Project 2.1.2 – Human values and aspirations for coastal waters of the Kimberley: Social values and management preferences using Choice Experiments

ALAYA SPENCER-COTTON, MARIT E. KRAGT, MICHAEL BURTON

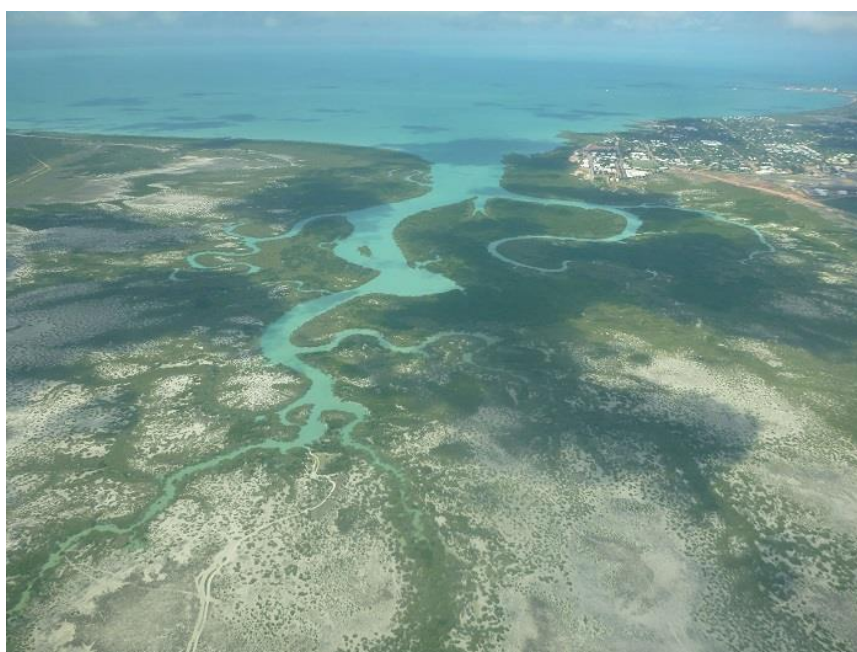*The University of Western Australia, Perth, Western Australia, Australia*

March 2016

Image 1: Arial photo of Broome and Dampier Creek, photograph by Alaya Spencer-Cotton

THE UNIVERSITY OF
WESTERN
AUSTRALIA

SEEK WISDOM

Image 1: Arial photo of Horizontal Falls in the Buccaneer Archipelago, photograph by Marit E. Kragt

Extracted from WAMSI II Science Project Plan, Node 2 Project, (REVISED AUGUST 2014).

Year 3	July 2014 – June 2015 (project suspended July 2014 – January 2014 inclusive: 6 mths)		Status
	1. Annual project planning completed		
3/2	Plan for assigned values (PP GIS) and management preferences combined online survey to be conducted over the period Apr-May 2015 (objective 2) (MU)	Feb 2015	Completed
3/3	Plan for social values mapping with up to two Traditional Owner groups to be conducted over the period May-June 2014 (objective 4) (MU)	Apr 2015	In progress with Karajarri TLA; delayed owing to the lengthy nature of developing agreement-based research
3/4	Plan for stated preference research as part of PP GIS online survey to be conducted over the period Apr-May 2015 (objective 3) (UWA)	Mar 2015	Completed
	2. Annual field program completed		
3/5	PP GIS and stated preferences online survey completed	May 2015	Completed
3/6	Social values mapping with up to two Traditional Owner groups completed	June 2015	Completed
	3. Annual data analysis completed		
3/7	PP GIS data analysed	June 2015	Completed
	4. Annual data management completed		
	GIS data (from interview-based mapping) provided to custodian (DPaW)	June 2015	Completed August 2014
	5. Annual reporting completed (outputs)		
	5.1 Science		
3/9	Annual fieldwork program and progress report completed	June 2015	Completed
3/10	PP GIS for Kimberley coast as technical report 2 (objective 2) (MU)	June 2015	Completed
3/11	Submit manuscripts: • Mapping marine social values for Kimberley coast (MU) • Social values & tourism (MU) • Tourism and awe: the Kimberley coast (MU)	June 2015	Ongoing
	5.2 Communication		
	5.3 Knowledge transfer		
3/14	Update WAMSI, DPaW, DPC, KLC & other key stakeholders on progress and proposed fieldwork for 2015	Mar 2015	Completed & ongoing
Year 4	**July 2015 – December 2015 (project scheduled for completion December 2015)**		
	1. Annual project planning completed		
4/1	Confirm completion schedule with Research Team members & WAMSI	July 2015	*N/A for this reporting period*
	2. Annual field program completed		
	Fieldwork completed in Year 3		Completed
	3. Annual data analysis completed		
4/2	Stated preference data analysed	July 2015	Completed
4/3	Traditional Owners' values information analysed	July 2015	Ongoing. Delayed owing to time-intensive nature of securing agreement based research
	4. Annual data management completed		
4/4	GIS data provided to custodian	Aug 2015	
	5. Annual reporting completed (outputs)		
	5.1 Science		
4/5	Stated preferences – Kimberley coastline as technical report 3 (objective 3) (UWA)	Sept 2015	Completed
4/6	Traditional Owner values for a selected marine park as technical report 4 (objective 4) (MU)	Sept 2015	In prep; delayed owing to time-intensive nature of securing agreement based research
4/7	Complete final report (MU & UWA)	March 2016	*N/A for this reporting period*

4/8	Submit manuscripts: • Social mapping using PP GIS (MU) • Spatially locating human values for marine park planning & management (MU) • Stated preference research & marine parks (UWA)	March 2016	*N/A for this reporting period*
	5.2 Communication		
4/9	Present final results at DPaW PVS Annual Conference (MU)	Oct 2015	*N/A for this reporting period*
4/10	Present findings at Resources Economics conference (if funding is sourced) (UWA) Present findings at European conference (if funding is sourced) (MU)	Aug 2015	Completed and ongoing
	5.3 Knowledge transfer		
4/11	Provide briefing for DEC PVS, marine & planning staff on final results and how they can be presented and used in planning & management (MU & UWA)	Dec 2015	Completed and ongoing

Personnel and staffing: *Use this section to discuss staffing issues i.e. technicians hired, PhD or MSc or honours students working on the project (project completions etc). This section should be completed anew each 6-monthly reporting cycle. (Note: Do not delete this header text.)*

No personnel or staffing issues.

Data/metadata reporting: *The Data and Information Management Plan (DIMP) articulates the datasets and data products that will be produced during the project and how they will be made accessible. The milestone report should list the datasets and data products produced up to and including the reporting period and should confirm that these have been entered into the metadata database and updated, where necessary, in the DIMP. (Note: Do not delete this header text.)*

Data collection has been ongoing during this reporting period. Six datasets have been produced from this research and aggregate data information will be available to interested parties e.g. Department of Parks and Wildlife.

Links to other projects: *Use this section to note the links to other WAMSI projects and to provide information on the arrangements between projects for field logistics and/or data/information sharing and the progress that has been made in this regard during the reporting period. (Note: Do not delete this header text.)*

This project was completed as a collaborative project as part of Western Australian Marine Science Institution Kimberley Research Node Project 2.1.2 *Values and aspirations for coastal waters of the Kimberley*, with Murdoch University and the University of Queensland. This is the third Technical Report in the node, more information on the collaborative survey and project is reported by Strickland-Munro et al. (2016a) and in the Final Report (Strickland-Munro et al. 2016b).

Other issues (including IP) and new or emerging risks: *Use this section for other comments including production of project intellectual property (PIP) and use of background intellectual property (BIP) or identification of new risks to the project that have emerged. (Note: Do not delete this header text).*

Communication Activities – Publications, Presentations, Media releases: *List all communications that have occurred up to and including the reporting period. This should include publications (peer reviewed and general) as well as other communication activities such as presentations, workshops, meetings and media activities associated with the Project. Include hyperlinks to media releases if possible. This section should become a regularly updated permanent record of all outputs of the Project. Add pages and journal numbers and DOIs when they become available. Fill in the table below as a cumulative summary of communication activities (i.e. adding those that have occurred during the current reporting period to the ongoing tally). (Note: Do not delete this header text.)*

For complete list of all communication activities – Publications, Presentations and Media releases related to this project also see Strickland-Munro et al. (2016a) and Strickland-Munro et al. (2015) and Strickland-Munro et al. (2016b).

Presentations and Meetings

Spencer-Cotton A, Kragt E M, Burton M (2015) Social values and management preferences using Choice Experiments. Preliminary discussion. WA Department of Parks and Wildlife Head Office, Kensington, WA, 28 January 2015

Spencer-Cotton A, Burton M (2015) Social values and management preferences using Choice Experiments. Attribute Briefing. WA Department of Parks and Wildlife Head Office, Kensington, WA, 5 March 2015

Burton, M. (2015) Spatially explicit discrete choice experiments: an application to coastal management in the Kimberley, Western Australia. Seminar to the Environmental and Resource Economics Group, School of Social Sciences, University of Manchester, October 2015

Spencer-Cotton A, Kragt E M, Burton M (2016) Implications of geographical scope in valuing wilderness management in the Kimberley. The 60th Australian Agricultural and Resource Economics (AARES) 2016 Annual Conference, 2-5 February 2016, Canberra ACT.

Kragt E M, Spencer-Cotton A, Burton M (2016) Valuing remote wilderness – estimating spatially explicit values for the Kimberley coast. The 60th Australian Agricultural and Resource Economics (AARES) 2016 Annual Conference, 2-5 February 2016, Canberra ACT.

Kragt, ME, Brown, G, Burton, M, Kobryn, H, Moore, SA, Spencer-Cotton, A, Strickland-Munro, J (2016) Estimating spatially explicit values for the Kimberley Coast. Invited presentation for South Australian branch of the Australian Agricultural and Resource Economics Society, University of Adelaide, Adelaide, 16 March 2016

Media and internet

For Communication Activities – Publications, Presentations, Media releases related to this project also see Strickland-Munro et al. (2016a), Strickland-Munro et al. (2015) and Strickland-Munro et al. (2016b).

Communication Activity	Total to date
Peer reviewed publication	
Popular publication (i.e. Landscope, newsletter, etc.)	
Conference Presentation	
Presentations/Meetings with DPAW managers	
Presentations/Meetings with Traditional Owners	
Presentations/Meetings with other stakeholders (i.e. industry, tourism)	
Presentations to general public	
Media releases	
Radio interviews	
Newspaper articles	
Other	

Certification

I certify that the reporting is complete and accurate to the best of my knowledge, and I have reported any substantial deviation from the Project Plan and matters which I believe may affect the ability of the project to meet its objectives. I certify that each Project Party has provided Contributions as required under the Project Agreement.

Project
Leader:

Michael Burton

Date:
23/03/16

This section needs to be signed for the Final Project Report only by the relevant Joint Venture Partner Executive.

Certification

I certify that this report has been reviewed by the agency and reflects the standards of this agency in reporting.

WAMSI JV
Partner Executive:

Date:

The section below is completed by WAMSI

Metadata up to date – confirmed by Data Manager: Date:

Milestone Report approved by Node Leader: Date:

Milestone Report approved by WAMSI: Date:

Contents

Human values and aspirations for coastal waters of the Kimberley: Social values and management preferences using choice experiments

Executive summary

This is the third report from the Kimberley Research Node Project 2.1.2 "Human values and aspirations for coastal waters of the Kimberley" research project funded by the Western Australian Government and administered by the Western Australian Marine Science Institution. The study area is the Kimberley coastline and waters extending from south western part of Eighty Mile Beach to the Northern Territory border. This research complements the research undertaken by Murdoch University on the human values and preferences in the Kimberley, reported in Strickland-Munro et al. (2015). The Kimberley is recognised as lacking in research and data for physical and social environments. This research contributes towards building the social and 'human values' knowledge base and affords many interesting insights relevant for policy and management in the Kimberley region. This research supports the management intentions of the State Government to establish a network of marine parks in the State waters along the Kimberley coast.

This report presents the findings of an online choice experiment survey conducted with a range of participants and stakeholders. The online survey comprised of two parts, it was a collaboration with Murdoch University who conducted a public participatory GIS (PPGIS) mapping exercise in the first part of the survey (reported in Strickland-Munro et al. (2016a)). The second part consisted of the choice experiment questions. Participants in the choice experiment survey included visitors to the Kimberley; local residents; local, State and Federal Government employees; scientific researchers; members of the tourism industry; environmental non-government organisations; oil and gas industry employees, Aboriginal people (Traditional Owner status unknown); commercial fishing and aquaculture employees; and others. People were recruited to the study using two methods: following active public recruitment such as email invitation, or through a commercial research company and their online panel.

In the choice experiment, respondents were presented with two active management options, and a third 'no-action' option, and asked to select their single preferred choice. Each active management option comprised a number of changes in management, the effects of which are described by changes in a number of outcomes (also called 'attributes'). The discrete choice forces respondents to make trade-offs between the different options and the outcomes of each option.

A particular research focus of this choice experiment is the impact of making the choice experiment questions spatially explicit. Researchers were interested in people's choices for management options that were linked to a specific region (or 'management zones') of the Kimberley coast. In this study the Kimberley region was divided into six management zones, determined in consultation with key stakeholders.

The management options contained four spatially specific attributes and an associated management cost. The spatially specific attributes were: percentage of State waters zoned as sanctuary areas; number of Aboriginal rangers, level of average recreational facilities in the region, and whether additional development (as defined using a description and photograph) would occur in the region. These attributes were developed based on the values and preferences discovered in interviews conducted by Murdoch University and reported in Strickland-Munro et al. (2015). The attributes, attribute levels, management zones, choice sets and survey questions were discussed in focus groups and tested in a pilot survey with relevant participants and stakeholders.

Two respondent sample groups were recruited using different methods. A Public sample focussed on people that live in, or are associated with, the Kimberley. These respondents were recruited publically through a number of methods such as via email, online links, postcards and letters. The Public choice experiment survey received 320 completed responses.

The other sample group is a Panel sample, recruited using an online research company who used respondents from their online research panel who live in Western Australia. The Panel sampling was split into five versions of the experiment. This was done to allow the research team to explore different aspects of the choice experiment survey design. The first version is a full replication of the Public choice experiment, to allow for comparisons across the two sample groups. One version included the same choice experiment questions, but excluded the PPGIS mapping exercise. The final three versions also excluded the PPGIS mapping exercise, and showed respondents only management change in a single zone rather than in six zones. Two of these three versions showed management zones that were also used in the full choice experiment (but presented only one instead of six zones). The final version showed the whole Kimberley coast as a single zone. In these three 'single

zone' experiments, people were not asked to make spatial trade-offs between any zones, but instead focussed on trade-offs between the attribute levels only. The five split samples administered in the Panel sample are thus: six zone-experiment with PPGIS mapping (same survey as the Public, 155 respondents), six zone-experiment without PPGIS (385 respondents); single-zone experiment - Roebuck Bay (189 respondents); single-zone experiment - Camden Sound (182 respondents), and single-zone experiment – whole Kimberley Coast (181 respondents).

Mixed logit models were estimated to account for random taste differences across respondents. Interactions between socio-economic variables and the choice attributes were included to account for systematic heterogeneity. Separate models were estimated for each sample as preliminary analysis suggested there is unlikely to be a single unifying model of preferences,

Results suggest that both people recruited publically and people from the Panel, hold values and preferences for the choice attributes presented. Focussing on the key management question of providing marine sanctuary zones in State waters, all models confirmed that increasing the area of sanctuary zones is valued by WA residents - both those who have a direct connection with the region and also those drawn from the Panel, who mostly live in Perth. The Perth sample have a tendency to place a greater weight on increases in sanctuary zones in the Dampier Peninsula and North Kimberley, while the Public sample values them equally across the coast.

Increasing recreation facilities to a relatively high level (equivalent to the WA Department of Parks and Wildlife category of Highly Modified) was generally not valued or valued negatively. For the Public sample in particular, this change reduces welfare especially in the four northern more remote zones (Dampier Peninsula, Buccaneer Archipelago, Camden Sound, and North Kimberley). The same pattern emerges for the coastal development attribute. Coastal development was defined as a relatively small change, representing impact on the sense of remoteness. There was a strong aversion to this change, particularly in the northern zones.

Although there was some heterogeneity in preferences, the overall picture that emerges from the analysis is that respondents are prepared to pay to increase environmental protection in coastal waters and wish to avoid development along the coast, even where this would improve current public access. This holds for both local and metropolitan populations, both of whom appear to value the Kimberly's unique sense of place.

Management Implications: Knowledge to action

The following conclusions and management implications derive from the research reported in this document.

Management Implication 1: All respondents hold values for the Kimberley coastal regions – including people who are not residents or members of groups who might be identified as having special interests in the area.

People revealed preferences for all the attributes presented in the choice experiment, regardless of where respondents lived. Given the remoteness of the region, these values will include non-use values for people (values not associated with actively using a resource). These non-marketed, non-use values are important for environmental goods and services. Hence, environmental managers and planners need to recognise that the relevant 'stakeholders' to consider includes Kimberley non-residents, who may not typically be identified as stakeholders. Recognising all relevant stakeholders is important if management decisions are to maximise the overall benefits to society.

Management Implication 2: Peoples preferences for management are influenced by identifiable characteristics; socio-economic or other.

There were significant interactions in all models between some of the attributes of the choice experiment and respondents' characteristics. This demonstrates that preferences differ, and can be related to respondents' socio-economic characteristics, demographics and/or attitudes towards the Kimberley region.

The three most significant characteristics influencing opinions were: levels of educational achievement, how easy or difficult a respondent felt they could access the Kimberley Coast, and respondents' perceived levels of knowledge of the Kimberley region. The influence of these socio-economic characteristics was different between all the samples. For policy makers and resource managers, information about how socio-economic and other characteristics affect people's preferences is relevant to identify which segments of the population may support or oppose particular proposals.

Management Implication 3: Preferences for management attributes vary spatially, in particular between northern and southern areas of the Kimberley region.

For the Public sample (people with some association with the Kimberley), we observed spatial differentiation in preferences between the zones. This group of people were willing to pay more for management in the Dampier Peninsula, Buccaneer Archipelago, Camden Sound and North Kimberley ('northern' zones) over management in Eighty Mile Beach, and Roebuck Bay ('southern' zones). Preferences for the attributes sanctuary area, High recreational facilities, and coastal development were also found to be spatially differentiated. In the Public sample, preferences for High recreational facilities and coastal development were more opposed in the northern zones than in the southern zones. Respondents in the Panel sample were willing to pay more for sanctuary areas in the Dampier Peninsular and North Kimberley zones. In the preliminary analysis undertaken for this report, no spatial differentiation was found across the region for increasing the number of Aboriginal rangers or for changing recreational facilities to what we define as "Medium" (comparable to Parks and Wildlife category of "Recreation").

The implication for managers is that they need to be aware that specific values will be associated with the specific region they are planning for, as values for management outcomes are not necessarily consistent across the whole Kimberley coastal region.

Management Implication 4: People hold, on average, positive values for sanctuary in State waters.

The results from our choice experiment models demonstrate that respondents from both the Public sample (respondents from the Kimberley region) and the Panel sample (respondents from Perth), have a preference for allocating more State waters as sanctuary zone. We show that this preference is stronger in some zones than in others (see Management Implication 3). Further studies are required to investigate whether there exists an 'optimal' amount of sanctuary area in each zone. Nonetheless, the results from our study suggest that increasing sanctuary areas along the Kimberley coast would generally be supported by WA residents.

Management Implication 5: People often disliked development of high levels of recreational facilities.

Preferences for improvement of recreation level to Medium were mixed, depending on the sample and respondents' socio-economic characteristics. There was, on average, a strong preference against developing a High average level of recreation facilities (comparable to DPAW category of "Highly Modified"). In particular, there were strong preferences against a High level of recreation facilities in the Dampier Peninsular, Buccaneer Archipelago, Camden Sound and North Kimberley zones. This finding suggests that managers may wish to limit the development of recreational facilities in the Kimberley coastal region. It also highlights the need for managers to appreciate that the demand for improvement or changes to recreational infrastructure will depend on the location, the scale of improvement, and the specific facilities on offer.

Management Implication 6: People who completed the PPGIS mapping exercise prior to the choice experiment survey are, on average, willing to pay more for management actions in the Kimberley.

This research finding suggests that greater exposure to potential attributes and management changes in the region, as manifested via the simple PPGIS mapping process, may increase people's values for all attributes. Further research is needed to investigate how different types and levels of information will influence respondents' choices. For managers, this finding implies that communication campaigns, information provision, and public engagement around Kimberley issues may improve the uptake of policies and plans.

Management Implication 7: Although people hold values for the Kimberley coastal region—and should be consulted—, they also sometimes want scientists and managers to make decisions.

In the choice experiment survey, about a quarter of respondents said that they did "not feel qualified to make a choice; scientists or managers should do this". This implies that some people may wish to hear more expert opinion on what management is being considered and what its impacts might be, before they will express an opinion about that management. Therefore, in any community engagement and consultation process, it is crucial that unbiased scientific information is provided and discussed with stakeholders first, before aiming to elicit their preferred management option.

Management Implication 8: Choice experiments offer managers unique insights into how people make trade-offs for management outcomes.

There are many insights to be gained from using choice experiments for environmental policy and planning. People's preferences for environmental management can be difficult to determine through more 'traditional' consultation processes. In particular, the values that people hold for different outcomes of management ('attributes' in the choice experiment) are hard to determine because there is usually no market in which values for management outcomes are expressed. In a world where resources are constrained, managers typically need to make trade-offs between different management options. Choice experiments offer a suitable approach to elicit people's values and preferences for the different outcomes of management.

The research described in this report is particularly valuable because of its spatially explicit choice sets. The successful completion of the study suggests that respondents are able to make trade-offs between spatially different management options, and that respondents' preferences vary for attributes in multiple locations where environmental management is implemented. Thus, decision makers and management bodies should consider: (a) the non-market values impacted by environmental policy and planning, and (b) the spatial nature of values for environmental policy outcomes.

Human values and aspirations for the coastal waters of the Kimberley: Social values and management preferences using choice experiments

1. Introduction

1.1 Scope and purpose of research

This is the third technical report produced from the Western Australian Marine Science Institution Kimberley Research Node Project 2.1.2 *Values and aspirations for coastal waters of the Kimberley*. The study area is the Kimberley coast and coastal waters stretching from the southern part of Eighty Mile Beach to the border with the Northern Territory, see Figure 1. The primary focus of the funding for this research, by the Western Australian Government, is to support the management of the proposed marine parks in the Kimberley coastal waters. The Kimberley Marine Research Program Plan (Simpson 2011) establishes the major research priorities for the State and is the guiding document for the development of the Kimberley Marine Research Node Projects. The two primary areas of research are the 'bio-physical and social characterisation', and 'understanding key ecosystem processes'. This third technical report in Project 2.1.1 contributes to the first major area by contributing to social characterisation of the Kimberley coastline and marine environment by exploring the social values of the region beyond human uses and impacts.

WAMSI Research Objective:

Undertaking comprehensive stated preference choice analyses. This will be achieved by including a series of questions designed to elicit respondents' preferences regarding future activities on the Kimberley coast and future management of this coastline and its waters in the web-based survey detailed under Objective 2.

Previous research by Murdoch University reported by Strickland-Munro et al. (2015), showed that people derive 17 types of use and non-use values from the Kimberley coast and marine environment. This information was gathered in open-ended interviews that allowed interviewees to define their own values and map the locations of those values using polygons (in an unconstrained mapping exercise).

The present study uses stated preference discrete choice experiment (CE) surveys to reveal human values, using a survey instrument where respondents are given a choice of options and asked to state their preferred option. This current research will explore how the values identified in the previous research relate to each other, specifically by asking people (indirectly) to make trade-offs between different values at different Kimberley locations. This study is part of a collaborative project with Murdoch University, the University of Western Australia, and The University of Queensland. Another component of this project uses an online Public Participatory GIS (PPGIS) mapping survey for values and preferences, as reported in Strickland-Munro et al. (2016a).Of specific interest in the CE reported here is people's willingness to pay (WTP) for the outcomes of different management actions in different Kimberley regions.

1.2 The Kimberley

The Kimberley coastline extends along 7,331 km of beaches, estuaries, rocky shores and mangroves, and 13,296 km including the islands (Geoscience Australia 2015). The characteristics of the region include remoteness, low or sparse human population, varying degrees of accessibility along the coast, and potentially conflicting use and non-use-values. The region has received much attention due to conflicts in oil and gas developments (e.g. at James Price Point), agricultural and tourism development (e.g. Ord river irrigation scheme and Broome tourism), and recent significant State and Commonwealth marine reserve planning. The WA Department of Parks and Wildlife is the agency with responsibility for managing the State's marine parks and undertaking environmental management in the Kimberley national parks and marine reserves under the Conservation and Land Management Act 1984 (WA) and the Wildlife Conservation Action 1950 (WA). For a more detailed description of the European history of the Kimberley see Strickland-Munro et al. (2015) section 1.4.3.
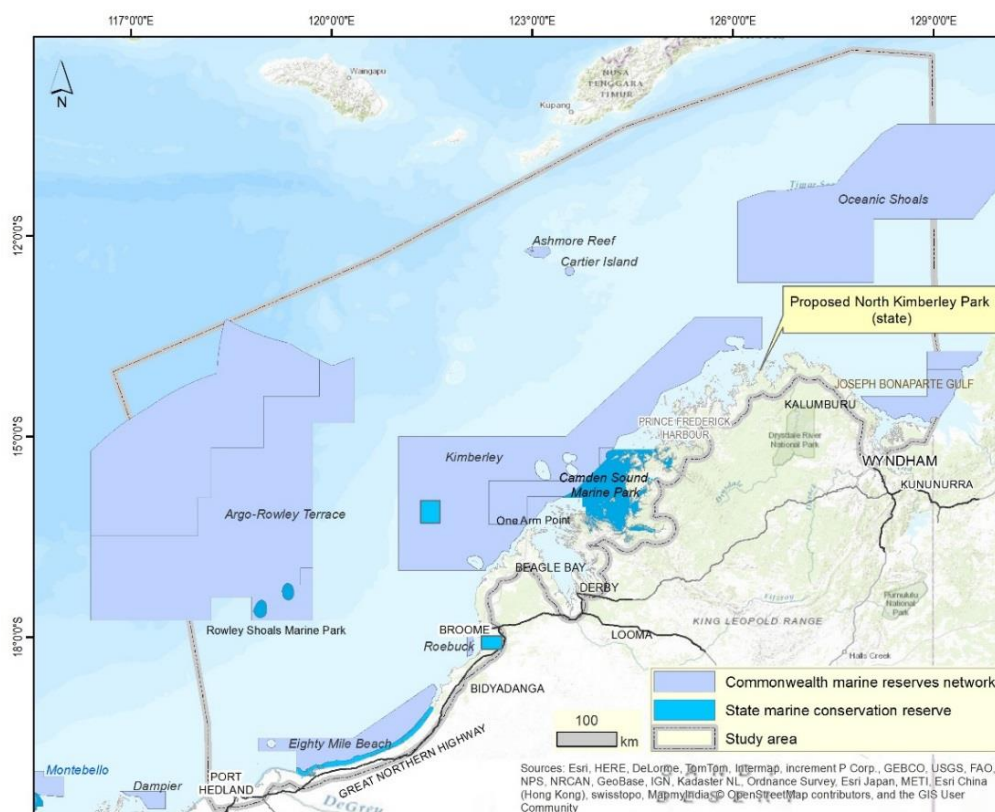
Figure 1. Study area with Kimberley marine parks (current and proposed) (Source: Geoscience Australia 2014, Department of Parks and Wildlife)

Considering the high profile of the Kimberley, Western Australian respondents are likely to have some prior knowledge of the region, and that will be further influenced by whether they have previously visited the Kimberley coast. A recent CE on management options for an offshore marine protected area found that even participants with little or no prior knowledge of the marine park could still reliably express preferences for the area, provided that the relevant information was provided (Börger et al. 2014). The implication for the current study, where knowledge may vary between participants and with limited time to provide information, is that the amount of information provided in the survey needs to be carefully determined. For example, parts of the north of the Kimberley are largely inaccessible (to most visitors) and therefore people may be less familiar with the landscape or the biodiversity values in the region.

