## **MARINE SCIENCE PROGRAM**

REPORT TO THE MARINE PARKS AND RESERVES AUTHORITY

What did we learn?
Who did we tell?
What difference did it make?

**SUMMARY OF ACTIVITIES, OUTPUTS AND EXPENDITURE FOR 2009/10** 

**REPORT No. 4** 

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## SUMMARY

This report outlines the performance of the Marine Science Program (MSP) for the 2009/10 financial year and is part of the Department of Environment and Conservation's (DEC) reporting and accountability obligations, under the CALM Act, to the Marine Parks and Reserves Authority. The report is based around the MSP Marine Science Business Plan: 1 July 2009 – 30 June 2010. The current focus of the research and monitoring projects is on WA's system of marine protected areas (MPAs) and on threatened marine fauna.

Funding for marine science in DEC occurs in the MSP, regional and specialist branch cost centres. This report focuses primarily on expenditure and outputs for 2009/10 by the MSP and includes some expenditure on marine science by regions and specialist branches. 'In kind' contributions from collaborating external agencies are not included.

The report format consists of individual project progress summaries of science projects outlined in the MSP Business Plan 2009/10 using the Science Division Annual Research Activity Report<sup>1</sup> proformas for both MSP and Regional marine science projects. The Science Division Scientist Productivity Framework proformas are used to summarise the major science, communication and knowledge transfer outputs of each scientist in the MSP for the 2009/10 financial year. Financial information for MSP projects and activities is also provided.

The MSP has had a significant increase in staff capacity in 2008/09. Following a 'settling in' period, the new staff are now making major progress in their respective areas. A strategy to provide a blueprint to guide the development and implementation of a state-wide marine monitoring, evaluation and reporting (MER) program has been drafted. This MER program is known as the Western Australian Marine Monitoring Program (WAMMP) and is now in the early stages of being progressively implemented. Similarly, a draft strategy for the development of integrated tropical and temperate marine research programs in Western Australia has been formulated to guide DEC research projects and DEC-supported research. The progress of MSP projects currently underway is outlined in this document.

The administration of the WAMSI Node 3 Ningaloo Research Program is continuing with most projects due for completion in December 2010. A major focus for 2009/10 has been the ongoing implementation of an operational knowledge transfer framework to assist the process of transferring the scientific knowledge gained through the research activities into practice (i.e. into policy, planning and operational management). Two major surveys to Montebello/Barrow islands MPAs, in November 2009 and in April 2010, resurveyed over 20 monitoring sites, established in December 2006. These surveys, which will continue over the next 2-3 years, form part of the Gorgon Gas Project (GSP) environmental offsets to DEC to assess the potential impacts of this GSP (specifically, the effects of dredging and dumping) on the marine biodiversity of these MPAs.

The report also includes lists of projects, staff and operational budgets for the MSP Business Plan 2010/11 (Section 11) and WAMMP projects planned for 2010/11 (Section 12). A list of recent research projects in Ningaloo Marine Park and relevant project details is provided in Section 13.

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<sup>&</sup>lt;sup>1</sup> Progress against all approved Science Division projects are reported annually in September in Science Division Annual Research Activity Reports.

## 1. INTRODUCTION

This report outlines the performance of the Marine Science Program (MSP) for the 2009/10 financial year and is part of the Department of Environment and Conservation's (DEC) reporting and accountability obligations, under the CALM Act, to the Marine Parks and Reserves Authority. Copies of this report will also be provided to the Director General, Directors and all Regional, District and Specialist Branch Managers of DEC.

Funding for marine science in DEC occurs in the MSP, regional and specialist branch cost centres. This report focuses primarily on expenditure and outputs for 2009/10 by the MSP and includes expenditure and outputs on marine science projects by DEC Regions but not by specialist branches and does not include 'in kind' contributions from collaborating external agencies.

The report format consists of individual project progress summaries using the Science Division Annual Research Activity Report proformas for both MSP and Regional marine science projects. The Science Division Scientist Productivity Framework proformas are used to summarise the major science, communication and knowledge transfer outputs of scientists in the MSP for the 2009/10 financial year. Financial information is also provided.

## 2. REPORT ON ACTIVITIES AND OUTPUTS FOR 2009/10

The major marine science projects, activities and outputs for the Marine Science Program for 2009/10 are outlined in the section below. The report summaries are largely based on the MSP component of the Science Division's Annual Research Activity Report (SDARAR) which is published each year in August/September and distributed widely.

## 2.1 WAMSI Node 3: Science administration, coordination and integration Core project.

Team members K Waples (0.6), C Simpson (0.1).

#### Context

In 2005 the State Government allocated \$5million to undertake research at Ningaloo Marine Park that would underpin its management. A research plan was developed in consultation with DEC marine resource managers and scientists to address key strategies in the Ningaloo Marine Park Management Plan. In 2007 a joint research body, the Western Australian Marine Science Institution (WAMSI) was formed. Research within WAMSI was divided into several themes, each with a lead agency. DEC is the leader of Node 3 of WAMSI which addresses research in marine biodiversity and conservation. Key ecological and biodiversity elements of the research plan were accepted as the science plan for Node 3 of WAMSI.

At the same time as the development of WAMSI, CSIRO Wealth from Oceans National Research Flagship program established the Ningaloo Collaboration Cluster (the Cluster) to address the integration of knowledge of reef use, biodiversity and socio-economics into a Management Strategy Evaluation (MSE) model for Ningaloo Marine Park and the Gascoyne region in general.

The research program of the Cluster complements that undertaken through WAMSI and collectively these two programs, along with core research undertaken by AIMS at Ningaloo,

have become known as the Ningaloo Research Program (NRP). DEC is working together with representatives from the Cluster and AIMS to ensure the research program will meet management needs and be properly integrated and communicated to those who will use it.

The science plan for Node 3 of WAMSI consists of 6 main projects which include up to 20 subprojects. Each project area is led by a different institution/University. Thus the coordination and administration role entails ensuring that all project plans are in place and are running smoothly according to the agreed outputs and timeframes. A key focus of this project is to ensure the transfer and uptake of knowledge generated through the research into DEC management policies, practices and actions. The latter element will become an increasing focus of this project as the research program progresses to completion in 2010 and the final synthesis report is developed for the wrap up of WAMSI in December 2011. As such, both communication and data management are critical elements in knowledge transfer and uptake and are being addressed through this program.

Integration of research within the NRP is managed through the formation of the Ningaloo Research Coordinating Committee (NRCC) and through the following activities which serve to provide forums for sharing information, increasing collaboration between scientist groups and engaging managers and stakeholders:

- Annual Ningaloo Research Symposium.
- WAMSI Operations Group.
- WAMSI cross-nodal symposia and meetings.
- Directed workshops for specific projects (e.g. Management Strategy Evaluation).

#### Aims

- To ensure the coordination and administration of the research program conducted under Node 3 of WAMSI.
- To ensure the integration of this research program with other research within WAMSI and with external programs relevant to the Ningaloo Marine Park.
- To ensure the outputs of research undertaken through the NRP reach target audiences.
- To ensure that knowledge transfer and uptake occurs between scientists, resource managers and decision-makers.
- To ensure the long term storage and custodianship of data from research undertaken through Node 3 of WAMSI.

## Summary of progress (2009/2010) and main findings

- Milestone reports received from the projects underway demonstrate that research is on track
  and is producing relevant findings on sanctuary zone effectiveness, biodiversity distribution,
  patterns and processes, geomorphological, geological and oceanographic processes,
  benthic habitat distribution and reef use patterns.
- A WAMSI science review of all Node 3 research projects was undertaken in March 2010. All
  projects were deemed to be producing quality science and to generally be progressing well.
- A synthesis workshop was held to bring together the scientists engaged in the NRP. The
  main aim of the forum was to identify the key research findings that are beginning to emerge
  and to collectively develop a strategy to enhance and ensure the transfer of this information
  to those agencies responsible for the management of this region. The workshop was well
  attended and led to constructive and informative discussions between scientists and
  managers.
- A Ningaloo Student Research Day was held on 30 March in Perth. This event was well attended, with 10 presentations made on a range of topics. Several interviews with the media were undertaken on the day.

- Data management was enhanced at DEC through the adoption of the MEST (Metadata Entry and Search Tool) and development of an internal metadata database.
- A draft technical report was developed on the rationale and process for a knowledge transfer and uptake framework that will be used for all research project/programs undertaken in the Marine Science Program.
- A draft paper was prepared outlining the details of the knowledge transfer and uptake process that will be carried out over the next 18 months.
- A number of presentations were made to other Sections, Branches and Divisions within DEC regarding the knowledge transfer and uptake process and its application through the Ningaloo Research Program.

## Management implications

- A key role of this project is to ensure that outcomes of the research both within the NRP and
  from external research programs are reviewed and used in refining and updating
  management of the Ningaloo Marine Park through changes to policy, management activities
  and planning exercises where relevant. Specific implications for management will come from
  each of the individual projects in the research program and will be implemented as
  appropriate over time.
- The development of a knowledge transfer and uptake framework will be instrumental in ensuring a similar process is followed for other research projects and programs conducted by DEC.

## Future directions (next 12-18 months)

- Continue to monitor progress of the various research projects and provide advice to project leaders to inform project reports.
- Prepare a WAMSI Node 3 synthesis report by 30 June 2011 that will bring together the key findings and implications for management of the Ningaloo Research Program.
- Continue to interact with the NRCC and develop and implement joint communication activities to further integrate the research programs.
- Develop the knowledge transfer and uptake framework further and submit a paper for publication in a peer reviewed journal on the framework and process.

## **2.2 Conservation of marine turtles in Western Australia** SPP# 1993-040

Team member

Team member B Prince (0.75).

#### Context

All marine turtles found in Western Australian waters are listed as threatened species by the Commonwealth of Australia and the State of Western Australia (WA). This long-standing statewide research project aims to provide the critical scientific information for the conservation of marine turtles in WA and the management of human pressures on these animals. Currently turtle research and monitoring in WA is undertaken by DEC Science Division and regional staff, academics and industry consultants with limited standardisation of methods or integration of data. There has also been a significant increase in turtle research in WA by external (to DEC) scientists over the past decade as a result of the potential impacts on these species from industrial development. A comprehensive review of all (internal and external) historical and current turtle research and monitoring is needed to underpin the development of an integrated statewide approach to turtle research and monitoring in WA, as outlined in the recently

completed Western Australian turtle recovery plan.

## Aims

- To gain an adequate understanding of the distribution and abundance of marine turtle populations utilising WA rookeries and marine habitats, the nature of inter-relationships within species at the regional level between groups using different rookeries, and the linkages between nesting and living areas important for the maintenance of these adult turtle populations.
- To develop an understanding of the processes affecting maintenance and abundance of these marine turtle populations as an aid to addressing management needs.
- To develop appropriate management measures and interpretation packages.

## Summary of progress (2009/2010) and main findings

- Completed and submitted paper on olive ridley turtles in WA.
- Draft data report prepared on historical time-series data from Exmouth Gulf.

## Management implications

Provision of knowledge will allow adequate management of marine turtle stocks.

## Future directions (next 12-18 months)

Project to be reviewed in 2010/2011 as part of a broader review of turtle research and monitoring in DEC.

## 2.3 Development of a strategic marine research plan for the Western Australian Department of Environment and Conservation: 2010-2015

Core Project

## Team members

S Wilson (0.1), A Kendrick (0.1), C Simpson (0.1).

#### Context

Historically much of the research needed to inform DEC's marine conservation and management programs has been delivered through externally-funded programs such as the Northwest Shelf Joint Environmental Management Study, the Strategic Research Fund for the Marine Environment and the Western Australian Marine Science Institution. Although a small research capacity has recently been established within the newly-formed DEC Marine Science Program, external delivery of research will remain a key mechanism to meet DEC's marine research needs for the foreseeable future.

A strategic marine research plan is being developed to ensure that DEC marine research needs are identified, prioritised and delivered in a timely manner so that appropriate scientific information is available to support DEC's marine protected areas, marine fauna management and marine environmental protection programs.

The document will outline a systematic framework to identify and prioritise DEC's marine research needs, the opportunities and constraints to meeting these needs and the strategies needed to take advantage of the opportunities and overcome the constraints.

#### Aim

To develop and progressively implement a strategic marine research plan to support WA's marine protected areas , marine fauna management and marine environmental protection programs.

## Summary of progress (2009/2010) and main findings

- A revised draft of the strategic plan was completed for internal review.
- Discussions have been held with the Australian Institute of Marine Science, CSIRO and the newly-formed WA Oceans Institute on how to better align these agencies' research programs and DEC's research needs.
- A consultant has been engaged to collate recent (last ten years) temperate marine research in Western Australian and identify the management implications of this research for DEC.
- Research planning meetings were held with regional marine park staff, and feedback from these meetings contributed to the development of the draft strategic plan.
- A number of high priority research projects have been identified and initiated in the Walpole Nornalup Inlets Marine Park, the metropolitan marine parks and the Ningaloo Marine Park.
- Existing data from a 12 month DEC survey of water quality of the Jurien Bay Marine Park has been analysed and a manuscript has been prepared for submission to a peer-reviewed journal.

## Management implications

Development and implementation of the strategic marine research plan will enhance DEC's capacity to identify, prioritise and deliver DEC's marine research needs for departmental marine conservation and management programs.

## Future directions (next 12-18 months)

- Completion and distribution of the strategic marine research plan.
- Progressive implementation of the strategic marine research plan.

## 2.4 Strategic plan for the development and implementation of the Western Australian Marine Monitoring Program (WAMMP)

SPP # to be allocated

## Team members

K Friedman (0.1), C Simpson (0.05).

#### Context

The successful establishment of a long-term, broadscale, institutional marine monitoring, evaluation and reporting (MER) program requires a strategic approach to be taken. The strategic plan for the Western Australian Marine Monitoring Program (WAMMP) will outline the rationale, major tasks, timelines and delivery models that are required in the development and implementation of an integrated long-term, statewide marine protected area and threatened marine fauna monitoring program in Western Australia's coastal waters.

#### Aim

To develop a strategic plan to guide the development and implementation of an integrated long-term, statewide marine protected area and threatened marine fauna MER program in Western Australia.

## Summary of progress (2009/2010) and main findings

- A draft strategic plan to guide WAMMP was completed in 2008/2009. The plan identified six major sub-projects of WAMMP. These are:
  - o WAMMP Sub-project 1: Asset Knowledge Reviews.
  - o WAMMP Sub-project 2: Historical Time-series Development.

- WAMMP Sub-project 3: 'Fit to Park' (i.e. monitoring program implementation).
- WAMMP Sub-project 4: MPRA/DEC Audit Support.
- o WAMMP Sub-project 5: Community Participation.
- WAMMP Sub-project 6: Data Management and Presentation.

Each of the major WAMMP sub-projects is outlined in detail in the following sections of this report. No further progress was made on the strategic plan in 2010/2011.

## Management implications

The development and implementation of the strategic plan for marine MER within DEC's marine conservation programs in an adaptive management context will guide the development and deployment of DEC's marine monitoring capacity over the next 10 years. Ultimately the WAMMP will provide the data to continuously improve the efficiency and effectiveness of DEC's marine operational management.

Future directions (next 12-18 months) Finalise and publish the strategic plan.

## 2.5 WAMMP Sub-project 1: Asset knowledge review and standard operating protocol documentation

SPP # to be allocated

#### Team members

K Friedman (0.2), C Simpson (0.1), A Kendrick (0.1), S Wilson (0.1), K Bancroft (0.1), K Onton (0.1), T Holmes (0.1), M Rule (0.1), K Waples (0.05).

#### Context

Monitoring the status of environmental assets assists DEC to fulfill its statutory responsibilities for the conservation of the State's biodiversity, as it is recognized that the 'health' of the environment is a powerful surrogate for biodiversity conservation. Long-term systematic integrated marine monitoring, together with evaluation and reporting of change, is a key management strategy for measuring success of Marine Protected Area (MPA) and marine fauna management plans, as early detection of detrimental impacts facilitates responsive active adaptive management for the conservation of marine biodiversity.

In the past, DEC marine monitoring work has largely proceeded opportunistically or in response to particular concerns, whereas the purpose of the Western Australian Marine Monitoring Program (WAMMP) is to develop and implement a more strategic integrated program, initially focusing on WA's MPAs and on threatened marine fauna. The condition (structure and function) or 'health' of assets identified in MPA management plans and threatened marine fauna recovery plans is affected by pressures; natural pressures, anthropogenic pressures/uses and climate change pressures. Pressures can be both biotic (e.g. recruitment, predation etc) and abiotic (e.g. sea temperature, cyclonic storms). The primary purpose of monitoring programs is to identify undesirable changes in asset condition as a result of human pressures (as expressed relative to a management target) and to instigate management response/s to mitigate these effects.

Monitoring programs must, therefore, be designed to detect changes when they occur, and identify whether these changes are caused primarily by natural factors, human use or climate change, so that appropriate management responses can be formulated and implemented. Use of a Condition-Pressure-Response (CPR) monitoring framework, assists managers in assessing management efficiency and effectiveness, which is a critical element of an adaptive management framework. Each Asset Knowledge Review will need to have sufficient breadth and detail to guide the development of this aspect of WAMMP. Implementation of the reviews

will permit trials of the methods, an output of which will be the documentation of appropriate standard operating protocols (SOPs).

#### Aim

Develop Asset Knowledge Reviews that identify what to measure (i.e. indicator/s); how to measure these indicators (i.e. method/s) with due consideration of scientific 'power', cost, relevant historical data and practicality; and why these indicator/s and methods were chosen (i.e. rationale).

## Summary of progress (2009/2010) and main findings

- Guidelines on the process of developing Asset Knowledge Reviews were developed and distributed to Asset Knowledge Review authors.
- Draft reviews were completed for internal review for the following assets: coral, seagrass and mangrove communities and Little Penguins.
- Draft reviews were completed for the following assets: finfish, intertidal communities, coastal birds, cetaceans, pinnipeds and water quality.
- A data management and reporting review for WAMMP was completed.

## Management implications

Monitoring, evaluation and reporting programs are a key element in the adaptive management cycle and are aimed at continuously improving the efficiency and effectiveness DEC's conservation and management programs.

## Future directions (next 12-18 months)

- Complete all reviews outlined above, including an external peer-review process, and publish as appropriate (e.g. DEC technical reports of as papers in *Conservation Science*).
- Initiate three new reviews from the following asset list: dugong, stromatolites, sharks and rays (including manta rays and whale sharks) and turtles.
- Develop guidelines on the development of SOPs within WAMMP.
- Develop draft SOPs as field procedures are trialed and protocols are standardized.

## 2.6 WAMMP Sub-project 2: Historical time-series development SPP # to be allocated

#### Team members

K Friedman (0.1), K Bancroft (0.3), C Simpson (0.05).

#### Context

Extensive monitoring of the marine environment of Western Australia has been undertaken over the last three decades or more by State and Commonwealth Government agencies, universities, industry and community groups. Although many of these monitoring programs were often issue specific and constrained in time and space, these data have significant potential to help understand historical trends in the condition of biodiversity assets, the pressures on these assets and, in some cases, the management responses to these pressures. This project will examine historical datasets from marine research and monitoring programs in Western Australia that are relevant to the objectives of the Western Australian Marine Monitoring Program (WAMMP). While the main aim is to reconstruct historical trends in asset condition and pressures to extend our understanding 'backwards in time', this project will also inform the process of selecting indicators and methods and temporal and spatial scales of WAMMP monitoring programs into the future. This will further help to ensure relevant past and future datasets are comparable. Historical timelines are, potentially, also a key aid in improving our

understanding of climate change impacts on marine biodiversity over the past several decades.

## Aim

- Develop a framework outlining the decision rules to guide the construction of historical timeseries on asset condition, pressure and management response and on accessing data for high priority biodiversity assets identified in MPA management plans and threatened species recovery plans.
- Incorporate datasets into MPA annual report cards which are part of the Marine Parks and Reserves Authority audit process (see WAMMP sub-project 4).

## Summary of progress (2009/2010) and main findings

- Draft Historical Time-series Development guidelines was completed.
- A historical time-series for coral community data from Ningaloo Marine Park was used to trial the guidelines.
- Preliminary assessment of historical data of water quality, fish and seagrass was completed for the September 2009 MPRA Audit review.

## Management implications

The construction of historical data will capture past DEC investment in marine monitoring programs and assist the design of future WAMMP monitoring programs. Knowledge of historical trends in marine biodiversity asset condition, pressure and management response will also facilitate an improved understanding of future trends, thereby improving the efficiency and effectiveness of DEC marine conservation and management programs.

## Future directions (next 12-18 months)

- Submit a manuscript on the Historical Time-series Development guidelines.
- Develop a database of past monitoring programs relevant to WAMMP objectives for priority marine biodiversity assets.
- Collate historical information on all previous DEC marine monitoring programs to assist in the temporal and spatial design of future WAMMP monitoring programs.
- Continue the identification, retrieval and assessment of historical time-series (including data from sources external to DEC) of asset CPR data with Marine Park Coordinators and other DEC staff for progressive inclusion into the Marine Parks and Reserves Authority audit process (see WAMMP sub-project 4).

