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Ningaloo Collaboration Cluster:
NINGALOO CLUSTER COORDINATION AND MANAGEMENT

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Contents

1. SUMMARY OF MAJOR FINDINGS AND THEIR IMPLICATIONS

1.1 Objectives

This aim of this project was to coordinate research in the Ningaloo Cluster and to integrate and coordinate research across the Cluster and the WA Marine Science Institution on Marine Biodiversity and Conservation Planning (Node 3).

1.2 Outcomes

Work in this project focused initially on providing oversight of the research in the Ningaloo Cluster, and coordinating and enhancing activities with other research activities at Ningaloo, particularly those in the WA Marine Science Institution on Marine Biodiversity and Conservation Planning. In the last 18 months of the project, the focus shifted to developing ways of best communicating the results of the project to government agencies and the community in Exmouth.

The Ningaloo Cluster Collaboration project provided opportunities for training and building research capacity. A total of nine PhD students completed research as part of the Ningaloo Collaboration Cluster. Three of these students have completed their studies, one has submitted her Thesis and the research of the remaining five students is in progress. Five projects by Masters students, one by an Honours student and one by a third year Bachelor of Science student were completed as part of the Ningaloo Cluster.

1.3 Non-technical summary

This project was responsible for coordinating research in the Ningaloo Cluster and integrating and coordinating research across the Cluster and the WA Marine Science Institution Node on Marine Biodiversity and Conservation Planning (Node 3). A Cluster Management Committee (CMC), with representatives from the research organisations and CSIRO, was established as part of the contractual agreement with CSIRO and Murdoch University. This committee reviewed progress on the Cluster research and provided guidance and advice on research directions, communication of the research findings and the implications of the research to researchers within the Cluster and different groups external to the Cluster e.g. managers, industry and the community in both Perth and the region.

In collaboration with the WAMSI Node 3 leadership team, a Ningaloo Research Coordinating Committee was established to ensure good coordination, communication, collaboration, and data sharing was achieved across both major programs of research on Ningaloo. The activities of both committees have been successful in jointly funding, planning and running: three Symposia on the findings of the research, three student symposia, a number of joint workshops as well as establishing a web site for information on the research (http://www.ningaloo.org.au/).

The establishment of the Cluster was instrumental in attracting additional funding from BHP Billiton, coordinated through the Australian Institute of Marine Science, to obtain and analyse remotely sensed data to map the depth, habitats and access points for the whole of the Ningaloo lagoon to a depth of 20 m, at very high spatial resolution (3.5 m). Additional funding and collaborations were also made with the Cooperative Research Centre for Sustainable Tourism for developing models to evaluate future development scenarios for tourism in the region. These models for tourism, and those developed for the marine ecosystem and resource use, provided a mechanism for integrating and coordinating research activities and for discussing research, and the implications of the research, with researchers, managers, industry and the community in the region and Perth.

1.4 Implications for Management

The experience gained from the Integration and Coordination project has highlighted the value of brief frequent meetings of management and ensuring that the research managers/leaders are kept informed of the latest research findings across the program. It also highlights the value of engaging with groups and people interested in the research, beyond the government agencies with the responsibility for implementing the findings of the research, as part of the research activities.

1.5 Other Benefits

A number of methods for communicating the research findings effectively, and to a wide variety of audiences, were developed as part of the Ningaloo Cluster and WAMSI Node 3 research program (see Section 3.5 below). These included project profiles (Fig. 3.1), one slide powerpoint presentations (Fig. 3.2), establishing a website for Ningaloo research (http://www.ningaloo.org.au/), developing a communication and engagement plan (Appendix 8) and the establishment of a regional reference group and research coordinator (Appendix 4).

1.6 Problems Encountered

Details are provided in the individual research projects. Not relevant to this project.

1.7 Acknowledgements

Dr Keith Sainsbury provided excellent advice and guidance in developing and implementing the successful Cluster proposal. We thank Kelly Waples and Chris Simpson, leaders of the WAMSI Ningaloo research program (Node 3), for their time, energies and ideas in developing collaborations with the Cluster. The contribution of the communication teams from CSIRO (Meg Rive, Edwina Hollander, Sarah Wood and Bryony Bennett) and WAMSI (Sue McKenna) was invaluable and critical for developing material to capture the key messages from the research. The CSIRO Flagship Directors (Craig Roy, Kate Wilson and Tom Hatton) have provided strong support and advice on this research program. The Cluster Management Team and the researchers have made this challenging task much easier and more enjoyable than it might otherwise have been.

2. COMMUNICATION OF PROJECT RESULTS AND DATA

2.1 Publications and planned Publications

Details are provided in the individual research projects. Not relevant to this project.

2.2 Communications

Details are provided in the individual research projects. Not relevant to this project.

2.3 Presentations

Loneragan, N. R. and Wilson, K., 2007. Reef use, biodiversity and socio-economics for integrated management strategy evaluation of Ningaloo. Australian Coral Reef Society Conference, Fremantle, Australia.

Loneragan, N. R. and Wilson, K., 2007. Reef use, biodiversity and socio-economics for integrated management strategy evaluation of Ningaloo. Ningaloo Marine Park Symposium, Perth, Australia.

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3. NINGALOO CLUSTER COORDINATION AND MANAGEMENT

3.1 Background

Ningaloo Reef is among the worlds largest, most diverse and most pristine coral reef ecosystems. Without effective integrated management its value may be threatened by the increase in tourists and other human activity. The Ningaloo Marine Park (NMP) was established in 1987 and the original ten-year management plan was approved in 1989. In January 2005, the Western Australian State Government approved an updated plan for the management of the NMP for the period 2005-2015. The revision of the plan highlighted two issues for planning and management: the potential impact of increased recreational use and tourism development on the NMP and controversy associated with an increase in the extent of sanctuary zones (from 10 to 30%). A lack of knowledge to address these issues and to adequately manage the Marine Park was identified. Subsequently, the WA State Government provided $5 million for a 4-year research program, as well as on going funding for the management of the marine park by the Department of Environment and Conservation and Department of Fisheries. As a result, the Ningaloo Research Program (NRP) was developed through consultation with the marine science community and relevant State Government departments. In 2006, the WA Marine Science Institution (WAMSI) was formed as a collaborative venture of government, research, university and industry partners and the Ningaloo Research Program became Node 3 of WAMSI. As the Ningaloo program and WAMSI were being developed, CSIRO launched its Flagship Collaboration Fund, which was designed to enhance collaboration between CSIRO and other research organizations by complementing the research undertaken in CSIRO and building capacity for Australia.