1.2.1   Kimberley: marine parks and management

The Kimberley Conservation and Science Strategy (Government of Western Australia 2011) clearly presents the Western Australian Government's intention to increase the scientific understanding of the Kimberley and to establish a network of marine parks in the State waters along the Kimberley coast. State waters extend from the high tide line to approximately 3 nautical miles from the coastline. As of August 2015, the marine parks established with management plans are Eighty Mile Beach and Lalang-garram / Camden Sound Marine Park and there are three marine parks yet to be formalised in Roebuck Bay, Horizontal Falls and the North Kimberley (two of these are referred to in Figure 1).

The Commonwealth marine reserves are located in Commonwealth waters extending up to 200 nautical miles from the coastline, not including State waters. The Federal Government has given General Approval for the Kimberley, Roebuck Bay and Eighty Mile Beach Commonwealth Marine Reserve, which stretches along the western coast of the Kimberley, also shown in Figure 1.

1.2.2   *Kimberley values and preferences*

The supporting research on the human values and aspirations of the Kimberley Coast was conducted by Murdoch University and reported by Strickland-Munro et al. (2015). Murdoch University conducted 167 in-depth face-to-face interviews with 232 people. Stakeholders interviewed included: Aboriginal Traditional Owners; Aboriginal and non-Aboriginal residents; tourists and the tourism industry; commercial and recreational fishing, and aquaculture; Federal, State and Local government; mining, oil, gas and tidal energy interests; marine transport and aviation; and environmental non-government organisations. The analysis of the interviews by Murdoch University using NVivo (a qualitative data analysis Software; QSR International Pty Ltd. Version 10, 2012) produced a list of values categories that were referred to in the interviews (Table 1). The value categories were not predefined but emerged from the qualitative analysis and detailed coding of the interviews. Further analysis of the interview data by NVivo reveals key areas of future aspirations and threats (Table 2). These values and aspirations provided the theoretical basis for the development of the attributes used in the choice experiment component of this project.

Table 1. Categories of values from the interviews and their definitions (direct reproduction from Strickland-Munro et al. (2015) Table 7 page 30).

Value category[*]	Definition
Direct use, non-consumptive values	
Physical landscape (77%)	Values derived from components of the physical landscape. Major elements: aesthetics, tidal phenomenon, coastal geology, unique nature experiences, the Kimberley's 'pristine untouched environment', and the coastline being 'wilderness' and a 'last frontier'.
Aboriginal culture (63%)	Values derived from the transmission of Aboriginal wisdom, knowledge, traditions, and way of life. Major elements: cultural sites, connection to country, evidence of historical use, and transmission of cultural knowledge. DOES NOT include SPIRITUAL values relating to profound or awe inspiring nature experiences as expressed by non-Aboriginal people.
Therapeutic (62%)	Values derived from places that make people feel mentally better, calm, or recharged. Major elements: escapism, relaxation, remoteness, and personal recharge.
Social interaction and memories (56%)	Social values derived from a place. Major elements: social experience and home/ childhood memories.
Recreation–other (62%)	Values derived from places that provide opportunities for outdoor recreation unrelated to camping or fishing. Major theme: exploration.
Learning and research (34%)	Values derived from the ability to learn from a particular place. Typically expressed in terms of scientific research, but also monitoring, exploration, discovery and more generally the ability to learn about the environment (i.e.' lay' learning). DOES NOT include transmission of cultural knowledge within Aboriginal society (included in ABORIGINAL CULTURE).
Experiential (51%)	Values derived from places offering a unique personal experience. Major elements: adventure, iconic destination, 'blown away' experience, private experience.
Historical (19%)	Values derived from places of natural and human history that matter to an individual, others, Australia or the world. Major elements: European and missionary history. DOES NOT include evidence of historical Aboriginal use (included in ABORIGINAL CULTURE).
Spiritual (11%)	Values derived from places that are sacred, religious, unique, or that provide deep and/or profound experiences of nature. Typically related to an expressed reverence/ respect for nature by non-Aboriginal people. Major elements: nature as a spiritual landscape. DOES NOT include ABORIGINAL CULTURE e.g. those values related to the transmission of wisdom, knowledge, traditions and way of life.
Direct use, consumptive values	
Recreation–camping (58%)	Values derived from places that offer recreational activities centred on overnight or longer stays in transient and/or fixed accommodation in coastal areas.
Recreation–fishing (54%)	Values derived from places that offer recreational activities relating to the catching of fish species as well as gathering of other marine life e.g. mud crabs, cockles, oysters and stingrays. DOES NOT include fishing undertaken by Aboriginal people as this activity was more commonly referenced as subsistence rather than recreational pleasure.
Subsistence (44%)	Values derived from places that provide for basic human needs. Major elements: subsistence food collection and fresh water provision. DOES include Aboriginal hunting where specifically mentioned in the context of subsistence hunting.
Economic–tourism (36%)	Generic tourism values, or more specifically refers to eco or nature based tourism, or Aboriginal cultural tourism.
Economic– commercial fishing, pearling and aquaculture (24%)	Values derived from commercial fishing, aquaculture and pearling activities. DOES NOT include subsistence food collection (included in SUBSISTENCE).
Indirect use values	
Biodiversity (80%)	Values derived from the presence of flora, fauna and/or other living organisms. Major elements: marine fauna, reef biodiversity, migratory shorebirds and mangroves.
Non-use values	
Bequest (7%)	Values derived from places that offer future generations the ability to know and experience places, landscapes and habitats as they are now.
Existence (4%)	Values derived from knowing that a particular place, environmental resource and/or organism exists, regardless of having physically been to or directly used an area.

[*] Numbers in brackets refer to percentage of interviews in which each value is mentioned.

Table 2. Summary of future aspirations and threats, derived by ASC from the interview transcripts collected by Strickland-Munro et al. (2015).

Aspirations	Description
Aboriginal Futures	Provide opportunities for Aboriginal people to live and work on country, to look after it as land managers and rangers. Also to work as tourism operators.
Improved access and visitor management	Clear accessibility rules- people want to still access the Kimberley coast but want to be better informed (regarding Aboriginal Land and development infrastructure).
	Better visitor education and access to management systems.
Industrial Development	Resource extraction and transport.
Development- Tourism	Tourism, eco-tourism, and low key development.
Conservation-protection	Future generations, Iconic location - through conservation estate- protected areas or through management as a wilderness area.
Fisheries Management	Improved fisheries management.

Threats	Description
Sealing of access roads	Increasing visitor numbers and environmental damage.
Development Impacts	Threat to coastal values from commercial and tourism development, especially from mining and associated marine accidents.
Visitor Impacts	Increased visitor numbers from unmanaged access and poorly managed tourism operators. Increasing environmental impact and rubbish.
Nature	Impacts from climate change and natural events such as cyclones.
FIRE	Unmanaged and deliberately lit fires
Weeds and invasive species	Threat to biodiversity especially Cane toads. Introduced marine organisms from shipping and cruise ships.
Overfishing/overhunting	

1.3   Aboriginal engagement

The Kimberley coast has a rich and alive Aboriginal culture and history. Aboriginal people have been living in and moving through the Kimberley region for 40-60,000 years. Evidence of the history can be seen on the landscape as rock art and in cultural sites, however their relationship with the country is more than just sustenance and utility. It provides the fabric of their cultural and spiritual relationships. The Kimberley is home to around 200 Aboriginal Communities (Government of Western Australia) and around 27 Native Title claims with almost 70 percent of the region holding determined Native title claims (Kimberley Land Council). Each group has their own special relationship to their land and sea country and have distinctive connections to particular sites within a region. The idea of the landscape or 'country' is a place that "…*gives and receives life. Not just imagined or represented, it is both lived in and lived with*" (Rose 2002, 14). Aboriginal culture, or values relating to Aboriginal wisdom, knowledge, traditions, and way of life were mentioned in 63 percent of the interviews conducted during the first phase of this human values research (Strickland-Munro et al. 2015).

The research conducted by Murdoch University and reported in Strickland-Munro et al. (2015) included talking to around 50 Aboriginal Traditional Owners, rangers and residents during 37 interviews. Significant effort was made by the researchers to capture the values held by these respondents as they are central in understanding landscape values in the Kimberley coast. Interviews were conducted under the principle of agreement-based research and the format of these interviews (in person and using maps) was appropriate for relationship building and the development of these 'agreements'.

It is potentially difficult to engage with Aboriginal people for choice experiment research. Both the methodology itself and the data collection technique provide barriers to effective engagement with Traditional Owners. Firstly, the survey would be administered through an online internet survey. Given potential low internet literacy rate and limited internet access in some Aboriginal communities in the Kimberley, it may be difficult to reach a sufficient number of respondents. Secondly, we need sufficient data for the statistical analysis of choices. Given

the potential for low response rates, there would be considerable risk that values cannot be distinguished statistically and meaningfully interpreted. Lastly, the spatially explicit nature of this CE may have implications for use with Aboriginal people. The nature of Aboriginal relationship to their land and sea country may impact on preferences in a way that the models cannot unpack. The CE survey frames management in a way that suggests you can speak on behalf of regions, which may not be appropriate for some people and groups. Therefore, people may, for example, only choose options for their family region, thinking that if they cannot 'infringe' upon other families' regions. While this will happen to some extent with non-Aboriginal respondents, Aboriginal preferences are more likely to be shaped by various use and non-use values intimately tied to their family's country. While a CE could certainly be designed to account for these considerations (through agreement-based research and collaboration with Aboriginal people to design, trail and test the survey), such an extensive survey development process was considered beyond the scope of this study.

It is therefore acknowledged that the community preferences reported in this study may not include the values held by Aboriginal people. Other components of the broader human values research project, such as reported by Strickland-Munro et al. (2015), are likely to be better suited to both agreement-based-research and adequately capturing the values and preferences of Aboriginal people in the Kimberley.

1.4   The choice experiment method

In this project, people's preferences for management options on the Kimberley coast are elicited using a choice experiment survey technique. Choice experiments are a stated preference technique that is frequently employed by researchers to explore non-market values. CEs are a survey method that combines theories from economics, consumer theory and statistics. In a CE survey, participants are asked to make a choice between different hypothetical options (and usually a status quo or 'no action' option) that each describe the outcomes of different management alternatives. These outcomes are characterised by various 'attributes' that take on different levels across the choice options.

There are two main theories that support the methodology of choice experiments. The first is that a good is made up of characteristics and consequently is the value of the sum of its parts (Lancaster 1966). For example, a car is made up of engine size, colour, tyres, body shape etc. CEs use this theory by presenting options with varying attributes and levels (e.g. 1.8 vs 2.1 litres, red vs blue vs white colours). In a discrete CE, respondents choose their single preferred option from the available options and attribute levels are traded off against each other.

The second theory supporting CE is random utility theory, in which respondents, when faced with alternatives, are assumed to select the one alternative that provides them with the highest utility (sometimes referred to as 'welfare', 'value', or 'satisfaction'). If a cost attribute is included in the choice set, consumers or respondents are assumed to make trade-offs between costs and the other attributes, with the aim of maximising their utility given a personal budget constraint (Hoyos 2010). This allows researchers to infer the amount of money (costs) consumers or respondents are willing to give up to gain some improvement in another attribute. The way in which we will use CEs to infer people's preferences for the Kimberley coast is further explained in the Methods section.

The choice context of this study pertains to alternative management options within the Kimberley. The attributes we used are based on the values identified in the previous Kimberley research, particularly in the areas of conservation (e.g. biodiversity and the physical landscape), development (e.g. tourism or resources), recreation (e.g. camping and fishing), and Aboriginal culture (e.g. land management and subsistence). They were developed with consideration of the framing of values and management preferences of the PPGIS component of the survey and through consultation with Murdoch University, WAMSI, WA Department of Parks and Wildlife (Parks and Wildlife), and relevant stakeholders. Because of the size of the region and the presence of spatial differentiation in the PPGIS mapping research, it was decided to design the context of the CE survey around a number of discrete geographical areas, which we call 'zones', and see if the values identified within the CE are differentiated by geographical zones.

1.5   Choice experiments and the environment

Choice experiments have become increasingly popular to value environmental resources. Environmental CEs typically use environmental outcomes as attributes to describe the choice alternatives (e.g. Semeniuk et al. 2009, Börger et al. 2014, Holland & Johnston 2014). For example, a choice set might specify the number of species that will be protected, the size of an animal population saved, or the area of land under conservation. CEs may

also use a qualitative description to specify the overall level of environmental quality achieved, such as used by Schaafsma et al. (2012) for 'low', 'medium' or 'high' lake water quality.

Choice sets in CEs are commonly presented in a tabular form, with each row depicting an attribute and columns depicting the different choice options. Participants are asked to select their preferred column (i.e. option). An example of such a choice set is shown in Box 1.

Box 1 Example of an environmental choice experiment question

Consider the following two options. Assuming these are the only options available to you, which one would you choose?

Features in the reserve network	Option 1	Option 2
Of **9** bioregions…	**4** contain zones with high protection level	**2** contain zones with high protection level
Of **14** seafloor types…	**7** can be found in zones with high protection level	**9** can be found in zones with high protection level
Of **8** important ecological areas…	**4** are partly covered by zones with high protection level	**6** are partly covered by zones with high protection level
Of **3** important areas for White sharks…	**1** is partly covered by a zone with high protection level	**1** is partly covered by a zone with high protection level
% of areas less than 1500m depth in protection zones (**10%** in total)	**1%** is covered by zones with high protection level	**5%** is covered by zones with high protection level
Additional cost to you each year, *for* **10** *years*	$0	$300

Source: Burton et al. (2015)

1.6   Choice experiments and spatial information

Spatial information is especially relevant for CEs that refer to spatially embedded attributes, such as those associated with natural resources and the environment (Schaafsma & Brouwer 2013). Spatial information about attributes can be communicated through photographs, diagrams and maps in the pre-choice information and/or within the choice sets (as used by García-Llorente et al. 2012).

Most studies in agricultural and natural resource economics that have incorporated spatial information in their CE analysis focus on the residential location of survey respondents, rather than the spatial location and distribution of attributes. A common analysis in CE research is to explore so called 'distance decay' effects, where the distance between the study site and respondents' residential location is assumed to impact preferences (Hanley et al. 2003). Given the size and remoteness of the case study area (~2,500 km from Perth), it is not expected that distance decay effects will be particularly relevant for our analysis of Perth residents. Comparing responses with a sample of regional residents may reveal a difference in preferences at that binary level (i.e. in the Kimberley versus in Perth), which we will explore below.

More relevant to our analysis than respondents' location, is to present spatial information about where the Kimberley management options will occur clearly in the survey. To date, there are relatively few studies that have explicitly included spatial information in their choice survey to compare preferences between heterogeneous ecosystems. The current project contributes to the growing literature on spatially explicit choice experiments, by incorporating multiple sites with multiple attributes at multiple levels in the experiment.

Johnston et al. (2002) analysed spatial and non-spatial attributes for rural land development preferences. Choice sets were provided on maps of the study site and spatial attributes were only presented implicitly on the map (rather than explicitly stated). The authors found that participants' preferences for both spatial and non-spatial attributes were influenced by implicit spatial features, such as distance to road or the fragmentation of land development.

The volume and form of visual information shapes participants' preferences in different ways. For example, Holland and Johnston (2014) found that the inclusion of an individualised map that included the respondent's location relative to the affected policy area influenced preferences for some attributes. Furthermore, Schaafsma and Brouwer (2013) tested the impact of changing map scale on preference, thereby including more substitution opportunities. They found that decreasing the map scale to include a wider area (and thus more substitution options) did not significantly change preferences. However the change in scale did increase the variation of individuals' choices (choice variance), which suggests an increase in cognitive strain.

This previous work demonstrates the importance of carefully presenting spatial information to clarify study location and attribute characteristics, both to reduce cognitive burden and to ensure that respondents are aware of the location of attributes and potential substitute resources. Due to the site-specific trade-offs that we are concerned with in this study, presenting the choice sets spatially on a map was a critical component of our experimental design.

1.6.1   Spatially explicit choice experiments

In the past decade, there have been a limited number of spatially explicit analyses in CE. Those that were spatially explicit in their delivery used either a single map or multiple maps to present choice sets (Table 3). Below is a short discussion of these studies and the relevance of each to this research.

A basic visual setup for a choice experiment was used by Kubo and Shoji (2014), whose choice questions presented a map of a Japanese peninsular that had six sites and one binary attribute (the site could either have bears or no bears). The study aimed to elicit respondents' preferences for having bears at the six sites (Kubo & Shoji 2014). Another spatial study, by Brouwer et al. (2010), included one attribute (river water quality) with three levels (low, medium, high) plus an overall cost attribute. The study area was divided in four regions. Respondents were residents of the study area and the research analysed the effect of respondents' location on their willingness to pay for different levels of action in different regions.

Table 3. Examples of choice set presentation in spatially explicit choice experiments.

Reference	Study location	Sites	Number of attributes (plus cost)	Environmental attribute/s	Description
Kubo and Shoji (2014)	Japan	6	One attribute	Bears (2 levels: presence or absence)	4 choice situations each with their own map
Brouwer et al. (2010)	Spain	3	One attribute	River condition (levels: low, medium, high)	3 choice situations each with their own map
Horne et al. (2005)	Finland	5	Three attributes per zone	Scenery, Species Richness, *Whole region scenery*	3 choice situations each with their own map
Schaafsma et al. (2012)	The Netherlands	11 lakes	One attribute	Improvement in lake water quality (levels: green, blue)	Choice between 7 of the 11 lakes shown on a single map

A spatially explicit CE of forest recreation sites in Finland (Horne et al, 2005) included five sites with four attributes that varied in levels between sites. The attributes included were: scenery management, species richness, average species richness over the five sites, and costs. Each management option was shown on a map and in a table form. The authors found that 21 percent of respondents always selected the status quo option (no new management) in each choice set, which is uncommonly high for a choice experiment. This high rate of status quo responses suggests that the use of multiple maps potentially increases the cognitive burden on respondents which leads them to opt-out of choosing a change option and instead choose a no-change status quo option. A conclusion relevant to the current study is that an increasing complexity of choice sets may increase the risk of status quo bias. Nevertheless, Horne at al. (2005) argued the high rate of status quo selection was not due to cognitive burden but represented respondents' true preference for no change.

Schaafsma et al. (2012) present a CE that considered respondents' preferences for water quality of 11 lakes in the Netherlands. The researchers presented all available choices on a single map (an example is shown in Figure 2). Each choice set consisted of a map that showed each site with one attribute (lake water quality - two levels) and a cost attribute. Not all 11 sites were shown in the same choice set, because the authors found that the cognitive burden was too great when they included all 11 sites. Instead, seven of the 11 potential lake sites would be 'activated' for each choice set. The other sites were at their status quo quality with an associated cost of $0. Participants chose their preferred site, with its associated outcome and costs, or chose the 'no action' alternative.

Lake	Kager-plassen	Braasse-mermeer	Lange-raarse Plassen	Nieuw-koopse Plassen	Reeu-wijkse Plassen	Naarder-meer	Loos-drechtse Plassen	None of these options
Improvement level	Green	Blue	Green	Green	Green	Blue	Blue	
Annual tax increase	€35	€40	€20	€15	€5	€25	€30	€0
Choice	O	O	O	O	O	O	O	O
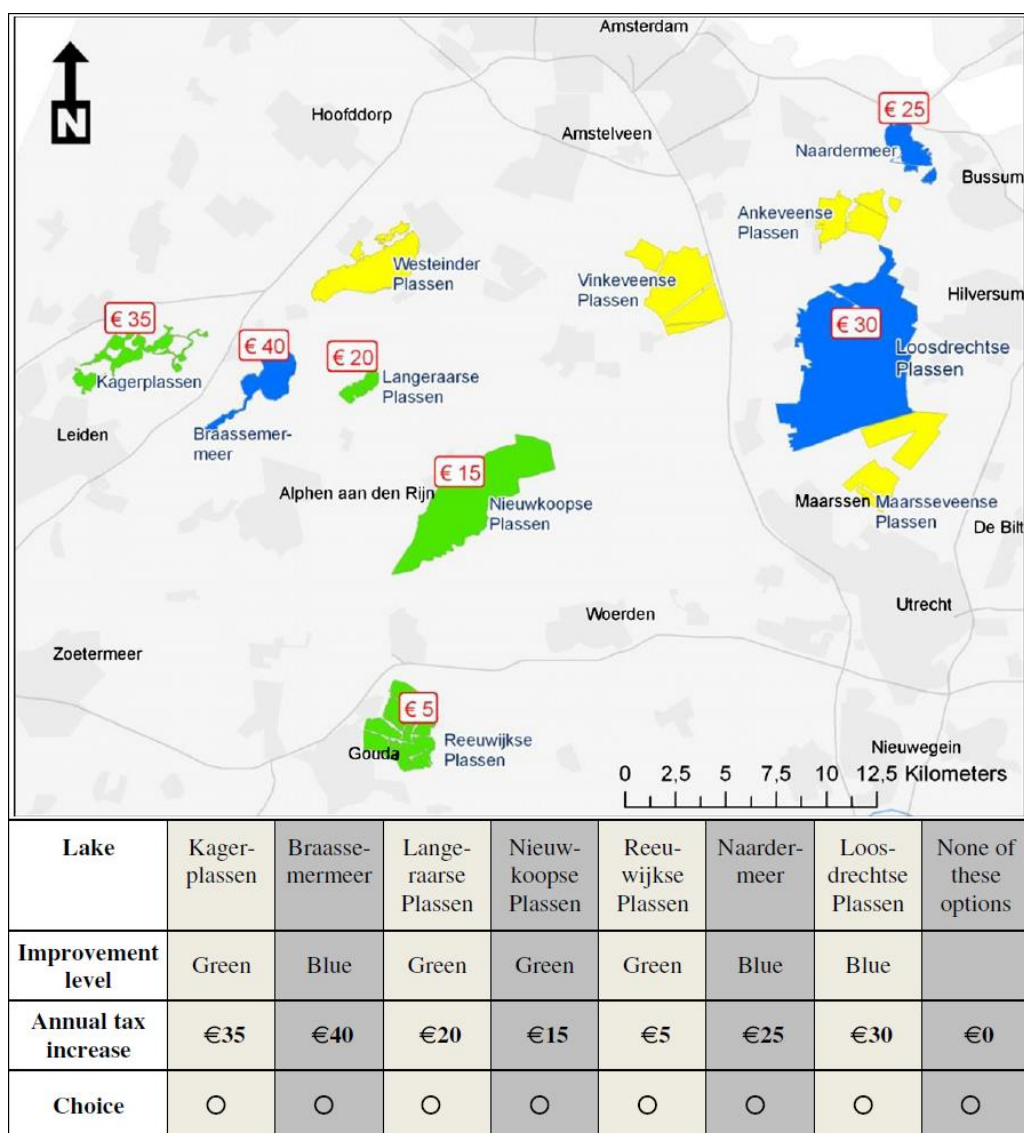
Figure 2. Example of a single map choice set used in Schaafsma *et al.* (2012).

Spatially explicit CEs may assess preference trade-offs between parts of a single ecosystem, such as within a catchment (Brouwer et al. 2010), or between similar ecosystems in a region, such as forest recreation sites (Horne et al. 2005) or lakes (Schaafsma et al. 2012). Less common are analyses between sites that have different landscapes or ecosystems. An exception is Dehlavi et al. (2010), who assessed participants' preferences between different ecosystems for a study of the Indus River system in Pakistan. The primary difficulty with such an analysis is finding attributes and levels that can be logically compared between the sites. Dehlavi et al. (2010) used "numbers of species to be protected" to reflect non-use values at four heterogeneous ecosystem sites, which meant that different species could be protected at each site. The current study in the Kimberley faces similar challenges, in that landscapes and ecosystems may vary along the Kimberley coast.

Spatially presenting information is critical for the CE in this study, as we want to explore site-specific trade-offs in attributes. Our primary motivation for including spatial information is to encourage participants to consider

the different regions of the Kimberley and their values. This links to how managers and decision-making authorities may make spatial trade-offs for resources during planning. Our CE gives people an opportunity to make some of the resource allocation trade-offs that managers may face. In our choice question, we present a single map of the study region at a scale that shows all potential substitutes (i.e. the whole Kimberley region). This scale was considered appropriate given evidence that participant's preferences remain consistent at wider geographical areas (Schaafsma & Brouwer 2013). A challenge in our study was to find attributes and levels that can be compared between regions which consist of multiple landscapes and varying ecosystems (compare Dehlavi *et al*, 2010). In addition, we had to consider how to effectively communicate the availability of substitutes of the various regions, with regions potentially being around 1.5 million hectares in size. The geographical scale here far exceeds that of any other study that has explicitly accounted for spatial distribution of outcomes. The implications of the results from Schaafsma *et al.* (2012) for our current study (which uses multiple zones and multiple attributes and levels for each zone), is that the number of zones may need to be limited to avoid excessive cognitive burden for respondents. We therefore represented the Kimberley coastline as six zones, but only two of the zones would be present in any choice set. In this way, the cognitive load was reduced within each choice question, but all six zones would be valued across the entire experimental design.

1.7   PPGIS

This choice experiment was developed as a collaborative process between all researchers on the project. The online survey includes two methodologies; the choice experiment facilitated by The University of Western Australia and the PPGIS mapping from Murdoch University and The University of Queensland. For the PPGIS mapping exercise respondents are presented with an interactive Google map of the study region on which they place icons from a list of values and preferences. The PPGIS values and preferences list was developed from the Murdoch University human values interviews and past PPGIS research. The PPGIS survey was completed first, giving the benefit that respondents were primed to think about the values associated with the area before completing the CE. The methodology and results from the PPGIS component of the survey and the collaboration is reported in-depth in a separate Technical Report (Strickland-Munro et al. 2016a). Methodological objectives of our collaborative study, not reported here, include identifying what effect the PPGIS process has on respondents' choices in the CE survey component, comparing the outcomes from the two approaches when identifying values, and exploring how they may inform each other.

