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Research, Monitoring, Assessment and Development Plan 2011 – 2012

Department of Fisheries, Western Australia

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Introduction

Background

The 2011/2012 Research, Monitoring, Assessment and Development Plan (RMAD Plan) for the Department of Fisheries outlines the current and proposed activities to support the collection and analysis of data to assist the Department meet the objectives of the *Fish Resources Management Act* (1994) over the coming five year period. The name or this plan reflects that a large proportion of the activities undertaken for management are assessment and monitoring rather than new 'research', and this distinction in terminology is consistent with the approved National RD&E framework (CoA, 2010)[1].

The RMAD Plan specifically outlines those activities that are currently planned or have already been identified which directly contribute to the effective management of the aquatic resources of Western Australia through the management of a specific fishery, aquaculture sector or any other activity directly managed through the FRMA. Consequently, it not only documents the research, monitoring and assessment activities being done directly by the Department, but covers any relevant activities being done by other agencies that have been identified as being directly relevant to a particular fishery/sector/asset or issue. Given the dynamic nature of aquatic resource management, this plan is updated on an annual basis based on current priorities and risks. This plan should be read in conjunction with the most recent *State of Fisheries and Aquatic Resources* report where comprehensive analyses of the current status of each of WA's fisheries and other aquatic resources (assets) are described. A summary of the information within the RMAD plan will be included in FishPlan which describes all the activities associated with the management of each fishery.

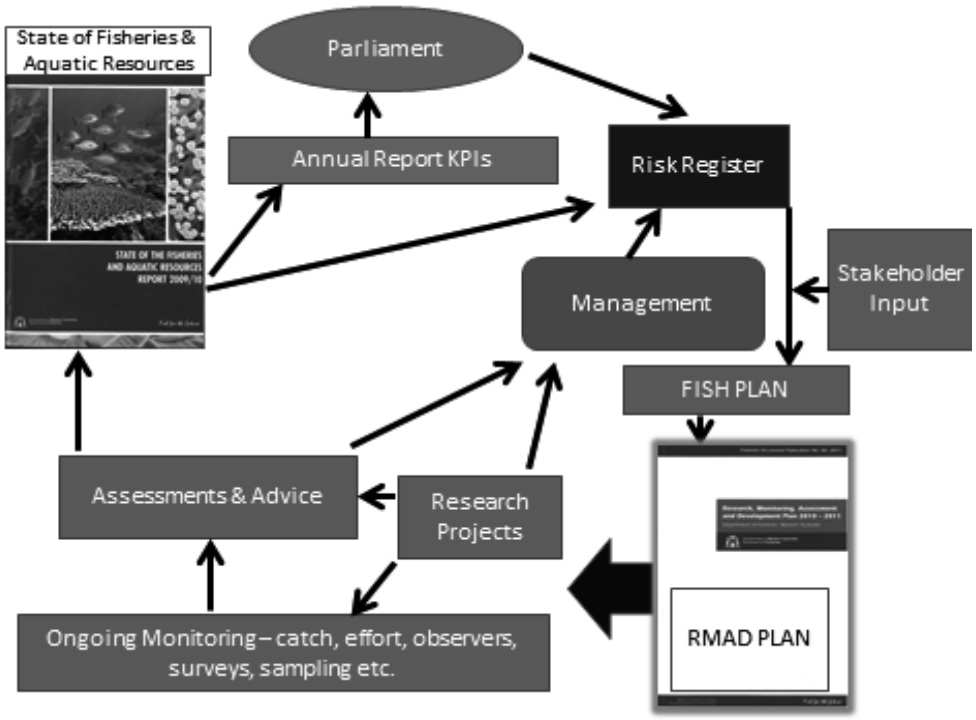
The plan is generated from an aquatic resource management perspective and therefore may not cover all research and development activities required to assist the commercial operations of a fishery. Thus, many industry development activities such as marketing are not covered in a comprehensive fashion. The Department acknowledges that such priorities are best determined and managed directly by industry. Similarly, the plan does not document all marine related research being undertaken in WA especially where this is focused on the discovery of new scientific knowledge with no direct linkage to management.

The focus for the monitoring, assessment or research activities currently being undertaken within each of the sectors documented in this plan have been the result of deliberations and discussions by internal Departmental committees and, for some sectors, with direct input from relevant industry/sector bodies. Thus, where specific industry/advisory group research plans exist, this document will have utilised this information.

Given the diverse levels of risk and differing relative community values associated with each of the various assets and sectors covered by the Department, there are large difference in the level of research, monitoring and assessment activities planned among the different fisheries and ecosystems. These differences also reflect differential levels of ongoing information

[1] Commonwealth of Australia (2010) Working Together: the National Fishing and Aquaculture RD&E Strategy 2010. Fisheries Research and Development Corporation for the Strategy Working Group http://www.frdc.com.au/LiteratureRetrieve.aspx?ID=65590

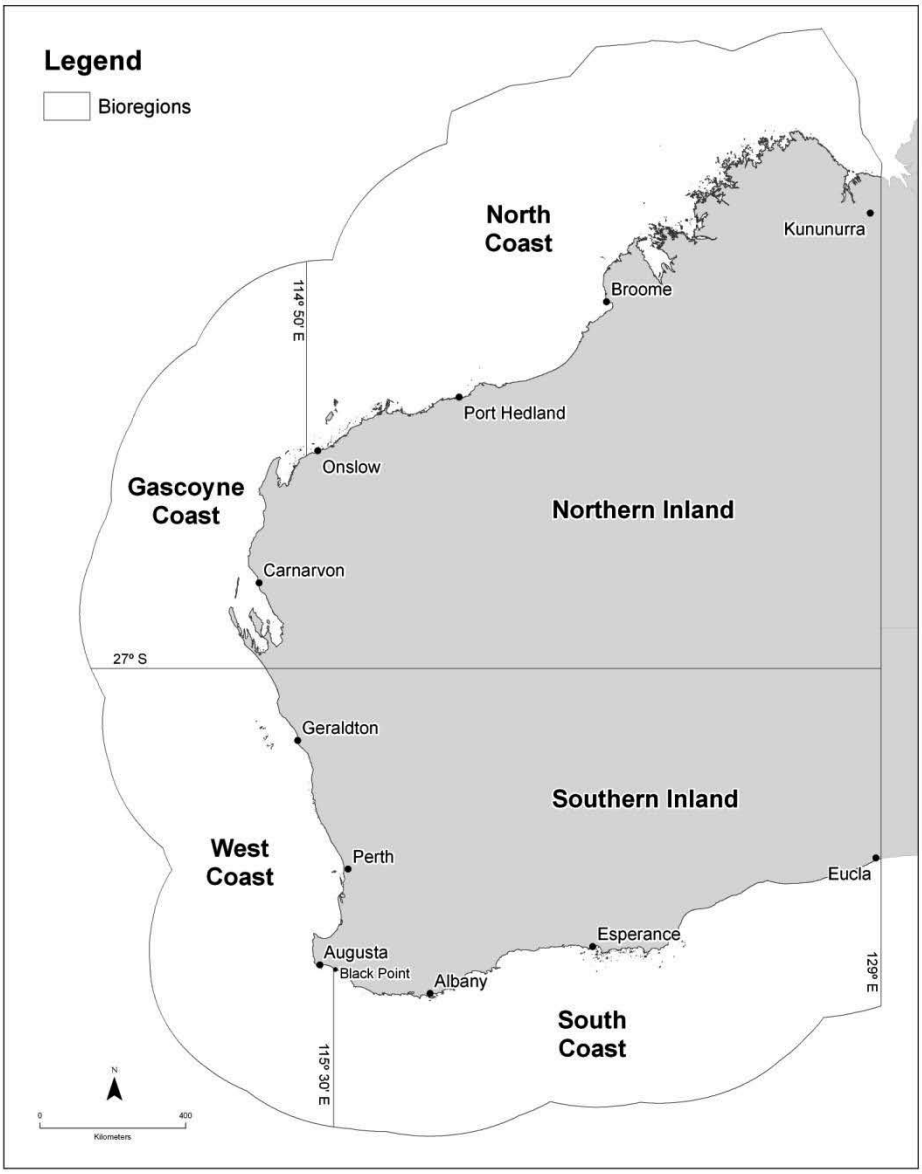
required to enable each of the current management processes to operate effectively and generate acceptable, cost effective outcomes.



INTRODUCTION FIGURE 1.
An outline of the proposed planning cycle used for determining research, monitoring and assessment activities.

To determine priorities, the Department now applies formal risk assessment and risk management techniques to each of the ecological, social and economic assets within each bioregion, using the Ecosystem Based Fisheries Management (EBFM) Framework (Fletcher *et al*., 2010)[1]. The annual update of the RMAD Plan is therefore based on the updated risk profiles across the range of objectives listed within the FRMA and summarised as the Department's KPI's to Parliament and presented within the Annual Report which should ensure that resources are directed to those areas with the highest overall community priority. The risk values are as outlined in the current State of the Fisheries and Aquatic Resources Report (DoF, 2010). The new internal and external consultation framework currently being finalised in conjunction with WAFIC and RecFishWest will form the basis for finalising priorities for both FishPlan and for future editions of the RMAD Plan.

[1] Fletcher, W.J., Shaw, J., Metcalf, S.J. & Gaughan, D.J. (2010). An ecosystem based fisheries management framework: the efficient, regional-level planning tool for management agencies. Marine Policy 34:1226-1238



INTRODUCTION FIGURE 2
Map of Western Australia showing the general boundaries of the bioregions referred to throughout this document.

Potential uses of the plan

From an internal Departmental perspective, it is essential to have a consolidated document that outlines the agreed research, assessment and monitoring requirements for each aquatic resource asset and sector within WA. It needs to be recognised that most of the activities (about 80%) outlined in the plan are ongoing monitoring or assessment activities, not new 'research' projects. The frequency and timing of some monitoring programs is being reviewed so that the resulting stock assessments can be scheduled to align with management reviews. This should optimise the use of limited capacity in areas such as stock assessment and

simulation modelling.

The plan provides the mechanism to identify and track any major gaps in knowledge, resources and expertise which assists capacity planning, future funding applications and planning in a broader context. Each of the reports identifies what needs to be done, but also summarises what has already been done. This should minimise the development of unnecessary research proposals for issues already adequately covered by previous research or for issues where no management risks have been identified. Consequently, the current risk levels for each of the bioregional resource assets relevant to each report are now listed and updated annually.

The introductory section of the plan includes a report that outlines, from the Department's perspective, what new or additional research, assessment or monitoring initiatives will be needed for the management of Western Australia's aquatic resources in the coming few years. The introductory section also contains the consolidated list of projects and activities that have a material attribution to assisting manage the recreational sector. Finally, in recognition of the large number of collaborative projects that are underway, recently funded or proposed in WA, there is a list of the collaborative projects which will be used in management considerations. This both includes multi agency projects for which the Department is principal investigator (PI), plus those where the lead agency is not the Department but we are a collaborator.

The information in this document should also be of benefit to a number of other groups:

- Each of the commercial industry and recreational sectors can use this document to facilitate their own discussions and formulation of their short and long term research priorities which they can then feed up through their relevant sector/peak body;
- Individual fishers can examine and compare the research that is occurring, or is proposed, in their fishery/sector. This knowledge may help increase the level of input received by the peak and sector bodies and therefore result in higher quality community and industry feedback;
- Other research institutes and universities can use the plan to assist in developing possible new projects to address the major research issues that have been identified;
- National research co-ordinating bodies such as the AFMF (including the RD&E framework) and major funding agencies such as the Fisheries Research and Development Corporation (FRDC), can use this information to assist in the future planning of national priorities and sub-program development;
- The general public and conservation groups will have the opportunity to comment upon the monitoring, assessment and research which is proposed or underway, in one of their areas of great general interest, fisheries and aquatic resources.

Description of the report structure

The EBFM based framework identifies and assesses aquatic resources (assets) at a bioregional level, but for practical purposes many of the individual reports in this plan remain at the fishery or activity level. There are separate reports for each of the main wild-capture fisheries and each of the main aquaculture industries. Many of these reports do, however, report on all the activities associated with the management a specific ecological assets (e.g. West Coast Demersal).

Within each bioregion there are also reports that outline the activities examining broader ecosystem and biodiversity issues and some that cover State-wide issues. Given the overlapping nature of issues, when a project is dealing with more than one level of asset or more than one objective, the project can be repeated in more than one report to make each report self-contained.

Each of the reports has a brief overview of the sector/issue/resource asset being addressed plus a short summary description of previous relevant research or monitoring, including a list of recent publications. The current risk levels associated with the resource assets being addressed and therefore the focus of research are updated each year.

Following these background descriptions, most reports have a detailed matrix that is divided into a number of categories (based on EBFM/ESD principles) to clearly detail proposed activities. The categories used are:

- Retained/Key Species Stock Analysis (biology, stock assessment, fishery monitoring)
- Habitat and Ecosystem (bycatch, protected species interactions, habitat impacts, ecosystem effects and the environment)
- Management Analysis (Socio-economic surveys, Resource Access issues, Compliance Research, Management strategy evaluation)
- Industry Development (Production technology, post Harvest, Marketing, OHS) that the Department is directly engaged

Within the matrix each report documents:

- research topics already completed to at least a sufficient level for management,
- research/monitoring activities currently underway and the time frame for completion
- topics for which proposals have been submitted but not yet confirmed
- risk issues that have been identified by management which may require research/monitoring but are to yet be addressed.
- Comments concerning each of the issues relevant to the section (e.g. identifying any EPBC requirements) are also recorded.

The most common shorthand assessments are listed below:

Complete – Activity/project is complete, no more currently needs to be done.

Ongoing – Monitoring or assessment activity is continuing and occurs annually

Periodic – Monitoring or assessment activity occurs at regular intervals, but not annually.

Underway – A short term project has commenced and will continue for a defined period

Proposed – Research is proposed but unfunded

Not Needed – Risk level is too low to warrant dedicated research or monitoring activities.

Indicative priorities for new research and development projects 2011/12

The following list of topics summarises the areas where new research or development requirements have been identified that are likely to be useful for resource management purposes and for which obtaining additional or external funding will be required, or a significant shift in the allocation of internal funds will be needed. This list does not include studies that have been underway for more than a year; it also does not cover minor changes or planned shifts in ongoing monitoring projects.

The topics have been annotated to indicate where the research initiative is already:

* part funded, ** fully funded, # funding proposal pending.

If no annotation is provided it indicates that no funding is yet been found and no project proposal development has been initiated.

While this list will contain topics that are in the R&D priorities generated by the WA FRAB, in some cases there may be additions or omissions given the different scope of the Department's RMAD Plan requirements compared to the largely FRDC based scope of the WA FRAB list of priorities.

To assist in the use of this document, there is a distinction made between those issues that were listed last year from the new issues that have more recently been identified. Where a project has identified problems and the funding status has changed, *these items are indicated by being in italics*. It is encouraging that most of the projects listed last year have already had some success in attracting resources.

Statewide

*Spatial and temporal dynamics of Western Australia's commercially important sharks, examining stock recovery and movement***

Developing mechanisms for cost effective monitoring of shore based and boat based recreational fishing at a Statewide level **

*Understanding environmental effects (and effect of climate change) on recruitment and other biological parameters for key indicator fish stocks***

*Developing a fully integrated project management platform***

Management implications of climate effects on fisheries in WA**

Understanding community preferences and expected outcomes for the use and access to WA's aquatic resources

*Minimising the complexity of fishery management systems **

*Aligning the planning for monitoring, stock assessment analysis and management review cycles for all wild capture fisheries in WA.***

Determining the difficulties and benefits of expanding the EBFM framework to the EBM level.*

*Marine Pest monitoring at major WA ports***

West Coast

Generating a better understanding of the relationships between rock lobster puerulus settlement, oceanographic conditions and spawning stock levels **

*Improved robustness for fishing efficiency for modelling rock lobster egg production.***

*Determining the stock status of key nearshore finfish stocks***

Understanding the impact of management changes on behaviour of recreational fishers in West Coast demersal and nearshore fisheries **

Stock assessment of developing minor fisheries (octopus) **

*Bio-economic assessments of WRL fishery***

Developing indicators of natural and anthropogenic pressures on critical marine habitats at the Abrolhos Islands*

*Developing cost effective rock lobster habitat mapping methods***

*Determining critical habitat for juvenile Dhufish***

Determining the relationship between algal habitats and juvenile lobster recruitment and potential impacts of range contraction #

Restocking Roe's abalone in the Kalbarri region

Gascoyne

Stock assessment of Shark Bay crabs#

Developing ongoing ecosystem and bycatch monitoring

North Coast

*Stock status of key nearshore species, including barramundi and other recreational species (extending the threadfin work).**

Updating and streamlining the monitoring and assessment mechanisms for demersal fish stocks in Pilbara and Kimberley regions.#

Investigating the long term recovery of demersal fish stocks and their associated habitats in the North West Shelf region.#

Developing ecosystem monitoring

South Coast

South Coast finfish stock status (inshore demersal)

*Bio-economics of abalone stock enhancement***

Assessment of brownlip abalone population parameters

Commercialisation of abalone stock enhancement **

Inland

*Baseline surveys of threatened native fish in South West Region***

Aquaculture

Innovative solutions to support octopus production **

Collaborative Projects 2011/12

To improve the effective utilisation of research expertise and enhance the outcomes generated for management and the community in general, many projects now involve more than one agency. The proportion of collaborative projects undertaken to meet Departmental objectives has increased dramatically in the last decade and especially through the formation and funding by the WA State Government of the WA Marine Science Institution (WAMSI). The Department is a supporter of collaborative projects where there are clear benefits either in terms of efficiency or where the scope and comprehensiveness of the problem requires a broader range of expertise.

The following is the current list of collaborative projects listed within this RMAD Plan for which the Department is directly involved (i.e. has a formal and active involvement in at least one of the collection, analysis or interpretation of data) either as the lead agency (i.e. Principal Investigator) or as a formal co-investigator or even as a participant. The symbol (W) indicates a WAMSI project.

Project Title	Lead Agency	Collaborators
STATEWIDE		
Determination of catch and effort by recreational boat based fishers	DoF	Murdoch ECU
Applying the EBFM framework: Using the West Coast and Gascoyne Bioregions as case studies (W)	DoF	Murdoch Uni DEC
Qualitative modelling for development of EBFM case study (W)	DoF	Murdoch Uni CSIRO
Modelling Recreational Fishing Behaviour (W)	UWA	Murdoch DoF
Characterisation of native viruses in Australian prawns	DoF	SARDI
WEST COAST		
Examination of the impacts of the western rock lobster fishery on ecosystems within deep-water regions. (W)	DoF	Murdoch Uni ECU UWA
Examination of the impacts of the western rock lobster fishery on ecosystems within shallow water regions. (W)	ECU	DoF UWA
Development of bioregional level assessments of the status of community structure based on fishery dependent and/or fishery independent data (W)	UWA	DoF CSIRO
Establishment of indicator regions for long term monitoring of marine ecosystems (W)	UWA	DoF
Establishment of fishery dependent indicators of climate change (W)	DoF	CSIRO UWA
Evaluating how food webs and the fisheries they support are affected by fishing closures in Jurien Bay, temperate Western Australia (W)	Murdoch Uni	CSIRO DoF
Assessment of marine communities and the impact of anthropogenic influences (W)	UWA	DoF Murdoch Uni
Development of bioregional level assessments of the status of community structure based on fishery dependent and/or fishery independent data (W)	UWA	DoF Murdoch Uni
Evaluating the use of novel statistical techniques for determining harvest rates and efficiency increases in the Western Rock Lobster Fishery	DoF	VIMS TAFI
Decision-support tools for economic optimization of western rock lobster fishery	DoF	WRLC

Project Title	Lead Agency	Collaborators
Evaluating source-sink relationships of the Western Rock Lobster Fishery using oceanographic modelling.	DoF	CSIRO
Identifying factors affecting the low western rock lobster puerulus settlement in recent years.	DoF	CSIRO
The effect of climate change on the western rock lobster fishery off WA	DoF	CSIRO
Evaluation of population genetic structure in the western rock lobster.	UWA	DoF CSIRO
The Biological Oceanography of Western Rock Lobster Larvae	UWA	DoF CSIRO Murdoch Uni
Assessing possible environmental causes behind the reduced colonization of puerulus collectors by a wide suite of species	DoF	UWA, WA Museum
Implications of mobility and stock structure of key indicator species for management of demersal scalefish in the West Coast Bioregion. (W)	DoF	Murdoch Uni CSIRO
Pink Snapper diet composition	Murdoch Univ	DoF
Predicting the impact of shifting recreational fishing effort toward inshore species	Murdoch Univ	DoF, RFW
Identification of critical habitats for juvenile West Australian Dhufish.	DoF	UWA
Assessment of stock structure and movement of nearshore finfish species	DoF	Murdoch University
Socio-economic assessment of fisheries in the West Coast Bioregion (W)	UWA	Murdoch Uni DoF
GASCOYNE		
Population genomics tools for detecting and monitoring fine scale population patterns in recreational fish species at Ningaloo. (W)	CSIRO	DoF DEC
Minimising resource sharing issues in the Shark Bay Scallop fishery	DoF	UWA
NORTH COAST		
Development of a DNA microarray to identify markers of disease in pearl oysters (*Pinctada maxima*) and to assess overall oyster health	DoF	Uni Qld Macquarie Uni
Sustaining productivity of tropical red snappers using new monitoring and reference points	QDPI	DoF NT
Relative efficiency of fishing gears and investigation of resource availability in tropical demersal scalefish fisheries (NDSF).	DoF	UWA
Connectivity and stock structure of reef species between WA and IOTs	JCU	DoF
Connectivity of shared stocks of deepslope snappers between WA locations, IOTs and the Indo-Pacific	Univ. Hawaii	DoF
Demography of serranids	JCU	DoF
SOUTH COAST		
Bioeconomics of abalone stock enhancement	DoF	WA Chem Ctr.
Using GPS technology to improve fishery dependent data collection in abalone fisheries	TAFI	DoF
Informing risk assessment through estimating interaction rates between Australian sealions and WA temperate demersal gillnet fisheries.	Murdoch Uni	DoF
INLAND		
Developing native fish research and policy strategies	DoF	DoW DEC
Native fish Breeding	DoF	UWA
Dam rehabilitation	DoF	DoW
Native fish surveys in south west	DoF	UWA

Recreational Fishing Related Projects 2011/12

The following is the current list of projects listed within this RMAD Plan for which there is a direct application to the management of recreational fisheries. The activities listed below are presented in a collated form at a much greater degree than in the fishery level reports.

Project Title	Lead Agency	Collaborators
STATEWIDE		
Estimation of catch and effort by recreational boat based fishers	DoF	Murdoch ECU
Monitoring of catch and effort by Charter Boat based recreational fishers	DoF	Charter boat sector
Develop survey methods that can be used in an ongoing manner to cost effectively measure the catch of non-commercial fishing sectors (W)	DoF	Murdoch TAFI
Modelling Recreational Fishing Behaviour (W)	UWA	Murdoch DoF
Exploration of the effectiveness of alternative management responses to variable recruitment of fish	Murdoch	DoF
Investigation of fisheries enhancement devices	DoF	
Understanding environmental effects (and effect of climate change) on recruitment and other biological parameters for key indicator fish stocks	DoF	CSIRO
WEST COAST		
Estimation of catch for metropolitan recreational abalone fishery	DoF	
Stock assessment of metropolitan abalone	DoF	
Monitoring of recruitment and breeding stock plus annual stock assessment and catch prediction for Cockburn Sound blue swimmer crab fishery	DoF	
Annual stock assessment of Peel Harvey blue swimmer crab fishery	DoF	
Recreational catch estimates for western rock lobster fishery	DoF	
Monitoring of recruitment levels and annual stock assessment of western rock lobster fishery	DoF	
Age structure monitoring of indicator species for nearshore finfish	DoF	
Age structure monitoring of indicator species for demersal finfish	DoF	
Long term beach seining & volunteer angling projects to monitor recruitment of some key species (whiting, tailor, herring, mullet, others)	DoF	
Research Angler program	DoF	
Fish indicators for monitoring estuarine health and that of black bream stocks and the implications for fish of algal blooms	Murdoch Uni	DoF Swan River Trust
Movement of pink snapper associated with spawning aggregations in Cockburn Sound (DoFWA).	DoF	UWA
Development of ecosystem models for the high priority estuarine regions of the Swan River, Peel Harvey and Leschenault Inlets and the coastal embayment of Cockburn Sound. (W)	Murdoch Univ	UWA DoF SRT ECU CSIRO

Project Title	Lead Agency	Collaborators
Pink Snapper diet	Murdoch Univ	DoF
Predicting the impact of shifting recreational fishing effort toward inshore species	Murdoch Univ	DoF, RFW
Egg survey/DEPM model for pink snapper in Cockburn Sound, BRUVS survey of juvenile recruitment.	DoF	UWA
Identifying factors affecting the low western rock lobster puerulus settlement in recent years.	DoF	CSIRO
The effect of climate change on the western rock lobster fishery off WA	DoF	CSIRO
Implications of mobility and stock structure of key indicator species for management of demersal scalefish in the West Coast Bioregion. (W)	DoF	Murdoch Uni CSIRO
Identification of critical habitats for juvenile West Australian Dhufish.	DoF	UWA
Assessment of stock structure and movement of nearshore finfish species	DoF	Murdoch University
Passive acoustic techniques to monitor aggregations of sound producing fish species	Curtin Uni	DoF
Socio-economic assessment of fisheries in the West Coast Bioregion (W)	UWA	Murdoch Uni DoF
GASCOYNE		
Egg production estimates of pink snapper spawning stock in each of the Shark Bay Gulf stocks.	DoF	
Integrated stock assessment model based estimates of pink snapper stocks	DoF	
Population genomics tools for detecting and monitoring fine scale population patterns in recreational fish species at Ningaloo. (W)	CSIRO	DoF DEC
Biodiversity Assessment, Ecosystem Impacts of Human Usage and Management Strategy Evaluation. (W)	CSIRO	Curtin U DoF DEC
Age based assessments and monitoring of spangled emperor in northern Gascoyne region	DoF	
NORTH COAST		
Age based assessment of nearshore finfish indicator species	DoF	
Defining the stock structure of northern Australia's threadfin salmon species	JCU	DoF
Demography of serranids	JCU	DoF
SOUTH COAST		
Research Angler program	DoF	
Annual trends in juvenile recruitment of nearshore finfish	DoF	
Monitoring of recreational catch of brown and greenlip abalone	DoF	
Age-based assessment of indicator species using 'weight-of-evidence' approach for nearshore (herring) and demersal finfish	DoF	

Project Title	Lead Agency	Collaborators
INLAND		
Annual stocking of trout fingerlings	DoF	
Annual assessment of recreational angling catch and effort	DoF	
Annual catch estimates of recreational marron fishing	DoF	
Fishery independent surveys of marron stocks	DoF	

Statewide

Statewide – Biosecurity (Diseases and Aquatic Health)

Description and Scope of Issues

Australia's fisheries and aquaculture are the fastest growing primary industry sectors in terms of both job creation and average growth in production. In addition there is a growing recreational involvement in fishing. Western Australia is fortunate to have an aquatic animal sector relatively free from many diseases that cause significant economic impact elsewhere in the world and in the eastern states. Increasingly, disease is becoming a trade issue. The Department has responsibility under the Fish Resources Management Act (1994) for the control of exotic and endemic aquatic animal diseases in the State. Protecting the disease status of the state and the aquatic industries within the state requires that there is ongoing surveillance and monitoring for endemic and exotic diseases, the regulation and certification of production, imports and exports, and the capacity to detect and respond to diseases as they occur.

Relevant Resource Assets and Risks from all Activities

Statewide – Diseases and Pests Moderate Risk

Summary of Historical Research Completed

The Fish Health Unit was formed in 1988 following an outbreak of disease in the state trout hatchery. The unit, from its inception, has been co-located within the Animal Health Laboratory of the Department of Agriculture and Food, bringing economies of scale through sharing of equipment and personnel. The unit has provided a disease diagnostic service to the seafood industries; has undertaken disease surveillance for key fisheries, including trout; dhufish; pearl oysters; prawns; yabbys, rock lobsters; mulloway, ornamental fish, barramundi and yellow-tail kingfish. In addition, protocols for high health hatchery status have been developed and adopted by key industries.

Current Research Focus

The Fish Health Unit of the Department of Fisheries is accredited to ISO 17025 and provides a diagnostic service to the fishing and aquaculture industry in Western Australia, investigates ‘fish kills’, contributes to policy advice developed by the Department, carries out research on diseases of aquatic organisms, and has a minor extension role. Greater emphasis has been placed on staff visiting aquaculture farms to encourage sustainable farming practices. Key activities are as follows:

- Undertakes diagnostic services for industry
- The provision of export health certificates for marron.
- The provision of pearling and finfish translocation certificates.
- Centre for receipt of notifiable diseases. This year the diseases were all records of iridovirus in ornamental fish.
- Provides technical advice to the Department on diseases of concern, including risk

assessments where required.

- Investigation of disease in pearl oysters (Pinctada maxima) through two Fisheries Research and Development Corporation (FRDC) funded projects; FRDC 2008/30 to develop methods to detect stress in oysters and FRDC 2008/31 to investigate novel Chlamydia-like bodies in pearl oysters has continued.
- In collaboration with staff from the Department of Water and the Water and Rivers Commission, investigates reports of 'fish kills' throughout the State.
- Assist with a range of national committees including the national Subcommittee on Aquatic Animal Health, the national Laboratories for Emergency Animal Disease Diagnosis and Response and the Aquatic Animal Health Subcommittee of the Fisheries Research Development Corporation. The federal government departments Biosecurity Australia and Department of Agriculture Fisheries and Forestry frequently also seek the expertise of the Fish Health Unit.
- Provide a regional resource centre for aquatic animal health within the Network of Aquaculture Centres (NACA) in the Asia-Pacific.

Priority Setting Process and Review Timeline

Meetings between the Department of Fisheries and industry.

Key to symbols in the matrix/summary tables:

■ Indicates that the activity is funded and planned to occur.

O Indicates that the activity is part of a proposal but is not yet funded.

Statewide – Biosecurity (Diseases and Aquatic Animal Health)	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained/Cultured Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
1.2 Other Biology							
OOD research	Underway	■					
1.3 Fishery Monitoring							
Translocation certification	Ongoing	■	■	■	■	■	Fee per service basis
Characterise native viruses in prawns	Underway	■	■	■			Funded
Characterise Perkinsus infections in WA	Underway	■	■	■			Funded
2. Habitat & Ecosystem							
2.1 Other impacts							
Fish Kill investigations	Ongoing	■	■	■	■	■	In conjunction with DoW
Disease Surveillance and monitoring	Ongoing	■	■	■	■	■	National reporting requirement
3. Management Analysis							
National Coordination	Ongoing	■	■	■	■	■	

Statewide – Biosecurity (Diseases and Aquatic Animal Health)	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
4. Industry Development							
4.1 Production Technology							
Diagnostic Services	Ongoing	■	■	■	■	■	Fee per service basis
4.2 Post Harvest							
Provision of Export Certifications	Ongoing	■	■	■	■	■	Fee per service basis
4.3 Marketing							
5. Priority Review							
6. Science Review							

Statewide – Biosecurity (Pest Incursions)

Description and Scope of Issues

The issue of biosecurity, particularly marine biosecurity, is becoming critical for Western Australia. There are a number of national and international agreements that bind the state, including the *National System for the Prevention and Management of Marine Pest Incursions* (Marine IGA).

Within Western Australia, the Department of Fisheries is the lead Agency to develop and implement the necessary management arrangements and activities to, where possible, reduce the risk of introduction and translocation of aquatic pest animals and plants as well as animal and plant pathogens and diseases. These obligations also extend to the Indian Ocean Territories through contract agreements with the Federal government.

There are three overarching functions associated with the management of aquatic biosecurity:

Prevention to reduce the risk of introduction of non-indigenous aquatic organisms into Western Australia and to manage the translocation of non-indigenous aquatic organisms within Western Australia using a risk based approach;

Emergency Response Management (preparedness and response) to provide a co-ordinated emergency response to new incursions of non-indigenous aquatic organisms; and

On-going, Risk Based Management to control introduced aquatic organisms already within Western Australia.

Relevant Resource Assets and Risks from all Activities

Statewide Diseases and Pests High Risk

Summary of historical research completed

A literature review was conducted to collate existing knowledge on introduced marine species relevant to Western Australia. Currently 60 introduced marine species have been identified. This report served as the basis for a popular publication outlining the natural values of the Western Australian marine environment, the threat presented by introduced marine species, and what we can do about it.

An analysis of the current risks to WA ports and marinas, based on assessment of vessel movements, has been completed. Three WA ports have been identified on the national list of ports at high risk for introductions. Nationally approved marine pest monitoring designs have been developed and implemented for four WA ports, including Port Hedland, Dampier, Fremantle and Christmas Island ports. On-going background marine pest monitoring is also underway at Port Hedland, Dampier and Fremantle ports.

Current Research Focus

- To develop molecular tools/methods for the detection of marine pests.
- Determine relative risk of marine pests to establish in WA waters.
- Prioritise target species for monitoring.
- Undertake research into the growth and physiology of high risk marine pests e.g. Asian green mussel
- To evaluate and improve methods for detecting, monitoring and controlling invasive species incursions.
- Continue with ongoing background port monitoring at Port Hedland, Dampier and Fremantle ports.

Priority Setting Process and Review Timeline

Department of Fisheries meeting with stakeholders, including Federal Government.

Key to symbols in the matrix/summary tables:

■ Indicates that the activity is funded and planned to occur.

O Indicates that the activity is part of a proposal but is not yet funded.

Statewide – Marine Pest Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
2. Habitat & Ecosystem							
2.6 Other impacts on fishery							
Port monitoring	Ongoing	■	■	■	■	■	Annual IMP surveys as well as ongoing background monitoring for IMPs
Introduced marine pests	Ongoing	■	■	■	■	■	Develop molecular tools/methods for the detection of IMPs

Statewide – Marine Pest Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
Introduced marine pests	Ongoing	■	■	■	■	■	Determine relative risk of IMPs to establish in WA waters and prioritise target list
Introduced marine pests	Ongoing	■	■	■	■	■	Undertake growth and physiology studies on high risk pests
Introduced marine pests	Ongoing	■	■	■	■	■	Evaluate and improve methods for detecting, monitoring and controlling invasive species incursions
3. Management Analysis							
National coordination	Ongoing	■	■	■	■	■	
4. Industry Analysis							
5. Priority Review							
6. Science Review							

Statewide – Specimen Shell Managed Fishery

Description and Scope of Issues

The Specimen Shell Managed Fishery (SSF) is based on the collection of individual shells for the purposes of display, collection, cataloguing, classification and sale.