## 2.7 WAMMP Sub-project 3: 'Fit to Park'

SPP # not yet allocated

#### Team members

K Friedman (0.3), A Kendrick (0.1), S Wilson (0.1), K Bancroft (0.4), T Holmes, (0.4), K Onton (0.4), M Rule (0.4).

## Context

The Western Australian Marine Monitoring Program (WAMMP) sub-project 3: 'Fit to Park' is focussed on implementation of monitoring programs in the field using the indicators and methods identified in WAMMP Sub-project 1 with due acknowledgement of historical data identified in WAMMP Sub-project 2. The initial focus of this project will be to determine the appropriate temporal and spatial scales of WAMMP monitoring programs prior to their implementation. This will ensure that monitoring locations and monitoring frequency allow biodiversity asset monitoring data to be comparable within and between major geographical

areas of interest (e.g. MPAs). The project will also identify the practical constraints (including costs) in regard to field implementation and assess the capacity and role of regional and other DEC staff and community involvement in WAMMP.

#### Aims

- Develop guidelines for determining the spatial (WHERE) and temporal (WHEN) scales of asset CPR monitoring programs;
- Identify the practical constraints to the implementation of WAMMP monitoring programs within geographical areas of interest;
- Progressively implement asset CPR monitoring programs for assets priorities outlined in MPA management plans.
- Progressively implement CPR monitoring programs for threatened marine fauna according to established DEC priorities.

## Summary of progress (2009/2010) and main findings

- Draft guidelines for determining the locations and spatial scale of WAMMP monitoring sites were developed.
- Coral communities were surveyed at previously established and newly established monitoring sites in the Ningaloo Marine Park, Shark Bay Marine Park and the Montebello/Barrow islands MPAs.
- Seawater temperature data loggers were deployed at Shark Bay Marine Park and the Montebello/Barrow islands MPAs.
- Fish community monitoring sites were established and surveys undertaken in the Shoalwater Islands Marine Park, Shark Bay Marine Park and the Montebello/Barrow islands MPAs.
- Seagrass monitoring sites were re-surveyed at Jurien Marine Park under historical sampling regime.
- Coastal sea-bird and shore-bird populations were monitored in the Shark Bay Marine Park.
- New sites and methods were established for DEC regional staff and community monitoring of coral communities, litter and coral predator abundance in 'high use' areas of Ningaloo Marine Park.
- Historical seagrass monitoring sites were re-surveyed in the Shark Bay Marine Park.
- The 'beach camera system' to monitor Little Penguin beach-landing numbers was reestablished to help determine the most effective use of beach camera records for monitoring Little Penguins.
- A 'stand-alone' remote camera system for monitoring loggerhead turtle nesting activity at Dirk Hartog Island, Shark Bay Marine Park was established. Operational for 2009/2010 nesting season.
- Methods were trialled for the monitoring of 'coastal biological communities' along the coastal strip in Ningaloo Marine Park, including the establishment of monitoring sites.
- New video and still imagery methodology were trialled to increase the efficiency of in-water data collection.
- Software applications for post-processing of imagery were developed.
- A newly developed integrated drop-camera method was tested for the remote collection of seagrass community data in Jurien Bay Marine Park.
- A newly developed integrated drop-camera method was tested for the remote collection of macroalgae community data in Marmion Marine Park.
- Temperature loggers were deployed in Little Penguin nest boxes on Penguin Island, Shoalwater Islands Marine Park.

## Management implications

In due course, the CPR data being collected on the assets (outlined above) will be available for Marine Park Coordinators and senior regional staff to help them assess the efficiency and effectiveness of management actions. The data will also be incorporated into the MPRA audit process of Western Australia's MPA system.

## Future directions (next 12-18 months)

- Finalise the guidelines for determining the spatial and temporal scales of asset CPR monitoring programs.
- Continue to identify and address the practical constraints to the implementation of WAMMP monitoring programs.
- Progressively implement CPR monitoring programs using asset priorities outlined in MPA management plans.
- Progressively implement CPR monitoring programs for threatened marine fauna according to established DEC priorities.
- Continuing focus on integration of monitoring across assets, improving the efficiency of field data collection and data post-processing.

## 2.8 WAMMP Sub-project 4: MPRA/DEC Audit Support

Core project

## Team members

K Friedman (0.1), C Simpson (0.05).

## Context

Marine protected areas (MPA) in Western Australia are established under the *Conservation and Land Management Act 1984* (CALM Act) and are vested (i.e. legally entrusted) in the Marine Parks and Reserves Authority (MPRA). One of the statutory roles of the MPRA is to monitor (i.e. audit) the implementation of MPA management plans.

The audit function of the MPRA is expressed in three levels of review:

- 1. An annual review (including an asset CPR report card) of the progressive implementation of the strategies in the MPA management plans.
- 2. Audit of management performance for each MPA on a periodic basis, partly based on the preceding three annual reviews.
- 3. A 10-year audit of the implementation of the management plan.

A comprehensive MPA performance assessment report, including a CPR report card, is presented to the MPRA annually. The Western Australian Marine Monitoring Program (WAMMP) assists DEC regional MPA staff, in this regard, by providing asset CPR monitoring data to 'populate' the MPRA's MPA performance assessment framework.

#### Aim

The aim of this project is to assist DEC MPA managers in meeting DEC MPRA audit requirements by advising on and, where appropriate, providing CPR data to 'populate' the MPA performance assessment framework the MPRA use to service their audit function.

## Summary of progress (2009/2010) and main findings

• Meetings were held between the MSP and most regional MPA managers (usually Marine Park Coordinators) to better understand roles, responsibilities, capacity and processes

needed to meet MPRA audit reporting priorities and needs.

- Asset CPR data from WAMMP was provided, as it became available, to all MPA managers.
- A presentation was made to the MPRA Audit Committee and regional MPA managers on the progress of the WAMMP.
- Additional CPR data (including historical datasets) was provided to MPA managers where data was sourced from external providers.

## Management implications

The MPRA audit process provides an annual understanding of asset CPR for all Western Australian MPAs and is a statutory requirement of DEC under the CALM Act. The same data are used as part of an emerging adaptive management culture by regional MPA managers to improve the efficiency and effectiveness of their management programs.

## Future directions (next 12-18 months)

- Development of a clearer understanding of MPRA audit requirements.
- Finalisation of the process (including roles, responsibilities and capacity between the MSP and regional MPA managers) to meet MPRA audit reporting requirements.
- Continued provision of asset CPR data from WAMMP and sources external to DEC, as it becomes available, to all MPA managers.

## 2.9 WAMMP Sub-project 5: Community participation

Core project

## Team members

K Friedman (0.08), K Waples (0.05).

#### Context

Community engagement and participation is recognised as a key strategy to develop better links between managers, scientists and the community at large. Community partnerships within the context of the Western Australian Marine Monitoring Program (WAMMP) offer the opportunity of extending the scope of an early warning system for detecting change in the marine environment and opportunities to inform and improve understanding of marine conservation issues and priorities in the general population.

## Aims

- To successfully engage with the general community on issues of marine conservation, with special regard to WAMMP activity.
- To provide opportunities for direct involvement in monitoring, related activities and presentations of information to ensure the community is involved in managing the health of our marine and coastal environment.
- To ensure the data collected by the community will complement the monitoring data collected by Government agencies and scientists so that, together these data will be used by management agencies and local communities to help manage human impacts on their local marine environment.

## Summary of progress (2009/2010) and main findings

- Eight presentations were made on WAMMP, including how the public can participate, were delivered to community groups.
- A community coral monitoring program was established by an Exmouth School group in Ningaloo Marine Park.

• Six community volunteers were supported and trained in the post-processing of ecological asset imagery following Little Penguin surveys at Shoalwater Islands Marine Park and coral and fish community surveys in Ningaloo and Montebello Marine Parks.

## Management implications

The management of MPA's and threatened marine fauna will benefit from increased community understanding resulting from extensive communication of and direct community participation in WAMMP.

## Future directions (next 12-18 months)

- Continue community presentations on the objectives of WAMMP.
- Seek external funding/sponsorship to fund a Community Monitoring Coordinator for three years.
- Continue to foster public participation in WAMMP programs where possible.

## 2.10 WAMMP Sub-project 6: Marine Science Program Data management and presentation

Core project

Team members K Friedman (0.05)

## Context

The research and monitoring capacity within the Marine Science Program (MSP) focuses effort on the ecological and social science needed to inform the adaptive management of Western Australia's marine protected area network, the conservation of threatened marine fauna and the conservation of the State's marine biodiversity generally. These programs will generate enormous volumes of data that must be analysed, presented and stored for future uses. To complete these tasks a framework is needed to support research and monitoring data management requirements. Data management in this context is the development and execution of architectures, policies, practices and procedures that properly manage the full data lifecycle needs of the MSP, particular emphasis on the long-term datasets required for the Western Australian Marine Monitoring Program (WAMMP).

## Aim

To establish and implement a best practice data management system for the Marine Science Program, with particular emphasis on the long term datasets required for WAMMP.

## Summary of progress (2009/2010) and main findings

- A preliminary review of the data management requirements of WAMMP has been completed.
- A decision to fund a half-time data manager position for 2010/2011 was made. This position has been filled and will begin work on the above data management system in August 2010.

*Management implications* Not applicable.

Future directions (next 12-18 months)
Employ a contract MSP Data Manager for 2-3 years.

## 2.11 Spatial and temporal patterns in benthic invertebrate communities of the Walpole and Nornalup Inlets Marine Park

SPP# 2009-013

Team members

A Kendrick (0.2), M Rule (0.2), contract (0.15).

#### Context

The Walpole and Nornalup Inlets Marine Park (WNIMP) was created in 2009 to include the entrance channel, both basins and the tidal extent of the Frankland, Deep and Walpole rivers. Invertebrates are recognized as a significant ecological value of the marine park and a Key Performance Indicator of management effectiveness. The benthic invertebrate community of the inlets has been described by Hodgkin & Clark (1999) from surveys conducted in 1984 and 1987. The fauna was found to be relatively diverse compared to most estuaries in the southwest of WA because of the predominantly marine conditions that are sustained in the inlets. The benthic invertebrate community at this time was dominated by capitellid polychaetes, and several amphipod and mollusc species, and the deeper mud of the Nornalup inlet supported an impoverished fauna compared to the peripheral sand flats. Few subsequent studies have examined this fauna, and the current knowledge of benthic invertebrates in the system is considered to be inadequate for marine reserve management. Little is known, for example, of how the fauna varies in response to the seasonal hydrological cycle.

#### Aims

- Determine spatial patterns in the WNIMP benthic invertebrate community.
- Determine temporal variation in the WNIMP benthic invertebrate community, particularly in relation to seasonal changes in the hydrological cycle of the inlet system.
- Assist DEC's Marine Monitoring Unit develop methods for long-term monitoring of benthic invertebrate communities in the WNIMP and more broadly across temperate estuarine marine protected areas.

## Summary of progress (2009/2010) and main findings

- The Concept Plan and Science Project Plan were completed and approved.
- Invertebrate sampling was completed with Frankland District staff in 'summer' and 'autumn' 2010. Approximately 60 benthic core and grab samples were collected in each season and the invertebrates were sorted and removed from the samples. A collection of voucher specimens is now being identified.
- Sediment cores were collected at each site during the 'summer' sampling period and the analyses for grain size, composition and organic is underway.
- MSP and Frankland District staff collaborated with ECU's 2010 Coastal and Marine Management course by delivering lectures and participating in a student survey of bivalve diversity and abundance on the large peripheral sandflats of the Nornalup Inlet.

## Management implications

This study will provide knowledge of how benthic invertebrate in the WNIMP are structured in space and time. Such 'inventory' and/or 'baseline' information is required to determine the composition of these ecological assets in relation to natural processes, and to benchmark their condition with regard to the impact of current and future anthropogenic impacts.

## Future directions (next 12-18 months)

 Seasonal invertebrate sampling will continue for three years. Four sampling trips are planned for 2010/2011.

- Data from the first four 'seasons' will be analysed in 2010/2011.
- Collaboration with ECU to continue during 2011.
- Progress will continue on building the voucher specimen collection with input from the WA Museum and other taxonomists.

# 2.12 Spatial and temporal patterns in the structure of intertidal rocky platform communities of the Shoalwater Islands and Marmion marine parks SPP# 2009-002

## Team members

A Kendrick (0.2), M Rule (0.2), Contract (0.15).

#### Context

The Marmion Marine Park (MMP) and Shoalwater Islands Marine Park (SIMP) are located on the north and south Perth metropolitan coast, respectively. The MMP and SIMP comprise a similar geomorphology dominated by sub-tidal and emergent limestone reefs and shallow sandy embayments. Both marine parks support a diverse range of marine conservation values ranging from various marine habitats to threatened marine fauna. These marine parks are subject to high levels of recreational and commercial human activity due to their proximity to the Perth metropolitan area. Occurring along mainland and island shores and as isolated offshore patch reefs, significant areas of intertidal reef platform occur in both the MMP and SIMP.

Management of intertidal reefs in the Perth region has increased significantly in recent decades through the creation of marine parks and reserves and enhanced fishery controls. While a number of local studies of intertidal communities provide a significant regional knowledge base, the broad spatial patterns of intertidal biodiversity across both the MMP and SIMP are not adequately understood. Particular gaps exist in knowledge of the intertidal communities of the SIMP and offshore platform reefs. This project will significantly expand on the knowledge generated by Wells *et al.* (1987, 2007) by increasing the number of sampling sites across both the MMP and SIMP and including offshore platform reefs. This study will determine relationships between the composition of these communities and the physical structure and location of the reefs. It will focus on assemblages of algae, echinoderms, molluscs and barnacles, as these include major primary producers (i.e. algae), grazers (i.e. echinoderms and molluscs) and predators (i.e. molluscs) in these habitats. It is anticipated that this study will provide a basis for the design and implementation of comparative intertidal research in marine parks and reserves across WA.

#### Aims

- Determine the spatial and temporal patterns in the composition of intertidal reef communities in the MMP, SIMP and the proposed northern extension to the SIMP (comprising Garden and Carnac Islands).
- Determine if the intertidal reef communities in management zones protected from extractive activities differ from the intertidal reef communities of otherwise comparable reefs.
- Assist DEC's Marine Monitoring Unit in the development of methods for long-term monitoring of temperate west coast intertidal communities.

## Summary of progress (2009/2010) and main findings

- The Concept Plan and Science Project Plan were completed and approved.
- Seven mainland intertidal reef sites were sampled in the MMP and SIMP by MSP and Swan Coastal District staff in the 2009/2010 'summer' sampling period. Large swell waves severely restricted sampling opportunities during this period resulting in less progress than planned.

A collection of voucher specimens is being progressively developed as a taxonomic aid.

## Management implications

This study will provide knowledge of how intertidal reef communities in the MMP and SIMP are structured in space and time. Such 'inventory' and 'baseline' information is required to determine the composition of these ecological values in relation to natural processes, and to benchmark their condition with regard to the impact of current and future anthropogenic impacts.

## Future directions (next 12-18 months)

- Twenty sites in MMP and SIMP are planned to be sampled during the 'summer' season in 2010/2011. Sites at Garden and Carnac islands will also be sampled if conditions permit.
- The voucher specimen collection will continue to be expanded.
- On-going training will be provided to Swan Coastal District staff on sampling methodology and specimen identification.

## 2.13 Interactive effects of fishing and climate change on coral reef fish populations SPP# 2009-003

#### Team members

S Wilson (0.325), T Holmes (0.35), K Onton (0.1).

#### Context

Climate change and over-fishing are widely regarded as the major threats facing coral reef communities worldwide. Typically fishing has a 'top-down' affect on communities, through the removal of large predators, whilst climate change causes degradation of habitat which effects fish that recruit, feed and shelter within corals. The independent impact of these threats are well studied, however the interactive effects between fishing and climate change are yet to be examined. This is despite the fact that most reefs are simultaneously subjected to both pressures.

Climate change is predicted to increase the incidents of coral bleaching, outbreak of disease and intensity of tropical storms which will reduce the cover of habitat forming corals. Initially this will affect the handful of species dependant on live coral for food and shelter. But as dead coral skeletons are eroded and structural complexity lost the number of species affected by climate change will increase. Importantly it is the small bodied species, which are the major contributors to community diversity that are the most susceptible to coral and habitat complexity loss. How changes in fish community structure instigated by fishing interact with those caused by climate change is unknown. This interaction may be particularly important on reefs off the mid-western Western Australia coastline where per-capita boat ownership and recreational fishing pressure is extremely high.

Two critical processes that determine community structure of coral reef fish are recruitment and early post-settlement predation. It is hypothesized that degradation of coral associated habitat due to climate change will cause a decline in recruit numbers. Conversely fishing will reduce abundance of large predators and increase numbers of smaller habitat-associated predators, thereby increasing post-settlement predation. Examining how changes in habitat and predators interact and influence post-settlement survival of fish will be critical to understanding impacts to biodiversity of fish communities and fish populations. This will be the first study to specifically assess the combined effects of fishing and climate change on fish recruitment, providing management with information to develop strategies that will alleviate pressures placed on coral reef biodiversity.

#### Aims

- To determine how habitat degradation instigated by climate change and changes in predation instigated by fishing pressures effect the composition of the predator community on WA coral reefs.
- To assess diet of predatory species targeted by fishers.
- To identify microhabitats preferentially used by juvenile fish.
- To assess how variation in fishing pressure and habitat complexity/composition influence predation rates on juveniles.

## Summary of progress (2009/2010) and main findings

- Field work in November and December quantified abundance of small bodied cryptic predators and predation upon juveniles in the northern section of Ningaloo Marine Park. This work is being analysed and prepared for submission to a marine journal. Field work in February collected data on habitat associations of juvenile fish.
- A paper prioritizing research required to progress our knowledge of climate change impacts on coral reef fish has been published in the Journal of Experimental Biology. This paper is based on the opinions of 33 scientists from 23 institutes and 10 countries. The results were presented at the JEB conference in Japan in August 2009.
- A manuscript assessing diet of finfish targeted by fishers in North West Australia has been submitted to Environmental Biology of Fishes. The study highlights spatial and temporal variation in some species diets and identifies species where more dietary information is required.
- A manuscript identifying habitat associations of juvenile fish has been submitted to Marine Ecology Progress Series. The study demonstrates corals of high structural complexity are important habitat for ~ half the species investigated. The study also shows algal meadows are important juvenile habitat for some species, including species targeted by fishers.
- A data base of juvenile fish photos has been created and will form the basis of a photo ID field guide.

## Management implications

- The results of this will assess the capacity of current management strategies towards recreational fishing to alleviate pressures associated with climate change on fish communities.
- The project will identify appropriate indicators for ongoing monitoring programs, particularly those undertaken by MSP. Field work for the project will be carried out in the Ningaloo Marine Park, where the management plan recognises coral reef communities and finfish as ecological values that are key performance indicators (KPI's).
- The proposed project will address management strategies that place high priority on:
  - o Characterisation of finfish diversity and abundance in the reserve (H-KMS),
  - Identifying finfish species that require protection from recreational or commercial fishing in the reserve (H-KMS),
  - Research to assess the potential impacts of climate change on Ningaloo Marine Park over the next 50 years (H).

## Future directions (next 12-18 months)

• Complete analysis of data collected in November and December 2009 and prepare a manuscript for submission to international journal

- Assess diet of fish species that may be affected by fishing and where earlier study has identified such information is lacking.
- Continue to develop photographic library of juvenile fish
- Establish and monitor survey areas of differing coral complexity and fishing intensity.

## 2.14 Preliminary assessment of diseases affecting Western Australian corals SPP# 2009-011

#### Team members

K Onton (0.3), S Wilson (0.025), Technical officer (0.1)

#### Context

Coral diseases have contributed significantly to coral reef degradation locations around the world over the last three decades. There is however little information on the prevalence and type of disease on Western Australian coral reefs. Ningaloo Reef is the largest fringing coral reef in Australia, home to highly diverse marine life and is regarded as an icon of Western Australian marine conservation. Numerous studies have been undertaken documenting coral condition throughout the Ningaloo Marine Park (NMP) since the 1980's, however none of these have assessed prevalence of disease. Research into coral disease at NMP will create a baseline data set that can be used to measure how climate and anthropogenic drivers threaten coral reef sustainability over time and across regions with varying levels of anthropogenic influence.

#### Aims

The aim of the project is to investigate the prevalence and types of disease affecting corals in Western Australia. To achieve this, the project will use existing datasets and collect new information to:

- review the current knowledge of coral diseases on Western Australian reefs;
- document the prevalence of diseases affecting corals and the coral taxa/morphologies susceptible to various diseases within NMP;
- characterise coral disease legions morphologically and histologically; and
- develop expertise within DEC to enable the assessment of coral disease on WA reefs and contribute to the development of coral disease standard monitoring protocols.