The Ningaloo Collaboration Cluster was developed to build a program of research that complemented WAMSI research and provided information and focus for CSIRO's research on multiple use management, and the application of models to enhance understanding and management. A proposal based on Ningaloo, coordinated by Dr Nick D'Adamo, was submitted to the CSIRO Flagship Collaboration Fund Committee in July 2005. Following feedback from the Committee, Professor Neil Loneragan was asked to lead the development of a revised proposal that focused on the Ningaloo reef lagoon, including its bio-physical, social and economic characteristics. This research was developed with six Universities (Curtin University, Murdoch University, University of Western Australia, Australian National University, Edith Cowan University and the University of Queensland) and the Cooperative Research Centre for Sustainable Tourism (through Curtin University). The revised proposal was submitted in February 2006 and the contract agreement was signed in November 2006, with most research in the Ningaloo Cluster starting in January 2007.

Initially proposals submitted to the first round of Cluster Collaboration Funding were evaluated solely on science excellence and CSIRO researchers could not contribute to the development of the Cluster proposals. However, in subsequent funding rounds, Clusters were evaluated on science excellence as well as the impact of the Science, and CSIRO researchers could be involved in the development of the science in the proposals. We were fortunate to gain agreement from the Flagship Collaboration Committee to allow CSIRO, through Dr Keith Sainsbury, to be involved in the development of the revised proposal on Ningaloo. This

provided very significant direction for integrating research across the Cluster, and between the Cluster and research in WAMSI Node 3 on Marine Biodiversity and Conservation Planning. The Cluster and WAMSI research program on Ningaloo agreed to hold joint Symposia and wherever possible, seek opportunities for joint activities. For example, since 2009, joint meetings were held of the Cluster management Committee with the leadership team of the WAMSI Ningaloo research (Node 3) and a joint communication plan was developed during this time (see Section 3.5 and Appendix 8 below).

The Ningaloo Cluster used a multi-disciplinary approach to provide knowledge and develop models to assess the mutual dependency between the Ningaloo Reef system, human use of the reef and adjacent areas and the influence of zoning regulations on human activities. Research in the Cluster has provided high-resolution spatial data on the bathymetry (Klonowski et al. 2011), habitats (Kobryn et al. 2011), biodiversity (van Keulen and Langdon 2011, Skilleter et al. 2011) and reef use (Beckley et al. 2010), as well as information on tourism (Jones et al. 2011) and reasons for choice of activities in the region (Hailu et al. 2011). These data, and the models developed, will contribute directly to the models for Management Strategy Evaluation (Fulton et al. 2011). This project consisted of the following five linked, research components:

1. Bathymetry, Habitats and biodiversity: a) The bathymetry (Professor Merv Lynch, Curtin University), b) habitats and land-uses (Dr Halina Kobryn, Murdoch University), c) biodiversity of Ningaloo coastal lagoon areas (Dr Mike van Keulen, Murdoch University) and d) Validation of habitat surrogacy (Associate Professor Greg Skilleter, University of Queensland)
2. Human use: High resolution information on reef utilization by humans (Professor Lynnath Beckley, Murdoch University);
3. Socio-economics of tourism: Social and economic assessment of tourism along the Ningaloo coast: a dynamic modelling approach (Professor David Wood and Dr Tod Jones, Curtin University);
4. Socio-economic integration and Management Strategy Evaluation: Estimation and integration of socio-economic values of human use of Ningaloo in the Management Strategy Evaluation model structure (Associate Professor Atakelty Hailu, University of Western Australia); and
5. Integration, Modelling and Management Strategy Evaluation for the Ningaloo region (Dr Keith Sainsbury/Dr Bill de la Mare and Dr Beth Fulton, CSIRO). This research includes regional economics, qualitative ecosystem model development, enhancement of the quantitative ecosystem models, and support for uptake/adoption of Research and Development outputs. The integrating framework drew on work across the Cluster and research in the WA Marine Science Institution on Marine Biodiversity and Conservation Planning (WAMSI Node 3).

A total of nine PhD projects (3 completed, one submitted, five in progress) and five MSc projects (all completed) have been initiated as part of the Ningaloo Cluster Research. In addition, one Honours Thesis and one third year BSc project were completed (Appendix 1).

3.2 Management and Coordination arrangements

The management and coordination of research in the Cluster was facilitated through the Cluster Management Committee (CMC), whose roles and responsibilities were defined as part of the contractual agreement between CSIRO and Murdoch University. The establishment of the Ningaloo Research Coordinating Committee (NRCC) facilitated collaboration in research on Ningaloo across the Cluster and WAMSI. Brief details of these committees and their activities are provided below.

3.2.1 The Cluster Management Committee

The terms of reference for the Cluster Management Committee (CMC) are provided in Appendix 2. The membership of the CMC was: Chair - Cluster Leader (Murdoch University – Neil Loneragan), CSIRO Wealth from Oceans Science Coordinator (initially Kate Wilson, Ian Cresswell), CSIRO Wealth from Oceans Theme 4: Marine Nation, Theme leader – (Initially Keith Sainsbury, then Bill de la Mare), Cluster Project 3 leader (Curtin University and Sustainable Tourism CRC, David Wood/Tod Jones) and Cluster Project 4 leader (Atakelty Hailu, University of Western Australia) (See Table 3-1). The initial meeting of the Cluster Management Committee was held in March 2007 and since then over 40 meetings have been held, mostly by phone conference. At least two face-to-face meetings were held each year, often in conjunction with the Annual Research Symposia or other workshops.

3.2.2 The Ningaloo Research Committee

The Ningaloo Research Coordination Committee (NRCC) was formed in July 2007 and included representatives from Cluster, CSIRO, WAMSI, AIMS and DEC (Table 3-1, see Appendix 3 for the terms of reference of the NRCC). In 2010, representatives from the communications teams at CSIRO and WAMSI were included in the committee (See Table 3-1) to enhance the effectiveness of transferring information from the research findings to different groups. The objectives of the NRCC were to:

i) Integrate research between the Cluster and WAMSI Node 3,
ii) Look for opportunities to integrate field trips,
iii) Encourage data sharing across research projects and programs,
iv) Integrate communication activities, and
v) Provide guidance on engagement, outreach and adoption of research to different groups.

3.3 Link to Stakeholders

Within the Cluster, the Tourism research group (Jones et al. 2011) had planned a series of workshops with stakeholders to develop research directions and obtain information on issues facing people in the region. These activities were enhanced through the PhD research of Ms Kelly Chapman on evaluating regional perspectives on research and the effectiveness of information flow between researchers, managers and different interest groups. As part of this research, a regional reference group was established for the last 18 months of the research program (see Appendix 4). The establishment of the Regional Research Group included providing part funding for the appointment of a part time regional research coordinator with the Gascoyne Development Commission.