Up to 550 different shellfish species are collected by hand by a small group of divers operating from small boats in shallow coastal waters. While the fishery covers the entire Western Australian coastline, there is some concentration of effort in areas adjacent to population centres such as metropolitan Perth, Bunbury, Albany and Port Hedland.

Relevant Resource Assets and Risks from Fishery

Statewide Nearshore Molluscs Low Risk

Summary of historical research completed

Ponder and Grayson (1998)[1] examined the specimen shell industry on a nationwide basis, rating vulnerability to over-exploitation on the basis of species biology, accessibility to collection, and rarity. Species collected in Western Australia were identified by Ponder and Grayson as potentially vulnerable comprised 6 cowries and 2 volutes (*Amoria* spp.).

[1] Ponder, WF and Grayson, JE. 1998. The Australian marine molluscs considered to be potentially vulnerable to the shell trade. A report prepared for Environment Australia.

Current Research Focus

Current fishery-dependent data collection systems monitor the catch (species-specific), effort and catch rates for the fishery. Fishers within the SSF provide monthly returns under the statutory catch and effort system (CAES). These returns contain information on catch (species, numbers and spatial area), and days and hours fished by month and year.

In August 2004, fishers commenced reporting using 10 x 10 nautical mile (nm) grids rather than 60 x 60 nm grids, providing a finer spatial scale to the data collected. At the same time, they began collecting additional information on sightings of the 8 mollusc species identified as potentially 'vulnerable.' These data are used as the basis to provide research advice for fisheries management

Priority Setting Process and Review Timeline

Meetings between the Department of Fisheries and industry

Annual reviews of data occur in June.

Given the small amount of activity no matrix is provided.

Statewide – Marine Aquarium Fish

Description and Scope of Issues

The Marine Aquarium Fish Managed Fishery (MAF) targets more than 250 species of fish under the management plan. Other management arrangements authorise fishers to take coral, live rock, algae, seagrass and invertebrates. It is primarily a dive-based fishery that uses hand-held nets to capture the desired target species from boats up to 8 m in length. While the MAF operates throughout all Western Australian waters, catches are relatively low in volume due to the special handling requirements of live fish. Fishing operations are heavily weather-dependent due to the small vessels used. In addition, human constraints (i.e. physiological effects of compression) limit the amount of effort exerted in the fishery, the depth of water and the offshore extent where collections can occur.

Summary of historical research completed

Due to resourcing constraints the marine aquarium fish fishery is only assessed by compilation of catch data from the fishery in the form of the statutory monthly catch and effort returns.

Current Research Focus

Information provided by the fishery in the form of statutory monthly catch and effort returns is used as the basis to provide research advice for fisheries management. Statutory catch and effort reporting at the fine spatial scale of 10 minutes of latitude and longitude commenced in September 2004.

Priority Setting Process

Initial assessments were made through internal departmental meetings and forums discussing the history of research in the fishery, research activities that have been completed, current research as well as research and development gaps. Research issues have been discussed at annual industry consultation meetings once a year. Additional research needs have also been highlighted through the ESD assessment process.

Review Timeline

This fishery is of low priority relative to other fisheries in the State and is only reviewed when resources permit.

Given the small amount of activities no matrix is provided.

West Coast Bioregion

West Coast – Biodiversity & Ecosystem Issues

Description and Scope of Issues

The West Coast is characterised by exposed sandy beaches and a limestone reef system, which creates surface reef lines often about 5 km off the coast. Sea floors further offshore on the continental shelf are typically coarse sand interspersed with low limestone reef associated with old shorelines. There are few areas of sheltered water along the West Coast, the exceptions being near the Abrolhos Islands, in the lee of some small islands off the mid-west coast, and behind Rottnest and Garden Islands off the Metropolitan area. The major significant marine embayments of the west coast are Cockburn Sound and Geographe Bay. Beyond Cape Naturaliste the coastline changes from limestone to predominantly granite and becomes more exposed to the influences of the Southern Ocean. Along the west coast there are four significant estuarine systems, the Swan/Canning, Peel/Harvey and Leschenault estuaries and Hardy Inlet (Blackwood estuary), all of which are permanently open to the sea and form an extension of the marine environment except when freshwater runoff displaces the oceanic water for a short period in winter and spring.

Relevant Resource Assets and Risks from all Activities

WC Benthic - Estuaries	Severe (non fishing)
WC Benthic - Nearshore	Low
WC Benthic - Inshore Demersal	Low
WC Benthic - Offshore	Low
WC Protected species - non fish	Low
WC Protected species - non fish - mammals	Moderate
WC Protected species - fish	Negligible
WC Ecosystem - Estuarine	Severe (non fishing)
WC Ecosystem - Marine	Moderate
WC Abrolhos Ecosystem	Moderate
WC LN Ecosystem Estuarine	High (non fishing)
WC LN Ecosystem marine	Low
WC Introduced Pests & Diseases	Moderate (non fishing)

Summary of historical research completed

Bycatch: The Department of Fisheries conducted a study of the potential impacts on bycatch species and the benthic habitat of this region in the South West Trawl in the early 1990s and found minimal impact. Research to mitigate these interactions is developing such as the implementation of Sea Lions Exclusion Devices (SLEDs) in 2006 in the Rock Lobster fishery. Recently completed WAMSI project 4.4.1 established a risk analysis of interaction

rates between the collective fisheries and bycatch to identify which species, species groups or fisheries require more detailed assessment.

Introduced Marine Pests (IMPs): A nationally approved marine pest monitoring design has been developed and implemented for Fremantle Port. In addition, information has been gathered on the status of IMPs for Geraldton Port and Cockburn Sound.

Community structure and biodiversity: A long-term monitoring program to compare fish, rock lobster and sessile benthic communities inside and outside sanctuary zones of the NRM Swan region has been completed for the Swan Catchment Council (now Perth Region NRM). Marine Futures (NHT funded), the project collected baseline scientific data to develop marine resource indicators for marine habitats, biodiversity and human use patterns in SW Australia. The Strategic Research Fund for the Marine Environment (SRFME) undertook studies on several ecosystem topics in this Bioregion including pelagic productivity cycles of oceanic waters, coastal and shelf biogeochemical modeling, and benthic ecosystem dynamics (algae, invertebrates and fish communities) in shallow (<20 m depth) waters. Focus areas for community ecology in this Bioregion included Jurien Bay and Geographe Bay. Recently completed WAMSI projects have seen a substantial program of work on biodiversity and community structure on the West Coast including the Swan, Peel Harvey and Leschenault estuaries – WAMSI 4.2.

Current Research Focus

A number of research activities are underway within this Bioregion, many are undertaken by agencies other than the Department of Fisheries.

- Interaction rates with threatened, endangered and protected species (TEPS) are now recorded on daily logbooks and Catch And Effort Statistics (CAES) forms.
- The physical impact of fishing with lobster pots on coral communities at the Abrolhos Islands, is being monitored. Information on a number of environmental variables is also being collected as part of this project to assess the impact of natural and anthropogenic effects on the marine habitats of the Abrolhos Islands.
- Habitat mapping/modelling work is continuing at various West Coast locations including the Abrolhos.Islands.
- Deep water Lobster – (FRDC, WAMSI) this project focuses on determining the ecosystem effects of removing lobster from the ecosystem on the west coast Bioregion by comparing research areas open and closed to lobster fishing.
- Development and implementation of monitoring programmes for the Capes marine park.
- Continue with ongoing background port monitoring at Fremantle Port and adjacent waters including Garden Island.
- To evaluate and improve methods for detecting, monitoring and controlling invasive species incursions.
- Finalising the NRM project to identify critical habitats for juvenile dhufish.

Priority Setting Process

WAMSI projects were developed by executive direction of the Department with research input. The Department has developed a risk assessment process for the West Coast Bioregion under Its processes of considering Ecosystem Based Fisheries Management as a management goal.

Review Timeline

The projects falling into this R & D summary are varied and mostly short-term. Peer review of the projects has mostly been at the point of their submission as final reports.

Recent Publications

Metcalf, S. J., Pember, M. B., and Bellchambers, L. M. (2011). Identifying indicators of the effects of fishing using alternative models, uncertainty, and aggregation error. *ICES Journal of Marine Science*, 68: 1417–1425.

Molony, B. W., Newman, S. J., Joll, L., Lenanton, R. C. J. and Wise, B. (2011). Are West Australian waters the least productive waters for finfish across two oceans? A review with a focus on finfish resources in the Kimberley region and North Coast Bioregion. *Journal of the Royal Society of Western Australia.* 94: 323–332.

Bellchambers, L. (2010). The effect of western rock lobster fishing on the deepwater ecosystems of the west coast of Western Australia. *Final FRDC Report, Project 2004/049. Department of Fisheries, Government of Western Australia.* 96pp.

Bellchambers, L. M., Evans, S. N., and Meeuwig, J. J. (2010). Abundance and size of western rock lobster (*Panulirus cygnus*) as a function of benthic habitat: implications for ecosystem-based fisheries management. *Marine and Freshwater Research* 61, 279–287.

Evans, R. and Molony, B. W. (2010). Ranked Risk Assessment for Bycatch in Multiple Fisheries: a Bioregional Risk Assessment Method. *Fisheries Research Report No. 212. Department of Fisheries, Western Australia.* 88pp.

Mitsopoulos, G. and Molony, B. (2010). Protecting inshore and demersal scalefish-Identification of critical habitats for juvenile dhufish. *Fisheries Research Report No 210. Department of Fisheries, Western Australia.* 36pp

Bellchambers, L., Bridgwood, S., How, J., Lewis, P., de Lestang, S., Mackie, M., Coutts, T. (2009). Development of a long-term program to monitor coastal communities within the Swan region. *Fisheries Research Report No 183. Department of Fisheries, Western Australia.* 130 pp.

Waddington, K.I., Bellchambers, L. M. , Vanderklift, M. A. and Walker, D. I. (2008). Western rock lobsters (*Panulirus cygnus*) in Western Australian deep coastal ecosystems (35-60 m) are more carnivorous than those in shallow coastal ecosystems, *Estuarine, Coastal and Shelf Science*, Volume 79, 114-120

Key to symbols in the matrix/summary tables:

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O Indicates that the activity is part of a proposal but is not yet funded.

West Coast Biodiversity Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
2. Habitat & Ecosystem							
2.1 Bycatch (Trawl fisheries)	Completed						Completed in the 1990s
Non – trawl Fisheries	Completed						WAMSI 4.4.1 - Captured species assessments: bycatch non trawl fisheries
2.2 Listed Species	Completed						WAMSI 4.4.1 - Captured species assessments: bycatch
Australian sea lion (ASL)	Completed						Studies to ameliorate catch of pups in rock lobster pots has been completed.
2.3 Habitat							
Developing RCTs for benthic habitats	Completed						MF – DoF, UWA WAMSI 4.2
Deepwater rock lobster habitat	Ongoing	■					Identification of deep and shallow water habitat is being conducted by WAMSI & FRDC funded projects
Habitat Mapping	Ongoing	■					Marine Futures mapped the habitat and biodiversity at the Abrolhos, Jurien, Rottnest and the Capes. Has been extend for lobster habitats. Habitats have also been mapped at the Abrolhos Islands. Habitat work Is also part of NRM dhufish project led by the Department.
Coral habitats in Abrolhos	Ongoing	■					A DOF project is currently underway examining the effects natural and anthropogenic Impacts on sensitive coral habitats at the Abrolhos
Near shore seagrass	Ongoing	■					Seagrass communities are currently being studied by ECU as part of SRFME
Swan Catchment Council	Completed but part ongoing	■					A program to monitor rock lobster, fish and sessile benthic communities inside and outside of sanctuary zones at Rottnest Island, Marmion and Shoalwater Islands marine parks has been completed.
2.4 Ecosystem/Environment							
Trophic interaction, anthropogenic influences etc - Swan River, Peel Harvey; Leschenault	Completed						WAMSI 4.2 & 4.3.
Climate change, ecological processes	Underway						WAMSI Projects 1 & 2 (CSIRO, UWA, AIMS): e.g.
Western Rock lobster	Underway	■					FRDC deepwater ecology project and WAMSI are examining the effects of rock lobster fishing on the ecosystem It is likely that research will be ongoing in these areas
Ecosystem modelling	Completed						Conducted by Murdoch University with FRDC and WAMSI funding in the estuaries and Jurien Bay region
Marine Park monitoring	Ongoing	■	■	■	■	■	Capes Marine Park

West Coast Biodiversity Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
Fish Kills	Ongoing	■	■	■	■		Gov't response to fish kills coordinated through Fisheries Research (Fish Health).
2.5 Oceanography							
Hydrodynamic modelling	Underway						Some fine- and broad scale work has been completed (e.g. CSIRO/DoF WRL larval dispersal model) WAMSI Projects 1, 2, 3 & 4 (CSIRO, UWA, AIMS):
Nutrient/plankton cycles on shelf	Completed						Two Rocks transect - WAMSI node 1
Southern Surveyor Eddy cruise 1	Completed						cruise completed; papers accepted
Southern Surveyor Eddy cruise 2 – LC/shelf interactions	Underway						Data analysis underway. Another cruise is planned.
2.6 Other impacts on fishery							
Port monitoring for IMPs	Ongoing	■	■	■	■	■	Annual IMP surveys as well as ongoing background monitoring for IMPs
Introduced marine pests	Ongoing	■	■	■	■	■	Evaluate and improve methods for detecting, monitoring and controlling invasive species incursions
3. Management Analysis							
3.1 Socio-economic							
Social assessment	Developing						WAMSI 4.5: implications of proposed resource allocations.
Economic Analysis	Developing						WAMSI 4.5: implications of proposed resource allocations
3.4 Management Systems	Underway	■					WAMSI 4.1. Applying EBFM framework.
	Developing						EPBC/NOO south west regional plan
4. Industry Development							
5. Priority Review							
6. Science Review							

West Coast – Abrolhos Islands FHP Region

Description and Scope of Issues

The Houtman Abrolhos is a complex of islands and reefs located at the edge of the continental shelf between 28°15'S and 29°S, approximately 60km offshore from the mid-west coast of Western Australia and it is an extremely important component of the Western Australian environment. The "Abrolhos System" is of major significance for the conservation of flora and fauna, and is also significant in geological terms.

The adjoining State territorial waters contain some of the most highly valued marine systems in the State. Furthermore, these waters include the sites of some of the most important historic shipwrecks in Australia, with associated historic sites located on the islands themselves. In recognition of its importance, the Abrolhos was declared in 1999 as the first Fish Habitat Protection Area in Western Australia. It remains the largest in the State and is the only area in which DoF has primary management responsibility for the entire area (including the terrestrial component). A detailed overall management plan, released in 1998, is currently being revised. There are also management plans for tourism and aquaculture.

Relevant Resource Assets and Risks from all Activities

West Coast Abrolhos Ecosystem	Moderate Risk
West Coast Benthic Abrolhos	Low Risk

Summary of historical research completed

Van Herwerden, L., Choat, J. H., Newman, S. J., Leray, M. and Hillersøy, G. (2009) Complex patterns of population structure and recruitment of *Plectropomus leopardus* (Pisces: Epinephelidae) in the Indo-West Pacific: implications for fisheries management. *Marine Biology* 156,1595–1607.

Sumner, N. (2008). An assessment of the finfish catch by recreational fishers, tour operators, commercial lobster fishers and commercial wetline fishers from the Houtman Abrolhos Islands during 2006. *Fisheries Research Report No 175, Department of Fisheries, Western Australia.* 32pp.

Watson, D. L., Harvey, E. S. and Nardi, K. (2008). Long term monitoring of the effects of fishing and protection on reef fish assemblages at the Houtman Abrolhos Islands. *Final report for the Northern Agricultural Catchment Council (NACC).* 72pp.

Van Herwerden, L., Choat, J. H., Dudgeon, C. L., Carlos, G., Newman, S. N., Frisch, A. and van Oppen, M. (2006). Contrasting patterns of genetic structure in two species of the coral trout Plectropomus (Serranidae) from east and west Australia: Introgressive hybridisation and ancestral polymorphisms. *Molecular Phylogenetics and Evolution*. 41, 420 – 435

See further list of historical publications in previous editions of this document.

Current Research Focus

To develop programs to meet the following objectives:

- Assess the status of key indicator fish and invertebrate stocks distributed within FHPAs, particularly the Abrolhos FHPA.
- Satisfy the relevant fish and invertebrate abundance and biodiversity key performance

indicators set to maintain the FHPAs, particularly the Abrolhos FHPA.

- Determine the effectiveness of the FHPA fish and fishery related management procedures.
- Establish a system of benthic habitat monitoring in the Abrolhos FHPA to provide a baseline against which future anthropogenic changes can be assessed.
- Monitor and understand the resilience of coral reef communities to environmental change using the Abrolhos FHPA as a model system.

Priority Setting Process

Assessments of required research are made through departmental meetings, which involve discussions of stock status, previous research conducted, current research and existing research gaps required for more informed management. Relevant discussions of research outcomes and needs with stakeholder groups occur regularly.

Review Timeline

The management of the Abrolhos Islands was reviewed in 2007 (DoF 2007). – (FMP 220).

Key to symbols in the matrix/summary tables:

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O Indicates that the activity is part of a proposal but is not yet funded.

West Coast Abrolhos Islands FHP Regions Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reprod., diet, Natural mortality)							
Dhufish Regional Biology	Completed						
Dhufish Reproductive Biology	Completed						
Pink Snapper Biology	Completed						
Balchin Groper Biology	Completed						
Breaksea Cod Biology	Completed						
1.2 Other Biology							
Spawning Aggregations	Completed	■					Peer reviewed journal article In progress
Release Mortality	Completed						
Movement	Completed	■					Peer reviewed journal article In progress
Coral Trout Biology	Underway						PhD + ECU
Spangled Emperor Biology	Underway? Marriot In Gascoyne						
Red Throat Emperor	Underway	■	■				DoF and ECU
General fin fish assemblages	Ongoing	■	■	■	■		UWA

West Coast Abrolhos Islands FHP Regions Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1.3 Stock Assessment							
Annual C & E Assessment	Ongoing	■	■	■			
Age Structure Models (indicator species)	Periodic						Every two years after management
1.4 Fishery Monitoring							
Commercial Catch & Effort	Ongoing	■	■	■			
Age Structure of Indicator Species	Ongoing	■	■				Baldchin Groper
Fishing Power							
Recreational Creel	Periodic						Periodic
Recreational Indicator	Developing						
Charter Boat Catch and Effort	Ongoing	■	■	■			Compulsory catch returns, annual reporting In SOF In relevant sections
2. Habitat & Ecosystem							
2.1 Bycatch							
2.2 Listed Species							
Foraging ecology of Australian sea lions	Completed						
2.3 Habitat							
Impacts on coral from potting	Ongoing	■	■				Study currently underway to examine the effects of anthropogenic and natural Impacts on sensitive habitats includes ROA's Further assessment of indicators will occur through WAMSI 4.2
Resilience of coral communities to environmental change	Ongoing	■	■				AIMS and others
Habitat mapping	Completed						Marine futures habitat mapping. Published In peer reviewed
QuickBird Assessment	Ongoing	■					Habitat mapping of the shallow water habitats (State NRM)
2.4 Ecosystem/Environment WC Bioregion ecosystem study							
WAMSI 4.2 developing indicator sites and measures	Ongoing	■					UWA and others
2.5 Oceanography							
2.6 Other impacts on fishery							
3. Management Analysis							
3.1 Socio-economic							
Social assessment							
Economic Analysis							
3.2 Resource Access (Shares)							
Detailed determination of access shares							
Monitoring of shares							
3.3 Compliance							
Validation of Catch Records							

West Coast Abrolhos Islands FHP Regions Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
3.4 Management Systems							
4. Industry Development							
4.1 Production Technology	None						
4.2 Post Harvest	None						
4.3 Marketing	None						
5. Priority Review							
6. Science Review							

West Coast – West Coast Demersal Scalefish Resource

Description and Scope of Issues

The demersal scalefish resource in the West Coast Bioregion is fished mostly by commercial, charter and recreational line fishers. Approximately 100 species are caught by the fishery each year, with fishers in each sector primarily targeting West Australian Dhufish (*Glaucosoma hebraicum*) and Pink Snapper (*Pagrus auratus*). Substantial catches are also taken of other species, such as Red Throat Emperor (*Lethrinus miniatus*), Bight Redfish (*Centroberyx gerrardi*) and Baldchin Groper (*Choerodon rubescens*). A range of species is taken in offshore waters, including Eightbar Grouper (*Hyporthodus octofasciatus)*, Hapuku (*Polyprion oxygeneois)*, Blue-eye Trevalla (*Hyperoglyphe antarctica)* and Ruby Snapper (*Etelis carbunculus)*.

Relevant Resource Assets and Risks from Fishery

West Coast Inshore Demersal scalefish suite	High Risk
West Coast Offshore Demersal scalefish suite	Moderate Risk
West Coast Protected Species	Negligible Risk
West Coast Inshore Habitats	Negligible Risk
West Coast Marine Ecosystems	Low Risk

Summary of historical research completed

Completed studies of the biology of the demersal indicator species, West Australian Dhufish, Pink Snapper and Baldchin Groper include those of their reproductive biology, growth, age composition, mortality and diets. The biology of other demersal species has also been studied, including, for example, Breaksea Cod (*Epinephelides armatus)* and Western Blue

Groper (*Achoerodus gouldii)*. However, that of Bight Redfish has not and there is limited information on the biology of species in the offshore demersal suite.

Recently completed work includes a study of the stock structure of Baldchin Groper on the west coast of Australia and the implications of this for management of inshore demersal stocks (Department of Fisheries Western Australia, WAMSI).

Current Research Focus

Focus: The current research focus is to collect age composition data for stock assessments and also to monitor the degree to which recent management restructuring is reducing catch levels of the entire suite (and each of the indicator species) by each sector. This work will provide data on whether the reductions in catch are maintained and whether stock abundance is recovering. Investigation of the stock structures of West Australian Dhufish and Pink Snapper, with relevance to existing management boundaries, are almost complete.

Key Activities:

- Monitoring age compositions and assessments of fishing mortality of G. hebraicum, *P. auratus* and *C. rubescens* in the commercial and/or recreational sectors in the WCDSF for a stock assessment in 2012.
- Determining the stock structures of *G. hebraicum, P. auratus* and *C. rubescens* using genetic and otolith microchemistry techniques (WAMSI sub-project 4.4.2), in collaboration with Murdoch University, CSIRO and Department of Primary Industries Victoria. The project will also examine oceanographic influences on larval dispersal.
- Monitoring catch and effort by commercial fishers from daily/trip logbooks in conjunction with a vessel monitoring system.
- Onboard validation of logbooks is proposed.
- Monitoring of the numbers and species of fish caught as bycatch of the commercial rock lobster fishery is estimated annually from observer trips and the numbers retained for personal consumption under exemption are reported.
- Annual surveys of the numbers of *P. auratus* eggs in Cockburn Sound during the spawning season to produce estimates of spawning stock biomass.
- Annual surveys of the relative abundance of recruited 0+ *P. auratus* in Cockburn Sound to corroborate egg abundance.
- Monitoring of movements to and from Cockburn Sound of adult *P. auratus*, tagged with acoustic transmitters, to investigate the fidelity of individuals to that embayment.
- Biology of *Plectropomus leopardus* at the Abrolhos Islands and investigation of spawning aggregations (ECU).
- The diet of *P. auratus* and *Pseudocaranx georgianus* as part of a study of food webs (Murdoch University/Department of Fisheries WA/WAMSI).
- Identification of critical habitats for juvenile West Australian Dhufish (State NRM funded project).
- Investigation of passive acoustic methods for monitoring relative abundance of demersal species (Curtin University/Department of Fisheries WA/FRDC).
- Determine the potential links between oceanographic conditions, production processes and recruitment strength of West Australian Dhufish (*Glaucosoma hebraicum*) and other demersal fish with the view to improve the spatial management of the species

(CSIRO/Department of Fisheries WA/FRDC, due to commence in 2012).

Priority Setting Process

Assessments of required research are made through departmental meetings. Relevant discussions of research outcomes and needs with stakeholder groups occur regularly.

Review Timeline

Three indicator species (*G. hebraicum*, *P. auratus* and *C. rubescens*) are used to monitor and assess the status of the suite of inshore demersal species in the WCB. Two external independent reviews confirmed that overfishing of these species was occurring in in the WCB (Wise *et al.*, 2007[1]; O'Neill, 2009[2]). A new stock assessment of the indicator species will be completed in 2012.

Two additional species are being considered for inclusion as indicator species and age-based assessments, *i.e.* Redthroat Emperor in the Kalbarri zone and Bight Redfish in the South-west zone. Age-based assessments will no longer be conducted for Pink Snapper in the South-west zone. Since restructuring of the management of the fishery and the limited access to commercial fishing in the WCB, catches of that species in that zone are now very small.

Recent Publications

Fairclough, D. V., Edmonds, J. S., Lenanton, R. C. J., Jackson, G., Keay, I. S., Crisafulli, B. M. and Newman, S. J. (2011). Rapid and cost-effective assessment of connectivity among assemblages of *Choerodon rubescens* (Labridae), using laser ablation ICP-MS of sagittal otoliths. *Journal of Experimental Marine Biology and Ecology* 403, 46-53.

Fairclough, D. V., Potter, I. C., Lek, E. Bivoltsis, A. K. and Babcock, R. C. (2011). The fish communities and main fish populations of the Jurien Bay Marine Park. *Final Report to the Strategic Research Fund for the Marine Environment, Murdoch University, Perth.* 363 pp.

Fisher, E. A., Hesp, S. A. and Hall, N. G. (2011). Exploration of the effectiveness of alternative management responses to variable recruitment. *Final report to the Fisheries Research and Development Corporation, FRDC Project 2008/006, Murdoch University, Perth.* 167 pp.

Hall, N. G. and Wise, B. S. (2011). Development of an ecosystem approach to the monitoring and management of Western Australian fisheries. *FRDC report, Project 2005/063. Fisheries Research Report No. 215. Department of Fisheries, Western Australia.* 112 pp.

Wakefield, C. B., Fairclough, D. V., Lenanton, R. C. J. and Potter, I. C. (2011). Spawning and nursery habitat partitioning and movement patterns of *Pagrus auratus* (Sparidae) on the lower west coast of Australia. *Fisheries Research* 109, 243-251.

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[1] Wise, B. S., St John, J. and Lenanton, R. C. (Eds, 2007). Spatial scales of exploitation among populations of demersal scalefish: implications for management. Part 1: Stock status of the key indicator species for the demersal scalefish fishery in the West Coast Bioregion. Final report to Fisheries Research and Development Corporation, Project 2003/052. Fisheries Research Report No. 163, Department of Fisheries Western Australia. 130 pp. http://www.fish.wa.gov.au/docs/frr/frr163/frr163.pdf

[2] O'Neill, M. (2009). Scientific review of the West Coast Demersal Scalefish Fishery, Western Australia. Fisheries Occasional Publication No. 66, 2009. 24 pp. http://www.fish.wa.gov.au/docs/op/op066/fop66.pdf

McLean, D. L., Harvey, E. S., Fairclough, D. V. and Newman, S. J. (2010). Large decline in the abundance of a targeted tropical lethrinid in areas open and closed to fishing. *Marine Ecology Progress Series* 418, 189-199.

Key to symbols in the matrix/summary tables:

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O Indicates that the activity is part of a proposal but is not yet funded.

West Coast Demersal Scalefish Fishery Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, mortality)							
West Australian Dhufish biology (Adult)	Completed						Several studies completed.
Juvenile West Australian Dhufish	Underway	■					Studies on juvenile recruitment indices, important locations for recruitment, mechanisms for larval dispersal (NRM & WAMSI). Limited data on larval biology.
Larval West Australian Dhufish	Proposed	O	O	O			Study of oceanographic Influences on abundance, distribution and recruitment strength of larvae.
Pink Snapper biology	Completed						Several studies completed.
Pink Snapper diet	Underway	■					Study of diet/food-webs (MU, FRDC)
Baldchin Groper biology	Completed						Studies completed in West Coast and Gascoyne Bioregions. No data on movement, larval biology, juvenile recruitment.
1.2 Other Biology studies							
Movement	Underway	■	■	■			Movement of pink snapper associated with spawning aggregations in Cockburn Sound (DoFWA).
Biology of Coral Trout	Underway						Abrolhos Islands, PhD at ECU
Stock structure of indicator species (genetics, microchemistry)	Underway						WAMSI 4.4.2
Food-webs of fishes in south-western Australia	Underway	■					FRDC (MU)
1.3 Stock Assessment							
Annual C & E Assessment	Ongoing	■	■	■	■		Commercial fishery, charter fishery
Fishing mortality assessments against benchmarks (indicator species)	Periodic	■	■				DoFWA
1.4 Fishery Monitoring							
Commercial, charter catch & effort	Ongoing	■	■	■	■		Logbooks (DoFWA)
Age Structure of indicator species	Ongoing	■	■	■	■		DoFWA
Recreational survey	Underway	■					Survey of recreational fishing catch and effort In Western Australia based on boat license framework

West Coast Demersal Scalefish Fishery Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
Recruitment strength	Ongoing	■					Egg survey/DEPM model for pink snapper in Cockburn Sound, BRUVS survey of juvenile recruitment.
Monitoring bycatch of demersal species in the Western Rock Lobster fishery.	Underway	■	■	■	■		Onboard observer programme (DoFWA), compulsory reporting of personal consumption.
Testing use of passive acoustic methods for monitoring indicator species	Underway	■					Curtin (FRDC)
2. Habitat & Ecosystem							
2.1 Bycatch	Completed						WAMSI 4.4
2.2 Listed Species	Not needed						Low Risk
2.3 Habitat	Not needed						Low Risk from fishery.
2.4 Ecosystem/Environment							
Community structure	Underway						WAMSI WC Bioregion ecosystem study. Developing indicators of community structure for Abrolhos, Rottnest and Metropolitan regions
2.5 Oceanography	Underway						CSIRO (WAMSI) investigating oceanographic influences on dispersal of larvae of indicator species.
2.6 Other impacts on fishery							
3. Management Analysis							
3.1 Socio-economic							
Social assessment	Completed						WAMSI (UWA and MU)
Economic Analysis	Completed						WAMSI (UWA and MU)
Evaluation of Rec fisher incentives	Completed						WAMSI (UWA and MU)
3.2 Resource Access (Shares)							
Determination of access shares	Completed						
Monitoring of shares	Ongoing		■		■		
3.3 Compliance research	Nil						
3.4 Management Systems							
	Completed						Exploration of the effectiveness of alternative management responses to variable recruitment (MU) - FRDC
4. Industry Development							
5 Priority Review	Ongoing	■	■	■			Annual departmental industry meetings
6. Science Review	Ongoing		■				Next review in 2012

This assessment does not include the specific needs for the Abrolhos Islands region (see the Abrolhos Islands section for details).

West Coast – Western Rock Lobster

Description and Scope of Issues

Commercial: The West Coast Rock Lobster Managed Fishery (WCRLF) targets the western rock lobster, *Panulirus cygnus*, on the west coast of Western Australia between Shark Bay and Cape Leeuwin, using baited traps (pots). With an annual production that averages about 11,000 t, this is Australia's most valuable single-species fishery.

Recreational: The recreational rock lobster fishery primarily targets western rock lobsters in the Perth metropolitan area and Geraldton, using baited pots and by diving.

Relevant Resource Assets and Risks from Fishery

West Coast Nearshore Molluscs (Octopus)	Moderate Risk
West Coast Protected Species (Sea lions)	Low Risk
West Coast Nearshore Habitats	Low Risk
West Coast Ecosystem (Marine)	Low – Moderate Risk

Summary of historical research completed

Research activities into the western rock lobster have been underway for decades with a large amount of research having already been completed. This research covers lobster biology, ecology, stock assessment and the examination of fleet and fishery dynamics. A comprehensive listing of all these projects is contained in the Stock Assessment for the West Coast Rock Lobster Fishery document. Research Report 217; 2011 (http://www.fish.wa.gov.au/docs/frr/frr217/frr217.pdf).

Current Research Focus

Focus: Research activities focus on the core business of assessing stock sustainability and the forecasting of future catch levels. Most recently the focus of research has been to try and explain the series of low puerulus settlements that have occurred during the past 4 years.

Activities: The main activities still involve undertaking fishery-independent monitoring of breeding stock levels and puerulus settlement. Industry performance is monitored through compulsory catch disposal records from both fishers and processors and comprehensive data from the voluntary logbook scheme, all of which are used for modelling and stock assessment.

A risk assessment workshop to examine the low puerulus settlement was held in April 2009 and again in May 2011. The workshops focused on examining the 'likelihood' of factors that could have caused the decline in puerulus settlement. Conclusions from the 2009 workshop included that the decline in settlement could have been caused by changes in environmental conditions and productivity in the eastern Indian Ocean, or a decline in the abundance of the rock lobster breeding stock, particularly in the northern region of the fishery, or a combination of these two factors. A report from the 2009 workshop can be found on the Departments website (http://www.fish.wa.gov.au/docs/op/op071/fop71.pdf).

The five projects listed below were submitted to the Fisheries Research and Development Corporation (FRDC) and were successful in securing funding. The objectives of the projects are to investigate various aspects of the possible causes and factors associated with the low

puerulus settlements of 2007-08 - 2009-10.

Project 1 (FRDC 2009/018): Identifying factors affecting the low western rock lobster puerulus settlement in recent years.

Objectives:

- To use a larval advection model and the rock lobster population dynamics model to assess the effect of the spatial distribution of the breeding stock on the puerulus settlement.
- To assess environmental factors (water temperature, current, wind, productivity, eddies) and breeding stock affecting puerulus settlement.
- To examine climate change trends of key environmental parameters and their effect on the western rock lobster fishery.
- Provide industry (WRLC), RLIAC and Fisheries managers with an evaluation of relative impact of breeding stock and environmental effects on the puerulus settlement and its implications for management in the protection of the breeding stock.

Project 2 (FRDC 2008/087): Evaluating source-sink relationships of the Western Rock Lobster Fishery using oceanographic modeling.