## Summary of progress (2009/2010) and main findings

- Field work documenting disease occurrence and prevalence along NMP has been completed. Work focused on the northern sector, with some more intense surveying at Bills Bay, in central NMP. A data report detailing what information was collected and where it is stored has been completed.
- Samples from diseased corals have been prepared and examined for histological abnormalities.
- A draft manuscript has been prepared.
- Data has been submitted for presentation on the Ningaloo Atlas website.

## Management implications

 The results of this study will provide an indication of the spatial and temporal distribution of various diseases providing information on the prevalence and identity of diseases affecting Western Australian corals. This will assist in identifying the current threat posed by disease, provide a baseline for assessing changes in this threat and enable assessment of current management strategies designed to mitigate the impact of threats on coral communities.  Field work for the project will be carried out in the NMP, where the management plan recognises coral reef communities as ecological values that are key performance indicators (KPI's). Specifically the proposed project will address the management strategies that place high priority on the undertaking of research to assess the potential impacts of climate change on NMP over the next 50 years (Strategy 12), and to assess the nature, level and potential impacts of human activities on coral communities within the reserves (Strategy 2) (CALM 2005).

## Future directions (next 12-18 months)

- Analyse data and publish a manuscript in a marine journal.
- Present findings at the 2010 Australian Coral Reef Society conference and/or through public lectures.
- Submit an article to Conservation News or Landscope.

## 2.15 The biogeography of Shark Bay Marine Park mangrove communities SPP # to be allocated

Team members. A Kendrick (0.15), M Rule (0.15)

#### Context

The Shark Bay Marine Park (SBMP) and the adjacent Hamelin Pool Marine Nature Reserve are World Heritage-listed and support a diverse range of iconic marine conservation values. The ecological diversity of SBMP is high because this area is the southern distributional limit of many typically tropical species and the northern limit of many temperate species. The mangrove (i.e. *Avicennia marina*) communities of Shark Bay are the most southern, extensive mangroves on the Western Australian mainland and are recognized as a significant marine park conservation asset and eastern Shark Bay is listed under the Directory of Important Wetlands in Australia. While SBMP mangroves have sustained localised degradation due to impacts from, for example, activities associated with land-based recreational fishing and unmanaged visitor access, no significant mangrove areas are currently included in sanctuary zones of the marine park. Despite their recognised conservation value, the biota associated with SBMP mangrove communities are poorly understood.

#### Aims

- To determine relationships between the biological communities associated with mangrove stands and the physical structure and location of the stands within the SBMP.
- To determine a classification of mangroves within the SBMP based on canopy structure and environmental parameters.
- To assess the relationship between the mangrove-associated biota and the physical structure and location of the different stands.
- To assess the human impacts on mangrove-associated biota.
- To identify indicator species for on-going monitoring of mangrove community condition.

These objectives will be examined either concurrently or sequentially across the projected time frame.

## Summary of progress (2009/2010) and main findings

- A Concept Plan was completed and approved
- A pilot study to assess proposed methodologies, potential study sites, logistical constraints of this study in this remote and large marine park and the adequacy of the budget allocation to

complete the project has been completed.

- A Landscope article on the SBMP mangroves was published in the Spring 2009 edition.
- An analyses of the results of the pilot study in relation to the logistical constraints of this study and the adequacy of the budget allocation to complete the project was undertaken.
- As a result the project was suspended and the project scope is currently being reconsidered.

Management implications
Not applicable.

Future directions (next 12-18 months)
The project scope will be reconsidered.

## 2.16 Knowledge transfer and uptake of recent temperate marine research in WA Core project

Team members

A Kendrick (0.05), K Waples (0.05); contract (0.5).

#### Context

Over the past decade or so significant funding has been allocated for marine research in WA's temperate coastal waters. Over \$20 million was invested over 5 years through the Strategic Research Fund for the Marine Environment (SRFME), a joint venture between the WA State Government and CSIRO. Approximately \$1M of the SRFME funding was allocated for marine research on the Jurien Bay Marine Park and this attracted significant co-investment from CSIRO and local universities and supported a large program of research in this area. Node 1 and Node 4 of WAMSI also focussed on the temperate coastal waters of WA as did a number of large projects funded by the Commonwealth Government's NHT program (e.g. Marine Futures). The majority of this work was undertaken by science organisations external to DEC and hence there have been no formal attempts to ensure this research is incorporated into DEC policies and programs.

The Marine Science Program (MSP) of DEC has recently developed a Knowledge Transfer Framework (KTF) for facilitating the transfer of science into policy and/or management actions. The aim of the knowledge transfer and uptake process is to set out clear steps that can be undertaken to ensure that information moves between scientists and managers leading to informed decision-making and management activities based on sound science.

A consultant was engaged to apply the KTF to recent (last decade or so) marine research undertaken in the temperate coastal waters of Western Australia. The detailed implications of this research for DEC marine policy and management programs will be discussed with the relevant users within DEC and made available to them for future use in decision-making processes.

#### Aims

This project aims to ensure that the key findings of recent temperate marine research programs, such as SRFME, NHT and WAMSI, are assessed for their policy and management implications to DEC marine conservation and management programs and made accessible to DEC managers and decision-makers.

Summary of progress (2009/10) and main findings

Project proposal prepared;

- Consultant engaged to undertake project;
- Database of marine research in WA temperate waters completed; and
- Progress made on determining the process to prioritise research projects that will be described in detail in a knowledge transfer and uptake framework.

## Management implications

Undertaking the knowledge transfer and uptake process will ensure that the key findings and implications of this research program are made available to relevant DEC marine managers and decision-makers.

## Future directions (next 12-18 months)

- Management implications of the research projects contained in the database identified;
- · Generic applications for research categories identified; and
- Discussions held with DEC managers/decision makers with an interest in the research projects addressed through this project to bring the research to their attention and to prioritise management responses.

## 2.17 South coast pinniped survey

Core project

Team members K Friedman (0.025), R Campbell (0.1)

## Context

New Zealand fur seals (NZFS) are found throughout New Zealand, some sub-Antarctic islands and across the southern coastal regions of Australia. Extensive harvesting of this species during the 18<sup>th</sup> and 19<sup>th</sup> centuries lead to them becoming nearly extinct throughout Australia, although population and range increases have occurred over the last 30 years. The species is currently protected in Western Australia under both State and Commonwealth law, with a most recent population estimate (in 1999) of 15,000 NZ fur seals in WA.

Determination of abundance of fur seals has been traditionally assessed through large scale surveys of pup production at breeding sites. The proposed project will include a repeat survey of population range and abundance of NZFS in WA, subsequent to the previous surveys conducted in 1989 and 1999 (as proposed in the draft DEC Pinniped Management Plan).

Reported increases in interaction of NZFS with commercial fisheries are indicative of an increasing abundance and may also indicate resource competition with human activities. Previous estimates showed that the population of NZFS was increasing at approximately 10% per annum and there is the possibility that seal numbers have more than doubled in size since the last survey in 1999. The proposed project will deliver the most comprehensive population survey of NZ fur seals conducted to date, to allow us to estimate population abundance and determine population trends across the state. It will highlight the growth areas of NZFS populations (at the scale of individual colonies) as well as the range increases that are already evident on the west coast of WA. The information sought will also be used to determine the geographical variation in the rate of change of pup production at individual colonies and the density-dependent rate of growth at colonies (based on density estimates measured at colonies). Further understanding of the role of colony size and density along with geographical and oceanographic factors will allow us to predict where population increases and range expansion are likely to occur in the future. This will help wildlife managers better understand the effects of this population expansion for NZFS conservation management programs. Furthermore, it will assist resource managers to assess the potential consequences of a large, expanding population of top-order predators on south coast fisheries and the likely changes in interaction rates.

The current decadal cycle of population survey is considered too coarse to understand the effect of environmental variation on pup production. This prevents us determining the real rate of population increase as this species displays considerable inter-annual variability in pup production rates due to varying environmental conditions (i.e. Sea surface temperature and upwelling events). Analyses of the data from this survey, along with the previous two surveys, will allow us to design a more cost-effective methodology so that future surveys assess the abundance and distribution of NZFS populations at the appropriate spatial and temporal scales.

The proposed project also offers an opportunity to undertake *ad hoc* observations of the breeding status of sympatric Australian sea lion (ASL) colonies. This provides important information on the distribution and timing of the breeding cycle among this threatened species (listed as vulnerable under Commonwealth legislation). This information is necessary to determining breeding locations and survey times for subsequent DEC assessments of this endangered species.

#### Aims

This project aims to obtain a better understanding of the distribution, current condition (i.e. abundance and reproduction) and long-term trends of the NZFS population in WA. The survey will also contribute to the development of a more cost-effective monitoring program for NZFS populations in WA.

## Summary of progress (2009/10) and main findings

The field survey was initially planned for January/February 2010 but was cancelled due to a lack of funding. However, the preliminary planning that was undertaken helped secure additional funding to ensure the survey is carried out during January/February 2011.

## Management implications

This project will allow DEC to obtain a better understanding of the current condition (i.e. abundance and reproduction) and long-term trends of the NZFS population in WA. This will help inform conservation programs for this species. The survey will also contribute to the design of a more cost-effective, long-term monitoring program for future surveys. The survey will also provide further data to better understand how natural and anthropogenic, including climate change, pressures are influencing the abundance and distribution of this species. This information will allow DEC managers to better understand interactions with commercial fishing operators and to manage this interaction more effectively.

## Future directions (next 12-18 months)

- Contract a scientist to coordinate and lead the project over the next 12 months, including implementing the following activities:
- Collate and re-analyse historical time-series of NZFS datasets with the aim of developing a more cost-effective monitoring survey of NZFS;
- Plan and implement a NZFS survey of breeding colonies across the entire south and southwest coasts of WA in early 2011; and
- Train DEC regional staff on the south coast in pinniped survey techniques to facilitate future monitoring of NZFS.

## 2.18 Monitoring the impacts of dredging on fish and benthic communities in relation to the Gorgon development

Core project

Team members

K Friedman (0.1), K McAlpine (0.5), Ben Fitzpatrick (0.5), George Shedrawi (0.5),

#### Context

The Montebello/Barrow islands are situated in the Pilbara Offshore marine bioregions (IMCRA, 1997) approximately 1,600km north of Perth. The waters and reefs surrounding these remote islands are characterised by geomorphological and oceanographic conditions which provide a diverse range of marine habitats for a variety of both widely distributed and endemic tropical marine species. The marine environments are generally considered to be in a relatively undisturbed condition as a result of low human usage and strict management controls on industry activities in the area. The Montebellos Islands Marine Protected Areas (MBIMPA), incorporating the Montebellos Marine Park, Barrow Island Marine Park and the Barrow Islands Marine Management Area, were established in 2005 and the conservation and management objectives for these MPAs are expressed in MBIMPA's management plan.

The Gorgon Gas Project (GGP) which is based on Barrow Island is one of the world's largest natural gas projects and the largest single resource natural gas project in Australia's history. The plant will include three, 5 million-tonne-per-annum LNG trains, with domestic gas piped to the mainland, and a four kilometre long loading jetty for international shipping. The final environmental approvals for the Gorgon Project were awarded by the Western Australian and Federal Governments in August 2009. A final investment decision (FID) was made by Chevron and industry partners in September 2009.

The GGP includes a dredging program that will involved the removal and dumping of ~ 7.5 M tonnes of marine sediment over a period of approximately 18 months and started in June 2010. The conditional approval for the GGP included conditions for environmental compliance monitoring programs (including a marine baseline project and a 'near-field' marine monitoring program by Chevron) and a number of environmental offsets, one of which was a total of \$2.5 M over three years to DEC to assess the potential impacts of the dredging on the marine biodiversity of MBIMPA.

The Gorgon Dredging Offset Monitoring Evaluation and Reporting Project (Gorgon MER) provides an opportunity to investigate the potential impacts of the dredging and dumping activities on the marine communities of the MPAs (i.e. the 'far-field'). The Gorgon MER project will also help inform future environmental impact assessments (EIA) of comparable projects by regulatory and management agencies by improving predictions of the spatial scale and nature of the likely impacts of these projects on sensitive marine communities. Additionally, this project will increase the knowledge base of the marine environment of the MBIMPA.

#### Aims

**Primary** 

 To assess the nature and extent of potential impacts of the Gorgon dredging program on the condition<sup>2</sup> of coral, fish and other important ecological (if appropriate<sup>3</sup>) communities of MBIMPA.

<sup>&</sup>lt;sup>2</sup> Asset condition includes structure and functions

<sup>&</sup>lt;sup>3</sup> Current focus is on corals and fish but other ecological (e.g. macroalgae) and social assets should be considered. This will involve collation and assessment of existing marine habitat data in areas of interest.

- To determine the cause/s, with a particular focus on dredging, dumping and re-suspension
  of spoil, of any changes in the condition of the above communities
- To assess the effects of potential confounding natural (e.g. cyclones, disease, predation, bleaching) and other anthropogenic (e.g. fishing) pressures on the condition of coral communities of MBIMPA.
- To assess the nature and extent of the impacts from the Gorgon dredging program on the social assets (if appropriate<sup>2</sup>) of the MBIMPA.

## Secondary

- To ensure that the Gorgon MER is integrated with the DEC Western Australian Marine Monitoring Program (WAMMP).
- To ensure, where possible, that the Gorgon MER is complementary to industry compliance monitoring programs
- To contribute data, as appropriate, to the development of a strategic capability for predicting the impact of dredging and dumping on shallow tropical communities.

## Summary of progress and main findings

Two surveys to Montebello/Barrow islands MPAs, in November 2009 and in April 2010, resurveyed over 20 monitoring sites that were initially established and surveyed in December 2006. These three surveys provided data on the condition of the coral and fish communities before dredging began (June 2010). The analysis of these data is underway and preliminary indications suggest that the coral communities have remained largely undisturbed over the past three years. These data will be presented to the MPRA 2009/10 Annual Review in October 2010.

Surveys of the condition of the coral and fish communities and a range of natural and anthropogenic pressures (particularly sediment deposition rate) will continue over the next 2-3 years to assess the potential impacts of the dredging and dumping activities on the marine biodiversity of these MPAs.

## Management implications

The program provides a baseline for assessing potential impacts and recovery of key benthic and fish communities within the Montebello/Barrow Islands MPAs, with a particular focus on potential impacts related to the dredging program associated with the development of the Gorgon LNG Plant on Barrow Island. It also provides information that will assist DEC with the management and protection of the Montebello/Barrow Islands MPAs into the future.

## Future directions (next 12-18 months)

At present a Science Project Plan (SSP) is being developed to detail the experimental design to be implemented over the life of the project. The experimental design will take into account the data that has been collected by a range of programs in the area including the Baseline State and Environmental Impact Report and the Dredging and Spoil Disposal Management and Monitoring Plan. This will ensure that the data collected will complement the data that is presently available in the area which will be made available to DEC during the life of the dredging program. The SSP will be externally reviewed to ensure scientific robustness of the experimental methods proposed.

# 3. REGIONAL MARINE SCIENCE PROJECTS, ACTIVITIES AND OUTPUTS

Section 3 outlines the science projects, activities and outputs that are being undertaken by the Regional Service Division. Projects are initiated at the District/Regional level. These project updates have been provided to the Marine Science Program by DEC regional staff who are responsible for these projects.

## 3.1 Kimberley

No current projects

## 3.2 Pilbara

## 3.2.1 Monitoring of the Ningaloo Marine Park whale shark industry and whale sharks (*Rhincodon typus*) through industry data

SPP #: (to be allocated)
Core project

Team members
J Wildforster, E Wilson

#### Context

The whale shark (*Rhincodon typus*) is listed as a threatened species under WA State legislation and protected under Australian Commonwealth legislation. Internationally, the conservation status of the whale shark is recognised as "vulnerable" in the World Conservation Union Red List of Threatened Species.

The Department of Environment and Conservation (DEC) is responsible for the management of whale shark tourism interactions in the Ningaloo Marine Park under the *Wildlife Conservation Act 1950*. Whale sharks are seasonally present in this marine park and these animals have become the focal point for a tourism industry that provides in-water experiences with whale sharks. DEC developed a whale shark management program in 1997 to monitor and manage human interaction with whale sharks and the industry that provides these experiences. A primary objective of the management of the whale shark interaction program is ensure that any potential impacts on individuals and the overall Ningaloo 'population' are identified in advance so that an adaptive management regime can be applied.

Every whale shark interaction conducted throughout the season is required by license conditions to be recorded in vessel logbooks by each commercial operator. This data has been recorded since 1995. However, the data required to be recorded by the operators have been changed several times over the past decade to improve the quality of the data collected. In 2008 the logbook data was finally reviewed to coincide with the development and implementation of an electronic monitoring system (EMS) to replace logbooks in 2009. Spotter pilot data has been collected from 2002 onwards.

## Aligns with

Corporate Plan: Strategy/s: 1.2, 1.3, 2.3, 7.4, 8.4, 8.5;

Management Plan for the Ningaloo Marine Park and Muiron Islands Marine Management Area

2005-2015: Strategy: 7.1.15

Whaleshark Interaction Management Program No 27.

#### Aims

This project aims to review the existing whale shark industry logbook data to evaluate the utility of the data to determine industry trends and ecological parameters relating to whale sharks while in Ningaloo Marine Park. The objectives of the project are:

- to ensure ecological data collected through the whale shark interaction industry has scientific applications; and
- to determine sources of error within the existing vessel logbook data set so that data accuracy and interpretation may be improved in the future.

## Summary of progress and main findings

Due to commercial whale shark tours operating into August this year there has been a delay in data processing and analysis. Data will be available by the end of October.

## Major activities and outputs

- An annual progress report: Whale Shark Interaction Management Program No 27
- Season updates.

## Management Implications

Monitoring industry trends within the whale shark industry at Ningaloo Marine Park has been ongoing since 1995. In regards to ecological parameters, the data can now provide an indication of intra- and inter-seasonal variation in relative abundance. Passenger levels will give an indication of when the carrying capacity of the industry has been reached and what, if any, impacts this will have on whale shark interactions. Estimated whale shark size and gender data has been collected in vessel logbooks and some uncertainty in regards to error sources requires further analysis and research for accurate interpretation of this dataset.

DEC cautions any researcher wishing to derive statistically valid results from the log book/EMS data set to familiarise themselves first with the sources of data errors. The log books were not intended to provide stand alone scientifically rigorous population modelling but rather were developed to reflect industry trends. Little effort has been spent in the past to either train recorders or verify that data recording is occurring with accuracy and consistency. Further reviews of the EMS data and collection method are in progress to ensure that information gathered is accurate and useful to scientists and decision-makers involved in the conservation management of the whale shark of Ningaloo.

#### Future directions

- Review transition to EMS and analysis of 2009 data;
- Finalise 2009 annual report;
- Amend EMS to improve data collection and quality by simplifying design prior to 2010 season;
- Continue to collect and analyse data during 2010 season;
- Further analysis of aerial data to provide better search effort data that can be correlated with other factors that may have an influence on inter-seasonal variability of relative whale shark abundance; and
- Undertake more detailed size data analysis and accurate length measurements of whale sharks to assist with management actions to address the indicative trend of reduced average size.

## 3.2.2 Monitoring of Coastal Camping along Ningaloo Coast

SPP #: (to be allocated)

Core project

Team members

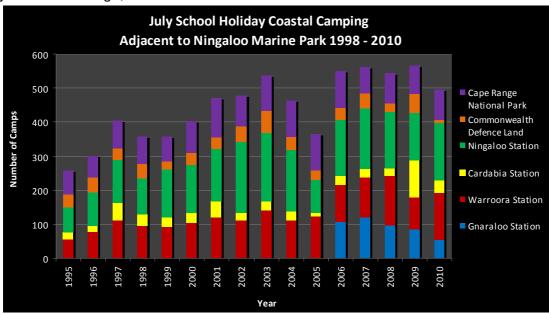
M. Hughes, R. Mau, H. Taylor

#### Context

In order to ascertain the level of visitation in the Ningaloo Marine Park, it is important to understand the level of camping activity on the adjacent pastoral lands to the Park. A systematic monitoring program has been in place for 15 years, collecting counts of coastal camping and identifying trends in recreational activities along a set path within the April, July and October school holidays every year.

## Summary of progress and main findings

There has been in increase in the numbers of campers on the Ningaloo coast over the past 15 years. On average, there is almost twice the number of visitors that in 1995 in 2010.



## Major activities and outputs

- Coastal flights from the northern boundary of NMP to Red Bluff, on the southern boundary, are conducted on the same days in each school holiday period each year;
- The district patrol log is completed, with counts of camps, vehicles, boats, fishers, passive retreaters, commercial tours etc collection for each delineated section of the NMP.

## Management Implications

Increased education and compliance activities will occur in peak periods and locations over time.