Table 3-1: People and roles in the CSIRO Ningaloo Cluster: Cluster Research Leaders, Cluster Management Committee (CMC) and the Ningaloo Research Coordination Committee (NRCC).

Institution	Position	Name	Role
CSIRO	Director wealth from oceans flagship	Mr Craig Roy *(to April 2007)* Dr Kate Wilson *(Oct 2007-Nov 2009)* Dr Tom Hatton *(from Nov 2009)*	Oversight
CSIRO	Wealth from Oceans Science Coordinator	Dr Kate Wilson *(to Oct 2007)* Mr. Ian Cresswell *(from Sept 2008)*	Oversight
CSIRO	Wealth from Oceans Theme leaders Marine Nation: Regional marine development and growth Our Resilient Coastal Australia Executive Officer	Dr Keith Sainsbury *(to July 2007)* Dr Bill de la Mare *(Jul 2007-May 2009)* Dr Andy Steven *(from May 2009)* Ms Wendy Steele	CMC, NRCC CMC, NRCC NRCC CMC, NRCC
Murdoch University	Project 1 Leaders	Dr Mike van Kuelen Dr Halina Kobryn	
Murdoch University	Project 2 Leader	Assoc Prof Lynnath Beckley	
STCRC/Curtin	Project 3 Leader	Prof David Wood Dr Tod Jones	CMC, NRCC CMC, NRCC
University of WA	Project 4 leader	Prof Michael Burton Assoc Prof Atakelty Hailu	CMC CMC
CSIRO	Project 5 Leader Regional multiple use management project Client Outreach Project	Dr Keith Sainsbury *(to July 2007)* Dr Bill de la Mare *(from July 2007)* Dr Beth Fulton Prof Geoff Syme	CMC, NRCC CMC, NRCC NRCC
Murdoch University	Project 6 Leader	Prof Neil Loneragan Dr Irene Abraham	Cluster Leader, CMC, NRCC Executive Officer
Department of Environment and Conservation	Leader Marine Science Program Marine Science Program Communications Officer	Dr Chris Simpson Dr Kelly Waples Ms Sue McKenna	NRCC, WAMSI Node 3 Leader NRCC, WAMSI Node 3 Coordinator NRCC
Western Australian Marine Science Institute	CEO Communications Officer	Dr Steve Blake Ms Sue McKenna	NRCC NRCC
Australian Institute of Marine Science		Mr Luke Smith Dr Andrew Heyward	NRCC NRCC
CSIRO	Communications Officer	Ms Meg Rive Ms Edwina Hollander *(to July 2009)* Ms Sarah Wood *(from Nov 2009)*	NRCC NRCC NRCC
Ningaloo Regional Reference Group	Coordinator	Mr Bryan Skinner	NRCC

Research conducted at CSIRO examined the networks, information flows and perceptions of people in the region on research and management in Ningaloo (Dzidic et al. 2011).

In addition to these mechanisms, and the activities of other projects in the Cluster, the representatives from the CMC and Cluster researchers met with the Ningaloo Sustainable Development Committee in the Region in December 2007 and October 2008.

Extensive consultation was carried out as part of the activities of the modelling projects by Curtin University (Jones et al. 2011) and CSIRO (Fulton et al. 2011). This included training workshops on the use of the models for people in the region and Perth in 2010 and 2011.

3.4 Evaluating Progress of Research in the Cluster

Project leaders provided written progress reports, including an executive summary, every 6 months to the Cluster Management Committee. Progress reports were submitted in a template developed by modifying the Fisheries Research and Development Corporation of Australia's template for milestone reports (Appendix 5). Milestone reports were reviewed by the CMC and collated into an overall summary report for submission to the CSIRO Flagship for evaluation. This reporting also allowed issues in the research to be identified and potential solutions suggested by the CMC. For example, some of the difficulties encountered in gaining completed survey data on the socio-economics of recreational activities in the region were resolved with input and assistance from the Tourism research team.

Detailed information on the research was gained from the Annual Symposia and workshops, which provided the basis for discussions between the CMC and NRCC at meetings held immediately following these events. It also allowed the management implications of the research, and key aspects for communication to different groups, to be identified.

Several meetings were held with the remote sensing groups and CSIRO representatives to discuss the different approaches being used by the Curtin University and Murdoch University research groups.

3.5 Enhancing communication among researchers and managers

Protocols were developed to guide the format of Media releases for Cluster research results (Appendix 6) and for data sharing within the Cluster (Appendix 7).

Three Annual Research Symposia were held (2007, 2008, 2009): two at Murdoch University and the third one in Exmouth. Each Symposium had 80 to 90 participants from Universities, CSIRO, and Government Agencies, with some representatives from industry and the community. The proceedings of the three Ningaloo Research Symposia have been posted on the web at http://www.ningaloo.org.au .

Symposia were also held for higher degree research students each year. These Symposia provided a platform for students to present their work and receive feedback from other researchers and students in the field.

In addition to these Symposia, a Synthesis and Integration Workshop was held in March 2010. Researchers made a three-minute, one-slide presentation of their work. These short presentations enabled researchers and the research leaders to develop a cohesive overall picture of the various areas of research (see example in Figure 3-1).

The aims of the Synthesis and Integration workshop were to:

a) Identify important implications of the research findings for resource managers and other stakeholders and to articulate the changes to policy, planning or operational management that these may lead to.
b) Identify pathways for effective transfer of the science results to management agencies and the community.
c) Identify possible collaborations between projects for information exchange, joint publications or new research initiatives.

Researchers and research students in the Cluster and WAMSI were asked to develop brief Project Profiles of their research activities at Ningaloo. The project Profiles were given a consistent format and layout for all research activities and identified the research group and research partnership in the banner of the profile (see example in Figure 3-2). A total of 32 Project profiles were developed and can be viewed at: http://www.ningaloo.org.au/www/en/NingalooResearchProgram/Research.html. The project profiles were printed and distributed at the Whale Shark Festival in Exmouth in May 2011.

Final Reports are in the process of being produced for printing and are being made available on the web as they are produced: http://www.ningaloo.org.au/www/en/NingalooResearchProgram/Publications.html.

3.6 Communication and Engagement Plan

A Ningaloo Communication and Engagement Plan was developed and implemented. The focus of communication was the website, distribution of project profiles in print form and on the website and workshops to demonstrate the use of the models to relevant stakeholders and members of the community. The aim of the Communication and Engagement Plan was to demonstrate the value, relevance and usefulness of the Ningaloo research to all stakeholders so that research outcomes could be adopted and practically implemented (Jones et al. 2011). The Executive Summary of the Communication Plan is included in Appendix 8.