Objectives:

- To determine the relative contribution of larval production from different areas to the abundance and spatial distribution of puerulus settlement over 15 years using a larval advection model.
- Provide industry (WRLC), RLIAC and Fisheries managers with an evaluation of source-sink relationships and its implications for management in the protection of the breeding stock

Project 3 (FRDC 2009): Evaluating the use of novel statistical techniques for determining harvest rates and efficiency increases in the Western Rock Lobster Fishery. The project looks at using change-in-ratio and index removal to further examine fishing efficiency and harvest rates and pulls together some of the best mathematicians in this field, i.e. Professor Norm Hall, Assoc Professor Stewart Frusher and Professor John Hoenig

Objectives:

- Assess current data sources and their potential for use in estimating harvest rates and efficiency increases in the western rock lobster fishery.
- Evaluate whether additional sources of information are needed to produce more robust estimates of harvest rate and efficiency increase.
- Assess whether the estimates of harvest rate and fishing efficiency are reliable and could be used to assist in the management of the western rock lobster fishery.
- Provide industry (WRLC), RLIAC and fisheries managers with an evaluation of change-in-ratio and index removal techniques for determining harvest rates and efficiency creep.

Project 4 (FRDC 2009): Evaluation of population genetic structure in the western rock lobster

Objectives:

- Develop additional new microsatellite markers for western rock lobster.
- Test whether the adult population of western rock lobster is genetically homogeneous

throughout its range.

- Test whether the spatial genetic structure in the next generation of recruits (pueruli) matches the spatial genetic structure found in adults. (If so, this suggests spatial structure is due to limited dispersal or local adaptation).
- Estimate effective population size of the western rock lobster and test for severe bottlenecks in population size.

Project 5 (FRDC 2008): Assessing possible environmental causes behind the reduced colonization of puerulus collectors by a wide suite of species.

Objectives:

- Begin monitoring the community composition of marine flora and fauna along the Western Australian coastline during this current poor settlement period.
- Develop standard methodology for monitoring the spatial and temporal variability in the settlement of marine flora and fauna.
- Determine what environmental parameters may be linked to the majority of variation in the floral and faunal communities colonizing puerulus collectors, focusing on those relating to puerulus settlement.
- Identify indicator marine flora and fauna species for monitoring the influences of environmental change on Western Australian marine environment.
- Detect any known or potential introduced marine pests within the Western Australian environment.

Preliminary results from these projects were presented at the 2011 workshop. Conclusive answers as to the cause(s) of the low puerulus settlements of 2007, 2008 and 2009 were not provided by any of the projects. However, results indicated that possible causes of the poor settlements included a reduced egg production in the north of the fishery related impart to a reduced northward migration resulting from strong northerly currents in January/February over the past decade. Another likely factor affecting settlement appears to be the high incidence of positive Indian Ocean Dipole events that influence winter/spring wind patterns along the West Australian Coast. A report from the 2011 workshop will be released soon on the Departments website.

In the 2010 FRDC round one lobster related project was submitted and was successfully funded.

Project 6 (FRDC 2011/021): Development of an industry-based habitat mapping/monitoring system. The aim of this project is to develop a cost effective tool to collect spatially explicit environmental information,

Objectives:

- Development of a cost-effective system for obtaining geo-referenced environmental information
- Trial implementation of system by industry to test concept
- Cost-benefit analysis with conventional ground-truthing techniques

An FRDC funded project to examine the effects of western rock lobster fishing on the deep-water ecosystem off the west coast of Western Australia has recently been completed. This project provided critical baseline data on the relationships between the abundance and size distributions of rock lobster and the different benthic habitats located in deeper waters, plus

preliminary data on diets and the trophic role of rock lobster within these depths. Further ecological research in deep waters will be based on comparing fished and unfished areas using research closures. This research is supported by the WAMSI and FRDC. (FRDC 2008/013): Assessing the ecological impact of the Western Rock lobster fishery in fished and unfished areas. The objectives of this project include negotiating a suitable closed area in deep water to assess the ecological impacts of fishing, developing cost effective methods to monitor benthic communities in deep water and the collection of baseline information on lobster stocks, habitats and community structure to facilitate comparisons between fished and unfished areas. A suitable area in deep water has now been closed to lobster fishing to enable these comparisons and monitoring has commenced. The ultimate outputs of this project will enable any impacts of lobster fishing on deepwater ecosystems to be quantified.

A second project examining lobster populations between fished and unfished zones is ongoing at Rottnest Island. This project consists of annual sampling using pots and underwater dive surveys at Armstrong Bay and Parker Point sanctuary zones. Results from the first three years after the no-take regions were implemented have shown a rapid increase in lobster numbers within the protected areas. This study also aims to provide additional information on growth, natural mortality and size/sex-specific catchability.

For the recreational component of this fishery, an annual mail-based survey of participants has been used to estimate the annual catch and effort for the past 20 years. These trends, together with data on puerulus settlement, are used to predict the recreational catch and effort in following seasons. Since 2000/01, telephone diary surveys of recreational rock lobster fishers have been undertaken in most years. Estimates of recreational catch using this method are compared to the estimates from mail surveys. Phone diary surveys are considered to be more accurate than those from mail surveys because they eliminate the recall bias in the mail surveys and additionally, there is a higher participation rate in the survey from random sample selection. Sample sizes for the phone diary surveys have been increased since the 2006/07 survey to improve the accuracy of the result.

Research has commenced that aims to identify those parameters derived from mail surveys that are to be adjusted to lead to a catch estimate that is comparable to the diary survey estimates. Thus, mail survey effort estimates may be altered in the future. The comparison between effort levels from one season to the next season should, however, not be affected.

Priority Setting Process

Commercial: Until recently this was undertaken though the Rock Lobster Industry Advisory Committee (RLIAC) and subcommittees; annual RLIAC coastal tour. This will now occur through meetings between the Department of Fisheries and industry facilitated by WAFIC/Western Rock Lobster Council.

Recreational: Until recently this was undertaken by the Recreational Fishing Advisory Committee, a new process that will be facilitated by RecFishWest is in the process of being developed.

Review Timeline

A stock assessment workshop took place from 20 – 24 May 2010. The objectives of the workshop were motivated by the audit conditions set by the Marine Stewardship Council's auditors for the Western Rock Lobster Fishery (WRLF), as well as the need for regular review of the 2010 stock assessment. The workshop considered the structure of the current

model to be appropriate, however its complexity could be simplified. The workshop also advised that more data sources and parameters should be incorporated within the model to improve its estimates of precision. A major outcome of the workshop was the development of an ITQ version of the model that also incorporated many of the suggested changes made by the reviewers.

This version of the model has been completed and now used as the current version of the model. Upon its completion it was again subjected to review by Andre Punt (April/May 2011). This review will be available on the Department website in the near future.

The WRLF was reassessed by the MSC in may 2011 and was recertified for another five years.

Recent Publications:

Caputi, N., Melville-Smith, R., de Lestang, S., Pearce, P. & Feng, M. (2010). The effect of climate change on the western rock lobster (*Panulirus cygnus*) fishery of Western Australia. *Canadian Journal of Fish and Aquatic Sciences,* 67, 85-96.

Melville-Smith, R, de Lestang, S. & Johnston, D. J. (2010). Higher water temperature leads to precocious maturation of western rocklobsters (*Panulirus cygnus*), but are things that simple? *Journal of the marine Biological Association of India.* 52: 257-263.

de Lestang, S., Bellchambers, L. M., Caputi, N., Thomson, A. W., Pember, M. B., Johnston, D. J. and Harris, D. C. (2010). Stock-Recruitment-Environment Relationship in a *Portunus pelagicus* Fishery in Western Australia. In: G. H. Kruse, G. L. Eckert, R. J. Foy, R. N. Lipcius, B. Sainte-Marie, D. L. Stram, and D. Woodby (eds.), Biology and Management of Exploited Crab Populations under Climate Change. *Alaska Sea Grant, University of Alaska Fairbanks.*

Caputi, N., de Lestang, S., Feng, M. & Pearce, A. (2009). Seasonal variation in the long-term warming trend in water temperature off the Western Australian coast. *Marine and Freshwater Research*. 60: 129-139.

Caputi, N., Melville-Smith, R., de Lestang, S., Pearce, P. & Feng, M. (2009). The effect of climate change on the western rock lobster (*Panulirus cygnus*) fishery of Western Australia. *Canadian Journal of Fish and Aquatic Sciences*. 67: 85-96

de Lestang, S., Caputi, N. & Melville-Smith, R. (2009). Using fine-scale catch predictions to examine spatial variation in growth and catchability of *Panulirus cygnus* along the west coast of Australia. *New Zealand Journal of marine and Freshwater Research*. 43: 443-455.

Melville-Smith, R., de Lestang, S. & Thomson, A. W. (2009). Spatial and temporal changes in egg production in the western rock lobster (*Panulirus cygnus*) fishery. *New Zealand Journal of marine and Freshwater Research*. 43: 151-161.

Melville-Smith, R., de Lestang, S., Beale, N.E., Groth, D. and Thompson, A. (2009). Investigating reproductive biology issues relevant to managing the western rock lobster broodstock. *Final Report to Fisheries Research and Development Corporation project 2003/005:* 114 pp.

Key to symbols in the matrix/summary tables:

■ Indicates that the activity is funded and planned to occur.

O Indicates that the activity is part of a proposal but is not yet funded.

West Coast Western Rock Lobster Fishery Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)	Ongoing	■	■	■	■	■	Still some work required
1.2 Other Biology							
Recruitment Dynamics	Underway	■	■				Investigating 2008/09 recruitment failure
Migration	Underway	■	■				
Lobster spawning rates	Underway	■	■				
Lobster mating behavior	Underway	■	■				UWA PhD student
By-product Octopus basic biology	Underway	■	■				The basic life history studied / recruitment
1.3 Stock Assessment	Ongoing	■	■	■	■		
Annual Assessment	Ongoing	■	■	■	■	■	
Develop New Model	Underway	■	■				Models updated as new data developed
Shallow Water Depletion Assess.	Underway	■					
Deep Water Depletion Assessment	Underway	■					Initial trials underway
Change in Ratio and Index Removal	Proposed	■					Funded by the FRDC
1.4 Fishery Monitoring	Ongoing	■	■	■	■	■	
Commercial Catch & Effort	Ongoing	■	■	■	■	■	
Processor Returns	Ongoing	■	■	■	■	■	
Commercial Monitoring	Ongoing	■	■	■	■	■	
Puerulus Monitoring	Ongoing	■	■	■	■	■	
Research Logbooks	Ongoing	■	■	■	■	■	
Spawning Stock Survey	Ongoing	■	■	■	■	■	
Fishing Power	Ongoing	■	■	■	■	■	
Recreational Catch and Effort	Ongoing	■	■	■	■	■	
Stock & recruitment	Ongoing	■	■	■	■	■	
Meshed Pot monitoring	Ongoing	■	■	■	■	■	
2. Habitat & Ecosystem							
2.1 Bycatch	Ongoing	■	■	■	■	■	Monitoring
2.2 Listed Species	Ongoing	■	■	■	■	■	Monitoring of all interactions
Sea Lion Interactions and behaviour	Completed						Pot design to stop juvenile sea lions entering pots has been developed and implemented
2.3 Habitat	Ongoing	■	■	■	■	■	
Seagrass and Limestone reef effects	Completed						Sufficient for management
Coral Reef effects	Underway	■	■				Study at the Abrolhos Islands

West Coast Western Rock Lobster Fishery Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
Habitat Mapping	Underway	■	■				FRDC funded
Habitat - recruitment relationships	Proposal						FRDC proposal to understand relationship between habitat and puerulus recruitment requirements
2.4 Ecosystem/Environment	Ongoing	■	■	■	■	■	
Deep water ecosystem study	Underway	■	■	■			Closed area monitoring
Jurien Bay inshore	Completed						SRFME/WAMSI study
Dongara inshore	Completed						CSIRO studies in the 1980s
Rottnest Sanctuary zones	Underway	■	■	■	■	■	Comparing fished *vs*. unfished
2.5 Oceanography	Underway	■	■				
Leeuwin Current monitoring	Ongoing	■	■	■			
Oceanographic Modelling	Underway	■					FRDC funded
Impacts of ocean conditions on catch rates	Underway	■	■				
2.6 Other impacts on fishery							Nothing identified
3. Management Analysis							
3.1 Socio-economic							
Bio-Economic modelling	Underway	■					In principle CRC funding
Economic Analysis (MEY)	Underway	■					Examination of Maximum Economic Yield
3.2 Resource Access (Shares)							
Determination of access shares	Periodic		■				Needed for IFM / ITQ
Monitoring of shares	Ongoing	■	■	■	■		Needed for IFM ITQ
3.3 Compliance							
Enforcement efficiency	Underway	■	■				
3.4 Management Systems							
Input vs output controls	Completed						Industry moving to Quota In 2010/11
4. Industry Development							
4.1 Production Technology							
Puerulus growout	First Stage Completed						Awaiting outcomes of policy on ownership of puerulus
More Efficient Lobster Pot Design	First Stage Completed						
4.2 Post Harvest							
4.3 Marketing							Completed by Industry
5. Priority Review							
WRLC/WAFIC		■	■				Annual review of R&D plan
6 Science Review							
Stock Assessment	Ongoing	■	■	■	■	■	Last completed in detail in 2010
MSC audits	Ongoing	■	■	■	■	■	Yearly audits

West Coast – Nearshore and Estuarine Finfish Resources

Description and Scope of Fishery

The finfish resources in West Coast nearshore and estuaries waters are structurally complex, they are multi-sector (commercial, recreational and non-harvest), multi-species and some species comprise genetically distinct breeding stocks in different estuaries (e.g. black bream *Acanthopagrus butcheri* and cobbler *Cnidoglanis macrocephlus*). The commercial catch includes Australian salmon (*Arripis truttaceus*), whitebait (*Hyperlophus vittatus*), sea mullet (*Mugil cephalus*), Australian herring (*Arripis georgianus*), yellow-eye mullet (*Aldrichetta forsteri*), yellow-finned whiting (*Sillago schombergkii*), southern sea garfish (*Hyporamphus melanochir*) and many other species. The recreational catch includes Australian herring, whiting (*Sillago* spp. and *Sillaginodes punctata*), tailor (*Pomatomus saltatrix*), southern sea garfish, black bream and many other species.

The status of many stocks is strongly affected by non-fishing impacts, including coastal development, habitat degradation within estuary catchments and reduced river flows. These fisheries are small-scale and have relatively low commercial value but have high social, recreational and historical values.

Relevant Resource Assets and Risks from Fishery

West Coast Nearshore Finfish	Moderate Risk
West Coast Estuarine Finfish	Low Risk (Severe Risk from non fishing)
West Coast Protected Species	Negligible Risk
West Coast Nearshore Habitats	Negligible Risk (Moderate Risk from non fishing)
West Coast Estuarine Habtitats	Negligible Risk (Severe from non fishing)
West Coast Estuarine Ecosystems	Low Risk (Severe from non fishing)

Summary of historical research completed

The basic biology is adequately understood for most captured species from an extensive set of research projects that have been undertaken mainly by the Department and Murdoch University over the past 30 - 40 years.

The recreational catch share of many key finfish species including herring, tailor, sea garfish and bream is >50%. The total recreational finfish catch share is now estimated to be at least 30% in the Peel/Harvey Estuary, 95% in the Swan/Canning Estuary and 50% in the Hardy Inlet/Blackwood River and almost 100% in other estuaries (combined) of the region. This has implications for the collection of information because commercial catches can no longer be used to generate indices of abundance or provide samples.

Previous nearshore and estuarine recreational fishing surveys

There are a number of estimates of recreational fishing for finfish in nearshore waters of the West Coast Bioregion covering boat- and shore-based fishing dating back to the early 1970s. The most recent surveys in these regions have been restricted to boat-based fishing.

Current Research Focus

The indicator species were selected for these resources using a risk assessment process. Indicators for estuaries are black bream, cobbler (estuary stocks only) and Perth herring. Indicators for the nearshore suite are Australian herring, tailor, whiting species, sea garfish, sea mullet and whitebait.

- Monitoring of these indicator species is based on fishery-independent surveys of annual recruitment, compulsory monthly catch and effort returns from commercial fishers and voluntary recreational logbooks.
- An NRM funded research project commenced in mid-2009 to develop/improve assessments methods and determine stock status of West Coast nearshore indicator species (Australian herring, tailor, garfish and whiting). This major project is examining age structure, growth, reproduction, sources of recruitment and factors associated with annual recruitment variation. Due for completion in mid-2012.
- In 2010, an NRM funded project trialled various methods to measure the catch of shore-based recreational fishers.
- There are a number of ecological projects underway/recently completed by Murdoch University in the Swan-Canning, Peel-Harvey and Leschenault estuaries.

Priority Setting Process

A Departmental risk assessment was recently completed and issues are reviewed at regular internal meetings. Discussions are also held between the Department of Fisheries, industry members and peak bodies (Western Australian Fishing Industry Council, Recfishwest).

Review Timeline

Status of key nearshore stocks will be presented for internal review in late 2010. The science relating to whitebait stock assessments was reviewed extensively in 1996. This fishery was last reviewed in 2008 and is considered low risk. It will be reviewed within the next four years.

Recent Publications

Smith, K. A. and Norriss, J. (2011). The status of the black bream *Acanthopagrus butcheri* (Pisces: Sparidae) population in Lake Clifton, south-western Australia. *Journal of the Royal Society of Western Australia.* 94:25–28.

Smith, K., Norriss, J. & Brown, J. (2009). Population growth and mass mortality of an estuarine fish, *Acanthopagrus butcheri*, unlawfully introduced into an inland lake. *Aquatic Conservation: Marine and Freshwater Ecosystems* 19:4–13.

Gaughan, D., Ayvazian, S., Nowara, G., Craine, M. & Brown, J. (2006). The development of a rigorous sampling program for a long-term annual index of recruitment for finfish species from south western Australia. *Final Report FRDC Project 1999/153. Fisheries Research Report No 154. Department of Fisheries, Western Australia.*

Smith, K. A. (2006). Review of fishery resources and status of key fishery stocks in the Swan-Canning Estuary. *Fisheries Research Report No 156. Department of Fisheries, Western Australia.*

Key to symbols in the summary matrix:

■ Indicates that the activity is funded and planned to occur.

O Indicates that the activity is part of a proposal but is not yet funded.

West Coast Nearshore and Estuarine Finfish Resources Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
Black bream	Complete						Adequate for management
Cobbler	Complete						Adequate for management
Sea mullet	Complete						Adequate for management
Whitebait	Complete						Adequate for management
King George & other whiting	Complete						Adequate for management
Tailor, Australian herring	Underway	■					Develop age-based monitoring of west coast fishery. Describe local growth rates & age structure. Available tailor data mostly from elsewhere, limited data from WA. NRM-funded project.
Southern sea garfish	Underway	■					Re-examine local age structure, growth & reproduction. Available data mostly from other states, limited data from WA. NRM-funded project.
Perth herring	Possible						Need to re-examine age & growth. Validate otolith annuli. Ages previously determined from scales & are unreliable.
Silver trevally	Funded	O	O				FRDC funding application lead by Murdoch Uni. funded
1.2 Other Biology							
Spawning, recruitment & stock structure of Australian herring and tailor	Underway	■					Examine spawning & recruitment dynamics to improve understanding of stock structure. NRM-funded project.
Whiting (all species)	Underway	■	O				Review composition of 'whiting' suite of species in recreational catch. Review assessment methods. NRM-funded project.
King George whiting	Underway	■	■				Investigate mortality & other aspects of biology. FRDC application lead by Murdoch Uni funded.
1.3 Stock Assessment							
Annual trends in catch and CPUE	Ongoing	■	■	■	■		CAES data & recreational logbooks
Annual trends in juvenile recruitment	Ongoing	■	■	■	■		Beach seining, volunteer angling (tailor only)
Age-based assessment using 'weight-of-evidence' approach (herring)	Developing	■	O	O			Otoliths being collected (West & South Coasts). Develop ongoing monitoring. NRM-funded project.
Age-based model (Swan River bream)	Underway						Murdoch Uni project.
1.4 Fishery Monitoring							
CAES	Ongoing	■	■	■	■	■	Limited. Minimal Swan R. & Hardy Inlet data, No Leschenault estuary data. No Geographe Bay data after 2009.
Boat based recreational survey	Underway	■		■		■	West Coast survey in 2010, state-wide phone diary survey in 2011 & then

West Coast Nearshore and Estuarine Finfish Resources Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
							every 2nd year.
Voluntary recreational logbook	Ongoing	O	O	O	O	O	Research Angler Program (RAP)
Fishing tournament & club records	Ongoing	O	O	O	O	O	RAP
Age structure monitoring	Ongoing	■	■	■	■	■	Indicator species - Australian herring (W & S coasts), tailor, whiting.
Recruitment Surveys	Ongoing	■	■	■	■	■	Various methods used to monitor annual recruitment of key species (whiting, tailor, herring, mullet, others)
2. Habitat & Ecosystem							
2.1 Bycatch	Not needed						Low risk
2.2 Listed Species	Not needed						Low risk
2.3 Habitat							
2.4 Ecosystem/Environment							
Whitebait in Warnbro Sound	Proposed						Critical prey for penguins (Murdoch Uni.). DEC developing project
Fish community surveys	Underway						Faunal surveys In Swan, Peel Harvey & Leschenault. Ecosystem modeling (Murdoch Uni projects).
Fish kills	Occasional						Respond to reports and investigate cause of fish kills. Opportunistic sampling, logistically difficult, limited resources available
Climate change	Possible						Impact of declining rainfall in estuaries
Coastal habitat condition	Possible						Cumulative impacts of coastal developments
2.5 Oceanography							
Leeuwin Current monitoring	Ongoing	■	■	■	■	■	Influence on larval dispersal & recruitment
2.6 Other impacts on fishery							
3. Management Analysis							
3.1 Socio-economic	Not needed						
3.2 Resource Access (Shares)	Possible						
3.3 Compliance	Possible						
3.4 Management Systems	Underway						Predicting impacts on shifting recreational fishing effort. (Murdoch Uni project)
4. Industry Development							Nothing identified
5. Priority Review		■					
6 Science Review			■				Science review planned

West Coast – Purse Seine Fishery

Description and Scope of Issues

The West Coast Purse Seine Fishery operates between latitudes 31°S and 33°S (the metropolitan fishery). There are also two purse seine development zones currently operating north and south of this area; the Northern Development Zone and the Southern Development Zone. The metropolitan fishery mainly targets both pilchards (*Sardinops sagax*) and sardinella (the tropical sardine *Sardinella lemuru*), the Northern Development Zone targets sardinella and the Southern Development Zone targets pilchards. There is no recreational fishery.

Relevant Resource Assets and Risks from Fishery

West Coast Pelagic Low Risk

Summary of historical research completed

Many aspects regarding the biology of this species, including its reproductive and distributional characteristics were determined through a major research project completed during the early-mid 1990s. This gathered data on the biology and stock assessment of pilchards in this region and other areas of WA. Directed research during the period 1999-2007 focused on fishery-independent spawning biomass surveys using egg production techniques and age structured samples, was completed as part of a six-year FRDC-funded project examining the regrowth of the pilchard stocks in WA following the two mass mortality events in the mid to late 90s. These biomass surveys and age monitoring programs have stopped.

Exploratory fishing for the *Sardinella lemuru*, offshore of Geraldton on the Midwest coast of Western Australia, in the early 1990s led to the establishment of a developmental purse seine fishery in this region. The biology and fishery for sardinella in WA was therefore investigated over a three-year period by the Department between July 1995 and June 1998 with the aim of providing stock assessment advice. Egg production techniques of estimating biomass were unsuccessfully attempted for this species.

Pilchards and other small pelagic fish are consumed by several species of seabirds, pinnipeds, cetaceans and protected sharks (white shark), but there is currently no evidence to indicate any major interactions between these and the purse seine industry in the West Coast Bioregion.

Current Research Focus

Given the current small size of the catch of both species in this region and the low risk to the stocks, the current level of research and monitoring is restricted to an annual examination of the commercial catch and effort data supplied by the fishers. The resources previously allocated were shifted to other, higher-risk fisheries in the southern bioregions.

Priority Setting Process

Priorities are reviewed on an annual basis through consultation between Scientists of the Finfish Branch (Research Division) and Fishery Managers.

Review Timeline

The science was reviewed extensively in the late 1990s and early 2000s while the fishery was recovering after the mass mortality events. This fishery was last reviewed in 2008 and is considered low risk will be reviewed within the next four years.

Recent Publications

Gaughan, D. J., Craine, M., Stephenson, P., Leary, T., Lewis P. (2008). Regrowth of pilchard (*Sardinops sagax*) stocks off southern WA following the mass mortality event of 1989/99. *Final FRDC Report - Project 2000/135. Fisheries Research Report No. 176. Department of Fisheries, Western Australia.* 82 p.

Muhling, B. A., Beckley, L. E., Gaughan, D. J., Jones, C., Miskiewicz, A. G., Hesp, A. (2008). Spawning, larval abundance and growth rate of *Sardinops sagax* off southwestern Australia: influence of an anomalous eastern boundary current. *Marin Ecology Progress Series* 364: 157 - 167

Rogers, P., Gaughan, D. & Ward, T. (2006). Small pelagic fishes. In S. McClatchie, J. Middleton, C. Pattiaratchi & G. Kendrick (eds), The South-west Marine Region: Ecosystems and Key Species Groups. *The National Oceans Office (DEH, Govt. of Australia).*

Given the small amount of activities no matrix is provided.

West Coast – Abrolhos Islands and Midwest Trawl, South West Trawl and South Coast Trawl Fisheries

Description and Scope of Fishery

The catches in all these fisheries are taken using low opening otter trawl systems. The Abrolhos Islands and Mid West Trawl Managed Fishery (AIMWTMF) is based on the take of saucer scallops *(Amusium balloti),* with a small component targeting the western king prawn *(Penaeus latisulcatus)* in the Port Gregory area.

The South West Trawl (SWTMF) Fishery (includes Fremantle and Geographe Bay) is a multi-species fishery that targets western king prawns and saucer scallops. The South Coast Trawl Fishery (SCTF) principally targets scallops and associated by-products but licensees have an option to use other trawl gear to target fish species. Scallop landings for the fishery have varied dramatically over the years, depending primarily on the strength of recruitment. While the fishery has theoretical access to a large section of the coastal waters, it is effectively restricted to small areas of higher scallop abundance.

The catches in all these fisheries is taken using otter trawling.

Relevant Resource Assets and Risks from Fishery

West Coast Nearshore Crustaceans	Moderate Risk
West Coast Protected Species	Negligible Risk
Abrolhos Habitats	Low Risk
LN Habitats	Low Risk
LN Ecosystem	Negligible Risk
Abrolhos Ecosystems	Negligible Risk

Summary of historical research completed

Research into the biological and environmental aspects of WA scallop stocks and commercial exploitation, has been carried out by the Department since the late 1960s, but mostly through work in Shark Bay and adapted to these other locations.

A survey of the bottom types in the Abrolhos Islands and mid-west Trawl fishery was undertaken in 1994. A detailed study of the SWTMF fishery in Geographe Bay was completed by the Department which examined the potential impacts on bycatch species and the benthic habitat of this region and found it had minimal impacts.

Current Research Focus

Prior to monitoring of the scallop stocks being undertaken using daily logbooks becoming mandatory in 2008, monthly catch and effort returns were used. In the AIMWTMF monitoring of the fishery through the use of daily logbooks and completing pre-season surveys is undertaken to forecast the following season's catch and to determine opening and closing dates. Due to low recruitment and apparent slow growth rate of scallops in parts of the Abrolhos Islands, additional sampling surveys have been undertaken in 2009 to collect scallop samples for analysis by Fish Health and monitor size composition. A small tagging study was undertaken in late 2009 to provide additional growth information. This additional

sampling was continued into 2010 focussing on scallop health and meat quality.

Square mesh cod-end trials were planned to take place in the Abrolhos Islands during the 2009 but due to low stock levels the fishery remained closed and the trials could not be undertaken. A short trial was completed during the 2010 fishing season but further commercial trials are required in Abrolhos Islands and/or in Shark Bay.

A comprehensive EPBC assessment of this fishery has determined that performance should be reported annually against measures relating to the `breeding stocks of target species (saucer scallop). Some information on ongoing bycatch levels and composition will be required to meet the requirements of the EPBC assessments. Some limited information has been gathered in the Abrolhos Islands during and the SC during a NHT funded project (UWA) in 2008.

Priority Setting Process

Initial assessments were made through internal departmental meetings in 1998 discussing research undertaken, current research and research and development gaps and a plan was drafted for five years. Regular meetings (at least annually) have been held with the Research Division and the AIMWTMF licensees to discuss research priorities and planning. Additional research needs have also been highlighted throught the ESD Assessment processs for which a re-assessement has been completed in 2008.

The most recent Industry, Research Division meeting for the AIMWTMF and the SWTMF was held in early 2011.

Review Timeline

The five-year EPBC accreditation with the Commonwealth Department of Sustainability, Environment, Heritage, Water, Population and Communities renewed in 2008 for the AIMWTMF. Some aspects of the research conducted in the Abrolhos Islands was reviewed during the Shark Bay scallop research review held in August 2010.

Key to symbols in the matrix/summary tables:

■ Indicates that the activity is funded and planned to occur.

O Indicates that the activity is part of a proposal but is not yet funded.

West Coast Abrolhos Islands and Mid West Trawl Fisheries Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
Scallop biology	Completed						Studies completed in the 1980's
1.2 Other Biology							
Recruitment Dynamics	Completed						Studies completed in the 1980's
1.3 Stock Assessment							
Stock-recruit-environ. effects	Ongoing	■	■	■	■	■	

West Coast Abrolhos Islands and Mid West Trawl Fisheries Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
Fishery independent surveys and monitoring	Annual	■	■	■	■	■	Determines forecasts of next years catch for AIMWTF
Survey indices-catch relationships	Ongoing	■	■	■	■	■	AIMWTF only
1.4 Fishery Monitoring							
Logbooks	Ongoing	■	■	■	■	■	
Pre-season skippers briefings	Ongoing	■	■	■	■	■	
Fishing power monitoring	Ongoing	■	■	■	■	■	
Processor returns	Ongoing	■	■	■	■	■	
Effort impact assessment (GIS)	Ongoing	■	■	■	■	■	EPBC requirement for AIMWTF
2. Habitat & Ecosystem							
2.1 Bycatch	-						
BRD Implementation	Completed						Implemented in 2003 for AIMWTF
Bycatch monitoring	Completed						NHT (MF) Funding for 07/08 –
Bycatch in trawled and untrawled areas	Completed						Study completed in 1990s for SWTMF Low Risk
2.2 Listed Species							
Listed species interactions - logbooks	Ongoing	■	■	■	■	■	EPBC requirement/MOU with DSWPC underway for AIMWTF, low risk in SWTMF
2.3 Habitat							
Habitat mapping and videoing – sensitive habitats	Completed						NHT (MF) Funding for 07/08, Low risk in SWTMF and study completed in 1990's.
2.4 Ecosystem/Environment							
Formal risk assessment	Periodic						EPBC requirement
2.5 Oceanography							
Leeuwin Current monitoring	Ongoing	■	■	■	■	■	
Modelling water movements and larval transport	Possible						In collaboration with UWA
2.6 Other impacts on fishery	Not needed						No other risk identified
Aquaculture sites	Possible						
3. Management Analysis							
3.1 Socio-economic							
Social assessment	Possible						
Economic Analysis –average price data	Ongoing	■	■	■	■	■	
Fuel consumption./expenses	Ongoing	■	■	■	■	■	
3.2 Resource Access (Shares)							
Rock Lobster – Scallop interaction	Underway						
Marine Park Planning	Ongoing	■	■	■	■	■	For all scallop fisheries
3.3 Compliance							
3.4 Management Systems							
4. Industry Development							
4.1 Production Technology							

West Coast Abrolhos Islands and Mid West Trawl Fisheries Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
Re-seeding	Ceased						FRDC funding – project now ceased.
Meat quality monitoring	Possible						
5. Priority Review							
Industry/Department Meetings	Annual	■	■	■	■	■	
6. Science Review	Periodic						Part of SB Scallop review in August 2010

West Coast – Blue Swimmer Crab Fishery

Description and Scope of Fishery

Blue swimmer crabs (*Portunus pelagicus*) are found along the entire Western Australian coast, in a wide range of inshore and continental shelf areas, from the inter-tidal zone to at least 50 metres in depth. Blue swimmer crabs are targeted using a variety of fishing gear. The commercial blue swimmer crab fisheries in the West Coast bioregion use traps in the Cockburn Sound Crab Managed Fishery, the Warnbro Sound Crab Managed Fishery, the West Coast Estuarine Managed Fishery (Swan, Peel Harvey), and the Mandurah to Bunbury Experimental Crab Fishery. Blue swimmer crabs are also retained by trawlers operating in Comet Bay.

Crabbing is one of the most popular recreational fishing activities. In the West Coast bioregion it is centred largely on the estuaries and coastal embayments from Geographe Bay north to the Swan River and Cockburn Sound. While the majority of recreational fishers use either drop nets or scoop nets, diving for crabs is becoming increasingly popular.

Relevant Resource Assets and Risks from Fishery

West Coast Nearshore Crustaceans (Crabs)	Moderate - High Risk
West Coast Nearshore Habitats	Low Risk
West Coast Ecosystem (Marine)	Low Risk

Summary of historical research completed

Information on the biology and ecology of blue swimmer crabs in this region was generated through a number of FRDC-funded projects conducted by the Department of Fisheries and Murdoch University. A FRDC project completed in 2005 developed a catch prediction model for the Cockburn Sound blue swimmer crab fishery that forecasts future commercial catches within the Sound.

Data for the assessment of blue swimmer crab stocks in the West Coast Bioregion was traditionally obtained from commercial catch and effort data. Additional programs now include on-board catch monitoring during the commercial fishing season, and fishery independent trawl and trap surveys conducted by the Department to provide information on the status of the spawning stock and subsequent strength of recruitment, along with data on the general crab population.

The decline in recruitment experienced within the Cockburn Sound fishery since 2003 resulted in the fishery being closed in December 2006. A comprehensive research program funded by the Minister through DIBF was developed for Cockburn Sound that included:

- Monitoring the recovery of the breeding stock and strength of recruitment in Cockburn Sound following the closure.
- Modifying and improving the juvenile index used in the catch-prediction model for the Cockburn Sound crab fishery including a residual index now incorporated into the model.
- An examination of the genetic difference between the Cockburn Sound stocks with those in Warnbro Sound and the Swan River was completed in 2008.
- Development of a commercial monitoring program for Warnbro Sound and Swan River crab fisheries.

In addition, an assessment of the potential impact on Cockburn Sound crab stocks of the Fremantle Port Authority's Outer Harbour development proposed for the southern area of Jervois Bay was completed in early 2009.

Based on concerns, the sustainability of crab stocks in the Peel-Harvey Estuary, a research program for this region was also funded through DIBF. This involved:

- A comprehensive recreational survey undertaken between Nov. 2007 and Oct.2008.
- A monthly commercial monitoring program to assess the impact of commercial fishing in the Peel-Harvey Estuary, Comet Bay and Mandurah-Bunbury fisheries.
- Fishery Independent monitoring of crab stocks inside and outside the Peel-Harvey estuary.