2.   Methods

2.1   Choice modelling

Choice experiments and their models are based on Lancaster's (1966) consumer theory that the value of goods is determined by the characteristics that comprise the good (see Section 1.4). These characteristics are varied in a choice experiment, to enable an assessment of their overall impact on preferences for the good.

Choice models are probabilistic models that build on McFadden's (1980) random utility theory. In analysing preferences and choices, the analyst assumes that an individual aims to rationally maximise his or her utility, the latter comprising of a deterministic element (*V*) that can be observed and explained, and a random, unobserved component (*ε*). The utility function for an individual *n* in a given choice situation *s* from 'consuming' alternative *j* is given as (Hensher et al. 2015):

$$U_{nsj} = V_{nsj} + \varepsilon_{nsj}$$

Equation 1

The discrete choice model used in this research is the multinomial logit (MNL) model and associated logit models. In a MNL model, the probability that alternative *i* is chosen is expressed as:

$$\text{Prob(i)} = \frac{\exp(V_{nsi})}{\sum_{j=1}^{J} \exp(V_{nsj})}$$

Equation 2

In our MNL models, observed utility is assumed to be a linear, additive function of the choice attributes. We allow for the possibility that the marginal utility parameters (β's) may vary across individuals by including interactions between individuals' characteristics (X_n) and the attributes (X_{sj}) in our utility specification:

$$V_{nsj} = \beta_X X_{sj} + \beta(X_{sj} X_n) \qquad \text{Equation 3}$$

The interaction effects defined in equation 3 allow us to explore presence heterogeneity across individuals. This model specification assumes there is no unobserved heterogeneity across individuals in the deterministic part of utility.

The MNL model results from the assumption that observations are independently and identically distributed (IID) across individuals. We test this assumption through further modelling of the choice data using a mixed logit (ML) model. The ML model relaxes the IID assumption and further allows us to account for unobserved heterogeneity across individuals, by specifying that the marginal utility parameters vary stochastically across individuals, which can be implemented using a random parameter specification.

If cost is included in the utility modelling (included as an attribute in the choice question) part-worths or willingness to pay (WTP) can be calculated (Equation 4). WTP is more easily interpreted than estimated attribute coefficients estimated in the models because WTP represents the marginal value associated with a unit change in the attribute, expressed in dollars.

$$WTP_x = \frac{-\beta_X}{\beta_{cost}} \qquad \text{Equation 4}$$

All estimation used Stata/IC 13.1 (StataCorp 2013). Confidence intervals around WTP estimates are derived using the Delta method, as implemented in the _nlcom_ command within Stata 13.

2.2   Survey testing

The development of the survey and the choice questions involved multiple rounds of testing and consultation. The choice sets and their attributes were first discussed with staff at the WA Department of Parks and Wildlife. This consultation occurred via a written brief and a face-to-face meeting with key agency staff. Feedback was gathered on the management zones, the attributes, and appropriate attribute levels.

This was followed by a pilot testing phase. Respondents were asked to complete the survey online and provide detailed survey design feedback. Pilot testing respondents included middle to senior level managers at the WA Department of Parks and Wildlife, social science research staff at Murdoch University in Environmental and Conservation Sciences, and a recreational user of the Kimberley coast.

The survey was then shown to stakeholder groups in the Kimberley region for survey feedback. Groups included the Shire of Broome, Environs Kimberley, Parks and Wildlife, Department of Fisheries, and PMJ Tourism Solutions. This stakeholder consultation process also allowed us to test the choice questions and survey characteristics, and to encourage survey recruitment by the groups.

The final testing phase was an intensive focus group session with six people. Respondents from the UWA School of Agricultural and Resource Economics in Perth were selected and/or self-nominated to participate in the two hour session. The session went through the entire survey in an open discussion format. Besides seeking feedback on any aspect of the survey the session focused on how clear any instructions and descriptions were, any specific terms and words that were confusing, the layout and wording of the choice sets, and ensuring that people understood all choice attributes. This final phase ensured that the survey was understandable to respondents who were not direct stakeholders in the Kimberley region.

Many changes and adjustments were made to the survey questions, design and format following each of these detailed testing phases. In addition to general survey design developments, changes included improvements in the questions and choice sets for better readability and clarity, adjusting the text and instructions for the choice experiment, clarifying the definitions and levels of all attributes, and removing questions that were seen as providing limited additional information to reduce survey load.

2.3 Management zones

To enable the CE to be spatially explicit, the Kimberley coastline was divided into hypothetical management zones (Figure 3). These were developed in consultation with Parks and Wildlife. The management zones roughly follow physical landscape features and some major marine park planning areas. As a consequence, there are both similarities and heterogeneity in the natural ecosystems that occur within each zone. Common ecosystems include intertidal areas, mangrove ecosystems, sandy beaches and rocky shorelines, although their extent may vary within each zone. There are also similarities and heterogeneity in some of the human values between zones. For example, there are regions within all zones that have physical landscapes not impacted by modern human development. This value was expressed in the interviews as 'wilderness', 'pristine', untouched coastline', and by describing the aesthetics, and coastal ecology and geology. Other regions in the zones may have significant amounts of recreational values (fishing and camping).
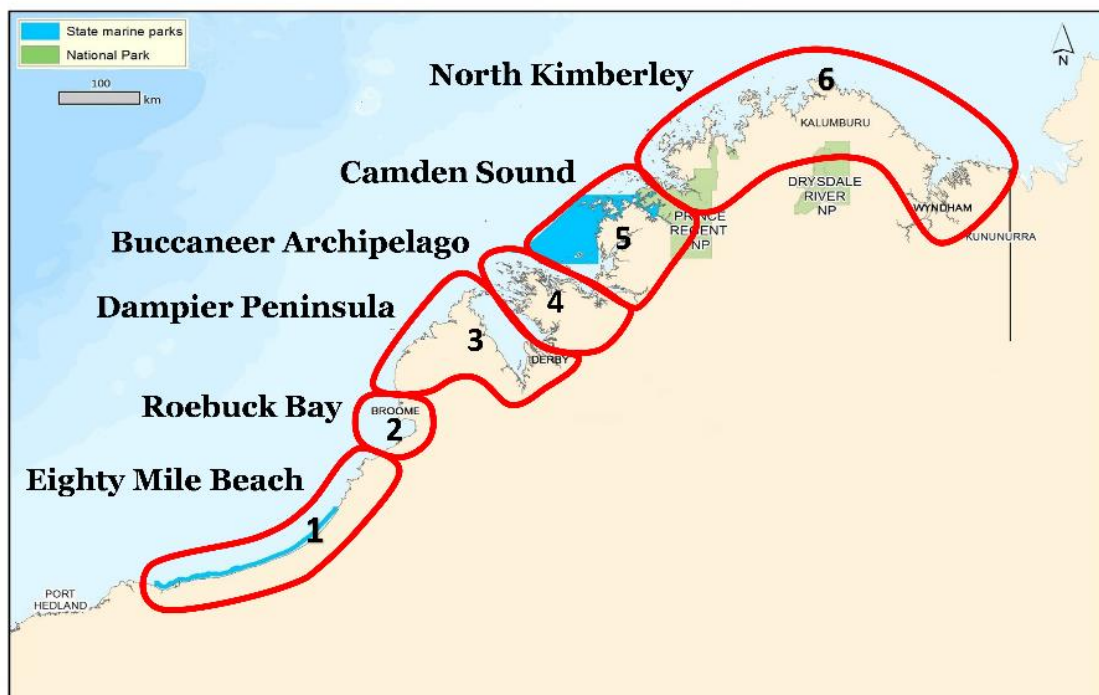
Map source: Geoscience Australia 2014, Department of Parks and Wildlife 2014

Figure 3. Map of the Kimberley coast study area showing the six hypothetical management zones used in the choice experiment.

Below are brief descriptions of the management zones, similar to how they were presented in the choice experiment.

1. Eighty Mile Beach

This zone has sandy natural beaches, rocky shores and headlands, creek entrances, mud and mangroves, including Western Australia's longest sandy beach, Eighty Mile Beach. Stretching out over 220 km the area is an important feeding ground for migratory shorebirds and nesting site for flatback turtles. The Eighty Mile Beach Marine Park that covers much of this region currently has sanctuary zones.

2. Roebuck Bay

Roebuck Bay is characterised by mangroves and sweeping intertidal mudflats that are important for migratory shorebirds. The area also has seagrass meadows that feed and sustain dugongs, dolphins and turtles. This zone includes Broome and surrounding coastline north of Cable Beach up to Willie Creek and 60km south of Broome to Jack's Creek.

3. Dampier Peninsula

This zone includes the sandy natural beaches, rocky shores and headlands of the entire coastline of the Dampier Peninsula, including Derby and the intertidal mudflats of King Sound. Endangered Monsoon Vine Thickets occur along the sandy coastline, while in the waters along the peninsula humpback whales nurse and migrate. The peninsula is also home to many Aboriginal communities.

4. Buccaneer Archipelago

The Buccaneer Archipelago has more than 1,200 islands and includes Talbot Bay and iconic Horizontal Falls. Most islands have rocky and cliffy shorelines with patches of mangroves and sandy white beaches. The islands are natural refuges for plants and animals. Turtle Reef, one of the largest reefs in the Kimberley, links an island with the mainland and is home to coral communities, tropical fish and turtles.

5. Camden Sound

This zone is also characterised by islands and rocky headlands, with coral reef communities and rocky shoals, sandy beaches and mangroves. It contains the Montgomery Reef where the tide rushes off and exposes the reef at low tide. The Lalang-garram/Camden Sound Marine Park covers most of the waters, including important humpback whale nursery areas and has sanctuary zones.

6. North Kimberley

This is the largest of our management zones. The North Kimberley stretches along the coastline from York Sound in the west to the border with the Northern Territory in the east. Along the coast there are archipelagos, rocky shorelines, sandy beaches and mangrove and mud flats. Intertidal zones and creek entrances also characterise this remote region that is considered a national biodiversity hotspot[1].

2.4 Attributes

Four environmental attributes, in addition to the six management zones and cost, were used in the final choice experiment: sanctuary areas, recreation facilities, Aboriginal rangers and coastal development. This section briefly explains each attribute and demonstrates how the attribute definitions and levels were developed and changed in consultation with Murdoch University, Parks and Wildlife, Kimberley residents, pilot testing and focus groups.

2.4.1 Attribute selection process

In this study, attributes were derived from previous research undertaken by Murdoch University on the values people hold for the Kimberley (Table 1). Table 4 shows how the concepts from previous Murdoch University research are linked to possible outcomes and processes (land use preferences) that could be used as attributes in our CE, and the attributes that we used.

From Table 4, six possible attributes were shortlisted by the research team for comment and consultation with Murdoch University and Parks and Wildlife. This consultation was important for policy relevance and is especially important for this particular CE as it intended to provide management implications for the Kimberley.

Throughout the process of attribute selection the measurability of each attribute was considered against Parks and Wildlife management actions and priorities from marine park management plans. Measurability is not only important in counteracting the hypothetical nature of the choice question, but for the usability of the final model results in management planning and policy. For example, the 'ranger' attribute that was used in the choice experiment is linked to values and preferences for Aboriginal culture and heritage (which is listed as a KPI in the two Kimberley marine park management plans (Department of Parks and Wildlife 2013, 2014)). This attribute is referred to as a management action in the Eighty Mile Beach Management Plan: *Establish a program to train and mentor new traditional owner rangers and support the Karajarri Ranger group*. To achieve the management objective: *To ensure the marine park has appropriate legal, administrative, financial and human resource frameworks in place so that it is jointly managed with traditional owners and in a collaborative setting with other agencies* (Department of Parks and Wildlife 2014). Rangers are mentioned in the management plans as having a role to play in achieving joint management and monitoring the marine parks.

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[1] According to the Australian Government the North Kimberley is one of the top fifteen biodiversity hotspots in Australia (Commonwealth of Australia Australia's 15 National Biodiversity Hotspots. Accessed 29/07/15. http://www.environment.gov.au/biodiversity/conservation/hotspots/national-biodiversity-hotspots#hotspot15).

Table 4. Human values and potential choice attributes derived from values from interviews reported in Strickland-Munro et al. (2015). Final attributes used in the choice experiment are bold and underlined.

VALUES	Identified from interviews (% of interviews that mentioned this value)	Aspirations	Threats	Possible preferences and attributes	Possible indicators and attributes
Indirect use values	Biodiversity (80%)	Conservation/Protection Wilderness Protection	Fire Invasive Plants and Animals Marine invasive species	**Protected Areas** (no-take zone)	Biodiversity Loss (KPI)
Non-use values	Bequest (7%) Existence (4%)				Invasive Species
Direct use, non-consumptive values	Physical landscape (77%) Therapeutic (62%) Social interaction and memories (56%) Recreation–other (62%) Learning and research (34%) Experiential (51%) Historical (19%) Spiritual (11%)				Seascape Impact (KPI) Iconic Species Protection – e.g. Turtles (from project 2.1.2. p. 60) (KPI)
	Aboriginal culture (63%) (KPI)	Aboriginal Futures - Self-Management - Ranger Teams - Living on Country - Tourism Ventures		Aboriginal Land Management IPA's Joint-management (MA KPI) Native Title Determinations	**Ranger Groups** (MA, KSCS)
Direct use, consumptive values	Recreation–camping (58%) Recreation–fishing (54%) Subsistence (44%)	Good fisheries management Improved visitor management systems	Increased visitors without good visitor management Causing: - Rubbish - Environmental damage - Overfishing/Overhunting	**Improved/ New Recreational Areas (KSCS)**: - Camping - Fishing Sealing of Roads Increased controlled/patrolled fishing zones.	Visitor Numbers Fish Stock Levels (KPI)
	Tourism (36%) Commercial fishing, pearling and aquaculture (24%)	Low-key tourism development Fisheries Management Industrial economic development	Development impacts (including mining operations and oil spills) Concerns about coastal access	**Infrastructure and economic development** Development rezoning and licenses	Seascape Impact (KPI) Eco-Tourism Operators (KSCS)

MA refers to management actions and KPI to key performance indicators that are mentioned in management plans by Parks and Wildlife (Department of Parks and Wildlife 2013, 2014). KSCS refers to outcomes mentioned in the Kimberly Conservation and Science Strategy (Government of Western Australia 2011). Items in bold refer to attributes that were included in the choice experiment survey.

Sanctuary area

A number of the dominant value categories for the Kimberley—such as biodiversity, bequest/existence, and the physical landscape—support values for conservation and protection of the natural environment. Marine sanctuary areas were chosen as an attribute in the CE that would effectively allow people to show their preferences for these environmental values.

Sanctuary areas are zones of high conservation protection usually within a larger marine park. They are 'no-take' areas for the protection and conservation of biodiversity and the environment, corresponding to IUCN category 1a Strict Nature Reserve or 1b Wilderness Area. Low-impact nature appreciation activities are allowed (such as sightseeing and snorkelling) but fishing and extractive activities are not allowed.

Baseline levels for sanctuary zones were calculated using the area Parks and Wildlife have currently zoned as sanctuary areas (from management plans) as an approximate percentage of the State waters within each zone, using Google Earth Pro. Approximate baselines are satisfactory to measure change as the attribute levels are large and distinguishable enough for preferences. Attribute levels were modified after consultation with Parks and Wildlife to increases of 0, 15, 30, and 40 percent of the State waters of the specified zone or area.

Recreation facilities

Recreation is a popular activity in the Kimberley and was mentioned in 62 percent of the interviews, with 54 percent specifically referring to fishing and 58 percent of interviewees mentioning camping (Strickland-Munro et al. 2015).

The levels used in the choice experiment for recreation facilities were created in consultation with Parks and Wildlife categories for recreational facilities and visitor experience (Table 5). Three levels were tested in the focus groups to confirm that people who did not previously know the details of the specific levels would have consistent idea of what a Low, Medium or High level of recreational facilities represented. We consulted with the Broome Visitor Centre confirming the popularity of recreational activities in the Kimberley, and consulted with Kimberley residents and the Broome Visitor Centre about the average existing level of recreational facilities for the zones that would be used as the base level in the choice experiment. It is from this base level that recreation facility levels can be improved from in the choice options.

Table 5. Recreational facilities categories.

	LOW	**MEDIUM** = LOW + the following	**HIGH** = MEDIUM + the following
WA Parks and Wildlife equivalent	NATURAL	RECREATION	HIGHLY MODIFIED
Boat facilities	NONE	Small moorings Small boat ramp	Large boat ramp Jetty
Road access	Difficult access; 4WD rough track	Seasonal 2WD access	Sealed road
Other facilities	No facilities	Basic toilet Designated camping and parking areas Tables Basic visitor information with some signage	Toilet with running water High level of facilities for camping and parking Shade shelters Gas BBQ's Extensive visitor information

Aboriginal rangers

The Aboriginal ranger attribute attempts to capture the values that people hold for supporting Aboriginal people, culture and connection to country. Aboriginal culture and values for the Kimberley were mentioned by 62 percent of interviewees (Strickland-Munro et al. 2015).

Currently there are more than 13 ranger groups operating across the Kimberley. These groups provide training and career development, undertake land management and visitor education, and work 'on country' to protect cultural values, including recording and managing cultural sites such as rock art, and sharing cultural activities with their communities. The focus of the Aboriginal ranger attribute in this study is on the cultural

values that Aboriginal rangers support rather than on the conservation and protection of biodiversity, although in reality they are interlinked as looking after country is looking after culture (Rose 2002).

Figure 4. Parks and Wildlife Yawuru Ranger Preston Manado conducting a bushtucker walk through Dabadabagun (Minyirr Park). Image supplied by WA Department of Parks and Wildlife

The status quo number of rangers is different between zones, approximately ranging from 4-12 full-time rangers in each zone, with many more as casual or part time rangers. Base levels were approximated using public information (Griffiths & Kinnane 2011) and from contacting some of the ranger leaders directly. These base levels are intended to be an *approximate* guide at the time of the survey since employment and ranger groups are constantly changing. Attribute levels for the increases in the number of Aboriginal rangers employed full-time in each zone were set at 0, 5, 10, or 30 people.

Coastal development

The Kimberley coast is a pristine and remote region with an impressive coastline of natural beaches, rocky shores, mudflats and mangroves headlands, cliff-lined shores and archipelagos. It is possible to travel along the Kimberley coast and see little evidence of modern development.

The coastal development attribute was initially approached as a protection of the natural physical seascape and the 'unspoilt' panoramic vistas that dominate the Kimberly coastline. The value categories protected by this attribute are those associated with the physical landscape including scenic/aesthetic value, 'wilderness' value and remoteness (Table 4). This value is threatened by development that impacts on the natural seascape by changing coastlines. Through the process of focus groups and pilot testing we determined that the attribute most effective at communicating 'wilderness' values would be to present an impact on the coastline by development. Coastal development can range from large scale projects such as oil and gas, mining, ports, dredging activity and building developments, and larger tourism development such as resorts and marinas; to smaller scale development projects such as small jetties, marinas, floating activity, boat ramps and shore recreation facilities.

Following extensive pre-testing, the attribute was described to respondents as: *if you were to travel through the zone you would see some modern development every day*. The base case status quo scenario would be to potentially not seeing development in any given day. 'Modern development' was communicated visually using Figure 5 below.

Figure 5. Anthon's Landing in Wyndham, Kimberley. Source Maritime Constructions, photo by David Wilcock Photography.

Cost

The final attribute included in our choice experiment is a monetary attribute. Achieving management outcomes in the Kimberley will cost money. For example improving recreational areas will require planning, hiring builders and landscapers to complete the works and then maintaining the facilities. Including a cost attribute in the choice experiment allows us to estimate the marginal willingness to pay for changes in other attributes. The cost attribute in this CE captures the management costs to provide the 'bundle' of attribute levels in a management option.

The literature refers to the way in which a cost attribute is presented in a choice question as the 'payment mechanism'. Different payment mechanisms can be used in CE studies, such as a fee for service or entry, a tax increase, or a tax reallocation. For example, Rogers (2013) used an increase in income tax as an environmental levy for a CE on marine parks. Carcia-Llorente *et al.* (2011) found that—in their study region in Spain—respondents rejected the idea of new taxes, and that therefore a tax reallocation was more appropriate in their study region. For the present study, the payment mechanism used is an overall increase in payments to Government. In our pre-tests, respondents accepted that management will cost the taxpayer money and did not object to an increase in payments. The cost attribute of the management options was proposed to be met through revenue sourced from a combination of increased taxes by both Commonwealth and State governments. These costs were proposed to continue forever because management action will need to be maintained into the future. The levels of these increased annual tax levels were tested and adjusted before survey launch, with a final selection of $10, $50, $75, $100, $150 and $200. A summary of all attributes and their levels is shown in Table 6.

2.5   Experimental design

The spatial aspect of the design involved splitting the Kimberley into six zones (see Figure 3). As discussed in Section 1.6, we had to determine how to present the zones in the choice sets. If all possible zones options would be included in a single choice set, a respondent would have to evaluate the levels of five attributes in each of the six zones. This was deemed to be too much information for respondents to process, and hence a simpler design was required.

The design that was eventually chosen for our study is what is known as an 'availability design'. In each choice set, we only showed management changes for two of the six zones, plus a status quo option (which would imply no change in any zone across the Kimberly). Respondents had to select their preferred option from the three available choice options. Each alternative describes management within one specific zone. This is called a 'labelled' experimental design: associated with each alternative shown is an explicit label identifying the zone.

The statistical design of the attribute levels within an availability design is an emerging area of research. We are interested in spatial heterogeneity in preferences, and hence require a design that allows us to identify zone-specific preference parameters. The design used here involved the following steps:

1) Prior estimates of the parameters were collected during the pilot testing using a simple design that assumed the impact of the attributes was going to be the same for each zone.
2) These priors were then used to estimate an s-efficiency design in the Ngene statistical design package (ChoiceMetrics (2012) Ngene 1.1.1) for two zones (A and B), assuming that separate parameters would be estimated for each zone (i.e. a labelled design). This labelled design comprised 10 choice sets, and hence 20 attribute profiles. The design had sufficient flexibility to identify parameters for both Option A and Option B.
3) Option A was then re-labelled Zone 1, and the 10 alternatives in Option B were re-labelled as Zone 2-5, twice each.
4) This design was replicated five times, and Option A in each case labelled as one of the six zones used in our Kimberley survey. The 10 alternatives within option B were then assigned to the five other zones

As a result, we used a design with 60 choice sets. Each zone appears 20 times, and appears once for each attribute profile. There is perfect balance in terms of the number of times each zone appears, and how many times it appears with other zones.

The efficiency of the full design to identify the underlying priors assuming separate parameters for each zone was evaluated *ex post* using the Ngene software. This evaluation showed that we would require 170 respondents completing six choice sets each to identify the priors assuming a critical significance level of five percent.

Manually evaluating the resulting design showed a design gap for low levels of recreation at low costs. To achieve more balance in the full availability design, the recreation levels in nine choice sets were manually changed. Recreation levels in choice sets with a low cost were changed from High down to either Low or Medium depending on the zone (Low for Zone 3 to 6, Medium for Zone 1 and 2).

Efficiency testing of the adjusted full design (with changed recreation levels) gave a D-Error[2] of 0.013 and an S estimate of 18.23 (i.e. 19 people needed to complete a full set of 60 questions, or 190 people completing sets of six questions). This reduction in statistical efficiency was deemed acceptable to ensure that we achieved improved attribute balance.

Table 6. Summary of the choice attributes used in choice set and experimental design.

Attributes	Description	Levels
Management zones	The hypothetical zones in which management will occur	1. Eighty Mile Beach 2. Roebuck Bay 3. Dampier Peninsula 4. Buccaneer Archipelago 5. Camden Sound 6. North Kimberley
Sanctuary area	Percentage of extra sanctuary area in each zone	0%, 15%, 30%, 40%
Recreation facilities	Average level of recreational facilities within a zone	LOW, MEDIUM , HIGH Zones 1 & 2 are at MEDIUM and can only be upgraded to HIGH Zones 3, 4, 5 & 6 are at LOW and can be upgraded to MEDIUM and HIGH
Aboriginal rangers	Number of extra Aboriginal rangers in each zone	0, 5, 10, 30
Coastal development	**NO:** no additional coastal development in that zone, **YES**: if you were to travel through the zone you would see some modern development every day	NO (0) YES (1)
Cost	Annual increase in costs to the household forever. The cost of the management options will be met through revenue sourced from a combination of increased taxes by both Commonwealth and State governments	$10, $50, $75, $100, $150, $200

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[2] For more information on these design measures please see Scarpa R, Rose JM (2008) Design efficiency for non-market valuation with choice modelling: how to measure it, what to report and why*. Australian Journal of Agricultural and Resource Economics 52:253-282.

2.6   Survey development

Following the literature review and survey testing process, the final choice questions were presented using a map of the Kimberley and a table to show the attribute levels (Figure 6). In the example in Figure 6, if a respondent chooses Option B it would mean that they prefer to pay $75 a year to get an extra 30 percent State waters in sanctuary area, upgrade recreational facilities from Low to High, support 30 new Aboriginal rangers, and have some increased coastal development in the North Kimberley zone. The alternatives that provides them with less utility would be Option A (payment of $150 a year to get 40 percent sanctuary area, upgrade recreational facilities from Low to Medium, 10 new Aboriginal rangers, and no increased coastal development in the Dampier Peninsula zone), and Option C (the status quo scenario representing 'no new management action on the Kimberley coast').

