcrowding, which was measured through a ratio of the number of visitors present during the peak season to the number of residents.

A key difference between the locations was housing availability. Exmouth and Coral Bay both have housing shortages. In Exmouth, residents identified dislocation due to increased house prices as the most negative impact of tourism, while it was not a factor in Carnarvon. Due to the importance of housing dislocation in Exmouth and Coral Bay, we included this issue as a negative impact. It is measured through assessing the demand for housing relative to housing availability.

Table 8: Social Impacts in the Ningaloo Destination Model

Impact	How the data can be divided
Employment (jobs)	Location (three towns)
Cultural Diversity	Location (three towns)
Showcase the Region	Location (three towns)
Environmental Impact	Location (three towns)
Delinquent Behaviour and Disturbances	Location (three towns)
Overcrowding	Location (three towns)
Residential Housing Available/Demand	Location (three towns)

Environmental Impacts

Tourism to the Ningaloo Coast region is primarily nature-based and also relies on natural resources, such as water. This includes visiting the region to experience the reef and associated marine life as well as beaches and Cape Range National Park. A study by Carlsen and Wood (2004) highlighted the importance of the protected areas in this region for tourism, with more than 90 percent of visitors participating in nature-based activities in a protected area in the region. Given the central importance of the natural areas to continuing tourism, careful management is required to ensure the impacts of tourism activities do not compromise the natural values of these areas.

Tourists visiting the Ningaloo region also rely on access to limited natural resources, such as fresh water as well as energy. Given the annual number of tourists to towns such as Exmouth and Coral Bay far outstrip the resident population, consumption of water and power is high relative to the number of residents. The large number of tourists means their demand for water and power is higher than that of the resident population. Careful management is required such that finite resources such as fresh water are used in a sustainable manner such that resident populations are not denied this resource while tourism activity is supported. The large number of tourists to the region also results in a higher demand for energy relative to the resident population size, which more than doubles in the region as a whole during the busiest times of the year. This can result in increased costs as demand outstrips supply and new generators are required. For these reasons, continued monitoring of environmental impacts and resource use is necessary to ensure sustainable use. Use of this data in a destination model can help inform planners of likely consequences on natural assets given particular tourism development scenarios.

The Ningaloo Destination Model calculates two kinds of environmental impacts. The first is use of natural resources. Water is a key resource in the region. The Shire of Exmouth has an average annual rainfall of 200 millimetres per year. The region is reliant on underground water from the Gascoyne River in the south and the Cape Range Aquifer in the north. If water is overdrawn, these two water sources will take many years to recover. At present, the wells are monitored by the Water Corporation and restrictions are put in place if salt is greater than 1000 parts per million. The region has a finite water supply that needs to be both carefully invested in future growth and conserved.

Horizon Power supply electricity to the region. Expansion of generators is expensive and there are plans to use alternative sources of energy in Carnarvon. Landfill is managed by the Shires, who will need to put land aside for future landfill sites. The model also calculates the additional human waste of different levels of development.

Water use, electricity use and waste generation can all be reduced. The model assists managers explore these options through allowing them to test different resource saving devices. For instance, the impact of introducing recycling can be run through the model, producing outputs for both total amount of landfill generated, the amount of landfill reduced, and annual figures on waste generation. This is a way of exploring how to manage a valuable resource like water in a way that maximises its return for the community.

The ecological impacts are calculated through an ecological model of the region developed by Beth Fulton from the CSIRO's Marine and Atmospheric Research Division using Ecopath software. Changing patterns of visitor use are calculated in the Ningaloo Destination Model, which are then run through the ecological model. Outputs can be displayed for the whole of the Ningaloo Coast, or on a map with a 10 km grid. Key outputs that relate to recreational fishing are for the biomass of fish stocks and spangled emperor, which is the key target species and is also considered an indicator species by marine scientists, and catch rates. These results also feed into the social impact indicators due to their connection to the marine environment and their impact on an important resident activity. Other key species are coral and whale sharks due to their importance for tourist activities. Coral is impacted by the volume of snorkelling and the visitor mix, as educated snorkelers have much reduced impacts compared to uneducated snorkelers. Whale sharks could be reduced through increased shipping and recreational boating due to resource sector development. Marsupials are also included as reduction in kangaroos is a measure of road kill, which also links to safety issues. There is virtually no chance of the kangaroo population in the area being decimated.

Table 9: Environmental Impacts in the Ningaloo Destination Model

Impact	How the data can be divided
Water (GL)	Location, User Group (Tourism Accommodation/Resident/Other Industry)
Electricity (KWH)	Location, User Group (Tourism Accommodation/Resident/Other Industry)
Landfill (M3)	Location, User Group (Tourism Accommodation/Resident/Other Industry)
Human Waste (L)	Location, User Group (Tourism Accommodation/Resident/Other Industry)
Impact of Sustainable Technologies	On water, electricity, landfill
Fish Stocks (biomass)	Whole Region, 10km Grid
Catch Rates (biomass)	Whole Region, 10km Grid
Coral (biomass)	Whole Region, 10km Grid
Spangled Emperor (biomass)	Whole Region, 10km Grid
Whale Sharks (biomass)	Whole Region, 10km Grid
Marsupials (biomass)	Whole Region, 10km Grid

Case Studies: Two Futures of the Ningaloo Coast

Developing an asset as valuable as the Ningaloo coastline has been controversial and not without political fallouts. The Western Australian Liberal Party's decision to support a large marina development at Maud's Landing a few kilometres north of Coral Bay caused a media campaign by environmental groups that contributed to their loss in the 2001 state elections. The Gallop Labour government rejected the marina proposal and in 2004 launched the *Ningaloo Coast Regional Strategy*. The Regional Strategy had at its core an approach that located high-intensity development in the towns of Carnarvon and Exmouth while protecting the existing values of the coast, in particular the remoteness and environmental values. The Coastal Strategy capped Coral bay at 3600 people, and specified nodal developments of varying sizes along the coastline. As a result of the strategy, Coral Bay had a large state investment to provide clean water and power, and there are plans to develop workers' accommodation.

The two case studies explored in this chapter relate to the decision to pursue a 'nodal' development rather than a large resort development. The first case study explores the *Ningaloo Coast Regional Strategy*. The second case study explores a theoretical resort development on the coastline. As such the case studies explore the differences between a nodal development and a resort development in an environmentally sensitive region with highly seasonal visitation. These are the two alternative futures the region was facing in the early 2000s.

Each of the case studies is preceded by a scenario, which is a brief description of the future that the model is addressing. More detail makes a scenario more comprehensive and easier to understand as there are fewer unknowns. The scenarios are presented as stories about a particular future that frame the results from the model.

The case studies provide information at the scale of the entire region. It should be noted that the same results can be provided for six subregions (described below), which ensures that the model is relevant for town planning (Carnarvon, Exmouth and Coral Bay) and land managers (Cape Range National Park).

The Ningaloo Coast Regional Strategy

The Scenario

The Ningaloo Coast Regional Strategy began to be rolled out in 2004. Following much debate in 2011, it becomes the centre piece of a bilateral approach between the Liberal and Labour political parties in Western Australia. The nodes identified in the coastal areas on the pastoral stations are incrementally developed until they reach full capacity in 2034. This is a major change on the pastoral stations as the campsites that previously dominated the coastline are almost halved as new hotel and caravan park developments are built on some of the existing campsites. However, 600 campsites are retained. There are also over 800 new hotel beds and 150 caravan park sites. These new visitors do less fishing, but more beach activities and snorkelling than the campers they have displaced, who now travel further north for their camping holidays. Coral Bay grows to 3200 tourist beds, with most of the growth occurring once the workers' accommodation has been built. Of the three town sites, Exmouth experiences the largest growth, with 4 hotels being developed in the marina and its surrounds in the 2010s, before the town consolidates with little growth in the following years. The region as a whole remains dominated by caravan parks, which have more capacity than the campsites, hotels, backpackers and holiday rentals combined. Hotels had the most growth, tripling in capacity to 3000 beds. Campsites are the only category of accommodation which has reduced.

Growth to the region is steady but not rapid, with an average growth of 2 percent in the peak season, and smaller levels of growth in the shoulder and off seasons. The exception is the pastoral stations, where the new accommodation drives a growth rate of 4 percent as groups that had previously only stayed in the towns take advantage of the new facilities and access points.

Changes to the Region

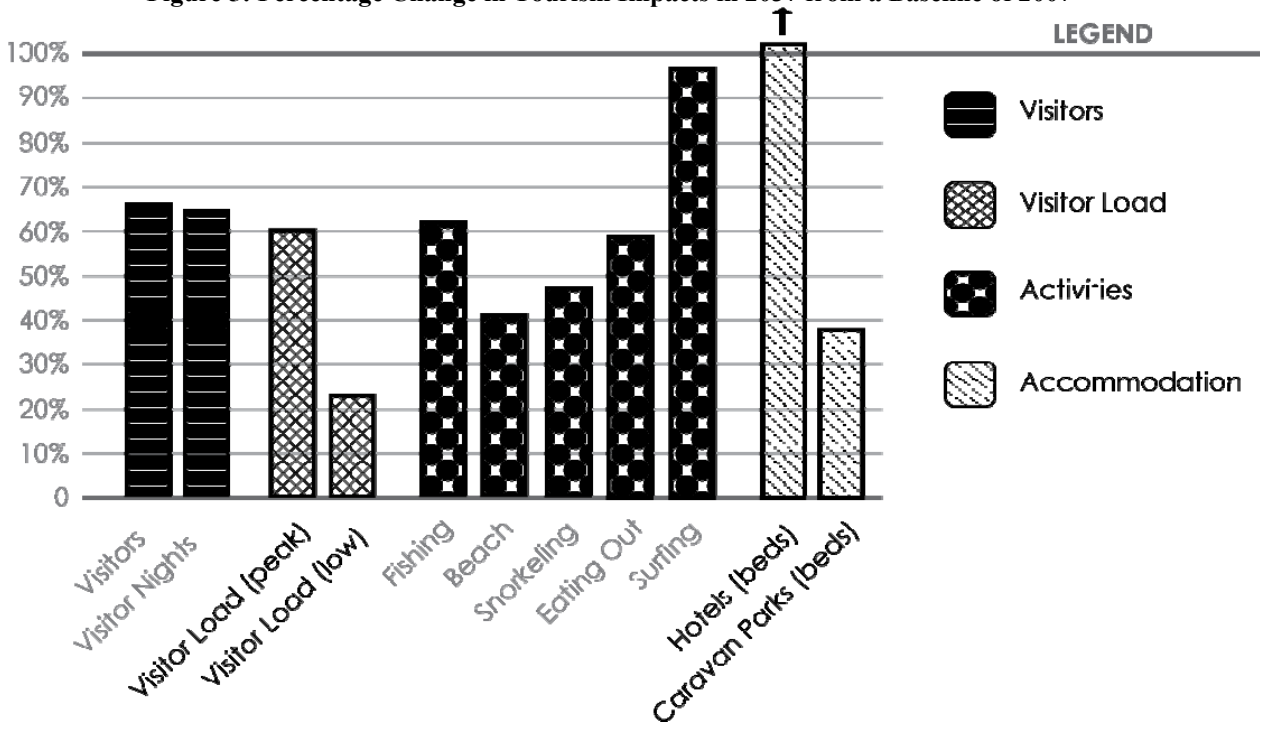
The graphs below summarise the changes to the region addressing changes to tourism, the economy, social impacts and environmental impacts. The graphs present the percentage change in 2037 from 2007 levels. This is a convenient way to look at how the region has changed from 2007. Data are provided in the text.

Visitors to the region increase by 66 percent with 300 000 people visiting the region for the first time in 2031. Visitor nights increase by a slightly smaller percentage as the visitor mix has changed to attract shorter-staying visitors in most of the coastline, with the exception of Carnarvon where growth has mainly been in caravan parks. While the region previously had approximately 9000 visitors staying at the same time during the school holidays, this has now increased to 13 000 in 2037. Low season numbers have also grown by a much smaller margin from 1200 people to 1600 people. Tourism is still seasonal, creating problems for tourism businesses.

Visitor activities have grown markedly as well. Fishing has increased by 60 percent despite the reduction in campsites. This is because of the availability of fishing across the region compared to other activities (like snorkelling and going to the beach) which are only available in certain areas. Growth in caravan parks, particularly in Carnarvon, increases fishing to a greater degree than other activities as certain visitors spend much of their time with a line in the water. Snorkelling increases by 48 percent, but this is concentrated in particular areas—it amounts to a doubling of snorkelling in Cape Range National Park, which required a large public investment to cope with the influx of visitors to its most popular snorkelling spots and beaches. Eating out is important to visitors. Surfing almost doubles, but this is from a very low base. The most common activity is still fishing, which surpasses the other activities.

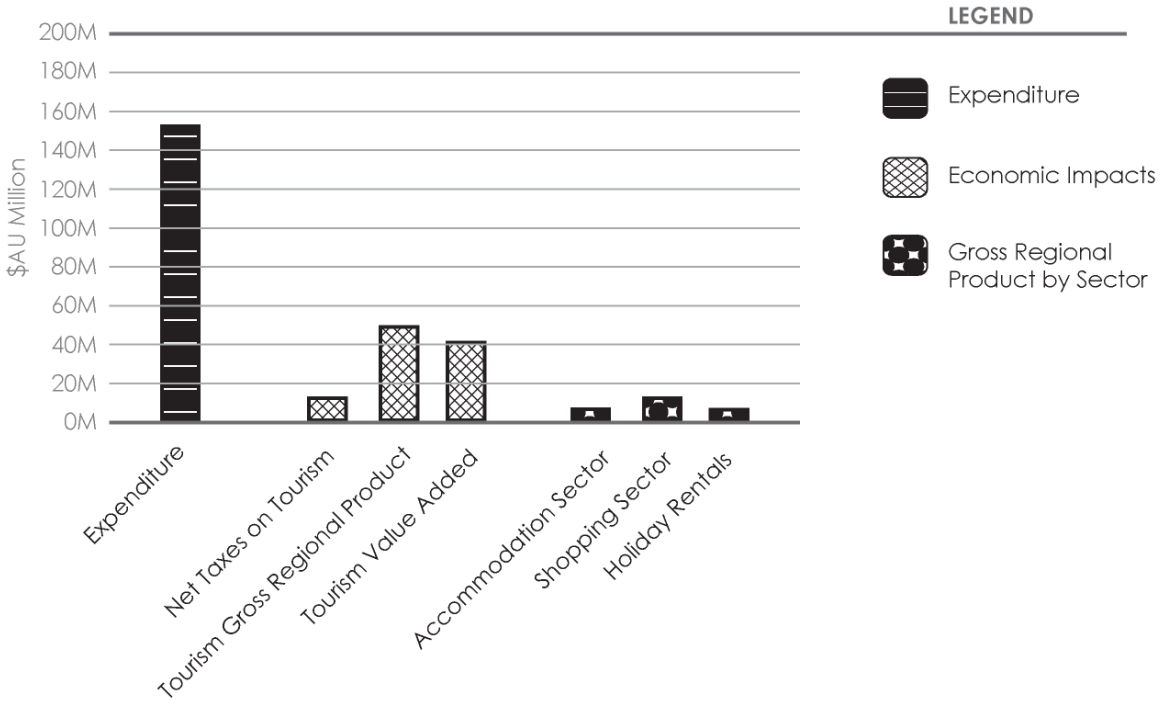
Changes in hotels and caravan parks were mentioned previously—hotels increased in capacity by over 200 percent to 3000 beds, while caravan parks increased by 37 percent, but still are by far the most common accommodation type with a capacity of over 8000 beds.