3.7 Lessons learnt

- Engagement of people living in the region with the development of the research, through the Tourism projects was very valuable for the whole Ningaloo Cluster. These activities helped gain an understanding of local issues, perceptions and knowledge. Feedback from people in the region also helped refine research directions and develop the best means for communicating research findings. In future research programs, a component of regional engagement during the planning phases of the research is likely to benefit the research directions and understanding of regional issues and knowledge by researchers.

- The Cluster Management Committee aimed to provide an environment that minimised bureaucracy and encouraged excellence, innovation, collaboration and data sharing. This

philosophy was fostered through regular monthly CMC meetings and participation of the CMC members in all Symposia and Workshops. These frequent short meetings and participation in the research symposia also helped identify problems and their solutions, as well as identify opportunities for new research directions.

- The communication group made an invaluable contribution to maximising the impact of the research. A number of different methods of communication were developed that are likely to have value for several years and also be valuable for other research activities. They will make a major contribution to transferring knowledge of the research from the Ningaloo Cluster.

- Knowledge transfer/mobilisation (i.e. the two-way transfer of knowledge), and the adoption of research results into changes in policy and management, is a long-term process that goes well beyond the life of the Ningaloo Collaboration Cluster and its research. The success of this activity requires the commitment of a government agency to ensure that it is fully utilised.

- Effective research collaboration requires all parties to be willing collaborators and enjoy working together. It can be difficult to establish new collaborations in short time frames.

Figure 3-1 Two examples of the one slide presentations used for the Synthesis and Integration Workshop in 2010.

Example: Deep water biodiversity
(A. Heyward, AIMS)

Management Questions

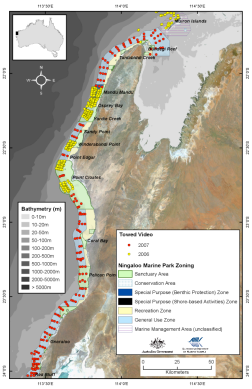
- What are the major benthic communities?
- Are they adequately protected?
- What physical factors relate to biodiversity?

Findings

- There are significant filter feeder communities in deep waters that are generally represented in the current SZ scheme
- Water depth and benthic features correlate with patterns in biodiversity

Implications

- Review of the NMP management plan should include minor modifications to sanctuary zone size and extent based on identified biodiversity
- Geo-referenced habitat maps can be used to direct operational activities in the marine park (e.g. compliance, tourism)
- Information on correlation between biodiversity and habitat/physical features can be used to apply to other similar areas in WA.



Benthic Biodiversity & Surrogacy
(G. Skilleter, A. McCarthy – Univ. of Qld; N. Loneragan & H. Kobryn - Murdoch)

Management Questions

- Do geo-referenced habitat maps based on physical composition predict biodiversity in shallow water reef environments?
  - (i) diversity of the habitat forming corals and macroalgae
  - (ii) diversity of macroinvertebrates, specifically molluscs and echinoderms

Findings (to date)

- Habitat maps provide excellent guide upon which to base sampling and experimental schemes
- Recurring combinations of habitats (mosaics) could be identified in the field from the maps *but* these mosaics did **NOT** consistently and reliably predict biodiversity for either of the two groups examined

Implications

- Geo-referenced habitat maps **cannot** be used to predict some components of biodiversity and therefore should not, at this stage, be used for that purpose – surrogacy is not supported for these shallow water benthic habitats
- Information on correlation between biodiversity and habitat/physical features may not apply elsewhere in marine parks and more information is needed on why and under what circumstances surrogacy fails

Figure 3-2 An Example of the one page Project Profiles produced from each project and sub-project in the cluster and WAMSI.

Ningaloo
Collaboration Cluster

Scientists have been working to test the concept of habitat surrogacy, and its use in decision-making for marine parks.

Assessing measures of biodiversity in the shallow-water lagoon

Effective management and monitoring of large marine protected areas is often based on detailed information about the distribution of marine habitats. This information has the potential to enable effective management, but only if it is actually a reliable indicator of marine biodiversity.

The concept of habitat surrogacy, or developing simplified measures of habitat to provide an indicator of habitats and their associated biodiversity, is widely established in terrestrial reserve planning and has also been applied in marine reserve planning, despite a lack of testing of the concept. However, if surrogates of habitat do not represent the habitats and their biodiversity in the field i.e. the surrogacy hypothesis is not upheld, decisions for the management and monitoring of the marine park, based on habitat information alone, may fail to protect a large proportion of the reef biodiversity. This may be a problem where the maps of habitat fail to reflect the distribution of rare and uncommon species.

Testing the habitat surrogacy hypothesis

High-resolution, geo-referenced habitat maps were developed as part of research on classifying habitats from remote sensing. These maps were used to identify specific combinations of habitats. Habitat maps are meant to provide the basis for identifying different areas of biodiversity. The development of zoning plans or other management actions are then, theoretically, able to make decisions on which areas to protect using information on habitat diversity and distribution. This is especially important for regions such as Ningaloo, where little detailed information is available for the distribution and abundance of most species.

Based on preliminary analyses of the data, these habitat maps failed to provide a reliable surrogate for the composition of the (i) habitat-forming hard corals and macroalgae and (ii) the animals living on the seafloor. Hence, maps depicting the distribution of major habitat types and the resultant mosaics (consistent and repeated combinations of particular groupings of habitats) may not at this stage provide adequate, reliable and repeatable representations of biodiversity within the shallow water lagoon.

Given the lack of detailed information about biodiversity in the shallow water lagoon along Ningaloo Reef, the high resolution maps still provide the best possible information currently available for input into management and planning decisions. These results show that the maps need to be used cautiously and zoning plans based solely on these maps should not be considered to represent all biodiversity on the reef.

Continuing the work

Continued detailed sampling of different mosaics to test the surrogacy hypotheses would be valuable. Now that appropriate tests of these hypotheses have been devised and the methods developed for collecting the appropriate data, it would be extremely cost-effective to continue this component of the project.

Further detailed analysis of the relationship between the distribution of other groups of organisms (i.e. other components of biodiversity) and the different habitats and fine resolution analyses to generate the mosaics, incorporating factors such as depth and aspect into the selection of patches to be sampled would also be valuable future work.

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Ningaloo research is an initiative of the Western Australian Marine Science Institution, CSIRO's Ningaloo Collaboration Cluster and the Australian Institute of Marine Science, working in partnership with government, local communities and enterprises.

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APPENDIX 1: PHD AND MSC PROJECTS ACROSS THE NINGALOO CLUSTER

PhDs

Catlin, J. (2010). *Development and Change in the Whale Shark Tourism Industry at Ningaloo Marine Park, Western Australia.* PhD Thesis, Curtin University, Perth, Australia.