Zone	Dampier Peninsula	North Kimberley	None
Annual cost to you	$150	$75	$0
Sanctuary area (% State waters already sanctuary)	40% (0%)	30% (0%)	No new management on the Kimberley coast
Recreational facilities (existing level)	MEDIUM (LOW)	HIGH (LOW)	
Aboriginal rangers (existing number)	22 (12)	40 (10)	
Increase coastal development	NO	YES	
	OPTION A	OPTION B	OPTION C
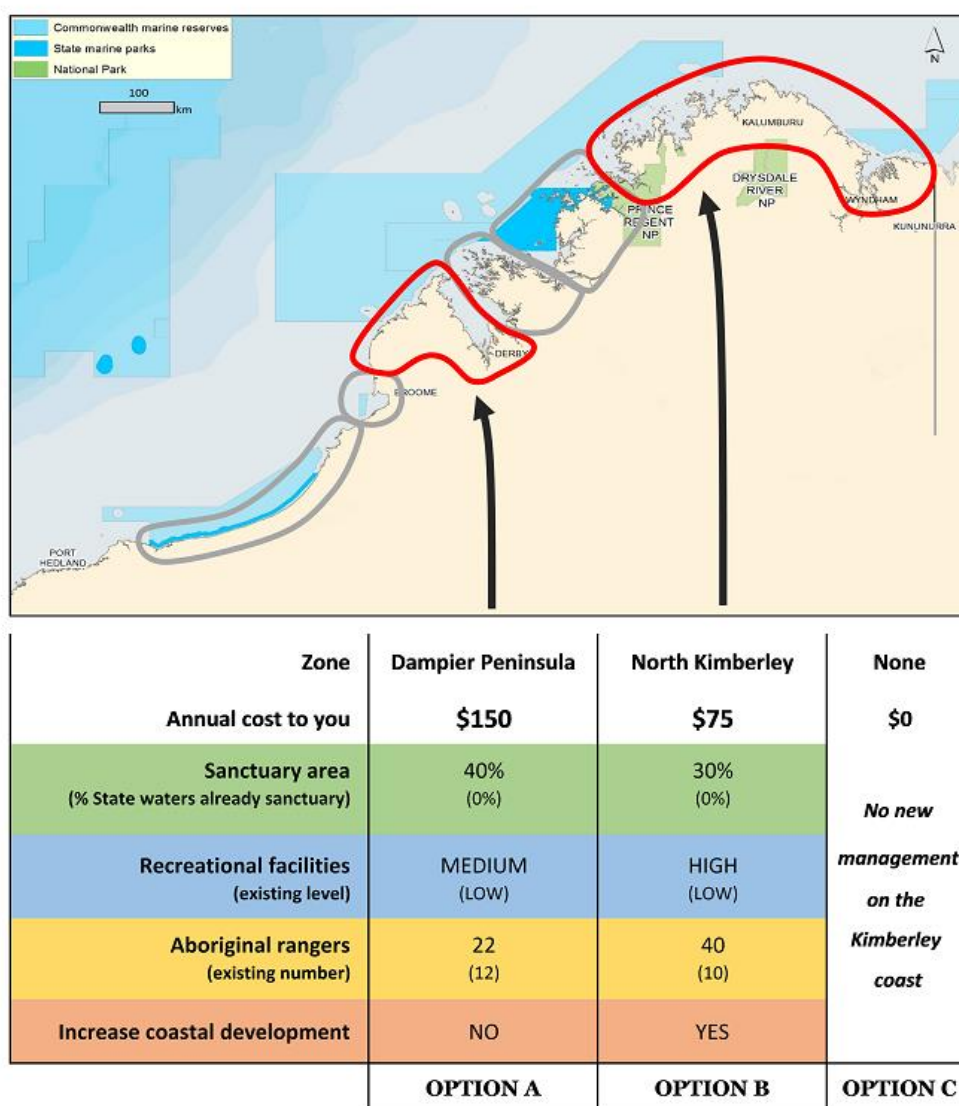
Figure 6. An example of a multi zone choice question used in this Kimberley choice experiment survey.

A range of socio-demographic questions were also recorded in the survey. Socio-demographic questions are needed to determine sample representativeness, and help us understand how the characteristics of the respondents might influence their preferences and choices.

To ensure that respondent characteristics would be comparable to population averages, the answer categories for the age and income questions were based on categories used by the Australian Bureau of Statistics (ABS).

One of the attitudinal variables measured was environmental attitude. This was measured using the Environmental-Economics Priority (EEP) Scale. This scale has been used in a number of studies to capture environmental attitudes, such as Abrams et al. (2005) and Czap and Czap (2010). In our study, respondents are first given some context, and are then asked to place themselves along a 7-grade Likert scale with three descriptive reference points (Box 2).

Box 2. Environmental-Economics Priority (EEP)question included in the questionnaire

Coastal and marine management decisions often involve trade-offs between environmental and economic factors. Thinking about your own personal values, where would you place yourself on the scale below?

Highest priority should be given to maintaining the natural environment even if there are negative consequences.			*Environmental and economic factors should be given equal priority.*			*Highest priority should be given to economic consideration even if there are negative environmental consequences.*
1	2	3	4	5	6	7
○	○	○	○	○	○	○

In the choice experiment questions, if a respondent chose the status quo in each of the six choice questions they were asked about their motivation for this serial 'opt-out' behaviour. This is needed because choosing the status quo does not necessarily mean that respondents do not hold values for the Kimberley regions. In some cases, respondents may exhibit 'protest' behaviour, which means the respondent indicate they are not willing to pay for a good when in reality they do have value for it (Freeman III 2014). In this study, protest votes were considered to be those respondents who objected to paying any more taxes (a 'protest' against the payment vehicle), those who believed they should not be the one making decisions for the Kimberley, those who did not want to choose between the available options, or those who generally suggested that they held values for the attributes but for some reason they did not want to reveal their preferences. These respondents are included in the general sample descriptive statistics. Comparative analysis are also provided for the protester subgroup in each sample. Protesters are not included in the data used to estimate the final choice models, as their responses do not represent true preferences.

2.7   Survey administration

The survey was administered online in collaboration with Murdoch University and The University of Queensland. The full survey consisted of three parts: a series of socio-economic questions, the PPGIS mapping exercise, and the choice experiment. The series of socio-economic questions and the PPGIS mapping were hosted and administered by Greg Brown at UQ. The choice experiment was developed and administered in Qualtrics (2015) at UWA, with respondents being passed automatically between the two online surveys.

2.7.1   Survey recruitment

There were two main modes of recruitment: an open 'Public' survey and an online 'Panel' survey.

The open Public survey was particularly focused on the values and preferences held by stakeholders. Those who live, work and visit the Kimberley; we aimed to reach respondents with some familiarity with the region. The open Public survey initially targeted Kimberley residents. After the survey had been open for 2-4 weeks, we increased our recruitment strategy to include visitors and people who are associated with, or have a particular interest in, the region. In the last phase of the survey, we recruited respondents from other regions in WA. People from other Australian States and international respondents could also participate during this stage of the survey.

Recruitment for the Kimberley respondents was mostly undertaken by Jennifer Strickland-Munroe and the Murdoch University research team, with UWA supporting and providing access to networks and connections for recruitment where possible. The detailed recruitment strategy is reported in the technical report by Strickland-Munro et al. (2016a) in Section 2.2.

Given the nature of the public recruitment process, the sample may not be representative of the general WA or Kimberley populations. It is likely that the recruitment strategy will over-sample respondents with a particular interest in the management of the region. We therefore recruited an additional sample through an online research panel maintained by a commercial research company (Research Now). The survey company was instructed to sample a representative sample of WA residents. This Panel sample was collected to identify the preferences of those who may not have a close personal connection with the Kimberley. The opportunity to easily recruit more respondents further allowed us to explore additional research questions regarding the design of the choice experiment (see Section 2.8).

2.7.2   Survey incentives

To encourage respondents to complete the survey a $10 incentive was offered to the Public sample. The incentive was included to make it easier to recruit Kimberley residents, and was a way of thanking them for taking the time to complete the survey. Respondents could choose to donate their $10 (chosen by 12 percent) to one of three charities or to receive an Amazon gift voucher.

The three charities presented were the Royal Flying Doctors Service, a medical charity important in the Kimberley (chosen by 44 percent); Environs Kimberley, an environmental charity focusing on the Kimberley environment (chosen by 33 percent); and the Fred Hollow Foundation, a charity that does important medical work globally and in remote Aboriginal communities (chosen by 11 percent).

Respondents who completed the survey from the Panel sample were renumerated by the research company, Research Now.

2.7.3   Data management

Due to the incentive provided in the public survey, there were several occurrences where a respondent repeatedly took the survey to claim the reward ('gaming' respondents). This unusual activity was noticed and the data was searched for invalid entries. A process of identifying invalid data entries was developed, details are given in Box 3.

The dataset used as the basis for this report excludes those who were deemed to be 'gamers', or those who entered the survey but did not map any dots or did not complete the survey.

Box 3. The workflow process for identifying invalid 'gaming' respondents.

1. All responses that have selected to receive the incentive via the Amazon gift voucher are assessed.
2. Of those, respondents with unexpected IP addresses were shortlisted. Unexpected locations are those where it is unlikely that the recruitment strategy would have led to respondents.
3. Of those shortlisted, an evaluation of the choice experiment survey response was made to ensure the responses are not from a valid respondent. This was done by, for example, looking at the email address provided, to see if they match names given, and searching for any other intelligent comments made in the survey to prove they are real people.
4. This list of suspected gamers was then evaluated again using the PPGIS data to confirm that those respondents were 'gamers'. For example, if they tended to place a minimum or no dots in the mapping process.
5. Once the PPGIS data verified that the response was invalid, a record was kept of the 'gamers' and these were removed during data preparation.

2.8   Variation in survey design within the Panel samples

For the online panel, five versions of the survey were administered. These surveys were consistent with the Public Kimberley survey (i.e. the same text and wording of questions, the same presentation of choice sets). Some differences were introduced in the way that zones were presented in the choice sets, and whether the PPGIS activity was completed. The design of all survey versions ensures comparability of choice data across the samples, and with the Public sample. Each version is described below. The number of target respondents to each survey version is included in brackets (n = #).

Version 1)   Six Zones with PPGIS (n = 200)

This is an exact replication of the survey with Kimberley stakeholders (called the 'Public' survey), including the PPGIS mapping task. This replication is included to compare answers between Kimberley stakeholders and the panel respondents. It was anticipated that a standard online panel may find the combined task of PPGIS mapping and CE difficult to complete. In particular, the open ended nature of the PPGIS may cause low completion rates when respondents have no specific experience with the Kimberley. Therefore, a relatively low sample size was set, and as anticipated, completion was slow: it took one month to fill the quota.

Version 2)   Six Zones without PPGIS (n = 400)

In this version, the choice experiment was presented as a stand-alone survey without the PPGIS component. This version was included to explore the effect, if any, from undertaking the PPGIS mapping exercise before answering the choice questions. It was also anticipated that the mapping task may prove challenging for panel members. Dropping the PPGIS component was expected to increase the probability of successfully completion of the CE part of the survey and hence increase the number of observations for CE data analysis.

Version 3) Roebuck Bay (n=200) and Version 4) Camden Sound (n=200)

These two versions present a single zone in the choice sets instead of six zones. These versions did not include the PPGIS task. The intention of these surveys was to explore whether respondents answer a survey differently when shown only one zone rather than six. Versions 3 and 4 still described the Kimberley region using the same framing as other versions: the six zones of the Kimberley were shown. However, in the description of the management options, and in the choice sets, only one zone was presented to respondents e.g. respondents were asked to make choices between two options, both occurring in Roebuck Bay (version 3) or Camden Sound (version 4). The intention was to allow a comparison of values for Roebuck Bay and Camden Sound derived from a six zone model to be compared with values derived from a single zone model.

Because this is not an availability design, and there is no need to construct an experimental design that would allow for zonal specific parameters to be estimated, new experimental designs were created for these two versions. An 18 choice set, unlabelled choice set design was generated, and blocked into three versions each with six choice questions.

Version 5) Kimberley Coast (n=200)

This version was similar to the single zone surveys in V3 and V4, but instead of the six zones being represented, the management actions were represented as occurring throughout the Kimberly region as one whole zone. The interest here is to see if there is a scope effect present: one would expect respondents to value increases in attributes across the whole Kimberly more than changes occurring in individual zones. In particular, it would allow comparison of aggregate values from V1 or V2 (i.e. aggregating implied WTP across zones) with that derived directly for the whole region.

3. Results

3.1 Panel samples without PPGIS

3.1.1 Descriptive statistics

Table 7 presents the descriptive statistics for the respondents in Panel samples V2-Zones, V3-Roebuck Bay, V4-Camden Sound, and V5-Kimberley Coast. None of these Panel samples included the PPGIS mapping exercise in the survey. Respondents who did not complete the questionnaire, or who took less than 300 seconds, were not used as they moved quickly through the survey and are unlikely to have read the information and instruction pages carefully. The first row in the table shows the final number of respondents used for the descriptive statistics and modelling.

Table 7. Descriptive statistics for the Panel samples without PPGIS, including those who exhibit protest behaviour.

Variable		V2) Zones	V3) Roebuck Bay	V4) Camden Sound	V5) Kimberley Coast
Respondents	**Total n for descriptive statistics (with protesters)**	**n=385**	**n=189**	**n=182**	**n=181**
Age	Mean respondent age in years (st.dev.)	54.52 (13.36)	50.06 (14.32)	48.93 (15.10)	47.46 (15.70)
Female	Female (%)	58	55	62	61
	WA: 49.7 % (ABS 2011)				
Education	Vocational/technical training (%)	19.48	24.34	25.82	22.65
	WA: 28.1% (ABS 2010)				
	Bachelor's degree or equivalent study (%)	25.71	27.51	26.92	26.52
	WA: 15.0% (ABS 2010)				
	Postgraduate degree (%)	14.03	12.17	10.99	13.81
	WA: 3.3% (ABS 2010)				
Life category	Have kids at home (%)	32.20	31.74	34.07	29.28
	Mature couple/no children at home or mature single (%)	57.40	49.21	47.80	44.20
Household income	Mean annual household income in '000 $ (st.dev.)	72.93 (40.56)	78.89 (38.35)	69.89 (37.43)	69.78 (41.30)
	Median WA household income: ~$85,176 (ABS 2013)				
EEP	Mean Environmental Economic Paradigm (st.dev.)	3.16 (1.38)	3.38 (1.43)	3.07 (1.20)	3.14 (1.27)
Visit	Visited the Kimberley in their lifetime (%)	55.06	50.26	43.96	42.22
	Of these ~ Visited Roebuck Bay / Camden Sound in their lifetime (%)		86.32	15	
	Mean number of visits in their lifetime (st.dev.)	2.77 (6.00)	2.60 (6.24)	4.15 (28.26)#	2.98 (11.31)
Knowledge	Mean knowledge of the Kimberley coast (st.dev.) (1 'poor', 2 'below', 3 'average', 4 'above', 5 'excellent')	2.71 (.94)	2.50 (1.02)	2.62 (1.03)	2.48 (1.07)
Access	Mean ability to access the study region (st.dev.) (1 'very easy', 2 'easy',3 'neutral', 4 'difficult', 5 'very difficult')	3.40 (0.90)	3.25 (0.95)	3.71 (1.01)	3.36 (0.87)
Choice difficulty	Choice question difficulty (1= It was very difficult; 5= It was very easy) Mean (st.dev.)	3.12 (1.01)	3.27 (0.94)	3.22 (0.98)	3.27 (0.94)
Choose no management action	Proportion of choices (%) for the 'no action' option	45.19	43.56	39.29	37.57
	Proportion of respondents (%) who chose the 'no action' alternative in every choice set they faced	22.86	23.81	17.58	20.44

Descriptive statistics in Table 7 show that the Panel samples are higher educated than average in WA. In particular there was a high proportion of people who hold Postgraduate degrees: between 11 and 14 percent compared to the WA average of 3.3 percent. There are more females in the sample than average and in sample V2-'Zones

without PPGIS' an under represented group was males aged 18-34 years. For the Roebuck Bay, Camden Sound, and Kimberley Coast samples, missing representative groups were males aged 18-34 years and females aged 65 and over.

Between 17.6 and 23.8 percent of respondents always choose the 'no management' option. Most of these respondent were identified as protesters (see Section 2.6). Testing for differences between the protesters and the rest of the respondents show that in the V2-'Zones' and V3-'Roebuck Bay' samples there are significantly more males in the protester group than in the rest of the sample (Table 8). In the V2-'Zones' sample, the protester group has significantly fewer years of education and a higher EEP score (more priority is given to economic considerations).

Table 8. Descriptive statistics for the protest respondents and tests for significant differences between protesters and the rest of the sample, in the Panel samples without PPGIS.

Variable		V2) Zones	V3) Roebuck Bay	V4) Camden Sound	V5) Kimberley Coast
Total n (with protesters)		**n=385**	**n=189**	**n=182**	**n=181**
Protesters	(% of n)	**19.74**	**19.05**	**17.03**	**16.02**
Female	Female %	51* pro<sample	42* pro<sample	61[a]	66[a]
Education	Mean respondent education in years (st.dev.)	14.57* (2.00) pro<sample	15.00 [a] (1.76)	14.58[a] (1.78)	14.79[a] (1.66)
Age	Mean respondent age in years (st.dev.)	55.01[a] (12.77)	50.83[a] (12.04)	48.71[a] (15.00)	45.59[a] (15.83)
EEP	Mean Environmental-Economic Paradigm (st.dev.)	3.54*** (1.58) pro>sample	3.64 [a] (1.55)	3.00[a] (1.32)	3.14[a] (1.25)

***Difference significant at 1% ($P<0.01$), **Significant at 5% ($P<0.05$), * Significant at 10% ($P<0.10$), [a] No significant difference between sample groupings

Table 9. Additional descriptive statistics for Panel samples.

	V2) Zones	V3) Roebuck Bay	V4) Camden Sound	V5) Kimberley Coast
Total n (with protesters)	**n=385**	**n=189**	**n=182**	**n=181**
Relationship to the Kimberley (%) ^				
Kimberley resident	0	1.06	1.10	0
Former Kimberley Resident	5.71	3.17	2.75	5.52
Aboriginal	0.52	1.59	0	0
Visitor	83.12	80.95	79.67	85.64
Commercial fishing, pearling or aquaculture interest	0.52	1.06	0	0
Commonwealth government employee	0.26	1.59	2.20	1.66
State government employee	4.68	4.23	4.40	2.21
Local government employee	0.52	0.53	0	0.55
Non-government organisation member	1.30	2.65	1.65	0
Work in tourism industry	0.78	2.12	1.65	0.55
Work in oil and gas industry	1.82	1.06	2.20	1.66
Researcher	0.52	1.06	0.55	0.55
Other	10.13	13.23	13.74	7.73
People were most concerned about (%)				
Making sure there are recreation opportunities for local people	2.86	5.29	2.75	2.21
Ensuring the rights of Traditional Owners/Aboriginal people in the region	9.35	13.23	8.24	12.71
Protecting biological and ecological features found in the region	52.73	41.80	53.85	51.38
Maintaining and developing tourism opportunities	13.77	13.23	9.89	11.05
Ensuring the region supplies natural resources	3.12	3.17	4.40	2.21
Ensuring marine/coastal plans are developed/implemented/supported	9.09	12.70	7.69	8.84
I am not concerned about the future of the Kimberley	4.16	3.17	6.59	4.97
No response	4.94	7.41	6.59	6.63
Reasons for difficulty with choice questions (%) ^				
The choices were complex	25.71	25.93	18.68	22.65
The choices were confusing	7.01	7.41	7.69	6.63
I did not have enough information	12.73	12.70	8.79	12.71
I do not feel qualified to make a choice. Scientists or managers should do this	26.23	20.11	24.18	24.31
The outcomes of the management options were irrelevant to me	6.75	5.82	6.04	2.76
I did not understand the information presented	3.38	3.17	2.20	3.87
Other	9.09	12.70	13.74	11.05
Did it matter in which zone management occurred? (%)				
Yes, all the time	20.78			
Yes, sometimes	45.71			
No, I ignored it	22.60			
Unsure	10.91			

^ Respondents could select multiple options

Around 80 percent of Panel respondents identified 'Visitor' as their main relationship with the Kimberley (Table 9). This is perhaps unsurprising, as the Panel sample includes mostly Perth residents who may only have holidayed in the Kimberley region. Respondents were most concerned about 'protecting biological and ecological features found in the region'; on average 50 percent selected this option. This is followed by 'ensuring the rights of Traditional Owners/Aboriginal people in the region', 'ensuring marine/coastal plans are developed/implemented/supported' and 'maintaining and developing tourism opportunities' all selected by about 10 percent of respondents as their primary concern for the Kimberley from the list of options.

Respondents were asked to select how difficult they thought it was to answer the choice questions. If they selected 'it was very difficult', 'it was difficult', or 'it was a little difficult' they were asked their reasons for the difficulty. The two most selected responses were 'the choices were complex', which is not an unexpected answer

considering the relative unfamiliarity and complexity of the choice task. Notably, the other most selected response to finding the choice task difficult was 'I do not feel qualified to make a choice, scientists or managers should do this'.

In the V2-'Zones' Panel sample, 66.49 percent of respondents stated that it mattered to them in which zone management occurred, while 22.60 percent said they ignored the zones during the choice task (Table 9).

Additional statistics for the Panel samples are provided in Appendix I.

3.1.2   Modelling strategy

In the sections below, we provide summary results from modelling the Panel data sets that did not include the PPGIS mapping task. There is a wealth of data available, which lends itself to a number of different modelling strategies. What we have undertaken is independent analysis of each data set. We have not yet undertaken any formal tests of pooling or comparing data sets in the Panel samples without PPGIS. Our preliminary analysis indicates strong differences between models, suggesting that it is unlikely that there is a single unifying model of preferences. Of the many possible statistical models, we assessed MNL models and a number of mixed logit models with a random parameter distribution assigned to the status quo (SQ) only (see Section 2.1). Estimating a coefficient for the SQ option captures the possibility that respondents saw the 'opt out' option (the option for no management actions) differently compared to the two 'management change' alternatives. Estimating the SQ coefficient as a random parameter allows for the fact that preferences for the two 'management change' alternatives may vary between individual respondents. Furthermore, the mixed logit model accounts for the panel nature of the data. That is, the model accounts for possible correlations between the multiple choices made by the same respondent. Finally, we allow for observed heterogeneity in preferences by introducing interactions between respondents' characteristics and the attributes. See Table 10 for a description of the variables used in modelling.

Table 10. Variables used in modelling analysis.

Variables	Description
Zone	Management zones
	z1 Eighty Mile Beach
	z2 Roebuck Bay
	z3 Dampier Peninsula
	z4 Buccaneer Archipelago
	z5 Camden Sound
	z6 North Kimberly
Sanctuary	Percent of State waters as sanctuary area in the zone (%)
Recreation	Improvement to average recreation facilities levels (LOW, MEDIUM, HIGH)
Rangers	Number of Aboriginal rangers
Development*	Coastal development binary variable (1 = Some development)
Cost	Annual household cost ($)
SQ	Alternative Specific Constant (for status quo option)
PPGIS*	Observation is from Panel sample version V1-Zones with PPGIS
Know	Knowledge rate of the Kimberley
	Poor/little knowledge (-2)
	Below average (-1)
	Average (0)
	Good (+1)
	Excellent (+2)
Access	How difficult or easy is it to access the Kimberley coast/study area
	Very easy to access (-2)
	Easy to access (-1)
	Neither difficult nor easy to access (0)
	Difficult to access (+1)
	Very difficult to access (+2)
Kids	Binary variable for having kids in the household (1 = Yes)
Inc	Annual household income, before tax or anything else is taken out ($ '000)
Uni*	Holds a University degree
PGEdu*	Holds a Post-graduate degree
Visit*	Has visited the Kimberley coast/study area in their lifetime (includes residents)
Non Res Visit*	A non-resident of the Kimberley who has visited the Kimberley coast/study area
Number of Visits	Number of visits to the study region in their lifetime

*Binary variable (0, 1)

In the sections below, we report the results of the estimated model coefficient, and the willingness to pay values for a unit change in an attributes (in $/unit) estimated at the relevant values of the sociodemographic interaction variables. We start with the analysis of the Panel data sets that have present the Kimberley as a single zone in the choice sets (V5), followed by the versions that showed only one single zone in the choice sets (V4 and V3).

Version 5) Kimberley Coast

The first three model estimations are from the single zone samples (versions 3-5). These are simpler models as the attributes were not spatially differentiated in the experiment, hence why those models are presented first. The first model is from the sample that presented all six zones as a single zone that covers the entire study area, the Kimberley coast.

Table 11. Mixed logit estimation results for the Kimberley Coast panel data (survey V5).

	Coefficient	Std. Error	p>|z|
Cost	-0.011	0.001	<0.001
Sanctuary area	0.019	0.003	<0.001
Rangers	0.011	0.004	0.014
Rangers × PGEdu	-0.032	0.010	0.002
Recreation Medium	0.150	0.260	0.565
Recreation Med × Access	0.632	0.290	0.029
Recreation High	-0.109	0.120	0.363
Recreation High × Access	0.407	0.133	0.002
Development	0.015	0.127	0.907
Development × Visit	-0.512	0.184	0.005
SQ	-2.526	0.394	<0.001
SQ × Know	-0.585	0.253	0.021
SQ × Access	1.052	0.366	0.004
Standard Deviation of SQ	2.586	0.317	<0.001
Log likelihood	-741.44		
Number of choice observations	912		
Number of respondents	152		

[a] Each respondent answered 6 choice questions, hence the number of choice observations is 6 x the number of respondents.

The results for V5-Kimberley Coast (Table 11) are largely in line with expectations. Respondents prefer lower costs, more sanctuary areas, more rangers, and medium recreational facilities in the Kimberley coastal region. For this sample, having a postgraduate degree reduces the welfare associated with rangers, to the point where this group actually *lose* utility as ranger numbers increases (marginal utility is -0.021, p = 0.026).

Respondents who see access as neither easy nor difficult (*Access*=0) did not hold significant values for improvements in recreational facilities from Low to Medium or High. This comprises 45 percent of the sample. Respondents for whom access is currently difficult (*Access*=+1 or +2), improvements in recreational facilities is viewed positively (indicated by a positive coefficient on the interaction between recreation and access).

For those who have visited the Kimberley, comprising 42 percent of the sample, development was viewed as a negative impact. For respondents how have not visited the Kimberley, the development attribute was not a significant factor in utility. Those with more difficulty accessing the region are more likely to select the status quo, while those with greater than average knowledge of the region are less likely to select the status quo option – as indicated by a positive and negative interaction between access and SQ and between knowledge and SQ respectively.

Table 12. Willingness to pay estimates for the Kimberley Coast model V5 ($/year).

		WTP ($)	95% confidence interval	
Sanctuary area		1.74	(1.17	2.32)
Rangers	PGEdu=0	0.99	(0.22	1.76)
	PGEdu=1	-2.02	(-3.83	0.22)
Recreation Medium	Access=0	13.95	(-33.78	61.69)
	Access=-2	-104.0	(-237.4	29.29)
	Access=2	131.9	(34.20	229.7)
Recreation High	Access=0	-10.17	(-32.00	11.67)
	Access=-2	-86.16	(-145.77	-26.54)
	Access=2	65.81	(18.66	112.96)
Development	Visit=0	1.38	(-21.31	24.67)
	Visit=1	-46.37	(-71.63	-21.10)

In Table 12, we show respondents' average willingness to pay (WTP) for the different attributes in the choice experiment. These are given by the ratio of attribute parameters to the cost parameter (see Section 2.1, Equation 4). These WTP estimates are shown for respondents with different characteristics (having a postgraduate education, ease of access, and having visited the Kimberley).

In this survey version where we presented the Kimberley Coast as one study region, sample respondents were willing to pay on average an ongoing $1.74 per household per year per percentage increase in marine sanctuary area in State waters. Respondents who do not have a postgraduate education have an average annual WTP of $0.99 per additional Aboriginal ranger. WTP for Aboriginal rangers was not significant for respondents with a postgraduate degree.

There was a high degree of variability in how much a respondent was willing to pay to obtain (or avoid) more recreational facilities, depending on how well the respondent felt they could access the Kimberley coast region. For example, respondents who were indifferent (*Access*=0) or had easy access (*Access*=-2) had a negative WTP for high recreation facilities. This indicates a disutility for these respondents from high recreation. Only respondents who currently have difficult access to the Kimberley coast (*Access*=2) have a positive WTP for both levels of recreation. Respondents' WTP for development depends on whether they have ever visited the region. Respondents who have never visited did not have a significant WTP for development, while respondents who have visited the region were willing to pay to avoid development.