Figure 5: Percentage Change in Tourism Impacts in 2037 from a Baseline of 2007



The economic impacts of implementation of the NCRS blend with growth in Carnarvon and Exmouth. Overall, expenditure increases from $95 million to $155 million, an increase of over 60 percent. However, as explained in the economics section earlier in this chapter, visitor expenditure does not all benefit the region exclusively as many goods and services in small, remote locations like Carnarvon and Exmouth are imported into the region. Regional Value Added is the economic impact of tourism once purchases of these goods and services have been allowed for. Tourism Value Added is $40 million in 2037, an increase of 65 percent. Tourism's contribution to Gross Regional Product increases from $32 million to $52 million, with almost three quarters generated by domestic visitors. The three industry sectors that experience the most economic impact from tourism expenditure are shopping ($11 million), accommodation ($6.3 million) and holiday rentals ($5.9 million). Employment due to tourism (included in the social impacts discussion below) doubles, as the growth in hotels generates more employment in the region, to 1400 people (see Figure 6).

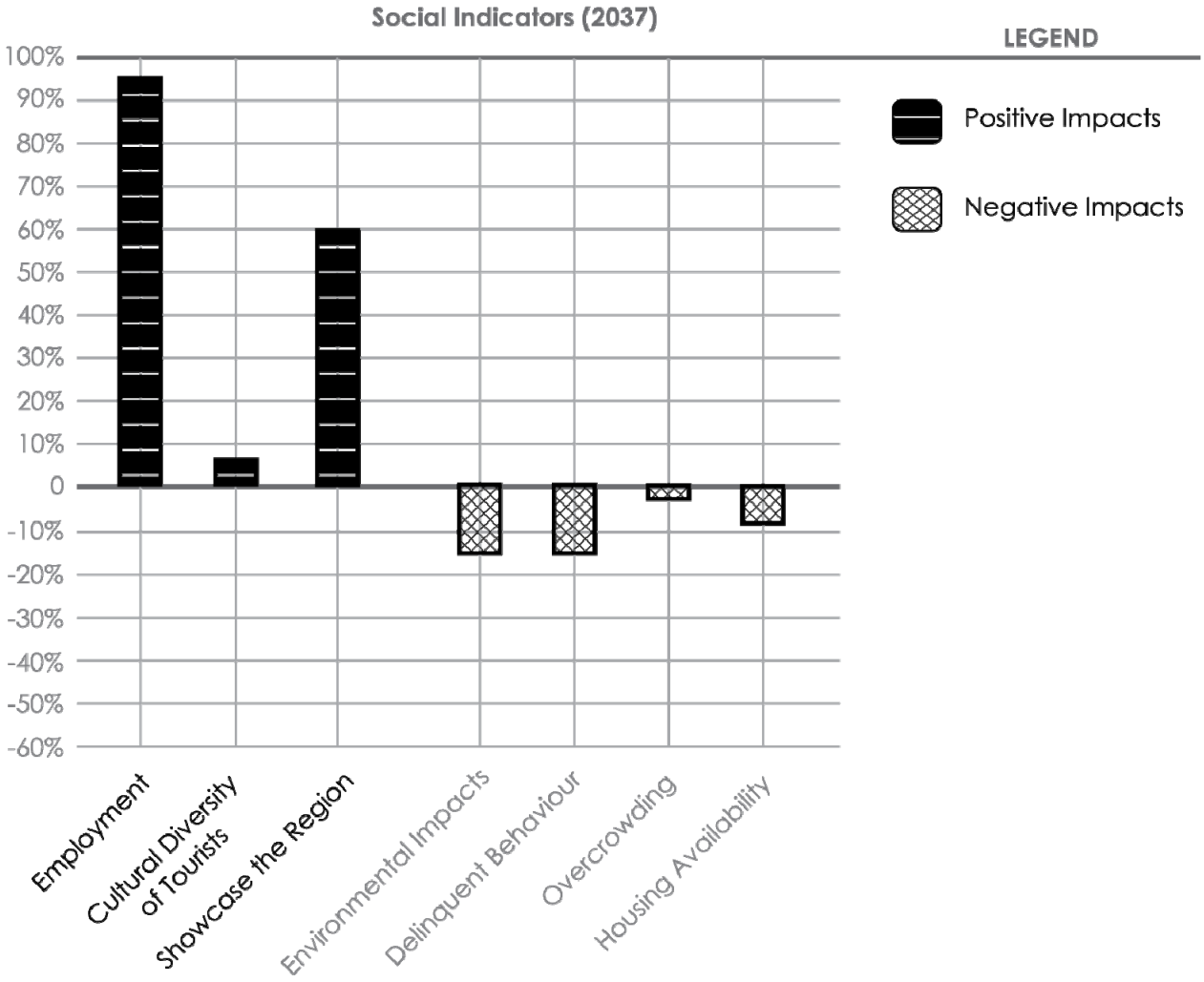
Figure 6: Economic Impacts in 2037 in $AU Million



The social impacts of growth in the Ningaloo Coast Regional Strategy are summarised in Figure 7. Employment is the greatest benefit. However, the greater amount of people coming to the region also creates more opportunities to showcase the region, increasing community pride. Cultural diversity amongst tourists due to tourism (measured here as the proportion of international tourists to domestic tourists) increases marginally—although there are more international visitors, there are also more Australian visitors.

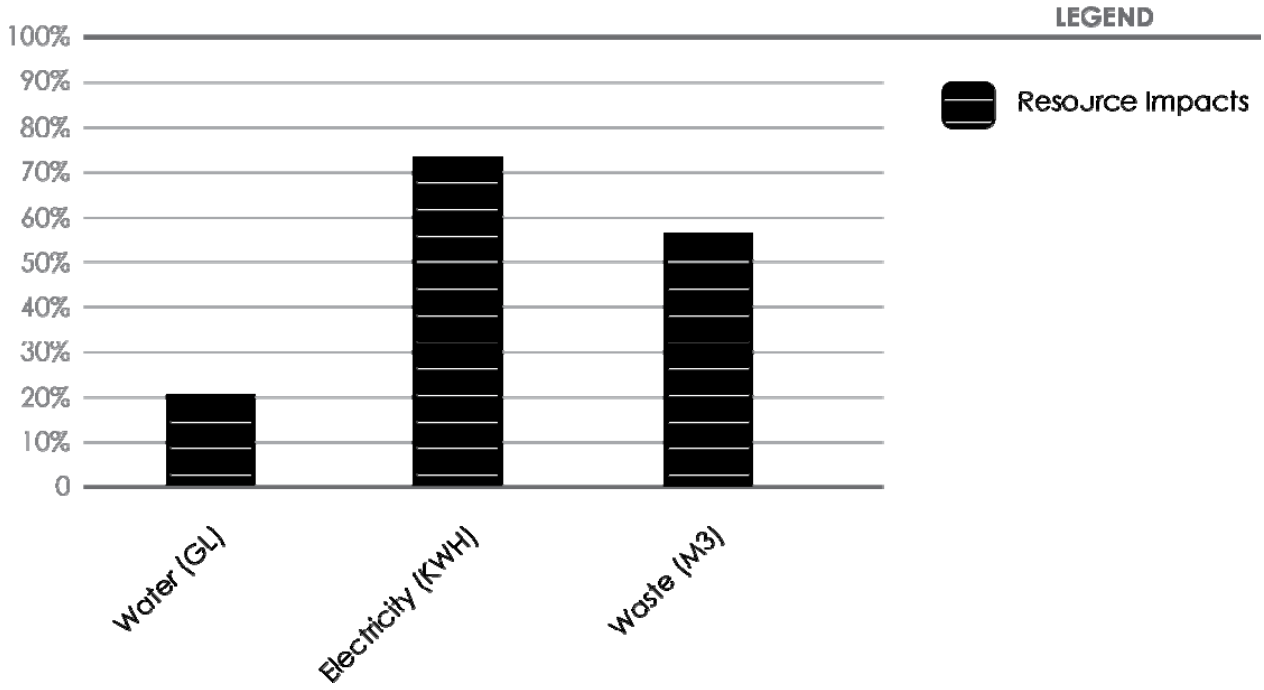
Negative social impacts are also felt by the region. Decreases to fish stocks and impacts on corals cause negative feelings due to tourism increase. Delinquent behaviour also increases due to greater numbers of holiday accommodation next to resident accommodation and higher levels of transient workers. Overcrowding is addressed in Coral Bay through the workers accommodation, but is still an issue in Exmouth and becomes more of an issue in Carnarvon. Growth in resident accommodation in Carnarvon and Exmouth is beneath the growth rate of the population required for tourism to grow. The regional population grows to over 12 000 people, with the largest growth in Exmouth, which now houses over 4000 residents. This is a major change for a town that has experienced only small growth since its inception in the early 1960s when it was built to house 2500 people. Residential accommodation is a major limiting factor on regional growth.

Figure 7: Percentage Change in Social Impacts in 2037 From A Baseline Of 2007



Tourism growth has increased resource use. The growth in residents and visitors has increased water use by 20 percent to over 150 000 GL (see Figure 8). While not reaching the limits of water draw on the underground water supplies, water restrictions are more common and have more impact on the agricultural sector. This scenario does not include expansion of other industries including agriculture, which could further restrict supply. Electricity increases by over 70 percent. Electricity supply is expanded in Exmouth to address increasing demand. The nodal developments are forced to supply their own power through generators and some alternative energy sources, supply their own water and to ensure that they do not allow waste water to enter the ocean due to their proximity to the Ningaloo Reef. They are using over 20 000 KWH and 71 GL of water, which they are self-managing on the coastline, with close monitoring by the Shires and utility providers. The provision of these services is very expensive, which greatly increases the cost of staying in the new hotels and caravan parks in this subregion.

Figure 8: Percentage Change in Resources Impacts in 2037 from a Baseline of 2007

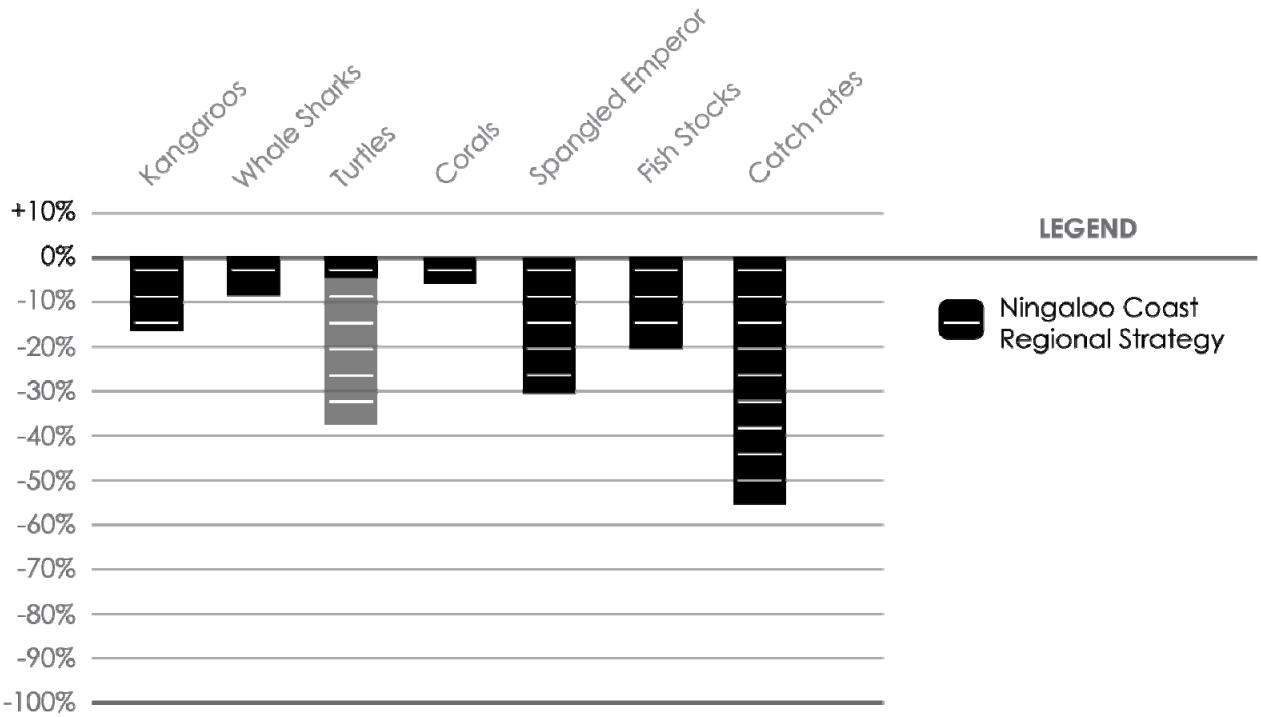


There are negative ecological impacts from fully implementing the Ningaloo Coast Regional Strategy (see Figure 9). This is not surprising given the increase in visitors and the growth in residents. The kangaroo population remains at a similar level. Whale sharks decrease by 5 percent due to increased strikes from boats. However, the whale sharks that are currently the focus of whale shark tourism are the smaller sharks that stay near the surface. A small decrease of 5 percent results in the possibility of not seeing a shark while on a tour doubling, causing greater cost to the industry as they have a policy of a free repeat tour if a whale shark is not sighted. Corals decrease by 4 percent, but this is concentrated in the areas where the majority of people snorkel. The easily accessible corals in the most popular coral viewing spots in Coral Bay and Turquoise Bay are severely degraded. Fish stocks are reduced by 14 percent and catch rates reduce by 15 percent. Spangled Emperor, the key target species in the northern part of the region, is reduced by 20 percent by recreational fishing. These kinds of reductions impact an important part of the ecosystem and a popular resident activity.