Fishery-independent trawl and trap surveys conducted during 2009 indicated that the strength of both recruitment and breeding stock in Cockburn Sound had improved sufficiently to allow the crab fishery to re-open to both the commercial and recreational sectors for the 2009/10 fishing season. However, a precautionary management approach was adopted under the following management controls:

- a 20% reduction in commercial pot numbers;
- an increased commercial size limit of 140mm;
- a recreational size limit of 127mm and
- a limited commercial and recreational season from 15 December 2009 to 31 March 2010.

Current Research Focus

Fishery-independent trawl and trap surveys conducted during 2010 indicated that the strength of both recruitment and breeding stock in Cockburn Sound had improved further to again allow the crab fishery to open to both the commercial and recreational sectors for the 2010/11 fishing season. However, it was considered prudent to maintain a precautionary approach to the management of the fishery, so the commercial season in Cockburn Sound remained at

three and a half months, (Dec 15th 2010 - March 31st 2011) and the fishers again operated with a 20% trap reduction. However, the minimum commercial size limit was lowered from 140 mm CW to 135 mm CW in light of the further improvement in recruitment and breeding stock and a smaller mean size of the recruiting cohort in 2010, and the recreational season was increased by one month to run from Dec 15 2010 to April 30th 2011.

Although the three-year DIBF project in Cockburn Sound has now been completed, the comprehensive program developed to monitor the recovery of the Cockburn Sound crab stock has been maintained to assess the impacts of the fishery's re-opening, and provide timely data to managers to prevent a repeat of the stock decline experienced in the mid 2000s. In addition, the commercial monitoring and fishery independent trap programs developed to assess the Peel-Harvey Estuary crab stock and monitor the other South-West commercial crab fisheries have also continued to inform management decisions in these fisheries.

Priority Setting Process

Research priorities are set in consultation with management, and feedback obtained during meetings with industry and major stakeholder groups (WAFIC, RecFishWest) as required.

Review Timeline

Research advice has been presented to assist with the development of management guidelines for the 2009/10 and 2010/11 fishing seasons of the Cockburn Sound Crab (Managed) Fishery. The DBIF funded research project monitoring the recovery of the Cockburn Sound crab stock was completed at the end of 2010, as was the three-year research project on crab stocks in the Peel-Harvey Estuary. The DIBF report on Cockburn Sound is in print, while the Peel-Harvey Estuary report will be published by the end of 2011. The recreational creel survey data on Peel-Harvey Estuary was made available during 2011.

Management arrangements in the Mandurah to Bunbury Inshore Developing Crab Fishery have been assessed as part of the Developing New Fisheries review process. Outcomes of this assessment are expected in late 2011.

Recent Publications

Johnston, D., Harris, D., Caputi, N. and Thomson, A. (2011). Decline of a blue swimmer crab (*Portunus pelagicus*) fishery in Western Australia—History, contributing factors and future management strategy. *Fisheries Research* 109(1), 119-130.

de Lestang, S., Bellchambers, L. M., Caputi, N., Thomson, A. W., Pember, M. B., Johnston, D. J. and Harris, D. C. (2010). Stock-Recruitment-Environment Relationship in a Portunus pelagicus Fishery in Western Australia. In: G. H. Kruse, G. L. Eckert, R. J. Foy, R. N. Lipcius, B. Sainte-Marie, D. L. Stram, and D. Woodby (eds.), Biology and Management of Exploited Crab Populations under Climate Change. *Alaska Sea Grant, University of Alaska Fairbanks*. doi: 10.4027/bmecpcc.2010.06.

Key to symbols in the matrix/summary tables:

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O Indicates that the activity is part of a proposal but is not yet funded.

West Coast Blue Swimmer Crabs Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
Blue swimmer crab biology, size at maturity and release mortality	Completed						Studies completed in 90's
1.2 Other Biology							
Genetic structure of populations	Completed						A study of genetic differences between Warnbro Sound, Cockburn Sound and Swan River was completed in 2008.
1.3 Stock Assessment							
Stock Assessment	Ongoing						For Cockburn Sound
	Ongoing						For Peel-Harvey Estuary
Annual C&E Assessment	Ongoing	■	■	■	■	■	For all commercial crab fisheries in West Coast Bioregion
1.4 Fishery Monitoring							
Commercial Catch & Effort	Ongoing	■	■	■	■	■	
Commercial Monitoring	Ongoing						Twice monthly for Cockburn Sound and Peel-Harvey, monthly monitoring in other west coast fisheries.
Recreational Catch and Effort – Cockburn Sound	Completed						Recreational crabbing survey for 2009/10 Cockburn Sound fishing season conducted. Data being analysed.
- Peel-Harvey Estuary	Completed						Data collection for 12-month Peel-Harvey recreational survey completed in October 2008. Report being finalised.
Fishery Independent Research Surveys – Cockburn Sound	Ongoing	■	■	■	■	■	Trawl surveys to determine recruitment and breeding stock levels.
– Peel-Harvey Estuary	Ongoing						Trap surveys to determine recruitment and breeding stock levels both inside and outside Estuary
Stock & recruitment	Ongoing	■	■	■	■	■	Commercial catch prediction for Cockburn Sound only
2. Habitat & Ecosystem							
2.1 Bycatch	Nil						Low Risk
2.2 Listed Species	Nil						Low Risk
2.3 Habitat	Underway						Relationship to be investigated for Cockburn Sound
2.4 Ecosystem/Environment							
2.5 Oceanography	Underway	■					Environmental data being compiled. Temperature loggers deployed
2.6 Other impacts on fishery							None identified
Dedicated logbook	Ongoing	■	■	■	■	■	Mandurah-Bunbury fishery only

West Coast Blue Swimmer Crabs Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
3. Management Analysis							
3.1 Socio-economic							
3.2 Resource Access (Shares)							This is a major management issue. Independent consultation between RecfishWest and WAFIC has occurred on this issue.
3.3 Compliance Research							
3.4 Management Systems							Industry proposed study on co-management - funded
4. Industry Development							
5. Priority Review							
Industry/Department Meetings	Annual	■	■	■	■	■	
6. Science Review	Periodic						Science review held In October 2010

West Coast – Abalone Managed Fishery

Description and Scope of Issues

The Western Australian commercial abalone fishery is a dive fishery operating in shallow coastal waters along WA's western and southern coasts and is divided into eight management areas. In the west coast the commercial fishery targets mainly Roe's abalone, which are harvested by a diver working off 'hookah' using a diving 'iron' to prise abalone off rocks. The commercial Roe's abalone fishery is managed primarily through output controls in the form of total allowable commercial catches (TACCs), set annually for each area.

The recreational fishery in the west coast is a dive and wade fishery that mainly operates in the metropolitan region and targets Roe's abalone. This fishery has a very restricted set of seasonal and daily opening times.

The sophisticated suite of management arrangements in place and the proactive management used in the Abalone Fishery have resulted in the maintenance of abalone stocks and the successful continuation of a fishery on a vulnerable species in a highly populated area.

Relevant Resource Assets and Risks from Fishery

West Coast Nearshore Molluscs (Abalone)	Moderate Risk
West Coast Protected Species	Negligible Risk
West Coast Nearshore Habitats	Negligible Risk

Summary of historical research completed

An extensive amount of research on the biology and stock status of Roe's abalone has been undertaken to support the management of this fishery. The basic biology (growth, reproduction, maturity) and ecological studies (population densities, settlement and recruitment) for Roe's abalone have been completed by researchers from the Western Australian Museum in the 1980s, and the Department of Fisheries in the 1990's and 2000's. Preliminary aquaculture studies on roe's abalone have been completed by Fremantle TAFE, however most of the aquaculture research has focused on the larger greenlip and brownlip species.

The historical time series of daily catch information on the total weight of abalone collected, the hours fished, the date and location of harvest and the person(s) harvesting has been used to generate a standardized catch per unit effort (CPUE) model to be developed that accounts for variation in spatial and temporal fishing effects, as well as technological improvements that aid fishing efficiency. An FRDC funded disease survey of entire Australian abalone stocks was completed in 2006 was also of relevance to this fishery.

Current Research Focus

Commercial: Current research is focused on stock assessment using catch and effort statistics, fishery-independent surveys of Perth metropolitan stocks, and digital video imagery (DVI) surveys by industry divers, who survey selected sites with an underwater video camera. Commercial abalone divers provide daily catch information which are used to assist in research, compliance and management matters. The standardized CPUE data are now being used in a decision-rule framework for quota setting in of the fishery on an annual basis.

Size and density of Roe's abalone across the near-shore sub-tidal reef habitat are measured annually at 11 indicator sites between Mindarie Keys and Penguin Island. Nine of these are fished while the other 2 are the Waterman's Reserve Marine Protected Area (MPA), and the Cottesloe Fish Habitat Protection Zone. The ability of this survey data to provide a predictive index for future stock abundance is a current topic of research.

Recreational: Current annual recreational catch and effort estimates are derived from an annual field survey in the Perth metropolitan fishery, and a biennial telephone diary survey covering the entire state (2007 was the last year of a state-wide survey). The field survey provides estimates of the catch and effort from each stock of Roe's abalone stock within the Perth fishery. This method provides a comprehensive assessment for this region but is too resource-intensive to be applied outside of the Perth metropolitan area. A catch prediction model based on environmental conditions and number of abalone licenses is currently being developed to assist in the management of the new 40 tonne TARC (Total Allowable Recreational Catch).

The telephone diary survey, which estimates the catch of all 3 abalone species on a state-wide basis, is completed about every second year. In 2007, around 500 licence holders were randomly selected from the licensing database, with selection stratified by licence type (abalone or umbrella) and respondent location (country or Perth metropolitan area). The licence holders were sent a diary to record their fishing activity and were contacted every 3 months by telephone for the duration of the abalone season, or at the end of the season for those only involved in the Perth abalone season.

Priority Setting Process

Annual meetings are held between the Department of Fisheries and the commercial abalone industry. Input on the recreational program has previously been obtained from the RFAC and the IFAAC groups.

Review Timeline

The fishery and stocks are reviewed annually, with quota decisions made each February. A mid-season research update is carried out during August - September. The research associated with this fishery was reviewed during a workshop in October 2010. External reviewers were Professor Neil Loneragan of Murdoch University and Dr Steve Mayfield of SARDI (South Australian Research and Development Institute).

Recent Publications

Hart, A. M., Fabris, F. P., Caputi, N. (2009). Performance indicators, biological reference points, and decision rules for Western Australian abalone fisheries (*Haliotis* sp.): (1) Standardised catch per unit effort. *Fisheries Research Report No 185, Department of Fisheries, Western Australia,* 40 p

Hart, A. M., Fabris, F. P., Brown, J., Murphy, D. (2008). Digital video surveys of abalone (*Haliotis* sp.) stocks by commercial fishers in Western Australia. *Fisheries Research*. 93: 305-314.

Hesp, A., Loneragan, N., Hall, N., Kobryn, H., Hart, A. M., Fabris, F. P., Prince, J. (2008). Biomass and commercial catch estimates for abalone stocks in areas proposed as sanctuary zones for the Capes Marine Park. *Fisheries Research Report No 170, Department of Fisheries, Western Australia,* 62 p

Hart, A. M., Fabris, F. P. (2007). Digital video techniques for assessing population size structure and habitat of greenlip and roe's abalone. *Final Report to the Fisheries Research and Development Corporation on Project No 2002/079. Fisheries Research Report No. 167, Department of Fisheries, Western Australia,* 58 p.

Key to symbols in the matrix/summary tables:

■ Indicates that the activity is funded and planned to occur.

O Indicates that the activity is part of a proposal but is not yet funded..

West Coast Abalone Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
Roe's Biology - growth etc	Completed						Sufficient for management
Early juvenile life history and habitat, natural mortality and predation	Underway	■	■				Natural mortality studies underway for roe's metropolitan stocks

West Coast Abalone Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
Reproduction/Fecundity, spawning Periodicity	Completed						Research by the Museum completed in the 1980s
Disease survey/atlas	Completed						FRDC funded survey of entire Australian abalone stocks completed in 2006
1.2 Other Biology							
Environmental effects on recruitment	Underway						Long-term datasets on annual recruitment and relevant environmental factors are being developed
1.3 Stock Assessment							
Catch statistics (wildstock)	Ongoing	■	■	■	■	■	40 years of catch and effort statistics
Mapping of areas	Periodic						FRDC funded project using GPS trackers, headed up by TAFI; Use of Google Map to evaluate Perth metro reef areas
Fishing efficiency	Ongoing	■	■	■	■	■	Environmental and technological factors continually monitored
Commercial length frequency monitoring		■	■	■	■	■	Catch sampling from industry used to estimate F
Population dynamics and harvest strategy assessment model	Ongoing	■	■	■	■	■	Model under development
Recreational Impact	Ongoing	■	■	■	■	■	Annual monitoring of recreational catch
Yield and egg-per-recruit analysis for size limits	Underway						Analysis in 2009 assessment
1.4 Fishery Monitoring							
Research monitoring and recruitment sites	Ongoing	■	■	■	■	■	11 sites annually surveyed, including marine protected areas.
Industry video monitoring sites	Ongoing	■	■	■	■	■	20 to 30 sites surveyed annually
Recreational fishery monitoring – field surveys	Ongoing	■	■	■	■	■	Perth fishery, annual counts of high density and plane surveys of low density zones
Recreational Fishery Monitoring –phone surveys	Ongoing Biennially		■		■		Phone diary survey undertaken every two to three years
2. Habitat & Ecosystem							
2.1 Bycatch	Not Needed						No Bycatch
2.2 Listed Species	Not Needed						No interactions
2.3 Habitat	Not Needed						Low risk
2.4 Ecosystem/Environment	Not Needed						Low risk
2.5 Oceanography							Collaboration with CSIRO
2.6 Other impacts on fishery							
Abalone Health - Contingency plan and monitoring and diagnosis	Ongoing	■	■	■	■	■	
AVG (Abalone Viral Ganglioneuritus)	Ongoing	O	O	O			Watching brief
3. Management Analysis							
3.1 Socio-economic							
3.2 Resource Access (Shares)	Completed						IFAAC process completed for Perth fishery,

West Coast Abalone Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
3.3 Compliance							
3.4 Management Systems							
3.5 Translocation/protocol	Ongoing	■	■	■	■	■	
4. Industry Development							None identified
5. Priority Review		■	■	■	■	■	Annual industry meetings
6. Science Review				■			Major assessment reports peer reviewed every three years. Last assessment In October 2010

West Coast – Deep Sea Crab Fishery

Description and Scope of Issues

The West Coast Deep Sea Crab (Interim) Managed Fishery operates between Cape Leeuwin and the Northern Territory border and is managed by TAC of 140t for crystal crabs and 14t each for champagne and giant crabs which was introduced in 2008. The fishery targets giant (king) crabs, crystal (snow) crabs and champagne (spiny) crabs using baited pots operated in a longline formation in the offshore waters if the west coast.

In the late 1990s when this fishery first commenced, it targeted champagne crabs. However, within a couple of years the fishery moved into deeper waters targeting crystal crabs. Since 2001 catches of champagne crabs have been insignificant but recently (2009) this species has once again been targeted. Landings of giant crab have always been minimal (<1t per annum). The FRDC has funded research on aspects of the crystal, giant and the champagne crab fisheries and final reports are available on all three projects.

Relevant Resource Assets and Risks from Fishery

West Coast Crustaceans Moderate Risk

Summary of historical research completed

Biological (growth, reproduction, movement patterns etc) and fisheries data are available for crystal crabs in Melville-Smith et al. (2007). That study showed the main distribution on the west coast to be between North West Cape and Fremantle although the range did go much further south. Tagging has shown the species to be slow growing with best estimates suggesting legal sized male crabs to be ~13-15 years old and some large crabs in the population being ~30 years old. The species is capable of substantial movement patterns, with the majority moving <50 km, but some moving >100 km while they were at large.

Reproductive data including size at maturity for both sexes and seasonality of spawning is available for champagne crabs in Smith et al. (2004)[1].

Comprehensive biological information is available for giant crabs in Australian waters in Levings et al. (2001)[2] although sampling was most intense in the centre of that species' distributional range off Victoria and South Australia and less so in Western Australia.

Current Research Focus

Research monitoring of the west coast deep sea crab fishery is currently undertaken utilising fishers' monthly returns data to monitor activities.

Priority Setting Process

Research and management meetings are held with industry as required.

Review Timeline

Within next five years

Recent Publications

Melville-Smith, R., Norton, S.M.G., Thomson, A.W. (2007). Biological and Fisheries Data for Managing Deep Sea Crabs in Western Australia. *FRDC Final Report for Projects 2001/055.*

Key to symbols in the matrix/summary tables:

■ Indicates that the activity is funded and planned to occur.

O Indicates that the activity is part of a proposal but is not yet funded.

West Coast Deep Sea Crab Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
Giant Crabs	Completed						
Crystal and Champagne Crabs	Completed						
Growth & Reproduction	Completed						
Migration	Completed						

[1] Smith, K.D., Potter, I.C., Hall, N.G. (2004). Biological and fisheries data for managing the deep-sea crabs *Hypothalassia armata* and *Chaceon bicolour* in Western Australia. FRDC Final Report for Projects 1999/154 and 2001/055.

[2] Levings, A., Mitchell, B.D., McGarvey, R., Mathews, J., Laurenson, L., Austin, C., Murphy, N., Miller, A., Rowsell, M., Jones, P. (2001). Fisheries Biology of the giant crab *Pseudocarinus gigas*. FRDC Final Report, Project 93/220 and 97/132.

West Coast Deep Sea Crab Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1.2 Other Biology	Not needed						No other species caught in number
1.3 Stock Assessment							
Annual assessment	Ongoing	■	■	■	■	■	
Commercial catch and effort	Ongoing	■	■	■	■	■	
Processor returns	Ongoing	■	■	■	■	■	
Commercial length freq monitoring	Ongoing	■	■	■	■	■	
2. Habitat & Ecosystem							
2.1 Bycatch	Nil						Negligible risk
2.2 Listed Species							
Whales; dolphins; turtles	Nil						Negligible risk
2.3 Habitat							
Benthic muds	Nil						Negligible risk
2.4 Ecosystem/Environment							
Ghost fishing; other trophic levels	Nil						Negligible risk
2.5 Oceanography							
2.6 Other impacts on fishery							Nothing identified
3. Management Analysis							
4. Industry Development							
5. Priority Review							
6. Science Review						■	

West Coast – Octopus Fishery and Aquaculture

Description and Scope of Issues

The octopus fishery in Western Australia primarily targets *Octopus cf. tetricus*, with occasional bycatch of *O. ornatus* and *O. cyanea* in the northern parts of the fishery, and *O. maorum* in the southern and deeper sectors. Fishing activities targeting octopus in Western Australia can be divided in four main categories: bycatch from the West Coast Rock Lobster Managed Fishery (WCRLF); the Cockburn Sound (Line and Pot) Managed Fishery (CSLPF); the Developmental Octopus Fishery (DOF); and recreational fishery. In addition to these 4 main sectors, numerous trawl and trap fisheries land small amounts of octopus as a bycatch.

During the past decade, the octopus fishery in WA has doubled, while human consumption of octopus has increased 5-fold. This trend is reflected by an increase in market price from

around $4 to over $12 per kilogram, with similar trends observed overseas. The recent introduction of a new gear type into the developing octopus fishery has increased fishing efficiency dramatically and opened up new fishing grounds. These advancements are further increasing the rapid rise of the octopus fishery. However, there are significant knowledge gaps in the fisheries biology of *Octopus cf. tetricus*, with only small-scale biological studies having been carried out at present. To address this issue a major project funded by the FRDC is being carried out to determine the stock status and future sustainable harvest of the fishery.

Initial trials have indicated that *O. tetricus* can easily acclimate to captivity, has fast growth rates, readily accepts frozen/moist foods, is highly fecund and can demand a solid market price with value adding. These attributes have generated an interest from industry in culturing *O. tetricus*. A major obstacle to achieving this goal is to closing the life cycle of the species. FRDC funding has been attained to conduct this research with promising initial results.

Relevant Resource Assets and Risks from Fishery

West Coast Nearshore Molluscs	Moderate Risk
West Coast Protected Species	Negligible Risk
West Coast Nearshore Habitats	Negligible Risk
West Coast Marine Ecosystems	Negligible Risk

Summary of historical research completed

While predation on lobsters by octopus has been studied, minimal stock assessment research has been carried out on the octopus fishery. A daily catch and effort logbook has been tested and introduced into the DOF, and some sub-sections of the CSLP, and two recent University theses on aspects of the biology and fishery of *Octopus cf. tetricus* have been completed.

Current Research Focus

The aforementioned FRDC funded projects granted to the Department of Fisheries are titled:

- 2010/200, "Innovative development of the *Octopus tetricus* fishery in Western Australia" and
- 2009/206 "Development of Octopus Aquaculture."

These projects will develop robust stock assessment and aquaculture methodologies for *O. cf. tetricus* to assist the future development of octopus as a sustainable fishery and important seafood product of Western Australia.

Priority Setting Process

Research priorities are set through meetings with the Department of Fisheries, industry and other stakeholders. In addition, each of the FRDC projects are bound by a project agreement which has set aims and a series of milestones that need to be achieved.

Review Timeline

The Fisheries Research Division reviews the fishery and stocks annually in December.

Recent Publications

Franken, L, E, (2010). The Western Australian Developmental Octopus Fishery: Assessment,

Development and Biology. *Honours Thesis, University of Groningen.* 102 p.

Herwig, J. (2010) Life history and ecology of *Octopus cyanea* at Ningaloo Reef, Western Australia: assessing its vulnerability. *Honours Thesis, University of Western Australia.* 54 p.

Larsen, R. J. (2008). The Western Australian Developmental Octopus Fishery: species composition and aspects of morphology and biology. *Honours Thesis, School of Biological Sciences and Biotechnology, Murdoch University.* 116 p.

Kernan, P. (2008). Female mating preference, polyandry and paternity bias in *Octopus tetricus*. *Honours Thesis, University of Western Australia.* 85 p.

Key to symbols in the summary matrix:

■ Indicates that the activity is funded and planned to occur.

O Indicates that the activity is part of a proposal but is not yet funded.

West Coast Octopus Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							Information on growth, density, size at maturity and mortality are needed to improve the management of West Coast stocks
Age and Growth	Underway	■	■	■			Current FRDC project
Size-at-maturity	Underway	■	■	■			Current FRDC project
Mortality	Underway	■	■	■			Current FRDC project
1.2 Other Biology							
Genetics	Low Priority						Genetics work on *O. cf. tetricus* would help establish species connection with East Coast
1.3 Stock Assessment							
Sustainability of stocks	Underway	■	■	■	■	■	Current FRDC project will determine the present stock status and a means of predicting future sustainable catch rates.
1.4 Fishery Monitoring							
Research logbook implementation	Underway	■	■	■	■	■	
1.5 Aquaculture							
Develop the hatchery techniques for octopus larvae and juveniles	Underway	■	■				Current FRDC project
Optimising octopus ranching and grow out	Underway	■	■				Current FRDC project
2. Habitat & Ecosystem							
2.1 Bycatch							Negligible Risk
2.2 Listed Species							Negligible Risk
2.3 Habitat							Negligible Risk
2.4 Ecosystem/Environment							Negligible risk

West Coast Octopus Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
3. Management Analysis							
4. Industry Development							Expansion of the DOF (developing octopus fishery) currently underway
5. Priority Review							
6. Science Review							At conclusion of current FRDC projects

West Coast – Artemia Aquaculture

Description and Scope of Issues

Early life stage husbandry, and in particular larval nutrition is a key element for marine fish culture. The use of live food for successful hatchery culture of marine fish larvae is currently considered obligatory. Live food is expensive, especially during recent years where global harvests of Artemia cysts have decreased sharply leading to a worldwide shortage. Compounding this issue, new AQIS regulations and biosecurity issues in Australia may limit future importation. The reliance that Australian hatcheries have on imported Artemia is a major constraint to the sustainable development and expansion of this industry. Western Australia has unique environmental conditions that allows mass production of Artemia at relatively low cost. It is especially beneficial to rural areas where salt ponds and lakes are located for which there is no other commercial application or use.

Summary of historical research completed

During FRDC project 2004/238 a large scale commercial production system was designed and built for the culture of Artemia using *Dunaliella salina* algae. The system is fully integrated with the algae production for beta-carotene at Hutt Lagoon, Port Gregory and is a completely closed system with no waste output. The integration of the algae – Artemia production not only makes this aquaculture sector the biggest in Western Australia, it is also sustainable, utilizing the waste output from the Artemia system as a nutrient stream to the algae ponds. Currently, the company is already producing tens of tonnes of Artemia for the Australian and international markets.

Current Research Focus

The current R&D work funded jointly by FRDC and Cognis Australia focuses on optimizing the production including development of new harvesting devices and filtration systems, adding value to the final product and cyst production.

The company is planning to scale up the production capacity and therefore, optimizing and enhancing efficiency are an essential part of this expansion activity.

Priority Setting Process

The project is a direct result and continuation of the previous FRDC - Cognis Australia – DoFWA commercialization of Artemia project.

Review Timeline

Reviewed during the R&D plan 2010-11.

Given the small amount of activity no matrix is provided

Gascoyne Bioregion

Gascoyne – Biodiversity Issues

Description and Scope of Issues

The attractive features of the Gascoyne, including its protected coastal waters and fish stocks, have resulted in the area being a focus of marine management, beginning in the 1960s. The state's earliest marine habitat protection areas, in the form of extensive prawn nursery trawl closures over the sand flats and seagrass beds, were introduced in the 1960s in both Shark Bay and Exmouth Gulf. This system of fisheries closures, later expanded to cover all significant coral areas, has provided long-standing protection to virtually all fragile marine habitats in the Bioregion. The subsequent development of marine parks over Ningaloo Reef and the inner gulfs of Shark Bay have added further, complementary protection to these highly valued areas. In June 2011 the World Heritage Committee inscribed the Ningaloo Coast on the World Heritage List.

Specific commercial fishing regulations implemented in the 1970s and 1980s also preclude the use of large-mesh gillnets and longlines throughout the Gascoyne, to prevent the incidental entanglement of the large populations of dugongs and turtles which inhabit the region. These controls have also provided protection for the large shark species, including whale sharks, which are a feature of this region. More recently, bycatch reduction devices (grids) installed in trawl nets have increased the protection encountered on trawl grounds.

Relevant Resource Assets and Risks from Fishing Activities

Benthic Habitats - Shark Bay Gulfs	Moderate Risk
Benthic Habitats - Ningaloo	Low Risk
Benthic Habitats - Zuytdorp	Low Risk
Protected species - non fish (turtles)	Low Risk
Protected species - non fish - mammals	Low Risk
Protected species - fish	Low Risk
Ecosystem- Shark Bay Gulfs	Low Risk
Ecosystem - Ningaloo	Low Risk
Ecosystem - Zuytdorp	Low Risk
Introduced Pests & Diseases	Low Risk

Summary of historical research completed

Bycatch: To date most of the research on bycatch in this Bioregion has focused on the trawl fisheries, which extract large quantities of discarded bycatch relative to target and by-product species. All trawl fisheries in this Bioregion now include Bycatch Reduction Devices (BRD) to reduce the incidental catch of turtles and other large fauna as well as secondary bycatch devices such as square mesh panels to reduce the capture of fish species. The Department of Fisheries has undertaken a number of studies on the potential impacts on bycatch species and

on the benthic habitats, from prawn and scallop fisheries in Shark Bay and Exmouth Gulf. These published studies found the impact to be minimal. There was some concern during the 1990's that commercial pink snapper (*Pagrus auratus*) catches were declining in Shark Bay due to trawling bycatch of juveniles. The Department of Fisheries found no difference between *P. auratus* stocks, inside and outside trawled areas, and suggested the reason for declining adult stocks might be due to increased recreational fishing. Interaction rates with threatened, endangered and protected species (TEPS) have received attention in most fisheries with the inclusion of protected species interactions included on daily logbooks and Catch and Effort Statistics (CAES) forms.

Current Research Focus

Many of the studies in this region are being done as part of WAMSI Nodes 1, 3 & 4.

Bycatch Monitoring and Assessment - Establishing a risk analysis of interaction rates between the collective fisheries and bycatch to identify which species, species groups or fisheries require more detailed assessment (WAMSI 4.4.1). This assessment includes Threatened, Endangered and Protected species (TEPs), discarded undersize target species, and all other discarded species in this Bioregion. This work was published in late 2010.

Input to SEWPaC's north-west Marine Bioregional planning.

Respond to reports and investigate cause of fish kills.

Priority Setting Process

WAMSI projects, of which the above bycatch project is associated, were developed by executive direction of the Department with research input.

Recent Publications

Molony, B.W., Newman, S.J., Joll, L., Lenanton, R.C.J. and Wise, B. 2011. Are West Australian waters the least productive waters for finfish across two oceans? A review with a focus on finfish resources in the Kimberley region and North Coast Bioregion. *Journal of the Royal Society of Western Australia.* 94: 323–332.

Evans, R. and Molony, B. (2010). Ranked Risk Assessment for bycatch in multiple fisheries: a Bioregional risk assessment method. *Fisheries Research Report No 212. Department of Fisheries, Western Australia.* 88pp

Review Timeline

The bycatch project is a one-year project and it is being reviewed through the WAMSI project review process. The project was completed in 2010 and was published as a peer-reviewed Fisheries Department Research Report series. It is available to download from the Department's website.

Key to symbols in the matrix/summary tables:

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Gascoyne Biodiversity Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
General finfish communities	Ongoing						Includes movement, habitat usage etc occurring as part of WAMSI
2. Habitat & Ecosystem							
2.1 Bycatch							
	Completed						WAMSI 4.4.1 - Captured species assessments & monitoring
2.2 Listed Species							
	Completed						WAMSI 4.4.1 - Captured species assessments & monitoring
2.3 Habitat							NRP (*including WAMSI Project 3) – CSIRO, AIMS, Unis.
Habitat Mapping	Ongoing						Habitat Mapping at Ningaloo is occurring as part of WAMSI
2.4 Ecosystem/Environment							
Biodiversity, Trophic interaction, anthropogenic influences etc	Developing (some underway)						WAMSI 4.2 & 4.3
Climate change	Developing						WAMSI Project 1, 2 (CSIRO, UWA, AIMS)
Fish Kills	Ongoing				■		Gov't response to fish kills coordinated through Fisheries Research (Fish Health)
2.5 Oceanography							
Hydrodynamic modelling	Developing (some underway						WAMSI Projects 1, 2 & 3 (CSIRO, UWA, AIMS):
Hydrodynamics & nutrient dynamics of shelf waters in relation to LC.	Completed						SRFME (including Southern Surveyor cruise). .
	Underway	■					Southern Surveyor – cruises completed; data analysis underway. Another cruise is planned.
2.6 Other impacts on fishery							
Introduced Marine Pests	Completed						Was funded by Natural Heritage Trust.
3. Management Analysis							
3.1 Socio-economic							
Social assessment	Underway						NRP/WAMSI, CSIRO Cluster, Sustainable Tourism CRC, NRM. E.g. Human Usage survey. Note: some underway but more work is planned
3.4 Management Systems	Completed						WAMSI 4.1. Applying EBFM framework.
	Developing						DEH/NOO south west regional plan

Gascoyne Biodiversity Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
4. Industry Development							
5 Priority Review	Ongoing						Annual departmental industry meetings
6. Science Review	Just Completed						Next review due in 2013

Gascoyne – Gascoyne Demersal Scalefish Fishery

Description and Scope of Issues

The Gascoyne Demersal Scalefish Fishery encompasses commercial and recreational fishing for demersal scalefish (e.g. pink snapper, goldband snapper, spangled emperor) in the continental shelf waters of the Gascoyne Coast Bioregion. This includes the activities of the Gascoyne Demersal Scalefish Fishery (GDSF) and recreational fishing from both licensed charter and private vessels.

Pink snapper in oceanic waters off Shark Bay ('oceanic' stock) and those in waters off Kalbarri are currently treated as separate populations; the latter are managed under arrangements within the West Coast Demersal Scalefish Fishery. Integrated Fisheries Management (IFM) for the Gascoyne is scheduled to commence in 2010-2011, based on advice from the Research Division on the current status of demersal scalefish stocks.

Relevant Resource Assets and Risks from Fishery

Gascoyne Demersal Scalefish	Moderate – High Risk
Gascoyne Protected Species	Low Risk
Gascoyne Shelf Habitats	Negligible Risk
Gascoyne Ecosystems	Low Risk

Summary of historical research completed

Detailed research on pink snapper in oceanic waters off Shark Bay and the associated GDSF (formerly the Shark Bay Snapper Managed Fishery) was undertaken through the 1980s and early 1990s (see Marriott et al., 2011 for details). An integrated stock assessment model for pink snapper was initially developed as part of an FRDC-funded project in 2002 and has been routinely updated since. Preliminary biological information on spangled emperor and other key emperor species in northwest WA was obtained via an FRDC-funded project in the early 1990s. The first major survey of recreational fishing throughout the entire Gascoyne Coast

Bioregion was undertaken in 1998/99 and was repeated (boat-based fishing only) in 2007/08.

Current Focus and Summary of Activities

The current focus is monitoring the recovery of the pink snapper (oceanic) spawning stock. Stock assessments have recently been completed and externally reviewed for the two other demersal indicator species for this Bioregion (goldband snapper and spangled emperor). Results of this work will soon be published in an independently peer-reviewd Fisheries Research Report. Monitoring of spangled emperor in the north Gascoyne will need to continue as the current level of fishing (2007/08) has been determined to be unacceptable. Monitoring of the goldband snapper age structure is on-going given the uncertainty in the F-based stock assessments and the species biological vulnerability ahead of the next assessment (due in 2015). Some information on the status of red emperor in the Gascoyne may be required and concern remains for some vulnerable deeper-water species (e.g. ruby snapper and eightbar grouper) and the effect of any expansion of fishing operations by Commonwealth Western Deep Water Trawl licensed vessels. There is also a need for regular ongoing monitoring of recreational fishing activity in the Gascoyne.

Current Activities - Commercial catch and effort information is obtained from daily/trip logbook returns for GDSF vessels and charter vessels. An integrated statewide survey of recreational boat fishing involving the use of phone-diaries, boat ramp surveys and remote cameras is currently underway. A report on the status of demersal scalefish stocks is being finalised following the completion of a recent external review.