Version 4) Camden Sound

For the V4-Camden Sound Panel sample (Table 13), the effect of cost on utility is negative as expected. Increased sanctuary areas increase utility and development on the coast reduces utility. The effect for rangers and recreation facilities development is more complex. Increasing the numbers of rangers does not increase utility for the majority of respondents (the 'ranger' coefficient is not significantly different from zero). However, the positive coefficient on the interaction term for having a postgraduate degree suggests that those with a postgraduate degree value an increase in rangers positively. This is in contrast to the result obtained for the Kimberley Coast model. Similarly, an increase in the status of the recreation facilities from Low (the base) is complicated by interaction terms. Specifically, values are conditioned by the level of self-reported knowledge about the Kimberley. Changes to a medium level of recreational facilities do not affect the utility for any group, as indicated by the insignificant parameter estimates on recreation Medium. The insignificant estimate on Recreation High implies that those with average knowledge (*Know*=0) are indifferent to an increase in recreational facility provision from Low to High, but those with higher knowledge (*Know*=1 or 2) place a negative value on such a change.

Table 13. Mixed logit estimation results for the Camden Sound panel data.

	Coefficient	Std. Error	p>|z|
Cost	-0.014	0.001	<0.001
Sanctuary area	0.017	0.003	<0.001
Rangers	-0.001	0.005	0.863
Rangers × PGEdu	0.039	0.011	0.001
Recreation Medium	0.137	0.279	0.623
Recreation Med × Know	-0.162	0.233	0.487
Recreation High	-0.019	0.126	0.881
Recreation High × Know	-0.204	0.116	0.077
Development	-0.388	0.106	<0.001
SQ	-2.296	0.354	<0.001
SQ × Access	0.493	0.243	0.069
Standard Deviation of SQ	2.455	0.285	<0.001
Log likelihood	712.80		
Number of choice observations[a]	906		
Number of respondents	151		

[a] Each respondent answered 6 choice questions, hence the number of choice observations is 6 x the number of respondents.

The negative coefficient on the status quo implies that respondents, on average, preferred one of the two 'new management' options over the 'no new management' option. The significant standard deviation of the status quo coefficient justifies the use of the random parameter specification, and implies a high degree of heterogeneity in in people's preferences towards the SQ option, compared to the management options. The significant interaction term between the access variable and SQ suggests that those who find it harder to access the region have a greater preference for maintaining the status quo.

The estimated parameters are be more easily interpreted as WTP estimates; the dollar values associated with a unit change in the attribute. Table 15 reports these for each attribute and, where appropriate, at different levels of the sociodemographic interaction variables.

Table 14. Willingness to pay estimates for the Camden sound model ($/year).

		WTP ($)	95% confidence interval	
Sanctuary area		1.22	(0.76	1.68)
Rangers	PGEdu=0	-0.07	(-0.72	0.60)
	PGEdu=1	2.75	(1.26	4.23)
Recreation Medium	Know=0	9.83	(-29.44	49.11)
	Know=-2	33.08	(-28.41	94.57)
	Know=+2	-13.41	(-102.39	75.56)
Recreation High	Know=0	-1.35	(-19.10	16.36)
	Know=-2	27.92	(-5.76	61.59)
	Know=+2	-30.61	(-70.74	9.52)
Development		-27.77	(-42.17	-13.37)

For the Camden Sound sample, respondents were willing to pay, on average, $1.22 per household per year forever per percentage increase in marine sanctuary in State waters. For increases in rangers, households were

willing to pay on average $2.75 per year for every additional ranger if the respondent held a post graduate degree of some kind. Respondents who did not have a postgraduate degree were not willing to pay for extra rangers.

If the respondent had an 'poor' knowledge of the study region, they were willing to pay on average $27.92 per year for improved recreational facilities from Low to High but if they had an 'excellent' level of self-reported knowledge of the region then they were willing to pay to avoid improvement of recreation facilities from Low to High (WTP for recreation Medium is not significant). This indicates that there is some optimal level of facilities for Camden Sound according to how well the respondent 'knows' the region.

There was, on average, a negative preference for development (according to how the study defined development), indicating at 95 percent confidence, households are willing to pay to avoid development in Camden Sound.

Version 3) Roebuck Bay

In this version of the survey respondents were only presented with management options in the Roebuck Bay zone. Results of the model are presented in Table 15. Cost has a significant and negative affect on utility, increases in sanctuary areas increases utility, and there is significant interaction with income (defined in $'000, and as deviations from mean). Those with higher incomes place greater weight on increases in area of sanctuary zones. One might interpret the interaction term with income as a theoretic possibility for the marginal utility of income to be negative when a respondent has a sufficiently low level of income. However, for the income range in the sample there are no significant negative marginal values. Nevertheless, for the 30 percent of the sample who are at the lowest income levels, the implied marginal value of increased sanctuary areas is zero.

Increased ranger numbers are valued positively across the sample, with those who held a postgraduate degree holding higher values. A shift from medium recreation facilities (the baseline for Roebuck bay) to higher levels (Recreation High) reduces utility. At the baseline, sociodemographic values (those without children and those who do not think it is difficult or easy to access the zone) development in the region does not change utility (the coefficient on development is not significant). For those who have children (*Kids*=1), development reduces utility, as it does for those who believe access is difficult (*Access*=+1 or +2). The negative coefficient on the interaction between development and access means that those who believe they can access the zone easily or very easily (*Access*=-1 or -2) will hold positive values for development.

Table 15. Mixed logit estimation results for the Roebuck Bay panel data.

	Coefficient	Std. Error	p>|z|
Cost	-0.015	0.001	<0.001
Sanctuary area	0.014	0.004	<0.001
Sanctuary area × Inc	0.000	0.000	0.020
Rangers	0.010	0.005	0.039
Rangers × PGEdu	0.030	0.012	0.013
Recreation High	-0.229	0.125	0.067
Development	0.062	0.136	0.646
Development × Kids	-0.498	0.224	0.026
Development × Access	-0.379	0.115	0.001
SQ	-2.794	0.463	<0.001
SQ × Know	-0.482	0.216	0.026
SQ × Uni	1.002	0.433	0.021
Standard Deviation of SQ	1.966	0.243	<0.001
Log-likelihood	-648.95		
Number of choice observations[a]	816		
Number of respondents	136		

[a] Each respondent answered 6 choice questions, hence the number of choice observations is 6 x the number of respondents.

Regarding the status quo alternative, those with a university degree have a greater preferences for the status quo, while those who believe they have a higher than average knowledge of the zone (*Know*=+1 or +2) are less likely to select the status quo option, *ceteris paribus*. Table 16 below reports willingness to pay estimates for particular socio-demographic groups where appropriate.

Table 16. Willingness to pay estimates for the Roebuck Bay model ($/year).

		WTP ($)	95% confidence interval	
Sanctuary area	Mean income	0.91	(0.45	1.37)
	25th percentile income	0.48	(-0.12	1.08)
	75th percentile income	1.61	(0.88	2.33)
Rangers	PGEdu=0	0.66	(0.05	1.27)
	PGEdu=1	2.65	(1.20	4.09)
Recreation High		-15.30	(-31.72	1.13)
Development	Kids=0, Access=0	4.16	(-13.63	21.94)
	Kids=1, Access=0	-29.07	(-53.25	-4.89)
	Kids=0, Access=-2	54.79	(16.74	92.83)
	Kids=0, Access=2	-46.47	(-77.81	-15.13)

For the Roebuck Bay sample, respondents at mean income were willing to pay on average $0.91 per household per year per percentage increase in marine sanctuary in State waters. Those with higher income have a higher WTP for sanctuary area, while respondents with lower income did not have a significant WTP for sanctuary area. For increases in rangers, households were willing to pay on average $2.65 per year for every extra ranger if the respondent held a post graduate degree of some kind. Respondents were not willing to pay for improvement to recreational facilities.

The values associated with development are affected by both the presence of children in the household and respondents' self-reported ability to access the region. Those without children and for whom access is neither easy nor hard do not have a significant WTP for development. However, those with children have a negative value. If there are no children and access is easy (-2) then the WTP for development is significant and positive ($54.79), while for those who do not believe access is easy (access=2) hold significant negative WTP i.e. they would be prepared to pay $46.47 to avoid development.

3.1.3   Comparing the three single-zone models

Before moving on to further analysis, it is useful to identify whether notable similarities or differences in the results exist between the three single-zone models.

In all three models, the percentage of State waters in sanctuary zones had a significant, positive impact on utility. Although the marginal value for sanctuary zone is greater for the Kimberley sample than the Camden sound or Roebuck Bay values, it is comparable to the sum of the two. This suggests that respondents may have a strong diminishing marginal utility from sanctuary area (because the sum of only two out of six zones is comparable to the whole Kimberley coast). Another possibility is that responses reveal a degree of insensitivity to scope, that is, respondents reveal a positive utility for sanctuary zone but this value may not be affected by the scale of the sanctuary zone along the Kimberley coast.

Increases in Ranger numbers are valued in the Kimberley model for the majority of the sample, but not by those who hold a postgraduate education qualification. In Camden sound the reverse is true: it is only those with a postgraduate education who value Rangers. In the case of Roebuck Bay, both group's value rangers, but those with a postgraduate degree value them more. It is unclear why these discrepancies occur.

In the case of changes in recreation facilities, there is relatively little support for moving to the higher provision levels: in both the Kimberley and Camden Sound, respondents are indifferent to the change, while in Roebuck bay, those with good access support high levels of recreational facilities, while those without good access do not. In the case of shifting to the medium recreational level, in the Kimberley only those who feel they have poor access support developing medium recreational facilities, while in Camden Sound, those who feel they have high

knowledge of the region support it, while those who do not have much knowledge of the region loose utility by such a change.

In the Kimberley model, the utility of respondents who have visited the area reduces if coastal development is introduced, while others are indifferent. In Camden Sound, all respondents lose utility as a result of development, while in Roebuck Bay, the effect is moderated by presence of children and access: those without children and who feel that there access is poor see benefit in development, while the utility of other categories of respondents is reduced by development.

Although there are some differential effects due to sociodemographic differences between respondents, the general picture which emerges is one of a desire to preserve the environmental features of the region, with only moderate support for improving recreational access to the medium level.

3.2   Panel sample with PPGIS and Public sample with PPGIS

3.2.1   Descriptive statistics

The following Tables (Table 17, 18, and 19) present the descriptive statistics for the survey's that included the PPGIS mapping exercise: the Panel sample (V1) and the Public sample. This section highlights some of the descriptive statistics and provides qualitative remarks on the differences between the Public and Panel samples. Respondents who did not complete the survey, or who took less than 300 seconds to complete, were not used to ensure reliability of results. The first row in Table 17 shows the final number of respondents used for the descriptive statistics and modelling, remember that protesters are included in the descriptive statistics but not in the modelling. The Public survey registered 338 completes (incentives issued), but entries were removed that they did not meet the above requirements or fully complete the first part of the survey (partial completion during the PPGIS section), resulting in 320 completed responses.

The Panel samples have a higher proportion of female, at around 64 percent, than the Public sample with 45 percent. From the Public sample the missing demographic are females with children at home. Both samples are higher educated that the WA average with double the proportion of Bachelor degrees and significantly more people with Postgraduate degrees in the Public sample: 33.13 percent compared with the 3.3 percent WA census level. Generally the Public sample prioritises the environment over economic outcomes more than the Panel sample and has a higher average knowledge of the Kimberley. This is as expected, since the Public sample captures people with a relationship to the Kimberley while the Panel sample targeted Perth residents. As expected, the Public sample has visited the Kimberley more and has a higher number of visits per person.

Table 17. Descriptive statistics for the Panel samples with PPGIS and Public sample with PPGIS, including those who exhibit protest behaviour.

Variable		V1) PANEL	PUBLIC
Respondents	Total n for descriptive statistics (with protesters)	**155**	**320**
Age	Mean respondent age in years (st.dev.)	45.95 (14.16)	48.04 (14.33)
Female	Female (%)	64	45
	WA: 49.7 % (ABS 2011)		
Education	Mean respondent education in years (st.dev.)	15.10 (1.62)	15.93 (1.77)
	Vocational/technical training (%)	22.58	15.31
	WA: 28.1% (ABS 2010)		
	Bachelor's degree or equivalent study (%)	30.32	29.38
	WA: 15.0% (ABS 2010)		
	Postgraduate degree (%)	13.55	33.13
	WA: 3.3% (ABS 2010)		
Life category	Have kids at home (%)	42.58	30.94
	Mature couple/no children at home or mature single (%)	40.00	45.31
Household income	Mean annual household income in '000 $ (st.dev.)	82.42 (40.9)	80.61 (40.2)
	Median WA household income: ~$85,176 (ABS 2013)		(Median 91)
	Annual Household income over $104,000 (%)	33.83	31.56
EEP	Environmental Economic Paradigm, Mean (st.dev.)	2.93 (1.48)	2.42 (1.46)
Visit	Visited the Kimberley in their lifetime (%)	55.78	90.94
	Mean number of visits (st.dev.)	2.68	6.45
	PUBLIC= mean number of visits<100 (there are 8 very large estimates (>100))	(5.16)	(12.71)
Knowledge	Mean knowledge of the Kimberley coast (st.dev.)	2.66	3.53
	(1 'poor', 2 'below', 3 'average', 4 'above', 5 'excellent')	(1.01)	(0.81)
Access	Mean ability to access the study region (st.dev.)	3.38	3.30
	(1 'very easy', 2 'easy',3 'neutral', 4 'difficult', 5 'very difficult')	(0.91)	(1.00)
Choice difficulty	Choice question difficulty (1= It was very difficult; 5= It was very easy) Mean (st.dev.)	3.00 (0.93)	2.72 (1.01)
Choose no management action	Proportion of choices (%) for the 'no action' option	33.76	29.06
	Proportion of respondents (%) who chose the 'no action' alternative in every choice set they faced	19.35	14.06

Table 18 reports the characteristics of respondents identified as protesters in the two samples. For both the Panel and Public survey there are significantly more men in the protest group and they have a higher average EEP score (more priority is given to economic considerations). In the Public sample the protest group are on average older and have significantly less years of education.

Table 18. Descriptive statistics for protest respondents and tests for significant differences between protesters and the rest of the sample for completes with PPGIS.

		V1) PANEL	PUBLIC
Total n (with protesters)		**n=155**	**n=320**
Protesters	(% of n)	**12.26**	**10.62**
Female	Female %	44**	24***
		pro<sample	pro<sample
Education	Mean respondent education in years	14.74 a	14.88 ***
	(st.dev.)	(1.73)	(1.97)
			pro<sample
Age	Mean respondent age in years (st.dev.)	47.06 a	52.53 **
		(14.03)	(15.13)
			pro>sample
EEP	Mean Environmental-Economic	3.68***	3.21 ***
	Paradigm, (st.dev.)	(1.42)	(1.77)
		pro>sample	pro>sample

***Significance at 1% (P<0.01), **Significance at 5% (P<0.05), * Significance at 10% (P<0.10), a No significant difference between sample groupings

As expected, the Public sample comprised of less visitors and more residents, tourism workers, researchers, NGO members, and State government employees than the Panel (Table 20). This is a desired effect from the recruitment strategy that was employed for the Public sample. Similar to other Panel samples, respondents were most concerned with protecting the biological and ecological features found in the region. Compared to the Panel samples the Public sample appear to be less concerned about developing tourism opportunities (5.63 percent compared to average of 11.14 percent in the five Panel samples) and also less concerned about ensuring coastal management plans are developed.

Additional statistics for these samples are provided in Appendix I.

Table 19. Additional descriptive statistics for completes with PPGIS, percent selected.

	V1) PANEL	PUBLIC
Total number of respondents (with protesters)	**155**	**320**
Relationship to the Kimberley (%) ^		
Kimberley resident	0	33.13
Former Kimberley Resident	-	-
Aboriginal	1.29	2.50
Visitor	80.00	47.81
Commercial fishing, pearling or aquaculture interest	0.65	0.94
Commonwealth government employee	0	1.56
State government employee	8.39	16.56
Local government employee	0.65	1.56
Non-government organisation member	1.29	7.50
Work in tourism industry	0.65	9.69
Work in oil and gas industry	5.16	2.19
Researcher	1.94	18.75
Other	13.55	15.63
People were most concerned about (%)		
Making sure there are recreation opportunities for local people	2.58	7.50
Ensuring the rights of Traditional Owners/Aboriginal people in the region	12.90	11.56
Protecting biological and ecological features found in the region	54.84	65.31
Maintaining and developing tourism opportunities	7.74	5.63
Ensuring the region supplies natural resources	4.52	2.50
Ensuring marine/coastal plans are developed/implemented/supported	11.61	6.25
I am not concerned about the future of the Kimberley	3.23	0.63
No response	2.58	0.63
Reasons for difficulty with choice questions (%) ^		
The choices were complex	29.68	40.94
The choices were confusing	7.10	10.63
I did not have enough information	14.84	20.63
I do not feel qualified to make a choice. Scientists or managers should do this	32.26	14.69
The outcomes of the management options were irrelevant to me	5.81	1.88
I did not understand the information presented	3.87	2.50
Other	11.61	24.06
Did it matter in which zone management occurred? (%)		
Yes, all the time	21.29	41.88
Yes, sometimes	47.74	42.50
No, I ignored it	16.77	13.13
Unsure	14.19	2.50

^Respondents could select multiple options

Respondents who always selected the status quo option in the choice sets were asked for their reasons to do so (Appendix I, Table 25). In the Public sample, respondents often selected the 'Other', and wrote substantial comments on the box offered. These comments were inspected to help determine if the respondent was a 'protester' or not. The comments are not reported here to protect the privacy of respondents. The Public sample also found the choices more complex than the Panel sample, and notably less respondents in the Public sample selected that they 'did not feel qualified to make a choice', compared to the Panel sample.

For the Public sample, respondents considered the zones in the choice questions more than respondents in the Panel sample, 41.88 percent answered 'yes, all the time' compared to 21.29 in the Panel sample (Table 19).

3.3   Modelling preferences in Panel samples

Version 1) Six Zones with PPGIS and Version 2) Six Zones without PPGIS

As noted earlier, the choice experiment that included all six zones were delivered in two versions to the online panel: one that was preceded by the PPGIS mapping exercise, and one that did not include this activity. As anticipated, the completion rate of the panel with PPGIS was very slow, and the survey company struggled to fill the quota required. We are interested to see if respondents' choice behaviour differs as a result of having

completed the PPGIS task. If choice behaviour is not significantly influenced by the presence of the PPGIS task then the two six zone panel CE samples (versions 1 and 2) can be combined, to give one larger sample for analysis.

The data sets were combined and tested for differences, with summary results shown in Appendix I, Table 26 and Table 27. A mixed logit model with the status quo as a random parameter was chosen as the most useful model, because it can account for some preference heterogeneity. First, we tested whether the zonal alternative specific constants have a significant impact on preferences. The tests were performed by including zonal alternative specific constants (ASC) in the model and maintaining non-spatially explicit attributes. These zonal ASC's were found to be significant and are thus kept in the model.

Second, we tested for differences between the two datasets by including attribute interactions with the PPGIS task. This PPGIS task was defined as a binary variable that takes a value of one if the observation is from Panel sample version V1- Zones with PPGIS, and zero otherwise. The testing revealed that the attribute parameters are common across both samples, except for the interaction associated with cost. This implies that the datasets can be combined as long as an implicit interaction term is included to capture the effect of the PPGIS task on the marginal utility of costs. The implication of this interaction term is that the completion of the PPGIS mapping procedure has influenced the marginal utility of cost. This has implications for willingness to pay estimates, as shown in Table 21 below.

The spatial effects of the attributes was systematically explored, using the combined samples, by comparing the model fit with and without spatial effects (zone interactions) for each attribute. We introduced zonal binary interaction terms for all attributes, while maintaining zonal ASCs, and a PPGIS binary effect for cost. Restricted models were then tested against this. We thus investigated whether the effects of an attribute could be captured in a single variable irrespective of which zone it applied to, or if whether attributes needed to be spatially explicit by including binary interaction terms between zone and attributes. This testing method revealed that only sanctuary area was spatially differentiated. Inspection of the estimated spatial effects for sanctuary in zone 3 and 6 suggested statistically similar marginal utilities, as did sanctuary in zone 1, 2, 4 and 5. The best fit spatial model is one with sanctuary split into two regional effects (zones 1,2, 4, and 5 versus zones 3 and 6), is shown in Table 20. This model accounts for individual heterogeneity through the random parameter on the status quo, the SQ ASC. Using our best fit spatial model, we further allowed for observed heterogeneity in preferences by introducing interactions between respondents' characteristics and the attributes – similar to models presented earlier in this report. Table 10 above describes the variables used in modelling and model results are presented in Table 20.

Table 20. Mixed logit estimation results; merged sample V1- Six Zones with PPGIS and V2- Six Zones without PPGIS.

	Coefficient	Std. Err	P>|z|
Cost	-0.015	0.001	<0.001
Cost X PPGIS	0.005	0.001	<0.001
Zone 1	0.138	0.109	0.205
Zone 3	-0.469	0.150	0.002
Zone 4	-0.241	0.112	0.032
Zone 5	-0.023	0.110	0.832
Zone 6	-0.265	0.148	0.074
Sanctuary zone 1,2,4&5	-0.005	0.004	0.200
× Female	0.012	0.005	0.014
× Know	0.009	0.003	<0.001
Sanctuary zone 3 & 6	0.010	0.006	0.076
× Know	0.010	0.005	<0.001
× Female	0.014	0.006	0.019
x Uni	-0.014	0.005	0.004
× Edu (Voc&Post)	0.019	0.005	<0.001
Rangers	0.008	0.003	0.005
× Log Income	0.010	0.004	0.005
Recreation Medium	0.265	0.154	0.085
× Female	-0.456	0.192	0.017
Recreation High	-0.234	0.082	0.005
× Number of Visits	-0.036	0.011	0.001
Development	-0.258	0.077	0.001
× Access	0.164	0.077	0.033
SQ	-2.219	0.193	<0.001
Standard Deviation of SQ	2.256	0.148	<0.001
Log Likelihood	-2357.67		
Number of observations	2670		
Number of respondents	445		

Note: Zone 1=Eighty Mile Beach, 2=Roebuck Bay, 3= Dampier Peninsula, 4= Buccaneer Archipelago, 5= Camden Sound, 6= North Kimberley

The model in Table 20 estimates the combined panel data from V1- Six Zones with PPGIS and V2- Six Zones without PPGIS. This will henceforth be referred to as the 'Panel Zones' dataset.

In the Panel Zones data analysis, cost is significant and negative. However, respondents who completed the PPGIS mapping exercise have a smaller marginal utility of cost, and hence are on average willing to pay more for management action in the Kimberley. The zonal ASCs have to be interpreted against the base zone; zone 2 Broome. On the basis of the zonal ASCs one can suggest that zonal preferences are ranked zone 3< zone 6< zone 4< zone 5< zone 2< zone 1. Females and people with more knowledge of the Kimberley placed higher utility on sanctuary areas in zones 1, 2, 4, and 5. People preferred more sanctuary area in the zone 3 and 6 and obtained higher utility from more sanctuary areas if they had more knowledge of the region. 'Edu' is a combined education variable determined by testing the effect of the separate education categories (primary or secondary, vocational/technical or some undergraduate study, Bachelor degree, Postgraduate Degree). This variable is a merged variable including both people whose highest educational achievement is vocational and technical training, or they hold a Postgraduate degree. Respondents from these categories on average place a higher utility on sanctuary areas in zone 3 and 6 than those higher educational attainment is primary or secondary schooling or a Bachelor degree.

In general, an increase in rangers in any zone increases utility, and there is significant interaction with the log of income (defined in $'000). Those with higher levels of income place greater weight on increases in rangers. Income is included as a log variable in this model to improve fit, implying a decreasing marginal effect of income on the marginal utility of rangers.

Utility from improvement in recreation in zones 3, 4, 5 and 6 to Medium was influenced by a respondent's gender. Males did not significantly value this upgrade, however females did not prefer this improvement of recreation level. A shift from Medium recreation facilities to High reduces utility with additional decreases in utility depending on how many times you have visited.

Preference for development depends on the level of access. When access to the Kimberley coast is considered neither difficult nor easy (Access=0), increased coastal development leads to a reduction in utility. And as access becomes easier the aversion to development increases.

Table 21 reports the willingness to pay estimates for attributes, differentiated by particular socio-demographic groups where appropriate. WTP are presented for V1- Zones with PPGIS and V2- Zones without PPGIS to account for the different marginal utility of income between the two panel samples.

The willingness to pay estimates suggest that there is a degree of spatial heterogeneity in preferences. There is a relatively lower weight placed upon zones 3 and 4 (Dampier Peninsula and the Buccaneer Archipelago) compared to the other zones. In general, people were willing to pay more to get more sanctuary area in Dampier Peninsular and North Kimberley than in the other zones. It is notable that these are both areas where the current provision is zero, suggesting that respondents may see value in achieving a spread of protection. The other results support the general inferences from the single zone models: higher levels of recreation are typically seen as reducing welfare, and some people are indifferent to changes to achieve the Medium recreation level. Respondents for whom access is neither easy nor difficult or access is currently easy place a significant negative value on development, while respondents with difficult access did not have significant values for development.

Table 21. Willingness to pay estimates with interactions; merged sample V1- Six Zones with PPGIS and V2- Six Zones without PPGIS ($/year).