## 3.3 Midwest

## 3.3.1 Monkey Mia Dolphin Monitoring Program

SPP #: (to be allocated)

Core project

## Team members

L. Bejder, D. Holley

#### Context

The reduction in the number of commercially licensed operators in the Red Cliff Bay area off Monkey Mia was undertaken in response to research findings evaluating long term impacts of vessel activity on Dolphins. This management action was based mainly on 2 findings: 1) a statistically significant decline of 15% (equivalent to 1 in 7 individuals) in the use of Red Cliff Bay by individual dolphins during a time period when vessel activity doubled; and 2) female dolphins with high exposure to vessels are less successful at reproducing compared to the lower exposed females.

Follow up research is required to evaluate the effectiveness of management actions taken by DEC to restore dolphin abundance and reproductive success in Red Cliff Bay.

Specifically the objectives of this research are:

- To estimate the relative abundance of bottlenose dolphins in both 'control' and 'tourism' areas off Monkey Mia subsequent to management actions;
- Compare relative dolphin abundance estimates in both 'control' and 'tourism' areas before and after implementation of management actions; and
- To evaluate whether management implementations reverse the documented negative impacts on female reproductive success of cumulative tour and research vessel exposure.

## Aligns with

Corporate Plan strategy/s: 1.2, 2.3, 8.4, 8.5; KRA1, KRA2.

Science Division Strategic Plan strategy/s:

Shark Bay Marine Park Management Plan strategy/s: SBMR MP s5.5.7

## Summary of progress and main findings

This project is 1 year completed of a 5 year program. Year one was to have provided compiled datasets from the first year as well as cleaned and analysed data collected by others through the Dolphin Research Foundation. Difficulties have been encountered by the project leader in accessing datasets, resulting in a delay of the first annual report. It is anticipated that this report will be produced by the end of the calendar year.

## Major activities and outputs

Currently no reports have been produced. Some initial data analysis has been undertaken on dolphin abundance and distribution.

## Management Implications

This project will provide the appropriate post analysis of the reduction of tour operators in the Monkey Mia exclusion zone. The desired response would be a return to or increase in abundance levels to those before the introduction of a second tour vessel within the Red Cliff Bay Area.

## Future directions

The 1<sup>st</sup>, 3<sup>rd</sup> and 5<sup>th</sup> annual reports will outline summaries of the cleaned up and compiled datasets from each year- based on data provided by the Shark Bay Dolphin Research Group. This data will include the number of dolphin groups encountered within the defined 'tourism' and 'control' areas.

The 2<sup>nd</sup> and 4<sup>th</sup> annual reports will include relative dolphin abundance estimates within defined 'tourism' and 'control' areas and comparisons of relative dolphin abundances within both areas between two-year time blocks.

The annual report from the 4<sup>th</sup> and 5<sup>th</sup> year will include a complete analysis that will allow comparison of relative dolphin abundance within the defined areas.

The annual report from the  $3^{rd}$  and  $5^{th}$  years will include the female reproductive success analyses.

## 3.3.2 Shark Bay Loggerhead Turtle Tagging Program

SPP #: (to be allocated)

Core project

Team members

D. Holley (0.1) SB District Staff

#### Context

In 1994, the Department of Environment and Conservation (DEC) initiated as part of the Western Australian Marine Turtle Program (WAMTP) a tagging program of nesting female loggerhead turtles at Turtle Bay, Dirk Hartog Island. The tagging program utilises a mark and recapture methodology to estimate the population size based on the ratio of tagged and nontagged turtles surveyed annually. During each survey female turtles are intercepted as they come up on the beach to nest. Turtles are marked using small uniquely numbered titanium turtle tags attached to the trailing edge of the fore-flipper(s) allowing turtles to be individually identified and monitored over time. The tag number/s, carapace length and condition of each turtle surveyed are entered into the WAMTP database each year. The timing of the program corresponds with a peak in the annual December to April loggerhead turtle nesting season. The WAMTP database currently holds 14 years of tagging data (approximately 6,000 records for turtles tagged at Turtle Bay since 1994) which can be used to monitor the size and health of the loggerhead turtle population nesting at Turtle Bay. The development of a long term data set is essential for undertaking effective management and determining management effectiveness, given that change in turtle population abundance/health is only detectable over long periods. given their reproductive biology and longevity.

## Aligns with

Corporate Plan strategy/s: 1.2, 2.3, 8.4, 8.5; KRA1, KRA2.

Science Division Strategic Plan strategy/s:

Business Plan project no:

Shark Bay Marine Reserves Management Plan strategy/s: s5.5.4

## Summary of progress and main findings

Since 1994, with the exception of 1995 and 2006, the program has been conducted annually over a two week period in January. The WAMTP dataset has not been analyzed and as such there is not a current reliable estimate of the status of the Turtle Bay loggerhead turtle nesting population. The future analysis of this long-term dataset will need to address issues relating to a change in methodologies between 2004 and 2007 which reduced sampling effort from five beaches to two.

## Major activities and outputs

Annual mark recapture program continued during the 2010 nesting season, with all five nesting beaches surveyed over 1000 migrant and re-migrant turtles surveyed.

#### Management Implications

The Turtle Bay nesting population of the endangered Loggerhead turtle represents the largest rookery of this species in WA. Monitoring of this population is vital for long term maintenance of the species.

#### Future directions

- Define peak period for breeding season through use of remote camera monitoring;
- Continue with the 20010/11 nesting season program; and
- Assess validity of current mark recapture program for long-term monitoring against budget expenditure and personnel requirements. An assessment will be made as part of state-wide turtle monitoring and research program.

## 3.3.3 Jurien Bay Marine Park Australian Sealion Pup Counts.

SPP #: Unknown

#### Team members

I Hatch, L Butcher, G Ingliss, K Crane, E Richardson, S Glac, M Dasey, and other DEC Moora district staff.

## Context

Through anthropogenic pressures the west coast distribution of Sea Lions (*Neophoca cinerea*) has contracted to a few breeding colonies. Two of these colonies are within Jurien Bay Marine Park (Buller Island and North Fishermans Island) and a third (Beagle Island) is close to the park. The species is known to have a low fecundity and show extreme reproductive site-fidelity. This site fidelity is such that where a localized extinction has occurred recolonisation of that site from other colonies is not thought to be possible. Any decline in reproductive output from an individual colony therefore represents a significant threat to the species as a whole and needs to be identified. The following monitoring has been conducted by JBMP staff: three breeding colonies are visited at least twice through the pupping season and counts are made of live newborn, moulted pups and dead pups.

## Aligns with:

Jurien Bay Marine Park Management Plan Number 49: Strategy/s: 7.1.9/3 (Monitor trends in sealion pup production each breeding season); 8.5/1 (Develop and implement a prioritized monitoring program of key values and processes.)

## Summary of progress and main findings

- Annual pup production is stable at approximately 140 to 180 pups per season at the three islands in/near JBMP.
- Data has been provided to external researchers for value-adding.

## Major activities and outputs

• Strategy 7.1.9/3 has been achieved by this program (Monitor trends in sealion pup production each breeding season.).

## Management Implications

The main pressures on Sealion populations are thought to be from fishing. Commercial and recreational Western Rock Lobster (WRL) fishing places pressure on Australian Sealions in two ways: Pups may drown in cray traps; and there may be competition for food - crayfish are thought to be a key component of Sealion diet. Exclusion devices on craypots in the area are now widely accepted by the community and this would've prevented deaths of some sub-adults each season. However, pressure on WRL stocks by over fishing could lead to declines in Sealion fecundity, which would require a management response.

## Future directions

This is an ongoing program intended to run every breeding season. The next season is in mid/late 2011.

## 3.3.4 Jurien Bay Human Use Monitoring Program

SPP #: Unknown

#### Team members

I Hatch, L Butcher, G Ingliss, K Crane, E Richardson, S Glac, M Dasey

#### Context

Quantifying the spatial and temporal intensity of usage in and adjacent to Jurien Bay Marine Park has been conducted since 2003/04 using five main methods:

- Aerial surveys / counts of park visitors, including vehicles, camps, and vessels. There have been 48 flights April 2004 to June 2010 and records are in GIS system. Each aerial survey covers approximately 500 km² and records the location activity in the marine park or on adjacent lands.
- 2. The continuous recording of trailer traffic at Jurien Bay Marina (*MetroCount* data). There is almost continuous data recording from 12<sup>th</sup> September 2005 to July 2010, with two gaps of 9 weeks in total in all over 1600 days of data.
- 3. Land-based patrols and recording of visitors. Sporadic records mainly from 2004;
- 4. Gathering and collation of park visitor records from sea rescue and nearby camp grounds. Annual stats from Jurien Coastal Patrol and Sandy Cape camping 2004-2006.
- 5. Face-to-face interviews of park users. One series of interviews Easter 2003.

The data generated from this monitoring program is used to benchmark park visitation and identify areas of high use. Aerial flight records also contain information on illegal/informal camps, cray pot locations, watercraft, vehicles and boat trailers so a variety of management issues can be addressed with the data.

## Aligns with:

Management Plan Number 49 (JBMP) strategy/s:

- 8.5/2 (H-KMS: Develop and maintain a database of human usage);
- Activity Code EC1 Human Use Impacts

## Summary of progress and main findings

- All data for the surveys has been loaded onto databases and several GIS layers for each aerial survey have been created. Analysis has been performed on some of the data and correlations between data recorded in different methods have been used to extrapolate where data gaps exist.
- The surveys have quantified the number of number of visitors to different parts of the marine park in each month of the year. Clear annual patterns of park visitation have been identified and it is possible to extrapolate the date to estimate the total annual number of visitors to the park.
- The number of records of trailer movements are highly correlated (R<sup>2</sup> >0.75) with counts taken on simultaneous aerial surveys of vessels, vehicles, and general visitor numbers.
- Strategy 8.5/2 (H-KMS: Develop and maintain a database of human usage) has been achieved.

## Major activities and outputs

No major published outputs have arisen from this work other than in-house analysis for annual reporting. Key periods in the year have been identified as highest use. No significant changes is total annual park visitation are apparent from the existing data for 2006-09.

## Management Implications

This data gathering provides a means to plan compliance and educational activities and provides evidence of stable park visitation rates through time. It has identified areas and periods of high/low use, poor compliance and has allowed quantification of the number of park visitors in each area.

## Future directions

#### For 2010-11:

- The MetroCount data gathering is to be continued at the same location near Jurien Marina,
- Between seven and 12 aerial surveys are planned for the year with recording of data as has been done previously,
- Data is to be consolidated and passed on to DEC GIS unit for wider distribution.

## 3.3.5 Jurien Bay MP Seagrass Monitoring Program.

SPP #: Unknown

#### Team members

I Hatch, L Butcher, G Ingliss, K Crane, E Richardson, S Glac, M Dasey; and researchers from Edith Cowan University under the direction of Kathryn McMahon.

## Context

The dominant primary producer in Jurien Bay Marine Park is the extensive beds of macrophytes which encompass several species with a variety of growth forms. These seagrass beds are range in depth from intertidal to over 10 metres in depth and are found throughout the park on sandy substratum. The health of the seagrass is a KPI in the management plan, so monitoring the health of these beds is of high importance. The monitoring program consists of:

- In Posidonia sinuosa beds at two locations (near Boullanger Island and near Fishermans Island) four permanent transects have been establish at three separate depths (12 transects at each location). Along each of the permanent transects six permanent steel quadrats (0.2m x 0.2m) have been placed and the seagrass shoots in each quadrat have been measured on a number of occasions.
- Within each quadrat the following measures are made: The number of shoots in the quadrat; the length of the longest seagrass leaf in the quadrat; an estimate of the percent cover in the quadrat.
- The field sampling has been conducted in 2003, 04, 05, 07, 08, and 2010.

## Aligns with:

Management Plan Number 49 (JBMP) strategy/s:

- 7.1.4/4, (KPI, H-KMS: Monitor Seagrass meadows in areas at most risk from mooring and anchor damage.)
- 7.1.4/2, (KPI, KMS: Educate users of the important ecological role of seagrass communities...)
- 8.5/1 (KPI, H-KMS: Develop and implement a prioritized monitoring program of key values and processes.)

## Summary of progress and main findings

- Prior studies independent to this program have been published internally by How and Lavery (2003 and 2004).
- Data compilation and analysis of JBMP data has been performed in 2007 by ECU and is presented in an internal data report.
- There are no clear overall temporal trends apparent from the data between 2003 and 2008 although there are some statistically significant differences between years at some depths.
- Benchmarking of some seagrass meadow parameters has been achieved by this program.

## Major activities and outputs

- Strategy 7.1.4/4 has been achieved (Monitor Seagrass meadows in areas at most risk from mooring and anchor damage).
- Strategy 7.1.4/2 has been partially achieved (Educate users of the important ecological role
  of seagrass communities...) in that relevant information is available for publication, and
  some has been published.
- Strategy 8.5/1 is being addressed (Develop and implement a prioritized monitoring program of key values and processes.)

## Management Implications

Values for some basic parameters of seagrass meadows have been benchmarked so that change in this might be detected.

#### Future directions

It is anticipated to continue this program in 2010/11, and then reassess the effectiveness of the design to meet the management targets.

## 3.3.6 Jurien Bay MP Biodiversity Monitoring Program (UTAS)

SPP #: Unknown

#### Team members

I Hatch, L Butcher, G Ingliss, K Crane, E Richardson, S Glac, M Dasey, K Bancroft (MSP), external researchers from The University of Tasmania – N Barrett, G Edgar *et al.* 

#### Context

The goals of this program were/are to both identify areas of high biodiversity and representation that are worthy of being protected and to monitor change in those places through time, through a BACI-style design. The program has had two main phases: there were approximately 25 sites monitored eight times between 1999 to 2009, and an additional 17 sites that have been monitored from 2004. In summary the program consists of:

- Diver fish surveys. These consist of swum transects of 200m long whereby the diver records the species of each fish seen and the approximate size of each fish.
- Diver macroinvertebrate surveys. Within randomly cast quadrats along 200m transects counts of species sea urchins, gastropods, corals, sponges and other classes of invertebrate were made.
- Diver macroalgae surveys. Percent algal cover for several classes are estimated along transects at a number of points.

The data generated from this program has been analysed in a variety of univariate and multivariate ways to yield a wide range of diversity and temporal change data. At the start of the program it was envisioned to run the project 5 year pre zoning and 5 years post zoning and this will be achieved in 2009.

### Aligns with:

Management Plan Number 49 (JBMP) strategy/s:

- 7.1.5/2, (Initiate research programs to quantify the floral and faunal diversity in macroalgal habitat in relation to developing management targets.)
- 7.1.7/2, (H-KMS: Undertake research programs to characterize invertebrate diversity in the marine park)
- 7.1.8/2, (KPI H-KMS: Undertake research programs to characterize finfish diversity in the marine park
- 8.4/3, (KPI H-KMS: Identify and communicate high priority scientific and social research projects to appropriate research organisations.)

### Summary of progress and main findings

All data management is undertaken by UTAS and no significant analysis or reporting has been performed by DEC staff. However, data reports have been provided and some published work has been released with the consent of DEC.

A trend of increasing mean size for Breaksea Cod and Silver Trevally through time in protected areas are reported and the lack of representative deeper areas in sanctuary zone are key findings.

- Strategy 7.1.5/2, (H-KMS: Initiate research programs in macroalgal habitats) has been achieved.
- Strategy 7.1.7/2, (H-KMS: Characterize invertebrate diversity...in the marine park) has been achieved.
- Strategy 7.1.8/2, (KPI H-KMS: Characterize finfish diversity...in the marine park) has been achieved.
- Strategy 8.4/3, (KPI H-KMS: Identify and communicate research project) has been achieved.

### Major activities and outputs

Several internal data reports have been compiled and provided to JBMP.

#### Management Implications

Future rezoning of JBMP could be based on this program.

#### Future directions

The program is reaching its planned end in 2010.

### 3.3.7 Jurien Bay MP Water Quality Benchmarking Program

SPP #: Unknown

#### Team members

I Hatch, L Butcher, G Ingliss, K Crane, E Richardson, S Glac, M Dasey; K Bancroft (MSP), R Masini (MEB).

#### Context

The biota of the bioregion in which Jurien Bay Marine Park is situated has evolved in an environment with very little nutrient input having few riverine sources of terrestrial nutrients. The resultant clear water and low water nutrient concentrations have favoured the growth of extensive macrophyte beds in areas that might otherwise be dominated by macroalgae or bare substratum. Changes to water clarity and nutrient concentrations are known threats to

macrophyte beds. Two water quality benchmarking programs have been conducted on different spatial and temporal scales:

- 2004/05 Monthly sampling was conducted over a 12 month period at 19 sites with analysis for toxicants, nutrients and physico-chemical WQ. Data includes: TSS, PAR, OC, NH<sub>3</sub>, NOx, OP, Chl-a, Conductivity, Temperature, DO for most sites in monthly sampling.
- 2006, 08, 09. Four sites have been sampled over a 2 month period which included sites that
  had been sampled in the 2004-05 program. Data includes: TSS, PAR, OC, NH<sub>3</sub>, NOx, OP,
  Chl-a, Conductivity, Temperature, DO for most sites in weekly sampling spread over 2
  months.

### Aligns with:

Management Plan Number 49 (JBMP) strategy/s:

- 7.1.2/3. (KPI, H-KMS: Establish baseline water quality monitoring program in relation to nutrient enrichment.)
- 8.5/1 (KPI, H-KMS: Develop and implement a prioritized monitoring program of key values and processes.)

### Summary of progress and main findings

- Data compilation and analysis has been performed in some depth for the 2004-05 data and this showed that the overall the water quality of the area was good. The Jurien Marina was identified as have eutrophication and algae problems. Presented in Data Report: MMS/CWC/JBMP-83/2005
- Analysis of the 2006-09 data found that there were no clear temporal or spatial trends in the study period and that for many nutrient analytes the concentration of nutrients was close to or below analytical detection limits. In particular N as NOx and NH<sub>3</sub> were not present in measurable concentrations in most samples for 2009. Chl-a was low and variable but above detectable limits in the study period. The concentration of Chlorophyll a was greatest at the site closest to Jurien Bay town (PI3) and this could constitute an impact of nutrient enrichment from the community, though the concentration was below acceptable limits (mean of 0.56 μg/L).

### Major activities and outputs

- Strategy 7.1.2/3 has been achieved (Establish baseline water quality monitoring program in relation to nutrient enrichment) and a possible location of nutrient enrichment to the nearshore waters has been identified.
- Future changes in water quality parameters can be identified from established baseline data.

#### Management Implications

The suspected low ambient nutrient status of the area has been verified and benchmarked for many sites in the marine park. The low rate of nutrient inputs to the system because of low runoff is a characteristic of the ecology is identified as a key process in maintaining the macrophyte beds in these locations.

### Future directions

There is no plan to continue with the existing water quality monitoring program until 2011 as it is thought that sufficient data has been gathered for benchmarking.

### 3.3.8 Abandoned, Lost or Discarded Fishing Gear (ALDFG) Monitoring Program

SPP #: Unknown

### Team members

M Dasey, S Glac, R Koch, other district staff and Conservation Volunteers Australia

#### Context

In 2009 the United Nations Environment Program (UNEP) identified Abandoned Lost or otherwise Discarded Fishing Gear (ALDFG) as a common global threat to many aspects of marine ecological processes. This includes entanglement risks to marine mammals and the introduction of plastics to marine food chains. As well, ALDFG from local commercial rock lobster fishers is an unsightly feature of many of Jurien Bay Marine Park's beaches and represents a significant impact to the natural values of the area. This program is designed to both (a) remove plastics and ALDFG that could pose a threat to marine ecosystems, and (b) improve the amenity and natural values of areas of high recreational use. As well using UN protocols some sites have been sampled to classify and quantify waste to monitor future changes in behaviour, The intention is to remove ALDFG from all 90km of the park's beaches by 2011:

- October 2009 with Conservation Volunteers Australia 30km of beach was visited and all ALDFG and litter was removed.
- March 2010 Conservation Volunteers Australia and DEC removed waste from a further 12km of beach.
- October 2010 Conservation Volunteers Australia and DEC removed waste from a further 20km of beach.

### Aligns with:

Management Plan Number 49 (JBMP) strategy/s:

- 7.1.3. (KPI, H-KMS: Develop an appropriate understanding of the circulation and mixing of the marine park's waters.)
- 8.5/1 (KPI, H-KMS: Develop and implement a prioritized monitoring program of key values and processes.)

### Summary of progress and main findings

- Data compilation is currently underway and no reporting has been commenced.
- Significant amounts of floats and ropes from commercial and recreational fishing have been found in the surveys,
- ALDFG and litter has been found to accumulate at shoreline features such as headlands,
- Locations of high-deposition of ALDFG have been identified and can form the focus of ongoing efforts.

### Major activities and outputs

- Strategy 7.1.2 has been partially achieved (Develop an appropriate understanding of the circulation and mixing of the marine park's waters.) and a knowledge of where accumulations of ALDFG occur has been established.
- Future changes in ALDFG deposition can be identified from established baseline data.

### Management Implications

The removal of entanglement hazards reduces risks to Australian Sealions in the marine park. By restoring the amenity value of places with high-recreational use social values of the reserve are also enhanced. This program has been used to engage the community and could be used to raise awareness within the fishing industry of the problems associated with rogue fishing gear.

### Future directions

The intention is to visit all beaches of the marine park and remove ALDFG and recreational litter from them by 2011.

### 3.4 Swan

No current projects

### 3.5 Southwest

No current projects

### 3.6 South

No current projects other than joint research with MSP detailed in the section above.

### 4. CURRENT COLLABORATION WITH ACADEMIA

DEC Officer	Student	Project Title	Degree/ level	Duration	University Academic	University
Simpson, Chris	A Hill	Factors influencing the establishment of marine protected areas in Western Australia	PhD	2007- 2009	Dr S Shea	Notre Dame University
Alan Kendrick, Mike Rule	various	Marine & Coastal Management Course	3 <sup>rd</sup> yr	2010	A/Prof G Hyndes/ Prof P Lavery	Edith Cowan University
Simpson, Chris; Kendrick, Alan; Wilson, Shaun; Waples, Kelly	various	Science Connections: Marine Science Mentoring Program	U/grad.	2009	Dr M van Keulen	Murdoch University

### 5. EXTERNAL PARTNERSHIPS

Partnership Name	Project	Cash funding and source (\$)	DEC Involvement (in kind)
Aust. Institute of Marine Science	Coral reef fish recruitment study		S Wilson (0.1) T Holmes (0.1)
Aust Marine Science Assoc. (WA)	Rottnest Young Scientist Workshop	\$500 sponsorship (MSP)	T Holmes (0.01)
Birds Australia	Shark Bay Shorebird Survey	\$2k	K Onton (0.03) \$6500 in kind DEC Shark Bay District
CSIRO Marine and Atmospheric research	What is the role of predators at Ningaloo and how are they impacted by human use?	\$ 55K in kind	\$ 10K S Wilson (0.1) T Holmes (0.1)
Department of Fisheries, WA	Resource Condition Monitoring of Mangroves in Northwest Australia	Nil	K Friedman (0.02)
Edith Cowan University	Monitoring movement patterns of marine fauna using Vemco VRAP Acoustic tracking system	Nil	A Kendrick (0.01) S Wilson (0.01)
Edith Cowan University	Spatial and temporal patterns in benthic invertebrate communities of the Walpole and Nornalup Inlets Marine Park		A Kendrick (0.05), M Rule (0.05) 2.5 K
James Cook University	Monitoring fish and coral communities at Trunk reef	\$ 2K	S Wilson (0.05)
Kimberley Land Council	Movement behaviours and habitat usage of West Kimberley dugongs: A community based approach	\$129,990 (Australian Marine Mammal Centre- AMMC for 2 years2009-10, \$30,000 Woodside Energy	\$5500 in kind –vessel use D Holley (0.1), S Wilson (0.05)
Murdoch University	Monitoring management effectiveness: Monkey Mia dolphins	\$15k-\$25k p.a. for six years (2006/07- 2012/13) (from Shark Bay Marine Park budget)	C Simpson
Murdoch University	An ecosystem approach to estimating the viability of dolphin populations exposed to industrial/port activities	\$10k p.a. for three years (2007-2009)	C Simpson
Murdoch University	Little Penguin Study: Development of a monitoring protocol	\$27.5k for three years (2006-2008)	C Simpson
University of Western Australia	Assessing fish communities in Shoalwater Islands Marine Park	Nil	K Friedman (.01 ) A Kendrick (.01 ) S Wilson (0.01) M Rule (.05 ) K Bancroft (0.01) T Holmes (0.05) \$12k DEC
University of Western Australia	Assessing fish communities in Marmion Marine Park		K Friedman (.01); \$4k DEC

## 6. SUMMARY OF RESEARCH PROJECTS BY DEC AND NRM REGIONS

DEC Region	NRM Region	Project Title			
Pilbara	Rangelands	WAMSI Node 3: Science administration, coordination and integration			
Midwest, Pilbara, Kimberley,	Rangelands,	Conservation of marine turtles in Western Australia			
All	All	Development of a strategic marine research plan for the Western Australian Department of Environment and Conservation:2010-2015			
All	All	Strategic plan for the development and implementation of the Western Australian Marine Monitoring Program (WAMMP)			
All	All	WAMMP Sub-project 1: Asset knowledge review and standard operating protocol documentation			
All	All	WAMMP Sub-project 2: Historical time-series development			
All	All	WAMMP Sub-project 3: 'Fit to Park'			
All	All	WAMMP Sub-project 4: MPRA/DEC audit support			
All	All	WAMMP Sub-project 5: community participation			
All	All	WAMMP Sub-project 6: MSP Data management and presentation			
All	All	WAMMP International Commonwealth and State initiatives			
Warren	South Coast	Spatial and temporal patterns in benthic invertebrate communities of the Walpole and Nornalup Inlets Marine Park			
Swan	Perth	Spatial and temporal patterns in the structure of intertidal rocky platform communities of the Shoalwater and Marmion marine parks			
Pilbara	Rangelands	Interactive effects of fishing and climate change on reef fish populations			
Pilbara	Rangelands	Preliminary assessment of diseases affecting Western Australian corals			
Midwest	Rangelands	The biogeography of Shark Bay Marine Park mangrove communities			
Warren, Swan	Perth, South Coast	Knowledge transfer and uptake of recent temperate marine research			
Warren	South Coast	South Coast Pinniped survey			
Pilbara	Rangelands	Monitoring impacts of dredging on fish and benthic communities in relation to the Gorgon Gas Development			

### 7. SUMMARY OF SIGNIFICANT ACHIEVEMENTS FOR 2009/10

### **ACHIEVEMENTS**

Increased output of publications of results of research

Progressive implementation of integrated tropical and temperate marine research plans

Progressive implementation of an integrated marine monitoring plan for WA MPAs and threatened marine fauna

Completion of major research projects in WAMSI Node 3: Ningaloo Research Program

Implementation of a framework to facilitate better transfer of science into policy, planning and management

### 8. PRIORITIES OVER THE NEXT TWO TO THREE YEARS

#### PRIORITIES OVER THE NEXT 2 TO 3 YEARS

Continue to build capacity in the Marine Science Program

Progressive implementation of integrated tropical and temperate marine research plans across WA

Ensure research and monitoring programs associated with Gorgon Turtle and Dredging Offsets and Pluto Offsets to DEC are implemented

Progressive implementation of WAMMP in all MPAs and threatened marine fauna

Appoint a senior scientist to coordinate DEC-supported turtle research

Implementation of the knowledge transfer framework to promote uptake by DEC marine managers of recent temperate and tropical research programs in WA

Appoint a senior scientist to coordinate DEC-supported marine mammal research

Completion of WAMSI Node 3 Summary and Synthesis Report by 30 June 2011

Initiate a major program of marine research in the Kimberley region in 2011/12.

Building strategic alliances with outside research providers (e.g. CSIRO, AIMS and UWAOI)

Increase community involvement in DEC marine science programs through community monitoring and NRM groups

### 9. MARINE SCIENCE PROGRAM EXPENDITURE FOR 2009/10

Activity/Project Title	DEC Region	PI	Expenditure <sup>4</sup> (\$)
Marine Science Program administration	All	CSI	139,882
Committees/Advice/Ministerials etc	All	CSI	60,450
Program Leader contingency	All	CSI	80,955
WAMSI Node 3 Administration	Pilbara	KWA	10,000
WAMSI Node 3 Data management	Pilbara	KWA	0
WAMSI Node 3 Communication	Pilbara	KWA	0
WAMSI Node 3 Knowledge Transfer	Pilbara	KWA	14,463
Integrated Temperate Marine Research Plan	Midwest, Swan, South Coast	AKE	39,461
Jurien Bay MP Intertidal Reef Study	Midwest	AKE	0
Jurien Bay MP Knowledge Transfer Project	Midwest	AKE	0
Metro MPA Intertidal Reef Study	Swan	AKE	49,996
Shark Bay MPAs Mangrove Study	Midwest	AKE	34,996
Walpole/Nornalup MPA Study (TBD)	South Coast	AKE	50,687
Hamelin Pool MPA Ecosystem Study	Midwest	AKE	5,689
Integrated Tropical Marine Research Plan	Pilbara, Kimberley	SWI	49,336
Ningaloo Climate Change/Fishing Interaction Study	Pilbara	SWI	93,322
Ningaloo Coral Disease Baseline Study	Pilbara	SWI	38,511
Baseline Fish Survey of Rowley Shoals MPAs	Kimberley	SWI	9,811
Baseline Fish Survey of Montebello/Barrow MPAs	Pilbara	SWI	14,811
WA Turtle Project	Pilbara, Kimberley	BPR	39,827
Implementation of WAMMP Strategy	All	KFR	na
WAMMP: Knowledge review finalisation and standard operating protocol (SOP) documentation	All	KFR	66,511
WAMMP: MPRA/DEC Audit Support	All	KFR	23,572
WAMMP: Historical Timeseries Development (DEC/MPRA audit support)	All	KFR/KBA	81,750
WAMMP: Monitoring Program Implementation ('Fit to Park')	All	KFR	272,099
WAMMP: International/Commonwealth/State initiatives	All	KFR	5,150
WAMMP: Communication/community participation/liaison	All	KFR	15,080
WAMMP: Data management and presentation development	All	KFR	0
WAMMP: South Coast Pinniped Survey	South coast	KFR	23,599
TOTAL			\$1,219,958

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<sup>&</sup>lt;sup>4</sup> Includes all salary, equipment purchase and operational costs but does not include external funding

## 10. MARINE SCIENCE PROGRAM: SUMMARY OF BUDGET ALLOCATION AND EXPENDITURE FOR 2009/10

Budget expenditure exceeded individual MPA CF allocations in all cases (see below). The WAMMP projects are mostly cross-MPA projects and, as such, expenditure was split evenly across all MPAs, for convenience. Significant external funding was obtained for the Montebello/Barrow islands MPAs and the Ningaloo Marine Park.

MPA	Specific MPA CF Allocation (\$'000s)	Adjusted CF Expenditure <sup>5</sup>	External funding	TOTAL
Rowley Shoals Marine Park	0	132,360	0	132,360
Montebello/Barrow islands MPAs	160	137,360	~350,000 <sup>6</sup>	487,360
Ningaloo MPAs	350	318,672	~90,000 <sup>7</sup>	408,672
Shark Bay MPAs	80	163,234	0	163,234
Jurien Bay Marine Park	0	122,549	0	122,549
Metro MPAs	80	172,545	0	172,545
Walpole	30	173,239	0	173,239
MSP Core CF	520	-	-	-
Total	\$1,220	\$1,219,958	\$440,000	\$1,659,958

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<sup>&</sup>lt;sup>5</sup> Statewide component distributed across MPAs evenly (i.e. \$122,549).

<sup>&</sup>lt;sup>6</sup> From Gorgon Gas Development offsets funding to assess impacts of dredging program on MBIMPAs

<sup>&</sup>lt;sup>7</sup> From WAMSI Node 3 to manage Ningaloo Research Program

# 11. MARINE SCIENCE PROGRAM STAFF PRODUCTIVITY FOR 2009/10

#### MARINE SCIENCE PROGRAM: SCIENTIST PRODUCTIVITY REVIEW FRAMEWORK - Kim Friedman OUTPUTS FOR THE PERIOD - 1 July 2008 to 30 June 2009 Science Communication Knowledge Transfer Type Achievements (list) Type Achievements (list) Type Achievements (list) Advice (e.g. EIA, NRM etc) -SPP Media interviews Perth NRM: presentation on cross agency monitoring roles (verbal) Note to Ningaloo Regional Staff and Tour Operators on Long Term Coral Monitoring process and infrastructure Pamphlets/information Advice (e.g. EIA, NRM etc) -Data Report sheets/newsletters etc (written)) WAMSI Monitoring for Action Planning Committee Planning/Management Briefings/formal discussion guideline - (contributing Technical Report author) Friedman, K.J. 2009. WAMSI monitoring for action. http://www.wamsi.org.au/2009/monitoring-action-understandingwestern-australias-changing-marine-and-coastal-environments. Ram, R., Friedman, K. and Sobey, M.N. 2009. Impacts of Harvests and Post Harvest Processing Methods on Quality and Value of Bêche-de-mer in Fiji Islands. Proceedings of the 11th Pacific Web-based Conference Planning/Management Science Inter-Congress. 4p. guideline - (primary author) communications paper Dalleau, M., Andréfouët, S. Wabnitz, C.C.C., Payri, C. Wantiez, L., Pichon, M., Friedman, K., Vigliola, L., Benzoni, F. 2010. "Use of habitats as surrogates of biodiversity for efficient coral reef conservation planning in the Pacific Ocean islands." Conservation Species /Protected Area Biology 24(2): 541-552. management plans -Journal paper Second accepted. Fish and Fisheries Popular article (contributing author) Species /Protected Area management plans - (primary Milestone reports Book chapter author) Simpson, C., Friedman, K., Armstrong, S. (in internal review). Friedman, K.J. November 2010. "WAMMP" Western Knowledge Review relevant to the development of a monitoring, Australian Marine Monitoring Program Monitoring Strategies evaluation and reporting program in Western Australian marine for Active Adaptive Conservation Management of Marine protected areas: Coral communities. 64p Biodiversity in Western Australia. NRM Floreat. Friedman, K.J. November 2009. WAMSI monitoring for action. Cannell, B., Friedman, K., (in internal review). Knowledge Review http://www.wamsi.org.au/2009/monitoring-actionrelevant to the development of a monitoring, evaluation and understanding-western-australias-changing-marine-andreporting program in Western Australian marine protected areas: coastal-environments Little penguins. 47p Friedman, K.J. and Waples October 2009. Evidence Based Friedman, K., Huisman, J., (in internal review). Knowledge Review Management: strategies for active adaptive conservation relevant to the development of a monitoring, evaluation and management in reserve estate of Western Australia through reporting program in Western Australian marine protected areas: monitoring. Fifth WA State Coastal Conference Seagrass communities. 53p Sutton, P., Friedman, K.J. October 2009. Developing Collaborative Partnerships for Monitoring Marine Park Assets in Western Australia. Fifth WA State Coastal Conference Eriksson, H. De La Torre, C. Friedman, K.J. August 2009. Sea cucumber fisheries in the Western Indian Ocean, learning from the South Pacific. 6th WIOMSA conference in La Conference abstracts, presentations; Réunion. Ram, R., Friedman, K. and Sobey, M.N. 2009. Impacts of seminar/lecture Harvests and Post Harvest Processing Methods on Quality presentations: Poster/formal field day and Value of Bêche-de-mer in Fiji Islands. 11th Pacific Science Policy/Stratey statement Major review presentations Inter-Congress. (contributing author) Policy/Stratev statement (primary author) Book Paper reviews MEPS (abalone: 1), Aquaculture Research (sponges: 1)

### MARINE SCIENCE PROGRAM: SCIENTIST PRODUCTIVITY REVIEW FRAMEWORK - Shaun Wilson, Senior research scientist

Science		Communication		Knowledge Transfer		
Туре	Achievements (list)	Type	Achievements (list)	Type	Achievements (list)	
SPP	Effects of fishing and climate change on reef fish (SPP)  Preliminary assessment of diseases affecting Western Australian corals (SPP)	Media interviews	(100)	Advice (e.g. EIA, NRM etc) - (verbal)	2x research permits, advice to permits officer, regional marine parks coordinator	
Data Report	Preliminary assessment or diseases anecting western Australian corals (SPP)	Pamphlets/information sheets/newsletters etc	MundayPL, Cheal AJ, Graham NAJ, Meekan M, Pratchett MS, Sheaves M, Sweatman H, <b>Wilson SK</b> (2009) Climate change Marine report card-tropical fish	Advice (e.g. EIA, NRM etc) - (written))		
Technical Report		Briefings/formal discussion etc	11 x reviews for peer reviewd journal	Planning/Management guideline - (contributing author)	Underwood J, Wilson SK, Ludgerus L (completed draft) Guidelines for incorporating connectivity science into the conservation management of coral reefs in northwest Australia	
0	McClanahan TR, Ruiz SC, Cinner J, Maina J, Wilson S, Graham NAJ (2009) Managing	1A/-b-bd		Diam's a Management		
Conference paper	fishing gear to encourage ecosystem-based management of coral reefs fisheries. Proc 11th Int Coral Reef Symp 1: 1012-1016  Pratchett MS, Baird AH, Bradbury DM, Coker DJ, Cole AJ, <b>Wilson SK</b> (2009) Protracted declines in coral cover and fish abundance following climate-induced coral bleaching on	Web-based communications		Planning/Management guideline - (primary author)		
	the Great Barrier Reef .Proc 11th Int Coral Reef Symp. 1: 1042-1046.					
Journal paper	Cole A, Lawton R, Practhett MS, Wilson SK (in review) Chronic coral consumption by butterflyfish. Marine Ecology Progress Series  Farmer B, Wilson SK (in review) Diet of targeted finfishes and the implications for trophic	Popular article		Species /Protected Area management plans - (contributing author)		
	cascades Env Biol Fish  Graham NAJ, Chabanet P, Evans RD, Jennings S, Letourneur Y, MacNeil MA, McClanahan TR, Öhman MC, Polunin NVC, <b>Wilson SK</b> (submitted) Extinction risk in coral reef fishes. PNAS					
	Mora C, Aburto-Oropeza O, Ayala Bocos A, Ayotte PM, Bank S, Bauman AG, Beger M, Bessudo S, Booth DJ, Brokovich E, Brooks A, Chabanet P, Cinner J, Cortés J, Cruz-Motta JJ, Magaña A, DeMartini E, Edgar GJ, Feary DA, Ferse SCA, Friedlander A, Gaston KJ, Gough C, Graham NAJ, Green A, Hardt M, Guzman H, Kulbicki M, Letourneur Y, López Pérez A, Loya Y, Loreau M, Martinez C, Mascareñas-Osorio I, Morove T, Nadon M, Nakamura Y, Paredes G, Polunin N, Pratchett MS, Bonilla HR, Rivera F, Sala E, Sandin S, Soler G, Stuart-Smith R, Tessier E, Tittensor DP, Tupper M, Usseglio P, Vigliola L, Wantiez L, Williams I, Wilson SK, Zapata FA (In review) Human footprint on the linkage between biodiversity and ecosystem functioning in reef fishes. Science					
	Wilson SK, Depczynski M, Fisher R, Holmes TH, O'Leary RA, Tinkler P (In review) The importance of coral in the habitat use of juvenile reef fish.Marine Ecology Progress Series					
	Graham N, <b>Wilson SK</b> , Pratchett MP, Polunin NVC, Spalding M (2009) Coral mortality versus structural collapse as drivers of corallivorous butterflyfish decline Biod Cons 18:3325–3336					
	McClanahan TR, Graham NAJ, <b>Wilson SK</b> , Letourneur Y (2009) effects of fisheries closure size, age, and history of compliance on coral reef fish communities in the western Indian Ocean. Mar Ecol Prog Ser 396: 99-109					
	Wilson SK, Fisher R, Pratchett MS, Graham NAJ, Dulvy NK, Turner RA, Cakacaka A, Polunin NVC (2010) Habitat degradation compounds effects of fishing on the size structure of coral reef fish communities. Ecological Applications 20: 442-451					
	Wilson SK et al. (2010) Critical knowledge gaps in current understanding of climate change impacts on coral reef fishes Journal of Experimental Biology 213: 894-900					
Book chapter	Pratchett MS, Wilson SK, Graham NAJ, Munday PL, Jones GP, Polunin NVC (2009) Coral Bleaching and Consequences for Motile Reef Organisms: Past, Present and Uncertain Future Effects Pages 139-158. In: M van Oppen and J Lough (ed). Coral Bleaching: patterns and processes, causes and consequences. Springer.  Wilson SK (2009) Diversity in diet and feeding habits of Blennies. pp 139-162 In: Patzner RA, Goncalves EJ, Hastings PA, Kapoor BG (ed). The Biology of Blennies. Science	Milestone reports		Species /Protected Area management plans - (primary author)		
Major roviou	Piblications, New Hampshire, USA.  Kendrick A, Wilson SK (Draft) Fish communities: Review of information relevant to the	Conformed abotracts	Kendrick A. & Wilson S. (2009). Developing and implementing research in WA's	Policy/Ctratagy statement	Kendrick A, Simpson C J, Wilson S (2009). Strategy for the Development of Integrated Marine	
Major review	development of a monitoring program for FISH communities in Western Australia	Conference abstracts, presentations; seminar/lecture presentations; Poster/formal field day presentations	Renorlock A. & Wilson S. (2009). Developing and Implementing research in WAS marine parks and reserves. Presentation at the 5th WA State Coastal Conference, Fremantle, 7-9 October 2009.  Wilson S (2009) Climate change and coral reef fish. Presentation at the JEB symposium, Survival in a Changing World. Japan, Aug 2-6 2009  Wilson S (2009) Herbivory and Detritivory by coral reef fish (ECU invited lecture) Sept 2009  Wilson S (2010) DEC climate change and oceanographic research priorities. WAMSI node 2 Science planning workshop March 2010  Wilson S (2010) Ecology of Coral Reef Fish. Lecture to coral Reef Ecology intensive course at Murdoch University June 2010	Policy/Strategy statement (contributing author)	Research Plans. (Draft). Department of Environment and Conservation, WA. 11 pp.	
				Policy/Strategy statement (primary author)		

### MARINE SCIENCE PROGRAM: SCIENTIST PRODUCTIVITY REVIEW FRAMEWORK - Alan Kendrick, Senior Temperate Research Scientist

	Science	Communication		Knowledge Transfer	
Туре	Achievements (list)	Туре	Achievements (list)	Туре	Achievements (list)
SPP  Data Report	Spatial and temporal patterns in the structure of intertidal rocky platform communities in the MMP and SIMP (SPP 2009/2)  Spatial and temporal patterns in benthic invertebrate communities of the Walpole and Nornalup Inlets Marine Park WNIMP (SPP 2009/13) (April 2010)	Media interviews  Pamphlets/information sheets/newsletters etc		Advice (e.g. EIA, NRM etc) - (verbal)  Advice (e.g. EIA, NRM etc) - (written))	Perth Region NRM, Marine Reference Group (meetings)  Perth Region NRM, MRG Monitoring Working Group (meetings)  Perth Region NRM, 2009 State Coastal Conference Steering Committee (meetings)  WAMSI/UWA/Curtin/CSIRO CFOC Shark Bay Research propsal (meetings)  Advice to NPB/SCB (DEC) on marine research permit applications (various).  Advice to DEWHA for MACC R&D Working Group pilot study (SW Bioregion).
					MS reviews for Journal of Fish Biology  Review of DEC book Wonders of Western Waters.
Technical Report		Briefings/formal discussion etc	Temperate Research presentation, MPRA audit meeting (Sep 2009)  Temperate marine research planning meeting, Warren District (Sep 09)  Temperate marine research planning meeting, Swan Coastal District (Dec 09)  Temperate marine research planning meeting, Jurien Bay District (Dec 09)  Temperate marine research planning meeting, Shark Bay District (Mar 10)	Planning/Management guideline - (contributing author)	P. Hedge, P. von Baumgarten, <b>A. Kendrick</b> , C. Marshall <i>Demonstrating the contribution of the common assessment and reporting framework: South West Bioregion Pilot Study</i> . Report to the Monitoring, Evaluation and Reporting Taskforce of the Marine and Coastal Committee.
Conference paper		Web-based communications		Planning/Management guideline - (primary author)	
Journal paper	Rule M, Bancroft K, <b>Kendrick A</b> . Benchmarking nutrient values for relatively un-impacted warm temperate coastal waters. (Draft ms completed).	Popular article	Kendrick A, Huisman J & Rule M (2009) Marvellous mangroves. <i>Landscope</i> . <b>25</b> , 50-56.	Species /Protected Area management plans - (contributing author)	
Book chapter		Milestone reports		Species /Protected Area management plans - (primary author)	
Major review	Kendrick AJ, Wilson SK (2010) Temperate Fish communities: Review of information relevant to the development of a monitoring program for temperate fish communities in Western Australia (Draft).	Conference abstracts, presentations; seminar/lecture presentations; Poster/formal field day presentations	Kendrick A, Wilson S Developing and implementing research in WA's marine parks and reserves. 5th Western Australian State Coastal Conference (Oct 2009). Kendrick A & Rule M Spatial and temporal patterns in the structure of intertidal rocky platform communities in the MMP and SIMP. Research for Regions presentation to Swan Region (Nov 2009). Kendrick A. Marine parks and reserves in Western Australia. Lecture in Marine and Coastal Management, ECU (Mar 2010).	Policy/Strategy statement (contributing author)	Kendrick AJ, Wilson S Strategic marine research priorities for the Department of Environment and Conservation (Jun 2010)
Book chapter				Policy/Strategy statement (primary author)	

### MARINE SCIENCE PROGRAM: SCIENTIST PRODUCTIVITY REVIEW FRAMEWORK - Kelly Waples, Science Coordinator, WAMSI Node 3

	Science		Communication	Knowledge Transfer	
Type	Achievements (list)	Туре	Achievements (list)	Type	Achievements (list)
SPP  Data Report		Media interviews  Pamphlets/information	Media release: Ningaloo Student Research Day, March 10 Interview with GWN: Ningaloo Student Research Day, 30 March 10 Media release: new ray, Feb 10 Interview: ABC Drive, new ray species Feb 10 Media release: Foraminifera publication, Jun 10 2 interviews (The West, ABC Karratha) foraminifera publication, Jun/Jul/10	Advice (e.g. EIA, NRM etc) - (verbal)  Advice (e.g. EIA, NRM etc) -	National Marine Mammal Advisory Committee - grant application review for marine mammal research Ningaloo Research Coordinating Committee - integration of the Ningaloo Research Program CSIRO WfO Cluster Management Committee - integration of the Ningaloo Research Program Advice to Chief Scientist on Swan River dolphin mortality issue
	Metadata for all WAMSI node 3 projects entered into MEST and available through internal MEST which is under development by newly appointed data management officer	sheets/newsletters etc	WAMSI Node 3 information pamphlet and annual report (coordinated by WAMSI Communication Officer)	(written))	Briefings to DG re annual meetings of the National Marine Mammal Advisory Committee, August 2009 and May 2010;
Technical Report	Draft process paper on the knowledge transfer and uptake process developed for WAMSI node 3 research  Short paper on the focus of the knowledge transfer and uptake process over the next 6-12 months	Briefings/formal discussion etc	WAMSI science review of Node 3	Planning/Management guideline - (contributing author)	
Conference paper		Web-based communications	Input to the WAMSI website for Node 3 research.  Input and maintenance along with CSIRO of the Ningaloo Research  Program website (www.ningaloo.org.au). (ongoing process)	Planning/Management guideline - (primary author)	
Journal paper		Popular article		Species /Protected Area management plans - (contributing author)	
Book chapter		Milestone reports	Waples K (2009). WAMSI Project 3.6: Science coordination: administration, communication and data management. Milestone report submitted to	Species /Protected Area management plans - (primary author)	
Major review		Conference abstracts, presentations; seminar/lecture presentations; Poster/formal field day presentations		Policy/Strategy statement (contributing author)	
Book chapter				Policy/Strategy statement (primary author)	

### MARINE SCIENCE PROGRAM: SCIENTIST PRODUCTIVITY REVIEW FRAMEWORK - Kevin Bancroft

	Science	Communication		Knowledge Transfer		
Туре	Achievements (list)	Туре	Achievements (list)	Туре	Achievements (list)	
SPP		Media interviews		Advice (e.g. EIA, NRM etc) - (verbal)	Verbal advice to EMB, MEB re Gorgon Project offsetts & ministerial conditions;  The National Intertidal and Subtidal Benthic Habitat Classification Scheme workshop held in Canberra ACT, Sept 2009. Contributed to the development of a national marine benthic habitat classification scheme.	
	Bancroft KP, Dasey M (2010). Jurien Bay Marine Park long-term seagrass monitoring survey: 16-21 March 2010. Field Operations Plan. Marine Science Program, Department of Environment and Conservation, Perth, Western Australia. 14 p.  Bancroft KP (2010). Jurien Bay Marine Park long-term seagrass monitoring March 2010 field program. MSP Metadata Report July 2010. Marine Science Program, Department of Environment and Conservation, Perth, Western Australia. 10 p.  Fitzpatrick B., Bancroft KP, Shedrawi G (2010). Gorgon dredging monitoring program April 2010 field survey: Fish community, benthic community and pressure field monitoring. MSP Metadatta Report July 2010. Marine Science Program, Department of Environment	Compliants (information physics)			The National Intertidal and Subtidal Benthic Habitat Classification Scheme workshop held in Canberra ACT, Sept 2009. Contributed written comments and advice to the development of a national marine benthic habitat classification scheme.  Written input into Marine Parks and Reserves Authority Audit asset report cards for all 13 marine parts and for a septiment of the parts and its configuration	
Data Report	and Conservation, Perth, Western Australia. 11p.	Pamphlets/ information sheets/ newsletters etc		Advice (e.g. EIA, NRM etc) - (written))	protected areas for various assets including water quality, sediment quality, coral communities, macroalgal communities, seagrass meadows and finfish.	
Technical Report		Briefings/ formal discussion etc		Planning/Management guideline - (contributing author)		
Conference paper		Web-based communications		Planning/Management guideline - (primary author)		
Journal paper		Popular article		Species /Protected Area management plans - (contributing author)		
Book chapter		Milestone reports		Species /Protected Area management plans - (primary author)		
Major review	Bancroft KP (DRAFT) Knowledge review relevant to the development of a monitoring, evaluation and reporting program in Western Australian Marine protected areas: Water quality	Conference abstracts, presentations; seminar/lecture presentations; Poster/formal field day presentations		Policy/Strategy statement (contributing author)		
Book				Policy/Strategy statement (primary author)		

### MARINE SCIENCE PROGRAM: SCIENTIST PRODUCTIVITY REVIEW FRAMEWORK - Kim Onton

OUTPUTS FOR THE PERIOD - 1 September 2009 to 30 June 2010

Science		Communication		Knowledge Transfer		
Туре	Achievements (list)	Туре	Achievements (list)	Туре	Achievements (list)	
SPP	Onton K (2010) Preliminary assessment of diseases affecting Western Australian corals, Science Project Proposal SPP#2009-011. Department of Environment and Conservation, Marine Science Program, Kensington, 8p.	Media interviews	Shark Bay Shorebird Survey, ABC North West Mornings radio interview with Vanessa Mills, 23 April 2010.	Advice (e.g. ÉlA, NRM etc) - (verbal)	Advice to Swan Coastal District regarding establishing coastal bird monitoring programs.	
Data Report	Onton K (2010) Preliminary assessment of diseases affecting Australian corals, Metadata report. Department of Environment and Conservation, Marine Science Program, Kensington, 9p.  Onton K (2010) Survey of shorebirds and waterbirds in Shark Bay Marine Park, March 2010. Metadata report. Department of Environment and Conservation, Marine Science Program, Kensington, 7p.	Pamphlets/information sheets/newsletters etc	Coral research in Ningaloo Marine Park – Information for Commercial Tour Operators, leaflet distributed to key tour operators and accommodation establishments in the Ningaloo region  Production of Little Penguin life-cycle dvd for Swan Coastal District PVS staff	Advice (e.g. EIA, NRM etc) - (written))	Advice provided to Exmouth District regarding establishing community recreational impact monitoring at high use sites in Ningaloo Marine Park.	
Technical Report		Briefings/formal discussion etc		Planning/Management guideline - (contributing author)		
Conference paper		Web-based communications		Planning/Management guideline - (primary author)		
Journal paper	Forbes M, Vogwill R and Onton K (in review) A preliminary characterisation of the tufa deposits of south-west Western Australia. Sedimentary Geology.  Onton K, Page C, Wilson S, Neale S and Armstrong S (in prep) Coral disease in an Indian Ocean marine park: distribution and drivers. Marine Ecology Progress Series.	Popular article		Species /Protected Area management plans - (contributing author)		
Book chapter		Milestone reports		Species /Protected Area management plans - (primary author)		
Major review	Review of knowledge relevant to the development of a monitoring protocol for coastal birds in Western Australia (in progress)	Conference abstracts, presentations; seminar/lecture presentations; Poster/formal field day presentations	Onton K (2009). Community based monitoring. In Monitoring for Action symposium abstracts, 24 November 2009: understanding Australia's changing marine and coastal environment, Ningaloo Coordination Committee, Kensington, Western Australia, p.18.  Onton K, Page C, Wilson S, Neale S and Armstrong S (2010) Distribution and drivers of coral disease at Ningaloo Reef. (Poster and Abstract) 85 <sup>th</sup> Annual Australian Coral Reef Society Conference September 2010.	Policy/Strategy statement (contributing author)		
Book chapter				Policy/Strategy statement (primary author)		

### MARINE SCIENCE PROGRAM: SCIENTIST PRODUCTIVITY REVIEW FRAMEWORK - Thomas Holmes

	Science		Communication		Knowledge Transfer		
Туре	Achievements (list)	Type	Achievements (list)	Туре	Achievements (list)		
SPP	Wilson S K and <b>Holmes T H</b> (2009). Interactive effects of fishing and climate change on reef fish populations.	Media interviews	Television piece with SCOPE (childrens science based program)	Advice (e.g. EIA, NRM etc) - (verbal)	, ,		
Data Report	Holmes T (2009) Long term monitoring of coral and fish communities throughout the Montebello and Barrow Islands marine conservation reserves - November 2009 field program. MSPDR10	Pamphlets/information sheets/newsletters etc		Advice (e.g. EIA, NRM etc) - (written))	6 x reviews for Peer Reviewed Journals (2 x MEPS, Animal Behaviour, Aquatic Biology, Journal of Animal Ecology, Marine Environmental Research).		
	Holmes T (2009) Gorgon dredging program marine monitoring project - November 2009 field program. MSPDR11						
	Holmes T (2010) Preliminary assessment of the condition of coastal biological communities along the Ningaloo Marine Park coastal strip. MSPDR13						
Technical Report		Briefings/formal discussion	Regional meeting with Karratha staff discussing tropical research strategy	Planning/Management			
		etc		guideline - (contributing author)			
Conference		Web-based	DECmatters internal news article on initial Gorgon dredge plume project field trips	Planning/Management			
paper		communications		guideline - (primary author)			
Journal paper	Holmes T H and McCormick M I (2010). Smell, learn and live: the role of chemical alarm cues in predator learning during early life history in a marine fish. <i>Behavioural Processes</i> 83: 299-305.	Popular article	Stanley F, Morris K, <b>Holmes T</b> and Moore J (2010). Giant steps: Industry and conservation make history through Gorgon. <i>Landscope</i> 25(4): 10-16	Species /Protected Area management plans - (contributing author)			
	Holmes T H and McCormick M I (2010). Size-selectivity of predatory reef fish on juvenile prey. Marine Ecology Progress Series 399: 273-283.			(33 3 33 3 3 3 3 7			
	Holmes T H and McCormick M I (in review). Behaviour as a mechanism underlying size- based differences in vulnerability to predation. <i>Environmental Biology of Fishes</i> .						
	<b>Holmes T H</b> and McCormick M I (accepted). Response across a gradient: behavioural reactions of newly settled reef fish to predation cues. <i>Animal Behaviour</i> .						
	Wilson S K, Depczynski M, Fisher R, <b>Holmes T H</b> , O'Leary R A and Tinkler P (in review). The importance of coral in the habitat use of juvenile reef fish. <i>Marine Ecology Progress Series</i> .						
	Villacorta-Rath C, McCormick M I, Meekan M G and <b>Holmes T H</b> (in review) Environmental determinants of growth and selective mortality of a fast-growing clupeid. Journal of Marine and Freshwater Research.						
	Pecl G, Doubleday Z, Madin E, <b>Holmes T</b> , Smith F and Ban N (in prep) Ecological, socio-economic and management implications of range-shifting species in marine systems.						
Book chapter		Milestone reports	Depczynski M, Heyward A, Birrell C, Colquhoun J, Radford B, O'Leary R, Wilson S,	Species /Protected Area			
Book Chaptel		willestone reports	Holmes T and Tinkler P (2009) Methods for monitoring the health of benthic communities. WAMSI Node 3 Project 3.1.2, Milestone Report. 40 pgs.	management plans - (primary author)			
Major review	Holmes T H (submitted). Mangrove communities: Review of information relevant to the development of a monitoring program for mangrove communities in Western Australia.	Conference abstracts,	University lecture for Euan Harvey, August 2009.	Policy/Strategy statement			
	Holmes T H and Friedman K (draft). Supratidal sandy beach communities: Review of information relevant to the development of a monitoring program for supratidal sandy beach communities in Western Australia.	presentations; seminar/lecture presentations; Poster/formal field day presentations	AMSA student workshop lecture, July 2009.	(contributing author)			
Book chapter				Policy/Strategy statement (primary author)			

### MARINE SCIENCE PROGRAM: SCIENTIST PRODUCTIVITY REVIEW FRAMEWORK - Michael Rule

	Science		Communication	Knowledge Transfer		
Туре	Achievements (list)	Туре	Achievements (list)	Туре	Achievements (list)	
SPP	Spatial and temporal patterns in the structure of intertidal rocky platform communities of the Marmion Shoalwater Islands and Marmion Marine Parks (SPP 2009/2)  Spatial and temporal patterns in benthic invertebrate communities of the Walpole and Nornalup Inlets Marine Park (SPP 2009/13)	Media interviews	nomo romo (not)	Advice (e.g. EIA, NRM etc) - (verbal)	Advisory Committee member for project entitled 'Cost-effective bio-monitoring of mobile macro-invertebrates in Geographe Bay, WA'. Funded by Community Coastcare,	
Data Report	Rule, M. J. (2010) Re-establishment of long-term monitoring sites and assessment of seagrass communities in Shark Bay Marine Park. Draft data report	Pamphlets/information sheets/newsletters etc	Rule, M. J. and Holley, D. (2010) Remote cameras monitor marine assets. Western Australian Marine Monitoring Program newsletter, Feb 2010.	Advice (e.g. EIA, NRM etc) - (written))	Advice to NPB/SCB on marine research permit applications  MS reviews for Austral ecology, Biodiversity and Conservation, Cahiers de Biologie, Marine Ecology Progress Series, and Marine Biology  MS review for Landscope  Review of marine section of DEC book Exploring Western Australia's natural wonders national, marine and regional parks	
Technical Report		Briefings/formal discussion etc	Temperate marine research planning meeting, Warren District (Sep 09) Temperate marine research planning meeting, Swan Coastal District (Dec 09) Temperate marine research planning meeting, Jurien Bay District (Dec 09) Temperate marine research planning meeting, Shark Bay District (Mar 10)	Planning/Management guideline - (contributing author)		
Conference paper		Web-based communications		Planning/Management guideline - (primary author)		
Journal paper	Rule M. J, Bancroft, K. P., Kendrick, A. Benchmarking nutrient values for relatively un-impacted warm temperate coastal waters (draft ms complete)	Popular article	Kendrick, A., Huisman, J. & Rule, M. J. (2009) Marvellous mangroves. <i>Landscope</i> , 25:50-56	Species /Protected Area management plans - (contributing author)		
Book chapter		Milestone reports		Species /Protected Area management plans - (primary author)		
Major review		Conference abstracts, presentations; seminar/lecture presentations; Poster/formal field day presentations	Kendrick A. <b>Rule M. J.</b> Spatial and temporal patterns in the structure of intertidal rocky platform communities in the Marmion Marine Park and the Shoalwater Islands Marine Park. Research for Regions presentation to Swan Region (Nov 2009)	Policy/Strategy statement (contributing author)		
Book chapter				Policy/Strategy statement (primary author)		

## 12. MARINE SCIENCE PROGRAM: SUMMARY OF BUDGET ALLOCATION AND EXPENDITURE FOR 2010/11

Activity/Project	DEC Region	PI	Budget Total
Marine Science Program administration	All	CSI	188793
Committees/Advice/Ministerials etc	All	CSI	68531
Program Leader contingency	All	CSI	75537
WAMSI Node 3 Administration	Pilbara	KWA	14991
WAMSI Node 3 Knowledge Transfer	Pilbara	KWA	44972
Metro MPA Intertidal Reef Study	Swan	AKE	41987
Shark Bay MPAs Ecosystem Study	Midwest	AKE	36987
Walpole/Nornalup MPA Study (TBD)	South coast	AKE	60453
Marine Research Strategy	All	SWI/AKE	20858
Ningaloo Climate Change/Fishing Interaction Study	Pilbara	SWI	88287
Ningaloo Coral Disease Baseline Study	Pilbara	SWI	10081
Ningaloo Macroalgal Community Study	Pilbara	SWI	41960
Baseline Fish Survey of Rowley Shoals/Montebello/Barrow Is MPAs	Pilbara, Kimberley	SWI	12395
Comparison of Fish Monitoring Techniques	Pilbara, Kimberley	SWI	19095
WA Turtle Project	Pilbara, Kimberley	BPR	41280
WAMMP: Finalise Knowledge Reviews (PHASE I)	All	AKE	66997
WAMMP: Complete three new Knowledge Reviews	All	KFR	15224
WAMMP: 'Fit to Park'	All	KFR	262722
WAMMP: Constructing Historical Timeseries	All	KFR	29761
WAMMP: MPRA/DEC Audit Support	All	KFR	75168
MSP Marine Information Management	All	KFR	12427
WAMMP: International/Commonwealth/State initiatives	All	KFR	17026
WAMMP: Communication/community participation/ liaison	All	KFR	11530
TOTAL			\$1,257,061

# 13. SUMMARY OF WAMMP WORKS PROGRAM FOR 2010/11

The following table provides a summary of the projects that will be undertaken during 2010/11 as part of the Western Australian Marine Monitoring Program (WAMMP).

SUB-PROGRAMS	PROJECTS	WHO LEADS	WHO ASSISTS	WHERE	WHEN	ВҮ	COMMENTS	MSP FTE	REGIONAL FTE	OTHER FTE	OPERATONAL FUNDS (\$)
WAMMP Co-ordination	Overall Coordination of WAMMP	KFR	AKE, SWI	na	on-going	na	Need to develop a process to provide opportunities for staff from other Branches within DEC (e.g. MPPB, EMB) to assist WAMMP.	0.55			
	2. National MACC R&D WG	CSI	KFR	na	on-going	na		0.1			
	Finalise and publish the WAMMP Strategic Plan	KFR	CSI	na	na	30-Sep		0.04	na	na	3500
	2. Finalise and submit the WAMMP SPP for approval to SMT	KFR	CSI	na	na	30-Sep		0.04	na	na	na
	3. Develop and implement a process to ensure the key elements of the Asset Knowledge Reviews are subject to internal review prior to (where possible) the 2010/11 'Fit to Park' field work being undertaken (see below).	AKE	KFR, CSI, SWI	na	na	31-Dec	Five page summary of AKR to be used to communicate the essential elements to MSP and regional staff and external reviewers.	0.025	na	na	na
Ctrataria Flamenta	Develop a process to complete outstanding Asset Knowledge Reviews	AKE	KFR, CSI, SWI	na	na	31-Aug		0.025	na	na	na
Strategic Elements  All strategic elements are to be	<ol> <li>Develop generic guidelines to determine appropriate temporal and spatial scales for asset C-P-R MER projects for the 'Fit to Park' sub- project.</li> </ol>	SWI	KFR, CSI, AKE	na	na	30-Sep		0.05	na	na	na
fully documented as reports/guidelines/papers.	Develop guidelines to assess the validity of historical ecological and social C-P-R data relevant to WAMMP.	KBA	KFR, CSI, SWI, AKE	na	na	30-Sep		0.1	na	na	na
, , ,	7. Develop CPs and SPPs for 'Fit to Park' projects (listed below) and submit for approval to SMT	see below	KFR, CSI, AKE, SWI	na	na	30-Sep	Concept Plans should be completed by 31 August; SPPs by 30 Sept	0.02-0.05	na	na	na
	Develop a process for the systematic inclusion of WAMMP data into MPA performance assessment reports.	AKE	KFR, CSI, AKE, SWI	na	na	30-Sep	Include historical data, regional data as well as WAMMP data; discuss at MPRA workshop in October	0.025	na	na	na
	Design a Marine Information Management System relevant to MSP needs, with a particular focus on WAMMP, that is consistent with corporate data management policies.	FMA	KFR, CSI, AKE, SWI	na	na	30 April?	Output would be a report explaining how the MIMS will operate.	0.15	na	na	na
Asset Knowledge Reviews - (Selecting MER indicators, methods and	Coordinate the finalisation of outstanding Asset Knowledge Reviews (AKR).	AKE	All AKR authors	na	na	30-Jun	THO (0.05); MRU (0.04); RCA (0.1); SAR (0.01); KBA (0.03)	0.125			3000
rationale)	2. Initiate Asset Knowledge Reviews for ??	KFR					Which ones?	0.07			5500
	Co-ordinate annual Monitoring, Evaluation and Reporting (MER) for FINFISH COMMUNITY Condition Pressure Response (C-P-R)	THO	Regions GSH MRU, UTAS?	NMP MBIMPAs JBMP SBMP	July Nov Nov April		CP and SPP to be completed prior to fieldwork; CP and SPP being prepared for MBIMPAs Operational funding to include contributions from Gorgon Project. Includes Research time allocation.	0.14/0.115			15,000
	2. Co-ordinate MER for CORAL COMMUNITY C-P-R	SAR	Regions, JMO KMcA GSH	NMP MBIMPAs MBIMPAs	Aug Sept (P-only) mid-Nov		Include analysis of 2010 survey in NP. CP and SPP to be completed prior to fieldwork; CP and SPP being prepared for MBIMPAs	0.06			6000
	3. Co-ordinate MER for SEAGRASS COMMUNITY C-P-R	MRU	Regions JHU	JBMP MMP SIMP (?) SBMP	Mar Mar Mar April		CP and SPP to be completed prior to fieldwork; ? = if possible	0.14			5500
'Fit to Park' - (Temporal	4. Co-ordinate MER for MANGROVE COMMUNITY C-P-R	THO	Regions	NMP SBMP + MBIMPAs (option)	Jun remote managment		CP and SPP to be completed prior to fieldwork; Link to remote sensing projects (see below) and SBMP mangrove research project (being developed)	0.07			4000
and spatial scales of MER)	5. Co-ordinate MER for MACROALGAE C-P-R	MRU	Regions JHU	MMP SIMP (option)	Mar Mar		CP and SPP to be completed prior to fieldwork	0.1			3000
Locations, timing and budgets are nominal only and will be adjusted once detailed planning is complete	6. Co-ordinate MER for WATER QUALITY C-P-R	KBA	Regions	MMP SEMP? SIMP NMP	Jan Jan? Jan Oct		CP and SPP to be completed prior to fieldwork; Collate and assess existing data first before further data collection	0.08			7500
	7. Co-ordinate MER for COASTAL COMMUNITY C-P-R	THO	Regions	NMP NMP	Mar Jun (remote manage)		CP and SPP to be completed prior to fieldwork; Different locations?	0.07			3500
	8. Co-ordinate MER for INVERTEBRATE (targetted) COMMUNITY C-P-R	KBA	Regions	MMP SIMP	Feb Feb		CP and SPP to be completed prior to fieldwork; Includes abalone and lobster.	0.09			3000
	9. Co-ordinate MER for NZ Fur Seals C-P-R	RCA	Regions	NA	Feb		CP and SPP to be completed prior to fieldwork; Ops funding: MSP \$33,000; ECU \$20,000	0.25?			2500 ?
	10. Co-ordinate MER for ASL C-P-R	RCA	Regions	Abrolhos Islands	March/April		CP and SPP to be completed prior to fieldwork RCA's ECU time to be used on this project. DoF to provide logistical support.	0.1			
	11. Co-ordinate MER for Little Penguin C-P-R in SIMP	SAR	Regions	SIMP	on-going		CP and SPP to be completed prior to fieldwork;	0.1			2000
Constructing	1. Fish	THO	Regions					0.02			3000
Historical Timeseries	2. Coral	SAR	Regions					0.01			
see 'Comment' for T-drive location			-								
of historical datasets database)	3. Seagrass	MRU	Regions				The state of the s	0.03			

SUB-PROGRAMS	PROJECTS	WHO LEADS	WHO ASSISTS	WHERE	WHEN	ВУ	COMMENTS	MSP FTE	REGIONAL FTE	OTHER FTE	OPERATONAL FUNDS (\$)
	5. Macroalgae	MRU	Regions					0.01			
	6. Water Quality	KBA	Regions					0.08			
	7. Coastal Community	THO	Regions					0.03			
	8. Targetted Invertebrates	KBA	Regions					0.03			
	9. Little Penguins	SAR	Regions				504 504 1 1 1 1 1 1	0.05			
	10. Australian Sealion	RCA	Regions				RCA's ECU time to be used on this project.	0.05			
	11. NZ Fur Seal	RCA	Regions					0.25			
	Evaluation and Reporting Sub-Program management and coordination	KBA	As below	na	na	30-Sep		0.12			na
	Collation and evaluation of available benthic habitats (e.g. seagrass, macroalgae, coral communities) MER datasets for DEC/MPRA annual review in October 2010	KFR	MRU, SAR, KBA	na	na	30-Sep		0.07			na
Evaluation and Reporting - (DEC/MPRA	Collation and evaluation of available nearshore/coastal (e.g. mangroves, coastal vegetation) MER datasets for DEC/MPRA annual review in October 2010	THO	KMU, NC staff (Exmouth)	na	na	30-Sep		0.06			na
annual reviews)	Collation and evaluation of available Water/Sediment Quality MER datasets for DEC/MPRA annual review in October 2010	KBA		na	na	30-Sep		0.14			na
	5. Collation and evaluation of available Threatened Marine Fauna (e.g cetaceans, migratory birds, pinnipeds) MER datasets for DEC/MPRA annual review in October 2010	KWA	RCA, KON, DHO, BPR, DCR	na	na	30-Sep		?			na
	6. Collation and evaluation of available fish/invertebrates MER datasets for DEC/MPRA annual review in October 2010	SWI	THO, MRU, KBA	na	na	30-Sep		0.12			na
Marine Information	The development of interim information management guidelines for	FMA	KFR, AKE, SWI			31 Oct		.21			
Management	MSP staff; 2. The redesigning of MSP T-drive; 3. The establishment of of a photo/video and scientific reference library.	FMA FMA	KFR, AKE, SWI KFR, KBA, SWI, AKE	na	na	31 Dec 31 Dec		.05 .09	na	na	na
	Drupella impacts on coral communities MER	SAR		NMP	July	?	Link to FtP: Next full survey in 2011/2	0.05			?
	2. Coral (Bills) Bay Recovery Study	SAR		NMP	na		Next survey in 2011/12				
	3. Sanctuary Zone Study	THO		NMP JBMP Capes(option)	na		Summarise existing studies in WA MPAs				na
	Developing and maintaining the WAMMP sea temperature MER system	SWI		NMP MBIMPAs	?		Objectives/outputs as per KFR notes to SWI Consider WAIMOS, AIMS, industry temperature monitoring sites etc.	0.03			1000
WAMMP Special Issue MER	Developing and maintaining the WAMMP remote camera MER system	KBA		SIMP (2) SBMP WNIMP	?		Objectives/outputs to be determined	0.03			1000
	6. Gorgon Offsets Dredging Project	SFI	GSH, JMO	MBIMPAs	TBD		CP and SPP to be developed by 30 Sept; Benthic community and fish data from 2009 and 20010 to be analysed and summarised with Dec 06 data by 30 Sept.	2.6			TBD
	7. Gorgon Offsets Turtle Project	TBD	TBD	TBD	TBD	TBD	Goverance arrangements being finalised; SRS to be appointed by 31 Dec 2010.	TBD	TBD	TBD	TBD
	8. Pluto Offsets Dampier Archipelago MPAs	TBD	TBD	TBD	TBD	TBD	Goverance arrangements being finalised; SRS to be appointed by 31 Dec 2010.	TBD	TBD	TBD	TBD
WAMAD B.	Are feeding scars (e.g. number/area) a good indicator of <i>Drupella</i> predation pressure on coral communities?	SAR	Exmouth District	NMP	Aug		CP and SPP to be developed; Link to FtP	0.06			2000
WAMMP Research	2. A comparative assessment of finfish community condition using UVC and DOV (and BRUVS??)	THO/MRU	?	MBIMPAs JBMP	? ?		CP and SPP to be developed; Link to FtP (see above comments) R/M: 50/50 in time and \$?	0.125 (0.09/0.035)			15000
	Monitoring finfish community condition by DOV	THO	Exmouth District	NMP	July			0.02			na
1// / / / / / / / / / / / / / / / / / /	2. Drupella and coral community monitoring	SAR	Exmouth District	NMP	Aug		Approach to training to be formalised over the	0.02			na
WAMMP Training	3. Fish/benthic video post-processing	GSH/JMO		Metro	on-going		next year.	0.04			na
	Little Penguin population census and post processing of imagery	SAR		SIMP	on-going		1	0.02			na
WAMMP Community	Cape Conservation Group coral community MER in NMP (i.e Oyster Stacks and Turquoise Bay)	SAR	нта	NMP	on-going	na		advice only			na
Monitoring	Rockingham Bays Seagrass Monitoring Group: Seagrass community MER in SIMP	MRU		SIMP	on-going	na	Try to better align RBSMG's objectives with WAMP objectives	advice only			na
WAMMP Remote Sensing	Oversee the on-going acquisition of remote sensing datasets     (imagery and ground-truth data) relevant to marine habitat mapping and     WAMMP	KMU	SW/KFR	All MPAs	on-going		Report summarising remote sensing datasets available to WAMMP?	0.1			na

SUB-PROGRAMS	PROJECTS	WHO LEADS	WHO ASSISTS	WHERE	WHEN	ВҮ	COMMENTS	MSP FTE	REGIONAL FTE	OTHER FTE	OPERATONAL FUNDS (\$)
	Identify and construct historical timeseries of changes from remote sensing imagery in areal extent of representative, discreet areas of:     Mangroves;     Macro-algae; and     Coastal vegetation communities.	KMU	SWI/KFR/MRU/THO	(SBMP, NMP, MBIMPAs) NMP, MMP NMP	Link with FtP projects No. 4, 5, 7		Objectives/outputs will be identifed in mangrove, macroalgae and coastal vegetation SPPs (THO/MRU)	0.2 0.2 0.10			na
	3. Provide remotes sensing support for the Gorgon Dredging Project	KMU	SWI/KFR	MBIMPAS	as required		See Gorgon SPP	0.1	_		na

## 14. RECENT AND CURRENT RESEARCH IN THE NINGALOO MARINE PARK

The research projects outlined in the table below are from a database of Ningaloo research currently being compiled by DEC. The 109 research projects, currently in the database, have been mostly initiated over the past five years by the Western Australian Marine Science Institution (WAMSI) Node 3 and the CSIRO Ningaloo Collaboration Cluster. These projects mostly address the research and monitoring strategies outlined in the Ningaloo Marine Park Management Plan (2005-2015). These projects will provide the basis for the WAMSI Node 3 summary and synthesis report to be completed by 30 June 2011. The background, objectives, major findings and, in particular, the specific management implications of each research project will be summarised in the WAMSI Node 3 report. This will facilitate knowledge transfer and uptake of the Ningaloo research effort by DEC into institutional marine policy, planning and management programs for the Ningaloo Marine Park.

Principle Researcher	Title	Institution	Start Date	Finish Date	Brief Summary of Objectives
Armstrong, Shannon	Long term monitoring of NMP: Status of <i>Drupella</i> and shallow water benthic reef communities.	DEC	1989	ongoing	Determine changes to <i>Drupella</i> density and percentage cover of coral communities at NMP over time.
Armstrong, Shannon	Bills Bay Coral Recovery Study	DEC	1989	ongoing	Determine the recovery of corals in Bills Bay after the 1989 anoxic coral spawning event
Babcock, Russ	Ecosystem impacts of human usage and the effectiveness of zoning for marine biodiversity conservation in the Ningaloo Marine Park	CSIRO, UWA, ECU	2006	2010	Measure the distribution and abundance of organisms on the reef and assess their variation in the context of both previous and current zoning (size, age, configuration) and habitat in order to contribute to an assessment of the appropriateness of current management strategies for the NMP
Babcock, Russ	Broad scale fish surveys in the Ningaloo Marine Park lagoon waters to assess the effectiveness of sanctuary zones for protecting exploited sub-tidal fish species	CSIRO, UWA, ECU			Provide an assessment of indirect effects on fish community structure from fishing activities in NMP
Beckley, Lynnath	High resolution mapping of reef utilisation by humans in the Ningaloo Marine Park	Murdoch	2006	2009	<ul> <li>Determine spatial and temporal distribution of recreational activities along the shore and within the reef lagoon system of NMP</li> <li>Investigate the spatial distribution of recreational use in NMP in relation to biodiversity, habitats, physical conditions, park zoning, access roads and tracks and accommodation nodes</li> <li>Describe the demographics, frequency of visitation, choice of destination, socioeconomics, and catches of rec fishers</li> <li>Develop an understanding of historical use patterns at NMP from other potential sources of data on reef utilisation</li> </ul>
Bengston Nash, Susan	Persistent organic pollutants in Southern Ocean Humpback Whales	UQ	2008	2010	To quantify fluctuating contaminant burdens throughout the migratory journey and associated detoxification enzymal response in neighbouring dermal layers
Black, Bob	Intertidal invertebrates at Ningaloo Marine Park and the effectiveness of sanctuary zones in protecting exploited species on intertidal reefs	UWA			Provide an assessment of indirect effects on invertebrate community structure from fishing activities in NMP
Boschetti, Fabio	ScenarioLab - a desktop modelling tool for marine natural resource managers	CSIRO	2006	2010	To develop a modelling tool that can be used by managers/policy makers to consider the application of various management strategies in marine park management
Bunning, Jessica	Spatial quantification of the impacts of off-road vehicles (ORVS) along the remote Ningaloo coastline of Western Australia	Murdoch	2008	2009	<ul> <li>Quantify the relationship between potential turtle nesting sites and beach accessibility</li> <li>Determine the correlation between beach accessibility and categories of human-made roads</li> <li>Evaluate the degree of human interference at different turtle nesting beaches</li> </ul>

Principle Researcher	Title	Institution	Start Date	Finish Date	Brief Summary of Objectives
Burton, Michael	Estimation and integration of socioeconomic values of human use of Ningaloo: models for recreational fishing and non-	UWA, ANU	2006	2010	To develop an empirical model to explain choice of recreational sites and use as a basis for economic welfare and policy evaluation
	recreational fishing choices				To understand destination choice for users of the NMP
					To estimate economic values associated with recreational fishing in the NMP through random utility models (RUMs)
					To estimate economic values associated with other recreational activities in the NMP through RUMs
Caley, Julian	Census of Marine Life: Creefs Project	AIMS	2009	2011	To establish Ningaloo Marine Park as a global reference site for the Census of Marine Life project.
					To document the non-fish, non-coral biodiversity of the Ningaloo Marine Park.
Catlin, James	Sustainability of the whale shark tourism industry at Ningaloo	Curtin	2006	2009	Assess the sustainability of Whale Shark Commercial Tourism operators in Ningaloo Marine Park
Ceh, Janja	Coral associated microbes of the Ningaloo Reef	Murdoch			To investigate the dynamics of coral-associated microbial communities over a one year period in Ningaloo Reef
Cerutti, Florencia	Population ecology and movements of manta rays at Ningaloo Reef, Western Australia	CDU	2007	2011	To estimate manta ray population demographics and genetic structure
					To define local movement, site fidelity and migratory patterns
					To determine if there is genetic exchange with other populations in the Indo Pacific
Chandler, Philippa	International and domestic tourist perceptions and experiences of Ningaloo Marine Park	Curtin			To examine the experiences and attitudes of people who regularly holiday at NMP
					To evaluate the potential influence of repeat visitors attitudes and values on future tourism planning in the region
Chapman, Kelly	Impacts of tourism in the Ningaloo Marine Park	ECU	2008	2011	To explore institutional capacity to respond and adapt to feedback from research and modelling work being done in the Ningaloo region
					To bring together researchers, policy makers, resource managers and resource users in a bid to identify and overcome barriers to establishing adaptive institutional arrangements in the Ningaloo region.
Collins, Lindsay	Assessment of coastal groundwater and linkages with Ningaloo Reef	Curtin	2007	2009	To characterise the hydrological and geological aquifer system of Ningaloo including the coastal seawater/freshwater interface and pathways to the Ningaloo Reef lagoon
					To develop our understanding of the behaviour of the freshwater/seawater interface in relation to seasonal, tidal and episodic events

Principle Researcher	Title	Institution	Start Date	Finish Date	Brief Summary of Objectives
Collins, Lindsay	Characterisation of geomorphology, growth history and surface sediments	Curtin	2006	2009	To characterise the coastal and seabed geomorphology of the reef system, including the deeper reserve areas offshore of the fringing reef
					To characterise the surficial sediments of the shallow (lagoonal) waters
					<ul> <li>To characterise the morphology and growth history of the reef system and identify growth characteristics relevant to maintenance of marine biodiversity and climate change impacts</li> </ul>
Collins, Lindsay	Geological history of Cape Range and the coral reefs of Ningaloo Marine Park	Curtin Uni	2007	2010	Collection of core samples for study into geological evolution, marine processes, reef growth history and land management of the Cape Range region
Dambacher, Jeff	Qualitative modelling for sustainable tourism development in the Ningaloo region	CSIRO	2007	2010	Develop alternative constructs of socio-economic and ecological system modelling based on patterns, processes and responses determined from Cluster and WAMSI projects
					To explore the consequences of model structure and system dynamics; and facilitate stakeholder involvement in the process
D'Andrea, Luisa	Using hyperspectral imagery to map vegetation condition and ground cover of the coastal area at Coral Bay	Murdoch		2007	To assess the hyperspectral imagery of the coastal strip around Coral Bay to interpret vegetation condition, distribution and substrate type
Davis, J	Coastal stewardship in WA	Murdoch			Not currently available
De la Mare, Bill	Management Strategy Evaluation (MSE) for the Ningaloo Region	CSIRO	2007	2010	Develop and provide the integrated modelling and analysis for multiple- use MSE of the Ningaloo region. It will draw upon the outputs of the other Cluster and WAMSI projects and provide additional outputs in relation to ecosystem modelling, integrate the work of the Cluster and WAMSI and provide outreach capacity to stakeholders.
Deery, Marg	Resident survey of social impacts of tourism	VU	2009	2010	Compile information on residential views of the impacts of tourism for inclusion into the Ningaloo Coast dynamic model.
Depczynski, Martial	Methods for monitoring the health of benthic communities	AIMS	2007	2010	Develop cost-effective methodologies for long-term monitoring for coral and fish recruitment in Ningaloo Marine Park
					Provide baseline data for this program
Depczynski, Martial	Stock assessment of target invertebrates	AIMS, UWA	2008	2010	Assess status of target species and characterise habitats associated with abundance and compare abundance in relation to human use
Dwyer, Larry	Assessment of economic values of tourism	UNSW	2009	2010	Provide an assessment of the economic value of tourism in the Ningaloo Coast area to the socio-economic tourism model
Feng, Ming	Impact of climate variability and climate change on coastal marine ecosystem	CSIRO	2007	2011	Quantify the climate variability in the Leeuwin Current physical forcings on the coastal ecosystem

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Fitzpatrick, Ben	Lagoonal and cross shelf patterns in the trophic structure of demersal fish assemblages	UWA	2006	2009	Characterise the fish biodiversity and assemblages associated with habitat types and dominant macro benthic communities in sanctuary zones and nearby comparison sites in lagoon and deeper waters of NMP northern areas
Foster, Taryn	Assessing the resilience of corals from tropical waters	Murdoch	2008		To assess natural variability in photosynthetic performances of reef building coral within and between colonies of P. damicornis
					<ul> <li>To assess the resilience of P. damicornis from WA tropical waters, to higher sea surface temperatures predicted to occur as a result of climate change, in an aquarium setting</li> </ul>
Fromont, Jane	Species inventory database for the deepwater biodiversity of Ningaloo Marine Park	WAM AIMS	2007	2010	Collect voucher specimens to form the foundation of a species inventory database for the deeper waters of Ningaloo Marine Park.
Fromont, Jane	The significance of historical WA Museum collections in Ningaloo Marine Park	WA museum	2008	2010	Data base the common marine invertebrates from Ningaloo as indicated from historical collections dating back to the 1960s
Fulton, Beth	Integrated software for multiple use management strategy evaluation	CSIRO	2007	2010	<ul> <li>Simulate using a variety of factors including biophysical, social, assessment, monitoring and management policy for multiple use management strategy evaluation</li> </ul>
Fulton, Chris	The effect of wave energy on algal growth	ANU			Not currently available
Gazzani, Flavio	Economic valuation of biodiversity conservation	Murdoch			Estimate the benefits of the non-use values of the Ningaloo Reef and how choices may be related to socio-economic characteristics using Choice Modelling.
Harcourt, R	Australian Telemetry and Acoustic Monitoring System	IMOS			Initiate both a fine and broad scale acoustic curtain at several sites along the NMP to enhance research projects identifying fine and large scale movement of particles and species
Harvey, Euan	Fish biodiversity associated with habitat types in sanctuary and adjacent zones in deeper waters	AIMS	2008	2010	Characterise the fish biodiversity associated with habitat types and dominant macro benthic communities in sanctuary zones and nearby comparison sites in waters between 20-100 m depth
Heyward, Andrew	Distribution and patterns of deepwater biodiversity of Ningaloo Marine Park	AIMS	2007	2010	<ul> <li>Assess the biodiversity value of the deeper waters seawards of the reef crest in the NMP with a focus on representativeness of sanctuary zones.</li> </ul>
Heyward, Andrew	Mapping the deepwater habitats of the Ningaloo Marine Park	AIMS	2007	2010	Characterise the habitat types and dominant macro benthic communities in sanctuary zones and nearby comparison sites in waters between 20-100 m depth
Heyward, Andrew	Long-term growth and calcification rates of <i>Porites</i> in of Ningaloo Marine Park to assess potential impacts of climate change	AIMS			Not currently available
Heyward, Andrew	Coral population dynamics and annual recruitment processes in Ningaloo Marine Park	AIMS	2007	2010	Not currently available

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Heyward, Andrew	Coral reef disease - White Syndrome	AIMS			Detect whether Ningaloo has been infected with white syndrome
Hodgson, Amanda	Distribution and abundance of dugongs in Ningaloo Marine Park and Exmouth Gulf	James Cook University	2001/2	Every 5 years	Establish the abundance of dugong in NMP in relation to Shark Bay and Exmouth Gulf
How, Jason	Movement patterns of Serranids (cods) as they relate to marine park planning at Ningaloo Marine Park	ECU	2008	2009	To look at the movement patterns of serranid (cod) species to determine their home range, and see if an existing sanctuary zone boundaries provide adequate protection for these species from fishing activities
					To examine movement of fish across reef passes and determine whether they provide a natural barrier to fish movement
Hughes, Michael	Environmental load survey of accommodation providers	Curtin	2009	2010	Develop a dynamic model of Ningaloo incorporating social, economic and environmental management assessment of tourism along the Ningaloo coast
Humphries, Stuart	Suspension feeders and energy flow through reefs	UWA	2005	2009	Not currently available
Jenner, Curt	Geographical and temporal boundaries for whales of Ningaloo	Centre for Whale Research	1997	ongoing	Identify the movement and distribution patterns of humpback whales relative to the NMP.
Johansson, Charlotte	Managing coral reefs - the importance of working with functional groups to maintain resilience	JCU			To assess potential variations within ecological functions for herbivorous populations on Ningaloo and GBR
					To understand how these are structured and how they contribute to the build up of resilience.
Jones, Tod	Ningaloo destination model for scenario evaluation and collaborative planning	Curtin		2010	Develop a dynamic model of Ningaloo incorporating social, economic and environmental management assessment of tourism along the Ningaloo coast
Keesing, John	An assessment of likely dispersal patterns for marine organisms based on hydrodynamic and population genetic models	CSIRO	2006	2010	The distribution of genetic structure throughout WA range of two (or more) widespread urchin species with differing reproductive and larval biology and contrasting dispersal potential will be characterised using DNA sequence information
Kingham, A	Sustainability of the wilderness experience : a case study in environmental stewardship	Curtin	2005		Not currently available
Kobryn, Halina	Hyperspectral mapping - Habitats	Murdoch	2006	2009	Develop a high resolution characterisation of the reef and shallow water habitats of the NMP that will provide the basis for future multiple use management and planning
Kuchling, Gerald	Temperature profiles of sea turtle nesting beaches in Western Australia	UWA, DEC	2004	2007	<ul> <li>Provide an overview of temperature variation at sea turtle nesting beaches and allow rough estimates of sex ratio variations according to published male and female producing temperatures for the different species</li> </ul>

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Langdon, Mark	The trophic ecology of the grazing sea urchin ( <i>Echinometra mathaei</i> within NMP: comparing the effects of different closure regimes on urchin distribution and trophodynamics	Murdoch			Comparing the effects of different closure regimes on urchin distribution and trophodynamics
Lewis, Anna	Sustainable camping along the Ningaloo coast: how campsite location, facilities and activities influence environmental impacts	Curtin	2008	2011	To assess campsite environmental impacts, and determine how impacts vary between sites  To assess the average level of waste, water and energy consumption per camper and how waste is disposed of  To assess camper activities and determine influence on campsite selection  To develop indicators to assist in future monitoring of campsite environmental impacts
					To identify whether camping on the beach or dunes create the least environmental impact and determine suitability of campsite locations
Little, Rich	ElfSim: Modelling the effects of fishing on Ningaloo Marine Park	CSIRO	2007	2010	Assess the impact of existing zonal management strategies on key target fish species and biodiversity using background data and knowledge currently held or being gathered
Lovelock, Cath	Nutrient limitation and impact of nutrient enrichment on arid zone mangroves	UQ	1999	On-going	Understand the degree of connectivity between the terrestrial environment and estuaries in the arid tropics of Australia.
Lowe, Ryan	Hydrodynamics of Fringing Reef Systems	UWA	2007	2009	Develop a model that will predict circulation on reefs and other similar coastal systems for the Ningaloo Reef, providing insight into various ecological processes that are linked to hydrodynamics and threatening processes.
Lowe, Ryan	Hydrodynamic control of nutrient uptake and reef metabolism using a portable flume mesocosm at Ningaloo Reef	UWA	2009	2010	To conduct process-based experiments to study the impact of key physical parameters (water motion, light, temperature) on nutrient uptake by reef communities at Ningaloo.
Lowe, Ryan	Benthic productivity and calcification on Ningaloo Reef: role of oceanic forcing and response to climate change	UWA	2007	2009	Not currently available
Marriott, Ross	Stock assessment of spangled emperor	DoF			To assess spangled emperor stock in NMP for integrated fisheries management of the Gascoyne bioregion.
Mawson, Peter	Sand temperature data loggers in turtle nesting beaches	Queensland	2008	On-going	To gather data on sand temperature over time at turtle nesting beaches
McCartney, Abbie	The policy relevance of Choice Modelling: an application to Ningaloo Marine Park	UWA	2007	2010	Investigate the suitability of Choice Modelling as a tool for valuing marine parks and coral reefs using NMP as a case study
					Investigate the differences between traditional and non-market valuation payment vehicles and tax reallocation using CM for an environmental good
					Contribute towards determining the policy relevance of CM

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McCauley, Rob	High resolution data on cross shelf bathymetry and sediment facies	Curtin, AIMS	2006	2010	Improve the understanding of the biophysical domain via high resolution data on cross shelf bathymetry and distribution of sediment facies
McCauley, Rob	Passive acoustics off Exmouth, whales and fish	Curtin, CWR	2000		To gather information on marine mammal presence and movement patterns on the north west shelf
McElroy, Seamus	Economic and social aspects of recreational fishing in WA	UWA			Not currently available
McGregor, Frazer	Trophic ecology of Manta Rays within lagoonal systems of the NMP	Murdoch University	2007	2009	Investigate the tropic links between manta rays and the Ningaloo Reef using mark recapture studies and assessing primary production.
Meekan, Mark	Local and regional migratory patterns of whale sharks	CSIRO	2007	2008	Characterise whale shark abundance in and use of the NMP in support of management strategies for the whale shark ecotourism industry.
Meekan, Mark	Whale sharks, migration and ecology, movements and behaviour of whale sharks with use of acoustic, satellite, PAT, <i>Crittercam</i> and genetic tagging.	AIMS, CSIRO, NOAA	2006	2009	Determine movement and behaviour of Whale Sharks - part of the Whale Shark Management Program
Michael, Peter	Herbivorous fish of Ningaloo	ECU		2010	Qualitatively characterise species specific algal-herbivore interactions across reef habitats
Moore, P	Using the past to understand the future: the effects of climate change on regional diversity patterns of coralline algae	UQ			Investigate the regional effects of climatic warming on the community composition and bio-geographic range of crustose coralline algae along a 12 degree latitudinal gradient of Western Australia's coral reefs
Neiman, Jodie	Diurnal variability in beach use patterns at Bundegi, Turquoise Bay and Coral Bay, Ningaloo Marine Park	Murdoch, DEC	2007	2007	Determine the diurnal pattern of human usage at Bundegi, Turquoise Bay and the main beach at Coral Bay by addressing the diurnal variation in beach use and can an understanding of beach use patterns facilitate an improved approach to beach management
Norman, Brad	Long-term whale sharks tagging study in Ningaloo Marine Park	Eco-oceans	1996	ongoing	Collect baseline data on whale sharks at NMP by photo id, whale shark sex and size, deployment of data logging tags and collection of plankton samples to determine whale shark prey items
Pandolfi, John	Ecological effects of climate change on regional diversity patterns of WA coral reefs	UQ			Not currently available
Parker, Justin	Foraminifera from Ningaloo Reef, Western Australia: Systematics and taxonomy	UWA	2005	2008	Identify and describe the foraminifera of Ningaloo Reef
Pattiaratchi, Chari	Characterisation and modelling of oceanographic processes in Ningaloo Reef and adjacent waters	UWA	2007	2010	Develop the capacity to numerically simulate waves, currents, sediment transport and particle dispersion in a shallow complex reef environment over time and space scales

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Pattiaratchi, Chari	Transient coastal upwelling along Western Australia: the dynamics of the Ningaloo Current system	UWA	2009	2011	The principal aim of this project is to conduct the first detailed study into the dynamics of coastal upwelling along the North West Cape by:  1) Characterising the spatial and temporal variability of upwelling at Ningaloo through field experiments;  2) Develop a three-dimensional circulation model of the Ningaloo region;  3) Use the model to develop suitable parameterizations to predict the meteorological and oceanic conditions responsible for generating upwelling (including annual frequency, duration and cumulative effects over seasons); and  4) Apply the numerical model to assess the role of upwelling on the overall cross shelf exchange of material between Ningaloo and offshore, and investigate how these exchange processes may be affected by forecasted climate related changes to regional meteorological and oceanic forcing.
Pattiaratchi, Chari	SERPENT: Scientific and Environmental ROV Partnership using Existing Industrial Technology	UOS, UWA, UOW, UTS, Woodside, Santos, Chevron			International project in collaboration with oil and gas industry to undertake deep-sea research using ROV technology
Pattiaratchi, Charitha	WAIMOS - West Australian Integrated Marine Observation System	UWA	2008	On-going	The WA component of IMOS, real time monitoring concentrated along the Jurien-Cape Peron coastal stretch and 3 long term reference sites; Dampier, Rottnest and Esperence.
Prince, Bob	Turtle tagging program	DEC	1993	On-going	Long term monitoring program of marine turtle nesting populations in the NMP
Roberts, Rebecca	Economic strategies for disaster risk-reduction in coastal areas: a case study of Exmouth Gulf	Murdoch	2007		To assess the socio-economics of vulnerability on communities who live in the coastal area of Exmouth
Rodger, K	Role of science in managing the impacts of wildlife tourism	Murdoch, Sustainable Tourism CRC	2006		Not currently available
Rouillard, Denis	The use of hyperspectral imagery in detecting linkages between soils and marine sediments at Ningaloo	Murdoch		2008	Produce a classification of distinct soil and sediment types within the Osprey Sanctuary Zone
Rousseaux, Cecile	Production and transport of particulate matter in a regional current system	UWA	2007	2010	To quantify the mechanisms governing the amount of offshore primary production that crosses the continental shelf off Ningaloo Reef to contact the reef front, ultimately entering the Reef via wave-driven lagoon circulation
Scheffer, Sander	Coring of <i>Porites</i> to determine impacts of climate change - Exmouth Gulf	SCU	2010		Not currently available
Sleeman, J	Modelling whale shark distribution	Charles Darwin uni	2004	2007	Not currently available

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Smallwood, Claire	Spatial patterns of human usage in the Ningaloo Marine Park	Murdoch	2007	2009	To understand the patterns and trends in human use of Ningaloo Marine Park
Stevens, John	Diversity, abundance and habitat utilisation of sharks and rays	CSIRO, DoF	2007	2009	Characterise shark and ray diversity and abundance in the reserves and support development of management targets for them.
Stewart, Brent	Range and habitats of whale sharks in the Eastern Indian Ocean	Hubbs SeaWorld Research Institute, CSIRO, AIMS, NOAA	2005	2008	Document the seasonal movements and habitat use of whale sharks at NMP between March and June using satellite tags
Symes, Geoff	NREP Client outreach	CSIRO		2010	Integrate the WAMSI and Cluster research and ensure implementation of outcomes through relevant stakeholders
Taebi, Soheila	Hydrodynamic processes in the Ningaloo Reef system	UWA		2010	To develop hydrodynamic models of circulation in lagoon areas of NMP
Tonge, Joanna	The influence of place attachment on the management of marine parks and their hinterlands	Murdoch			To measure and understand visitor attachment to the NMP To use this information to better inform management and development decisions
Treml, Eric Anton	Reef connectivity and conservation: an empirical and theoretical synthesis	UQ	2008	2011	<ul> <li>Evaluate connectivity (larvae dispersal) between reefs in the Coral Triangle and the GBR using physical and genetic methods.</li> <li>Use this information to predict the impact of climate change on connections among reefs to prioritise their conservation</li> </ul>
Trocini, S.	Conservation of the endangered loggerhead turtle ( <i>Caretta caretta</i> ): health assessment and hatching success of Western Australian populations	Murdoch Uni, DEC	2007		Identify & quantify various biotic & abiotic risk factors that reduce hatching success of loggerhead turtles
Twiggs, Emily	Mapping geomorphology and sedimentary environments for conserving marine biodiversity of the Ningaloo marine park	Curtin		2009	<ul> <li>To Characterise the coastal and seabed geomorphology of the reef system, including the deeper reserve areas offshore of the fringing reef</li> <li>To Characterise the surficial sediments of the shallow (lagoonal) waters</li> </ul>
Usher, Kayley	Investigating the importance, diversity and host specificity of photosynthetic symbionts in marine sponges from tropical and temperate regions	DEC/UWA	2008	2010	Determine; the percentage of photosynthetic sponges on temperate and tropical reefs, diversity of photosynthetic symbionts of sponges, biogeography of symbiont classes, the abundance of symbiont classes and range of host sponges.
van Keulen, Mike	Habitats and Biodiversity of Ningaloo Reef lagoon	Murdoch, Curtin, UQ	2006	2010	Provide comprehensive information on habitats and biodiversity in the NMP  Qualitatively and quantitatively describe the biodiversity values of t selected areas of the reef in relationship to the bio-physical environment, patterns of reef use and access form land, linking these with physical and biological surrogates to enable specific biodiversity values to be applied across the NMP

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					Identify hot spots and develop an understanding of the environmental and habitat factors that explain the distribution of these hotspots
van Keulen, Mike	Biodiversity - soft corals, macroalgae, macro invertebrates	Murdoch	2007	2010	Provide comprehensive information on habitats and biodiversity with a focus on sponges, soft coral and macroalgae
van Keulen, Mike	Seagrasses and macroalgae of Ningaloo	Murdoch Uni	2002		Not currently available
Verges, Adriana	Assessment of trophic cascade effects	CSIRO, ECU	2007	2009	Provide an assessment of indirect effects on benthic community structure from fishing activities in NMP
Waite, Anya	The biological oceanography of Ningaloo Reef: coastal plankton as a food source for the reef. Assessing the vulnerability of Ningaloo Marine Park to pollution	UWA	2006	2009	Not currently available
Warren, Kristin	A study of hatching success and sea turtle health in Western Australia	Murdoch Uni	2006	2009	Determine disease prevalence, health risk factors, causes of mortality, and factors influencing hatching success in three sea turtle species.
Webster, Fiona	Coral reef resilience: balancing production and herbivory	Murdoch	2004	2007	To examine the roles of herbivores and nutrients on macroalgal growth and consequences for coral settlement, survival and growth of coral recruits
Williams, Alan	Southern Surveyor Voyage	CSIRO	2005	2005	<ul> <li>To collect sediment and fauna samples, imagery and mapping data in the Commonwealth Ningaloo MPA as part of a large biodiversity project to support regional marine planning and management of Commonwealth MPAs.</li> </ul>
Wilson, Shaun	Preliminary assessment of disease in Australian corals: Ningaloo Marine Park	DEC	2009	2010	The overarching objective of this project is to investigate the prevalence and types of disease affecting corals in Western Australia.
Wilson, Shaun	Effects of fishing and climate change on reef fish	DEC	2009	2012	Determine how habitat degradation instigated by climate change and changes in predation instigated by fishing pressures effect the composition of the predator community on WA coral reefs.
					Assess diet of predatory species targeted by fishers.
					Identify microhabitats preferentially used by juvenile fish.
					Assess how variation in fishing pressure and habitat complexity/composition influence predation rates on juveniles.

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Wood, David	Social and economic assessment of tourism along the Ningaloo Coast: a dynamic modelling approach (Socio-economics of tourism)	STCRC, Curtin, ECU, Murdoch	2006	2009	Develop a dynamic model of Ningaloo incorporating social, economic and environmental management assessment of tourism along the Ningaloo coast     Assess the social-economic implications of tourism to the Ningaloo coast     Use the model to investigate the impacts of different tourism and development scenarios on the economy, communities and environments of Ningaloo and its surrounding regions
Wood, David	Continuation of long term survey of visitation	Curtin			Not currently available
Wyatt, Alex	Trophic ecology of coral reefs: the role of oceanographic-to- organism scale processes in trophodynamics and benthic- pelagic coupling	UWA		2010	Link benthic ecology and biological oceanography to elucidate the extent and mechanisms by which coral reefs are nutritionally linked to the surrounding pelagic environment and susceptible to its alteration