Pink snapper: Commercial catches are sampled on a monthly basis to provide representative catch-at-age data that are used to update the integrated stock assessment model every 3 years (next assessment due 2012). Limited at-sea monitoring (interactions with endangered species, bycatch) is undertaken to meet EPBC Act/WTO Exemption requirements (next review due 2014). The WAMSI 4.4.2 project has been using genetics and otolith chemistry to investigate the relationships between pink snapper stocks from Shark Bay to the South Australian border; results will now be available in late 2011.

Goldband snapper and Spangled emperor: Comprehensive research on these species commenced in 2007. A 'weight of evidence' based assessment for both species has recently been completed and reviewed and will be reported in Gascoyne IFM Stock Status Report later this year. On-going base level monitoring of spangled emperor stocks continues, involving a trial of low cost methods including biological sampling at recreational fishing tournaments and collections of filleted carcasses at public filleting tables. In addition, some limited biological research into red emperor is on-going.

Priority Setting Process

Overall priorities are set based on the current level of understanding of the key species, stock status and fishery, and potential future risks and issues identified, using a risk assessment approach and expert opinion (see Anon, 2011 for details). Specific priorities are discussed internally by researchers and managers prior to stakeholder meetings.

Science Review Timeline

The 'weight of evidence' based assessments for both spangled emperor and goldband snapper have been externally reviewed and will be reported in a Fisheries Research Report shortly. The stock assessment of pink snapper was externally reviewed in July 2006. Assessments for

oceanic pink snapper and goldband snapper will be updated in 2015. The next EPBC related review is scheduled for 2014.

Recent Publications

Marriott, R. J., Adams, D. J., Jarvis, N. D. C., Moran, M. J., Newman, S. J. & Craine, M. (2011). Age-based demographic assessment of fished stocks of spangled emperor, Lethrinus nebulosus in the Gascoyne Bioregion of Western Australia. Fisheries Management and Ecology 18: 89-103.

Marriott, R. J., Mapstone, B. D., Ballagh, A. C., Currey, L. M., Penny, A., Williams, A. J., Jackson, G., Lou, D., Mapleston, A. J., Jarvis, N. D. C., Keay, I. S. & Newman, S. J. (2010). Accepting final counts from repeat readings of otoliths: should a common criterion apply to the age estimation of fish? *Marine and Freshwater Research* 61: 1171–1184.

Norriss, J.V. and Crisafulli, B. (2010) Longevity in Australian snapper *Pagrus auratus* (Sparidae) *Journal of the Royal Society of Western Australia* .

Key to symbols in the summary matrix:

■ Indicates that the activity is funded and planned to occur.

O Indicates that the activity is part of a proposal but is not yet funded.

Gascoyne Demersal Scalefish Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
Pink snapper (oceanic stock) biology	Complete						Adequate for management
Goldband snapper biology	Complete						
Spangled emperor biology	Underway	■					Gascoyne IFM project, completing analysis and write-up of results
Red emperor biology	Proposed	O	O				Project Identified, limited biological sampling occurring
1.2 Other Biology							
Pink snapper juvenile recruitment	Ongoing	■	■	■	■		Shark Bay trawl surveys
Stock structure – pink snapper (oceanic)	Underway	■					WAMSI 4.4.2, genetics (Murdoch PhD), otolith chemistry, oceanographic modeling
Stock structure – spangled emperor	Underway	■					Collaboration with CSIRO/AIMS, publication of results imminent
1.3 Stock Assessment							
Age-structured modelling for pink snapper	Periodic		■				Need to monitor stock recovery to 40% target level (next assessment 2012).
Age-based assessments for goldband	Periodic					■	Need to re-run assessment In 2015
Age-based assessments for spangled emperor	Periodic				■		Need to re-run assessment In 2014.
Age-based assessments for red emperor	Proposed						Project Identified

Gascoyne Demersal Scalefish Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1.4 Fishery Monitoring							
Pink snapper, age structure of catch	Ongoing	■	■	■	■		Need to monitor stock recovery to 40% target level (next assessment 2012).
Goldband, age structure of catch	Ongoing	■	■	■	■		Need to re-run assessment In 2014.
Spangled emperor, age structure of catch	Ongoing			■	O	O	Indicator species, will need additional resources to continue
Spangled emperor, low-cost proxies for age monitoring		■	■		O	O	Continuation based on evaluation of methods and funding available.
Red emperor, age structure of catch	Proposed			O			Project Identified
CAES catch and effort data	Ongoing	■	■	■	■		Daily logbooks since Feb 2008
Charter boat catch and effort	Ongoing	■	■	■	■		Monthly returns
Recreational fishing surveys	Ongoing	■	■	O	O	O	ISurvey
2. Habitat & Ecosystem							
2.1 Bycatch	Ongoing	■	■	■	■		EPBC Act, low level at sea monitoring,
2.2 Listed Species	Not needed						Low risk
2.3 Habitat	Not needed						Low risk
2.4 Ecosystem/Environment	Not needed						Low risk
Recruitment and environment	Underway	■					Recruitment to oceanic snapper, minor project with UWA underway
3. Management Analysis							
3.1 Socio-economic Research/Monitoring							
3.2 Resource Access (Shares)		O					IFM process re-scheduled to commence 2011-2012
3.3 Compliance Research							
3.4 Management Systems Research							
4. Industry Development							
5. Management Review and Priority Setting							
6. Science Review		■	O				Goldband and Spangled Emperor stock assessment external review completed. Snapper assessment scheduled for 2012

Gascoyne – Blue Swimmer Crab Fishery

Description and Scope of Fishery

The blue swimmer crab (*Portunus pelagicus*) is found along the entire Western Australian coast, in a wide range of inshore and continental shelf areas, from the inter-tidal zone to at least 50 m in depth. Crabbing activity in the Gascoyne Coast bioregion is centered in the embayment of Shark Bay, and to a lesser extent Exmouth Gulf. The Shark Bay Crab Fishery has developed into the largest crab fishery in WA. It is a limited-entry fishery with a total of 5 trap permits targeting crabs. In addition, the Shark Bay prawn and scallop trawl fleet also retain crabs as a by-product. The Developing Fisheries Assessment Committee conducted a review of the Exmouth Gulf Developing Crab Fishery between 2007 and 2009 and recommended that the trap fishery was not economically viable due to poor performance and low catch and should not be continued. On this basis, this fishery was closed in June 2009. Crab trap fishers in the Shark Bay and Pilbara Developing Crab Fisheries are only permitted to use 'hourglass' traps. The Pilbara Developing Crab Fishery currently has one exemption holder operating up to a maximum of 400 traps.

Relevant Resource Assets and Risks from Fishery

Gascoyne Nearshore Crustaceans (Crabs)	Moderate - High Risk
Gascoyne Protected Species	Negligible Risk
Shark Bay Gulf Habitats	Negligible Risk
Shark Bay Gulf Ecosystems	Negligible Risk

Summary of historical research completed

Data for the assessment of blue swimmer crab stocks in the Gascoyne and North Coast bioregions are obtained from fishers' compulsory catch and effort returns and voluntary daily log books. Department of Fisheries' research staff also conduct quarterly catch monitoring surveys aboard commercial crab trap vessels in Shark Bay.

Some base-line information on the biology and ecology of blue swimmer crabs has been generated by a number of Fisheries Research and Development Corporation (FRDC)-funded projects conducted by the Department of Fisheries and Murdoch University over the past decade. A FRDC project completed in early 2005 produced a preliminary stock assessment of the Shark Bay blue swimmer crab fishery.

A review of the available blue swimmer crab research data for Shark Bay conducted in 2010/11 suggests there are signs the blue swimmer crab breeding stock size and abundance may be declining. However, an accurate assessment of sustainable catch levels could not be provided due to insufficient scientific data. As a result of this uncertainty, precautionary management options for the commercial trap and trawl sectors were being considered until a more robust stock assessment can be completed.

Current Research Focus

The review of the Shark Bay Crab Interim Management Plan, which has been extended until 31 August 2011, requires an updated stock assessment to be completed as part of this process. An externally reviewed workshop was conducted in May 2011 to review the current research

program. A preliminary stock assessment (Harris *et al*) is currently being prepared. A FRDC pre-proposal is currently being developed to improve understanding of the biology of Shark Bay crab stocks and develop a decision-rule framework to better manage the fishery.

Priority Setting Process

Research priorities are set in consultation with management, and feedback obtained during meetings with industry groups and major stakeholders (WAFIC, RecFishWest) as required.

Review Timeline

An update of this stock assessment for the Shark Bay Crab (Interim) Managed Fishery was completed in 2011. Both the Exmouth Gulf and Pilbara Developing Crab Fisheries were formally (externally) reviewed in mid-2007 by the Developing Fisheries Assessment Committee (DFAC) as part of the 'Developing New Fisheries' process.

Recent Publications

Johnston, D., Harris, D., Caputi, N. and Thomson, A. (2011). Decline of a blue swimmer crab (*Portunus pelagicus*) fishery in Western Australia—History, contributing factors and future management strategy. *Fisheries Research* 109(1), 119-130.

de Lestang, S., L.M. Bellchambers, N. Caputi, A.W. Thomson, M.B. Pember, D.J. Johnston, and D.C. Harris. (2010). Stock-Recruitment-Environment Relationship in a Portunus pelagicus Fishery in Western Australia. In: G.H. Kruse, G.L. Eckert, R.J. Foy, R.N. Lipcius, B. Sainte-Marie, D.L. Stram, and D. Woodby (eds.), Biology and Management of Exploited Crab Populations under Climate Change. *Alaska Sea Grant, University of Alaska Fairbanks*. doi: 10.4027/bmecpcc.2010.06.

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Gascoyne Blue Swimmer Crab Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
Blue swimmer crab biology							Small amount of research has been conducted
1.2 Other Biology							
Genetic structure of populations	Completed						
1.3 Stock Assessment							
	Periodic						A preliminary stock assessment (Harris et al) has been completed. A FRDC proposal has been submitted in July 2011 to conduct more detailed stock assessment analysis.

Gascoyne Blue Swimmer Crab Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
Annual C&E assessment	Ongoing	■	■	■	■	■	
1.4 Fishery Monitoring							
Commercial Catch & Effort	Ongoing	■	■	■	■	■	
Processor Returns	Ongoing	■	■	■	■	■	For Shark Bay only
Commercial Monitoring	Ongoing	■	■	■	■	■	3 times per year for Shark Bay
Recreational Catch and Effort	Periodic	■			■		Will be part of WA Recreational Boat Fishing Survey.
Stock & recruitment	Ongoing	■	■	■	■	■	
2. Habitat & Ecosystem							
2.1 Bycatch	Underway						Qualitative only
2.2 Listed Species							NegligibleRisk
2.3 Habitat							Negligible Risk
2.4 Ecosystem/Environment							Low Risk
Heavy metal content of crabs	Completed						
2.5 Oceanography							
2.6 Other impacts on fishery							
3. Management Analysis							
3.1 Socio-economic							FRDC proposal submitted In July 2011 that Includes an objective to assess the socio-economic Impacts of the exploitation of the Shark Bay crab stock
3.2 Resource Access (Shares)			■				Determination of access shares will be critical in the next few years
4. Industry Development							A significant amount of work is undertaken in this area by industry in this region
5. Priority Setting	Periodic						Regular Industry/Departmental meetings
6. Science Review		■					Conducted in May 2011

Gascoyne – Exmouth Gulf Prawn Fishery

Description and Scope of Fishery

The Exmouth Gulf Prawn fishery (EGP) is the second largest prawn fishery in WA and is located in the relatively sheltered waters in Exmouth Gulf. This otter trawl fishery targets western king prawns, brown tiger prawns, endeavour prawns and banana prawns when available.

Management of this fishery is based on input controls, which include limited entry, seasonal,

and area openings and closures, moon closures, ban on daylight fishing and gear controls. These management arrangements are designed to keep fishing effort at levels that will maintain sufficient spawning biomass of prawns (particularly tiger prawns).

The yearly cycle of operation for the fishery is dynamic and multi-faceted. Opening and closing dates vary each year, depending on environmental conditions, moon phase and the results of fishery-independent surveys, which estimate tiger prawn recruitment and spawning stock.

Relevant Resource Assets and Risks from Fishery

Gascoyne Nearshore Crustaceans (Prawns)	Moderate Risk
Gascoyne Protected Species	Low Risk
Exmouth Gulf Habitats	Low Risk
Exmouth Gulf Ecosystems	Negligible Risk

Summary of historical research completed

Research and monitoring of the fishery has been conducted for about 40 years. Since the commencement of the fishery in 1963, catch and effort statistics (both target and byproduct species) has been collected for the EGP fishery including voluntary logbook information which provides a valuable long-term data that spans varying effort levels and environmental variations.

Fishery-independent surveys have been undertaken each year since the 1980s to determine the spawning stock and recruitment levels. The tiger prawn recruitment index is used to provide a catch prediction for tiger prawns for the season. A research risk assessment conducted in 2003 identified the need to collect additional information and re-analyse old data sets to provide a better understanding of the stock distribution, size and abundance of king prawns and preliminary assessment of variation in recruitment levels for this species.

Some inshore sampling in the nurseries for tiger pawns was conducted in 1998 and a FRDC (1999/222) project sampled for presence and abundance of seagrass and algal communities on both the eastern and western parts of Exmouth Gulf during 1999-2001 as part of a tiger prawn stock enhancement project. The Department continued sampling selected inshore sites for seagrass/algal abundance in 2003, 2005 and 2006(Loneragan et al. submitted). .

The Department has completed direct comparisons of boats between twin and quad gear to ensure catch efficiencies are incorporated into tiger prawn catch rate thresholds.

A FRDC funded program on the implementation of bycatch reduction devices was completed in 2002 (Kangas and Thomson 2004[1]) with full implementation of grids during that year and of secondary devices by 2004. Another project funded by FRDC (2000/132), focussed on inshore fish assemblages of the Pilbara and Kimberley coasts, also quantified inshore and trawl caught fish species in Exmouth Gulf. The FRDC (2002/038) funded Biodiversity project compared faunal assemblages in trawled and untrawled areas within the Exmouth

[1] Kangas, M. and Thomson, A. (2004) Implementation and assessment of bycatch reduction devices in the Shark Bay and Exmouth Gulf trawl fisheries. Final Report FRDC 2000/189. 70pp.

Gulf prawn fishery was completed in 2007 (Kangas et al. 2007[1]).

Current Research Focus

Research activities continue to focus on stock assessment and surveys to monitor annual recruitment of tiger prawns and the residual spawning stock levels, and a pre-season survey of king prawns to assist with harvesting strategies. Monitoring of fleet fishing activity is undertaken to determine the timing of the closure of the tiger prawn spawning area. All boats complete daily shot by shot logbooks, which, together with survey data and factory catch unload records, provide the information sources for managing the fishery. In addition within season advice is provided on harvesting strategies and optimising value of catch whilst ensuring sustainability.

The joint evaluation and implementation of gear modifications (including square mesh cod-end trials) to reduce bycatch and improve product quality is ongoing. Sampling of bycatch composition and abundance has been undertaken during 2008 and 2009 during some square mesh cod-end trials to supplement the information gained through the Biodiversity study conducted in 2004.

Continued monitoring of seagrass abundance in nursery sites may be required to validate an apparent correlation between seagrass abundance and recruitment for tiger prawns.

The five-year Ecologically Sustainable Development accreditation with the Commonwealth Department of Sustainability, Environment, Water, Populations and Communities was renewed in late 2007. A comprehensive ESD assessment of this fishery has determined that performance should be reported annually against measures relating to the breeding stocks of target prawn species, bycatch species impacts, protected species interactions, habitat effects and provisioning effects.

Priority Setting Process

Initial assessments were made through internal departmental meetings in 1998 discussing research undertaken, current research and research and development gaps and a plan was drafted for five years. A formal risk assessment including reviewing research priorities was undertaken in late 2002 for the Exmouth Gulf prawn fishery. Annual meetings are still held with industry to discuss research priorities and planning. Additional research needs have also been highlighted throught the ESD Assessment processs for which a re-assessement has been completed in 2008.

The most recent Industry – Departmental meeting on research was held in 2007, next review due 2012.

Review Timeline

Apart from the review of information completed as part of the EPBC assessments there have not been any recent formal reviews. Early research and publications on the biology and spawning stock stock recruitment/environment relationships have been peer reviewed.

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[1] Kangas, M.I., Morrison, S., Unsworth, P., Lai, E., Wright I. and Thomson A., (2007) Development of biodiversity and habitat monitoring systems for key trawl fisheries in Western Australia. *Final FRDC Report 2002/038. Fisheries Research Report No 160 Department of Fisheries, Western Australia.* 333pp.

Recent Publications

Kangas, M., Sporer, E., O'Donoghue, S. and Hood, S. (2008) Co-management in the Exmouth Gulf Prawn Managed Fishery with comparison to the Shark Bay Prawn Fishery. In: Townsend, R, Shotton, R and Uchica, H. (Eds.) Case studies in fisheries self-governance. *FAO Fisheries Technical Paper.* 504: 231-244

Kangas, M.I., Morrison, S., Unsworth, P., Lai, E., Wright I. and Thomson A., (2007) Development of biodiversity and habitat monitoring systems for key trawl fisheries in Western Australia. *Final FRDC Report 2002/038. Fisheries Research Report No 160 Department of Fisheries, Western Australia.* 333pp.

Key to symbols in the matrix/summary tables:

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Exmouth Gulf Prawn Fishery Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet and Natural mortality)							
Brown tiger prawn biology	Completed						Completed in 1970-1990s
Western king prawn biology	Completed						Completed in 1970s
Endeavour prawn biology	Minimal						Low Risk
Banana prawn biology	Possible						Only caught infrequently. Low Risk
1.2 Other Biology							
Recruitment dynamics of western king prawns	Ongoing	■	■	■	■	■	
1.3 Stock Assessment		■	■	■	■	■	
Stock-recruit-enviro effects	Ongoing	■	■	■	■	■	Reports published 1980s and 1990s
Modelling (banana)	Ongoing	■	■	■	■	■	
Yield/recruit, $/recruit	Ongoing	■	■	■	■	■	
Catch/effort relationships	Ongoing	■	■	■	■	■	
Recruitment-catch relationship	Ongoing	■	■	■	■	■	
1.4 Fishery Monitoring							
Logbooks	Ongoing	■	■	■	■	■	
Pre-season skippers briefings	Ongoing	■	■	■	■	■	
Processor returns (target spp. and byproduct)	Ongoing	■	■	■	■	■	
Database maintenance	Ongoing	■	■	■	■	■	
Recruit and spawning stock indices	Ongoing	■	■	■	■	■	
Effort impact assessment (GIS)	Ongoing	■	■	■	■	■	EPBC requirement
Juvenile habitat monitoring	Periodic		■				Every 2 or 3 years or if disturbance occurs
Fishing power monitoring	Ongoing	■	■	■	■		

Exmouth Gulf Prawn Fishery Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
Commercial catch monitoring (king prawns)	Possible						
Electronic logbooks	Commenced but stalled						Transfer of industry data to DoF database required but this yet not facilitated at industry's end. New technology Is now available and needs to be assessed.
2. Habitat & Ecosystem							
2.1 Bycatch							
BRD implementation (grids)	Completed						Completed in 2002
BRD implementation (secondary devices)	Completed						Completed in 2004 with observer work Ongoing and additional trials to be done in 2009/10
Bycatch monitoring	Periodic		■				Review every 5 years. Need to establish an annual sampling program at an appropriate level.
Square mesh cod-ends	Underway		■				Industry initiative – requires observers to document effectiveness
2.2 Listed Species			■				
Listed species interactions - logbooks	Ongoing	■	■	■	■	■	EPBC requirement/MOU with DSEWPC underway
2.3 Habitat							
Habitat/effort monitoring	Ongoing	■	■	■	■	■	EPBC requirement (area of trawling only)
Closure of sensitive habitats on trawl grounds	Completed						
2.4 Ecosystem/Environment							
Biodiversity of trawled and untrawled areas	Completed				■		Completed in 2007 – may review every 5-10 years
Formal risk assessment	Periodic			■			EPBC requirement
US TED Accreditation	Periodic			■			
2.5 Oceanography							
Tidal movement	Possible						Information available from other sources
2.6 Other impacts on fishery	Possible	■					Salt production potential on eastern gulf
3. Management Analysis							
3.1 Socio-economic							
Social assessment	Possible						Social assessment
Economic Analysis – average price data	Ongoing	■	■	■	■	■	Economic Analysis – average price data
Fuel consumption/expenses	Ongoing	■	■	■	■	■	Fuel consumption/expenses
Extension of Co-Management	Possible						FRDC report completed 2009 (P. Rogers, Murdoch University)
3.2 Resource Access (Shares)							
Byproduct	Underway	■					Trialling size limits for crabs and bugs. Byproduct needs to be recognised as legitimate catch.
3.3 Compliance							

Exmouth Gulf Prawn Fishery Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
4. Industry Development							
4.1 Production Technology							
Onboard handling							
5. Priority Setting		■					
6. Science Review			■				

Gascoyne – Inner Shark Bay Scalefish Fishery

Description and Scope of Issues

This fishery includes commercial and recreational fishing for scalefish species within the waters of inner Shark Bay (includes the Shark Bay Beach Seine and Mesh Net Managed Fishery [SBBSMNF] and Inner Shark Bay Recreational Fishery). The SBBSMNF uses a combination of beach seine and haul net gears to take four main species/groups: whiting, sea mullet, tailor and yellowfin bream. Most recreational fishing is boat-based with vessels launching from boat ramps at Denham, Monkey Mia or Nanga. The main recreational species are SB Gulf demersal finfish - black snapper (grass or blue-lined emperor) and pink snapper plus Gascoyne nearshore finfish - whiting, tailor, western butterfish, school mackerel and blackspot tuskfish. A limited number of licensed charter vessels operate out of Denham and Monkey Mia.

Relevant Resource Assets and Risks from Fishery

Shark Bay Gulf Demersal Finfish	Moderate – High Risk
Gascoyne Nearshore Finfish	Moderate Risk
Gascoyne Protected Species	Negligible Risk
Shark Bay Habitats	Negligible Risk
Shark Bay Gulf Ecosystems	Low Risk

Summary of historical research completed

Considerable research has been conducted on the main SBBSMNF target species since the 1960s. Performance indicators for these species were determined as part of an Ecological Risk Assessment (ERA) process completed in 2003. Comprehensive biological research on pink snapper in the inner gulfs was undertaken between 1996/97 and 2005 with integrated stock assessment models now used to assess the status of the Eastern Gulf, Denham Sound

and Freycinet Estuary stocks separately and determine appropriate levels of TAC.

The first major survey of recreational fishing across the Gascoyne Coast Bioregion, including the inner gulfs, was undertaken in 1998/99 and was repeated in 2007/08; recreational surveys focussed on the inner gulfs only were carried out at the main boat ramps each year from 2000-2007.

Current Research Focus

The current focus is monitoring the status of the three separate inner gulf pink snapper spawning stocks and the four main target species taken by the SBBSMNF.

Pink snapper: Since 2002, integrated stock assessment models have been used to assess the status of the three stocks in relation to the management target. These assessments are now updated every 3 years (most recently in 2011).

Whiting, Mullet, Tailor, Yellowfin bream: Assessment of these four target species is based primarily on analysis of the commercial and charter vessel catch and effort data obtained from monthly statutory returns.

A recreational boat ramp survey was undertaken in inner Shark Bay in 2010 and involved the trial use of video cameras at the main public boat ramps. An integrated statewide survey of recreational boat fishing involving the use of phone-diaries, boat ramp surveys and remote cameras is currently underway.

Priority Setting Process

Research and Development priorities are reviewed every 3 years by the Inner Shark Bay Pink Snapper Working Group; Group is scheduled to meet again in August 2011. Inner Shark Bay pink snapper stock assessments have been updated in preparation for this meeting.

The creation of the Gascoyne Demersal Scalefish Managed Fishery, outcomes of Gascoyne IFM process, and the new peak-body representative structure may see this review process change in future.

Science Review Timeline

Stock status and management arrangements for pink snapper in the inner gulfs will be reviewed in August 2011.

Recent Publications

Jackson, G., Norriss, J.V., Mackie, M.C. and Hall N.G. (2010) Spatial variation in life history characteristics of snapper (*Pagrus auratus*) within Shark Bay, Western Australia. *New Zealand Journal of Marine and Freshwater Research* 44: 1-15.

Mackie M., Jackson G., Tapp N., Norriss J and Thomson. A. (2009) Macroscopic and microscopic description of snapper (*Pagrus auratus*) gonads from Shark Bay, Western Australia. *Fisheries Research Report No 184. Department of Fisheries, Western Australia,* 32 pp.

Mitchell R.W.D., Baba O., Jackson G., and Isshiki T. (2008) Comparing management of recreational *Pagrus* fisheries in Shark Bay (Australia) and Sagami Bay (Japan): conventional catch controls versus stock enhancement. *Marine Policy* 32: 27-37

Key Research Issues

The most important need is for on-going estimates of recreational catch and effort in the inner gulfs of Shark Bay.

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Inner Shark Bay Fishery Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
Whiting	Complete						Adequate for management
Sea mullet	Complete						Adequate for management
Tailor	Complete						Adequate for management
Western yellowfin bream	Complete						Adequate for management
Pink snapper	Complete						Adequate for management
1.2 Other Biology							Nil required
1.3 Stock Assessment							
CAES catch and effort data	Ongoing	■	■	■	■	■	
Egg production estimates of pink snapper in each gulf stock	Ongoing	■	■	■	■	■	Stocks completed on rotation
Model-based assessment for Pink Snapper	Planned	■		O			Next review due 2013
1.4 Fishery Monitoring							
CAES data	Ongoing	■	■	■	■	■	
Recreational fishing survey	Ongoing	■	■	O	O	O	ISurvey
2. Habitat & Ecosystem							
2.1 Bycatch	Not needed						Low risk
2.2 Listed Species	Not needed						Low risk
2.3 Habitat	Not needed						Low risk
2.4 Ecosystem/Environment	Not needed						Low risk
2.5 Oceanography	Not needed						Low risk
2.6 Other impacts on fishery	Not needed						Low risk
3. Management Analysis							Not a Priority
4. Industry Development							Not a priority
5. Priority Settings		■					
6. Science Review		■		O			

Gascoyne – Shark Bay Prawn Fishery

Description and Scope of Fishery

The Shark Bay Prawn fishery has the highest prawn production in Western Australia. The fishery targets western king prawns, brown tiger prawns and a variety of smaller prawn species including coral prawns and endeavour prawns in restricted areas of Shark Bay using otter trawls. Retention of byproduct species, in particular blue swimmer crabs provide additional income which allows this fishery to remain viable in today's economic climate. Fishing during the season involves 'real time' flexible fishing arrangements based on advice from the Research Division through voluntary rolling area openings and assessments of king and tiger prawn size via fishery-independent surveys. These openings and closures are designed to increase size, quality and market value of prawns while protecting the stocks from recruitment over-fishing. Permanently closed nursery areas within the fishery prevent the fishing of small prawns and provide habitat preservation, while spatio-temporal closures serve to maintain tiger prawn breeding stocks above the threshold abundance level.

Relevant Resource Assets and Risks from Fishery

Gascoyne Nearshore Crustaceans	Moderate Risk
Gascoyne Protected Species	Low Risk
Shark Bay Gulf Habitats	Low Risk
Shark Bay Gulf Ecosystems	Negligible Risk

Summary of historical research completed

Research and monitoring of the fishery has been conducted since 1962 when the fishery commenced. Catch and effort statistics (both target and byproduct species) and voluntary logbook information has been collected from fishers at the outset, providing a valuable long-term data set from which stock assessments can be made. Furthermore, this long-term data collection is valuable to the Department because it spans varying effort levels and environmental variations throughout the history of the SBP fishery.

Research was completed in the 1970's on the biology of the main target species and the determination of the habitat requirements of each of the species and the stock recruitment dynamics were also completed in the 1980's.

Fishery-independent data has also been collected since 1991 (with current sampling regime since 2000) to gauge the level of recruitment during March and April each year and to determine the level of tiger prawn spawning stock during June to August.

Between 2002 and 2004 bycatch reduction devices (BRDs) were implemented in this fishery and the implementation process included an observer program documenting the efficiency of BRD (Kangas & Thomson 2004[1]). A Fisheries and Research Development Corporation (FRDC) funded project was finalised on the biodiversity of bycatch in trawled and untrawled areas within Shark Bay in 2007 (Kangas et al. 2007).

[1] Kangas, M., Thomson, A.W., 2004. Implementation and assessment of bycatch reduction devices in the Shark Bay and Exmouth Gulf trawl Fisheries. FRDC Report Project 2000/189, Fisheries Western Australia.

Fleet interaction issues have been and continue to need to be addressed including snapper bycatch issues (Moran & Kangas 2003[1]) and scallop-prawn interactions.

A FRDC project, in collaboration with Edith Cowan University analysed prawn logbook data using geostatistics to provide a better understanding of stock and fleet dynamics and to assess the appropriateness of the tiger prawn spawning area was completed in mid 2008 (Mueller et al. 2008).

Current Research Focus

Stock assessment and monitoring of the status of prawn stocks, particularly tiger prawns is the primary focus but provision of advice on optimising the value of catch has also been a key research activity. This includes fisheries dependent monitoring (logbook program and processor unload records) and fishery-independent surveys that provide recruitment and spawning stock indices and within season prawn size and abundance information for 'real-time' management. Also harvesting strategies are being developed to optimise the value of catches with targeting of larger prawns whilst protecting smaller sizes. This requires 'real-time' management, closer industry liaison and monitoring. Additional within-season surveys are being conducted in the Extended Nursery Area, and Denham Sound to optimise size at capture.

The calibration of catch rates between twin and quad gear has been undertaken to measure changes in fishing efficiency.

A FRDC-funded project focusing on minimising gear conflict and resource sharing issues in the Shark Bay trawl fisheries commenced in 2008 and will be completed at the end of 2010. This will include hydrographic modeling of scallop and prawn larval movement within Shark Bay in collaboration with UWA.

Priority Setting Process

Initial assessments were made through internal departmental meetings in 1998 discussing research undertaken, current research and research and development gaps and a plan was drafted for five years. Current research and gaps were discussed in a 2006 review of the Shark Bay prawn and scallop fisheries through workshops with licensees and other stakeholders. In subsequent years, research issues were discussed with Shark Bay prawn fishery licensees during their association meetings. Additional research needs have also been highlighted throught the EPBC Assessment processs completed in 2007.

Review Timeline

A comprehensive EPBC assessment of this fishery and its underlying data and information was undertaken as part of the Commonwealth EPBC accreditation process in 2007. Early research and publications on the biology and spawning stock stock recruitment/environment relationships have been peer reviewed. Aformal review process is scheduled for May 2011.

Recent Publications

Chandrapavan, A. (2009) To square or not to square. *Western Fisheries, June 2009* p39-41.

[1] Moran, M. and Kangas M., (2003) The effects of the trawl fishery on the stock of pink snapper, *Pagrus auratus*, in Denham Sound, Shark Bay. *Fisheries Research Bulletin* 31:52 pp.

Kangas, M., Sporer, E., O'Donoghue, S. and Hood, S. (2008) Co-management in the Exmouth Gulf Prawn Managed Fishery with comparison to the Shark Bay Prawn Fishery. In: Townsend, R, Shotton, R and Uchica, H. (Eds.) Case studies in fisheries self-governance. *FAO Fisheries Technical Paper.* 504: 231-244

Mueller, U., Kangas, M., Dickson, J, Denham, A., Caputi, N., Bloom, L. and Sporer, E. (2008) Spatial and temporal distribution of western king prawns (*Penaeus latisulcatus*), brown tiger prawns (*Penaeus esculentus*) and saucer scallops (*Amusium balloti*) in Shark Bay for fisheries management. *Final FRDC Report 2005/038. Edith Cowan University. 214 pp.*

Kangas, M.I., Morrison, S., Unsworth, P., Lai, E., Wright I. and Thomson A., (2007) Development of biodiversity and habitat monitoring systems for key trawl fisheries in Western Australia. *Final FRDC Report 2002/038. Fisheries Research Report No 160 Department of Fisheries, Western Australia* 333pp.

Mueller, U., Bloom, L., Dickson, J., Kangas, M. and Sporer, E. (2006). Using geostatistics to analyse prawn and scallop catch. *Western Fisheries November 2006* pp50-51.

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Shark Bay Prawn Fishery Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
Brown tiger prawn biology	Completed						Completed in the 1970s and 1980s
Western king prawn biology	Completed						Completed in the 1970 and 1980s
Coral prawn biology	Minimal						Low Risk
1.2 Other Biology							
Juvenile habitat monitoring	Completed						Completed in 1970s
1.3 Stock Assessment							
Tiger prawn spawning stock assessment (Catch rate analysis)	Ongoing	■	■	■	■	■	Provides key PIs for fishery
Stock-recruit-environ effects	Ongoing	■	■	■	■	■	Undertaken for tigers and kings Since 1990s
Modelling	Ongoing	■	■	■	■	■	Some work done in late 1990s
Yield/recruit, $/recruit	Ongoing	■	■	■	■	■	Review needed
Spatial analysis	Completed						ECU FRDC project completed in early 2008
1.4 Fishery Monitoring							
Commercial catch monitoring	Ongoing	■	■	■	■	■	
Fishery independent surveys/size composition and abundance surveys	Ongoing	■	■	■	■	■	
Logbooks	Ongoing	■	■	■	■	■	
Pre-season skippers briefing	Ongoing	■	■	■	■	■	

Shark Bay Prawn Fishery Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
Effort – benthic impact assessment (GIS)	Ongoing	■	■	■	■	■	EPBC requirement
Fishing power monitoring/gear modifications	Ongoing	■	■	■	■	■	
Processor returns (target spp. and byproduct)	Ongoing	■	■	■	■	■	
Database maintenance	Ongoing	■	■	■	■	■	
Electronic logbooks	Future						Continued request by industry to have e-logbooks implemented. New technology now available needs to be evaluated for this fishery
2. Habitat & Ecosystem							
2.1 Bycatch							
BRD Implementation (grids)	Completed						Implemented in 2002
BRD Implementation (secondary devices)	Completed						Implemented in 2004 with limited Observer work Ongoing
Bycatch monitoring	Periodic						Review every 5 years, opportunistic sampling during surveys and any observer trips. Need to establish an annual sampling program at an appropriate level.
Square-mesh cod-end trials							Industry initiative – observers to document effectiveness
2.2 Listed Species							
Listed species interactions - logbooks	Ongoing	■	■	■	■	■	EPBC requirement/MOU with DEWHA underway
2.3 Habitat							
Habitat/effort impacts	Ongoing	■	■	■	■	■	EPBC requirement
Coral/sponge habitat mapping	Required						DEC
Closure of sensitive habitats	Possible						Consultation required
2.4 Ecosystem/Environment							
Biodiversity of trawled and untrawled areas	Completed		■				Review every 5-10 years
Formal risk assessment	Periodic			■			EPBC requirement
2.5 Oceanography							
Leeuwin Current monitoring	Ongoing	■	■	■	■	■	
Temperature loggers	Ongoing	■					To be reviewed
2.6 Other impacts on fishery							
Spatial closures	Possible						Component of FRDC project, not currently Implemented
3. Management Research							
3.1 Socio-economic							
Social assessment	Possible						Partly done during SB review in 2006/07
Economic Analysis – average price data	Ongoing	■	■	■	■	■	
Fuel consumption/expenses	Ongoing	■	■	■	■	■	
3.2 Resource Access (Shares)							
Prawn – Scallop fleet interactions and catch share – Snapper interactions	Periodic Catch share commence 2011		■	■	■	■	Currently review of prawn scallop fishery management/research arrangements

Shark Bay Prawn Fishery Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
Prawn-Scallop gear interactions	Completed						FRDC 2007/08 (2 yr project)
Byproduct	Ongoing	■	■	■	■	■	Voluntary adoption of gauge Increasing the size of crabs retained In 2011. Need to recognise byproduct as legitimate catch. Crab catch share Issues needs to be resolved.
World Heritage Areas							
3.3 Compliance							
4. Industry Development							
4.1 Production Technology							
Onboard handling							
OHS	Possible						Changes to fishing hours
Product quality certification							
Hoppers	Completed						Industry Lead initiative – all boats now using them
5. Priority Setting	Periodic	■					Industry Departmental Meetings
6. Science Review	Periodic	■					Scheduled for October 2011

Gascoyne – Shark Bay Scallop Fishery

Description and Scope of Issues

The Shark Bay Scallop fishery (SBS) is a limited entry, otter trawl fishery that operates within the waters of Shark Bay which is located in the Gascoyne bioregion of Western Australia. This is usually WA's most significant scallop fishery and has significant overlap with the Shark Bay Prawn fishery, with many boats licensed to operate in both fisheries.