		V2) Zones without PPGIS			V1) Zones with PPGIS		
		WTP ($)	**95% confidence interval**		**WTP ($)**	**95% confidence interval**	
Zone 1		9.30	(5.12	23.72)	14.45	(-8.09	36.99)
Zone 3		-31.72	(-51.67	-11.77)	-49.28	(-81.22	-17.34)
Zone 4		-16.27	(-31.15	-1.39)	-25.28	(-48.80	-1.75)
Zone 5		-1.59	(-16.21	13.04)	-2.47	(-25.20	20.27)
Zone 6		-17.89	(-37.51	1.74)	-27.79	(-58.68	3.10)
Sanctuary zone 1,2,4&5	Male; Know=0	-0.37	(-0.94	0.20)	-0.57	(-1.46	0.32)
	Female; Know=0	0.46	(3.4E-03	0.92)	0.71	(2.8E-04	1.43)
	Male; Know=+2	0.88	(0.02	1.74)	1.37	(0.01	2.72)
	Male; Know=-2	-1.61	(-2.51	-0.72)	-2.51	(-3.97	-1.05)
Sanctuary zone 3&6	Male; Know=0; Uni=0; Edu=0	0.69	(-0.07	1.45)	1.08	(-0.11	2.27)
	Female; Know=0; Uni=0; Edu=0	1.61	(0.94	2.28)	2.50	(1.40	3.61)
	Male; Know=0; Uni=1; Edu=0	-0.27	(9-1.12	0.58)	-0.42	(-1.75	-0.90)
	Male; Know=0; Uni=0; Edu=1	1.97	(1.07	2.87)	3.06	(1.58	4.53)
	Male; Know=+2; Uni=0; Edu=0	2.01	(0.93	3.09)	3.12	(1.37	4.88)
	Male; Know=-2; Uni=0; Edu=0	-0.62	(-1.75	0.51)	-0.97	(-2.74	0.80)
Rangers	Mean Income	0.51	(0.16	0.86)	0.79	(0.24	1.34)
	25th percentile	0.30	(-0.08	0.68)	0.47	(-0.12	1.06)
	75 percentile	0.75	(0.37	1.14)	1.17	(0.56	1.79)
Rec Medium	Male	17.90	(-2.38	38.19)	27.82	(-4.17	59.80)
	Female	-12.94	(-30.96	5.08)	-20.11	(-48.32	8.11)
Rec High		-15.79	(-26.33	-5.25)	-24.54	(-40.93	-8.14)
	Number of visits +	*-2.45*	*(-3.93*	*-0.98)*	*-3.81*	*(-6.16*	*-1.46)*
Development	Access=0	-17.46	(-27.45	-7.47)	-27.12	(-43.21	-11.04)
	Access=-2	-39.68	(-65.28	-14.08)	-61.66	(-102.84	-20.47)
	Access=2	4.77	(-14.75	24.29)	7.41	(-22.99	37.81)

Notes: z1=Eighty Mile Beach, z2=Roebuck Bay, z3= Dampier Peninsula, z4= Buccaneer Archipelago, z5= Camden Sound, z6= North Kimberley. + Additive WTP. NB Differences in WTP estimates between the samples are due solely due to the difference in the value of the cost coefficient between the two samples.

3.4   Public Kimberley sample

The spatial effects of the attributes in the Kimberley Public survey was systematically explored by comparing the model fit with and without spatial effects (zone interactions) for each attribute, tests are shown in Appendix I Table 28. General effects of the zones using zone alternative specific constants (ASCs) were tested for significance first. We then tested models where the effects of an attribute was captured in a single variable rather than explicit for each of the six zones. Remember that our model already has general zone constants (the zonal ASCs) that capture the effect of management action being offered in that zone. This testing procedure revealed that a model that included High recreation and the development attribute as spatially differentiated was a better fit. Visual inspection and testing of the model revealed that these effects can be divided into two regions. Zone 1 and zone 2 can be combined into a 'south' effect, and zone 3, 4, 5, and 6 can be combined into a 'north' effect for both attributes.

As we have done in our previous analysis of the samples, we used our best fit spatial model to then allow for observed heterogeneity in preferences by introducing interactions between respondents' characteristics and the

attributes. A description of the variables used in modelling is provided in Table 10, and model results are presented in Table 22.

Table 22. Mixed logit estimation results for a model with interactions, using Public PPGIS data.

	Coefficient	Std. Error	P>|z|
Cost	-0.006	0.001	<0.000
Zone 1	-0.003	0.125	0.984
Zone 3	0.678	0.195	0.001
Zone 4	0.680	0.197	0.001
Zone 5	0.951	0.198	<0.000
Zone 6	0.786	0.197	<0.000
Sanctuary	0.018	0.004	<0.000
Sanctuary × Uni	0.017	0.005	0.002
Rangers	0.014	0.003	<0.000
Recreation Medium	-0.170	0.141	0.227
Rec Med × Know	-0.239	0.133	0.073
Recreation High South	-0.120	0.150	0.423
Recreation High North	-0.689	0.118	<0.000
Development South	-0.285	0.140	0.042
Dev South × Log Inc	0.296	0.151	0.050
Development North	-0.962	0.154	<0.000
Dev North × Non Res Visit	0.324	0.170	0.057
SQ	-1.424	0.262	<0.000
Standard Deviation of SQ	2.229	0.198	<0.000
Log Likelihood	-1558.70		
Number of observations	1704		
Number of respondents	284		

Note: Zone 1=Eighty Mile Beach, 2=Roebuck Bay, 3= Dampier Peninsula, 4= Buccaneer Archipelago, 5= Camden Sound, 6= North Kimberley

For the Kimberley Public survey cost is significant and negative, respondents receive negative utility from extra costs. From the zonal ASCs, we can judge respondents' general preferences for management in the zones relative to zone 2. This shows that zone 5 received the highest preference, and that preferences are ordered as zone 1< zone 2< zone 3< zone 4< zone 6< zone 5. There is positive utility from extra sanctuary areas in State waters and respondents with a University degree gain additional utility from extra sanctuary areas in any zone. People further derive positive utility from additional Aboriginal rangers. People with average knowledge of the Kimberley received negative utility from improving recreational areas from Low to Medium in the zone, if they had a greater than average or excellent knowledge of the Kimberley they were more adverse to this attribute. However those with less than average knowledge of the Kimberley has less negative utility for Medium levels of recreation. Finally, there are strong negative values for improvement of recreation levels to High in the northern zones; Dampier Peninsula, Buccaneer Archipelago, Camden Sound, and North Kimberley. People also had negative values for development in the both the southern and norther regions. In the south (zone 1 and zone 2) the level of disutility was dependant on income; the higher your household income the less adverse you are to development in this region. However, for the development attribute in the northern region (zones 3, 4, 5, and 6) there is stronger negative utility with slightly less disutility if a person who is not a resident of the Kimberley but has visited the Kimberley in their lifetime.

The model and its estimated parameters can be used to estimate willingness to pay, or the dollar values associated with a unit change in the attribute. Table 23 below reports these for each attribute and where appropriate the different levels of the sociodemographic interaction variables.

Table 23. Willingness to pay estimates for Public PPGIS ($/year).

		WTP ($)	95% confidence interval	
Zone 1		-0.41	(-40.41	39.59)
Zone 3		110.46	(42.69	178.23)
Zone 4		110.69	(42.78	178.60)
Zone 5		154.86	(82.50	227.23)
Zone 6		127.97	(58.57	197.37)
Sanctuary area	Uni=0	2.95	(1.49	4.41)
	Uni=1	5.70	(4.16	7.24)
Rangers		2.30	(1.26	3.34)
Rec Medium	Know=0	-27.70	(-73.21	17.81)
	Know=-2	50.08	(-62.49	162.66)
	Know=2	-105.48	(-185.52	-25.44)
Rec High South		-19.57	(-66.17	27.02)
Rec High North		-112.16	(-147.91	-76.41)
Development South	Mean income	-46.43	(-92.10	-.76)
	25th percentile	-63.55	(-113.67	-13.42)
	75th percentile	-14.47	(-68.83	39.89)
Development North		-156.60	(-215.59	-97.60)
	Non-resident Visit=1	-103.86	(-146.24	-61.49)

Note: Zone 1=Eighty Mile Beach, 2=Roebuck Bay, 3= Dampier Peninsula, 4= Buccaneer Archipelago, 5= Camden Sound, 6= North Kimberley

3.4.1   *Comparing the Panel and Public models*

The spatial distribution of preferences in the Public sample is different to those displayed by the combined Panel sample with all six zones (versions 1 and 2). Here, the southern two zones are associated with a strong (relative) negative value through the zonal ASCs, while in the Public sample it was zones 3 and 4 that exhibited that effect. There are no regional effects associated with sanctuary zones, unlike those shown in the Public sample, but here there are strong regional effects for the higher level of recreational provision: again, the northern 4 zones show a much stronger negative effect than the southern two (i.e. shifting to this level has a greater effect in those zones than in the southern ones). Similarly, development in the northern zones has a stronger negative effect. The results suggest that respondents in the Public sample, who may have greater experience and connection to the region, have much stronger preferences to protect the unique characteristics of the more remote and undeveloped zones, than those in the Panel sample.

3.5   Study limitations

While every effort was made, with the research company and in the survey recruitment strategy, to collect a representative sample there remain groups whose values and preferences that are not captured by this research. In particular, the views of Traditional Owners are not adequately represented in this study and require targeted agreement-based research to ensure their values and preferences are captured. The data collected is not necessarily representative of any given population or community.

It is important to remember that the nature of choice experiment methodology means that results from this experiment must be considered within the context that they were obtained. This mean values for the attributes should be interpreted within the context of the choice experiment, the management zones used and the other attributes made available to respondents. This research suggests there is some spatial differentiation in

preferences for these attributes across the region however more data would be needed to explore the extent of spatial differentiation.

4. Conclusions and management implications

4.1   Management Implications

Management Implication 1: All respondents hold values for the Kimberley coastal regions – including people who are not residents or members of groups who might be identified as having special interests in the area.

People revealed preferences for all the attributes presented in the choice experiment, regardless of where respondents lived. Given the remoteness of the region, these values will include non-use values for people (values not associated with actively using a resource). These non-marketed, non-use values are important for environmental goods and services. Hence, environmental managers and planners need to recognise that the relevant 'stakeholders' to consider includes Kimberley non-residents, who may not typically be identified as stakeholders. Recognising all relevant stakeholders is important if management decisions are to maximise the overall benefits to society.

Management Implication 2: Peoples preferences for management are influenced by identifiable characteristics; socio-economic or other.

There were significant interactions in all models between some of the attributes of the choice experiment and respondents' characteristics. This demonstrates that preferences differ, and can be related to respondents' socio-economic characteristics, demographics and/or attitudes towards the Kimberley region.

The three most significant characteristics influencing opinions were: levels of educational achievement, how easy or difficult a respondent felt they could access the Kimberley Coast, and respondents' perceived levels of knowledge of the Kimberley region. The influence of these socio-economic characteristics was different between all the samples. For policy makers and resource managers, information about how socio-economic and other characteristics affect people's preferences is relevant to identify which segments of the population may support or oppose particular proposals.

Management Implication 3: Preferences for management attributes vary spatially, in particular between northern and southern areas of the Kimberley region.

For the Public sample (people with some association with the Kimberley), we observed spatial differentiation in preferences between the zones. This group of people were willing to pay more for management in the Dampier Peninsula, Buccaneer Archipelago, Camden Sound and North Kimberley ('northern' zones) over management in Eighty Mile Beach, and Roebuck Bay ('southern' zones). Preferences for the attributes sanctuary area, High recreational facilities, and coastal development were also found to be spatially differentiated. In the Public sample, preferences for High recreational facilities and coastal development were more opposed in the northern zones than in the southern zones. Respondents in the Panel sample were willing to pay more for sanctuary areas in the Dampier Peninsular and North Kimberley zones. In the preliminary analysis undertaken for this report, no spatial differentiation was found across the region for increasing the number of Aboriginal rangers or for changing recreational facilities to what we define as "Medium" (comparable to Parks and Wildlife category of "Recreation").

The implication for managers is that they need to be aware that specific values will be associated with the specific region they are planning for, as values for management outcomes are not necessarily consistent across the whole Kimberley coastal region.

Management Implication 4: People hold, on average, positive values for sanctuary in State waters.

The results from our choice experiment models demonstrate that respondents from both the Public sample (respondents from the Kimberley region) and the Panel sample (respondents from Perth), have a preference for allocating more State waters as sanctuary zone. We show that this preference is stronger in some zones than in others (see Management Implication 3). Further studies are required to investigate whether there exists an 'optimal' amount of sanctuary area in each zone. Nonetheless, the results from our study suggest that increasing sanctuary areas along the Kimberley coast would generally be supported by WA residents.

Management Implication 5: People often disliked development of high levels of recreational facilities.

Preferences for improvement of recreation level to Medium were mixed, depending on the sample and respondents' socio-economic characteristics. There was, on average, a strong preference against developing a High average level of recreation facilities (comparable to DPAW category of "Highly Modified"). In particular, there were strong preferences against a High level of recreation facilities in the Dampier Peninsular, Buccaneer Archipelago, Camden Sound and North Kimberley zones. This finding suggests that managers may wish to limit the development of recreational facilities in the Kimberley coastal region. It also highlights the need for managers to appreciate that the demand for improvement or changes to recreational infrastructure will depend on the location, the scale of improvement, and the specific facilities on offer.

Management Implication 6: People who completed the PPGIS mapping exercise prior to the choice experiment survey are, on average, willing to pay more for management actions in the Kimberley.

This research finding suggests that greater exposure to potential attributes and management changes in the region, as manifested via the simple PPGIS mapping process, may increase people's values for all attributes. Further research is needed to investigate how different types and levels of information will influence respondents' choices. For managers, this finding implies that communication campaigns, information provision, and public engagement around Kimberley issues may improve the uptake of policies and plans.

Management Implication 7: Although people hold values for the Kimberley coastal region—and should be consulted—, they also sometimes want scientists and managers to make decisions.

In the choice experiment survey, about a quarter of respondents said that they did "not feel qualified to make a choice; scientists or managers should do this". This implies that some people may wish to hear more expert opinion on what management is being considered and what its impacts might be, before they will express an opinion about that management. Therefore, in any community engagement and consultation process, it is crucial that unbiased scientific information is provided and discussed with stakeholders first, before aiming to elicit their preferred management option.

Management Implication 8: Choice experiments offer managers unique insights into how people make trade-offs for management outcomes.

There are many insights to be gained from using choice experiments for environmental policy and planning. People's preferences for environmental management can be difficult to determine through more 'traditional' consultation processes. In particular, the values that people hold for different outcomes of management ('attributes' in the choice experiment) are hard to determine because there is usually no market in which values for management outcomes are expressed. In a world where resources are constrained, managers typically need to make trade-offs between different management options. Choice experiments offer a suitable approach to elicit people's values and preferences for the different outcomes of management.

The research described in this report is particularly valuable because of its spatially explicit choice sets. The successful completion of the study suggests that respondents are able to make trade-offs between spatially different management options, and that respondents' preferences vary for attributes in multiple locations where environmental management is implemented. Thus, decision makers and management bodies should consider: (a) the non-market values impacted by environmental policy and planning, and (b) the spatial nature of values for environmental policy outcomes.

4.2   Future research

Recommendation 1

In this choice experiment study, the focus was on coastal and marine management of the Kimberley zone. The nature of the approach imposes a limit on the number of attributes included in the choice sets.

If one is interested specifically in marine management of the Kimberley region, it is recommended to undertake a specific marine choice experiment (for example in Rogers (2013)). This would allow us to include multiple attributes to reflect specific marine management outcomes and key performance indicators (for example for

species of special conservation interest, Aboriginal cultural and heritage values, biological habitats and more human use values) and reveal how preferences for management may vary across zones.

Recommendation 2

The amount of information provided to respondents, and the way in which information is presented, will affect the values people express through their choices in the choice experiment study. Thus, it is extremely important that information about environmental management changes and their impacts is presented in the 'right' way. Research is underway about the information load that choice experiment respondents may be able to process, but there is no research available that focuses on communicating management in remote wilderness areas such as the Kimberley.

Any future valuation work that targets remote regions will need to consider the best way to communicate the impacts of management changes to respondents. Potential ways to visualise changes are to incorporate videos, PowerPoint presentations or Virtual Reality scenarios in the non-market valuation survey[3]. Research into using such visual representations in choice experiment studies is still in its infancy and should be supported to improve the reliability of non-market valuation results. This research is also relevant to managers of remote areas, because knowing how to best communicate outcomes to respondents will help to improve public information campaigns.

Recommendation 3

In the current study, the Kimberley was divided into six zones. While this allows us to identify spatially differentiated preferences, it gives little spatial specificity. Managers who are interested in specific spatial preferences in, for example, a single zone would need to undertake a valuation study at the appropriate smaller spatial scale. A valuation study that focuses on a single area would be of value to identify preferences for different marine management options in that area, and allow integration of these values within a formal marine spatial planning process.

Recommendation 4

The statistical models in this report represent a preliminary investigation of the data collected from this research. Further analysis and research is required to tell a more comprehensive story of the values and preferences that WA residents hold for the Kimberley.

The research team will continue to interrogate the data and explore what differences in preferences may exist between respondents and between survey split-samples. This further investigation will not impact the overall preferences for or against the attributes but will provide further insight into the heterogeneity between respondents and variations in preferences. More complex statistical modelling is planned to investigate research questions such as:

1) Further studies are required to investigate whether there exists an 'optimal' amount of sanctuary area in each zone.
2) Are there observable sources of preference heterogeneity between respondents within and between split samples?
3) Are people's choices different when they are faced with a single zone survey, compared to more spatially explicit surveys that show multiple zones?
4) How do people's preferences change when the scale and scope of management impacts in the Kimberley region changes?
5) Are the PPGIS mapping methodology and the choice experiment revealing consistency in values and preferences?
6) Can PPGIS mapping behaviour help to predict choice experiment preferences?

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[3] CI Kragt on this project has recently been awarded an Australian Research Council DECRA Fellowship that aims to explore the question of how to best represent changes in remote regions to non-market valuation survey respondents.

4.3   Products and tools

This project has produced a number of products and tools available to user groups. These include:

1) Six choice experiment survey datasets.
2) Choice experiment research methodology presented in this Technical Report 3.
3) Management preference choice models estimating willingness to pay for the management preferences for different zones of the Kimberley.
4) Full choice experiment survey - found in Appendix II.

Although access to these tools is available, it is critical, both in terms of the validity of the findings and the cost-effectiveness of research, that social scientists, geographers with GIS expertise and resource economists design and are involved in the execution and analysis of this research. Choice experiments requires careful design to select, develop and implement. Who is surveyed and how they are presented with the choice questions is a critical design feature. Also essential is expert analysis to develop and test models that are realistic and robust, and finally to interpret the results.

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6. Appendix I – Additional statistics and figures

Table 24. Additional descriptive statistics for PANEL samples.

	V2) Zones	V3) Roebuck Bay	V4) Camden Sound	V5) Kimberley Coast
Total n (with protesters)	**n=385**	**n=189**	**n=182**	**n=181**
Have you ever visited these zones by land sea or air?				
(% -of people that had visited the Kimberley coast at all)				
Eighty Mile Beach	62.26	57.89	65.00	64.47
Roebuck Bay	81.60	86.32	83.75	89.47
Dampier Peninsula	65.09	49.47	52.50	57.89
Buccaneer Archipelago	26.89	21.05	16.25	22.37
Camden Sound	17.92	18.95	15.00	14.47
North Kimberley	37.26	36.84	35.00	42.11
Which one zone do you visit the most frequently?				
(% -of people that had visited the Kimberley coast at all)				
Eighty Mile Beach	18.40	16.84	13.75	15.79
Roebuck Bay	52.83	62.11	57.50	61.84
Dampier Peninsula	15.57	5.26	13.75	9.21
Buccaneer Archipelago	3.30	3.16	2.50	1.32
Camden Sound	0.94	2.11	2.50	0
North Kimberley	7.55	9.47	10.00	11.84
Intend on visiting any of the zones sometime in the future				
(% -of people that have not visited the Kimberley coast at all)				
Yes	56.07	41.49	48.04	52.88
No	9.83	20.21	16.67	9.62
Unsure	34.10	38.30	35.29	37.50
Select the following activities that you do regularly, anywhere. Please select all that apply to you.				
(% selected) ^				
Commercial fishing	0.52	1.06	1.10	2.21
Other marine commercial activities	1.82	4.23	1.10	1.10
Recreational fishing	27.01	33.33	29.67	34.81
Snorkelling/Scuba Diving	22.34	24.87	23.08	22.10
Camping	34.55	37.04	34.62	35.91
Swimming/Beach	57.66	60.32	50.55	57.46
Boating/Sailing	15.58	15.87	14.29	15.47
Aboriginal customary uses	0.78	1.59	0.55	0
I do not do any of these activities regularly	31.17	30.69	35.16	32.04
How likely do you think it is that the results of this study will influence future management decisions in the [study area]? Mean (st.dev.)				
1= Not likely at all 10= Very likely	4.94 (2.11)	4.79 (2.40)	4.77 (2.09)	4.88 (2.32)
Main reason for selecting to take no management action in any choice questions (%)				
I do not care about the Kimberley Coast	0	1.85	0	0
I would like to see some improvement in the management of the zone but I do not have the money to make a payment	21.00	25.93	21.95	23.68
I already pay enough in taxes and charges	33.00	22.22	14.63	28.95
I should not have to pay for any additional management action	10.00	18.52	24.39	10.53
I should not be making decisions for the study area	13.00	11.11	24.39	23.68
I do not want to choose between the available options	7.00	1.85	4.88	7.89
Other	16.00	18.52	9.76	5.26

^Respondents could select multiple options

Table 25. Additional descriptive statistics for completes with PPGIS.

	V1) PANEL	PUBLIC
Total respondents (with protesters)	**155**	**320**
Have you ever visited these zones by land sea or air?		
(% -of people that had visited the Kimberley coast at all)		
Eighty Mile Beach	63.64	76.51
Roebuck Bay	71.72	94.30
Dampier Peninsula	57.58	86.91
Buccaneer Archipelago	23.23	59.06
Camden Sound	16.16	47.99
North Kimberley	46.46	69.46
Which one zone do you visit the most frequently?		
(% -of people that had visited the Kimberley coast at all)		
Eighty Mile Beach	13.13	6.71
Roebuck Bay	46.46	44.30
Dampier Peninsula	19.19	15.77
Buccaneer Archipelago	1.01	9.06
Camden Sound	2.02	3.02
North Kimberley	9.09	20.47
Intend on visiting any of the zones sometime in the future		
(% -of people that have not visited the Kimberley coast at all)		
Yes	55.36	86.36
No	8.93	0
Unsure	35.71	13.64
Select the following activities that you do regularly, anywhere. Please select all that apply to you. (%) ^		
Commercial fishing	1.29	0.31
Other marine commercial activities	2.58	4.37
Recreational fishing	35.48	54.06
Snorkelling/Scuba Diving	32.90	55.00
Camping	42.58	83.44
Swimming/Beach	61.94	77.19
Boating/Sailing	21.94	45.00
Aboriginal customary uses	0.65	4.37
I do not do any of these activities regularly	25.81	5.93
How likely do you think it is that the results of this study will influence future management decisions in the [study area]? Mean (st.dev.)		
1= Not likely at all; 10= Very likely		
	4.26 (2.40)	3.93 (2.37)
Main reason for selecting to take no management action in any choice questions. (%)		
I do not care about the Kimberley Coast	0	0
I would like to see some improvement in the management of the zone but I do not have the money to make a payment	36.67	11.11
I already pay enough in taxes and charges	33.33	22.22
I should not have to pay for any additional management action	13.33	13.33
I should not be making decisions for the study area	3.33	4.44
I do not want to choose between the available options	3.33	6.67
Other	10	42.22

^Respondents could select multiple options

Table 26. Test results for merging samples V1- Zones with PPGIS and V2- Zones without PPGIS.

Mixed Logit (Random SQ)	Variables used in Model	#	Log Likelihood	Likelihood Ratio Test		COMMENTS
Model 1	Sanctuary, Rangers, Rec Med, Rec High, Development, Cost, SQ	8	-2418.81			
Model 2	Model 1 + Zone ASCs	13	-2411.80	Model 2 restricted to Model 1 [Zone Dummy's]=0	LRchi2(5)= 14.02 P>chi2= 0.015	reject the restrictions
Model 3	Model 2 + *PPGIS sample Binary* interaction with zone ASCs and all attributes	25	-2396.02	Model 3 restricted to Model 2 [Sample interaction with zones and attributes]=0	LRchi2(12)= 31.57 P>chi2= 0.002	reject the restrictions However [Cost X PPGIS]***
Model 4	Model 2 + *PPGIS sample Binary* interaction with Cost ONLY	14	-2399.55	Model 3 restricted to Model 4 [Sample interaction with zones and attributes]= 0; except cost	LRchi2(11)= 7.06 P> chi2 = 0.794	Cannot reject the restrictions Only cost is different between the datasets ~Can combine datasets if keep [Cost X PPGIS]

Parameters in model including SQ mean and Standard Deviation
Models excludes protesters, non-completes and those that took less than 300 seconds to complete.

Explanation for Table 26 above: The Panel data sets V1)Six Zones with PPGIS and V2) Six Zones without PPGIS were combined and tested for differences. A mixed logit model with the status quo as a random parameter was chosen as the most useful model, because it can account for some preference heterogeneity. First the zonal ASCs were tested to see if they have a significant impact on preferences (test between Model 1 and Model 2). The model tests were done including zonal alternative specific constants (ASC) but maintaining non-spatially explicit attributes. The alternative specific constant for each zone are shown to be significant and are kept in the model. Second, we tested for differences between the datasets, reported as the test between Model 2 and Model 3. Model 3 included attribute interactions with the PPGIS task. This PPGIS task was defined as a binary variable, that takes a value of 1 if the observation is from Panel sample version V1- Zones with PPGIS, and zero otherwise. The testing reveals that the samples do not have common parameters. However, a less restrictive model (Model 4), which assumes that parameters are common across both samples, except that associated with cost, shows that the datasets can be combined (test between Model 3 and Model 4). The implication is that the completion of the PPGIS mapping procedure has influenced the marginal utility of cost, but no other attributes in the model.

Table 27. Results for spatial model testing using merge dataset V1- Six Zones with PPGIS and V2- Six Zones without PPGIS.

	Variables used in Model	#	Log likelihood	Likelihood-ratio Test		COMMENTS
Model 5	Full Spatial model Model 4 + All zone interactions with attributes, (Sanctuary, Rangers, Rec II, Rec III, and Development) UNRESTRICTED	37	-2383.65			
Model 6	Model 5 with NO Zone interactions for Sanctuary	32	-2390.88	Model 5 restricted to Model 6 [San × Zone]	LR chi2(5)= 14.47 P > chi2= 0.012	Reject restrictions
Model 7	Model 5 with NO Zone interactions for Rangers	32	-2386.74	Model 5 restricted to Model 7 [Rangers × Zone]	LR chi2(5)= 6.19 P > chi2= 0.288	cannot reject the restrictions
Model 8	Model 5 with NO Zone interactions for Rec Medium	34	-2384.76	Model 5 restricted to Model 8 [Rec Med × Zone]	LR chi2(3)= 2.26 P > chi2= 0.520	cannot reject the restrictions
Model 9	Model 5 with NO Zone interactions for Rec High	32	-2384.54	Model 5 restricted to Model 9 [Rec High × Zone]	LR chi2(5)= 1.78 P > chi2= 0.879	cannot reject the restrictions
Model 10	Model 5 with NO Zone interactions for Development	32	-2386.29	Model 5 restricted to Model 10 [Dev × Zone]	LR chi2(5)= 5.28 P > chi2= 0.382	cannot reject the restrictions
Model 11	Model 4 + Zone interactions for Sanctuary	19	-2391.96	Model 5 restricted to Model 11 [(Rangers, Rec Med, Rec High, Development) × Zone]	LR chi2(18)=16.62 P> chi2= 0.549	cannot reject the restrictions
				Model 11 restricted to Model 4 [Sanctuary × Zone]	LR chi2(5)= 15.67 P > chi2= 0.008	reject the restrictions
	San*z3=San*z6				chi2(1)= 0.87 P> chi2= 0.352	cannot reject the restrictions
	San*z1=San*z2= San*z4=San*z5				chi2(3)= 0.93 P > chi2= 0.818	cannot reject the restrictions
Model 12	Model 4 with zone interactions for Sanctuary **Divided into 2 regions: Zone 3,6 Zone 1,2,4,5**	16	-2392.98	Model 5 restricted to Model 12 [(Rangers, Rec II, Rec III, Development) × Zone] [San × regions]	LR chi2(22)=18.68 P> chi2= 0.665	cannot reject the restrictions
				Model 12 restricted to Model 4 [Sanctuary × region']	LR chi2(1)= 13.61 P> chi2= 0.000	reject restrictions

\# Parameters in model including SQ mean and Standard Deviation
Models excludes protesters, non-completes and those that took less than 300 seconds to complete.