Ceh, J. (Submitted) *The role of microbial communities in reef-building corals of Ningaloo Reef, Western Australia.* PhD Thesis, Murdoch University, submitted May, 2011.

Chandler, P. *Reef Encounters: How Repeat Visitors to the Ningaloo Region are Impacted by Changing Management.* Estimated completion time: August 2011.

Chapman, K., *Translating research into practice: working to build adaptive institutions for sustainable tourism in Western Australia's Ningaloo Region.* PhD Thesis, Edith Cowan University, Perth, Australia. Estimated completion time: June 2012.

Gray, M. Interim Title: *Retrieving and Optimising Multi-instrument Shallow Water Coastal Ocean Properties.* PhD Thesis, Curtin University, Perth, Australia. Estimated completion: Nov. 2011

Langdon. M. *The trophic ecology of the grazing sea urchin Echinometra mathaei: a study of the effects of closure regimes within Ningaloo Marine Park, Western Australia.* PhD Thesis, Murdoch University. Estimated completion 2012.

Lewis, A. *Sustainable tourism development in a sparsely populated remote landscape: Camping along the Ningaloo coastline.* PhD Thesis, Curtin University, Perth, Australia. Estimated completion time: June 2012.

McCartney, A.A. (2011). *The Policy Relevance of Choice Modelling: An application to Ningaloo Marine Park.* PhD Thesis, University of Western Australia.

Smallwood, C.B. (2009). *Spatial and temporal patterns of recreational use at Ningaloo Reef, north-western Australia*. PhD Thesis, Murdoch University, Australia, 316 pp.

MSc

Bunning, J. (2008). *Hyperspectral Techniques to Detect Off-Road Vehicle Tracks along the Ningaloo Coastline*, MSc Murdoch University, Australia.

D'Andrea, L. (2007). *Using hyperspectral imagery to map vegetation condition and ground cover of the coastal area at Coral Bay*, WA, MSc Murdoch University, Australia.

Nieman, J.L. (2007). *Diurnal variability in beach use patterns at three beaches in the Ningaloo Marine Park, Western Australia.* MSc thesis, Murdoch University, Australia. 42pp.

Rouillard, D.A.I. (2008). *The Use of Hyperspectral Imagery in Mapping Marine and Terrestrial Sediment Distribution on the Cape Range Peninsula*, MSc Murdoch University, Australia.

Simon Wee Beng Huat, (2009). *Extent and density of roads and tracks along the Ningaloo coastline, North West Australia*, MSc Murdoch University, Australia, 61pp.

Other Projects

McCarthy, A. (2010). *Mapping coral reef biodiversity; Surrogacy at two levels.* Honours Thesis. University of Queensland.

Noyer, J. (2010). *Spatial patterns of 4WD tracks along the coast of Ningaloo*, Australia, 3rd year BSc project, 34pp.

APPENDIX 2: CLUSTER MANAGEMENT COMMITTEE - TERMS OF REFERENCE

Objectives

The Cluster Management Committee represents a major focal point for collaboration between the Parties to the Cluster. The objectives of the Committee include:

1. Enhancing collaborative linkages between the Parties to the Cluster;
2. Providing strategic and operational support to the Cluster Leader; and
3. Monitoring progress of the Cluster Projects.

Key Responsibilities

The Cluster Management Committee will (clause 10.4):

ii. Develop recommendations for the Flagship Director regarding proposed Cluster Projects;
iii. Report, through the Cluster Leader, to the Flagship Director and/or the Flagship Oversight Committee as required by them;
iv. Recommend, through the Cluster Leader, to the Flagship Director and/or the Flagship Oversight Committee changes to any Cluster Project Plan;
v. Meet at regular intervals to monitor the progress of the Cluster Projects (including against APG's);
vi. Prepare, at least annually, a written summary and progress report concerning the Cluster Projects for reference to the Flagship Director;
vii. Discuss and implement any variations to any aspect of the Cluster Projects as approved or directed by the Flagship Director; and
viii. Carry out any other tasks set out in this Agreement or as otherwise agreed by the Cluster Project Parties from time to time, including:
ix. [patent protection recommendations pursuant to Schedule 3 – Patent Protection];
x. [the duties of the IP Committee set out in Schedule 3 – Patent Protection]; and
xi. [publication review and recommendations pursuant to Schedule 4 – Publication].

Composition[1]

The Cluster Management Committee will be constituted by the following representatives:

(a) The Cluster Leader, as Chairperson;

(b) 1 representative from CSIRO, being a nominee of the Flagship Director;

(c) 1 representative from each of the following Cluster Parties:

  (i) [insert name of Cluster Party]

  (ii) [insert name of Cluster Party]; and

(d) [1] representative on behalf of the following Cluster Parties:

  (i) [insert name of Cluster Party]

[1] For large Clusters, this could become cumbersome eg 15 parties. The parties should consider keeping the size of the Committee manageable eg through joint appointments by smaller contributors. It is suggested that the Committee should not exceed 8 in total and 4/5 would be ideal.

(ii) [insert name of Cluster Party]; and

(e) [insert details of any external party as agreed by the Cluster Parties].

Meetings

1. All meetings to be convened by the Chairperson.

2. The Committee will meet at least three times per financial year as follows:

Meeting	Meeting Focus
End of July	• To consider the annual progress and financial report to be submitted within 60 days of the end of the financial year (clause 12) • To report on annual progress of Cluster Projects against APG's • Consider APG's, Cluster Projects, budgets and strategy for the year ahead. • Standing Items
Early November	• To monitor progress against APG's for the financial year as at end October. • Standing items
Early March	• To monitor progress against APG's for the financial year as at end February. • Standing Items
Standing Items	• To make recommendations in relation to any necessary change, amendment, variation or cancellation of Cluster Projects (clause 10.1(d)) • To consider any IP, patent protection or publication related issues • To consider the Cluster communications strategy • Other issues

3. The Committee may conduct its meetings by telephone, facsimile, email or any other method decided by the Chairperson.
4. A quorum of the Committee shall exist of 3 of the 4 members (excluding the Chairman).

Agenda

5. The Chairperson (or their nominee) shall prepare and circulate in advance of each meeting a formal Agenda, together with copies of all papers relevant to the business of the meeting.

Minutes

6. The Chairperson (or their nominee) shall prepare a formal record of business of the meeting in such form as the Chairman shall agree.

APPENDIX 3: NINGALOO RESEARCH COORDINATION COMMITTEE - TERMS OF REFERENCE

Objectives

The objectives of the Committee are:

1. To ensure scientific integration across the Cluster and WAMSI node 3, as well as with other relevant activities in the Wealth from Oceans Flagship

2. To ensure coordination with other WAMSI node activities of relevance to Ningaloo

3. To ensure operational integration of field trips, surveys etc.

4. To ensure integration of data across the cluster and WAMSI

5. To keep each other informed of communication activities and integrate them wherever possible

6. To steer end-user engagement, outreach, impact and adoption re Ningaloo

Composition[2]

(f) The Ningaloo Cluster Leader - Neil Loneragan

(g) WAMSI node 3 leader - Chris Simpson

(h) WfO - Bill de la Mare

(i) WfO Science Coordinator – Kate Wilson

(j) AIMS – Luke Smith, Andrew Heyward

(k) DEC – Kelly Waples

Meetings

7. All meetings to be convened by the Chairperson. The Chair will rotate between The Cluster, WAMSI and AIMS.
8. The Committee will meet three to four times per financial year and will follow the meetings of All Researchers and Cluster Management Committee.

Agenda

1. The Chairperson shall prepare and circulate in advance of each meeting an Agenda, together with copies of all papers relevant to the business of the meeting.

Minutes

1. The Chairperson (or their nominee) shall prepare a summary of business of the meeting.
2. Summaries of meetings will also be circulated to - the Chair of the WAMSI Board (Dr Peter Rogers), CEO of WAMSI (Dr Steve Blake), Director of the Wealth from Oceans Flagship (Dr John Gunn) and the Director of AIMS (Dr Ian Poiner).

APPENDIX 4: TERMS OF REFERENCE FOR REGIONAL REFERENCE GROUP

Ningaloo Regional Reference Group

Terms of Reference

Scientists have conducted a program of intense, coordinated and collaborative research in the Ningaloo region since 2005, and produced an unprecedented wealth of knowledge about the acclaimed Ningaloo coastal region. As some of this research will draw to an end in 2010 a vital step is transferring the key research findings to the people of Ningaloo, hence the Ningaloo Research Regional Reference Group has been established to provide advice, assistance and a communication pathway for this process.

Background

The Ningaloo Reef is Australia's largest fringing coral reef, extending across 300 km of coastline between Exmouth and Carnarvon. This spectacular area is a global biodiversity hotspot and a premier tourist destination, seeing as many as 200,000 visitors each year. Balancing the conservation of this unique marine ecosystem with sustainable development of the region is a major challenge. A range of organisations are working together through the Western Australian Marine Science Institution (WAMSI), CSIRO's Ningaloo Collaboration Cluster and the Australian Institute of Marine Science to help meet this challenge. This research collaboration brings together scientists and expertise from a range of disciplines with the aim of integrating knowledge of reef use, biodiversity and socio-economics into managing the Ningaloo region. Organisations contributing to the research through WAMSI and the CSIRO Cluster are:

- the WA Department of Environment & Conservation
- the Australian Institute of Marine Science
- Murdoch University
- the Australian National University
- Curtin University of Technology
- Edith Cowan University
- the University of Queensland
- the University of Western Australia
- the Sustainable Tourism Cooperative Research Centre
- CSIRO.

This research is scheduled for staged completion by mid-2011, with the CSIRO Cluster winding up in 2010 and WAMSI finishing in 2011. Most of the scientists are now writing up their research results. The next step is transferring the key research findings to the public and private organisations that are responsible for the management of the region. One element of this will be making the people who live, work and play in the Ningaloo region aware of the new information.

Purpose of the Regional Reference Group

Communicating research results to the people, groups and agencies of the Ningaloo Region (Carnarvon to Exmouth) is integral to the success of our research. The purpose of this group is to provide advice, assistance and a communication pathway (where appropriate) to transfer these results to the region. It will also provide information on the needs for knowledge, science and planning in the region and issues that the region is facing. The Regional Reference Group has been established under the Ningaloo Cluster Management Committee (CMC) and will report to the CMC.

Roles

1. Liaise with the Ningaloo research communication sub-committee to provide advice on communication within the region and assist with the roll-out of the re communication strategy.
2. Liaise with the CMC to provide advice on stakeholder engagement in the region and assist with roll-out of stakeholder engagement.

These roles will be reviewed and revised by the reference group in December 2010 and the results of the review will be discussed with the CMC at this time. Note that the Coral Coast Parks Advisory Committee is the community advisory group for DEC in the region, and this group will be re-constituted shortly.

Composition of the Regional Reference Group

Chair: TBD
Executive Officer: Ningaloo Regional Research Coordinator (TBD)
Members:
Membership is encouraged from all sectors and individuals in the region possessing a genuine interest in knowledge transfer between the Ningaloo research partners and the local region.
Karen Thompson, Exmouth GDC
Kim Whitehall-Holla, Carnarvon GDC
Ronnie Fleay, Ningaloo Research Centre, Shire of Exmouth
TBD, Shire of Carnarvon
TBD, Coral Bay Progress Association
Barry Sullivan, Exmouth Chamber of Commerce
Jackie Tapper, Exmouth Visitor Centre Marketing Committee
Chris Pain, Exmouth Visitor Centre
Jamie Campbell, DEC Exmouth District (TBD)
Susie Bedford, Exmouth High School, CCG
Ann Preest, Northwest Cape Aboriginal Corp (TBD)
Paul Baron, Baiyungu Aboriginal Corporation (TBD)
Leonie McLeod, Waroora Station (TBD)
Phil Kendrick, Ningaloo Station (TBD)
Paul Richardson/Karen Hattingh, Gnaraloo Station (TBD)
Tim Meecham, Quobba Station, (TBD)

Meetings

The Reference Group will meet monthly or as required. The Chair (or selected representative) of the Reference Group will attend monthly meetings of Ningaloo Cluster Management Committee (by phone), and occasional meetings of the Ningaloo Research Coordinating Committee. The Regional Reference Group and the Ningaloo Cluster Management Committee will endeavour to have one or two face-to-face meetings per year.

APPENDIX 5: TEMPLATE FOR MILESTONE PROGRESS REPORTS

(Developed from the milestone template for the Fisheries Research and Development Corporation of Australia)

MILESTONE PROGRESS REPORT

CLUSTER PROJECT:

MILESTONE NUMBER 5:

DATE DUE:

PRINCIPAL INVESTIGATOR:

OVERALL PROJECT PROGRESS:

Milestone Status

Has this milestone been achieved (Yes/No)	
Will the project be completed according to the current milestone schedule (Yes/No)	

[If you answer "no" to either of these questions, then please provide an explanation for how you propose to ensure the milestone is to be achieved and/or the project is to be achieved in a timely manner and complete the section "Variations to project".]

Summary Project Progress Description

[Report on the overall progress of the project and how that aligns with achieving the project objectives as specified in the agreement.]

Repeat the following three sections for each milestone in the period being reported on:

1. ORIGINAL MILESTONE DATE AND TITLE:

[As specified in agreement.]

2. REVISED MILESTONE DATE AND TITLE:

[Only if previously arranged – delete this heading if not applicable.]

3. PROGRESS AGAINST MILESTONE (Achieved/Not Achieved):

[Report on the research/activity undertaken to achieve each milestone since the last report. Reports should contain enough detail to establish the objectives and outputs of each milestone, as well as how it was achieved. Relevant tables and figures can also be included. Provide evidence that this has occurred – not a general description of what you did.

If the milestone (or milestone activity) is not achieved, provide a description on why the milestone was not achieved and complete the "VARIATION TO PROJECT" section.]

4. CONNECTIONS WITH OTHER PROJECTS

[Highlight links to other projects, information required from and being provided to other projects; consequences of delays in this project for other projects and vice versa.]

SPECIAL CONDITIONS

[You need to report on the special conditions specified in your project agreement where applicable.]

INTELLECTUAL PROPERTY ISSUES ARISING:

[Describe discoveries that need or may need protecting or given any other commercial considerations.]

CONTACT WITH BENEFICIARIES:

[List any project related communications with individuals or organisations, including workshops with stakeholders.]

COMMUNICATION & EXTENSION ACTIVITIES:

[Report on communication activities, including publications, media releases, workshops.]

VARIATIONS TO PROJECT:

[List any changes implemented or proposed, and outline reasons why these were/are necessary. Most variations will require approval from the Cluster Management Committee. If you intend revising future milestones, list the intended date and title together with any previous versions of that milestone. Ensure that you have flagged this in Part 1 of the milestone.]

[Include with the variation a table showing the link between the existing milestone schedule as outlined in the agreement or a previously approved variation.]

Original MS date	Original Description	Original Cost	Status	Revised MS date	Revised Description	New Cost

APPENDIX 6: PROTOCOLS FOR NINGALOO COLLABORATION CLUSTER MEDIA RELEASES

3.8.1 Protocols for Ningaloo Collaboration Cluster Media Releases

1. The media releases will be generated by the institution where the project leader is based. Each institution will have its own protocols and approvals process for media releases that will need to be followed as a first step.

2. Once approved by the host institution, Wealth from Oceans will approve the media release. Meg Rive, Communications Manager Wealth from Oceans (Meg.Rive@csiro.au), has authority to approve releases.

3. In the case of Cluster Project 3, the Sustainable Tourism CRC will also approve the release. Margie Benson, External Communication Manager (margiebenson@mac.com) has authority to approve releases, delegated from Brad Cox.

4. Final approval will be from the Cluster Management Committee. Neil Loneragan (N.Loneragan@murdoch.edu.au) has authority to approve releases for the CMC.

5. The media release will be sent out by the initiating institution.

Prepared by Tod Jones (T.Jones@curtin.edu.au).

APPENDIX 7: PROTOCOLS FOR NINGALOO COLLABORATION CLUSTER DATA SHARING

3.8.2 Protocols for Ningaloo Collaboration Cluster Data sharing

Pro forma for data sharing between Ningaloo Cluster participants

Part I: General principles

1. This proforma does not have any consequences for formal data transfer agreements between cluster members.
2. Agreements on data sharing are to be approved by the relevant project leaders (source project and requesting project) before a transfer occurs.
3. Any data transferred between Cluster projects shall only be used for the purposes stated in the agreement, and shall not be passed to 3rd parties. The requesting project shall not use, disclose, market, release, show, sell, rent, lease, loan, or otherwise grant access to the limited data set files specified in the agreement, except as expressly permitted by the agreement or otherwise required by law.
4. Ownership of the data stays with researchers in the source project. None of the researchers in the requesting project obtain any right, title, or interest in any of the data furnished by the institution that collected the data. The parties further agree that the source project makes no representation or warranty, either implied or express, with respect to the accuracy of any data in the limited data set file(s).
5. The use of data shall be acknowledged in any reports/publications that are based on work which incorporates the data. Such publications shall be forwarded to the source project leader at the earliest time possible for verification before a manuscript is submitted for publication. The data shall not be included in a publication without the permission of the source project leader.
6. A list of people in the requesting project that have access to the data will be provided as part of the data sharing agreement. The data shall be kept in a secure location that can be accessed only by approved persons.
7. If a report/publication makes "significant" use of the data, members of the source project should be included as authors. The prospect and authorship for these reports/publications should be discussed with source project researchers as soon as possible after identifying the opportunity for publication.
8. 'Significant' is defined here as use of the data for any purpose apart from providing descriptive or background information or initial conditions for models.[3]
9. Any modelling that makes use of the data will be forwarded to the Project Leader of the source project for verification before it is presented.
10. Any concerns with the use of the data listed in the Request for Data Sharing form shall be respected by the requesting project and will be a major consideration if a dispute over the use of the data arises.
11. Where data are essential for the completion of Cluster research it should be provided in a timely manner. However, source projects should not be expected to configure data into specific formats.
12. The data collected by postgraduate students needs to be treated with care and respect so that they receive due recognition for their research and their opportunity to publish is not diminished by another report/publication.
13. Any issues arising from data sharing should be referred to the Cluster Management Committee who will be the arbiters of any disputes.

[3] On advice from Beth Fulton, providing initial conditions for modelling should not require express agreement from the source project for that specific task. However, using data for calibration or presenting data in plots for comparison should require express approval from the source project for that task.

Pro forma for request for data sharing between projects within the CSIRO Ningaloo Cluster project

To be completed by project leader requesting data:

Request by :……. Project……..
Request of …….. Project……..
Data requested: Format of data:
Intended use of data in research:
List of people who will have access to the data.
Anticipated reports/publications that may make use of data and expected time frame for production:

To be completed by Project leader of source Project:

Required security for data, any rules that must be followed when using/presenting the data in any form[4]:
Appropriate format for acknowledgement and journal articles for referencing if available:
Concerns with regards to the use of the data (including confidentiality):

Both project leaders:

Signatures Date
Project leader requesting data …… …….. Project leader of source project……. …… ……..

[4] e.g. the '5 boat rule' in Fisheries, where disaggregated data cannot be published when there are less than five boats working in an area, as it could give away commercially sensitive information about those operators.

APPENDIX 8: SUMMARY OF THE NINGALOO RESEARCH COMMUNICATION & ENGAGEMENT PLAN

EXECUTIVE SUMMARY

Ningaloo Reef

The Ningaloo Reef is Australia's largest fringing coral reef, extending across 300 kilometres of coastline between Exmouth and Carnarvon. This spectacular area is a global biodiversity hotspot; a premier tourist destination; home to the three communities of Carnarvon, Exmouth and Coral Bay; and a key service point for oil and gas.

The Ningaloo Marine Park (NMP) was established in 1987 and is one of the world's most pristine marine protected areas. After the marine park was extended in 2004, it now covers the full 300 km of the Ningaloo Reef and provides habitat for more than 500 fish, 250 coral and 600 mollusc species, as well as whale sharks, humpback whales, dolphins, manta rays, turtles and dugong.

The use and future management of the Ningaloo Reef raise continuing challenges because of the involvement of multiple tiers of government, industry, a passionate local and visitor community, and potentially worldwide attention with its recent nomination for World Heritage Listing. Decisions about its management need to consider accurate science with practical application to balance the social, economic and environmental interests in the area.

Ningaloo research

Research at Ningaloo over the past four years has been undertaken by a collaboration between the Western Australian Marine Science Institution (WAMSI), CSIRO's Wealth from Oceans Flagship, universities (Murdoch, Curtin, UWA, Edith Cowan, ANU and UQ), the Sustainable Tourism Cooperative Research Centre, the WA Departments of Environment & Conservation and Fisheries, and the Australian Institute of Marine Science (AIMS), working with local communities and enterprises.

The shared focus of this research has been on improving our understanding of the reef and the natural processes that support it so that managers may make well informed decisions about the management of the NMP and the region. The main research program is drawing to a close with research conducted as part of the Ningaloo Collaboration Cluster concluding at the end of 2010 and the WAMSI Node 3 research finishing by the end of June 2011.

By implementing a program of intense, coordinated and collaborative research the partners have produced an unprecedented wealth of knowledge about the Ningaloo coastal region. The scale of the findings demonstrates the benefits of coordinated research to achieve results beyond the capacity of individual research organisations.

The Ningaloo research outcomes will now help decision-makers and planners to manage the region, by providing information that was previously unknown and through practical decision support tools that have been developed to integrate that information. Training programs on the application and use of the decision support tools are being developed for people in the region (e.g. shire councils, the Gascoyne Development Corporation, government staff and the broader community) and in Perth.

The research will also contribute to improved understanding and management not only of Ningaloo, but of other coral reef systems in Australia and globally.

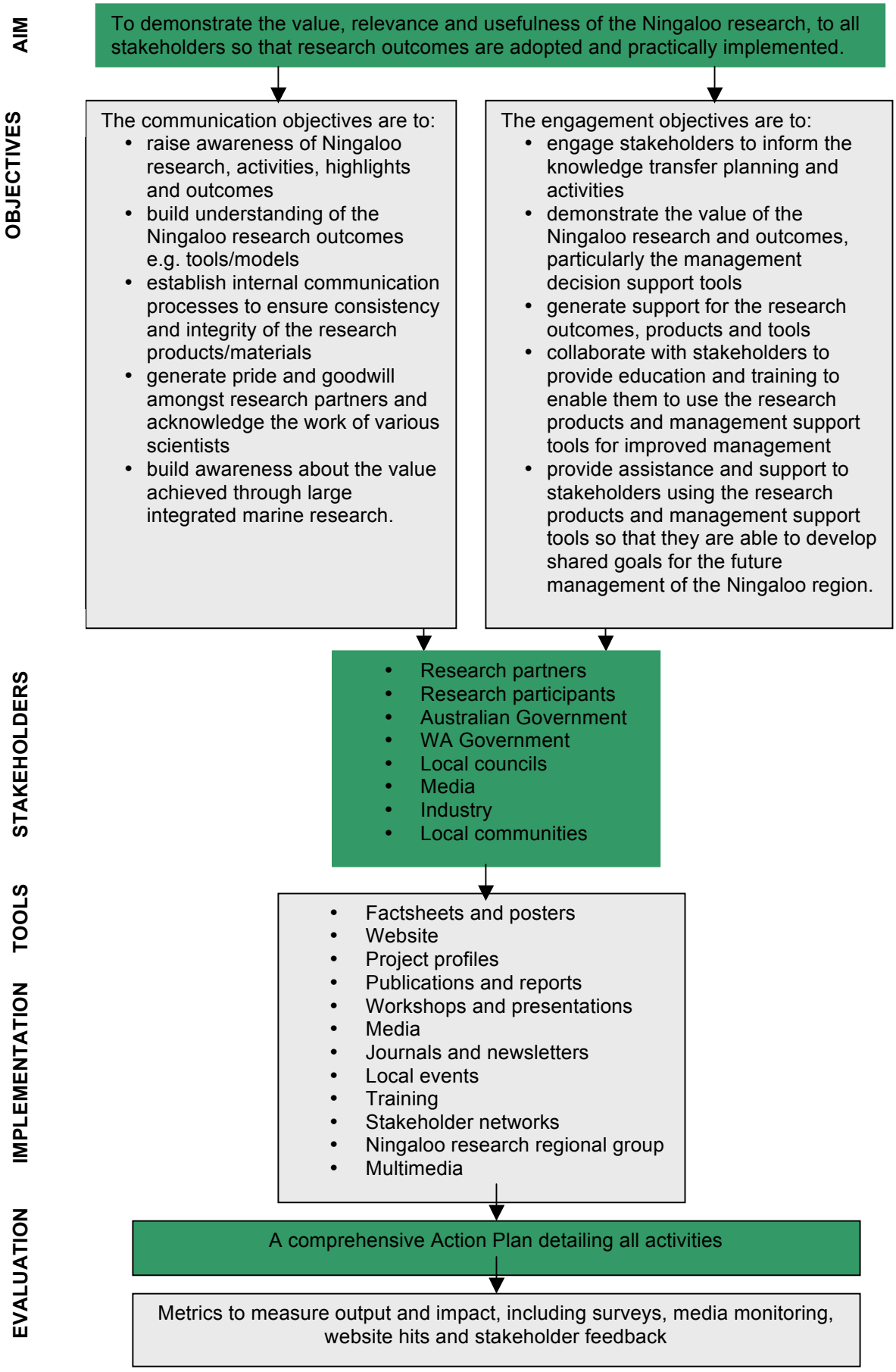
Communication and engagement

The crucial challenge now is ensuring that the products of the research can be maintained and used by planning and management agencies, industries and other stakeholders to assist in making wise decisions about and for the region.

This Communication and Engagement Plan (the Plan) outlines the approach to communication and engagement activities with internal and external stakeholders, from June to December 2010. The Plan establishes a framework and tools for the achievement of the engagement and communication objectives, and consists of two core components:

- inform (communication and information dissemination)
- involve and collaborate (engagement and knowledge transfer).

Diagram 1: Summary outline of the Ningaloo Research Communication and Engagement Plan



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