Relevant Resource Assets and Risks from Fishery

Gascoyne Nearshore Molluscs	Moderate Risk
Gascoyne Protected Species	Low Risk
Shark Bay Gulfs Habitats	Low Risk
Shark Bay Ecosystems	Negligible Risk

Summary of historical research completed

Research carried out by the Department since the late 1960s determined the basic biology of the saucer scallop *(Amusium balloti)* to ensure that the scallops are being harvested at

ecologically sustainable levels whilst achieving the best economic returns from the available scallop resource. Annual management arrangements are tailored to the expected abundance of scallops due to the significant correlation (0.81) that was determined between the abundance of recruits and the following year's catch (Joll and Caputi, 1995[1]).

A number of fleet interaction issues, including snapper bycatch issues (Moran & Kangas 2003[2]), and scallop-prawn interactions have been examined. Experimental approaches to harvesting and protection of spawning stock and newly settled scallops are being investigated, including refining catch rate thresholds to cease fishing and further temporal and spatial closures.

Bycatch reduction devices (BRDs) were implemented in this fishery and the implementation process included an observer program documenting the efficiency of BRD (Kangas & Thomson 2004[3]). An FRDC funded project was finalised on the biodiversity of bycatch in trawled and untrawled areas within Shark Bay (Kangas et al. 2007).

A FRDC project, in collaboration with Edith Cowan University was completed in mid 2008 (Mueller et al. 2008). This study analysed scallop logbook and survey data using geostatistics to provide a better understanding of stock and fleet dynamics and to assess the correlation of commercial catches and high abundance areas delineated in surveys. The study indicated that the annual survey was a good indicator of 'high' and 'low' scallop abundance areas within the fishery.

Current Research Focus

Focus: Fishing for scallops now commences earlier to optimise the meat size of scallops which requires real-time monitoring (daily) of catch rates so fishing can cease at an agreed threshold catch rate level to ensure sufficient spawning stock in left during the key spawning period

Activities: Research for monitoring the status of the scallop stock is based on detailed logbook records and factory receivals provided by industry. An annual research survey is carried out in November, which, together with existing detailed biological knowledge, enables an annual catch forecast to be provided. The Department has been conducting pre-season surveys that monitor the strength of recruitment in Shark Bay since 1982. These surveys measure the abundance of residuals and recruits to the Shark Bay population each year and provide an annual index of recruitment, which is independent of catch records (Joll and Caputi, 1995). Daily catch rate information (cumulative catch against CPUE) is used to determine the available stock within main fishing grounds and in conjunction with the catch prediction from the annual survey allows an assessment of residual scallop stock abundance. This information has, in the last few years, been used to determine how much stock can be taken after the spawning period closure. The methodology used will need to be reviewed in

[1] Joll, L. M and Caputi, N. (1995) Environmental influences on recruitment in the saucer scallop (Amusium balloti) fishery of Shark Bay, Western Australia, ICES mar. Sci. Symp., 199:47-53.

[2] Moran, M. and Kangas M., (2003) The effects of the trawl fishery on the stock of pink snapper, *Pagrus auratus*, in Denham Sound, Shark Bay. *Fisheries Research Bulletin* 31:52 pp.

[3] Kangas, M., Thomson, A.W., 2004. Implementation and assessment of bycatch reduction devices in the Shark Bay and Exmouth Gulf trawl Fisheries. FRDC Report Project 2000/189, Fisheries Western Australia.

two years.

Research will continue investigating the environmental influences that affect recruitment to scallop stocks in Shark Bay. More specifically, research into the effects that the Leeuwin Current has on the scallop recruitment and spawning or fertilisation activities will be further investigated.

A FRDC-funded project focusing on minimising gear conflict and resource sharing issues in the Shark Bay trawl fisheries commenced in 2008 and the draft Final Report was submitted to FRDC in March 2011. This includes hydrographic modelling of scallop and prawn larval movement within Shark Bay in collaboration with UWA.

Priority Setting Process

Initial assessments were made through internal departmental meetings in 1998 discussing research undertaken, current research and research and development gaps and a plan was drafted for five years. In 2006 a review of the Shark Bay prawn and scallop fisheries was undertaken which involved workshops with licensees and other stakeholders. In subsequent years, research issues have been discussed with Shark Bay scallop fishery licensees during their association meetings. Some additional research requirements were identifed through the EPBC processs for which a re-assessement was completed in 2007.

Review Timeline

Early research on the biology and reproductive cycle of scallops have been peer reviewed through journal publication processes. A research review was conducted in August 2010 (Penn, Joll and Gaughan 2010).

Recent Publications

Chandrapavan, A. (2009) To square or not to square. *Western Fisheries, June 2009*, 39-41.

Lenanton, R.C., N.Caputi, Kangas, M. & Craine, M. (2009). The ongoing influence of the Leeuwin Current on economically important fish and invertebrates off temperate Western Australia – has it changed? *Journal of the Royal Society of Western Australia* 92(2): 111-127.

Mueller, U., Kangas, M., Dickson, J, Denham, A., Caputi, N., Bloom, L. and Sporer, E. (2008) Spatial and temporal distribution of western king prawns (*Penaeus latisulcatus*), brown tiger prawns (*Penaeus esculentus*) and saucer scallops (*Amusium balloti*) in Shark Bay for fisheries management. *Final FRDC Report 2005/038 Edith Cowan University.* 214 pp.

Kangas, M.I., Morrison, S., Unsworth, P., Lai, E., Wright I. and Thomson A., (2007) Development of biodiversity and habitat monitoring systems for key trawl fisheries in Western Australia. *Final FRDC Report 2002/038. Fisheries Research Report No 160, Department of Fisheries, Western Australia.* 333pp.

Mueller, U., Bloom, L., Dickson, J., Kangas, M. and Sporer, E. (2006). Using geostatistics to analyse prawn and scallop catch. *Western Fisheries November 200*6 pp 50-51.

Key to symbols in the matrix/summary tables:

■ Indicates that the activity is funded and planned to occur.

O Indicates that the activity is part of a proposal but is not yet funded.

Shark Bay Scallop Fishery Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
Scallop Biology	Completed						Competed in the 1970s and 1980
Meat size and quality		■	■	■	■	■	Additional information on spatial and temporal differences in meat size and quality will be collected on an opportunistic basis
1.2 Other Biology							
Recruitment Dynamics	Completed						Studies Completed in the 1980's
Larval Advection	Underway	■					FRDC project UWA PhD student
1.3 Stock Assessment							
Stock-recruit-environ effects	Ongoing	■	■	■	■	■	
Fishery independent surveys and monitoring	Ongoing	■	■	■	■	■	
Survey indices-catch relationships	Ongoing	■	■	■	■	■	Review of methodology in 2011/12 (possible Honours project with ECU)
Modelling/Depletion exp.	Ongoing	■	■	■	■	■	Partly Completed
Spatial GIS	Ongoing	■	■	■	■	■	
Spatial analysis	Completed						ECU FRDC project completed in 2008
Catchability	Underway						Partly Completed including day-night trials
Mesh selectivity trials	Underway						FRDC project, no Industry adoption to date
1.4 Fishery Monitoring							
Logbooks	Ongoing	■	■	■	■	■	
Pre-season skipper briefings	Ongoing	■	■	■	■	■	
Fishing power monitoring	Ongoing	■	■	■	■	■	
Processor returns	Ongoing	■	■	■	■	■	
Database maintenance	Ongoing	■	■	■	■	■	
Effort impact assessment (GIS)	Ongoing	■	■	■	■	■	EPBC requirement
Spatial analysis of survey and logbook data	Completed						ECU collaboration – student project
2. Habitat & Ecosystem							
2.1 Bycatch							
BRD Implementation	Completed						Completed in 2003
Bycatch monitoring	Periodic				■		Review every 5 years

Shark Bay Scallop Fishery Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
2.2 Listed Species							
Listed species interactions - logbooks	Ongoing	■	■	■	■	■	EPBC requirement/MOU with DSEWPC underway
2.3 Habitat							
Habitat/effort impacts	Ongoing	■	■	■	■	■	EPBC requirement
Closure of sensitive habitats	Possible						Consultation required
2.4 Ecosystem/Environment							
Biodiversity of trawled and untrawled areas	Completed				■		Review every 5-10 years
Formal risk assessment	Periodic			■			EPBC requirement
Marine Park Monitoring	Possible						
2.5 Oceanography							
Leeuwin Current monitoring	Ongoing	■	■	■	■	■	
Temperature loggers	Ongoing	■	■	■	■	■	To be reviewed
Modelling of currents	Underway						FRDC UWA PhD project
2.6 Other impacts on fishery							
Spatial closures	Possible						Will be reviewed after completion of FRDC project, currently not Implemented
3. Management Analysis							
3.1 Socio-economic							
Social assessment	Possible						Partly completed during SB Review 06/07
Economic Analysis – average price data	Ongoing	■	■	■	■	■	Bio-economic modelling revisited in 09/10
Fuel consumption/expenses	Ongoing	■	■	■	■	■	Bio-economic modelling revisited in 09/10
3.2 Resource Access (Shares)							
Prawn – Scallop- fleet interactions and catch share - Snapper	Ongoing	■	■	■	■	■	Needed for the review of the three fisheries
Prawn-Scallop gear interactions	Completed						FRDC Project 2007/051 - draft report completed
4. Industry Development							
4.1 Production Technology							
Aquaculture /reseeding	Completed						Completed in 1990s
5. Priority Setting	Periodic	■		■		■	Regular Industry Departmental meetings
6. Science Review	Periodic			■			Aug 2010 review workshop

North Coast Bioregion

North Coast – Biodiversity Issues

Description and Scope of Issues

On the north coast, marine habitats have been locally affected by port developments, oil and gas exploration and extraction, and some fishing activities across the continental shelf. The offshore Pilbara area in particular, was trawled by international vessels in the 1960s and 1970s; however, this activity was phased out in the early 1980s. Since that time, extensive fisheries closures over coastal and most offshore waters have been introduced to manage fish trawl and trap fishing. Trawling for prawns is only permitted at a small number of locations associated with inshore nursery areas so that trawling occurs over a very small proportion of the habitat. In addition to the extensive fisheries closures protecting marine habitats, the Bioregion has a number of Reef Protected Areas under Fisheries legislation and marine parks and reserves around offshore islands and reefs.

This region is currently of importance for the future oil and gas development initiatives. It is also the subject of another Commonwealth Bioregional Marine Planning exercise led by SEWPaC.

Relevant Resource Assets and Risks from all Fisheries

Benthic - Estuaries/Nearshore	Low Risk
Benthic - Pilbara	Moderate Risk
Benthic - Kimberley	Low Risk
Protected species - non fish	Low Risk
Protected species - non fish - mammals	Moderate Risk
Protected species - fish	Moderate Risk
North Coast Ecosystem - Estuarine	Negligible Risk
North Coast Ecosystem - Pilbara marine	Negligible Risk
North Coast Ecosystem - Kimberley marine	Negligible Risk
Introduced Pests & Diseases	High Risk

Summary of historical research completed

A summary of the research information available for this region was complied as part of a WAMSI project undertaken by DEC. Further, the WAMSI Board has recently commissioned a research plan for the Kimberley Browse region. In addition, a recently completed NRM project made recommendations on the development of a strategic framework to inform and guide a future Coastal and Marine Resource Condition Monitoring Program for the Pilbara and Kimberley Regions.

Nationally approved marine pest monitoring design have been developed and implemented for Port Hedland and Dampier ports.

Current Research Focus

Respond to reports and investigate cause of fish kills.

Develop and implement monitoring programmes for the Camden Sound marine park and 80 mile beach marine park?.

Continue with ongoing background port monitoring at Port Hedland and Dampier Ports.

Evaluate and improve methods for detecting, monitoring and controlling invasive species incursions.

Input to SEWPaC's north-west Marine Bioregional planning

Priority Setting Process

There is currently no formal departmental priority setting process for this region. Significant work was done by WAMSI for research in this region.

Recent Publications

Molony, B. W., Newman, S. J., Joll, L., Lenanton, R. C. J. and Wise, B. (2011). Are West Australian waters the least productive waters for finfish across two oceans? A review with a focus on finfish resources in the Kimberley region and North Coast Bioregion. *Journal of the Royal Society of Western Australia.* **94:** 323–332.

Human, B.A., Murray, K., Zdunic, K., and Behn, G. (2010). Field trial of potential resource condition indicators, and an exploration of the utility of remote sensing, for mangroves and intertidal mud flats in the Pilbara – Pilot study. Coastal and Marine Resource Condition Monitoring – Scoping Project. Final NRM Report, Project 073001 – Part 2. Department of Fisheries, Government of Western Australia. 104 pp.

Human, B. A. and McDonald, J. I. (2009). Knowledge review and gap analysis: Resource condition monitoring in the Pilbara and Kimberley regions of Western Australia. Coastal and Marine Resource Condition Monitoring - Scoping Project. Final NRM Report, Project 073007 - Part 1. Department of Fisheries, Government of Western Australia. 192pp.

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North Coast Biodiversity Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
2. Habitat & Ecosystem							
2.1 Bycatch (Trawl fisheries)	Completed						Completed in the early 2000s
2.2 Listed Species							
Dolphins	Completed						Studies to ameliorate catch of dolphins in fish trawl nets has been completed by Murdoch University
2.3 Habitat							
Developing RCTs for benthic habitats	Underway						

North Coast Biodiversity Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
2.4 Ecosystem/Environment							
Marine Park monitoring	Underway	■	■	■	■	■	Planning has commenced
2.5 Oceanography							
Hydrodynamic modelling	Underway						
Nutrient/plankton cycles on shelf	Completed						
2.6 Other impacts on fishery							
Port monitoring	Ongoing	■	■	■	■	■	Annual IMP surveys as well as ongoing background monitoring for IMPs
Introduced marine pests	Ongoing	■	■	■	■	■	Evaluate and improve methods for detecting, monitoring and controlling invasive species incursions
3**. Management Analysis**							
3.1 Socio-economic							
Social assessment							
Economic Analysis							
3.4 Management Systems							
4. Industry Development							
5. Priority Review							
6. Science Review	Proposed	O	O				As part of WAMSI II

North Coast – Mackerel Fishery

Description and Scope of Issues

The commercial mackerel fishery includes the taking of all species of the genera *Scomberomorus, Grammatorcynus* and *Acanthocybium*, but the main targeted species is Spanish mackerel (*Scomberomorus commerson*). Mackerel are usually taken by trolling close to the surface in coastal areas around reefs, shoals and headlands, with jigs also used to capture grey mackerel (*Scomberomorus semifasciatus*). Recreational fishers also use methods such as shore-based drift fishing with balloons and spear guns to target mackerel. The commercial fishery mainly operates between Geraldton and the Western Australia/ Northern Territory border, with the largest catches taken off the Kimberley and Pilbara coasts. The main area of the recreational fishery is Perth to Dampier.

Relevant Resource Assets and Risks from Fishery

North Coast Pelagic Finfish	Moderate Risk
North Coast Protected Species	Negligible Risk
North Coast Habitat	Negligible Risk
North Coast Ecosystems	Negligible Risk

Summary of historical research completed

There were two major projects on mackerel funded by FRDC in 2002 which focused on the narrow-barred Spanish mackerel, *Scomberomorus commerson.* These projects provided descriptions of the biology, spatial structure and status of Spanish mackerel stocks in Western Australian waters, and served as a basis for developing the future management arrangements for this fishery.

Current Research Focus

A cooperative FRDC project focusing on the stock structure of grey mackerel (*Scomberomorus semifasciatus*) is between the Department of Fisheries WA and research groups in the Northern Territory and Queensland. It was completed in late 2010 and outcomes and research advice are being considered by Managers.

The fishery is monitored using the daily logbooks submitted by fishers and VMS (Vessel Monitoring System). Catch and effort has now been constrained under the management plan through the use of TACCs in a number of zones.

Priority Setting Process

Priorities are reviewed internally on an annual basis.

Review Timeline

The science underpinning this fishery was extensively reviewed in 2005. An internal review of the fishery is programmed in the next five years.

Key to symbols in the summary matrix:

■ Indicates that the activity is funded and planned to occur.

O Indicates that the activity is part of a proposal but is not yet funded.

North Coast Mackerel Fishery Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
Narrow barred Spanish mackerel	Completed						
Grey/other mackerel	Proposed						Not optimal for management; low risk and therefore low priority

North Coast Mackerel Fishery Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1.2 Other Biology							
Stock structure of Spanish mackerel	Completed						
Grey mackerel stock structure	Underway						As part of a QLD based FRDC research project. Due for completion in late 2010
1.3 Stock Assessment							
Annual Assessment	Completed						No planned update; currently monitored by catch and effort data and VMS
Biomass Dynamics and Yield/Egg Per Recruit Modelling	Completed 1998						No planned update; low priority
1.4 Fishery Monitoring							
Commercial Catch and Effort	Ongoing	■	■	■	■	■	Daily log books implemented in 2006
Charter Boat C&E	Ongoing	■	■	■	■	■	
Recreational Creel Surveys	Proposed						Unfunded
2. Habitat & Ecosystem							
2.1 Bycatch	Not needed						Low risk
2.2 Listed Species	Not needed						Low risk
2.3 Habitat	Nil						Nothing identified
2.4 Ecosystem/Environment	Nil						Nothing identified
2.5 Oceanography	Nil						Nothing identified
2.6 Other impacts on fishery							Shark predation of catch
3. Management Analysis							
3.1 Socio-economic							
3.2 Resource Access (Shares)							
Determination of access shares	Proposed						Between recreational and commercial sectors
Monitoring of shares	Proposed						Between recreational and commercial sectors
Review of IMP	Underway						
3.3 Compliance Research							
3.4 Management Systems	Proposed						Review of TACC with a view to increasing; may require additional monitoring
4. Industry Development	Nil						Nothing identified
5. Priority Review							
6. Science Review							

North Coast – Beche-de-mer Managed Fishery

Description and Scope of Issues

Beche-de-mer, also known as sea cucumbers or trepang are in the Phylum Echinodermata, Class Holothuroidea. They are soft-bodied, elongated animals that usually live with their ventral surface in contact with the benthic substrate or buried in the substrate. The Western Australian Beche-de-mer fishery is based in the northern half of the state, from Exmouth Gulf to the Northern Territory border. It is a hand-harvest fishery, with animals caught principally by diving, and a smaller amount by wading. There are six target species caught commercially in Western Australia, however 99% of the catch is sandfish (*Holothuria scabra*) and deep-water redfish (*Actinopyga echinites*).

Relevant Resource Assets and Risks from Fishery

North Coast Echinoderms	Moderate Risk
North Coast Protected Species	Negligible Risk
North Coast Habitat	Negligible Risk
North Coast Ecosystems	Negligible Risk

Summary of historical research completed

A daily catch and effort logbook has been tested and introduced into the fishery. There are significant gaps in knowledge about the biology of the species harvested in this fishery, and current size-limits are based on Northern Territory fisheries.

Current Research Focus

Current research is focused on: stock assessment using monthly catch and effort statistics and development of stock performance indicators that incorporate finer-scale, species-specific information.

Priority Setting Process

Meetings between the Department of Fisheries and industry

Review Timeline

The Fisheries Research Division reviews the fishery and stocks annually in January/February.

Key to symbols in the summary matrix:

■ Indicates that the activity is funded and planned to occur.

O Indicates that the activity is part of a proposal but is not yet funded.

North Coast Beche-de-mer Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							Information on growth and size at maturity are needed to improve the management of the Kimberley and Pilbara stocks
Growth	Proposed						
Size-at-maturity	Proposed						
1.2 Other Biology							
Genetics	Low Priority						Genetics work on *H. scabra* would help establish appropriate management boundaries
1.3 Stock Assessment							
Sustainability of stocks		■	■	■	■	■	
1.4 Fishery Monitoring							
Research logbook implementation		■	■	■	■	■	
2. Habitat & Ecosystem							
2.1 Bycatch							Negligible Risk
2.2 Listed Species							Negligible Risk
2.3 Habitat							Negligible Risk
2.4 Ecosystem/Environment							Negligible risk
3. Management Analysis							
4. Industry Development							Industry want a move to an Interim Managed Fishery
5. Priority Review							
6. Science Review							Will coincide with EPBC – WTO assessment

North Coast – Nearshore Fisheries

Description and Scope of Issues

The Kimberley Gillnet and Barramundi Managed Fishery (KGBF) extends from the WA/NT border (129ºE) to the top of Eighty Mile Beach, south of Broome (19ºS). It encompasses the taking of any fish by means of gillnet in inshore waters and the taking of barramundi by any means.

The species taken are predominantly barramundi (*Lates calcarifer*), king threadfin (*Polydactylus macrochir*) and blue threadfin (*Eleutheronema tetradactylum*). The main areas

of the fishery are the river systems and tidal creek systems of the Cambridge Gulf, the Ria coast of the northern Kimberley, King Sound, Roebuck Bay and the northern end of Eighty Mile Beach to 19ºS.

Recreational fishing activities are concentrated around key population centres, with a peak in activity during the dry season (winter months).

Relevant Resource Assets and Risks from Fishery

North Coast Nearshore Finfish	Moderate Risk
North Coast Protected Species	Low Risk
North Coast Habitats	Low Risk
North Coast Ecosystems	Low Risk

Summary of historical research completed

The biological characteristics required for fisheries management of the King threadfin and the Blue threadfin have been completed by a joint project between the Department and Murdoch University. The bycatch of elasmobranchs in the KGBF and along the Pilbara coast fishing area was examined by the Department during 2002 and 2003.

Current Research Focus

CAES data are used to assess the status of barramundi stocks targeted by this fishery. This status report is compiled annually and provided to industry and regional management.

Priority Setting Process

Initial assessments were made through internal departmental meetings and forums discussing the history of research in the fishery, research activities that have been completed, current research as well as research and development gaps. Research issues have been discussed at annual industry consultation meetings once a year.

Review Timeline

Next planned review in late 2012.

Key to symbols in the matrix/summary tables:

■ Indicates that the activity is funded and planned to occur.

O Indicates that the activity is part of a proposal but is not yet funded.

North Coast Nearshore and Estuarine Fishery Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
King threadfin	Complete						Sufficient for management
Blue threadfin	Complete						Sufficient for management

North Coast Nearshore and Estuarine Fishery Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
Barramundi	Proposed	O	O	O	O		Project identified
1.2 Other Biology							
Sawfish	Proposed	O	O	O	O		Project identified
Pig eye shark	Proposed	O	O	O	O		Project identified
Lemon shark	Proposed	O	O	O	O		Project identified
1.3 Stock Assessment							
Annual Catch and Effort Assessment	Ongoing	■	■	■	■		Ongoing
Fishing mortality assessments against benchmarks (indicator species)	Proposed	O					Project identified to assess threadfin Indicator species - anticipated to be periodic
1.4 Fishery Monitoring							
Commercial Catch and Effort	Ongoing	■	■	■	■		Ongoing
Age Structure of Indicator Species	Proposed	O		O			Periodic
Commercial monitoring (vessel monitoring at sea)	Proposed		O		O		Periodic
Recreational Creel	Proposed	O					Periodic
Charter Boat Catch and Effort	Ongoing	■	■	■	■		Ongoing
2. Habitat & Ecosystem							
2.1 Bycatch	Proposed	O					Periodic – Low risk – initial project completed
2.2 Listed Species							
Sawfish	Proposed	O	O	O	O		Project identified – High risk
2.3 Habitat	Not needed						Low risk – gillnet fishery
2.4 Ecosystem/Environment	Not needed						Nothing identified
3. Management Analysis							
3.1 Socio-economic							
3.2 Resource Access (Shares)	Proposed	O	O				Needed for IFM
3.3 Compliance Research							
3.4 Management Systems							
4. Industry Development							
5. Priority Review		■	■	■	■		Annual industry meetings
6. Science Review		■					Major assessment reports peer reviewed every five years

North Coast – Pearl Oyster Managed Fishery and Pearl Production

Description and Scope of Issues

Wild capture - The Western Australian pearl oyster fishery is the only remaining significant wild-stock fishery for pearl oysters in the world. It is a dive fishery that dates back to the 1850s operating in shallow coastal waters along the North West Shelf. The species targeted is the Indo-Pacific, silver-lipped pearl oyster (*Pinctada maxima*) and they are harvested by drift diving.

There is an extensive amount of relevant and accurate information on the biology of the silver lipped pearl oyster, history of this fishery (in excess of 30 years for the culture shell fishery and almost 100 years for the Mother Of Pearl fishery), as well as oyster culture, genetics, disease and pearl production techniques

Relevant Resource Assets and Risks from Fishery

North Coast Molluscs – Pearls	Low Risk
North Coast Protected Species	Negligible Risk
North Coast Habitat – Kimberley	Negligible Risk
North Coast Ecosystems	Negligible Risk

Summary of historical research completed

Fishery: Biology (growth, reproduction, maturity), ecological studies (population densities, settlement and recruitment), environmental effects and oceanography studies (larval drift and circulation, source-sink relationships) have been completed.

Historical time series of daily catch information on number of pearl oysters caught, diver hours, date and location of harvest. Historical catches and effort over the past 100 years have also been reviewed. An annual standardized catch per unit effort (CPUE) model has been developed that accounts for variation in spatial and temporal fishing effects, as well as technological improvements that aid fishing efficiency. The standardized CPUE data are being used in a decision-rule framework for quota setting in the fishery

Large scale surveys of Mother-of-Pearl (MOP) stocks and genetic relationships within and between Western Australian stocks of *Pinctada maxima* have been established

A recently study examined the management of bio-eroding sponges (*Cliona* sp.) on wild stocks, the project found no clear evidence that the incidence of this increasing.

Pearl oyster aquaculture and pearl production: studies on culturing of oysters and pearls were completed during the late 1980's and early 1990's, and a major review of the history of exploitation and culture of pearls has been completed.

Current Research Focus

Current stock assessment research is focused on:

- Stock assessment using catch and effort statistics (taking into account discard rates) and recruitment and length-frequency sampling to estimate the total allowable catch.
- Development of an index of recruitment for predicting future years catch levels using the relative number of piggy back spat.

- Decision rules for determining the TAC
- Environmental drivers (e.g. rainfall) of pearl oyster abundance

Current production research focuses on environmental management, pearl oyster health, and improved health and safety for pearl divers. Including:

- Comprehensive disease-testing program to the industry.
- Investigate aspects of oyster oodema disease (OOD) in Pinctada maxima, to assist in mitigating the impacts and understand pathways to disease and disease response in pearl oysters.

Priority Setting Process

Meetings between the Department of Fisheries and industry

Science Review and Timeline

The Stock Assessment Working Group (SAWG) reviews the fishery and stocks annually, with quota decisions made in October/November. A mid-season review is also carried out during April. The science used for this fishery was last reviewed by the stock assessment working group in October 2010.

Recent Publications

Hart, A. M., Thompson, A., Murphy, D. (2011). Environmental influences on stock abundance and fishing power in the silver-lipped pearl oyster fishery. ICES Journal of Marine Science. 68(3): 444-453.

Jones, J. B., Crockford, M., Creeper, J., Stephens, F. (2010). Histopathology of oedema in pearl oysters (*Pinctada maxima*) – is oedema a general problem for sick bivalves? *Diseases in aquatic organisms* 91:67-73.

Daume, S., Fromont, J., Hart, A. M. (2009). Management of bioeroding sponges in wild stocks of *Pinctada maxima* in Western Australia. Fisheries Research Report No 196, Department of Fisheries, Western Australia, 44 p

Bearham, D., Spiers, Z., Raidal, S., Jones, J. B., Burreson, E. M., Nicholls, P. K. (2008). Spore ornamentation in *Haplosporidium hinei* n.sp. (Haplosporidia) in pearl oysters *Pinctada maxima* (Jameson, 1901). Parasitology 135, 1-7.

Jones, J. B. (2008). Experiences in dealing with pearl oyster mortalities. In: Bondad-Reantaso, M., McGladdery, S. E., Berthe, F. C. J. (eds). Manual on South Sea Pearl Oyster Health Management. FAO Fisheries Technical Paper 503. Rome.

Jones, J. B. (2008). The Australian experience: pearl oyster mortalities and disease problems. In: Bondad-Reantaso, M., McGladdery, S. E., Berthe, F. C. J. (eds). Manual on South Sea Pearl Oyster Health Management. FAO Fisheries Technical Paper 503. Rome.

Southgate, P. C., Strack, E., Hart, A. M., Wada, K.T., Monteforte, M., Carino, M., Langy, S., Lo, C., Acosta-Salmon, H., Wang, A. (2008). Chapter 9: Exploitation and Culture of Major Commercial Species. pp. 303 – 356. *In:* The Pearl Oyster, Eds Southgate, P. C. and Lucas, J. Elsevier London.

Spiers, Z. B., Bearham, D., Jones, J. B., O'Hara, A. J., Raidal, S. (2008). Intracellular ciliated protozoal infection in silverlip pearl oysters, *Pinctada maxima* (Jameson, 1901). Journal of

Invertebrate Pathology 99: 247-253.

Hart, A. M., Joll, L. (2006). Growth, mortality, recruitment, and sex ratio in wild stocks of the silver-lipped pearl oyster *Pinctada maxima* (Jameson)(Mollusca: Pteriidae) in Western Australia. *Journal of Shellfish Research*. 25 (1): 201-210.

Hart, A. M. (2006). Predicting and assessing recruitment variation – a critical factor for management of the *Pinctada maxima* fishery in Western Australia. Final Report to the Fisheries Research and Development Corporation, Project No 2000/127. 86 p.

Key to symbols in the summary matrix:

■ Indicates that the activity is funded and planned to occur.

O Indicates that the activity is part of a proposal but is not yet funded.

Pearl Oyster Fishery and Pearl Production Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)	Completed						A number of studies using tag-recapture, monthly monitoring, and histological studies have been completed
Environmental effects on recruitment	Ongoing	■	■	■	■	■	Annual monitoring of recruitment and environmental variable such as rainfall, temperature, wind and SOI indices
MOP (FRDC)	Completed						A major project on demography and potential fishery completed in 2004
Growth rate of wildstock (FRDC)	Completed						Growth established in the northern, central, and southern sections of fishery
Heavy metals	Completed						
1.2 Other Biology							
Genetics (FRDC)	Completed						Two FRDC projects on connectivity completed
1.3 Stock Assessment							
Annual Assessment of catch rates and sizes	Ongoing	■	■	■	■	■	Annual assessments and analysis of diver CPUE and size-frequency
1.4 Fishery Monitoring							
Statistics (wildstock)	Ongoing	■	■	■	■	■	120 year time-series of catch and effort in the fishery
2. Habitat & Ecosystem							
2.1 Bycatch	Not Needed						Negligible Risk
2.2 Listed Species	Not needed						Negligible Risk
2.3 Habitat	Not Needed						Negligible Risk
2.4 Ecosystem/Environment							
Environmental impact of pearl oyster fishing	Not Needed						Low Risk
Environmental impact farm site	Completed						PPA project with University of Newcastle, looking at impacts on benthic habitat

Pearl Oyster Fishery and Pearl Production Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
Environmental impact/monitoring	Completed						PPA project with University of Newcastle, looking at impacts on benthic habitat
Site survey/food availability/density	Needed						
Site selection parameters	Needed						
EMS Template Pilot Project	Completed						Environmental monitoring studies
2.5 Oceanography							
NW Shelf study	Completed						On going CSIRO modelling research at a bioregional scale
Kimberley inshore bio-oceanography	Completed New proposal						Larval drift studies for *Pinctada maxima* spawning and settlement areas.
2.6 Other impacts on fishery							
3. Management Analysis							
3.1 Socio-economic							
Occupational Health & Safety							WAFIC/PPA issue
Diver safety/farm profiles	Completed						Studies on pearl diving and decompression protocols
3.2 Resource Access (Shares)	Not Needed						No recreational fishery
3.3 Compliance							
Compliance evaluation	Completed						Independent report completed in 07/08
3.4 Management Systems							
EMS	Completed						EMS was completed by industry for farming operations
4. Industry Development							
4.1 Pearl Culture Development							
Culture development (move to longlines)	Completed						Move from bottom culture to long-line culture completed in early 1990s
Irukandji Jellyfish Stings	Proposed						Protection for divers
Antifouling	Proposed	■	■				Industry project
Seeding techniques (private)							
Hatchery development project (FRDC)	Completed						Major FRDC projects by the Dept. of Fisheries on spawing and hatchery culture
Growth rates/nursery spat (FRDC)	Completed						Major FRDC projects by the Dept. of Fisheries on nursery culture
MOP nuclei production (FRDC)	Completed						Examination of use of MOP shell to produce nuclei for pearl seeding
4.2 Post Harvest & Marketing							Completed by industry
Market research/intelligence (Private)		O					
Promotion/Branding Mkt Resch		■					
4.4 Fish Health							
Fish health and diagnostics	Ongoing	■	■	■	■	■	general fish health and diagnostic services for the pearling Industry
Husbandry wildstock							
Disease survey/atlas (FRDC)	Completed						FRDC funded Australia-wide survey of wild stock diseases
Translocation/protocol	Periodic						

Pearl Oyster Fishery and Pearl Production Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
Ciliate Project	Completed						Characterize the Intracellular ciliate found In Zone 1 pearl oysters
Haplosporidian Project	Completed						Characterize the haplosporidian found In pearl oysters and rock oysters
Cliona Management in wild stocks (FRDC)	Completed						FRDC funded project on bioeroding sponges in wild stocks
Diagnostic test for OOD	Underway	■	■	■			FRDC funded projects on Chlamydiales-like organisms, stress response; industry funded work on oedema disease.
Test for Oyster Stress (Miroarrays)	Underway	■	■	■	■		FRDC project looking at generic stress response in *P. maxima*
5. Priority Review		■	■	■			Annual industry meetings
6. Science Review		■					Major assessment reports peer reviewed every three years

North Coast – Demersal Fisheries

Description and Scope of Issues

The demersal fisheries in this region targets, to varying degrees, 10 main species, bluespot emperor (*Lethrinus punctulatus*), threadfin bream (Nemipteridae), brownstripe snapper (*Lutjanus vitta*), crimson snapper (*Lutjanus erythropterus*), red emperor (*Lutjanus sebae*), saddletail snapper (*Lutjanus malabaricus*), goldband snapper (*Pristipomoides multidens*), spangled emperor (*Lethrinus nebulosus*), frypan snapper (*Argyrops spinifer*) and Rankin cod (*Epinephelus multinotatus*). A range of species is also taken in offshore waters, including eightbar grouper (*Hyporthodus octofasciatus*) and ruby snapper (*Etelis carbunculus*).