Explanation for Table 27 above: The spatial effects of the attributes was systematically explored, using the combined samples, by comparing the model fit with and without spatial effects (zone interactions) for each attribute. Model 5 introduces zonal binary interaction terms for all attributes, while maintaining zonal ASCs, and a PPGIS binary effect for cost. Restricted models were then tested against this. In other words we investigated whether the effects of an attribute could be captured in a single variable irrespective of which zone it applied to, or if whether attributes needed to be spatially explicit. This testing method revealed that only Sanctuary area was spatially differentiated (p=0.021 for the test between Model 5 and 6). Inspection of the estimated spatial effects for Sanctuary in zone 3 and 6 suggested statistically similar marginal utilities, as did Sanctuary in zone 1, 2, 4 and 5. The best fit spatial model (Model 12), with Sanctuary split into two regional effects.

Table 28. Results for mixed logit testing using Kimberley Public data.

	Variables used in Model	#	Log likelihood	Likelihood-ratio Test		COMMENTS
Model p0	Attributes, no zones (Sanctuary, Rangers, Rec II, Rec III, Development, Cost, SQ)	8	-1596.55			
Model p1	Model p0 with Zone Dummy's	13	-1586.32	Model p1 restricted to Model p0 [Zone Dummy's]=0	LR chi2(5) = 14.45 P > chi2 = 0.013	reject the restrictions
Model p2	**Full Spatial Model** All zone interactions with attributes, (Sanctuary, Rangers, Rec II, Rec III, and Development) Zone Dummy's	36	-1571.05			
Model p3	Model p2 with NO Zone interactions for Sanctuary	31	-1574.63	Model p2 restricted to Model p3 [San × Zone]=0	LR chi2(5)= 7.15 P > chi2= 0.210	cannot reject the restrictions
Model p4	Model p2 with NO Zone interactions for Rangers	31	-1574.72	Model p2 restricted to Model p4 [Rangers × Zone]=0	LR chi2(5)= 7.35 P > chi2= 0.196	cannot reject the restrictions
Model p5	Model p2 with NO Zone interactions for Rec Medium	33	-1571.33	Model p2 restricted to Model p5 [Rec Med × Zone]=0	LR chi2(3)= 0.56 P > chi2= 0.906	cannot reject the restrictions
Model p6	Model p2 with NO Zone interactions for Rec High	31	-1578.16	Model p2 restricted to Model p6 [Rec High × Zone]=0	LR chi2(5)= 14.22 P > chi2= 0.014	reject the restrictions
Model p7	Model p2 with NO Zone interactions for Development	31	-1575.30	Model p2 restricted to Model p7 [Dev × Zone]=0	LR chi2(5) = 8.50 P> chi2= 0.131	cannot reject the restrictions (close at 10%)
Model p8	Model p1 with zone interactions for Rec High and Development			Model p2 restricted to Model p8 [(San, Range, Rec Med) × Zone]=0	LR chi2(13) = 13.76 P > chi2 = 0.391	cannot reject the restrictions
				Model p8 restricted to Model p1 [(Rec High, Development) × Zone]=0	LR chi2(10) = 22.79 P> chi2 = 0.011	reject the restrictions
	TESTS Dev*z1=Dev*z2= Dev*z3=Dev*z4=Dev*z5= Dev*z6 Rec III*z1= Rec III *z2= Rec III*z3= Rec III *z4= Rec III *z5= Rec III *z6				chi2(1) = 0.25 P > chi2 = 0.614 chi2(3) = 5.09 P > chi2 = 0.165 chi2(1) = 1.14 P > chi2 = 0.286 chi2(3) = 2.97 P > chi2 = 0.397	cannot reject the restrictions cannot reject the restrictions cannot reject the restrictions cannot reject the restrictions
Model p9	Model p1 with zone interactions for Rec High and Development divided into 2 regions: South: Zone 1,2 North: Zone 3,4,5,6			Model p2 restricted to Model p9 [(San, Range, Rec Med) × Zone]=0	LR chi2(21) = 23.20 P > chi2 = 0.333	cannot reject the restrictions

Model p9 restricted to Model p1 [(Rec High, Development) × regions]=0	LR chi2(2) =13.35 P > chi2 =0.001	reject the restrictions

Parameters in model including SQ - mean and Standard Deviation

Note: z1=Eighty Mile Beach, z2=Roebuck Bay, z3= Dampier Peninsula, z4= Buccaneer Archipelago, z5= Camden Sound, z6= North Kimberley

Models excluded protesters, non-completes and those who took less than 300 seconds to complete. Number of choice observations= 1716. Number of Respondents = 286. Testing at 10 percent.

Explanation for Table 28 above: The spatial effects of the attributes in the Kimberley Public survey was systematically explored by comparing the model fit with and without spatial effects (zone interactions) for each attribute, tests shown in Table 26. General effects of the zones were tested for significant first using zone alternative specific constants, shown by the test between Model p0 and Model p1. Model p2 is the full spatial model with all attributes effects in each zone and zone effects themselves. Models with attributes restricted to a single effects were then tested against Model p2. In other words asking the data if the effects of an attribute could be captured in a single variable or did it need to be spatially explicit. Remember that our model already has a general zone constant that captures the choice effect of management action being offered in that zone. This testing method revealed that a model that included Recreation High and Development as spatially differentiated was better, Model p8. Visual inspection and testing of the model reveals that the effects can be divided into two regions. Zone 1 and zone 2 can be combined into a 'south' effect, and zone 3, 4, 5, and 6 can be combined into a 'north' effect for both spatial attributes, testing on Model p8.

7.   Appendix II – The choice experiment survey

Kimberley Coastal Values Study

Welcome to the Kimberley Coastal and Marine Values Study

The Kimberley coast is important to residents and visitors. We want to know what you value about this coast and its waters, what places you consider special, and what changes you would like to see.

This survey will ask you about your preferences for management options in the Kimberley.

We really value your opinion to help plan for the future management of the Kimberley coastline.

The survey should take 10-15 mins.

Research Partners

CONSENT TO PARTICIPATE
Please read the following information before deciding if you would like to take part in this study. You must be 18 years or older to participate.

Purpose of Research
The purpose of this research is to assist the West Australian Government to make informed decisions about coastal management, now and into the future.

Participation and withdrawal
Your participation in this study is entirely voluntary. You may withdraw at any point. Upon your request and provision of your access code (obtained on the previous page), we will remove your responses from the database.

Data Collection, Storage and Use
This survey is being administered on a secure computer server. The responses you submit will be stored in a secure database that contains every response we receive (located in the Environmental Sciences Building, South Street Campus of Murdoch University). Your responses will not be personally identifiable in this database. Non-identifiable data will be retained for seven years.

Reporting Findings
A summary of the research findings can be emailed to you at the completion of the study if you wish and choose to provide an email address for this purpose. A publicly accessible map summarising the results will be accessible via the West Australian Marine Science Institution website **(http://www.wamsi.org.au/).**

Contact Information
If you have any questions or concerns about the research, please contact:
Prof Sue Moore (S.Moore@murdoch.edu.au)
Murdoch University (Telephone 08 9360 6484)
Prof Michael Burton (Michael.burton@uwa.edu.au)
University of Western Australia (Telephone 08 6488 2531)

CONSENT STATEMENT
I have read the preceding information about this research and any questions I had were answered to my satisfaction. I am 18 years of age or older and freely consent to participate. I am free to withdraw from participating in this research at any time. I understand that while information gained during the study may be published, I will not be identified and my personal results will remain confidential, unless required by law. The project has been approved by the Murdoch University Human Research Ethics Committee (2015/014). If you have any concerns about the project or questions about your rights as a participant please contact the Murdoch University Research Ethics office on (08) 9360 6677 or email ethics@murdoch.edu.au.

I understand that by proceeding I consent to this study.

Click to access a printable version of this Consent to Participate.

Before we ask you about Kimberley management, please answer a few questions about yourself.

Q1. How old are you?

[▼]

Q2. What is the postcode of your normal place of residence?

[   ]

Q3. Are you of Aboriginal Heritage?
○ Yes. Which group(s):
[   ]
○ No

Q4. How would you rate your knowledge of the Kimberley coast?
○ Excellent
○ Good

○ Average

○ Below average

○ Poor/little knowledge

AGE SCREEN

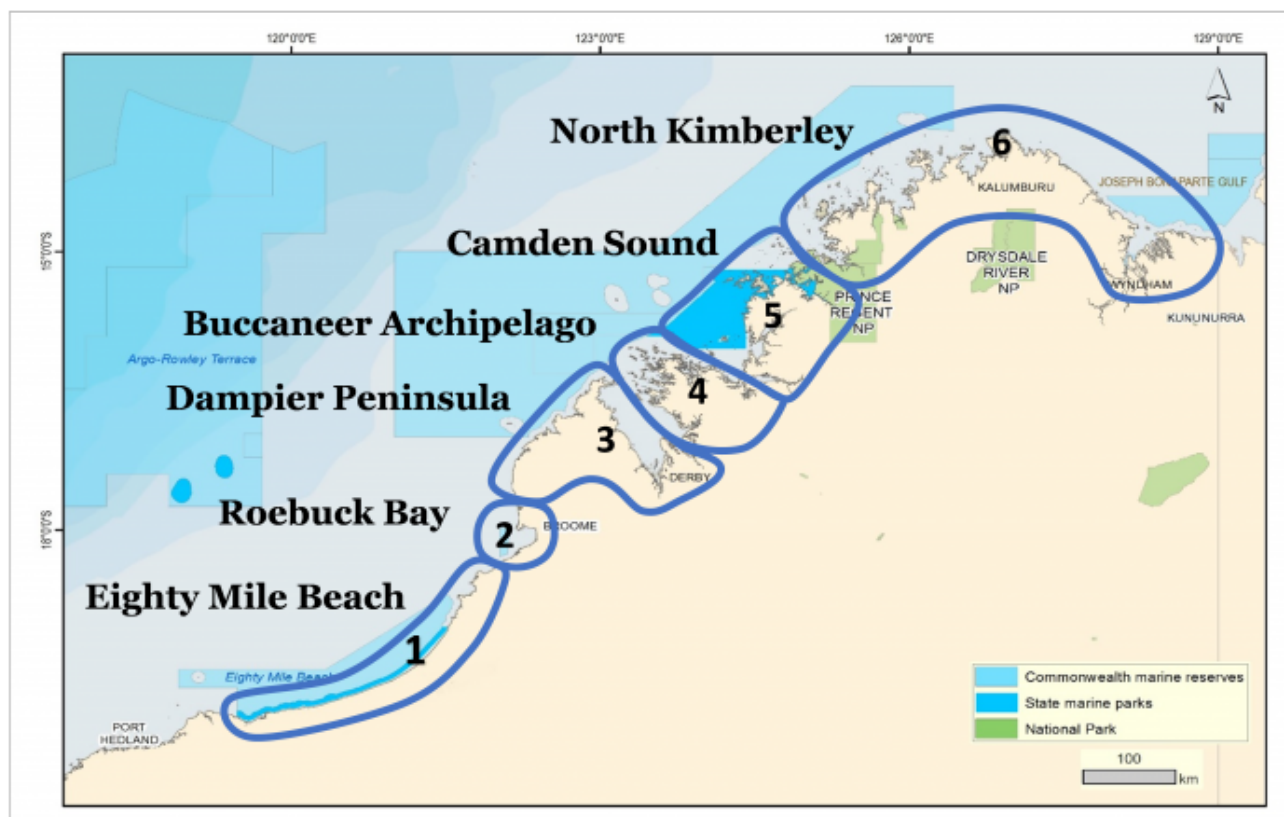Sorry, but you need to be over 18 years to complete this survey.

Thanks for your time.

INTRO

This survey is about your preferences for management in different zones of the Kimberley.

Please read all the information carefully.

In this survey the Kimberley has been divided into 6 management zones.

Map source: Geoscience Australia 2014, Department of Parks and Wildlife 2014

Hover your mouse over the zone names below to see a short description:

1. Eighty Mile Beach

2. Roebuck Bay

3. Dampier Peninsula

4. Buccaneer Archipelago

5. Camden Sound

6. North Kimberley

The entire Kimberley coastline is rich with Aboriginal history and culture. Aboriginal people today live and undertake cultural activities on country throughout the Kimberley.

Q5. About how many times have you visited the Kimberley coast <u>in your lifetime</u>?

○ Estimated Number of Visits

[   ]

○ I have never visited the Kimberley coast
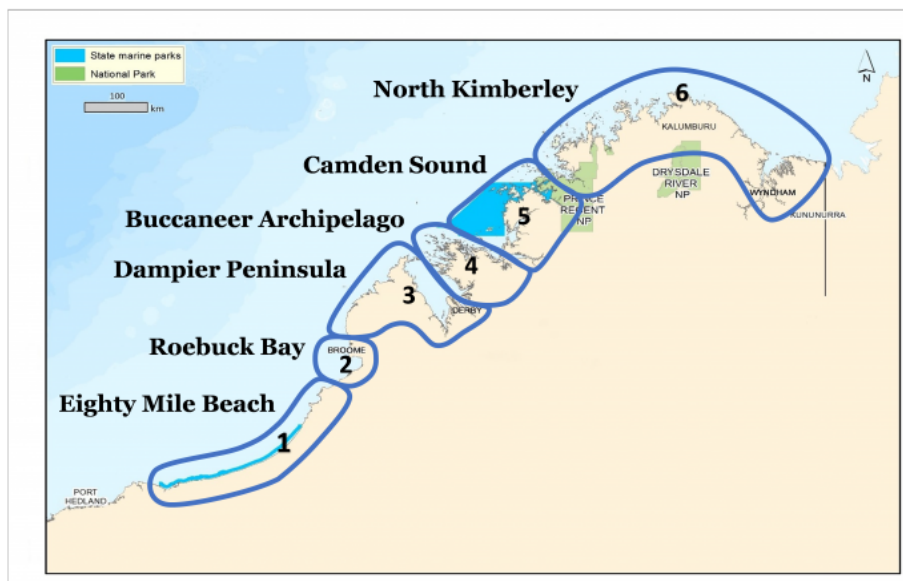
Map source: Geoscience Australia 2014, Department of Parks and Wildlife 2014

Q5a. Do you intend on visiting any of these zones sometime in the future?

○ Yes

○ No

○ Unsure
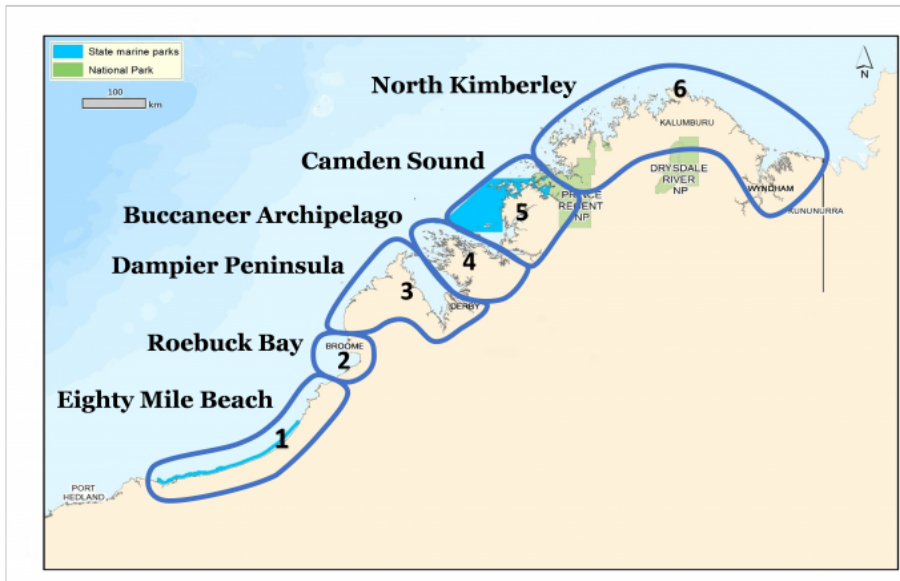
Map source: Geoscience Australia 2014, Department of Parks and Wildlife 2014

Q5b. Which of these zones have you ever visited by land, sea or air?

	No, I have never visited	Yes, I have visited
Eighty Mile Beach	○	○
Roebuck Bay	○	○
Dampier Peninsula	○	○
Buccaneer Archipelago	○	○
Camden Sound	○	○
North Kimberly	○	○

Q5c. Which <u>one</u> zone do you visit the most frequently?

○ Eighty Mile Beach

○ Roebuck Bay

○ Dampier Peninsula

○ Buccaneer Archipelago

○ Camden Sound

○ North Kimberly

○ I have never visited the Kimberley coast

Management Features

In a moment, you will see different management options for the Kimberley coast. These management options will have **5 features:**
- State marine sanctuary areas,
- Recreational facilities,
- Aboriginal rangers,
- Coastal development, and an
- Annual cost to your household.

Please carefully read the information, as you will need it later in the survey.

1. State marine sanctuary areas

Sanctuary areas are 'no-take' areas for the protection and conservation of biodiversity and the environment.

Low-impact nature appreciation activities are allowed (such as sightseeing and snorkelling) but fishing and extractive activities are not allowed.

The area of sanctuary will be increased to different levels as a percentage (%) of State coastal waters above the existing level.

The percentage increase will range from 10% (that looks like this),
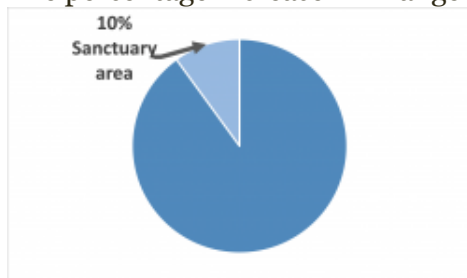
to 40% of State waters (that looks like this).
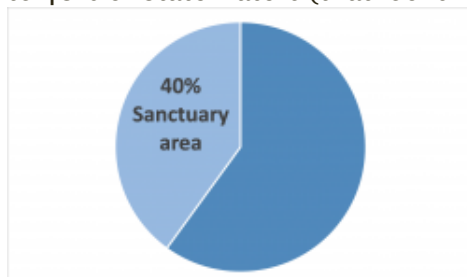
2. Recreational facilities

Recreational facilities allow for better enjoyment of recreation activities such as camping and fishing in the zone.

These can be of three different levels of quality. Within a zone, the average quality of recreational facilities will be defined as either:

LOW: Difficult 4WD access track with no boating or camping facilities provided.

MEDIUM: Seasonal 2WD access with designated camping and parking areas, basic toilets, tables, basic visitor formation and signage. Boating facilities include small moorings or a small boat ramp.

HIGH: Sealed road access with high level of camping and parking facilities, toilets, gas BBQ's, extensive visitor information. Boating facilities include large boat ramp or a jetty.

There are options to upgrade the average recreational facilities within a zone.

Q6. Select the following activities that you do regularly, anywhere.

Please select all that apply to you.

- ☐ Commercial fishing
- ☐ Other marine commercial activities
- ☐ Recreational fishing
- ☐ Snorkelling/Scuba Diving
- ☐ Camping
- ☐ Swimming/Beach
- ☐ Boating/Sailing
- ☐ Aboriginal customary uses
- ☐ I do not do any of these activities regularly

3. Aboriginal rangers

Aboriginal rangers look after and work on country to protect Aboriginal cultural values; including recording and managing cultural sites such as rock art, and sharing cultural activities with their communities.

Aboriginal Rangers manage visitors and deliver cultural awareness programs. They also undertake land and sea management.

There will be management options that increase the number of Aboriginal rangers employed in each zone by 0, 5, 10, or 30 people.

Parks&Wildlife Yawuru Ranger Preston Manado conducting a bushtucker walk through Dabadabagun (Minyirr Park). Source Department of Parks and Wildlife WA

4. Coastal development

The Kimberley coast is a pristine and remote region with an impressive coastline of natural beaches, rocky shores, mudflats and mangroves headlands, cliff lined shores and archipelagos. It is possible to travel along it and see little evidence of modern development.

However, this natural seascape and wilderness would be impacted by some types of additional economic development and the building of physical structures.

For each zone there will be 2 options:
- **NO:** no additional coastal development in that zone, or
- **YES**: if you were to travel through the zone you would see some modern development like

this every day:

Anthon's Landing in Wyndham, Kimberley. Source Maritime Constructions, photo by David Wilcock Photography.

5. Annual management costs

Achieving management outcomes in the Kimberley will cost money.

For example; improving recreational areas will require planning, hiring builders and landscapers to complete the works and then maintaining the facilities.

The cost of the management options will be met through revenue sourced from a combination of increased taxes by both Commonwealth and State governments. This means increased costs to your household and you will have less money to spend on other things.

These increased costs to you will continue forever because management will need to be maintained in the future.

You will need to consider the total cost of each option to you relative to your income.

Q7. What is your weekly (annual) combined household income, before tax or anything else is taken out? Please include pensions and allowances from all sources.

[dropdown field]

We will now present 6 proposals for management on the Kimberley coast.

You will be asked to choose your preferred option in each question.

Options A and B involve additional management actions that would lead to different management outcomes. These options involve additional costs to you.

Option C is the option to take no management action in any zone in the Kimberley. This means no extra sanctuary areas, no new recreational areas, no extra Aboriginal rangers, no coastal development, and no increased costs to you.

When answering the scenarios, don't forget to:
- Choose your most preferred option based on the assumption that these are the only options available to you.
- Treat each scenario independently. You do not need to remember the choices you make across the questions.

Here is an example of a choice question:

In each question 2 of the 6 zones will have management options available.

EXAMPLE
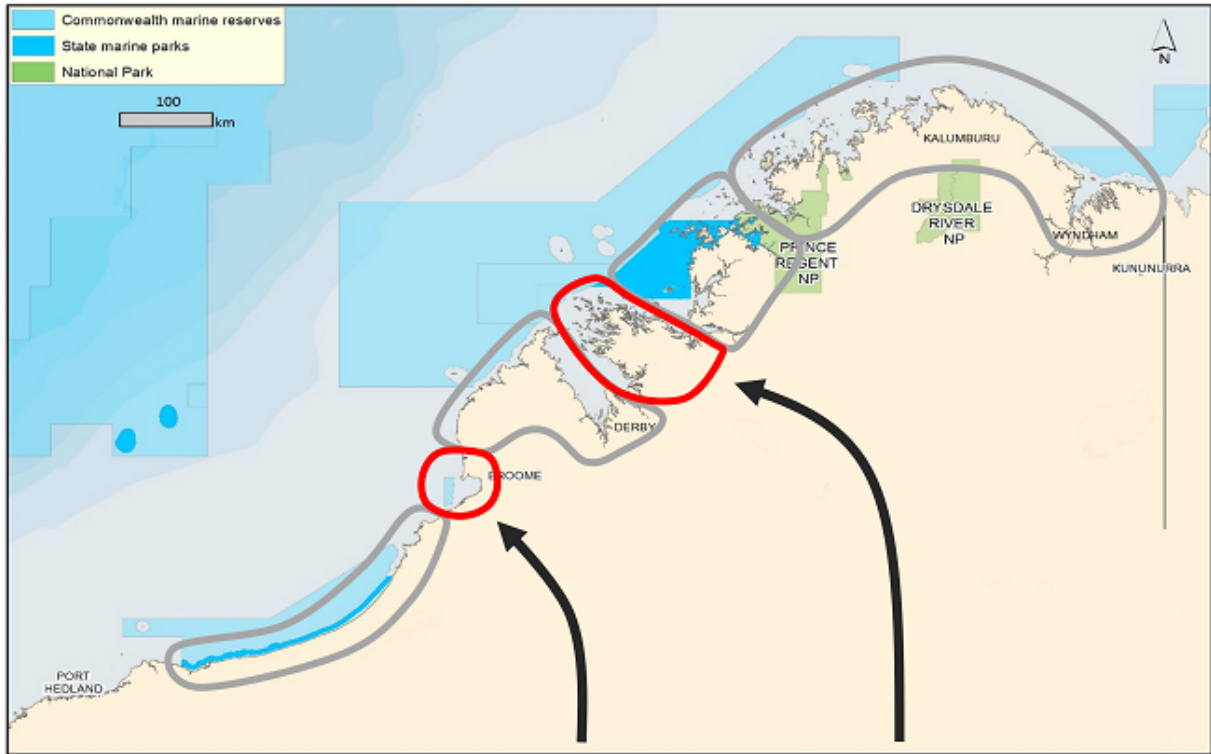
Zone	Roebuck Bay	Buccaneer Archipelago	None
Annual cost to you	**$50**	**$100**	**$0**
Sanctuary area (% State waters already sanctuary)	15% (0%)	15% (0%)	*No new management on the Kimberley coast*
Recreational facilities (existing level)	HIGH (MEDIUM)	LOW (LOW)	
Aboriginal rangers (existing number)	14 (4)	15 (0)	
Increase coastal development	YES	YES	
	OPTION A	**OPTION B**	**OPTION C**

For example, if you chose **OPTION B** it would mean that you prefer to pay $100 a year to get an extra 15% State waters in sanctuary area, no upgrade to recreational facilities, 15 new Aboriginal rangers, and some increased coastal development in the Buccaneer Archipelago zone.

Rather than:
OPTION A: Pay $50 a year to get 15% sanctuary area, upgrade recreational facilities from MEDIUM to HIGH, 10 new Aboriginal rangers, and some increased coastal development in the Roebuck Bay zone,

and OPTION C: No new management action on the Kimberley coast.

Now it's your turn!

The management options you will see have different impacts on the Kimberley coast, and different costs.

Keep in mind your available income and other expenses when making your choices.

Remember there is no right or wrong answer.

**Please consider each of the 6 questions independently, you don't need to remember your previous answers.**

BLOCK 1

QUESTION 1

Please select your preferred management option, assuming these are the only options available to you.

Remember, if you select OPTION C you will pay nothing and there will be no management change on the Kimberley coast.

Hover your mouse over the words to see the descriptions of sanctuary areas, recreation facilities, Aboriginal rangers, coastal development and costs.