The impacts on turtles depend on maintaining fox baiting in the region. With fox baiting, turtle numbers are only reduced by 5 percent (represented by the darker part of the graph). Without fox baiting, turtle numbers reduce by over 40 percent (the grey part of the graph). As long as fox baiting continues indefinitely, the turtle population remains close to the current level.

It should be remembered that this result assumes that current regulations stay in place for recreational fishing and boating. Another scenario we ran in the region changed recreational fishing regulations to 'wilderness fishing' standards, which specifies that fishers can only catch what they are going to eat that evening. Under this scenario, catch rates increased from the current levels by over 20 percent, and the available fish increased in size—fishers were taking less fish, but they caught them faster and the fish were larger.

Figure 9: Percentage Change in Ecological Impacts in 2037 from a Baseline of 2007



A Large Coastal Development

The Scenario

An alternative strategy for tourism development in the region is a large coastal enclave. During the review of the Coastal Strategy in 2011, the idea of a large coastal resort is revived. Proponents argue that the coastal resort will cater for the high-income residents in the Pilbara in particular, who already are using the Ningaloo Coast to recreate. In contrast to the phased development of the Coastal Strategy, the resort is built over four years beginning in 2014. It incorporates 900 hotel beds, 900 caravan beds, 700 beds in holiday rentals, and 500 backpacker beds. The new visitors attract a visitor mix much like Exmouth—mainly Western Australian, but with a number of internationals and interstate visitors. A major difference to the Ningaloo Coast Regional Strategy is that the resort development does not reduce coastal camping along the pastoral stations, which expands with the increased marketing and access that accompanies the resort.

Growth to the rest of the region is again steady but not rapid, with an average growth of 2 percent in the peak season, and smaller levels of growth in the shoulder and off seasons. However, the resort drives growth up substantially in the pastoral stations, resulting in growth rates in the years following the development well above 10 percent.

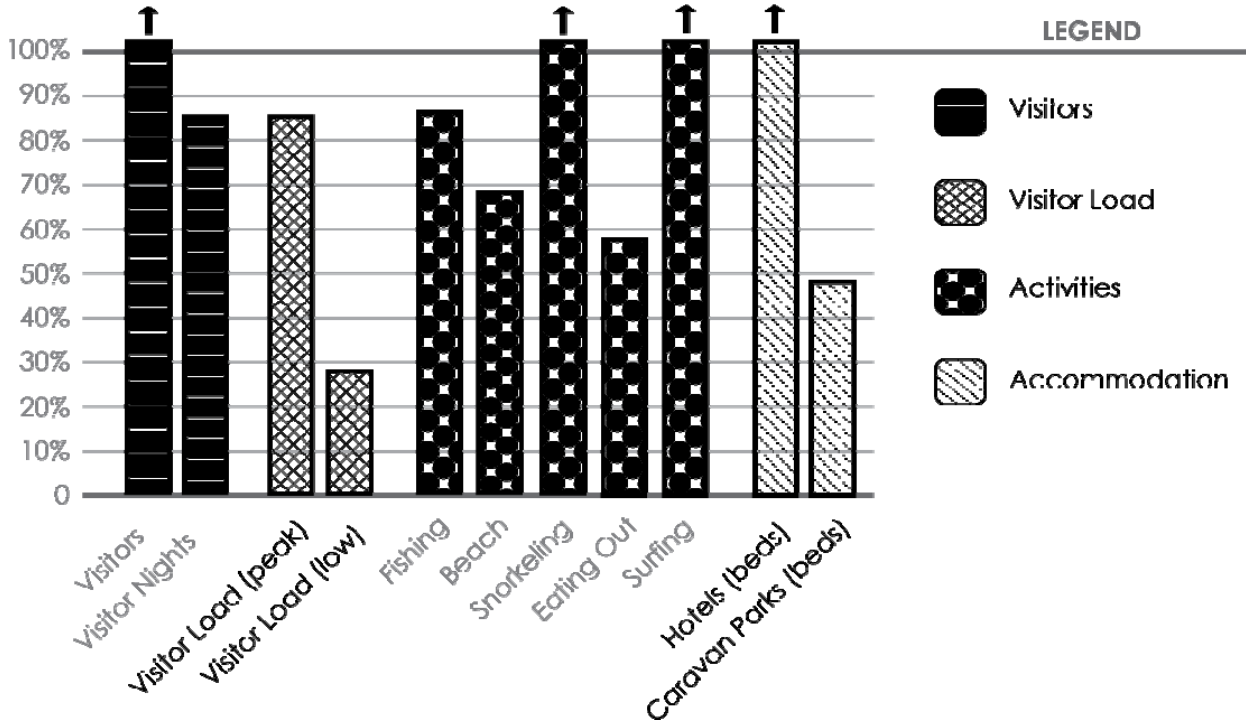
Changes to the Region

Visitor arrivals are nearing 400 000 in 2037, over double the current visitation level and 20 percent more than under the Coastal Strategy (see Figure 10). Visitor nights increase by 86 percent, as the growth in visitors who stay for shorter periods outstrips the visitors who stay for long periods. Visitor arrivals on the pastoral stations where the resort is located increases by 500 percent, although visitor nights in this region increase by 200 percent as there is a much shorter length of stay in the resort compared to the campgrounds. Low season numbers have grown slightly to over 1600 visitors per night. The region now has a peak 16 000 visitors staying at the same time during the school holidays, 3000 more than would be the case under the coastal strategy. Hotels increase to over 3000 beds (240 percent) and caravan parks to 8500 beds (50 percent).

These extra visitors are located right on the beach, close to the reef, which increases activities that use the beach. Snorkelling effort doubles to 102 percent more than 2007 levels. Beach going increases 68 percent to over 900 000 hours. Surfing increases threefold, but from a low base, to over 300 000 hours per year. The most popular beaches, surf spots and fishing spots are in constant use. The greatest increases are around the resort,

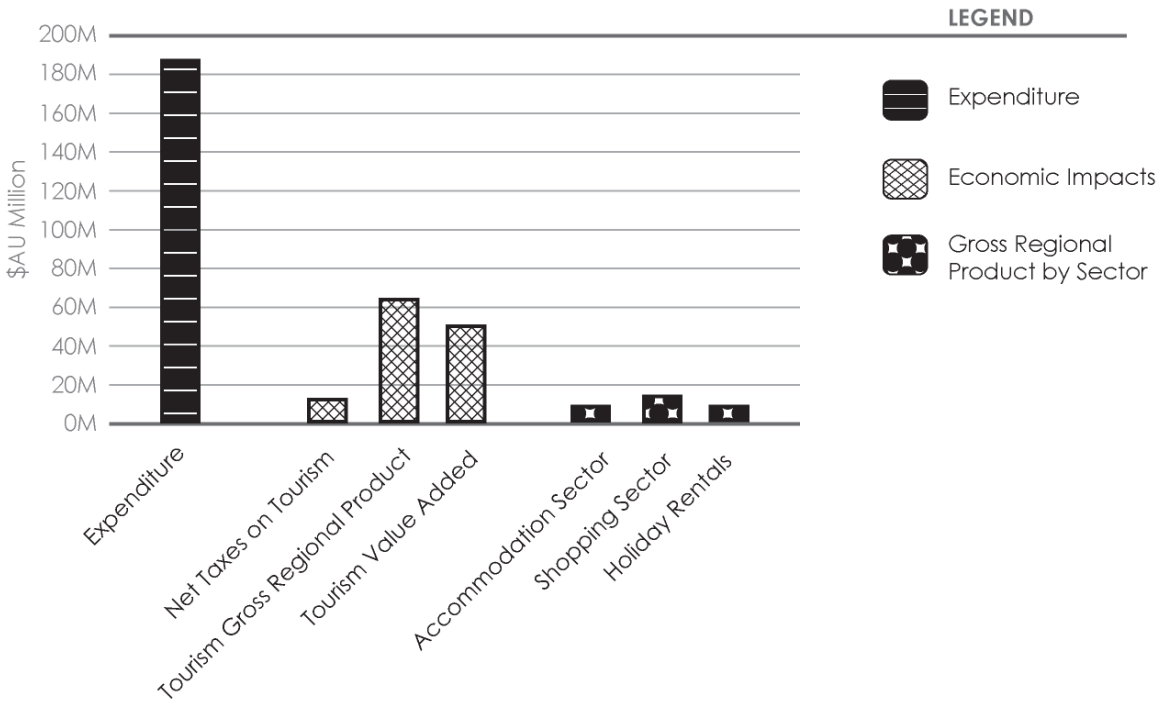
with increases of over 120 percent in fishing, 400 percent in snorkelling and 150 percent in beach use. This is driven by the large increase in visitation of over 200 percent in what is at present an area without the infrastructure to support medium-large scale development.

Figure 10: Percentage Change in Tourism Impacts in 2037 from a Baseline of 2007



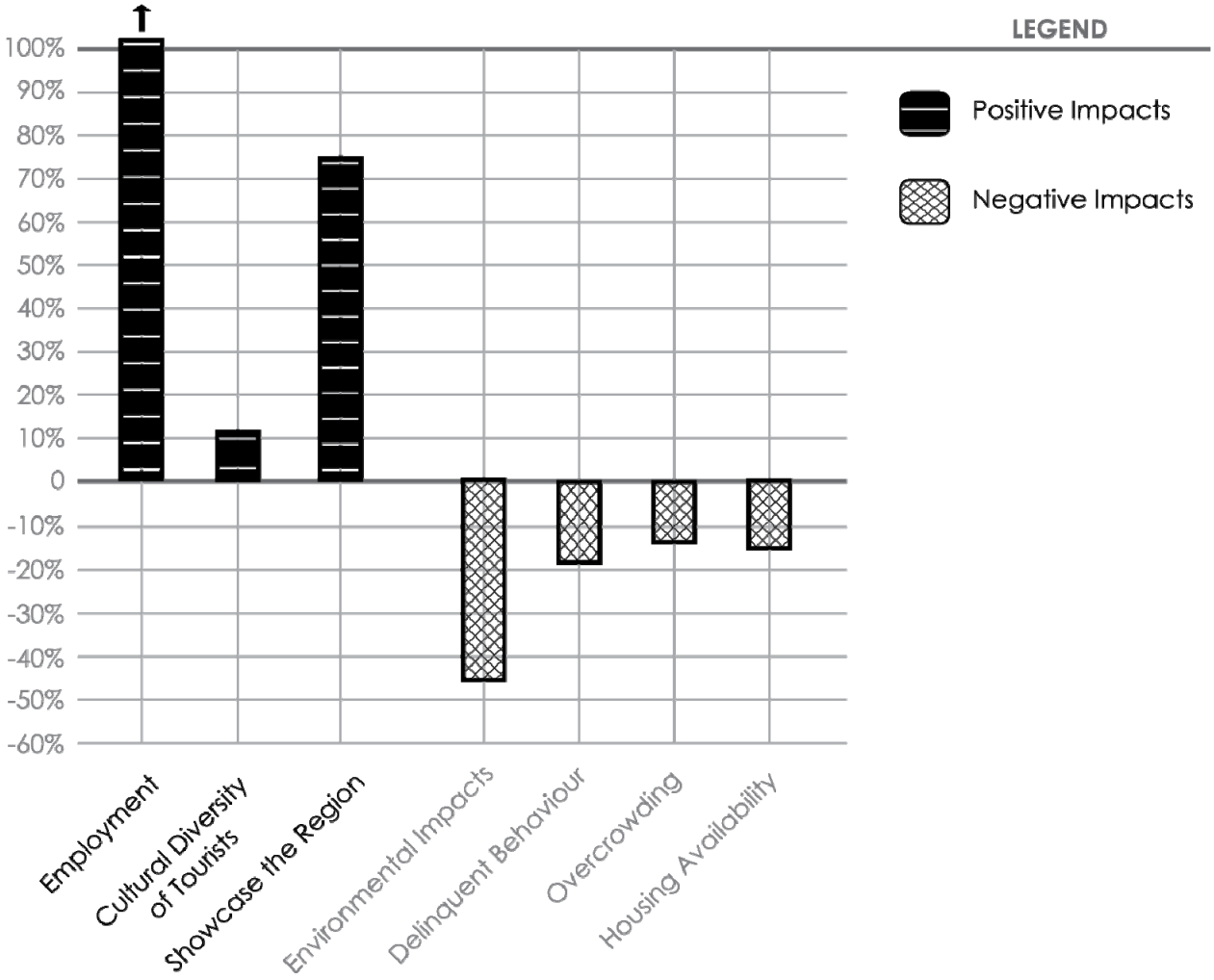
A resort development has a larger economic impact. If we look at the whole region, expenditure increases by 98 percent to $185 million (see Figure 11). Expenditure in the pastoral stations where the resort is located increases by over 300 percent. Tourism Value Added for the whole region increases to $50 million, which is $10 million more than in the Coastal Strategy case study. Tourism's contribution to Gross Regional Product increases by 50 percent to $63 million in 2037. The shopping, accommodation and holiday rental sectors all derive a larger increase in Gross Regional Product under this scenario, with shopping increasing to $13 million. The economic benefits are greater under this scenario. Employment, which is discussed in more detail in the social impacts section, increases by 113 percent to over 1400 employees, and employment from tourism in the pastoral stations increases tenfold to over 200 from its current level of approximately 30 people.

Figure 11: Economic Impacts in 2037 in $AU Million



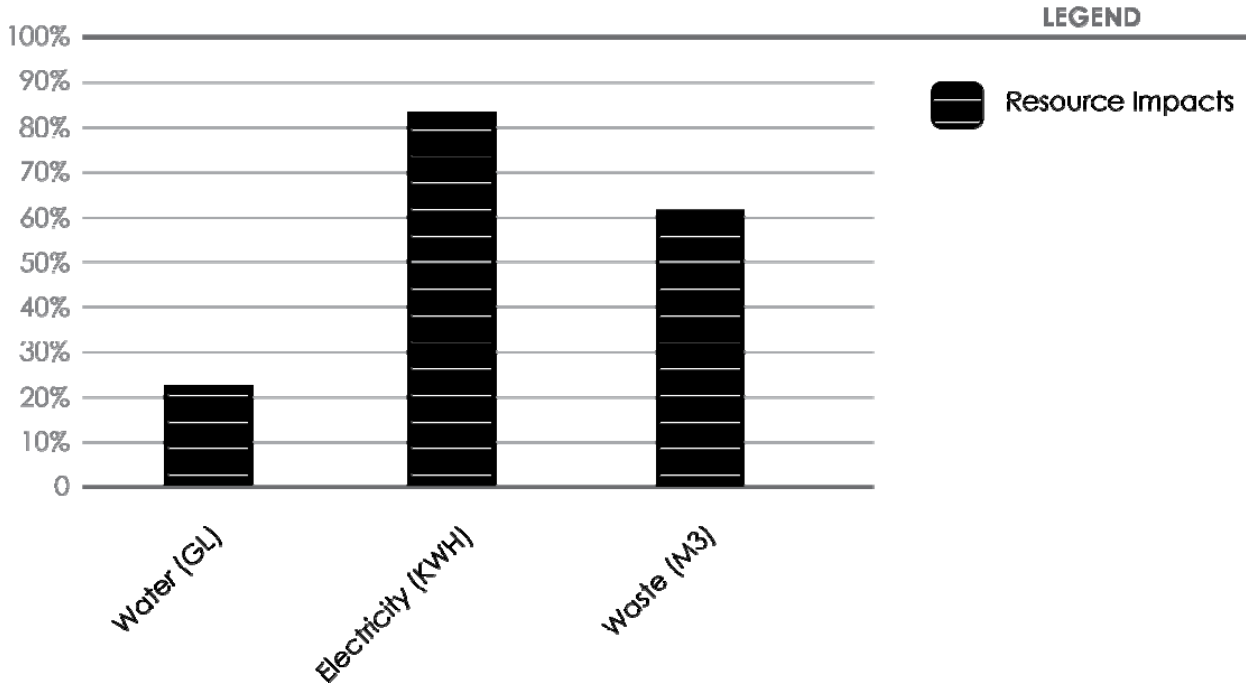
The social impacts of the resort are most positively felt through increased employment, which is higher due to the resort expansion (see Figure 12). Cultural diversity and showcasing the region are also higher due to a higher proportion of internationals and increased visitor hours undertaking activities that highlight the region's natural attractions in particular. The negative impacts are most felt through increased environmental impacts due to the much higher level of activities in the pastoral stations region. Environmental impacts from tourism more than double, increasing resident dissatisfaction with tourism. Delinquent behaviour and housing availability do not differ greatly from the Coastal Strategy as the additional growth occurs outside of the town sites where the communities are located. However, crowding increases in the most popular snorkelling and fishing spots and most popular beaches.

Figure 12: Percentage Change in Social Impacts in 2037 from a Baseline of 2007



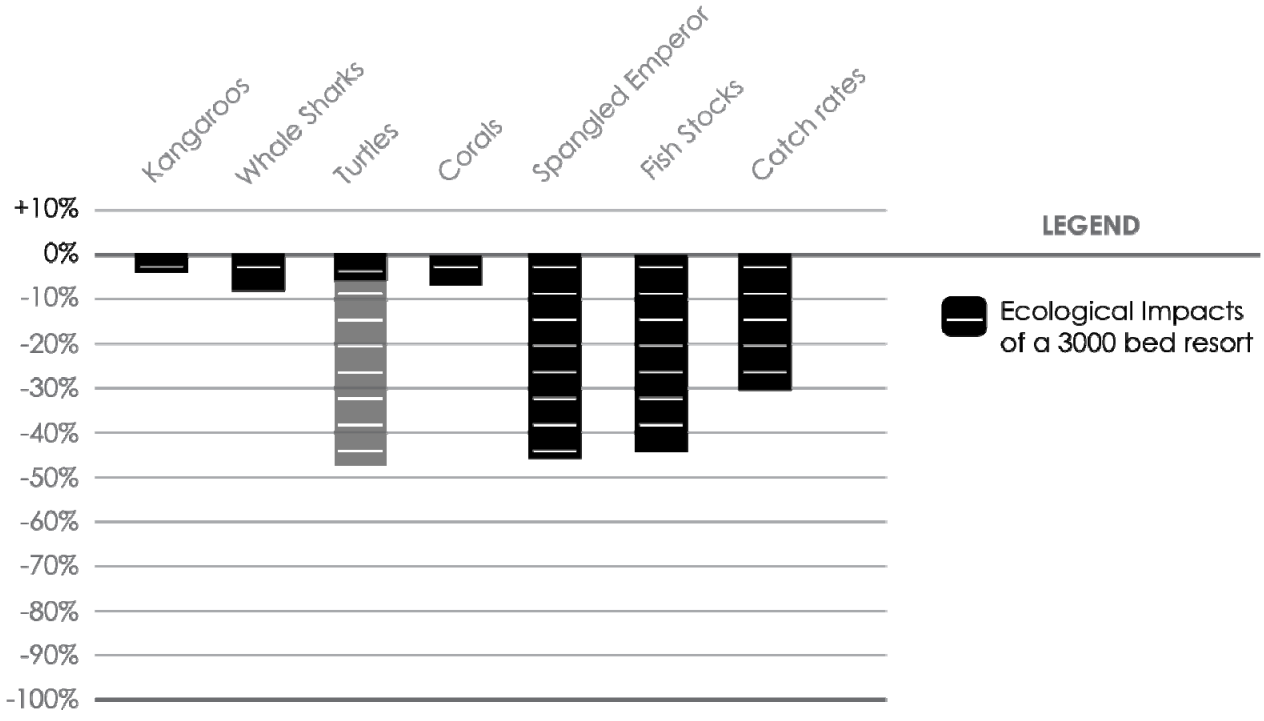
The resort development pushes up resource use in the region, but only marginally when looking at the region as a whole (Figure 13). Water use only marginally changes if looking at the whole region due to high water use in other industries like horticulture, but is an increase of over 900 percent in the pastoral station region. This is a concern due to the proximity to the reef and connectivity between groundwater and the reef that has been demonstrated by Lindsay Collin's research (presented to Ningaloo Research Program researchers at an Integration Workshop in March 2010). Electricity use increases by 83 percent in the Ningaloo Coast, and by a factor of 13 in the pastoral stations. Landfill in the pastoral stations increases by over 300 percent. Such changes could have a major impact on the coastal area surrounding the resort.

Figure 13: Percentage Change in Resources Impacts in 2037 from a Baseline of 2007



The ecological impacts of a large resort development are greater than the Regional Strategy (Figure 14). Drops in whale shark numbers and corals are only a couple of percent more, but these are amongst the whale sharks and corals that tourists can most easily access. Turtles would be more affected without baiting (the grey part of the graph), but can maintain their population as long as baiting continues (the darker part of the graph). The largest impacts are in fish stocks, in particular the popular spangled emperor species, which drops by 45 percent. Catch rates in the region fall by 30 percent, impacting a popular resident and visitor activity. These changes assume current fishing regulations stay in place. It is easy to test different regulatory regimes in the model, such as the wilderness fishing mentioned previously.

Figure 14: Percentage Change in Ecological Impacts in 2037 from a Baseline of 2007



Comparing Scenarios

The most effective means of assessing scenarios is to view two or more together in order to understand what is lost and gained when choosing one of two strategies. Figure 15 compares the two scenarios in two spider diagrams, with the Ningaloo Coast Regional Strategy presented on the left, and the 3000 bed resort development on the right. Spider diagrams are effective at presenting comparative data through the extent to which the shaded area extends to the edge of the diagram. For the ecological indicators, the higher species amounts and higher catch rates are represented by a higher score on these scales. Higher levels of visitor nights, gross regional product, housing availability and water availability are also represented by higher scores on these scales, extending the shaded area further towards the edge of the graph. This is perhaps best understood by turning to the graphs themselves.

The Coastal Strategy performs much better in terms of protecting the coastal assets, represented by the way the left side of the Coastal Strategy plot has a shaded area that extends closer to the outside of the graph. It outperforms the Resort in terms of maintaining catch rates, spangled emperor and corals (although coral reduction in key snorkelling sites is still a concern). However, the resort attracts more people, generates more Gross Regional Product, and more employment, represented by the way the shaded area of the large resort plot extends to the edges in the top right hand corner. The greater level of employment under the resort scenario contributes to increased pressure on housing availability. Housing availability is a major restriction on future growth as it limits employee availability—a crucial factor in the expansion of the tourism industry. Water use is an issue in the region, but there is little difference in water use between these scenarios when viewed from the perspective of the entire region (both scores quite similar). In summary, the Ningaloo Coast Regional Strategy appears to meet its goal of protecting the existing values of the region while contributing to regional development when compared to the alternative of a large resort development. The costs of increased tourism and economic returns are primarily environmental, which has consistently been identified as a major concern of the local communities in our workshops and in other community consultations.

While the previous summary captures the key differences, readers who are familiar with these kinds of graphs will appreciate that they can accentuate differences and similarities depending on the scales used. For this reason we examine the graphs in more detail and draw more detailed conclusions. The three ecological categories addressing spangled emperor, coral and catch rates measures change in the amount (biomass) of different species and the rate of catch from 2007 levels after 30 years in 2037. The scale for spangled emperor and catch rates is 0 to 100 percent at 2007 levels. This means that a decline of 90 percent would reduce the graph by 90 percent for spangled emperor and catch rates. While the Coastal Strategy reduces spangled emperor biomass to 79 percent of 2007 levels, the large resort reduces it to 55 percent. The focus here is largely through the pastoral stations, flowing north and south from Coral Bay which is the major recreational fishing launch point for this part of the coast. Catch rates are similar in nature. The Coastal Strategy reduces catch rates to 85 percent of 2007 levels, while the resort reduces catch rates to 69 percent. It should be remembered that there have already been large, unrecorded declines in catch rates since the early 1990s.

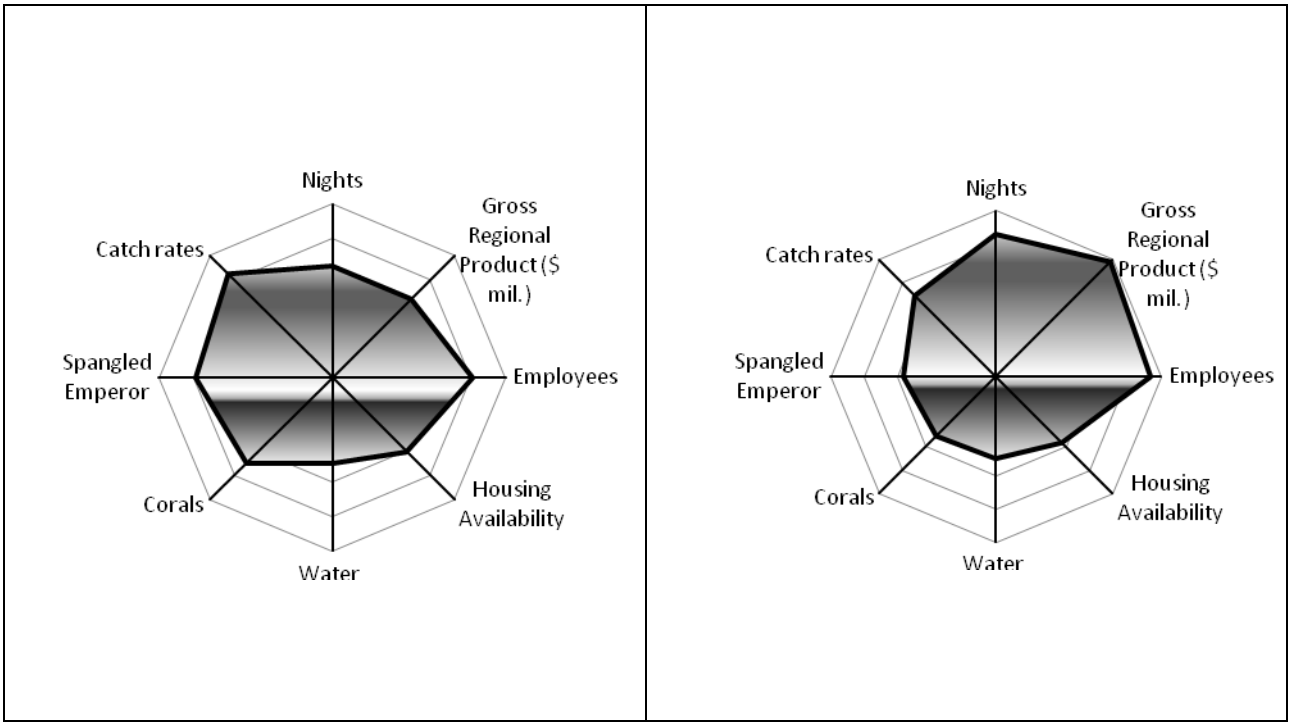
Coral decline differs from these two catch rates in that decline is strongly concentrated in areas of high use. A decline of 5 percent in coral biomass would be focused almost entirely in the most popular snorkelling spots (Coral Bay and Turquoise Bay in particular) and in the most accessible, in-shore areas, reducing these areas to rubble. The scale for coral is from 100 percent of biomass to 90 percent of biomass, as a 10 percent decline would be devastating for all of the popular snorkelling sites. The resort has a much higher impact on corals, and is focused in the areas closest to the resort, in particular Coral Bay, which would lead to a major decline in the quality of corals close to Coral Bay.

The other measures are also calculated as a percentage change from 2007 levels. The scale for visitor nights is from a 0 percent increase to a 100 percent increase (from 1.57 million to 3.14 million visitor nights). Gross regional product is from a 0 percent increase to a 100 percent increase (from $32 million to $64 million). The increase in employees is over 100 percent for the resort development, so the scale is from 0 to 120 percent (from 698 to 1535 employees). The desirability of these kinds of increases depends on the region's capacity to provide additional infrastructure and their desire for the kinds of lifestyle changes that this kind of growth brings. This is partially captured in the housing availability and water measures.

Water use also uses the percentage change since 2010. However, a doubling of water use would far outstrip supply without expensive infrastructure investment. The scale for water use ranges from no increase to a forty

percent increase (from 130 000 GL to 182 000 GL), which spans a large increase in water given the current resource limits. An important factor that is hidden by the regional scale is the way that the resort increases water use in the pastoral stations much more than the Coastal Strategy (155 GL versus 72 GL for the Coastal Strategy). Groundwater availability on the pastoral stations is highly uncertain and there is a strong likelihood that it is connected to the ecology of sections of the reef. Therefore, a large draw on groundwater could change the ecology of a section of the reef. Water may need to be provided by expensive techniques (such as desalination), and may need to be financed by the accommodation providers. Housing availability is a function of houses required versus the potential of the region to provide houses. It calculates this pressure using both the extent of time that there is no housing available and the number of people looking for housing. In both scenarios the growth in population outstrips the growth in housing. Housing availability should be used here to compare runs.

Figure 15: Comparing the Ningaloo Coast Regional Strategy (left) with a 3000 Bed Resort Development (right)



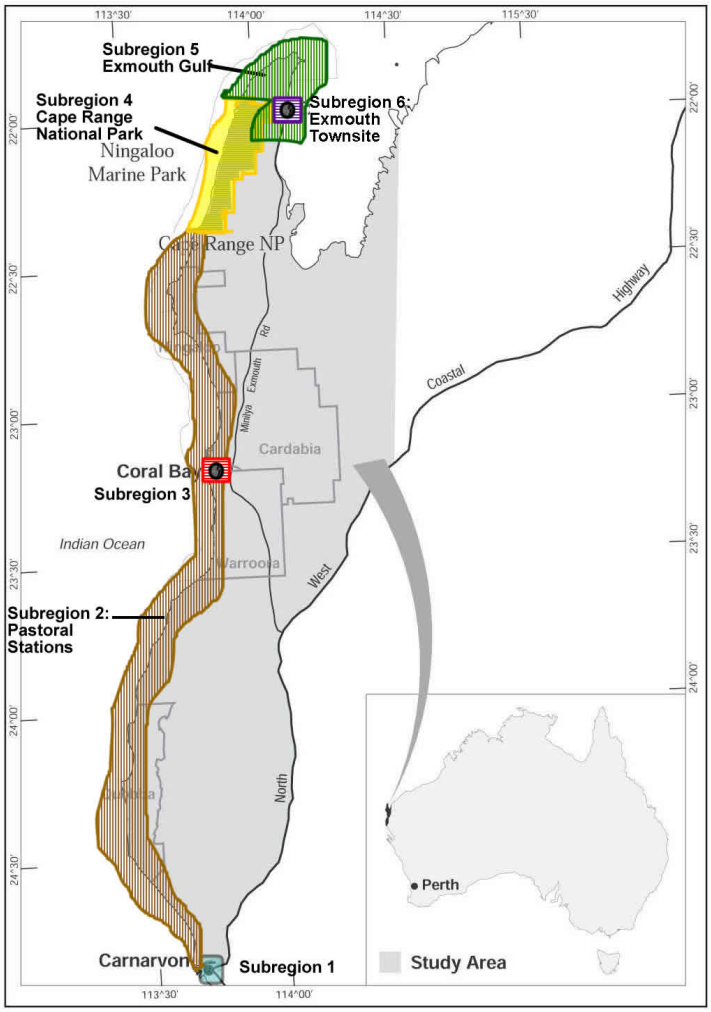
Key Characteristics of the Ningaloo Destination Model

This final section provides information that contributes to a deeper understanding of the operation of the Ningaloo Destination Model. Understanding the kinds of issues that the model can address requires an understanding of the details of key characteristics. This includes: the scales at which the model operates, the kinds of questions it can answer at these different scales; the shocks it can assess; and the different visitor segments that circulate within the model.

Scale

The Ningaloo Destination Model operates at three scales. First, it can assess impacts over the entire Ningaloo Coastal area. This can be helpful when comparing regional plans. Second, it operates at what we call the subregional level. The model includes six subregions and takes into account interactions between subregions. For instance, if there is tourism development in Exmouth, the model will calculate the subsequent increase in activities in the nearby Cape Range National Park. The subregions allow for separate assessment of, for instance, a tourism strategy in Carnarvon, or a new Structure Plan in Exmouth. The subregions are provided in Figure 16. Third, the ecological impacts can be calculated at the smaller scale of a ten by ten kilometre grid, using Ecopath with Ecosim software.

Figure 16: The Six Subregions



Modified from Department of Conservation and Land Management (2005b)

Types of Assessment

The Ningaloo Destination Model enables the examination of scenarios to guide future land-use planning of the terrestrial environment that would also influence the marine environments of Ningaloo (see Table 10). The model can assess the implications of changes in the number and kinds of tourists (discussed in the section that follows on the visitor segments). The model can also assess the impacts of shocks such as cyclones or pandemics or the loss of a significant tourism asset through events such as coral bleaching or cheaper plane ticket prices. At a very practical level, the model would enable the examination of scenarios driven by policy decisions; providing a tool through which to gaze into different futures shaped by land-use planning. The focus of the case studies is on this practical application.

Table 10: Examples of the Kinds of Changes the Model can Assess

Different activities and events	
Increasing or decreasing different types of visitors	Labour shortages/limits
Increasing or decreasing different types of tourist activities (e.g. snorkelling, fishing, whale sharking—linked to type of tourist)	Effect of growth of resource sector on tourism
Shocks to tourism (e.g. cyclones, terrorist attacks, financial crisis)	Cheap or expensive flights to the region
New infrastructure	
Providing different types of accommodation (e.g. caravan sites vs. . hotels vs. resident accommodation for oil and gas workers)	Adding new infrastructure (boat ramps, roads, waste facilities, parking lots, moorings)
Management interventions	
Different types of regulations (e.g. for fishing, scuba, snorkelling, beach access, etc.)	Changing zoning and land-use
Conservation measures	
Reducing water use	Reducing waste generation
Reducing electricity use	Introducing recycling

Shocks to Tourism

Shocks to tourism supply or demand refer to unexpected interruptions. This could be a natural disaster, such as a cyclone, or an event outside the control of the region, such as a pandemic or a terrorist attack that affects tourists' travel planning. The shocks included in the model are listed in Table 11, with reference to the data that was used to calculate the impacts.

The shocks can be split into two categories: international shocks and local shocks. International shocks are generated from outside of the region. Recent events, in particular the Bali bombings and the SARS virus, had implications for tourism to the Ningaloo Coast. While these events caused international visitation to decline slightly, domestic visitation increased for two years, then decreased sharply once Australians decided to travel overseas rather than take domestic holidays. The years with the highest visitation for the region were 2002 and 2003 due to these events. The oil impacts were assessed through surveys looking at travel intentions which yielded some data. However, intentions to travel in the future are hard to gauge in a survey. More relevant information was gained by looking at other countries which had experienced large increases in petrol prices (beyond the levels experienced in Australia which have not yet reached a point that have prevented people travelling in large numbers). Europe and New Zealand proved fertile examples. Peak oil was examined through modelling undertaken by the CSIRO in Australia and the Scottish Tourism Association. Airfares were examined through looking at experiences in other parts of Australia and the current travel patterns of the visitor segments in the model. The region is a self-drive region at present. However, the model has the capacity to examine the impact of the visitor segments that travel by plane increasing with cheap airfares.

Table 11: Shocks to Tourism Included in the Ningaloo Destination Model

Shock	Data
Terror Attack	Impact of September 11 Events and Bali Bombings
Pandemic outside Australia	Impact of SARS on travel in Asia and Australia
Pandemic inside Australia	Impact of SARS on travel in Asia and Australia
Global financial crisis	Changes in travel patterns in 2008-2010
Spike in Oil Prices	Changes in oil prices in Europe, New Zealand and over last five years in Australia
Peak Oil (low impact)	CSIRO Forecasting, Scottish Tourism Association Forecasting
Peak Oil (high impact)	CSIRO Forecasting, Scottish Tourism Association Forecasting
Cyclone	Cyclone Vance Impacts on Exmouth
Cheap Airfares	Budget Airline, Broome, Travel Pattern Information from surveys
Reduced Air Service	Budget Airline, Broome, Travel Pattern Information from surveys

The Visitor Segments

Key drivers of change in the region are visitor numbers and visitor types. For instance, different types of visitors will want to stay in a 4-star hotel than those who want the isolation of camping on a beach in a pastoral station with no running water, electricity and a long drive from the nearest supermarket or restaurant. Different visitor segments prefer different activities and have different patterns of expenditure and stay.

After long discussion, it was decided that visitors should be divided by both their origin (intrastate, interstate, international) and also by their holiday preferences. Factor Analysis of the 1574 visitor surveys used visitor preferences to identify three groups (see the STCRC Technical Report *Ningaloo Coast Region Visitor Statistics* for more detailed analysis of this division (Jones et al., 2009)), which were then divided again by origin.

The Comfortable Visitor

The first visitor type places a higher importance on facilities in the region and on sightseeing than other groups. The consistently high scores in the areas of facilities indicated that this experience was linked to travelling in a region that provides a well developed and maintained infrastructure for tourism, in particular self-drive tourism. We labelled this visitor experience the **Comfortable Visit**. These visitors tend to be older and place higher importance on camping facilities, going to viewpoints, bitumen access roads and toilet facilities. Interstate visitors were more likely to seek this kind of experience.

The Nature Lover

The second visitor experience received the highest scores for the natural environment (although it should be noted that all groups rated the natural environment as important) and accessing Ningaloo Reef. We labelled this visitor experience the **Nature Lover**. Nature Lovers tend to be younger and stay for shorter periods. They place a high importance on the natural environment, snorkelling, tours, going to the beach and a low importance on fishing. International visitors are more likely to be in this group and they tend to have higher expenditure levels.

The Fishing Escapee

The third type of experience was highly correlated with fishing, escaping from cool weather and getting away from it all. We labelled this experience the **Fishing Escape**. This group tends to be older and stays for the longest period. This group tends to place a low importance on other activities and has the lowest levels of expenditure. Visitors were divided by both their origin and their visitor segment, which makes nine groups. However, only a very small number of internationals were classed as fishing escapees, so this group was excluded. This left eight groups within the model.

Table 12: The Eight Visitor Segments

	Comfortable Visitor	Nature Lover	Fishing Escapee
Western Australian	1. WA Comfortable Visitor	2. WA Nature Lover	3. WA Fishing Escapee
Interstate	4. Interstate Comfortable Visitor	5. Interstate Nature Lover	6. Interstate Fishing Escapee
Overseas	7. Overseas Comfortable Visitor	8. Overseas Nature Lover	(Excluded due to small size)

Conclusion

A triple bottom line approach is now a requirement of planning more broadly and tourism planning in particular. The Ningaloo Destination Model enables decision makers and communities to weigh the benefits and costs of alternative decisions and plans during the planning process. The example of comparing the Coastal Strategy with a large resort development indicates the model's usefulness at the broad strategic level. It can also be used for more immediate planning decisions, such as deciding on whether to expand campgrounds in Cape Range National Park, or while developing a tourism strategy for Carnarvon. The next chapter examines the Model's range of applications for the Ningaloo Coast in more detail, and the possibility of applying the model to other locations with a smaller investment in research.

Chapter 5

THE APPLICATIONS OF DESTINATION MODELLING: TO NINGALOO, OTHER REGIONS AND OTHER SECTORS

A Destination Model integrates a wide variety of datasets for a tourism destination, providing a triple bottom line assessment of potential change to a region. Using a tool that can assess the potential impacts of decisions has a variety of applications beyond the broad regional planning explored through the case studies in the previous chapter. This chapter examines four overlapping applications of the Ningaloo Destination Model: operational planning, regional planning, participatory planning, and ongoing monitoring.

The broader relevance of destination modelling rests on its capacity to be applied to other regions. The key to the quick application of the model is to use existing data as much as possible and to retain a focus on stakeholder engagement. The essence of the issue is to ensure that data quality is not compromised by the requirement of rapid model development. The chapter concludes with a discussion about the potential of the destination modelling methodology for other industries.

Destination Model Applications

Operational Planning and Decision Making

The Ningaloo Destination Model makes its greatest contribution to land-use planning, including the implications of tourism land-uses for communities, businesses and the environment. The model has already been used to assess operational plans in Cape Range National Park through an assessment of changes in waste, human waste, and activity patterns of increasing the number of campsites. The model can also assess structure planning to examine residential and visitor accommodation issues and the flow on effects on recreational activities, resource use, social impacts and ecological impacts.

The model can assess plans that impact on access, such as a new boat ramp or increasing access to a particular beach or snorkelling site. Upgrading the Tantabiddi boat ramp was assessed in the model and found to have a small impact on fish stocks. However, a boat ramp on the southern point of the reef was found to have a large impact as it increases access to a location that currently has few access points for larger boats.

The model can also assess the impacts of events, such as a surf competition at Gnaraloo or a fishing competition at Exmouth. This includes both the added expenditure by visitors and the ecological impacts of having greater numbers on the coast and increased fishing effort.

Testing of operational planning and decision making in the model should also include measures to mitigate impacts. The model allows users to change resource use through increasing recycling or through introducing water or electricity saving measures. Fishing regulations can also be changed, and users can alter the visitor mix to explore how attracting different kinds of tourists impacts the region. These kinds of applications are particularly relevant for the Shires and the Department of Environment and Conservation.

An issue with operational planning and decision making is that it often assumes that the future will not be any different from today. The model can also be used to test how external changes could impact the operations of a specific organisation. For instance, growth in Exmouth has large implications for Cape Range National Park. The model can be used to calculate the levels of use of Cape Range National Park given different trajectories of growth in Exmouth, which then can inform future planning for the National Park, as well as Ningaloo Marine Park.

A powerful feature of the model is its capacity to focus on impacts at the subregional scale, and to quantify the impacts between subregions. Being able to focus on a particular subregion, such as any of the three town sites of Carnarvon, Exmouth or Coral Bay, or Cape Range National Park, allows for operational planning and decision making to be tested in the model.

Regional Planning

The Ningaloo Destination Model has the capacity to assess regional plans, and to make changes to achieve desirable outcomes. For instance, development can be spread out, or focused in one region. Accommodation development could focus on any of five different accommodation types. The Ningaloo Coast Regional Strategy and hypothetical resort development explored in the previous chapter could be compared with an expansion of Coral Bay, or substantially reducing camping. The visitor mix can be changed to explore the benefits of focussing on a specific visitor segment. The model operates is a way to compare the potential impacts of different plans, and then adjusting plans to improve outcomes.

An issue with regional planning is the cumulative impacts of different plans for a region. For instance, the new structure plan for Exmouth potentially expands the town well beyond the limits explored in the Ningaloo Coast Regional Strategy, the current regional land-use plan. The model can assess the cumulative impacts of different plans being implemented in the region. Additionally, the impact of broader changes on tourism, such as resource expansion in the northwest, can also be tested to explore how they could impact tourism and their ecological impacts. Preparing for cumulative impacts and contingencies greatly enhances the power of a regional plan and its capacity to respond to external and unexpected pressures.

An important element of using the model is to explore mitigation measures when costs are viewed as too great. This could be reducing resource use, or changing access to sites in order to protect an area of high social or ecological value, or altering the accommodation or visitor mix. Planning can also take into account unexpected events (the shocks described in the previous chapter), such as cyclones or interruptions to travel, and prepare strategies to respond to these contingencies.

Participatory Planning and Collaborations

The scope of the Ningaloo Destination Model provides the Ningaloo Coast region with a tool that connects the concerns of different agencies and groups. Impact assessments often only assess the immediate area around a development (for instance, run off from a hotel, the expenditure of visitors) without considering their broader implications (the activities of the additional visitors, the ecological impacts of those activities). The model provides implications of tourism development in the surrounding regions on, for instance, the Ningaloo Marine Park and Cape Range National Park. This would provide a way for the Department of Environment and Conservation to provide detailed comments on new plans about how they are likely to respond to increasing or changing pressures. Water and electricity use modelling can connect planning to utility providers. The model results can be a focus for collaboration between a variety of different agencies at the early stages of a project, providing information for strategic decisions and flagging unexpected consequences.

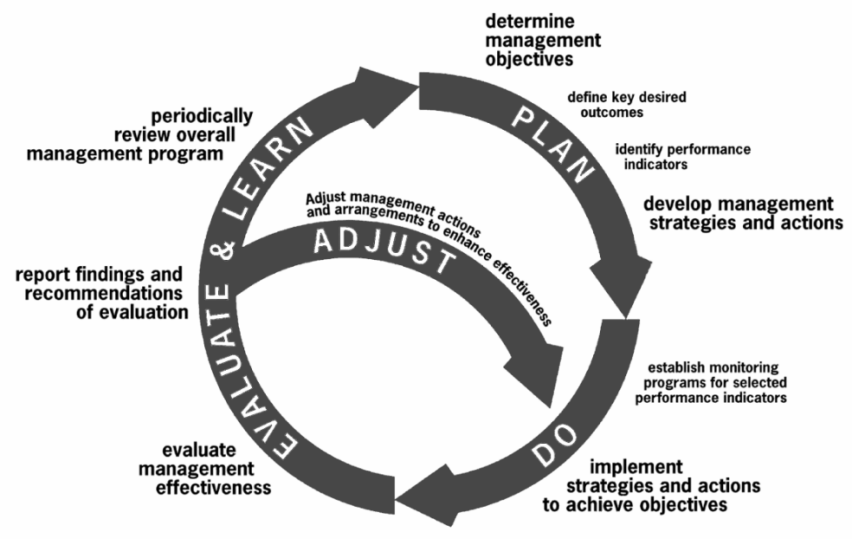
The model also provides an avenue for community groups to understand a fuller range of implications of different development decisions. Quite often community groups do not have the opportunity to explore a full range of impacts of a proposed plan or to test their ideas. The model can provide community consultations with a detailed picture of what the future holds under different planning strategies. The model has been used to inform a tourism strategy for Carnarvon. The two directions the strategy proposed could be held up to each other and compared, allowing those present to make a more informed decision about the consequences of the different directions. The model could inform a community visioning process on the region's future, with the outcomes selected by participants setting the criteria for proposed plans. The model would provide a powerful tool for an Enquiry by Design process.

Monitoring and Evaluation

Modelling is most effective when incorporated into an ongoing process of planning and adaptation. Modelling can assist monitoring in the first instance by identifying what indicators need to be monitored and at what scale. However, modelling is most effective when incorporated into a process of adaptive management.

A model of an adaptive management cycle is provided below. The adaptive cycle was developed as a tool for managing locations or resources that are impacted by both people and natural cycles. This could be as large as a water catchment or fishery, or be limited to a particular piece of land or type of plant or animal. The adaptive cycle enhances management through building in evaluation and adjusting strategies based on the results of evaluations. Modelling allows for a range of plans to be assessed immediately before a decision is taken. Once a decision is made, based on a range of data including the modelling results, monitoring is used to both refine strategies and the models that informed the strategy. Such a process ensures that the model is kept up to date and relevant, and that decisions on evaluation and planning are using accurate data.

Figure 17: The Adaptive Management Cycle



Source: www.cmar.csiro.au/research/mse/

Limitations of the Model

Tourism is an uncertain business. For instance, despite thousands of dollars spent on data and research, experts still struggle to predict tourist numbers. The Ningaloo Destination Model does not predict the future. It will not tell you how many people will be staying in hotels in Exmouth in 2024. What it does is provide insights into the future and its uncertainties and possibilities, which can be used in planning today. It helps us understand what is going on today, and plan for an uncertain future, using the best data available.

The Ningaloo Destination Model does not seek to proscribe an optimal strategy or decision. Instead it seeks to provide users with the information on which to base a rational decision, given their own objectives, preferences, and attitudes to risk. The point of the model is to learn how the 'system' responds to policy initiatives and sudden changes, rather than to give 'the answer'.

Broader Application of the model

Building Tourism Destination Models for Australian Destinations

The model can be applied to other regions by replicating the process for the Ningaloo Destination Model. The key issue is data availability, although stakeholder engagement is also important. Many of the key relationships are captured in the data, in particular where there are limitations on growth. In this section we discuss the data that are needed to populate the model and the options and issues surrounding this data.

The Ningaloo Destination Model utilised existing data, surveys and agreements with utility providers. To test the extent to which data is available for other tourism regions, we identified the data that would be required for a destination model of a tourism region. We then attempted to locate the data for the Margaret River – Augusta region of Western Australia. Margaret River – Augusta is a significant tourism destination with an emphasis on food and wine tourism and nature-based attractions including beaches and national parks. Links to the sources that you can use for your region are found in Appendix A, and the specific sources for the Margaret River – Augusta region are summarised in Appendix B.

The extent of data collection should be in proportion to the intended purpose of the destination model. A simple destination model would apply to one region (no subregions), keep all of the core features of the tourism system and elements of the social and environmental impacts. Research techniques developed by Whitelaw and Jago for the STCRC (2008) may make it possible to inexpensively disaggregate local government area information into subregions, which increases the scope for an inexpensive multi-region model. The destination model would address three visitor segments: international, interstate and intrastate visitors and would separate these into overnight visitors and day-trippers. The model would have the capacity to calculate how changes in

accommodation and visitation would impact on expenditure, activities, employment and use of resources (water, electricity and waste). Modelling of impacts on the ecology of the region would require an ecological model that could be integrated with the destination model (such as an Ecopath with Ecospace (EwE) model) that would need to be developed by ecological modellers). However, increased levels of activities also provide an indication of ecological impact. The data would be calculated annually or quarterly, but with additional information could include a seasonal breakdown.

Three Categories of Data

The data can be divided into three broad categories: tourism data; water, electricity and waste; and employment and accommodation capacity data.

Tourism Data

The tourism data is available for all local government areas through Tourism Research Australia's National Visitor Survey (NVS) and International Visitor Survey (IVS). The NVS is based on monthly phone surveys of Australian residents and the IVS is based on intercepts of departing international visitors at airports. This data can be accessed by contacting Tourism Research Australia (TRA) or by purchasing access to TRA's online database. The major issue with the use of the data for smaller tourism destinations is sampling error, which is generally reduced through using an annual average of data from the previous 4–6 years. The TRA data does not provide hours of activities, but instead number of activities, generally in very broad categories. However, this may not be necessary depending on the scope of the model. TRA's data provides a reliable and consistent basis for building destination models.

Expenditure data is essential to calculating the contribution of tourism. Expenditure data from the survey was also tested against higher level visitor expenditure from the TRA surveys for overall consistency and found to be consistent. While the TRA expenditure data has the same issues with sample size, this can be remedied by using the average of 4 years of data.

Water, Electricity and Waste

Detailed data for water, electricity and waste can be obtained two ways. First, the data can obtained through benchmarks provided by other locations and academic sources to estimate water, electricity and waste data for different accommodation types. Water use is available for local residents through ABS. Waste data is particularly difficult to obtain in regional locations, but benchmarks can be identified through existing data sources, such as the Gascoyne Development Commission's *Strategic Waste Management Plan* (2009). EC3 Global is a potential source for benchmarks if there is widespread interest in developing destination modelling further.

Second, water, electricity and waste data can be provided through agreements with service providers (and at times agreements with individual users such as hotels, caravan parks, etc.). This is a more time consuming method and requires that the providers are convinced of the merits of the research. However, we came to agreements with the providers that we approached and local operators were also happy to provide consent when required.

Employment and Accommodation Capacity

Employment and accommodation capacity information is available through the ABS. However, the visitor accommodation information does not include providers with less than 5 rooms, which excludes holiday rentals. This information needs to be supplemented with data from the region as it excludes providers with less than 5 rooms. However, phone calls to the local visitor centre and a visit to the local real estate agents who specialise in holiday rentals are usually enough to provide a complete dataset. Resident accommodation capacity is available through Census data, although care needs to be taken to exclude holiday accommodation. It is worthwhile also discussing residential accommodation capacity with real estate agents and local planners. Employment information is available through satellite accounts when available, and can be estimated using multipliers and tourist expenditure data. Employment multipliers are widely available (for instance from the Tourism Impact Model, which is available for free to local government from the Federal Department of Industry, Tourism and Resources).

Time and Resource Requirements

In summary, a basic destination model that makes use of TRA data and ABS data alongside a series of benchmarks for other data (water, electricity, waste) could be constructed in 5–8 days as long as it included

access to participants with knowledge of the region and its tourism industry and rapid responses to data enquiries. Involvement of the local visitors centre and local government are likely to assist access to existing data sources. Setting up such rapid prototyping would be slowed in the first instance by the need to develop a generic modelling framework based on the Ningaloo Destination Model. Almost all of the data for a simple model can be collected from the data sources listed in Appendix A. Appendix B, which lists the data sources for the Margaret River – Augusta region, provides an indication of the variety of places that data can be found. Local involvement, particularly from local government and agencies, can assist in identifying a broader set of data sources, which will vary between states and destinations.

A broader search that identifies and incorporates existing data sources that are specific to the region (such as commissioned reports for local government, development commissions, etc, reports by the water authority, electricity provider, etc) would greatly enhance the reliability of the data, but would add to the time required to build the model. This would take longer (10–15 days), but would result in a more robust model.

In addition to making use of publicly available data sources, the Ningaloo Destination Model has generated a substantial amount of data through visitor and resident surveys (Carlsen & Wood, 2004; Fredline et al., 2006). These surveys have been finalised and have been successfully applied in a number of locations (Fredline, 2002; Hughes et al., 2008). With the assistance of researchers involved in this project, the surveys can be quickly administered with minimal survey development costs, and would greatly enhance the data available for the destination model. Using a visitor survey would greatly enhance the reliability of the data by providing a second source and additional information including the activity hours, which is an important link and broad indicator of ecological and social impacts. Survey work such as this can take in the vicinity of 4–6 months in time (not all of it working on the project), including data analysis.

The extent of data collection should be linked to the intended use of the destination model. If the model is intended to be a general tool to broadly inform a tourism planning exercise, then a quick and inexpensive approach may be acceptable. If the intention is to make use of the model to monitor and assess tourism development, then we recommend a greater investment in data collection.

Model Development

The structure of the Ningaloo Destination Model is applicable to other regions. Developing a destination model requires access to Vensim software, which is a modelling program, and access to a modeller with experience in using this software. Replicating the model would require the involvement of researchers from this project in order to take advantage of the existing model structure. Vensim defines the relationships between the datasets in order to make predictions about future growth. It is possible to undertake modelling work with other software such as Stella.

Stakeholder Engagement

Since the biggest issue is trust in the data, a key element of this process should be a collaborative approach to reviewing the data to ensure that groups involved with tourism planning will accept the results of the modelling. It is important to capture the collaborative aspects of the modelling approach described in Chapters 2 and 3. If the benefits of collaboration are to be reproduced in other destinations, there needs to be participation by a broad range of groups informing the destination modelling process. The process would be further enhanced through identifying one or more champions in the region that can promote local involvement and use of the model. The structure for stakeholder engagement should be integrated with the model building so that stakeholders learn about the tourism system they are managing as the model develops.

Modelling Other Industries

The modelling techniques undertaken to assess tourism are flexible. They rely on a solid base of information and access to expertise in the relevant fields of economic, social and environmental impacts. Resident growth, resource use and activities are already calculated as part of the Ningaloo Destination Model. Applying the model building techniques to other sectors that impact on land-use planning is possible and model development would be faster due to the lessons learnt while developing the Ningaloo Destination Model. The regional scope of the model lends itself well to mining and agricultural development, although attention would need to be paid to problems such as salinity and potentially climate change if the event horizon keeps being reduced at the same rate with new scientific discoveries. The techniques for community engagement, conceptual modelling, data

gathering and working with an interdisciplinary research team are applicable to other industries.

Conclusion

The Ningaloo Destination Model manipulates data from a variety of sources to make it relevant and easily accessible when considering future changes to a destination and future tourism impacts. It contributes to four overlapping dimensions of tourism decision making that cut across the areas of operational planning, regional planning, participatory planning, and monitoring:

- The model assists decision makers (such as planners, managers, stakeholder groups) prepare for the future given high levels of uncertainty.
- The model can assess the cumulative impacts of different plans and changes on the region.
- The model can identify and assess measures to mitigate impacts deemed to be unwanted or unacceptable.
- The model can form the basis of a participatory planning process, between two or more organisations or involving a large number of stakeholders.

The structure of the model is applicable to other regions in Australia, and the data exists to quickly build simple models (5–8 days) if it was accompanied by the development of a generic modelling framework. However, more comprehensive models are likely to require further data collection and more time (10–15 days). Visitor and resident surveys provide the most comprehensive data, but would take 4–6 months to organise, run, enter the data and produce results to inform the modelling. Additionally, modelling software (such as Vensim) and modelling expertise are required.

Turning to the question of applying the modelling technique to other sectors, the process of model development has proved successful at community engagement, conceptual modelling, data gathering and working with an interdisciplinary research team. The lessons learnt from these processes are applicable to other sectors. The investment required for such model development depends on data availability, and the availability of expertise on issues specific to that sector.

Chapter 6

CONCLUSION

USING DESTINATION MODELLING TO IMPROVE PLANNING AND DECISION MAKING

The Ningaloo Destination Model provides a window to view different futures for tourism development on the Ningaloo Coast. It integrates a number of methodologies developed through STCRC research projects over a number of years to assess tourism characteristics and expenditure (Carlsen & Wood, 2004), social impacts (Fredline, 2002; Fredline et al., 2006), and makes use of tourism economics expertise that has formed through STCRC research (Dwyer et al., 2005). It also integrates data from other bodies, including EC3 Global, Horizon Power and the Water Corporation to provide projections of resource use. It links the tourism impacts calculated through these methods and data sources to the ecology of the region, which has been the focus of a research investment of over $30 million by the state and federal governments and research institutions. Most importantly, the model organises the data to answer important management and planning questions. The result is a dynamic model of the Ningaloo Coast that incorporates the socio-economic, load and ecological impacts of tourism that is relevant to, and trusted by, a broad range of stakeholder groups.

What are the Costs and Benefits of Destination Modelling for Industry, Community Groups and Government?

The Ningaloo Destination Modelling project has contributed to three key areas that demonstrate the potential benefits of destination modelling to industry, community groups and government. First, developing the model has used techniques that have successfully engaged a variety of different groups, integrated a wide variety of data types and utilised an interdisciplinary research team. The series of workshops that began with a scenario-setting workshop proved successful at introducing a variety of groups to the project and encouraging their involvement. The four scenarios that eventuated provided an important focus for model development and a means of ensuring the relevance of the finished model. The modelling process, in particular through the use of conceptual modelling, proved sufficiently flexible to incorporate a wide variety of data sets and disciplinary expertise. The integration of expertise across a variety of fields was central to the development of the model and applied techniques developed in organisational learning and adaptive management. We were fortunate in that the research team was familiar with each other and we had few issues with communication between disciplines due to the common language of tourism.

Second, destination modelling applies a triple bottom line approach to assess management decisions and future plans. It estimates changes in tourism such as visitor numbers, visitor nights, changes in accommodation supply and demand, and changes in activity levels. Economic impacts go beyond the blunt instrument of visitor expenditure to include tourism's contribution to value added and gross regional product. Social impacts were identified through resident surveys, and assessed both positive impacts (employment, cultural diversity and showcasing the region) and negative impacts (environmental impact, delinquent behaviour and disturbances, overcrowding and residential housing availability and demand). Environmental impacts looked at both resource use (water, electricity and waste) and ecological impacts to indicators including fish stocks, catch rates, coral, spangled emperor, whale sharks and kangaroos.

Third, the Ningaloo Destination Modelling project has explored potential applications of destination modelling both in the region and more broadly. In the region, the model can be applied in four different kinds of exercises: operational planning and decision making for specific organisations and groups (such as local government or agencies that manage land or sea use), regional planning, participatory planning and collaborations and to assist monitoring and evaluation.

Integrating destination modelling with adaptive management methodologies is recommended as the most effective use of the model and a way of ensuring its continued relevance.

The application of destination modelling to other tourism destinations was also explored and found to be applicable to other regions in Australia. The extent of data collection should be linked to the intended use of the destination model (explored in detail in Chapter 5). If the model is intended to be a general tool to broadly inform a tourism planning exercise, then a quick and inexpensive approach may be acceptable. If the intention is to make use of the model to monitor and assess tourism development, then we recommend a greater investment in data collection. The major cost of the modelling is the time and resources required to build the models. The cost of data gathering could be substantially reduced through construction of benchmarking data and facilitating access to data sources such as Tourism Research Australia and the Australian Bureau of Statistics. However, engagement with stakeholders is still required if the model is to be accepted by key groups and a broad enough collection of stakeholders to make a substantial contribution to decision making and planning. While there will still be costs, they can be substantially reduced through the lessons learnt in this project.

Legacies of the Ningaloo Destination Modelling Project

All projects end, but some end better than others. The legacies of the Ningaloo Destination Modelling project are twofold: how the model itself will be used and be available for stakeholders; and how the lessons learnt from the project can be applied to other destinations and sectors.

The Ningaloo Destination Modelling project has invested time into stakeholder engagement and is focused on ensuring that the model has the best possible chance of being used in the region and continuing to be available to stakeholders. This is being done through three avenues. First, two online versions of the Ningaloo Destination Model are nearing the end of development that will allow all stakeholders and the general public to access particular model results. This will prove a valuable avenue for sharing information from scenarios that explore important issues, and will be an educational tool about tourism for community groups and managers. Second, an easy to use desktop version of the model has been developed that will be provided to the Shires and agencies so that they can run their own scenarios. The prerequisite for having a desktop version of the model available is that the user will need to receive training in how to run the models. The major issue is not producing results, but interpreting the results correctly. A training manual will assist with both model use and interpreting the results. Ongoing use of the model could result in collection of information that can be used to refine the Model, if there is a need to update the model at a later date. Third, the Ningaloo Destination Model will be incorporated into a more detailed model of the Ningaloo Coast region that is being developed by Beth Fulton at the CSIRO's Marine and Atmospheric Research Division. This model, called the In Vitro Ningaloo Model, is much larger than the Ningaloo Destination Model and will take up to a week to run. In contrast, the Ningaloo Destination Model takes a few seconds to run on a standard computer, and therefore is potentially more directly accessible. The In Vitro Ningaloo model will be supported by CSIRO into the future.

STCRC and the CSIRO specified in intellectual property agreements at the start of the project that the Ningaloo Destination Model will be made freely available to relevant agencies. We have met with a number of different agencies to discuss how they would like to access the model and if they require training. Agencies in the region are keen to receive training. Discussions with agencies in Perth are ongoing. We are also exploring the option of using other funding sources to create a regional position whose job is to promote research including the model and to ensure that it is being considered for important decision making processes.

Destination modelling is relevant for other tourism destinations and a process for the rapid and cost-effective application of destination modelling is feasible. This would require research funding to develop a wireframe that is relevant for all tourism destinations. Most of the data that would be required is already available, and it would be possible to enhance this data further through establishing benchmarks for a range of region types—the information that would make this possible could be available through EC3 Global and literature searches. Making destination modelling tools broadly available would significantly broaden the impacts considered when undertaking tourism planning and lead to a more comprehensive understanding of how tourism functions as a system across Australia. Given the changing attitudes of people that have engaged with the Ningaloo Destination Model, a broad roll-out of destination modelling could lead to some of the detrimental effects of tourism development being identified and proactively addressed at the early stages of planning across Australia.

The techniques developed for destination modelling are applicable to other sectors, and have already been applied to issues such as water catchments and environmental management in other countries (see, for instance, van Den Belt, 2004). It is possible, for instance, to build a model for a regional town that would assess the implications of resource sector expansion on that site. The investment required for such model development depends on data availability, and the availability of expertise on issues specific to that sector.

APPENDIX A: CONTACT DETAILS FOR DESTINATION MODELLING DATA SOURCES IN AUSTRALIA

Source	Data	Unit	Specific Data Source	Other Sources (when available)
Australian Bureau of Statistics (ABS) www.abs.gov.au	Length of Stay	Nights	Tourist Accommodation (by local government area)	The local Visitors Centre also often keeps information on accommodation capacity. Can also be cross-checked with TRA data.
	Occupancy	Percentage		
	Accommodation Capacity	Beds		
	Number Of Residents	people	Census Quickstats	National Regional Profiles (ABS) provide similar information, but use smaller samples.
	Employed Residents	people		
	Workforce From Outside Of Region	people		
	Workers Supported By Other Industries	people		
	Estimated Growth Of Resident Population	percentage		
	Resident Accommodation Capacity	beds		
	Workers Supported By Tourism	people	Tourism Satellite Account	
	Water use by residents	Gigalitre	National Regional Profiles	
Federal Department of the Environment, Water, Energy and the Arts www.**environment**.gov.au	Electricity for residents	Kilowatt Hour	Australian residential energy consumption trends	Also see entry for EC3 Global This data is available from utility providers and may be available through the local government municipality Another source in Western Australia is the Water Corporation's Water Efficiency Project
	Electricity for other industries	Kilowatt Hour	National and State Energy Projections	
	Electricity for tourism	Kilowatt Hour	Becken, S. et al (2001). Energy consumption patterns… Journal of Ecological Economics	
Source	Data	Unit	Specific Data Source	Other Sources (when available)
EC3 Global www.ec3global.com	Water use by tourism accommodation	Gigalitre	Contact EC3 Global	Relevant academic publications are: • Becken, Frampton & Simmons (2001)
	Waste by tourism accommodation	KG		

Source	Data	Unit	Specific Data Source	Other Sources (when available)
	Electricity by tourism accommodation	MJ/guest night		• Do and Kumar (2005), and • Warnkena, Bradleya and Guilding (2005) See also the entry for the Federal Department of the Environment, Water, Energy and the Arts
Tourism Research Australia (TRA)	Visitor Arrivals	Tourists	National Visitor Survey and International Visitor Survey statistics Available by request or by paying for access to TRA's online database	
	Visitor Accommodation	Tourists		
	Length of stay	Nights		
	Activity Hours	Hours		
	Expenditure	$AU		

APPENDIX B: TABLE OF DATA AVAILABILITY FOR THE MARGARET RIVER REGION

#	Data	Unit	Source	Format	Access	Sample Size	Date	Quality Issues/ Measures	Personal Notes
1	Visitor Arrivals	Tourists	Tourism Research Australia (TRA)	Visitors by time of year (quarterly or monthly) by visitor segment (domestic overnight, domestic day-trip, international)	Registered user access	Approx 2,600	1998 to 2009	Sample size for less-visited regions	Visitor Accommodation and Arrival Information: Tourism Research Australia (TRA) provides a wealth of data on tourist activity and segments visitors into 1) International 2) Overnight-Domestic and 3) Day-Trip Domestic. The ABS provides small-area data on Length of Stay but does not distinguish between tourist segments. The ABS also collects data on International Visitor Arrivals for the Tourism Satellite Accounts but only down to the state level and does not report on domestic visitation.
2	Visitor Accommodation	Tourists	Tourism Research Australia (TRA)	Visitor Accommodation by time of year (quarterly or monthly) by visitor segment (domestic overnight, domestic day-trip, international)	Registered user access	Approx 2,600	1998 to 2009	Sample size for less-visited regions	
3a	Length of stay	Nights	Tourism Research Australia (TRA)	Length of stay by quarter, segment (international, domestic overnight, domestic day-trip) and accommodation type	Registered user access	Approx 2,600	1998 to 2009	Sample size for less-visited regions	
3b	Length of Stay	Nights	Australian Bureau of Statistics (ABS)	Length of stay by accommodation type (and choice of by SLA or by Star Rating)	Public	Survey does not have a sample component	Jun-09	Does not report on visitor segment	
4	Activity Hours	Hours	Tourism Research Australia (TRA)	Visitor segment: (international/domestic, day-trip/overnight) in number of participants	Registered user access	Approx 2,600	1998 to 2009	Estimates rounded to the nearest '1000' in some cases. At times specific location is unspecified.	Activity Data Sources: The TRA is a good source of tourism activity data; however, data is not supplied in terms of activity hours. For resident activity data, the

#	Data	Unit	Source	Format	Access	Sample Size	Date	Quality Issues/ Measures	Personal Notes
5	Resident Activities	Not Found	Not Found	Not Found	Not Found	Not Found	Not Found	Not Found	Community Facilities department of the A-MR shire was contacted but they only had information on the types of activities residents engage in, not on the frequency or duration. The local recreation centre was also contacted but the promise of this lead was inconclusive as the request for information did not receive a response despite repeated requests. Activity hours are important as they determine ecological impacts.
6a	Accommodation Capacity	Beds	Australian Bureau of Statistics (ABS)	Establishments, rooms, beds, etc. by short-term accommodation type	Public	Survey does not have a sample component	Jun-09	Survey only covered short-term accommodation (<2 mo's) & establishments must have 5 or more rooms for inclusion in survey	Accommodation Capacity Data Sources: The ABS has pretty good small-area accommodation capacity data; however, they only survey accommodations with a capacity of 5 or more rooms, thus leaving out some rental houses and properties. The Tourist Information Centre does have capacity data because they do facilitate bookings, however, they warn that not all accommodation businesses make suites available through them and of those that do, they often do not make all their units available for booking through the visitor's centre. They claim that more remote destinations will keep better accommodation capacity data b/c if accommodation cannot be found in A-MR, then there are likely to be vacancies in nearby towns.
6b	Accommodation Capacity	Beds	Margaret River Visitor Centre	Accommodation capacity by Accommodation provider				The visitor centre only has data on the units that members make available.	

#	Data	Unit	Source	Format	Access	Sample Size	Date	Quality Issues/ Measures	Personal Notes
7	Number Of Residents	people	Australian Bureau of Statistics (ABS)	Population by age and sex	Public		2006 Census		Resident Population and Employment Data: The ABS is a good source for these types of data; however, not all of it is free. Number of residents and employment levels can be found from census data provided online. One can specify if they want employment data by place of work or by place or residence, but neither can provide information on the number of employees living in or outside the administrative boundary. For this, either Origin-Destination Journey-to-work data would have to be purchased, a consultant would have to provide this data for a fee, or 'table-builder' could be purchased from the ABS for $1655 which includes a great variety of census data. Small area population growth is not provided by the ABS but historical population growth is and can be used as a proxy for estimated future growth.
8	Employed Residents	people	Australian Bureau of Statistics (ABS)		Public	Survey does not have a sample component	2006 Census	SLA employment can be found on the ABS website. The ABS 'Table Builder ($1655) or fee for service provides more complete data.	
9	Workforce From Outside Of Region	people	Australian Bureau of Statistics (ABS)		Purchase (ABS)	Survey does not have a sample component	2006 Census	As above	
10	Estimated Growth Of Resident Population	percentage	Australian Bureau of Statistics (ABS) Census		Public	Survey does not have a sample component	2007/08	It is possible to use the national average, but this would need to be adjusted for MR-A using local information and comparable regions.	
11	Transient Workforce	people	Not found	Not found	Not found	Not found	Not found	Not found	Tourism Employment and Tourism-Supported Employment Data: Transient Workforce data seems to not be estimated or held by any organization in WA. The Shire, the Chamber of Commerce, the Tourism Centre, Tourism WA, and even
12a	Workers Supported By Tourism	people	Tourism Western Australia	Number and share of people employed in each industry for WA (sourced from ABS tourism satellite accounts)	Public	Derived	2006/07		

#	Data	Unit	Source	Format	Access	Sample Size	Date	Quality Issues/ Measures	Personal Notes
12b	Workers Supported By Tourism	people	Australian Bureau of Statistics (ABS) Tourism Satellite Account	The number and share of people employed in each industry, nation-wide.	Public	Derived	2007/08	Augusta-Margaret River tourism-driven employment could be calculated from the national averages, but there is always the risk that August-Margaret River may deviate significantly from the mean.	recruitment offices were contacted an none could even provide an anecdotal rough estimate, although further searching could possibly provide something. Workers supported by tourism are estimated at the national and state levels by the ABS in their Tourism Satellite Account (TSA). Employment supported by tourism is determined by using the same ratio derived from the proportion of expenditure on goods by tourists, since 'tourism' is not actually an industry of its own and tourists often consume the same products as domestic residents. State Tourism Satellite account data for the 2007/08 year will be released soon. Employment supported by tourism is not estimated at the small-area level. Workers supported by other industries can be simply calculated as the balance remaining after subtracting tourism-supported employment from total employment.
13	Workers Supported By Other Industries	people	Australian Bureau of Statistics (ABS)		Public	Derived	2007/08		
14	Resident Accommodation Capacity	beds	Australian Bureau of Statistics (ABS) Census	Number of beds, minus holiday accommodation in the region	Public	Survey does not have a sample component	2006 Census	Length of time between census Capacity to address inclusion of holiday accommodation in the figures Capacity to address residents living in holiday accommodation	Resident Accommodation Capacity: ABS Census data includes a count of beds, but this includes holiday accommodation, which needs to be subtracted from the ABS figures. The figures for resident beds will need to be checked with relevant groups; in particular the local area's planning department and local real estate agents.

#	Data	Unit	Source	Format	Access	Sample Size	Date	Quality Issues/ Measures	Personal Notes
15a	Expenditure	$AU	Tourism Western Australia	Visitor segment, expenditure, and # of visitors and daily expenditure per annum	Public	2,500	2004 to 2007	Data is sourced from Tourism Research Australia. TWA can make this data available on request. Small sample size for some regions.	Tourism Expenditure: Tourism Research Australia (TRA) provides tourist expenditure data by tourist segment. Data is reported at the national scale. TRA provides expenditure for Local Government Areas on request, depending on the sample size. The issue of sample size can be addressed by providing an average across two more years to increase reliability.
15b	Expenditure	$AU	Tourism Research Australia (TRA)	Visitor segment, expenditure, and # of visitors by quarter and expenditure item, but not location specific	Registered user access	Varies month-to-month but generally from 20,000-50,000 nationally Samples vary between regions	1999 to 2007	Small sample size for local government area-sized regions.	
16a	Water use by tourism	Gigalitre	Warnken, J. et al (2006). Eco-resorts vs. mainstream accommodation… *Tourism Management*	Benchmarks energy and water consumption levels of eco-resorts with hotels and caravan parks	Subscription		2006	Applicability to MR-A and other regions Size of study	Water Data Sources: The International Council For Local Environment Initiatives has environmental data for some small areas. Contacting a Landcare/Environment officer for the Shire of A-MR was helpful as only those working for the Shire have access to their region's water data in ICLEI and Water Corporation Data bases. The Water Corporation requires a memorandum of understanding (and for data specific to accommodation providers, individual agreements) before they will release data. The Water
16b	Water use by tourism	Gigalitre	EC3 Global	Benchmarks energy and water consumption levels of different accommodation types across Australia	Agreement with EC3	Unknown	Unknown	Average taken from accommodation providers in regions with similar climates. Quality is assured through EC3 processes	
17	Water use by other industries	Gigalitre	Shire of Augusta-Margaret River Water Campaign	Water consumption is reported for a variety of industries for the Margaret River Region	Free from a contact in the Shire	Unknown, data sourced from Water Corporation	1999/00 to 2004/05		

#	Data	Unit	Source	Format	Access	Sample Size	Date	Quality Issues/ Measures	Personal Notes
18a	Water use by residents	Gigalitre	Water Services Association of Australia (WSAA)	Subregional data for average residential water use and total residential and commercial water supplied	Free data from Website			There are data for neighbouring regions.	Services Association of Australia (WSAA) has some aggregated data for states and subregions. The ABS has decent water data but only for WA. A major issue with acquiring water data is the need to set up an agreement with the utility provider before any data on the region can be obtained. The Water Corporation website has current dam capacity and dam storage levels but it is unclear which dams service which townships (further investigation would be needed). Contacting the Regional Communications Coordinator for Contacting the Shire proved fruitful, although there were large delays before they responded and required repeated requests. The email response to capacity issues was, 'Total supply capacity is approximately 1.2 Gigalitres annually. Supply capacity varies from year to year based on available yield from Ten Mile
18b	Water use by residents	Gigalitre	Australian Bureau of Statistics National Regional Profiles	Average residential water use for Augusta-Margaret River	Free data but need Super Table software		2002 to 2006		
18c	Water use by residents	Gigalitre	Shire of Augusta-Margaret River Water Campaign	Average annual water use for the residential sector, caravan parks, and a number of commercial activities	Free from a contact in the Shire	Unknown, data sourced from Water Corporation	1999/00 to 2004/05		
19a	Water availability		Water Corporation Water Efficiency Project Officer	Gigalitres per year (subject to variation annually)	Public	N/A		The estimate given was very rough, not allowing one to get a clear idea of what the implications of marginal changes in the regions residency or tourist visitations. Supply capacity varies annually and thus some uncertainty is unavoidable.	

#	Data	Unit	Source	Format	Access	Sample Size	Date	Quality Issues/ Measures	Personal Notes
19b	Water availability	Gigalitre	Water Corporation Website	Gives dam storage capacity, current storage, and storage % of all dams	Public		Current	One can select a region of interest and find the information on all the dams in the region. It is unclear which dams service which population.	Brook Dam and the Margaret River pumpback facility. Detailed planning work is under way to reduce per service consumption and significantly increase supply capacity.' There are a small number of journal articles exploring water consumption by tourist accommodation type from which it is possible to begin constructing a lookup table. However EC3 Global is a potential provider of high quality data for water, electricity and waste that can be divided into particular climates. The easiest way forward would be to construct a lookup table based on academic research and EC3 Global data to allow for quick estimation of water use.

#	Data	Unit	Source	Format	Access	Sample Size	Date	Quality Issues/ Measures	Personal Notes
20a	Waste per tourist	KG	EC3 Global	Divided by accommodation type.	Agreement with EC3 Global	Not given	2010	Average taken from accommodation providers in regions with similar climates. Quality is assured through EC3 processes.	Waste Data Sources: Contacting the Department of Environmental Services was able to provide me with aggregate average annual waste per person, but distinction between tourism and residential is apparently very difficult or impossible to make. The waste management and recycling centre had no data. It is possible to use other studies (such as the Gascoyne) and a breakdown of waste into different types to undertake estimation. EC3 Global is a potential provider of high quality data for water, electricity and waste. EC3 Global would prove a valuable source for this information that is only available if past studies have been undertaken. The easiest way forward would be to construct a lookup table based on academic research and EC3 Global data to allow for quick estimation of water use.
20b	Waste per tourist	m3	Shire of Augusta-Margaret River Environmental Services	875 Kg's per person per year	Public	12,400	2007	Contact said that they do not have the resources to do headcounts and distinguish waste production between residents and non-residents/visitors, thus a general average annual waste figure is presented.	
21	Waste per resident	m3	Shire of Augusta-Margaret River Environmental Services	875 Kg's per person per year	Public	12,400	2007	As above.	

#	Data	Unit	Source	Format	Access	Sample Size	Date	Quality Issues/ Measures	Personal Notes
22a	Electricity for tourism	Kilowatt Hour	Becken, S. et al (2001). Energy consumption patterns… *Journal of Ecological Economics*	Energy use per m-squared by accommodation type	Subscription	Drew results from 3 different surveys	2001	The study's results differed from similar studies conducted in Canada and Europe, thus climate may potentially influence energy-use rather significantly. This must be considered if using these figures in Australian areas.	Electricity Data Sources: First tried contacting Western Power. Their response to the region's electricity capacity question was 'The available supply of power is dependent on the load drawn. As load demand increases, Western Power will upgrade transformers to allow for the extra demand. Because of this there is no set figure for available electricity. The available amount depends on what time of the day it is and what infrastructure is around each suburb.' Attempts to contact Synergy for the other three data items were fruitless. The Planning Department for the Shire was contacted and it sources its own data (in aggregate form) from the ABS, which is not specific for the A-MR region. There are few quantitative academic studies on tourism accommodation energy consumption, but they do exist. The Australian Department of the Environment, Water, Energy and the Arts website has several publications with National energy data. EC3 Global is a potential provider of high quality data for water, electricity and waste. EC3 Global would prove a valuable source for electricity information that is only available through an agreement with the utility provider and from accommodation providers—a time consuming process. The easiest way forward would be to construct a
22b	Electricity for tourism	MJ/guest night	EC3 Global	Benchmarks energy consumption levels of different accommodation types across Australia	Agreement with EC3	Unknown	2010	Average taken from accommodation providers in regions with similar climates. Quality is assured through EC3 processes	
23	Electricity for residents	Kilowatt Hour	Australian Department of the Environment, Water, Energy and the Arts	GJ per household & per person	Public	Unknown	1986 to 2020	Energy consumption is not stated below the national level. See pg. 41 for average residential energy consumption.	
24	Electricity for other industries	Kilowatt Hour	Australian Department of the Environment, Water, Energy and the Arts	PJ per industrial sector	Public	Unknown	2001 to 2020	Energy consumption by industry is not stated below the national level.	

#	Data	Unit	Source	Format	Access	Sample Size	Date	Quality Issues/ Measures	Personal Notes
25	Electricity Capacity for Region	Kilowatt	Local power providers (Synergy and Western Power)	Not found	Not found	Not found	Not found	Response from Western Power: 'The available supply of power is dependent on the load drawn. As load demand increases, Western Power will upgrade transformers to allow for the extra demand.'	lookup table based on academic research and EC3 Global data to allow for quick estimation of water use.

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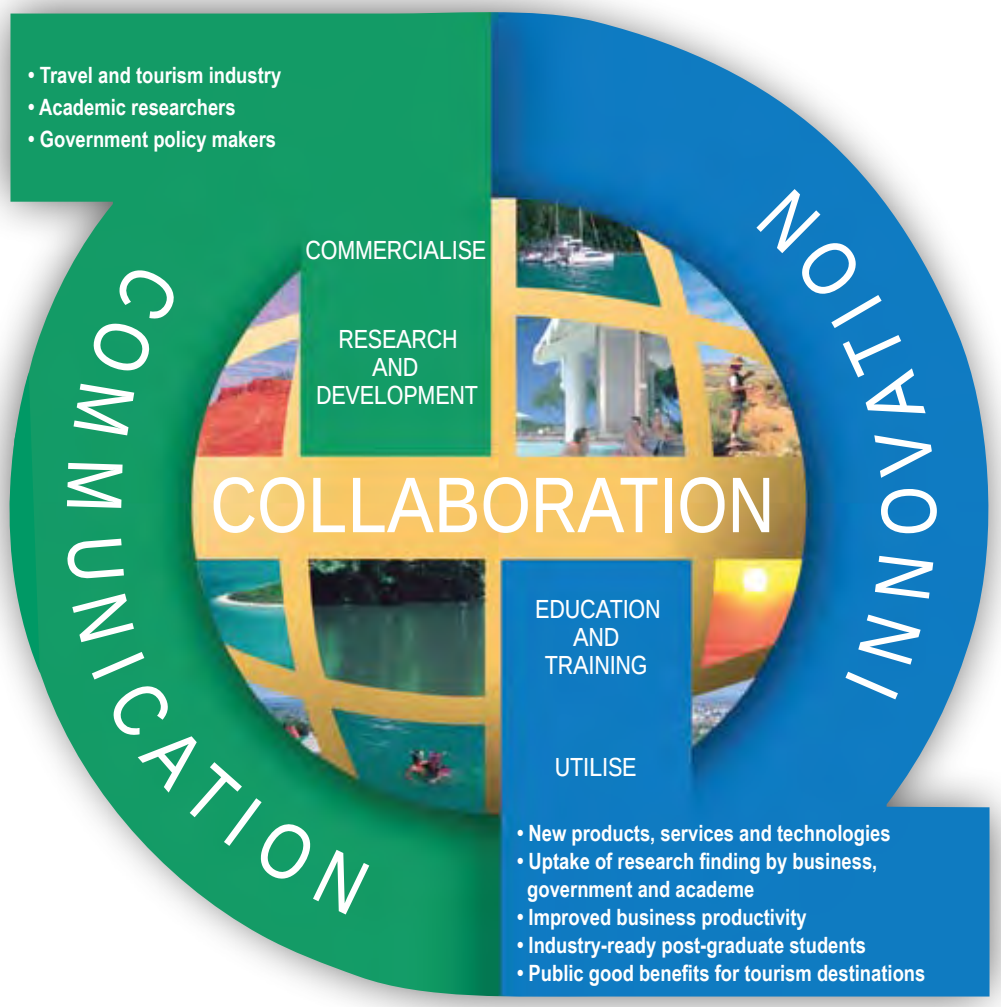

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STCRC is the world's leading scientific institution delivering research to support the sustainability of travel and tourism—one of the world's largest and fastest growing industries.

Introduction

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

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

Role and responsibilities

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

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

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

STCRC's objectives are to enhance:

- the contribution of long-term scientific and technological research and innovation to Australia's sustainable economic and social development;
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- collaboration among researchers, between searchers and industry or other users; and
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