In the Pilbara there are three separate commercial fisheries for these species - trawl, trap and line fisheries. In the Kimberley there is a single trap based fishery (NDSF). The trawl and trap fisheries are all managed primarily by the use of input controls in the form of individual transferable effort allocations monitored with a satellite-based vessel monitoring system.

Relevant Resource Assets and Risks from Fishery

North Coast Demersal Finfish	Moderate Risk
North Coast Protected Species	Moderate Risk
North Coast Habitat –Pilbara	Moderate Risk
North Coast Habitat – Kimberley	Negligible Risk
North Coast Ecosystems	Low Risk

Summary of historical research completed

Pilbara: Baseline research for managing the demersal fish stocks was undertaken in two FRDC funded projects from 1993 to 1999, providing the basis for long-term monitoring of the stocks of the indicator species.

The catch of protected species has been a focus of research from 2002 to 2009. Three projects have been completed that collected baseline data (NHT project) and evaluated mitigation devices (FRDC and DBIF). In 2008 a project to analyse the behaviour of bottlenosed dolphins was completed (Endeavour Grant project) and in 2009 Murdoch University completed a FRDC funded project (no. 2008/048) aimed at reducing dolphin bycatch in the Pilbara trawl fishery. This project identified the need to trial a top-opening in the trawl nets to potentially further mitigate the incidental capture of dolphins and turtles. A top-opening net configuration is currently being developed by industry and is scheduled for scientific trials in late 2011.

Kimberley: Baseline research for managing the demersal fish stocks was undertaken in an FRDC funded project from 1997 to 2000, providing the basis for long-term monitoring of the stocks of the indicator species. Age-based demographic data has been published on red emperor (Newman and Dunk, 2002) and goldband snapper (Newman and Dunk, 2003).

Current Research Focus

Pilbara: Monitoring and assessment of the Pilbara trawl, trap and line fisheries includes the collection of spatial data on effort and catch of 10 major target species from logbooks, VMS data, and weighed catches from unload data. Assessment of the status of the suite of retained demersal scalefish is based on the performance of indicator species using various assessment methods. These methods include trend analysis of catch rates using two measures of effort for five indicator species and the total catch in each of the trawl managed areas. In addition, otoliths are collected and ages determined for the indicator species, red emperor, rankin cod, bluespotted emperor, brownstripe snapper and goldband snapper in each of the trawl-managed areas and the trap fishery. Estimates of fishing mortality are derived from each of these age structures and compared to internationally recognised Exploitation Reference Points (ERPs). Every four to five years the spawning biomass of two indicator species, red emperor and rankin cod, is assessed using the age-composition and catch rate data in an age-structured model.

Discussions are in progress on developing a collaborative project with CSIRO to update the work conducted by CSIRO in the 1980's on the North West Shelf benthos abundance and scalefish species composition. The monitoring of two shorter lived indicator species, bluespotted emperor and brownstripe snapper, have been increased from a Tier 2 (catch rate) to a Tier 3 (fishing mortality based) assessment. Collection of age structure data from different sources (fishery independent and markets) is currently in progress. A Tier 3 (fishing mortality based) assessment of the offshore demersal indicator species ruby snapper (*Etelis carbunculus*) is also in progress for the line sector in the Pilbara as a result of increased catches in recent years.

Kimberley: The status of the demersal fish stocks in the NDSF is determined annually using catch and catch rates of the major species or species groups, and every four to five years using an age-based stock assessment model to assess the status of the two indicator species, red emperor and goldband snapper based on age-composition data collected in previous

years. Ongoing monitoring of this fishery is being undertaken using both CAES and VMS data.

An FRDC-funded research project examining the relative catching efficiency of traps in the NDSF and to investigate resource availability and contribute to the stock assessment process in the NDSF is to be completed in 2011.

The future catch from the NDSF may also include some species from the waters of Zone C in depths greater than 200 m. The resources of this zone are unlikely to be substantial, and given the lower production potential of these longer-lived, deeper-slope reef fish, and the sustainable catch from this zone is likely to be low.

Priority Setting Process

Commercial: Department–industry meetings for the fish trawl and trap fisheries.

Recreational: Regional Recreational Fishing Advisory Committee

Review Timeline

Pilbara: Pilbara stock assessment review was undertaken in 2008. It is anticipated that the next review will be completed in 2012.

Kimberley: An independent review of the stock assessment of the key target species in the NDSF was completed in mid 2009. It is anticipated that the next review will be undertaken in 2013.

Key to symbols in the matrix/summary tables:

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O Indicates that the activity is part of a proposal but is not yet funded.

North Coast Demersal Fisheries Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
Red emperor	Completed						Sufficient for management
Goldband snapper (Pilbara)	Proposed	O	O	O			Project identified – current gap – High risk
Goldband snapper (Kimberley)	Completed						Sufficient for management
Rankin cod	Completed						Sufficient for management
Bluespotted emperor (Pilbara)	Proposed	O					F-based assessment - High risk
Brownstripe snapper (Pilbara)	Proposed	O					F-based assessment - High risk
Rosy threadfin bream	Completed						Sufficient for management
Crimson snapper (Pilbara)	Proposed	O	O	O			Low priority
Saddletail snapper	Completed						Sufficient for management
Spangled emperor	Completed						Sufficient for management

North Coast Demersal Fisheries Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
Cod species (Kimberley)	Proposed	O	O	O			Project identified – High risk
Cod species (Pilbara)	Proposed	O	O	O			Project identified – High risk
Golden snapper	Proposed	O	O	O			Project identified – moderate risk
Ruby snapper	Proposed	O	O				F-based assessment – High risk
Eightbar grouper	Proposed	O	O	O			Project identified – High risk
1.2 Other Biology							
Stock structure – Red emperor/Rankin cod using stable isotopes	Completed						Sufficient for management
Stock structure – Goldband snapper stable isotopes	Completed						Sufficient for management
Genetics – goldband snapper	Completed						Sufficient for management
Genetics – red emperor	Completed						Sufficient for management
Stock structure – Ruby snapper using stable isotopes etc	Proposed	O	O	O			Project identified – High risk
Genetics – Ruby snapper	Proposed	O	O	O			Project identified – High risk
Stock structure – Eightbar grouper using stable isotopes etc	Proposed	O	O	O			Project identified – High risk
Genetics – Eightbar grouper	Proposed	O	O	O			Project identified – High risk
Stock structure – Brownstripe snapper, Golden snapper using stable isotopes etc	Proposed	O	O	O			Project identified – High risk
Genetics – Brownstripe snapper, Golden snapper	Proposed	O	O	O			Project identified – High risk
1.3 Stock Assessment							
Annual catch and effort assessment	Ongoing	■	■	■	■		Ongoing
Age structured models (indicator species)	Ongoing		■	■			Periodic for indicator species
Fishing mortality assessments against benchmarks (indicator species)	Periodic	■	■			■	Periodic for indicator species
1.4 Fishery Monitoring							
Commercial catch and effort	Ongoing	■	■	■	■		Ongoing
VMS data	Ongoing	■	■	■	■		Ongoing
Age composition data for indicator species	Ongoing	■	■			■	Periodic
Commercial monitoring (vessel monitoring at sea)	Ongoing		■				Periodic
Recreational survey	Proposed	O					Periodic
Charter Boat Catch and Effort	Ongoing	■	■	■	■		Ongoing
Catching efficiency of gears (Kimberley)	Completed						FRDC Project Draft Final Report
2. Habitat & Ecosystem							
2.1 Bycatch							
Monitoring and review (Pilbara)	Proposed	O	O	O			Joint Project proposal identified
Monitoring (Kimberley)	Ongoing		■				Periodic – low risk
2.2 Listed Species							
P: Dolphins (moderate risk), turtles (low risk). Sygnathids (low risk), sea snakes (low risk), sea horses (low risk). Sawfish (moderate risk)	Underway						Trials of top-opening In trawl net
P: Protected species mitigation - acoustic pingers	Completed						Acoustic pingers were ineffective
P: Selection grids	Completed						Dolphin catch has halved since 2005
K: Monitoring	Ongoing		■				Periodic – low risk

North Coast Demersal Fisheries Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
2.3 Habitat							
P: Survival of benthos	Completed	O	O				Work completed in the 1990s. part of joint proposal
K:	Not needed						Low risk
2.4 Ecosystem/Environment	Proposed	O	O				Part of joint proposal.
2.5 Oceanography							
Use of drifters to evaluate on-shelf oceanographic processes	Proposed	O	O	O			Project identified
2.6 Other impacts on fishery							
K: Effects of Indonesian impacts	Proposed	O	O	O			Project identified – low priority
3. Management Analysis							
3.1 Socio-economic							
Social assessment	Possible						May be needed for IFM
Economic analysis	Possible						May be needed for IFM
3.2 Resource Access (Shares)							
Detailed determination of access shares	Proposed						Needed for IFM
Monitoring of shares	Proposed						Needed for IFM
3.3 Compliance							
Validation of catch records	Proposed		O				Required for ESD assessment
3.4 Management Systems							
Management of recreational sector	Proposed						May be needed for IFM
Effort monitoring by VMS	Ongoing	■	■	■	■		Ongoing – gap for Pilbara line fishery
4. Industry Development							
4.1 Production Technology							
4.2 Post Harvest							
Seafood quality enhancement	Proposed	O	O	O			Project identified
4.3 Marketing							
5.1 Priority Review		■	■	■	■		Annual industry meetings
6. Science Review							
6.1 Pilbara			■				Major assessment reports peer reviewed every five years
6.2 Kimberley				■			An Independent review of the stock assessment for the NDSF was undertaken - Major assessment reports peer reviewed every five years

North Coast – Shark Fisheries

Description and Scope of Issues

The northern shark fisheries comprise the state-managed WA North Coast Shark Fishery (WANCSF) in the Pilbara and western Kimberley and the Joint Authority Northern Shark Fishery (JANSF) in the eastern Kimberley. Until July 2005, when new management arrangements were proposed for the two fisheries, the primary fishing method was demersal longlining in the WANCSF with only a small and intermittent amount of pelagic gillnetting in the JANSF. The intent of the proposed management revisions was to reduce the total effort capacity of the fisheries and re-target fishing towards more productive blacktip whaler stocks in the Kimberley.

Implementation of the proposed new management arrangements has been delayed by negotiations by the Joint Authority (comprising the Western Australian and Commonwealth ministers), although there has been lower than anticipated effort in the fisheries since 2005. This is mainly due to the closure of the WANCSF since 2005 under a Section 43 order.

Recent analyses of data relating to the status of northern shark stocks have identified additional sustainability concerns for multiple shark stocks taken by the northern shark fisheries, including the intended target stocks of blacktip sharks. Concerns for blacktip shark stock sustainability relate to new genetic research that suggests the species composition of the "stock" (or at least catches) has changed dramatically over the last three decades; questionable assumptions in the assessment model and inaccurate time-series of CPUE data (on which previous assessments have been based). Nominal CPUE data from the WANCSF prior to July 2005 also suggest that several other long-lived shark stocks may have been significantly depleted by a combination of documented and undocumented catches by domestic target and non-target fisheries and illegal foreign fishing vessels. Other stakeholders have also expressed concerns about mackerel stock sustainability and broader ecological impacts from increased pelagic gillnetting off the Kimberley and Pilbara coasts. In 2008 the JANSF's Wildlife Trade Operation (WTO) export approval was revoked by the Minister for the Environment, Water Heritage and the Arts. The WTO for the WANCSF expired in 2009.

Relevant Resource Assets and Risks from Fishery

Statewide North-West Sharks	High Risk
North Coast Protected Species	Low Risk
North Coast Habitat	Low Risk
North Coast Ecosystems	Low Risk

Summary of historical research completed

Research to monitor the status of northern shark stocks was initiated as an extension of the south and west coast shark research project. A three-year FRDC funded project, provided an age-structured demographic assessment of the fisheries' principal target species (sandbar shark) and an improved general understanding of the fisheries and the biology of northern shark stocks. Additional information from the WANCSF and other fisheries that are permitted to land sharks on the north coast was collected during a series of NHT and FRDC funded research projects that began in 1999. Results from those projects, which have been published in several project reports, have further improved our understanding of the various

elasmobranch sustainability risks across the northern half of Australia.

Current Research Focus

Demonstrating the ecological sustainability of the northern shark fisheries is dependent on establishing robust estimates of sustainable harvest levels for target, byproduct and bycatch species. In particular, issues associated with blacktip shark, sandbar shark and mackerel catches, as well as Threatened, Endangered and Protected (TEP) species interactions require careful evaluation. Further research to estimate key biological parameters and fishing mortality rates for numerous species would therefore be required as a high priority if the proposed transition to pelagic gillnets was to proceed. To support these requirements and to facilitate the proposed fishery management arrangements, a new daily/trip catch and effort reporting system was introduced in 2006/07. The transition to this new reporting regime proved problematic for some fishers and discrepancies were identified in the logbook data reported for 2006/07, 2007/08 and 2008/09. New data validation procedures have been developed and catch and effort statistics for 2006/07 – 2008/09 have been recovered. All reporting issues have been addressed.

A new FRDC project will commence in late 2010 examining the spatial movement of commercially important shark species.

Priority Setting Process

Research priorities are generally identified through the annual stock assessment processes and periodic analyses of data from the fisheries. Alternatively, research priorities are identified by the Northern Science and Management Working Group, NAFM, fishery managers and through external processes, eg. National Shark Recovery Group, EPBC approval, Marine Bioregional planning, NPOA, etc.

Review Timeline

Independent scientific reviews of the sandbar shark stock assessment were completed in 2005 (Professor Carl Walters) and 2007 (ICES Journal of Marine Science). The blacktip shark assessment was last reviewed in 2008 (Northern Science and Management Working Group). A comprehensive review of Sharks and Rays (Chondrichthyans) in the North-west Marine Region was undertaken for the Department of the Environment, Water, Heritage and the Arts in 2007 (Heupel and McAuley, 2007). A review of Western Australian shark management arrangements was undertaken for the national Shark Assessment Report (2009). A review of the assessments and performance of the fisheries is scheduled to occur in 2012.

Key to symbols in the matrix/summary tables:

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O Indicates that the activity is part of a proposal but is not yet funded.

Northern Shark Fishery Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
Sandbar shark	Complete						
Dusky shark	Complete						
Common blacktip	Incomplete						Only available for western North Atlantic population.
Australian blacktip	Complete						
Spottail shark	Complete						
1.2 Other Biology							
Other spp. reproduction	Partially complete						Data collected in the 1980s from Taiwanese-operated fishery
Other spp. age and growth	Proposed						
1.3 Stock Assessment							
Catch and Effort Assessment	Ongoing	■	■	■	■	■	
Sandbar	Underway	■	■	■			**HIGH RISK**: Fishing mortality rates last estimated in 2003/04 and require re-estimation to assess sustainability of current catches. Recent logbook-derived CPUE trend are contradictory and require further evaluation. New FRDC project will provide new Information
Blacktip age structured	Proposed						**HIGH RISK**: evidence for dramatic change in species or catch composition renders existing assessment model outputs unreliable.
Multi-species risk assessment (Productivity Susceptibility Analysis)	Complete						Several species identified at high risk from the northern shark fisheries
1.4 Fishery Monitoring							
Daily logbook	Ongoing	■	■	■	■	■	Validity of species identification in logbook records is questionable. Discarding levels need to be quantified but previously observed to be very high
At sea observers	Proposed						
Landing inspections	Proposed						
VMS	Partially complete						
DNA fingerprinting	Complete for some spp.						
2. Habitat & Ecosystem							
2.1 Bycatch							
Elasmobranchs	Proposed						Recently described for WANCSF demersal longline catches, uncertain for pelagic gillnet catches.
Teleosts	Proposed						Concern about mackerel catch rates in pelagic gillnets

Northern Shark Fishery Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
2.2 Listed Species							
Dolphins	Ongoing						Stated reason for Commonwealth Govt. restricting pelagic gillnets in the 1970s-1980s. WA input to SEWPaC's North West Marine Bioregional Planning process
Sawfish	Proposed						
2.3 Habitat							Low Risk
2.4 Ecosystem/Environment							
Trophic effects	Proposed						
Ghost fishing	Proposed						
2.6 Other impacts on fishery							
Illegal, Unreported and Unregulated (IUU) fishing	Proposed						
Indigenous fishing	Proposed						NPOA actions and WTO recommendation (for temperate demersal gillnet and demersal longline fisheries)
3. Management Analysis							
3.1 Socio-economic							
Full utilisation (finning)	Proposed						One of the Commonwealths NPOA-2 objectives
Mercury and other contamination	Proposed						
3.2 Resource Access (Shares)							
Indigenous fishing	Proposed						NPOA actions and WTO recommendation (for temperate demersal gillnet and demersal longline fisheries)
Recreational fishing	Underway	■					ISurvey will provide initial estimates
3.3 Compliance Research							
3.4 Management Systems							
4. Industry Development							
5. Priority Review							
6.Science Review							
Updated stock assessment based on recovered data and new CPUE standardisations	Ongoing	■					

North Coast – Northern Prawn Managed Fisheries

Description and Scope of Fisheries

There are a number of small prawn fisheries in the north coast region. The Onslow (OPMF) and Nickol Bay (NBPMF) Prawn Managed Fisheries operate along the western part of the North-West Shelf and OPMF targets western king prawns (*Penaeus latisulcatus*), brown tiger prawns (*Penaeus esculentus*), endeavour prawns (*Metapenaeus* spp.) and whereas NBPMF primarily targets banana prawns (*Penaeus merguiensis*). The Broome Prawn Managed Fishery (BPMF) operates in a designated trawl zone off Broome and targets western king prawns and coral prawns (a combined category of small penaeid species). The Kimberley Prawn Managed Fishery (KPMF) operates off the north of the state between Koolan Island and Cape Londonderry. It predominantly targets banana prawns but also catches tiger prawns, endeavour prawns and western king prawns. All fishing is undertaken using low opening otter trawl systems.

Relevant Resource Assets and Risks from Fishery

North South Coast Shelf Crustaceans	Moderate Risk
North Coast Protected Species	Low Risk
North Coast Habitat –Pilbara	Low Risk
North Coast Habitat – Kimberley	Low Risk
North Coast Ecosystems	Low Risk

Summary of historical research completed

The biology of king and brown tiger prawns was completed in other fisheries within the state in the 1970's. Some research on the biology, including the distribution and life history of the banana prawn and endeavour prawn has been completed in northern Australia by CSIRO and QDPI.

The defined trawling area for the BPMF was surveyed by Department of Fisheries Research Division and industry divers prior to establishing the boundaries to ensure minimal impact on the adjacent pearl fishery habitats. The relationship between catch and moon phase was investigated during 1997/98 which resulted in modification of management arrangements to optimise fishing times (catch rates) over the new moons. Some opportunistic data has been collected on bycatch species and exploratory trawling outside the 'box' have been undertaken in recent years to determine if alternative trawl habitats are available to supplement low prawn stocks.

Between 2002 and 2005 bycatch reduction devices (BRDs) were implemented in these fisheries. A Fisheries and Research Development Corporation (FRDC) funded project was finalised on the biodiversity of bycatch in trawled and untrawled areas within part of the Onslow fishery in 2007 (Kangas et al. 2007).

Current Research Focus

Research programs are focused to underpin the sustainable management of these small fisheries involves stock monitoring and assessment utilising information from daily logbooks catch unload data provided by industry and information from boat skippers.

NBPMF and KPMF rainfall records are also used to update the rainfall-catch relationship for banana prawns. In the OPMF a field-based consultative process is undertaken whereby industry and the Departments' Research Division decide on the extent of an area to be fished within the areas that are officially opened. This can involve fishery independent surveys.

ONPMF in most years since 2007, a pre-season survey and within season surveys have been undertaken to determine prawn abundance and distribution and size composition to assist with harvesting strategies.

NBPMF the introduction of Size Management Fish Grounds and permanently closed areas will require further consultation with fishers during the next few years and may require limited fishery independent surveys to monitor prawns size and abundance as well as record bycatch/byproduct species. A relationship has been identified between rainfall and catches of banana prawns in the NBFMF and provides for an annual catch prediction.

For the BPMF daily logbooks have been compulsory since its inception and a De Lury depletion analysis is usually undertaken which assists in the assessment of the king prawn stocks within the permitted fishing area. In the last four years this has not been undertaken due to extremely low effort (and associated catch) in this fishery.

KPMF a relationship has been identified between rainfall and catches of banana prawns (the dominant species taken in this area) that provides a degree of forecasting and this is updated annually.

Priority Setting Process

Initial assessments were made through internal departmental meetings in 1998 discussing research undertaken, current research and research and development gaps and a plan was drafted for five years. Regular meetings (at least annually) have been held with the Research Division and industry to discuss research priorities and planning. The comprehensive EPBC assessment of each fishery has determined that performance should be reported annually against measures relating to the breeding stocks of target prawn species (banana, tiger, king and coral). The most recent Industry – Departmental meeting was held in 2011.

Review Timeline

The five-year EPBC re-assessment for accreditation by the Department of Sustainability, Environment, Water, Population and Communities (formally DEWHA) has recently been completed for the NBPMF, OPMF, KPFM and BPMF trawl fisheries and export approval has been granted until 20 August 2015 for all fisheries under the one approval. Early research and publications on the biology and spawning stock stock recruitment and environment relationships have been peer reviewed.

Recent Publications

Kangas, M. I., Morrison, S., Unsworth, P., Lai, E., Wright I. and Thomson A., (2007) Development of biodiversity and habitat monitoring systems for key trawl fisheries in Western Australia. Final FRDC Report 2002/038. *Fisheries Research Report* 160: 333pp.

Key to symbols in the summary matrix:

■ Indicates that the activity is funded and planned to occur.

O Indicates that the activity is part of a proposal but is not yet funded.

Northern Prawn Trawl Fisheries Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
King prawn biology	Completed						Completed in 1970's and 1980's
Coral prawn biology	Possible	O					Low Risk, mainly for BPMF
Banana prawn biology	Minimal						Mainly for KPMF and NBPMF, occasionally caught in higher numbers in OPMF, opportunistic sampling in NBPMF
Brown tiger prawn biology	Completed						Completed in 1970-1990s
Endeavour prawn biology	Minimal						Low risk
1.2 Other Biology							
Biology of bugs	Completed						Desktop study done – trialling size limits in OPMF
1.3 Stock Assessment							
Lunar Phase	Ongoing	■	■	■	■	■	For BPMF
De Lury Depletion Analysis	Ongoing	■	■	■	■	■	When appropriate for BPMF
C&E Stock Assessment	Ongoing	■	■	■	■	■	All northern prawn fisheries
1.4 Fishery Monitoring							
Logbooks	Ongoing	■	■	■	■	■	All northern prawn fisheries
Processor returns	Ongoing	■	■	■	■	■	All northern prawn fisheries
Pre-season skipper briefings	Ongoing	■	■	■	■	■	For OPMF and NBPMF
Database maintenance	Ongoing	■	■	■	■	■	All northern prawn fisheries
Effort impact assessment (GIS)	Ongoing	■	■	■	■	■	EPBC requirement
2. Habitat & Ecosystem							
2.1 Bycatch	-						
BRD Implementation (grids)	Completed						Completed in 2004
BRD Implementation (secondary devices)	Completed	O					Further evaluation/trialling may take place
Bycatch monitoring	Periodic/ Possible	■					Limited - opportunistically, Review every 5 years
2.2 Listed Species							
Listed species interactions - logbooks	Ongoing	■	■	■	■	■	EPBC requirement/MOU with DSEWPC underway
2.3 Habitat							
Habitat/effort impacts	Ongoing	■	■	■	■	■	EPBC requirement
Habitat mapping outside 'box'	Completed						For BPMF, no significant areas identified in 2007 but industry wish to revisit
2.4 Ecosystem/Environment							
Formal risk assessment	Periodic						EPBC requirement
2.5 Oceanography	Not needed						None Identified
2.6 Other impacts on fishery	Not needed						None identified

Northern Prawn Trawl Fisheries Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
3. Management Analysis							
3.1 Socio-economic							
3.2 Resource Access (Shares)							
Byproduct rules	Underway						For all northern prawn fisheries
Marine Park Planning	Ongoing	■	■	■			For all northern prawn fisheries
Resource Development	Ongoing	■	■	■	■	■	Research Advice on Impacts to fisheries by resource developments In northern regions
3.3 Compliance							
VMS	Ongoing	■	■	■	■	■	
3.4 Management Systems							
375 rule/unitisation	Underway						
Size Management Areas and Permanent Closures	Underway						Implemented in OPMF and KPMF, consultation with licensees required for the NBPMF.
Gear development/changes	Ongoing	■	■	■	■	■	For all northern prawn fisheries
Latent effort/effort trends	Underway						For the KPMF
4. Industry Development							
5. Priority Setting	Periodic	■					
6. Science Review							

South Coast Bioregion

South Coast – Biodiversity Issues

Description and Scope of Issues

The inshore marine habitats of the south coast are largely unaffected by human activities, the exceptions being some estuaries and marine embayments (e.g. Princess Royal Harbour and Wilson Inlet) where significant eutrophication associated with farming has occurred. There are few fishing operations in this region that directly impact on marine habitats with only one very small scallop trawl fishery focused in small localised areas along the coastline east of Albany to Israelite Bay. There are reef protected area closures cover the *Sanko Harvest* wreck site, the end of the old Esperance Jetty and the HMAS *Perth* wreck site. This region has been the focus of a number of marine planning exercises from NRM, DEC and most recently SEWPaC. The latter is in the process of determining potential closures as part of the Commonwealths' Marine Bioregional Planning processes.

Relevant Resource Assets and Risks from all Fisheries

Benthic - Nearshore & Estuaries	Low Risk
Benthic - Shelf	Negligible Risk
Protected species - non fish	Moderate Risk
Protected species - mammals	Moderate Risk
Protected species - fish	Negligible Risk
Ecosystem - Eucla	Negligible Risk
Ecosystem - Estuarine	Moderate Risk
Ecosystem - Marine	Low Risk
Introduced Pests & Diseases	High Risk

Summary of historical research completed

The Marine Futures project habitat mapping and biodiversity sampling was undertaken. Information regarding the status of introduced marine pest species (IMPs) on the south coast has been gathered at the ports of Albany and Esperance. The SEWPaC process generated some research summaries of the key ecological features in this region. A WAMSI project determined cumulative bycatch taken by various fisheries in this region in order to develop an appropriate long term monitoring scheme and better understand the level of impact of interactions between fisheries and bycatch species, particularly protected and endangered species.

Current Research Focus

- Respond to reports and investigate cause of fish kills.
- Evaluate and improve methods for detecting, monitoring and controlling invasive species incursions.

- Input to SEWPaC's south-west Marine Bioregional planning

Recent Publications

Evans, R. and Molony, B. (2010). Ranked Risk Assessment for bycatch in multiple fisheries: a Bioregional risk assessment method. *Fisheries Research Report* No 212. Department of Fisheries, Western Australia. 88pp

Molony, B. W., Newman, S. J., Joll, L., Lenanton, R. C. J. and Wise, B. (2011). Are West Australian waters the least productive waters for finfish across two oceans? A review with a focus on finfish resources in the Kimberley region and North Coast Bioregion. *Journal of the Royal Society of Western Australia.* 94: 323–332.

Priority Setting Process and Review Timeline

No formal process in place.

No Research Activity matrix was generated due to small amount of current and planned work.

South Coast – Greenlip and Brownlip Abalone Fishery

Description and Scope of Issues

The commercial abalone fishery on the south coast of WA is a dive fishery operating in shallow coastal waters along WA's western and southern coasts and is divided into eight management areas. The fishery targets three species: greenlip abalone, brownlip abalone and to a lesser degree in this bioregion, Roe's abalone. This quota based fishery operates using a sophisticated suite of management arrangements. A number of predictive systems have resulted in the maintenance of abalone stocks and a profitable fishery.

Relevant Resource Assets and Risks from Fishery

South Coast Molluscs	Moderate Risk
South Coast Protected Species	Negligible Risk
South Coast Habitats	Negligible Risk
South Coast Ecosystems	Negligible Risk

Summary of historical research completed

An extensive amount of research on the biology and stock status of greenlip abalone has been undertaken to support the management of this fishery. The basic biology (growth, reproduction, maturity) and ecological studies (population densities, settlement and recruitment) have been completed by researchers from the Western Australian Museum in the

1990s, and the Department of Fisheries in the 1990's and 2000's. Major relevant work has also been completed for greenlip abalone in South Australia.

Hatchery, nursery, and grow-out culture systems to support aquaculture of greenlip abalone have also been extensively researched by the Department of Fisheries during the early 2000s. An FRDC funded disease survey of entire Australian abalone stocks was completed in 2006.

Using historical time series of daily catch information has enabled an annual standardized catch per unit effort (CPUE) model to be developed that accounts for variation in spatial and temporal fishing effects, as well as technological improvements that aid fishing efficiency for used in a decision-rule framework.

Current Research Focus

Current research is focused on stock assessment using catch and effort statistics, meat weight indices, length-frequency sampling, and stock surveys. Commercial abalone divers provide daily catch information on the weight and number of abalone collected, and effort in hours fished. The divers also supply a random selection of abalone shells from each fishing day, and these are measured and used to estimate fishing mortality. Fishery independent surveys are undertaken by industry divers, who survey randomly selected sites with an underwater video camera, and research staff who survey from 180 sites across the fishery on a biennial schedule.

An annual standardized catch per unit effort (CPUE) model that takes into account diver, sub-area and month of fishing as well as technological improvements, is used to assess long term fishery trends. These trends are then applied in a harvest control rule to set annual TACCs (Total Allowable Commercial Catches). A new tag-recapture study of brownlip abalone (*Haliotis conicopora*) growth and mortality was initiated in 2009. Results will be used to assess stocks and estimate fishing mortality in this fishery.

The biannual telephone diary survey estimates the catch of greenlip and brownlip abalone on a state-wide basis. In 2007, around 500 licence holders were randomly selected from the licensing database, with selection stratified by licence type (abalone or umbrella) and respondent location (country or Perth metropolitan area). The licence holders were sent a diary to record their fishing activity and were contacted every 3 months by telephone for the duration of the abalone season.

Research on stock enhancement continued in 2010, under the externally funded Seafood CRC project titled "Bioeconomic evaluation of commercial scale stock enhancement in abalone". Results from this project will inform industry and management on the viability of stock enhancement as a management tool for this fishery.

Priority Setting Process

Annual meetings are held between the Department of Fisheries and the commercial abalone industry. Input on the recreational program has been obtained from the RFAC and the IFAAC groups.

Review Timeline

The fishery and stocks are reviewed annually, with quota decisions made each February. A mid-season research update is carried out during August - September. The research associated with this fishery was externally reviewed by SARDI (South Australian Research

and Development Institute) in October 2010.

Recent Publications

Hart, A. M., Fabris, F. P., Caputi, N. (2009). Performance indicators, biological reference points, and decision rules for Western Australian abalone fisheries (*Haliotis* sp.): (1) Standardised catch per unit effort. *Fisheries Research Report No 185, Department of Fisheries, Western Australia*, 40 p.

Hart, A. M., Fabris, F. P., Brown, J., Murphy, D. (2008). Digital video surveys of abalone (*Haliotis* sp.) stocks by commercial fishers in Western Australia. *Fisheries Research*. 93: 305-314.

Hesp, A., Loneragan, N., Hall, N., Kobryn, H., Hart, A. M., Fabris, F., Prince, P. J. (2008). Biomass and commercial catch estimates for abalone stocks in areas proposed as sanctuary zones for the Capes Marine Park. *Fisheries Research Report No 170, Department of Fisheries, Western Australia*, 62 p.

Hart, A.M.**,** Fabris, F.P. (2007). Digital video techniques for assessing population size structure and habitat of greenlip and roe's abalone. Final Report to the Fisheries Research and Development Corporation on Project No 2002/079. *Fisheries Research Report No. 167, Department of Fisheries, Western Austral*ia, 58 p.

Hart, A.M., Fabris, F.P., Daume, S. (2007). Stock enhancement of *Haliotis laevigata* in Western Australia - a preliminary assessment. *Fisheries Research Report No 166, Department of Fisheries, Western Australia*, 40 p.

Jones, J. B., Stephens, F. (2006). Aquatic animal health subprogram: development of a national translocation policy using abalone and prawns as templates for other aquatic species. *Fisheries Research and Development Corporation Final Report 2004/080*, 86p.