Hover your mouse over the words to see the descriptions of Eighty Mile Beach, Roebuck Bay, Dampier Peninsula, Buccaneer Archipelago, Camden Sound and North Kimberley.
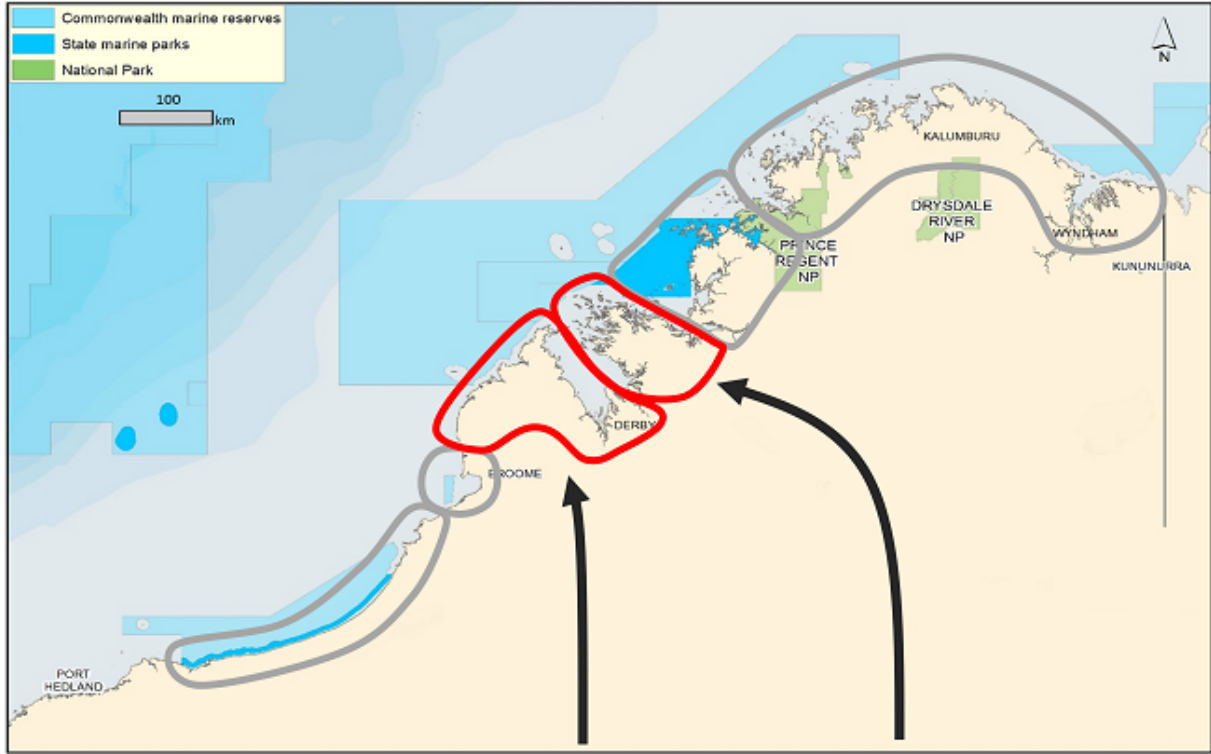
Zone	Dampier Peninsula	Buccaneer Archipelago	None
Annual cost to you	**$10**	**$100**	**$0**
Sanctuary area (% State waters already sanctuary)	0% (0%)	40% (0%)	*No new management on the Kimberley coast*
Recreational facilities (existing level)	HIGH (LOW)	HIGH (LOW)	
Aboriginal rangers (existing number)	17 (12)	30 (0)	
Increase coastal development	NO	NO	
	OPTION A	**OPTION B**	**OPTION C**

○ OPTION A and you pay $10 per year forever

○ OPTION B and you pay $100 per year forever

○ OPTION C and you pay $0 per year forever

QUESTION 2

Please select your preferred management option, assuming these are the only options available to you.

Remember, if you select OPTION C you will pay nothing and there will be no management change on the Kimberley coast.

Hover your mouse over the words to see the descriptions of sanctuary areas, recreation facilities, Aboriginal rangers, coastal development and costs.

Hover your mouse over the words to see the descriptions of Eighty Mile Beach, Roebuck Bay, Dampier Peninsula, Buccaneer Archipelago, Camden Sound and North Kimberley.
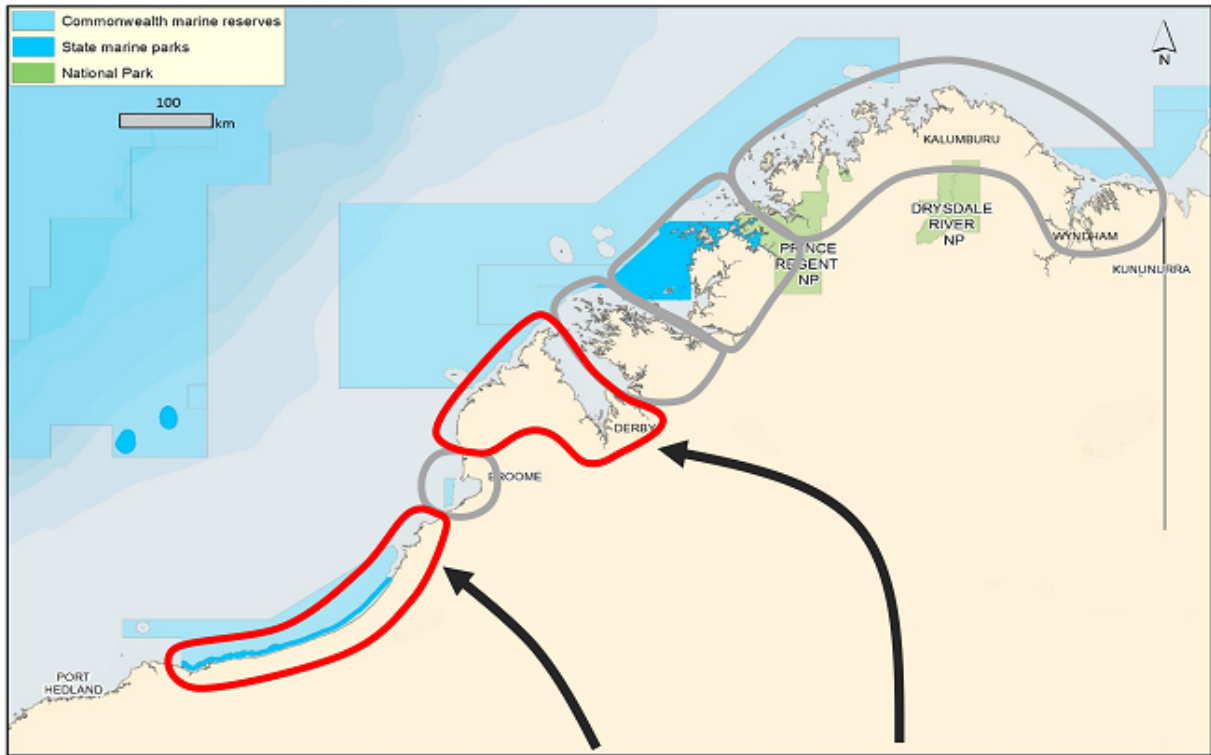
Zone	Eighty Mile Beach	Dampier Peninsula	None
Annual cost to you	$75	$150	$0
Sanctuary area (% State waters already sanctuary)	40% (10%)	0% (0%)	
Recreational facilities (existing level)	MEDIUM (MEDIUM)	MEDIUM (LOW)	No new management on the Kimberley coast
Aboriginal rangers (existing number)	6 (6)	42 (12)	
Increase coastal development	YES	YES	
	OPTION A	OPTION B	OPTION C

- ○ OPTION A and you pay $75 per year forever
- ○ OPTION B and you pay $150 per year forever
- ○ OPTION C and you pay $0 per year forever

QUESTION 3

Please select your preferred management option, assuming these are the only options available to you.

Remember, if you select OPTION C you will pay nothing and there will be no management change on the Kimberley coast.

Hover your mouse over the words to see the descriptions of sanctuary areas, recreation facilities, Aboriginal rangers, coastal development and costs.

Hover your mouse over the words to see the descriptions of Eighty Mile Beach, Roebuck Bay, Dampier Peninsula, Buccaneer Archipelago, Camden Sound and North Kimberley.
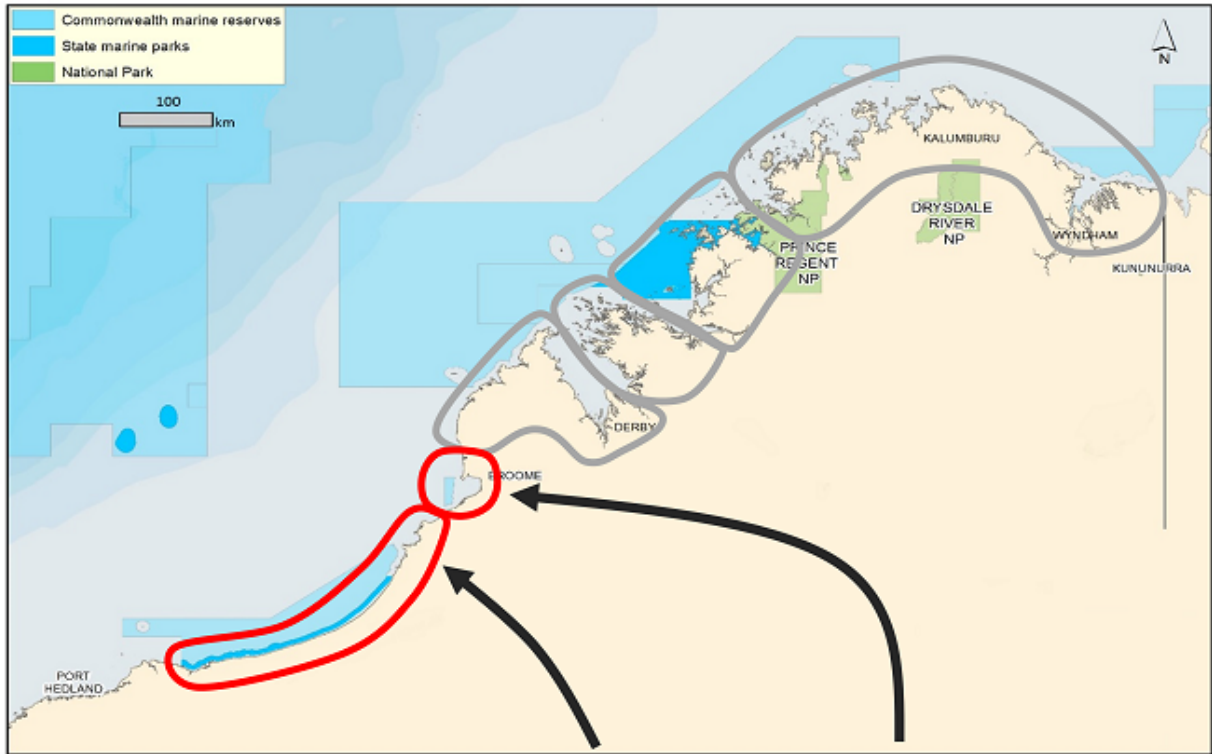
Zone	Eighty Mile Beach	Roebuck Bay	None
Annual cost to you	$200	$200	$0
Sanctuary area (% State waters already sanctuary)	10% (10%)	0% (0%)	*No new management on the Kimberley coast*
Recreational facilities (existing level)	HIGH (MEDIUM)	MEDIUM (MEDIUM)	
Aboriginal rangers (existing number)	6 (6)	34 (4)	
Increase coastal development	NO	NO	
	OPTION A	**OPTION B**	**OPTION C**

○ OPTION A and you pay $200 per year forever

○ OPTION B and you pay $200 per year forever

○ OPTION C and you pay $0 per year forever

QUESTION 4

Please select your preferred management option, assuming these are the only options available to you.

Remember, if you select OPTION C you will pay nothing and there will be no management change on the Kimberley coast.

Hover your mouse over the words to see the descriptions of sanctuary areas, recreation facilities, Aboriginal rangers, coastal development and costs.

Hover your mouse over the words to see the descriptions of Eighty Mile Beach, Roebuck Bay, Dampier Peninsula, Buccaneer Archipelago, Camden Sound and North Kimberley.
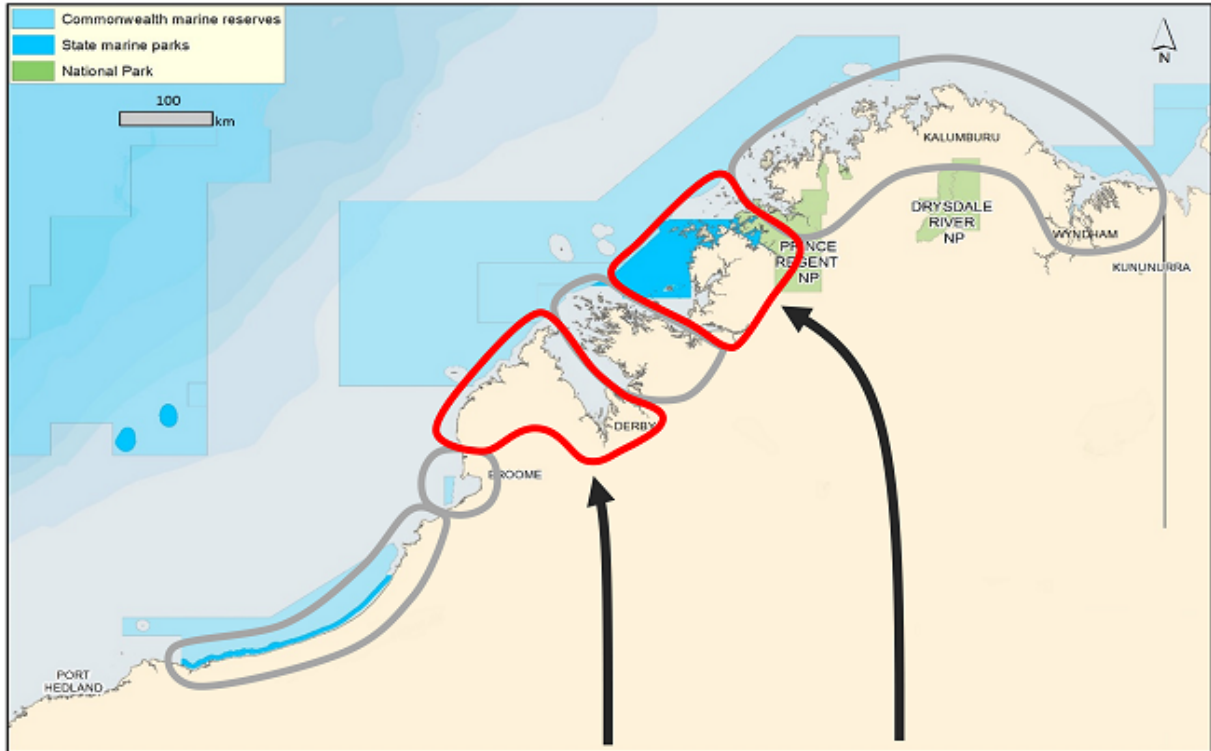
Zone	Dampier Peninsula	Camden Sound	None
Annual cost to you	**$10**	**$50**	**$0**
Sanctuary area (% State waters already sanctuary)	30% (0%)	50% (10%)	*No new management on the Kimberley coast*
Recreational facilities (existing level)	LOW (LOW)	HIGH (LOW)	
Aboriginal rangers (existing number)	17 (12)	12 (12)	
Increase coastal development	YES	NO	
	OPTION A	**OPTION B**	**OPTION C**

○ OPTION A and you pay $10 per year forever

○ OPTION B and you pay $50 per year forever

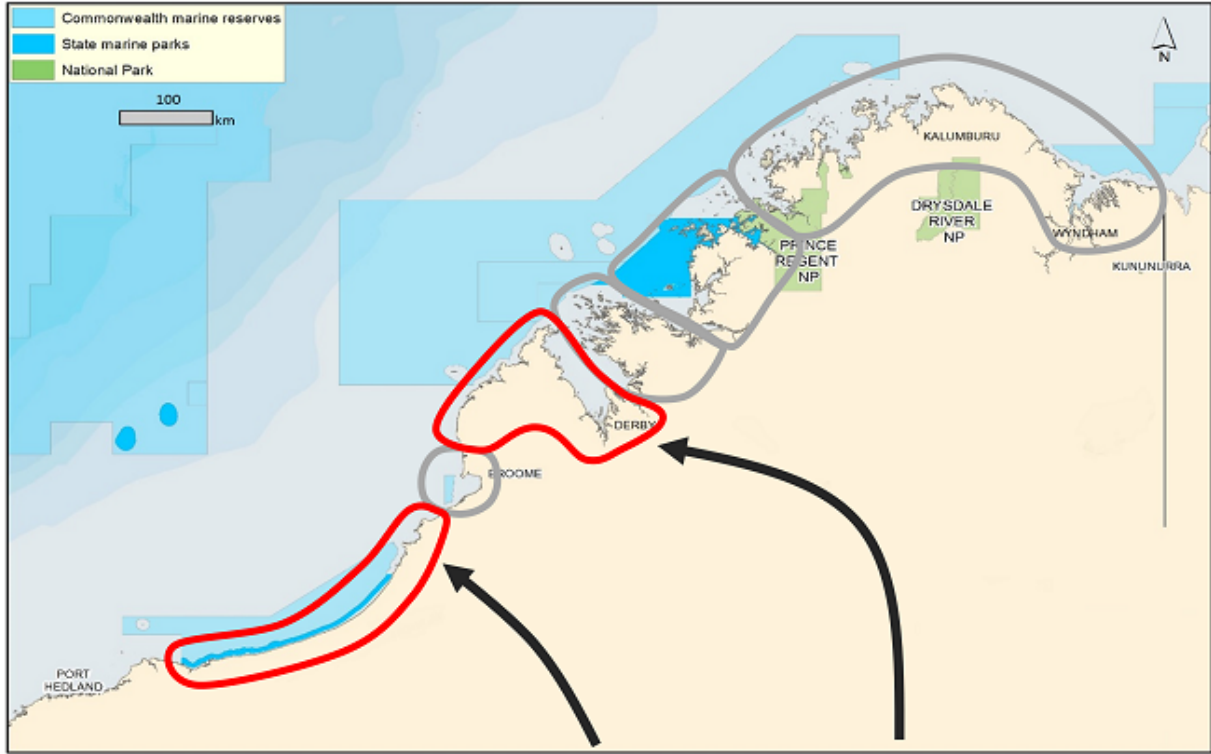○ OPTION C and you pay $0 per year forever

QUESTION 5

Please select your preferred management option, assuming these are the only options available to you.

Remember, if you select OPTION C you will pay nothing and there will be no management change on the Kimberley coast.

Hover your mouse over the words to see the descriptions of sanctuary areas, recreation facilities, Aboriginal rangers, coastal development and costs.

Hover your mouse over the words to see the descriptions of Eighty Mile Beach, Roebuck Bay, Dampier Peninsula, Buccaneer Archipelago, Camden Sound and North Kimberley.

Zone	Eighty Mile Beach	Dampier Peninsula	None
Annual cost to you	**$10**	**$50**	**$0**
Sanctuary area (% State waters already sanctuary)	40% (10%)	40% (0%)	*No new management on the Kimberley coast*
Recreational facilities (existing level)	MEDIUM (MEDIUM)	LOW (LOW)	
Aboriginal rangers (existing number)	11 (6)	12 (12)	
Increase coastal development	YES	NO	
	OPTION A	**OPTION B**	**OPTION C**

○ OPTION A and you pay $10 per year forever

○ OPTION B and you pay $50 per year forever

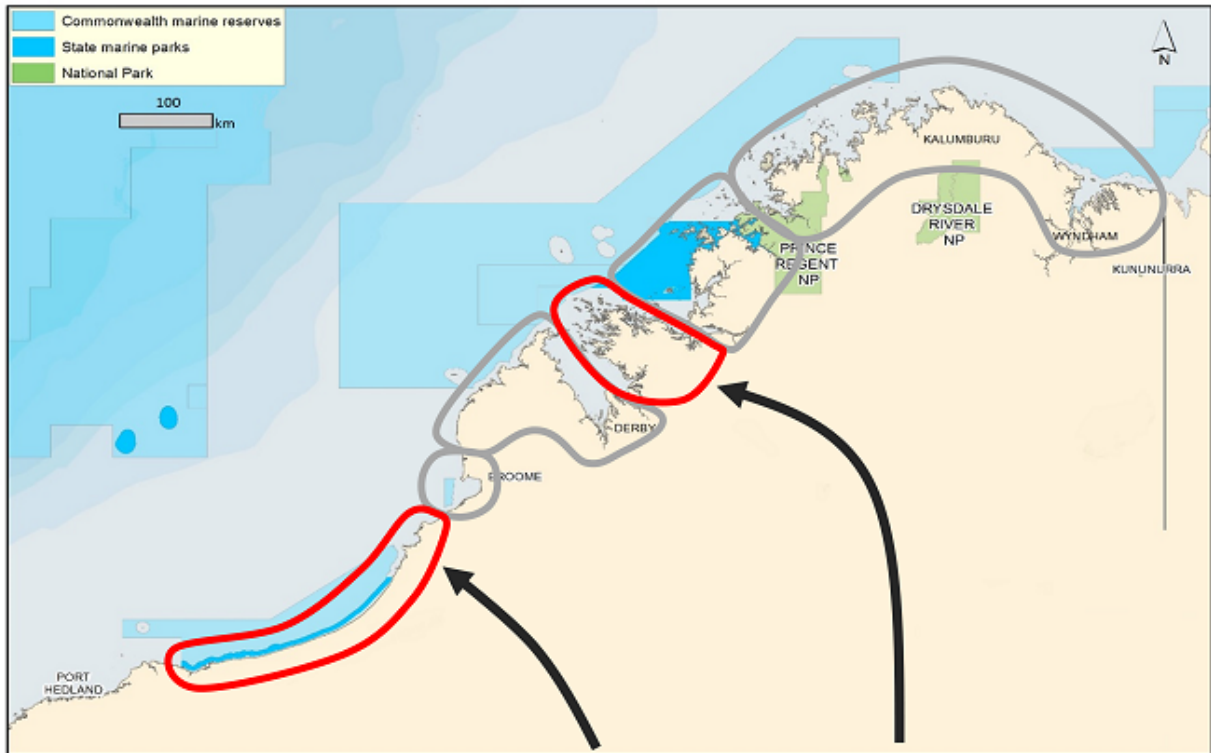○ OPTION C and you pay $0 per year forever

QUESTION 6

Please select your preferred management option, assuming these are the only options available to you.

Remember, if you select OPTION C you will pay nothing and there will be no management change on the Kimberley coast.

Hover your mouse over the words to see the descriptions of sanctuary areas, recreation facilities, Aboriginal rangers, coastal development and costs.

Hover your mouse over the words to see the descriptions of Eighty Mile Beach, Roebuck Bay, Dampier Peninsula, Buccaneer Archipelago, Camden Sound and North Kimberley.

Zone Annual cost to you	Eighty Mile Beach $50	Buccaneer Archipelago $100	None $0
Sanctuary area (% State waters already sanctuary)	25% (10%)	30% (0%)	*No new management on the Kimberley coast*
Recreational facilities (existing level)	MEDIUM (MEDIUM)	HIGH (LOW)	
Aboriginal rangers (existing number)	36 (6)	30 (0)	
Increase coastal development	NO	NO	
	OPTION A	OPTION B	OPTION C

○ OPTION A and you pay $50 per year forever

○ OPTION B and you pay $100 per year forever

○ OPTION C and you pay $0 per year forever

You often selected to take no management action. Was this because

○ I do not care about the Kimberley

○ I would like to see some improvement in the management of the Kimberley but I do not have the money to make a payment

○ I already pay enough in taxes and charges

○ I should not have to pay for any additional management action

○ I should not be making decisions for the Kimberley

○ I do not want to choose between the available options

○ Other, please specify

[   ]

BLOCK 2

QUESTION 1

Please select your preferred management option, assuming these are the only options available to you.

Remember, if you select OPTION C you will pay nothing and there will be no management change on the Kimberley coast.

Hover your mouse over the words to see the descriptions of sanctuary areas, recreation facilities, Aboriginal rangers, coastal development and costs.

Hover your mouse over the words to see the descriptions of Eighty Mile Beach, Roebuck Bay, Dampier Peninsula, Buccaneer Archipelago, Camden Sound and North Kimberley.

You often selected to take no management action. Was this because

○ I do not care about the Kimberley

○ I would like to see some improvement in the management of the Kimberley but I do not have the money to make a payment

○ I already pay enough in taxes and charges

○ I should not have to pay for any additional management action

○ I should not be making decisions for the Kimberley

○ I do not want to choose between the available options

○ Other, please specify

[_____]

Post-Choice Questions

Q8. Did you find it easy or difficult to choose your preferred management option in each question?

○ It was very difficult

○ It was difficult

○ It was a little difficult

○ It was easy

○ It was very easy

Q8a. What made the questions difficult? You may select more than one box.

□

☐ The choices were confusing

☐ The choices were complex

☐ I did not understand the information presented

☐ I did not have enough information

☐ I do not feel qualified to make a choice. Scientists or managers should do this

☐ The outcomes of the management options were irrelevant to me

☐ Other, please specify.

[   ]

Q9. When you made your choices, did it matter in which zone management occurred?

○ Yes, all the time

○ Yes, sometimes

○ No, I ignored it

○ Unsure

We have a few final questions to better understand your choices.

Q11. Coastal and marine management decisions often involve tradeoffs between environmental and economic factors.

Thinking about your own personal values, where would you place yourself on the scale below?

Highest priority should be given to maintaining natural environmental conditions even if there are negative economic consequences			Environmental and economic factors should be given equal priority			Highest priority should be given to economic considerations even if there are negative environmental consequences
1	2	3	4	5	6	7
○	○	○	○	○	○	○

Q12. Personally, how difficult or easy is it for you to access the Kimberley coast?

○ Very easy to access

○ Easy to access

○ Neither difficult nor easy to access

○ Difficult to access

○ Very difficult to access

Q13. How would you describe yourself in relation to the Kimberley? Please check all that apply.

☐ Kimberley resident

☐ Former Kimberley Resident

☐ Aboriginal

☐ Visitor

☐ Commercial fishing, pearling or aquaculture interest

☐ Commonwealth government employee

☐ State government employee

☐ Local government employee

☐ Non-government organisation member

☐ Work in tourism industry

☐ Work in oil and gas industry

☐ Researcher

☐ Other role. Describe →

Q14. When thinking about the future of the Kimberley, what are you most concerned about? Please select one category that fits *best*.

▼

Q15. Are you?

○ Male

○ Female

Q16. Which life stage category best describes you?

[▼]

Q17. Which of the following best describes the highest level of formal education you have completed?

○ Primary/some secondary school

○ Secondary school

○ Vocational/technical training

○ Some undergraduate tertiary study

○ Bachelors degree or equivalent

○ Postgraduate degree

Q10. Please indicate on the following scale how likely you think it is that the results of this study will influence future management decisions in the Kimberley.

	Not likely at all									Very likely	
	0	1	2	3	4	5	6	7	8	9	10

Final

Thank you so much for your participation in this survey.

Results will be available on the West Australian Marine Science Institution website from November 2015 (www.wamsi.org.au).

If you have any further comments about this survey please let us know: