

Regional Planning, Tourism and Resilient Destinations: Destination Modelling for Sustainable Tourism Planning

Tod Jones, John Glasson, David Wood, Beth Fulton

Abstract — the regional scale of planning is now acknowledged as an appropriate scale for the planning and management of more sustainable development. Yet regional planning faces many challenges, not least a contested stakeholder environment and the danger of being bypassed by key stakeholders. In such situations it is difficult to plan for resilient regional futures, and major shifts in the socio-economic and bio-physical environments can threaten the sustainability of a region. Tourism development in pristine and fragile environments is particularly prone to these problems. However engaging key stakeholders in a more participative learning process, with the implications of potential future changes clearly set out for all to see, is a more positive group approach to regional planning for resilient futures. The Ningaloo Destination Model project (NDM) is an example of the development and use of such an approach for a region in Western Australia which is home to one of the world's most significant fringing coral reefs. This paper focuses on how the process and use of the NDM project builds regional resilience to cope with disturbances to socio-ecological systems. The various stages of the development and use of the NDM are discussed. The paper concludes that the NDM needs more than good data and reliable modelling to contribute to regional planning; it also needs to encourage the characteristics that build regional resilience through the modelling process and model use.

Index Terms — Destination management, Destination modelling, Participatory planning, Tourism planning

1 INTRODUCTION

In many countries worldwide, for example from the Member States of the EU to the individual states in Australia, the value of a regional scale in the planning hierarchy is being increasingly recognized [1, 2, 3]. Very broadly, the aim of such planning is 'to better manage, or at least influence, the development of a region in the interests of society'[4]--but why at this intermediate level of the region? Wannop [5] identifies a 'strong regional planning imperative', because regional issues endure. Issues can range from rapid growth in congested metropolitan regions, to rural decline, resource booms, and/or tourism development in remote regions—the latter being the focus of this paper. There is also the fundamental

challenge of climate change and the drive for a much more sustainable approach to our development; indeed the regional level may be a particularly appropriate level for the territorial integration of natural and socio-economic systems [6, 7, 8].

In addition, major projects, now a familiar element of modern life, increasingly affect regions and are often the building blocks of regional strategies. The latter usually identify infrastructure requirements: economic-- such as roads, energy utilities and hotels, and social -- such as hospitals and schools. But such developments can have wide ranging impacts on a region and not all may be beneficial. Societal trends and the associated major projects can pose major challenges for regional planning, and particularly in the case of tourism developments in pristine and fragile remote environments. As an intermediate level of planning, regional planning is sometimes seen as an unwelcome intruder between local and national levels (and the state level in Australia—which is the country focus of this paper). Often lacking the power base and legitimacy of an underpinning level of government, it can be subject to the influence of dominant stakeholders--such as major landowners, tourism operators and mineral resource developers. Remote natural

-
- *Dr Tod Jones is a Research Fellow with the Curtin University Sustainability Policy Institute, Perth, Western Australia. E-mail: T.Jones@curtin.edu.au*
 - *Prof. John Glasson is an Emeritus Professor in the School of the Built Environment, Oxford Brookes University. Email: jglasson@brookes.ac.uk*
 - *Prof. David Wood is Deputy Vice-Chancellor (International), Curtin University. Email: D.Wood@curtin.edu.au*
 - *Dr Beth Fulton is a Principal Research Scientist, Marine and Atmospheric Research, CSIRO, Hobart, Tasmania. Email: Beth.Fulton@csiro.au*

areas may have many valuable resources—landscape, biodiversity, geology and cultural heritage. They may also be attractive development sites, for the exploitation of such resources through consumption and production. As such they are often at the forefront of the battle for sustainable development, with many examples of damaging trade-offs between for example tourism, fishing, mineral development and conservation. Regional planning exercises in contested environments are in danger of being bypassed by powerful stakeholders [9]. Regional planning may have problems in delivering outcomes—in making the transition from ‘plan formulation’ to ‘plan implementation’—simply producing just more reports to sit on top shelves gathering dust. Examples of successful regional planning suggest that key ingredients for an effective process include a *continuity* of both that process and responsible agency, *co-ordination* of a disparate array of stakeholders (including various levels of government agencies, private sector, voluntary sector etc—avoiding silo mentalities), improved *control*, through for example financial resources, but also possibly through democratic legitimacy, and *commitment*—with the need for a process which fully engages key stakeholders who become committed to the plan and the planning process [4].

This paper explores aspects of these ingredients, with a particular focus on how to engage stakeholders to deliver more resilient regional futures. The next section provides a brief introduction to regional planning, resilience and managing complexity. The core of the paper introduces modelling methods for integrating regional planning and regional resilience, followed by a discussion of the Ningaloo Destination Model (NDM). The remote and natural resource rich Ningaloo region in the larger Gascoyne Region of Western Australia, home to one of the world’s most significant fringing coral reefs, provides the test bed for the approach, drawing on a major research project funded under the Ningaloo Collaboration Cluster initiative. There are sections on the background to the Ningaloo area and its contested environment, and on the development and use of modelling for improved stakeholder participation, to build regional resilience to cope with future disturbances. A concluding section seeks to assess the costs and benefits of such an approach.

2 REGIONAL PLANNING, RESILIENCE AND MANAGING REGIONAL COMPLEXITY

This paper is set in the context of contemporary approaches to regional planning, and the importance of managing regional complexity to deliver regional resilience. Contemporary regional planning tends to be influenced by shifting attitudes to politics and legitimisation, raising crucial issues of consultation, participation and the interactions with a wide array of stakeholders [3]. Co-ordination of stakeholders is a major challenge, both vertically, especially to adjacent levels of government, and horizontally, for example between regional planning bodies and devolved levels of Central Government, key pressure groups (eg from industry and environment) and sectoral agencies [10]. The management of this co-ordination has been theorised in various ways, including strategic choice [11]—which argued that planners should be ‘reticulists’ with a role of reducing uncertainty in the process, by bringing together all the relevant actors with influence and resources. Rhodes [12] stressed the importance of networking, and argued for regional planning professionals to work with networks covering a wide range of interests. Of particular interest to our arguments here is the work of Healey [13] and others around the themes of collaboration and communication. This work focuses on the careful construction of arenas for dialogue, leading to the making of concerted storylines for areas, to form the basis of durable shared strategies. Yet all such approaches have limitations in practice; for example, the achievement of consensus through a fair and open process must often confront deep seated vested interests (eg: between householders wanting to build on sites on the edges of settlements, and environmentalists wishing to preserve open space /bushland). This also assumes a regional planning process with the provision for participation, and participants with the means and ability to participate.

Our approach to managing complexity draws on a history of ecological writings. Beginning in the 1970s, most notably with the book *Adaptive Environmental Assessment and Management* [14], ecological researchers began to critique management systems that reduced the natural variation in ecological systems, causing such systems to become less resilient to external change [15]. As the environment has been recognised as an essential resource, so social-ecological system (SES) principles and concepts have been applied to areas beyond managing

ecological systems, in particular the ecological and socio-economic elements of sustainable development [16, 17, 18], governance [19], and public policy more broadly [15, 20]. Ecological research links changes in SESs to their *resilience*—defined as the magnitude of disturbance that can be absorbed before the system alters its structure by changing the variables and processes that determine its behaviour [21].¹ Resilience focuses policy decisions on managing the capacity of SESs to cope with, adapt to and shape change [17]. Socio-economic resilience is “the ability of groups or communities to cope with external stresses and disturbances as a result of social, political and environmental change” [16]. Given that SES are complex adaptive systems, managers should not just set sustainability targets. Sustainability is better conceived as a learning process about a particular SES where a continual process of experimentation, monitoring, refinement of understanding and adaptation can adjust to new and changing circumstances [23, 24]. Resilience research has therefore focused on regional arrangements that have facilitated *group learning* and built trust between different groups.

Institutions, broadly interpreted here to include both public and private organisations, can have a bearing on the ability of a region to avoid unwanted outcomes, protect important resources and contribute to regional resilience in several ways. First, institutions are important caches of knowledge that contribute to the adaptive capacity and robustness of regions. The extent to which institutions understand the dynamics of a system [18], and are involved in monitoring and planning, will have important implications for a region's resilience. Second, creating strong relationships between institutions can increase resilience through building the trust, social networks and leadership that are necessary to respond together and effectively to address disturbances [19, 25]. Third, institutions (either separately or as a network) can facilitate experimentation in order to develop creative and improved methods to manage ecosystems [20]. There is also agreement in SES literature that regions are

the most appropriate scale for improving ecological and social resilience. Yorque *et al.* define regions as “the scale at which ecosystems and people are tightly connected” [8]. The issue is how to equip and work with the relevant groups to make informed decisions about regional socio-economic and environmental resilience within a regional planning framework.

3. MODELLING TO INTEGRATE REGIONAL PLANNING AND RESILIENCE

For the purposes of this paper, modelling refers to system dynamics modelling (a version of numerical modelling). This is a computer based methodology to support decision making by simulating the dynamics of complex systems through quantifying the effects of a system's interconnections and time delays [26, 27]. The main value of this modelling is not its capacity to predict the future [14]. This is because the delivery of a fully-fledged model without local involvement, no matter how accurate the model, ignores how model use needs to be linked to institutional learning, to build relationships between groups, and be trusted if it is going to facilitate experimentation. In short, modelling needs to contribute to the resilience of the organisation or group for whom it has been constructed.

While concepts from adaptive management and organisational learning [28, 29] have been applied at a number of different scales, tourism planning requires careful consideration because of the diversity of the groups affected by tourism, the changing organisational requirements of a destination over time, the high rate of transition of a large proportion of workers in a location, and the wide range of disparate areas on which it impacts. Similar modelling techniques have been used in other locations to assist tourism destination planning with a variety of levels of success (for an extensive appraisal, see [26]). The modelling work that has been most successful in achieving sustained change in planning processes focuses on participation and consensus building [30, 31].

A framework that analyses the challenges of using modelling in tourism destination planning is Schianetz *et al.*'s Learning Tourism Destination concept [26]. Through a review of the previous uses of similar models in tourism destination planning, Schianetz *et al.* indicate that modelling has the potential to be a valuable tool as long it is incorporated into a framework that addresses learning at the individual, group and inter-organisational

¹ In this article we focus on the resilience of SES related to tourism and use the literature from this field (for instance, the work of the Resilience Alliance (www.resalliance.org) and in *Ecology and Society*). Elements of this theory are present in economic geography [22] R. Martin and P. Sunley, "Complexity thinking and evolutionary economic geography," *Journal of Economic Geography*, vol. 7, pp. 573-601, Sep 2007., but this has focussed more on the application of such principles to social systems than on modelling and managing complexity in SES.

(regional) level. They identify four ways that modelling can contribute to destination planning. First, it can underlie an information system which is essential for a field like tourism where broad number of groups and individuals are affected. A model provides a way for different groups to test and refine their understandings of the tourism system, and a focus for information gathering and dissemination; it focuses stakeholder attention on thresholds and cumulative impacts [27] that can be overlooked in other planning processes. Second, building a model can contribute to cooperation and collaboration between disparate groups. Modelling provides a method through which people with different involvement in tourism can express their view of how tourism functions and then test that view in a setting with other groups. Third, modelling can contribute to continuous learning if the model is taken up as a focus for ongoing planning and evaluation; it has the potential to integrate a wide variety of research through a process that addresses the concerns and priorities of a wide variety of stakeholders [32]. Fourth, modelling contributes to adaptive management through providing a tool that assists in the articulation of assumptions and the perceived levels and types of uncertainties [33].

While providing a valuable framework to assess the effectiveness and define the purpose of modelling in tourism planning, Schianetz et al. [26] do not discuss any processes for how modelling can be initiated and implemented in a way that enhances resilience or assists with creating the learning framework that is central to the Learning Tourism Destination (LTD). However in another article, Schianetz et al. discuss the application of the LTD framework and the use of modelling through examining the early stages of this project [34]. In this article, we extend this earlier study to include initial engagement with stakeholders, the process of development and application of the Ningaloo Destination Model (NDM) to analyse how the use of modelling could advance regional planning through building regional resilience. The two broad stages of development, listed in Table 1, address both the process of model development (Stage 1) and the application and ongoing use of the model (Stage 2). The two stages are discussed separately following a brief outline of the regional context of the NDM project.

TABLE 1:
STAGES OF THE NINGALOO DESTINATION
MODELLING (NDM) PROJECT

Stage	Description
1.1	Stakeholder assessment
1.2	Stakeholder modelling workshops
1.3	Formal and informal meetings and communications with stakeholders
1.4	Data collection and dissemination
1.5	Model development
2.1	Learning about the tourism system through model use
2.2	Model use and integration with regional planning

4. CASE STUDY FROM THE NDM – REGIONAL CONTEXT

The Ningaloo Reef is the largest fringing coral reef in Australia stretching over 300 km along the northwest coast between Carnarvon and Exmouth (Fig. 1). Carnarvon, the southernmost tip of the Ningaloo Coast region, is 900 km from Western Australia's capital city of Perth. 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%), Exmouth (26%) and Coral Bay (2%). 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. The primary attraction of the region is the Ningaloo Marine Park, which Western Australia's Department of Environment and Conservation labelled the state's "premier marine conservation icon" [35]. The number of tourists to the Ningaloo Coast in 2008 was 176 000, which was lower than previous years due most likely to the advent of the global financial crisis. The highest recorded number of visitors was in 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 since then [36].

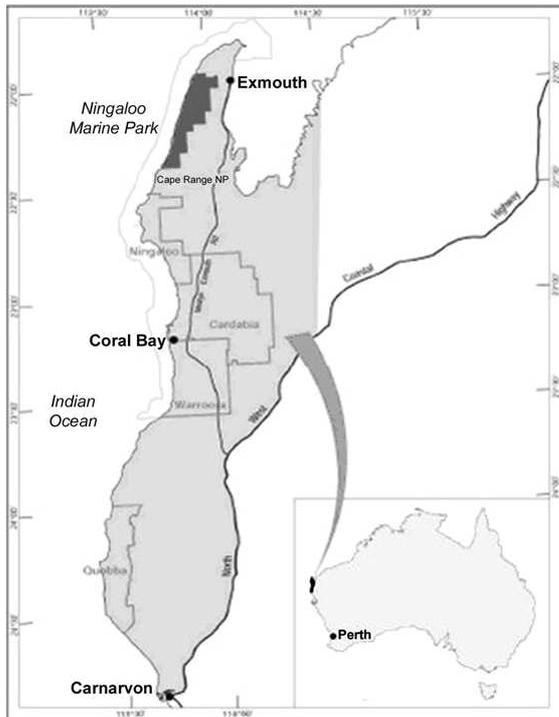


Fig. 1: The Ningaloo coastal region of Western Australia

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 [37]. The 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 Labor Government rejected the marina proposal in 2003 and began preparation of the 'Ningaloo Coast Regional Strategy Carnarvon to Exmouth' (the *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.² The *Regional Strategy* provides a comprehensive framework for tourism development in the region, limiting the construction of high impact developments, such as marinas and canals, to the towns of Carnarvon and Exmouth. 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 [35] and Cape Range National Park [38], and the Shire of Exmouth is undertaking a

² It should be noted that one of the authors, David Wood, was Chair of the committee that oversaw the NSDO.

Structure Plan and Local Tourism Planning Strategy to assist coordination of a new marina development and future town growth. While the existence of multiple plans suggests redundancy that could strengthen regional resilience, the independence of the planning processes raises the concern of the cumulative impacts of plans, which are focussed on drawing more people to the region, or on managing the impacts of human activity without considering the potential size of future numbers.

Additionally, recent changes to the regional planning framework for Western Australia may have implications for the Ningaloo region. In 2009, following the recommendations of this report, the Western Australian Planning Commission (WAPC) resolved to establish regional planning committees for each region, but it is not yet clear whether they will be supported by regional offices. In fact, the NSDO, was closed in June 2009 at the time the WAPC resolved to establish the Gascoyne Regional Planning Committee, the successor of the committee overseeing the NSDO. At the time of writing, this bureaucratic decision does not bode well for a regional staff presence.

Research efforts have been intensified in the last decade to protect the unique character and marine and terrestrial ecosystems of the Ningaloo Coast. The Ningaloo Collaboration Cluster group of projects aims to integrate the knowledge of reef use, biodiversity and socioeconomics into a framework to assess management strategies for the Ningaloo region.³ The Ningaloo Destination modelling project is one of six projects within the Ningaloo Collaboration Cluster and has the objective of developing a simulation model based on system dynamics modelling that incorporates both the socio-economic and environmental implications of tourism on the Ningaloo coast.

The largest risk to the region's ecology is recreational fishing catch, which on recent modelling work is likely to be over double the commercial catch (Beth Fulton, pers. comm.). Recreational fishing is an important resident and tourist activity and changes to its regulation are highly political. Changes to fishing regulations will impact some tourists' decisions to visit the region, although snorkelling is consistently the most popular and most important activity for tourists,

³ An initiative of the Commonwealth Science and Industry Research Organisation (CSIRO), the Cluster brings together multi-disciplinary researchers from six Australian universities, the Sustainable Tourism Cooperative Research Centre (STCRC) and the CSIRO Wealth of Oceans Flagship. The CSIRO is the Australian Federal Government's peak research body.

displacing fishing in popularity since the 1990s [36]. Another ecological threat to tourism is coral damage in the most popular snorkelling sites, which is unlikely to significantly impact biodiversity values when measured across the entire coast. Longer term threats are from climate change, which could impact ecological systems including the existence of coral reefs, and peak oil. Recent oil and gas initiatives north of the region also have raised both development opportunities for the region and concerns about the possible social and environmental impacts of increased industry and pressures from increased levels of recreational activities.

The project and region provides an ideal case study for testing the application of a modelling process as a method to increase regional resilience, as the main stakeholder groups⁴ expressed interest in engaging in collective learning processes. However there are some barriers to strengthening networks between stakeholders. A DEC decision to extend the sanctuary zones at Ningaloo Marine Park in 2004 was not received well by local residents, and the nomination of Ningaloo for a World Heritage listing by the Western Australian and Federal governments caused public dissent from the Exmouth Chamber of Commerce and Industry [39]. These issues have inhibited the development of local and state-wide social networks between institutions that support regional resilience.

5. CASE STUDY FROM THE NDM: DEVELOPING SCENARIOS AND MODELLING FOR IMPROVED STAKEHOLDER PARTICIPATION

5.1 Stakeholder assessment – getting to know the destination

The first step in the NDM project was to identify and establish contacts with stakeholder groups and consider their interests, issues and reasons for becoming involved in the project. Through a stakeholder assessment (summarised in the table in Appendix 1), a number of possible conflicts were noted that could impact on the capacity of the project to facilitate strong local networks and collaborative learning. While the largest barrier was between the protected area managers (DEC) and groups impacted by changes to fishing regulations, other issues

were also identified as important. These were the regulation of the tourism industry (which causes conflicts between the regulator DEC and tourism operators) and clashes between planners and DEC on the one side and pastoralists on the other over tenure and coastal planning. World Heritage became a major issue over the course of the project as the local Chamber of Commerce, the Shire of Exmouth and community members were concerned that World Heritage would prevent them from accessing resources (such as gravel for roads) and alter local leisure pursuits.

Resource sector developments were also raised consistently across the project as both an opportunity for industrial development (by the regional development commission, Chambers of Commerce and the Shires), and a threat through either oil spills, increased recreational fishing, and increased land and ocean traffic (local conservation groups, protected area managers, community members). From a community and Shire perspective, a major issue in the region was residential housing. Coral Bay has unsanitary and unsafe living conditions for staff as they wait for staff housing to be developed, and locals are being priced out of Exmouth. Despite these conditions, environmental impact has consistently been identified in community consultations as the greatest community concern. Indigenous participants identified participation in tourism development as a key issue and environmental protection. Many of these conflicts and issues manifest themselves throughout the process as issues that the model was requested to address.

5.2 Stakeholder modelling workshops – creating an environment for collective learning and collaboration

The stakeholder assessment fed into a series of four initial workshops that were held in each of the town centres (Exmouth, Carnarvon and Coral Bay) in June and September 2007. Groups were identified through the stakeholder assessment and invited to attend through phone calls and a follow-up email invitation or letter. We also distributed invitations through the visitors centres, and made general invitations through a radio interview and a newspaper article. Three of the workshops (one in each of the town centres) were aimed at introducing the modelling process, identifying the potential questions that the model should answer (expressed as scenarios for the future of tourism), discussing data availability and eliciting further involvement. 71 people attended the workshops, with attendees from

⁴ This includes government, tourism agencies and operators, research institutions, environmental groups, residents and tourists.

a broad range of backgrounds (see Appendix 1). Through a series of large and small group activities described in more detail in Schianetz et al. [34], participants refined a list of opportunities and concerns about tourism development into scenarios from the three workshops. The process of scenario development was the beginning of the process of linking groups through the modelling process, building relationships between groups and shared understandings. The four resulting scenarios (Table 2) were then used to focus the model building process.

TABLE 2:

THE FOUR COLLATED SCENARIOS AND THE RATING OF RELEVANCE FOR WORKSHOP PARTICIPANTS

Scenario	Score*
Scenario 1: A large increase in visitor numbers versus a controlled increase: This scenario addresses the impacts of growth in visitor numbers and, if you can control growth in particular market segments (for example in a particular accommodation type) 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 in tourism numbers? What are the best strategies for a fast recovery following an unexpected event or variations in visitor numbers to the region? The scenario also addresses the issue of capacity constraints by testing a variety of land release policies.	4.3
Scenario 4: Green technologies and development strategies This 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

* Participants were asked to rate the relevance to the region of the scenarios for all communities in the region, on a scale from 1 (not relevant) to 5 (very relevant).

The fourth workshop was a two day meeting to identify an agreed model structure for representing tourism development in Ningaloo and the process that could influence how it might evolve over the next 20-30 years. 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 3). Participants collaboratively designed sub-models that identified the economic, social and environmental drivers and impacts, as well as critical feedback loops and thresholds. 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. 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.

TABLE 3:

THE NINE SUB-MODELS ADDRESSED IN THE CONCEPTUAL MODELLING WORKSHOP

Sub-model	Summary content
Visitor numbers and mix	Links the visitor cycle (numbers, mix and seasonality) to other cycles in the region (weather, cyclones, marine, European visitation, holidays).
Residents and industry	Addresses growth in regional industries and housing availability as determinants of population numbers and the activities undertaken by the resident population.
Visitor activities	Links visitor activities and experiences to tourism infrastructure, environmental quality and the characteristics of the tourism industry.
Accommodation sector	Addresses accommodation supply and demand in the context of land availability, investment returns, demand from other sectors and staffing.
Visitor spending	Uses visitor spending and economic data to calculate employment, income, value added and gross regional product.
Environmental loads	Addresses water availability in the context of climate change and water consumption, waste water generation, treatment and the implications for the region's ecology, electricity demand and supply, and the potential impacts of sustainable technologies for reducing water and electricity use.
Environmental impacts	Links the activities of visitors and residents to a range of environmental impacts, including marine and terrestrial impacts such as coral damage, fish stocks and vegetation loss, and the monitoring of these impacts.
Transport linkages/options	Addresses transport to the region and within the region, including transport constraints and shocks that could disrupt travel, and links to national trends.
Social impacts of tourism	Identifies the positive impacts (extra facilities, regional pride) and negative impacts (crowding, incidents, dislocation) to residents' quality of life.

5.4 Data collection and dissemination – learning through data collection

Data collection was an important activity for building institutional knowledge and for populating the NDM. Due to the absence of key data to address the scenarios, the research team designed and implemented three surveys; 1574 visitor responses were collected to provide the detailed, geographically specific information on psychographic, visitation and activity patterns to inform the NDM.⁶ This data supplemented Tourism Research Australia data that was available from 1999. Additionally, a residents' perceptions of tourism impacts survey was distributed to residents in Carnarvon, Coral Bay and Exmouth providing a sample of 292 responses.⁷ The third survey was designed to estimate the water, electricity, waste water and waste produced by the tourist accommodation sector. Additional data on water use and electricity use was provided by service providers (Water Corporation and Horizon Power), and additional information on visitation was provided by the two visitor centres in the region and DEC.

A key element of this project was the close links to the CSIRO and the exchange of information from the NDM with its attention to land use planning and the CSIRO's ecological modelling. In addition to keeping communication channels open with stakeholders. A summarised version of all of the data was sent out through newsletters and the visitor statistics were freely available through a report [40]. The contribution of this data to institutional knowledge is best represented through the way it was immediately used in planning processes in the region that were underway simultaneously with the NDM project, such as the preparation of DEC landscape plans, local tourism planning strategies, and town planning schemes.

5.5 Model development – integrating world views and data

Two key methodologies were 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 aspects of the tourism system, such as the coastal camping diagram in Fig. 2, provided a language for ensuring that the important aspects of the tourism system were being captured [32]. While best undertaken in a group setting so that collaborative learning and networking 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. Furthermore, it facilitated research integration through identifying linkages between different aspects 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.⁸

The second method is putting data behind the conceptual diagrams using Vensim modelling software. This involved firstly refinement of the conceptual diagrams in Vensim 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. 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 against historical data and discussing results with members of the tourism industry and agency managers. The regional discussions of results, through 15 regional forums, were an essential element of building knowledge and understanding of the SES, particularly the consequences of current plans and decisions, and overlaps in areas of institutional responsibility (discussed in the next section). By integrating building regional resilience throughout the model building process, the use of the model could build on the increased knowledge and social networks of groups in the region, rather than expecting these elements to come together in the final stages of the project.

⁶ For a summary, see Jones et al. [40] T. Jones, *et al.*, "Ningaloo Coast Region Visitor Statistics: Collected for the Ningaloo Destination Modelling Project," Sustainable Tourism Cooperative Research Centre, Gold Coast 2009.

⁷ This survey identified employment and cultural diversity as the perceived most positive impacts, and environmental damage, delinquent behaviour, crowding and housing dislocation as the perceived most negative impacts.

⁸ The technique employed in the NDM project for integrating research from different disciplines is described in more detail in Jones and Wood [32] T. Jones and D. Wood, "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*, vol. 3, pp. 137-44, 2008..

6. CASE STUDY FROM THE NDM: USING SCENARIOS AND MODELLING FOR IMPROVED STAKEHOLDER PARTICIPATION

6.1 Learning about the tourism system through model use – demonstrating thresholds and feedbacks and enhancing group learning

The second stage of the NDM project was to contribute to regional resilience through, firstly responses to engagement with the model, and secondly to the challenges of organising ongoing use. An important lesson learnt through the project was that models for planning need to have a large degree of flexibility as planning priorities are constantly changing. The NDM needed to be capable of adaptation to address a variety of different processes in order to be responsive to the requests for information and experimentation of a wide group of collaborators. In the course of building the NDM, the range of submodels was refined and some were combined. Fig. 3 provides a summary of the different submodels and key variables within the model and their relationship to each other.

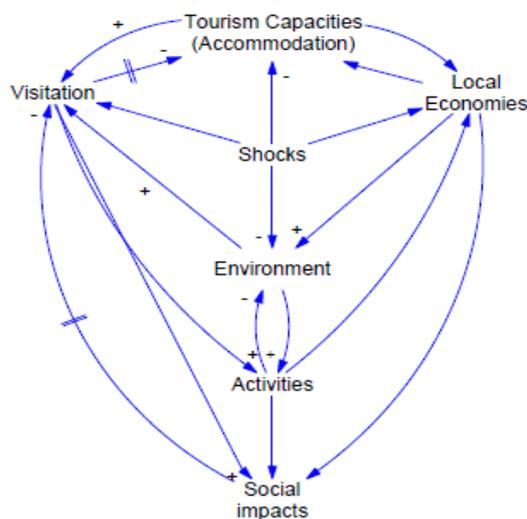


Fig. 3: NDM Conceptual Diagram

An example that we used regularly and is of great relevance to the region is an assessment of the implementation of the Ningaloo Coast Regional Strategy (the *Regional Strategy*). The scale used here is the whole region and takes into account plans for growth in the three towns of Carnarvon, Coral Bay and Exmouth. The area that will experience the greatest change is the pastoral stations that extend across approximately 190 kilometres of the coastline

(see Fig. 5.1 on the planned changing accommodation mix for the pastoral stations between 2007 and 2037). In order to run the model, the growth in tourism numbers throughout the area was assumed to be 2% pa, with the exception of the pastoral stations, where growth was set at 4% pa. While this is historically large, it is necessary to stimulate demand for the new accommodation to a reasonable level as demand for hotels and caravan parks are starting from a very low baseline. The model adjusts these growth rates for seasonality. The *Regional Strategy* reduces the capacity of the existing campgrounds as the new accommodation is to be located on these sites.

The results are summarised in Figs 5.2 through to 5.6. Visitors to the region increase by 66% with 300 000 people visiting the region for the first time in 2031. While the region previously had approximately 9000 visitors staying at the same time during the school holidays, this has now increased to 13000 in 2037. Tourism is still seasonal, creating problems for tourism businesses. Visitor activities have grown markedly as well. Fishing has increased by 60% despite the reduction in campsites. Snorkelling increases by 48%, but this is concentrated in particular areas—it amounts to a doubling of snorkelling in Cape Range National Park. The economic impacts of implementation of the *Regional Strategy* blend with growth in Carnarvon and Exmouth.

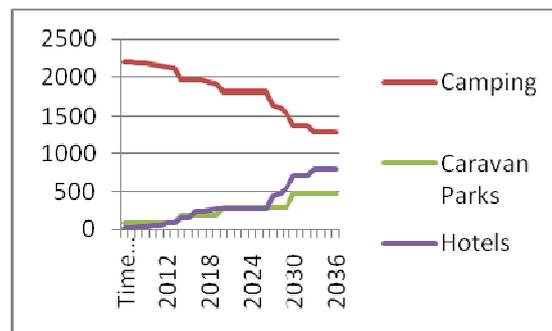


Fig. 4.1: Line graph of maximum change in hotel and campground accommodation in the pastoral stations allowed within the Ningaloo Regional Coastal Strategy

Overall, expenditure increases from \$95 million to \$155 million, and tourism's contribution to Gross Regional Product increases from \$32 million to \$52 million.

The social impacts of growth in the Ningaloo Coast Regional Strategy are summarised in Fig. 7. Employment is the greatest benefit with jobs increasing to 1400 people. However, the greater amount of people coming to the region also creates

more opportunities to showcase the region, increasing community pride. Negative social impacts are also felt by the region. Decreases to fish stocks and impacts on corals are negative social impacts, and delinquent behaviour also increases due to greater numbers of holiday accommodation next to resident accommodation and higher levels of transient workers.

Tourism growth has increased resource use. The growth in residents and visitors has increased water use by 20% to over 150 000 GL (see Fig. 8). While not reaching the limits of water draw on the underground water supplies, water restrictions would be more common and have more impact on the agricultural sector. Electricity increases by over 70%. 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 use over 20 000 KWH and 71 GL of water.

There are negative ecological impacts from fully implementing the Ningaloo Coast Regional Strategy (see Fig. 9). Whale sharks decrease by 5% due to increased strikes from boats. However, a small decrease of 5% 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%, 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% and catch rates reduce by 15%. Spangled Emperor, the key target species in the northern part of the region, is reduced by 20% by recreational fishing. These kinds of reductions impact an important part of the ecosystem and a popular resident activity. It should be remembered that this result assumes that current regulations stay in place for recreational fishing and boating.

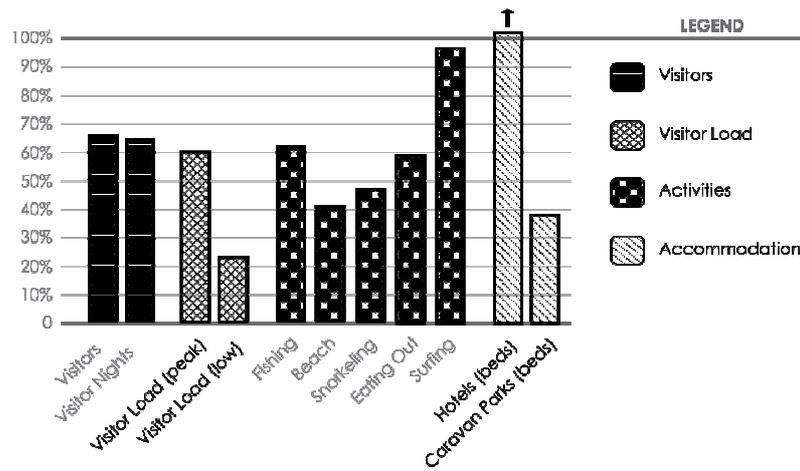


Fig. 4.2: Graph of Tourism Impacts for the Ningaloo Coast from a baseline of 2007

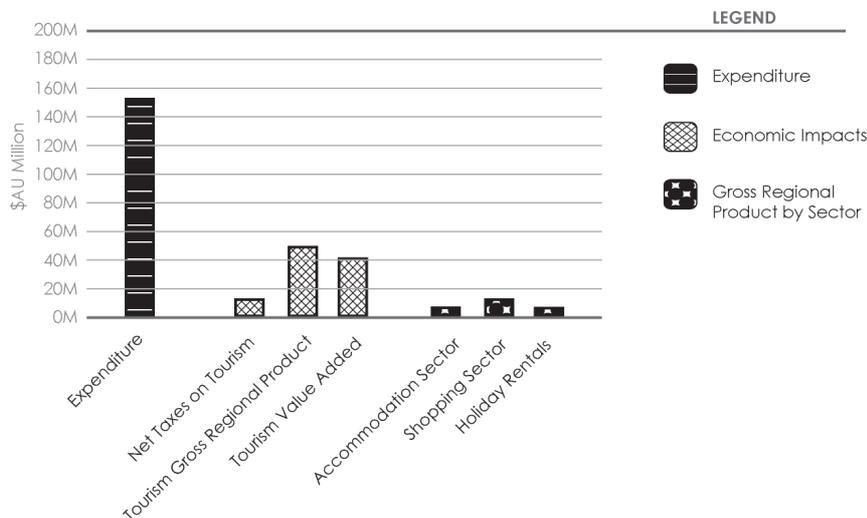


Fig. 4.3: Graph of Percentage Change for Economic Impacts for the Ningaloo Coast from a baseline of 2007

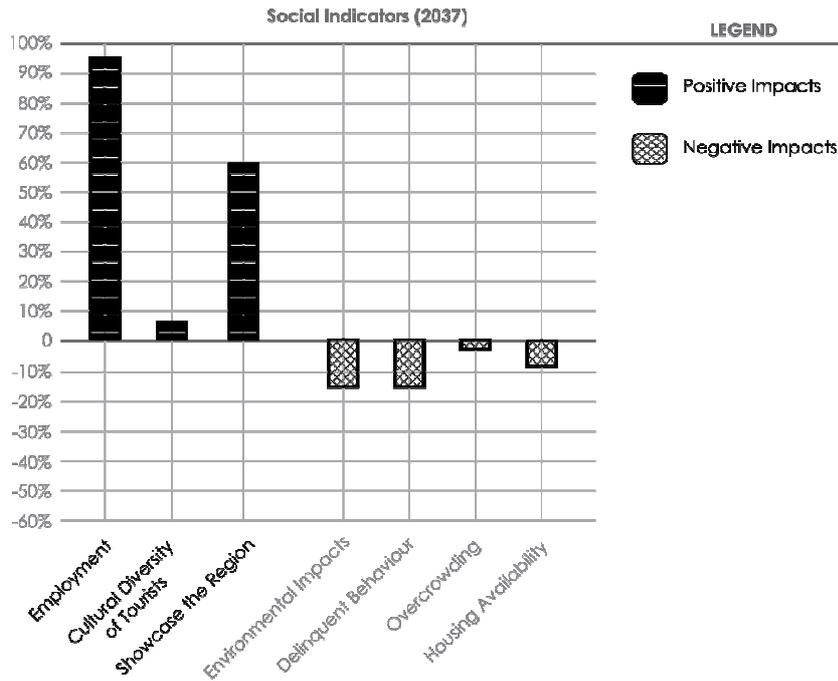


Fig. 5.4: Graph of Percentage Change of Social Impacts for the Ningaloo Coast from a baseline of 2007

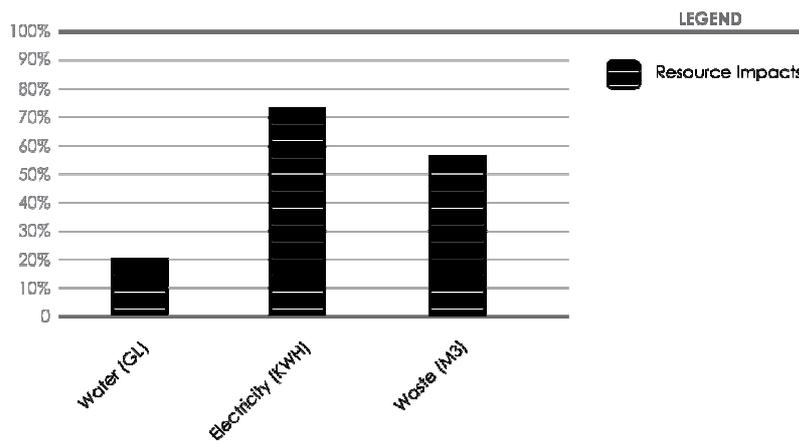


Fig. 5.5: Graph of Percentage Change of Demand for Resources for the Ningaloo Coast from a baseline of 2007

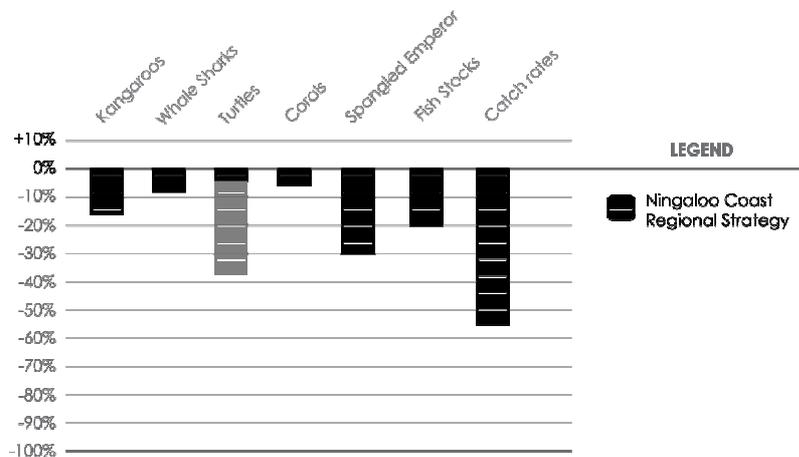


Fig. 5.6: Graph of Percentage Change of Ecological Impacts for the Ningaloo Coast from a baseline of 2007

We presented the model results to both institution specific and multi-stakeholder forums in the region and in Perth. Institutions had the opportunity to request specific issues, while a group of locals from different organisations and sectors chose the scenarios for the multi-stakeholder forums. The requests reflect different issues amongst different communities. Carnarvon Shire and business owners asked for a comparison of two different development strategies, Carnarvon as a gateway to different attractions versus Carnarvon as a destination in itself, and an exploration of the implications of a large surfing competition on the pastoral stations. Coral Bay residents explored the differences between a large resort near Coral Bay versus expanding Coral Bay and the implications of further delays in building workers' accommodation. An Exmouth group of local stakeholders chose to explore likely pressures on Exmouth, the effects of new resident accommodation, a boat ramp upgrade and the differences between caravan park and hotel accommodation. Exmouth Shire explored the impacts of a upgrading a boat ramp, housing issues and how recycling would reduce pressure at the local dump. We also regularly explored a large resort development as an alternative to the *Coastal Strategy*, which received responses in all forums that the ecological impacts outweighed the economic benefits. These requests are evidence of experimentation, where the models are used to explore likely and alternative outcomes and upcoming plans.

The model potentially is having its greatest impact in the areas of collaboration and learning. Linking development and infrastructure decisions to economic, social and ecological outcomes has demonstrated the importance of communication between local government and different agencies. Communication through a broadly representative local reference group convened to advise researchers about how to communicate with the region has led to requests for joint forums where groups originally recommended separate meetings. The ecological impacts have concerned participants, and have increased attention on the likelihood and thresholds of fish stock decline. 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, fish stocks increased so that the rate at which fishers catch fish

increased from the current levels by over 20%, and the available fish increased in size. This has encouraged a community response to seek change to fishing regulations. We have put locals in touch with a CSIRO researcher who is working with the Western Australian Department of Fisheries to test different recreational fishing regulations. These realisations and links indicate how modelling can build social networks within and across scales (local, state and national in the case of research networks). Local networks have been crucial to generating responses based on the new information.

6.2 Model use and integration with regional planning – getting buy-in and ongoing learning

The major failing of modelling projects is that they often are not used by the prospective recipients. We have attempted to address this issue through ongoing discussions about the project's legacy with stakeholders, particularly institutions involved in land management and planning, throughout the project.⁹ We presented two alternatives to stakeholders in the forums. The first was the current plans for the project's legacy, with training and desktop models available for local and state institutions, access to the researchers for consultation, and opportunities to pay for longer, more involved projects if required. The second alternative presented what could happen with a broad base of support and investment from other institutions. This included a Perth-based modeller to support the project, a region-based support person who could promote the models, an annual forum for model use, and the use of the models to construct a community vision for Ningaloo. Support was demonstrated by a number of stakeholders through letters of support to politicians and the CSIRO to resource model uptake. CSIRO has invested in a model uptake project that will extend for another year past the finalisation of the models.

The process of organising the training sessions has proved promising for the prospect of increasing regional resilience. Rather than providing model training, the training will incorporate broader adaptive management principles and how they can be

⁹ The primary institution in the early and middle stages of the project was the NSDO as the institution with the primary responsibility for regional planning. The closure of the NSDO underlines the need for a broad base of support and involvement with planning research projects, as well as indicating the difficulties political cycles pose for long term planning.

supported by the model. There is strong interest from local agencies who have requested that the training incorporate a wide variety of groups, including the pastoralists. Given the recent history of relationships between these groups, a desire for greater communication and networks is an important development. It also bodes well for increasing useful redundancy in management (a positive for regional resilience as the failure of one agency can be identified by other groups) as stakeholders will be aware of the concerns of other stakeholders as they undertake their monitoring and management. While there has been interest in the annual event and community visioning, the training is likely to be when a decision is made on whether these pathways to greater resilience will be pursued. The position of a regional research coordinator has also received funding from three research projects and the regional development commission, and will work with the committee of a new research centre that is planned for Exmouth.

Despite the closure of the NSDO, the NDM now has a broad base of support in a number of different institutions and there is a strong desire in the region and amongst a variety of different groups, agencies and the tourism industry for the model to be adopted into a broad range of planning processes. While the issues raised by these groups have been specific to their own planning processes and operations to date, there is strong support to use the model for upcoming planning processes, specifically the review of the *Regional Strategy* which is due to take place in the next 12 months. The enhanced relationships between stakeholders and knowledge of a common methodology for planning and assessment set the stage for more effective regional planning at the level of the region, but also through the planning and operations of individual stakeholders.

7 CONCLUSION AND SUMMARY ASSESSMENT OF THE NDM APPROACH

This paper has focussed on how increasing regional resilience strengthens the capacities of a region to successfully participate in and commit to regional planning. The process of using modelling described here should be understood as a version of a communicative approach and a contribution to regional planning knowledge. By using principles and practices from social-ecological systems research and organisational learning, modelling can assist regional planning to focus on building a region's capacity to

manage social-ecological systems and therefore better cope with change and uncertainty. In the Ningaloo case, the use of the model approach has highlighted in particular the resource and ecological implications of some of the scenarios considered, leading to both a valuing of much in the Regional Strategy, but also the need for a reconsideration of some of the elements, their phasing and the need for mitigation. The local response to these results has included a group requesting tougher fishing regulations, experimentation with a number of factors including the level of residential housing and recycling, and criticisms of the alternative strategy of a large resort.

The challenge for this work, and for other studies which might benefit from such an approach, is how to build inter-institutional decision making processes that are capable of understanding and working with variability and uncertainty. Our approach in the NDM project has concentrated on regional arrangements that build knowledge about important SES, improve relationships between institutions, and encourages experimentation in planning and management decisions. Systems dynamics modelling is seen as having many attributes which can contribute to these goals, in the stages of both model development and model use. In the first stage, the development in a collaborative way of tourism scenarios, model and sub-models helped to assess and integrate different stakeholder understandings of tourism systems. The work identified critical feedback loops and thresholds. It employed effective methods to keep people involved and strengthened regional information networks, using conceptual diagrams, the identification of causal links, and the provision of a common language for capturing important aspects of tourism in this sensitive location and for testing understandings of the tourism system. The second, application, stage of the NDM illustrated the way that model use can enhance experimentation and relations between institutions, and build knowledge about how SES work through exploring different scenarios. The example of the *Coastal Strategy* shows how the model can draw attention to cumulative impacts and thresholds that can often be overlooked in the regional planning process. Additionally, this process has developed a wide range of indicators for stakeholders to assess the impacts of plans, strategies and events, and provides a basis for stakeholder groups to

collaboratively draw and test their own thresholds, discuss mitigation measures if required, and potentially negotiate trade-offs.

Returning to some of the key ingredients for successful regional planning noted at the beginning of this paper, modelling can be seen to have positive outcomes for regional planning when it focuses on building regional resilience. In particular, the NDM process has helped to build co-ordination and commitment: coordination through a focus on strengthening social networks and group learning about the SES impacted by regional planning; and commitment through an acknowledgement of areas of shared concern and mutual dependence for positive outcomes, and a growing acknowledgement of the importance of coordination. Modelling has the capacity to assist collaborative regional planning and integrate it with learning about the key social-ecological systems that underpin the values and resources of a region. The need for broad involvement and commitment is a fundamental challenge, as exemplified by the demise of the NSDO. Regional planning supported by modelling for regional resilience could underpin the next generation of regional planning initiatives.

REFERENCES

- [1] N. Brenner, *New State Spaces: Urban Governance and the Rescaling of Statehood*. Oxford: Oxford University Press, 2004.
- [2] Commission of the European Communities (CEC), *Compendium of European Planning Systems*. Brussels: CEC, 1997.
- [3] J. Glasson and T. Marshall, *Regional Planning*. London: Routledge, 2007.
- [4] J. Glasson, *et al.*, "Regional planning in Western Australia: new initiatives, but old problems?," *Urban Policy and Research*, vol. 15 pp. 31-41, 1997.
- [5] U. Wannop, *The Regional Imperative: Regional Planning and Governance in Britain, Europe and the USA*. London: Jessica Kingsley, 1995.
- [6] B. Jenkins, *et al.*, "The evolution of sustainability assessment for Western Australia," *Australian Environmental Planning Law Journal*, vol. 20, pp. 56-65, 2003.
- [7] P. Roberts, "Evaluating regional sustainable development: approaches, methods and the politics of analysis," *Journal of Environmental Planning and Management*, vol. 49, pp. 515-532, 2006.
- [8] R. Yorque, *et al.*, "Toward an integrated synthesis," in *Panarchy: Understanding Transformations in Human and Natural Systems*, L. H. Gunderson and C. S. Holling, Eds., ed Washington D.C.: Island Press, 2002, pp. 419-40.
- [9] D. Wood and J. Glasson, "Giving the environment a voice: the transformational potential of valuing tourism in sensitive natural environments: the case of the Ningaloo coastal region, Western Australia," *Journal of Planning Practice and Research*, vol. 20, pp. 391-407, 2006.
- [10] F. McKenzie, "Regional matters: an inter-agency approach to understanding regional issues," *Australian Journal of Public Administration*, vol. 62, pp. 24-32, 2003.
- [11] J. Friend, *et al.*, *Public Planning: The Inter-Corporate Dimension*. London: Tavistock, 1974.
- [12] R. Rhodes, *Understanding Governance: Policy, Networks, Governance, Reflexivity and Accountability*. Buckingham: Open University Press, 1997.
- [13] P. Healey, *Collaborative Planning; Shaping Place in Fragmented Societies*. London: Macmillan, 1997.
- [14] C. S. Holling, Ed., *Adaptive Environmental Assessment and Management*. Oxford: International Institute for Applied Systems Research, 1978, p.^pp. Pages.
- [15] C. S. Holling and G. K. Meffe, "Command and control and the pathology of natural resource management," *Conservation Biology*, vol. 10, pp. 328-37, 1996.
- [16] W. N. Adger, "Social and ecological resilience: are they related?," *Progress in Human Geography*, vol. 24, pp. 347-64, 2000.
- [17] C. Folke, *et al.*, "Resilience and sustainable development: Building adaptive capacity in a world of transformations," *Ambio*, vol. 31, pp. 437-440, 2002.
- [18] C. Perrings, "Resilience and sustainable development," *Environment and Development Economics*, vol. 11, pp. 417-427, 2006.
- [19] L. Lebel, *et al.*, "Governance and the capacity to manage resilience in regional social-ecological systems," *Ecology and Society*, vol. 11, 2006.
- [20] C. S. Holling, "From complex regions to complex worlds," *Ecology and Society*, vol. 9, p. 11, 2004.
- [21] C. S. Holling and L. H. Gunderson, Eds., *Panarchy: Understanding Transformations in Human and Natural Systems*. Washington DC: Island Press, 2002, p.^pp. Pages.
- [22] R. Martin and P. Sunley, "Complexity thinking and evolutionary economic geography," *Journal of Economic Geography*, vol. 7, pp. 573-601, Sep 2007.
- [23] B. Farrell and L. Twining-Ward, "Seven steps towards sustainability: Tourism in the context of new knowledge," *Journal of Sustainable Tourism*, vol. 13, pp. 109-122, 2005.
- [24] T. Meppem and R. Gill, "Planning for sustainability as a learning concept," *Ecological Economics*, vol. 26, pp. 121-37, 1998.
- [25] B. Walker and D. Salt, *Resilience Thinking: Sustaining Ecosystems and People in a Changing World*. Washington DC: Island Press, 2006.
- [26] K. Schianetz, *et al.*, "The learning tourism destination: the potential of a learning organisation approach for improving the sustainability of tourism destinations," *Tourism Management*, vol. 28, pp. 1485-96, 2007.
- [27] M. van den Belt, *Mediated Modeling: A Systems Dynamics Approach to Environmental Consensus Building*. Island Press: Washington, 2004.
- [28] J. D. W. Morecroft and J. D. Sterman, Eds., *Modeling for Learning Organizations*. Portland, OR.: Productivity Press, 1994, p.^pp. Pages.
- [29] P. M. Senge, *The Fifth Discipline: The Art and Practice of the Learning Organization*. New York: Currency Doubleday, 1990.
- [30] P. Moser and W. Moser, "Reflections on the MAB-6 Obergurgl project and tourism in an alpine environment," *Mountain Research and Development*, vol. 6, pp. 101-118, 1986.
- [31] P. A. Walker, *et al.*, "The tourism futures simulator: a systems thinking approach," *Environmental Modelling and Software*, vol. 14, pp. 59-67, 1999.
- [32] T. Jones and D. Wood, "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*, vol. 3, pp. 137-44, 2008.
- [33] E. S. Schreiber, *et al.*, "Adaptive management: a synthesis of current understandings and effective application," *Ecological Management & Restoration*, vol. 5, pp. 177-82, 2004.

- [34] K. Schianetz, *et al.*, "The practicalities of a learning tourism destination: a case study of the Ningaloo Coast," *International Journal of Tourism Research*, vol. 11, pp. 567-81, 2009.
- [35] CALM (Department of Conservation and Land Management), "Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area, 2005-2015," Department of Conservation and Land Management, Perth 2005.
- [36] D. Wood and R. Dowling, "Tourism Surveys in the North West Cape Region 1989-2002," Department of Planning and Infrastructure, Perth, Australia 2002.
- [37] C. Pforr, *et al.*, "The Dynamics of a Coastal Tourism Development: Attitudes, Perceptions and Processes," Sustainable Tourism Cooperative Research Centre, Gold Coast 2007.
- [38] CALM (Department of Conservation and Land Management), "Cape Range National Park, Draft Management Plan," Department of Conservation and Land Management, Perth, Australia 2005.
- [39] B. Smith, "World Heritage not welcome in Exmouth," in *Northern Guardian*, ed. Camarvon, 2009, p. 1.
- [40] T. Jones, *et al.*, "Ningaloo Coast Region Visitor Statistics: Collected for the Ningaloo Destination Modelling Project," Sustainable Tourism Cooperative Research Centre, Gold Coast 2009.