Key to symbols in the summary matrix:

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South Coast Abalone Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
Roe's Biology - growth etc.	Completed						Sufficient for management
Green lip - Early juvenile life history and habitat, natural mortality and predation	Underway	■					Large scale experiments on released animals underway
Growth rate of Green Lip abalone – spatial, juveniles (hatchery)	Completed						Growth recapture studies completed
Green Lip Reproduction/Fecundity, spawning Periodicity	Completed						Research by the Museum and Dept of Fisheries completed in the 1990s

South Coast Abalone Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
Disease survey/atlas	Completed						FRDC funded survey of entire Australian abalone stocks completed in 2006
Brownlip abalone growth and mortality	Proposed						
1.2 Other Biology							
Environmental effects on recruitment	Underway	■	■	■			Long-term datasets on annual recruitment and relevant environmental factors are being developed
1.3 Stock Assessment							
Catch statistics (wildstock)	Ongoing	■	■	■	■	■	40 years of catch and effort statistics
Mapping of areas	Completed						FRDC funded project using GPS trackers, headed up by TAFI
Fishing efficiency	Ongoing	■	■	■	■	■	Environmental and technological factors continually monitored
Commercial length frequency monitoring	Ongoing	■	■	■	■	■	Catch sampling from industry used to estimate F
Population dynamics and harvest strategy assessment model	Ongoing	■	■	■	■	■	Model under development
Recreational Impact	Ongoing	■	■	■	■	■	Annual monitoring of recreational catch
Yield and egg-per-recruit analysis for size limits	Completed						
1.4 Fishery Monitoring							
Research monitoring and recruitment sites	Ongoing	■	■	■	■	■	140 sites surveyed every two years
Industry video monitoring sites	Ongoing	■	■	■	■	■	50 to 70 sites surveyed annually
Recreational Fishery Monitoring –phone surveys	Ongoing Biennially		■				Phone diary survey undertaken every two years
2. Habitat & Ecosystem							
2.1 Bycatch	Not Needed						No Bycatch
2.2 Listed Species	Not Needed						No interactions
2.3 Habitat	Not Needed						Low risk
2.4 Ecosystem/Environment	Not Needed						Low risk
Abalone Health - Contingency plan and monitoring and diagnosis	Ongoing	■	■	■	■	■	
AVG (Abalone Viral Ganglioneuritus)	Ongoing	O	O	O	O		Watching brief
3. Management Analysis							
Translocation/protocol	Ongoing	■	■	■			
4. Industry Development							
Stock enhancement	Underway	■	■				CRC project
4.1 Production Technology	Completed						Hatchery and grow out work in 1990s
5. Priority Review		■	■	■	■	■	Annual industry meetings
6. Science Review					O		Major assessment reports peer reviewed every five years

South Coast – Crustacean Fisheries

Description and Scope of Issues

The south coast crustacean fisheries cover a series of pot-based fisheries, which operate from Windy Harbour to the South Australian border. They include Windy Harbour/Augusta Rock Lobster Managed Fishery, the Esperance Rock Lobster Managed Fishery (ERLF), the rock lobster pot fishery (a Regulation fishery) operating in the Albany and Great Australian Bight (GAB) sectors, and the deep-sea crab fishery (a Section 43 Order fishery). The fisheries are multi-species and take southern rock lobsters and western rock lobsters as well as deep sea crab species including giant crabs, crystal crabs and champagne crabs.

Relevant Resource Assets and Risks from Fishery

South Coast Crustaceans	Moderate Risk
South Coast Protected Species	Negligible Risk
South Coast Habitats	Negligible Risk
South Coast Ecosystems	Negligible Risk

Summary of historical research completed

Data on the biology of southern rock lobsters exists for South Australia, Victoria, Tasmania and New Zealand but little exists for Western Australia. Biological data for these other areas need to be used with extreme caution because growth rates, $L\infty$, size at maturity and other variables are highly influenced by water temperature. A comprehensive study was undertaken on larval transport and recruitment processes of southern rock lobsters in Australia (Bruce *et al.* 2007). Modeling data produced by that study suggested that recruitment of southern rock lobsters in Western Australia is largely supported by parent stock in this state and any contribution from the east is minimal.

Research has been undertaken on the biology of champagne crabs on the south coast (Smith *et al.* 2004[1]). Conditions on the south coast are not conducive for spawning by this species and females migrate from the south to lower west coast for spawning.

An evaluation of the crystal crab resources on the south coast has been undertaken (Chuwen and Stevens 2006). That report suggested potentially sustainable long term landings of 20 – 108t depending on assumptions. The Department produced a different estimate of ~12t, also with caveats attached (Melville-Smith and Thomson unpub. Data). Comparatively good data are available on the biology of giant crab in Western Australia and in other areas of that species' distributional range (Levings *et al.* 2001[2]).

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[1] Smith KD, Hall NG and Potter IC (2004) Relative abundance and size composition of champagne crabs, Hypothalassia acerba, on two coasts and in difference water depths and seasons. Marine and Freshwater Research 55: 653-661

2 Levings A., Mitchell B. D., McGarvey R., Mathews J., Laurenson L., Austin C., Heeren T., Murphy N., Miller A., Rowsell M., Jones P. Fisheries biology of the giant crab Pseudocarcinus gigas. 2001. Final Report to the Fisheries Research and Development Corporation for Projects 93/220 and 97/132. School of Ecology and Environment, Deakin University, Warrnambool. 388 pp.

Current Research Focus

Only compulsory commercial catch and effort returns and a few voluntary catch log books are obtained from these fisheries. Given the downturn in southern rock lobster landings (which are the mainstay of the fishery) in recent years, there is a need for basic biological research to be undertaken, as well as for a regular length frequency monitoring programme to be established.

Priority Setting Process

Internal Departmental Risk Assessment.

Review Timeline

Not applicable.

Recent Publications

Bruce, B., Griffin, D., Bradford, R. (2007). Larval transport and recruitment processes of southern rock lobster. *FRDC Final Report*, Project 2002/007: 104pp.

Chuwen, B. M. and Stevens, R. (2006). Evaluation of crystal crab (*Chaceon bicolour*) resources on the south coast of Western Australia. *FRDC Final Report, Project 2003/077:* 60pp.

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South Coast Crustacean Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
Crystal crabs	Preliminary						Information on growth, movement patterns, size at maturity, are available for stocks on the west coast (probably similar on south coast)
Reproduction champagne crabs	Completed						
Movement champagne crabs	Completed						Only some data
Movement giant crabs	Completed						
Reproduction giant crabs	Completed						
Growth data giant crabs	Completed						
Western rock lobster	Completed						
Southern Lobster genetic structure of the populations							Information is needed for management

South Coast Crustacean Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
Southern rock lobster biology							Information is needed on size at maturity, growth rates, movement patterns
1.2 Other Biology	Nil						
1.3 Stock Assessment							
Annual assessment (rock lobster)	Ongoing	■	■	■	■	■	Rudimentary
Crystal crabs	Preliminary						One-off survey funded by FRDC.
1.4 Fishery Monitoring							
Commercial catch and effort	Ongoing	■	■	■	■	■	
Processor returns	Ongoing	■	■	■	■	■	
Commercial length freq monitoring							At least some sampling is desirable for future monitoring of stocks
2. Habitat & Ecosystem							
2.1 Bycatch							
Fin fish and sharks	Nil						Negligible risk
Octopus	Nil						Negligible risk
Spider crabs, hermit crabs starfish	Nil						Negligible risk
Cuttlefish	Nil						Negligible risk
2.2 Listed Species							
Seals and sea lions	Monitoring	■					Low risk
Whales and dolphins	Nil						Negligible risk
2.3 Habitat	Nil						
2.4 Ecosystem/Environment							
Debris							Negligible risk
2.5 Oceanography							
2.6 Other impacts on fishery	Nil						
3. Management Analysis							
4. Industry Development							
5. Priority Review							
6. Science Review							

South Coast – Nearshore and Estuarine Finfish Resources

Description and Scope of Fishery

Estuaries: The finfish resources in South Coast estuaries are multi-sector (commercial, recreational and non-harvest) and multi-species. South Coast estuarine fisheries are small-scale and have relatively low commercial value but have high social, recreational and historical values. Most south coast estuaries are intermittently open to the sea. Therefore, recruitment by marine-spawned fish is determined by sand bar openings and water levels within each estuary, independent of estuarine fishing pressure. Cobbler (*Cnidoglanis macrocephalus*) and black bream (*Acanthopagrus butcheri*) are the only true estuarine species with discrete stocks in each estuary.

The South Coast Estuarine Fishery (SCEF) has 13 estuaries and inlets open to commercial fishing, with Wilson Inlet being the most important. The fishery captures cobbler, bream, sea mullet (*Mugil cephalus*), Australian herring (*Arripis georgianus*), King George whiting (*Sillaginodes punctata*), flathead (Platycephalidae), leatherjackets (Monacanthidae) and many other species. Recreational fishing occurs in each of the 25 major estuaries on the south coast, including those commercially fished. The recreational catch includes the same species as in the commercial catch (except cobbler which is rarely taken recreationally).

Nearshore: The Australian herring trap net fishery and the South Coast Salmon Managed Fishery are the two main commercial fisheries operating in nearshore waters in the South Coast Bioregion. These commercial fishers mainly operate on beaches in the western portion of the Bioregion. The salmon and herring fisheries have historically been relatively large but the commercial catch and catch rates of both species on the South Coast have been declining since 2002 and have reached historically low levels in recent years. Recreational fishers in nearshore waters on the South Coast capture Australian herring, Australian salmon, trevally (*Pseudocaranx* spp.), King George whiting, southern school whiting (*Sillago bassensis*) tarwhine (*Rhabdosargus sarba*) and many other species.

Relevant Resource Assets and Risks from Fishery

South Coast Nearshore Finfish	Moderate Risk
South Coast Estuarine Finfish	Moderate Risk
South Coast Protected Species	Negligible Risk
South Coast Habitats	Negligible Risk
South Coast Ecosystems	Negligible Risk

Summary of historical research completed

Estuaries: The most recent estimates of recreational fishing catch are from a creel survey conducted by the Department in 17 estuaries/inlets in 2002/03.

Nearshore: The commercial fisheries for salmon and herring were established on the South Coast in the 1930's and 1940's, respectively. There is a substantial level of historical biological and catch data available on these fisheries, including factory sampling and salmon logbook information since the 1970s. An FRDC project in the 1990s examined aspects of herring age, growth, reproduction and stock structure from which a stock assessment model for herring was developed but which still needs to be validated. Another FRDC project in the

1990s developed a method to monitor juvenile recruitment for Australian herring, salmon, mullet and whiting. Recruitment indices are used to predict fishery landings.

Estimates for recreational catches in nearshore waters are only available from the National Recreational and Indigenous Fishing Survey conducted in 2000/01.

Current Research Focus

Indicator species were selected for these resources using a risk assessment process. Indicators for estuaries are black bream (various estuaries) and cobbler (Wilson Inlet, Oyster Harbour) and sea mullet. Indicators for the nearshore suite are Australian salmon and Australian herring.

The status of nearshore and estuarine finfish stocks in the South Coast Bioregion are currently assessed using CAES data, recreational logbook data and fishery-independent surveys of annual recruitment for some species. Fishery data is limited for most south coast estuaries, especially in recreational-only estuaries. Trends in commercial catch and catch rates, where available, form the basis of estuarine assessments. Annual fishery-independent monitoring of cobbler recruitment in Wilson Inlet commenced in 2007/08. Sampling of the age structure of the Wilson Inlet cobbler catch commenced in 2009/10.

A State NRM-funded research project commenced in mid-2009 to develop methods to monitor the age structure and status of Australian herring. It will also examine nursery signatures in otoliths to determine sources of recruitment to West Coast and South Coast Bioregions and identify factors associated with annual recruitment variation.

Murdoch University also regularly undertakes ecological projects relating to fish in South Coast estuaries.

Priority Setting Process

A Departmental risk assessment was recently completed and issues are reviewed at regular internal meetings. Through this process, salmon was assessed as a low risk (i.e. no concerns regarding stock sustainability) and no additional salmon research is planned in the next 5 years. Discussions are also held between the Department of Fisheries, industry members and peak bodies (Western Australian Fishing Industry Council, Recfishwest).

Review Timeline

An internal risk assessment of nearshore and estuarine finfish resources in the South Coast Bioregion was completed in 2009.

Key to symbols in the summary matrix:

■ Indicates that the activity is funded and planned to occur.

O Indicates that the activity is part of a proposal but is not yet funded.

South Coast Estuarine and Inshore Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
Australian herring	Complete						Adequate for management
Australian salmon	Complete						Adequate for management
Black bream	Complete						Adequate for management
Cobbler	Complete						Adequate for management
Sea mullet	Complete						Adequate for management
1.2 Other Biology							
Australian herring	Underway	■					Develop age-based monitoring. Examine recruitment dynamics & stock structure. Identify nursery signatures in otoliths NRM-funded.
Whiting (all species)	Underway	■	O				Review composition of 'whiting' suite of species in recreational catch. Review assessment methods.
1.3 Stock Assessment							
Annual trends in catch and CPUE	Ongoing	■	■	■	■	■	CAES data. Insufficient recreational data.
Annual trends In juvenile recruitment	Ongoing	■	■	■	■	■	Fishery-independent annual trapping & beach seining programs.
Age-based assessment using 'weight-of-evidence' approach (herring)	Developing	■	O	O			Otoliths being collected (west & south coasts). Develop ongoing monitoring. NRM-funded project.
1.4 Fishery Monitoring							
CAES	Ongoing	■	■	■	■	■	Data from commercial estuarine fisheries only.
Boat-based recreational survey	Underway	■		■		■	State-wide phone diary survey in 2011 & then every 2nd year.
Voluntary recreational logbook	Ongoing	O	O	O	O	O	Research Angler Program (RAP).
Juvenile recruitment surveys	Ongoing	■	■	■	■	■	Annual trapping & beach seining programs.
Voluntary commercial logbooks (salmon)	Ongoing	■	■				Providing minimal data due to low level of effort in fishery recently.
Observer program (salmon)	Underway	■	■				ESD requirement. Logistically difficult due to low & infrequent fishing operations & catches.
Age structure monitoring	Underway	■	■	■	■	■	Herring (W & S coasts) & cobbler (Wilson Inlet).
Commercial daily logbook (estuary)	Underway	O	O				Trial. Voluntary.
2. Habitat & Ecosystem							
2.1 Bycatch	Not needed						Low risk
2.2 Listed Species	Not needed						Low risk
2.3 Habitat							
Benthic habitat quality	Possible						Seagrass variation possible cause of cobbler stock fluctuations in Wilson Inlet

South Coast Estuarine and Inshore Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
2.4 Ecosystem/Environment							
Climate change, river flows & eutrophication	Possible						Ecological flow requirements for estuaries are unclear. Flow effects on bream reproduction & early life history may be major determinant of recruitment success.
Fish Kills	Occasional						Respond to reports and investigate cause of fish kills. Opportunistic sampling, logistically difficult, limited resources available.
2.5 Oceanography							
Leeuwin current monitoring	Ongoing	■	■	■	■	■	Influence on larval dispersal & recruitment
2.6 Other impacts on fishery	Not needed						Low risk
3. Management Analysis							
3.1 Socio-economic	Not needed						
3.3 Compliance	Not needed						
3.4 Management Systems							
Stock enhancement	Possible						Black bream
Adaptive management	Possible						Mainly bream. Responding to fluctuating stock levels due to recruitment, fish kills, bar openings.
4. Industry Development							
4.1 Production Technology	Not needed						
4.2 Post Harvest							
Salmon	Possible						Develop new value-added products. Low price for raw product.
4.3 Marketing							
Salmon	Possible						Develop new markets. Address negative public perception.
5. Priority Review							
6. Science Review				■			

South Coast – Purse Seine Fishery

Description and Scope of Issues

The South Coast Purse Seine Managed Fishery is based on the capture of pilchards (*Sardinops sagax*) by purse seine nets. The fishery is divided into three primary management zones – Albany, Bremer Bay and Esperance The management plan also covers the take of yellowtail scad (*Trachurus novaezelandiae*), Australian anchovy (*Engraulis australis*) and maray (*Etrumeus teres*). This fishery was the largest tonnage fishery during the late 1980s and early 1990s, until a pilchard virus hit in 1995 and 1998 which decimated stocks. The fishery is yet to fully recover.

Relevant Resource Assets and Risks from Fishery

South Coast Pelagic Low Risk

Summary of historical research completed

An extensive set of studies were completed into the biology and stock assessment of pilchards for this fishery in the 1980s and 1990s. This included growth, ageing, plankton studies, stock assessment by age-structured modeling and daily egg production techniques. Monitoring of catches from each region was undertaken monthly to provide age-composition data, from which relative recruitment strengths could be inferred. Estimates from biomass surveys and age-composition data were integrated via an age-structured model to provide a robust estimate of pilchard biomass in each of the three management regions. The model outputs, along with analyses of catches, allowed the annual review of stocks in each major zone.

Following the mortality events in 1995/98, the Fish Health Unit assessed the identification and spread of the herpes virus. Another project examined the recovery of the pilchard stocks using egg production methods to estimate biomass.

Murdoch University and SeaNet examined the interaction between the fishery and protected species, focusing on seabirds. The project examined the extent of interactions with wildlife (pinnipeds, cetaceans and seabirds) and potential mitigation methods to reduce these interactions. This project resulted in reductions in significant interactions via changes in fishery operations.

Current Research Focus

Current catches of all zones are currently below the TACs and the risk to the stocks are low. As a result, annual age-sampling and assessment of the stocks ceased in 2007 with the fishery monitored by statutory catch and effort data submitted by fishers.

Priority Setting Process

Priorities are reviewed on an annual basis through consultation between Scientists of the Finfish Branch (Research Division) and Fishery Managers.

Review Timeline

This science underpinning this fishery was extensively studied during the 1990s and 2000s. This fishery was last reviewed in 2008 and is considered low risk and will be reviewed within

the next four years.

Recent Publications

Barange, M., Bernal, M., Cercole, M. C., Cubillos, L., De Moor, C. L., Daskalov, G. M., de Oliveira, J. A. A., Dickey-Collas, M., Hill, K., Jacobson, L., Køster, F. W., Masse, J., Nishida, H., Ñiquen, M., Oozeki, Y., Palomera, I., Saccardo, S. A., Santojanni, A., Serra, R., Somarakis, S., Stratoudakis, Y., van der Lingen, C. D., Uriarte, A., Yatsu, A. (2009). Current trends in the assessment and management of small pelagic fish stocks. In: Checkley, D., Roy, C., Oozeki, Y., Alheit, J. (editors). Climate change and small pelagic fish stocks. Cambridge University Press, p.191-255.

Crockford, M., Jones, J. B., McColl, K., Whittington, R. J. (2008). Comparison of three molecular methods for the detection of Pilchard herpesvirus in archived paraffin-embedded tissue and frozen tissue. *Diseases in Aquatic Organisms* 82: 37-44.

Gaughan, D. J., Craine, M., Stephenson, P., Leary, T., Lewis, P. (2008). Regrowth of pilchard (*Sardinops sagax*) stocks off southern WA following the mass mortality event of 1989/99. Final FRDC Report - Project 2000/135. *Fisheries Research Report No. 176. Department of Fisheries, Western Australia.* 82 p.

Whittington, R., Crockford, M., Jordan, D., Jones, B. (2008). Herpesvirus that caused epizootic mortality in 1995 and 1998 in pilchard *Sardinops sagax neopilchardus* (Steindachner) in Australia is now endemic. Journal of Fish Diseases 31, 97-106.

Jones, J. B. (2006). Aquatic animal health subprogram: pilchard herpesvirus infection in wild pilchards. *Fisheries Research and Development Corporation Final Report 2002/044, 55p*

Rogers, P., Gaughan, D. & Ward, T. (2006). Small pelagic fishes. *In* S. McClatchie, J. Middleton, C. Pattiaratchi & G. Kendrick (eds), *The South-west Marine Region: Ecosystems and Key Species Groups*. The National Oceans Office (DEH, Govt. of Australia).

Given the small amount of activity no matrix is provided.

South Coast – Temperate Demersal Gillnet and Longline Fisheries

Description and Scope of Issues

The temperate demersal gillnet and longline fisheries comprise the state-managed West Coast Demersal Gillnet and Demersal Longline (interim managed) Fishery (WCDGDLF) and the Joint Authority Southern Demersal Gillnet and Demersal Longline Fishery (JASDGDLF), which is co-managed by the State and Commonwealth governments. Both fisheries are managed via limited entry, unitised input (effort) controls and gear-specification restrictions with most fishing by demersal gillnets. Catch limits are also being developed for catches of

demersal fishes by the sector of this fishery that operates in the West Coast Bioregion.

Target species vary by zone, with the primary targets being dusky sharks (*Carcharhinus obscurus*) in Zone 1 and gummy sharks (*Mustelus antarcticus*) in Zone 2 of the JASDGDLF and sandbar sharks (*Carcharhinus plumbeus*) in the WCDGDLF. The whiskery shark (*Furgaleus macki*) and school shark (*Galeorhinus galeus*) due to declines are no longer actively targeted. These fisheries also capture a range of scalefish (teleosts) which accounting for 15 - 20% of total fishery landings.

Relevant Resource Assets and Risks from Fishery

Statewide South West Sharks	High Risk
South Coast Demersal Finfish	Moderate Risk
South Coast Protected Species	Negligible-low Risk
South Coast Habitats	Negligible Risk
South Coast Ecosystems	Negligible-low Risk

Summary of historical research completed

Major FRDC-funded studies to assess the biology and status of targeted shark stocks on the south and west coasts of Western Australia were undertaken over the period 1993–2004. These studies have provided a detailed basis for managing the fishery and the extensive biological and fishery information gained from these studies has been reported in three FRDC final reports and numerous international journal articles. These data have been used to develop stock assessment models for the fisheries' key target stocks and to determine their likely responses to current levels of exploitation and to test alternative harvest regimes. A database of DNA profiles from protected and commercially important shark species and forensic sampling protocols have been developed for evidentiary purposes and NHT-funded studies of grey nurse shark movement and ecology have been undertaken.

Current Research Focus

Current research involves monitoring and analyses of fishing returns data and data from previous sampling of commercial catches. To support significant recent changes to fishery management arrangements, improve assessments of key stocks and to facilitate the more detailed reporting requirements of the fisheries' export accreditation under the Commonwealth Environment Protection and Biodiversity Conservation (EPBC) Act, a new daily/trip catch and effort reporting system was introduced in 2006/07. The transition to this new reporting regime has been problematic for some fishers and discrepancies have been identified in the logbook data reported for 2006/07, 2007/08 and 2008/09. New data validation procedures have been developed and catch and effort statistics for 2006/07 – 2008/09 have been recovered. All reporting issues have been addressed.

Interactions with protected species are still perceived as a risk and several projects are addressing the risk imposed by these fisheries. A new FRDC project will commence in late 2010 examining the spatial movement of commercially important shark species.

Priority Setting Process

Research priorities are generally identified through the annual stock assessment processes

and periodic analyses of data from the fisheries. These are discussed at the annual management meetings between the Department, WAFIC and license holders.

Review Timeline

A review of the assessment models and the performance of the fisheries is scheduled in 2012.

Recent Publications

McAuley, R. B., Simpfendorfer, C. A., Hyndes, & Lenanton, R. C. J. (2007) Distribution and reproductive biology of the sandbar shark, *Carcharhinus plumbeus* (Nardo 1827) in Western Australia. *Mar.Freshwater Res.*58: 116 - 126.

Chidlow, J., Gaughan, D. & McAuley, R. (2006). Identification of Western Australian Grey Nurse Shark aggregation sites - Final Report to the Australian Government, Department of the Environment and Heritage. *Fisheries Research Report 155, Department of Fisheries, Western Australia.* 48 p.

Key to symbols in the matrix/summary tables:

■ Indicates that the activity is funded and planned to occur.

O Indicates that the activity is part of a proposal but is not yet funded.

South Coast Temperate Demersal Gillnet and Longline Fisheries Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
Gummy shark	Complete						Reproduction complete, age & growth incomplete
Whiskery shark	Complete						
Dusky shark	Complete						
Sandbar shark	Complete						
1.2 Other Biology							
Temporal spatial dynamics	Proposed	■	■	■			FRDC funded project 2010/003
Wobbegongs	Proposed						Reproduction and diet complete; age & growth uncertain
Pencil shark	Proposed						Reproduction and diet complete; age & growth incomplete
Other spp. Biology	Ongoing						Further data collected opportunistically
Grey nurse ecology	Partially. complete						
1.3 Stock Assessment							
CPUE analysis	Ongoing	■	■	■	■	■	
Gummy	Proposed	■					One of the main target species for these fisheries; no assessment since 1996; Updated stock assessment will require development of new model and age structure.

South Coast Temperate Demersal Gillnet and Longline Fisheries Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
Whiskery	Proposed	■					HIGH RISK: not assessed since 2007. Age structure and CPUE requires updating.
Dusky	Proposed	■					HIGH RISK: Fishing mortality rates last estimated in 1995/96 and requires re-estimation to assess sustainability of current catches.
Sandbar	Proposed	■					HIGH RISK: Fishing mortality last estimated in 2003/04 and requires re-estimation to assess sustainability of current catches.
1.4 Fishery Monitoring							
Daily logbook development & analysis	Ongoing	■	■	■	■	■	
At sea observers	Proposed	O					Observer program is being considered as part of the WTO process
VMS	Ongoing	■	■	■	■	■	All vessels (>6.5m) are now fitted with ALCs. VMS will be used to monitor and acquit effort units from October 2009
DNA Fingerprinting							Proposal
2. Habitat & Ecosystem							
2.1 Bycatch							
Finfish & Elasmobranchs	Completed						WAMSI cumulative risk assessment completed
2.2 Listed Species							
Pinnipeds		■					Murdoch university led FRDC project being finalised
Other: Dolphins, Turtles, Grey nurse shark, White shark	Completed						WAMSI cumulative risk assessment completed
2.3 Habitat							Low Risk
2.4 Ecosystem/Environment							
2.6 Other impacts on fishery							
Targeted catch in Commonwealth Fisheries	Ongoing	■	■				Via involvement in Commonwealth Shark Resource Assessment Group.
Bycatch in Commonwealth Fisheries							HIGH RISK: resumption of fishing in SWTBF has significant potential to further deplete dusky and sandbar shark breeding stocks
Illegal, Unreported and Unregulated (IUU) fishing							HIGH RISK: Unreported catches in the WANCSF and JANSF have significant potential to further deplete dusky and sandbar shark breeding stocks
Recreational fishing	Underway	■					ISurvey will provide initial estimates
Indigenous fishing							NPOA actions and WTO Recommendation
3. Management Analysis							
3.1 Socio-economic							
Mercury and other contamination	Proposed						

South Coast Temperate Demersal Gillnet and Longline Fisheries Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
3.2 Resource Access (Shares)							
Recreational fishing	Proposed						ISurvey will provide initial information
Indigenous fishing	Proposed						
3.4 Management Systems							
Catch and effort triggers	Ongoing	■	■	■	■	■	
National Plan of Action (NPOA) for the conservation and management of sharks	Ongoing	O					
Protected species recovery plans	Ongoing	O					
EPBC Act export approval assessments	Ongoing	O					
4. Industry Development							
5. Priority Review							
SEWPaC	Ongoing	■					Potential impacts from new South-west Marine Bioregional planning process.
6. Science Review							
Updated stock assessment based on recovered data and new CPUE standardisations	Ongoing	■					

South Coast – South Coast Demersal Fishery

Description and Scope of Issues

Commercial

This fishery includes wetline fishers from small vessels in coastal areas around reefs targeting mainly demersal scalefish species, It also includes the haul net fishery operating in the South Coast Bioregion. It does not include the managed Temperate demersal gillnet and longline fisheries operating in the South Coast Bioregion (see Demersal Gillnet and Longline Fisheries Status Report).

Recreational

Recreational fishers also operate in the area but no data are currently available.

Relevant Resource Assets and Risks from Fishery

South Coast Demersal Finfish	Moderate Risk
South Coast Protected Species	Negligible Risk

South Coast Habitats	Negligible Risk
South Coast Ecosystems	Negligible Risk

Summary of historical research completed

Limited monitoring and assessment and tactical research have been focussed on this fishery and the resources that support it. Several studies of the growth, age composition, reproductive biology, mortality and/or diet of West Coast species been conducted by the Department and Murdoch University which may be used as basis for designing monitoring and assessment for the South Coast.

Current Research Focus

Monitoring catch and effort data from licensed operators that constitute this fishery. Finding applications to determine resource status and connectivity have been submitted.

Priority Setting Process

Priorities are set by the Department at relevant meetings. The priority for this fishery will be discussed both within the Department and with Stakeholders.

Review Timeline

To be determined with fishery managers and stakeholders.

Key to symbols in the matrix/summary tables:

■ Indicates that the activity is funded and planned to occur.

O Indicates that the activity is part of a proposal but is not yet funded.

South Coast Demersal Scalefish Fishery Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
Identification of Indicator species	Completed						Outlined in Finfish resource framework
Biology of Indicator species	Proposed						Similar to studies completed on West Coast.
1.2 Other Biology studies							
Stock structure of indicator species (genetics, microchemistry)	Underway						Small component of WAMSI 4.4.2
Bight redfish	Proposed						
1.3 Stock Assessment							
Annual C & E Assessment	Ongoing	■	■	■	■	■	Commercial fishery
1.4 Fishery Monitoring							
Commercial, charter catch & effort	Ongoing	■	■	■	■	■	Logbooks (DoFWA)
Age Structured monitoring	Proposed	O	O	O			

South Coast Demersal Scalefish Fishery Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
2. Habitat & Ecosystem							
2.1 Bycatch							
2.2 Listed Species							
2.3 Habitat							
2.4 Ecosystem/Environment							
2.5 Oceanography							
2.6 Other impacts on fishery							
3. Management Analysis							
3.1 Socio-economic							
3.2 Resource Access (Shares)							
3.3 Compliance							
3.4 Management Systems							
4. Industry Development							
5 Priority Review	Ongoing	■					Meeting with Department and Stakeholders
6. Science Review	Proposed						Not possible until priorities established and additional data collection commences

Northern Inland Bioregion

Northern Inland – Biodiversity Issues

Description and Scope of Issues

The Northern Inland Bioregion, encompassing the northern half of Western Australia, is predominantly a desert area, with few permanent water bodies. As a result of occasional summer cyclones, the various river systems flow at flood levels for short periods before drying-out to residual waterholes. The only exceptions to this are man-made dams, which trap rainfall for water supply purposes and irrigation.

The only significant fishable water body in the region is Lake Argyle, created by damming the Ord River. The continuous release of water from the dam has resulted in the Ord River maintaining its freshwater fish populations year-round, as does the lake, where some freshwater native fish populations have expanded. Populations of reptiles, such as the protected freshwater crocodile, are supported by the expanded food chain of native fish, and are thought to have increased significantly from their original billabong-based populations.

The creation of Lake Argyle has produced a unique inland aquatic environment which is now home to various fishing and tourism-related activities. The lake supports the State's only commercial freshwater fishery – for the silver cobbler or catfish – together with a processing facility supplying predominantly Western Australian and interstate markets. The lake and its associated river system also support recreational fishing for the freshwater component of the barramundi stock and cherabin (freshwater prawns).

Relevant Resource Assets and Risks from all Activities

Finfish- Native	Low Risk
Ecosystem	Low Risk
Introduced Pests & Diseases	Low Risk

Current Research Focus

The Department of Fisheries actively supports a number of studies into the native freshwater fish fauna and their habitats in northern river systems in conjunction with Murdoch University, the Department of Water and the Department of Environment and Conservation, and through involvement with local natural resource management councils. New aquaculture ventures are also subject to strict environmental evaluation under the Department's licensing and on-going arrangements, in conjunction with industry and TAFE. The Department also has 'introduced aquatic organism incursion' and 'fish kill incident response' programs in place.

Current Research Focus

- Respond to reports and investigate cause of fish kills.
- Support the Barramundi stocking initiative led by RecFishWest

Priority Setting Process

No formal process exists

Given the small amount of activity no matrix is provided.

Northern Inland – Lake Argyle Silver Cobbler Fishery

Description and Scope of Issues

The only commercial freshwater fishery in Western Australia is contained in the impounded waters of the Ord River at Lake Argyle in the north-eastern Kimberley. This gillnet fishery specifically targets the silver cobbler or shovel-nosed catfish.

Summary of historical research completed

Given the nature and priority of this fishery the Lake Argyle Silver Cobbler Fishery is only assessed by compilation of catch and effort data from the fishery in the form of the statutory monthly catch and effort returns. Little data is available on the biology of the Silver Cobbler.

Relevant Resource Assets and Risks from Fishing

Finfish- Native	Moderate Risk
Protected Species (Crocodiles)	Low Risk

Current Research Focus

Data for assessing the status of the silver cobbler stock in Lake Argyle are derived from the catch and effort returns provided by industry. These data are compiled annually and used as the basis for assessing this fishery.

The catch and effort data provided by industry are used to develop stock assessment models for the fishery. However the modelling approach used in the assessment of the fishery requires a number of assumptions, which creates a high degree of uncertainty around the results generated from the models. To reduce this uncertainty an understanding of some key characteristics of both the fishery and the biology of the species would be needed.

Priority Setting Process and Review Timeline

Initial assessments were made through internal departmental meetings and forums discussing the history of research in the fishery, research activities that have been completed, current research as well as research and development gaps. Research issues are discussed at industry consultation meetings as required.

Given the small amount of activity no matrix is provided.

Southern Inland Bioregion

Southern Inland – Biodiversity Issues

Description and Scope of Issues

This region contains the state's only natural permanent freshwater rivers, which are fed by rainfall through winter and spring. These permanent rivers are restricted to the high-rainfall south-west corner of the state and flow through the significant native forest areas. Some of the rivers are more saline in their upper reaches owing to the effects of agricultural clearing of native vegetation in more inland areas.

The southwest region of Western Australia is recognised by Conservation International as one of 34 global biodiversity hotspots. The rivers of the southwest have the largest percentage of native endemic fish species (80%) and crustacean species (100%) in Australia. As result they have been recognised by WWF as one of the Earth's 53 most biologically outstanding freshwater habitats. Significantly, the southwest rivers and streams in Australia are also one of 28 freshwater habitats identified by WWF as a Global Ecoregion that is considered to have a conservation status of critical or endangered.

The conservation of the 13 species of freshwater native fish which exist in Western Australia is a growing issue for the Department of Fisheries. Some of these species are endemic to Western Australia, and therefore their survival depends on proper environmental management. Most of these fish are under pressure because of deteriorating environmental conditions. Therefore the Department of Fisheries is working with other agencies and institutions to undertake research on the distribution and life history of these animals to obtain the information required to protect them. The Department also has a captive breeding program to prevent the extinction of critically endangered and vulnerable species. Further, the Department has an approval process in place for assessing proposals to translocate fish into and within Western Australia, to minimise the risks associated with movement of fish which may impact on endemic species.

Relevant Resource Assets and Risks from all Activities

Finfish- Native	Severe Risk (non fishing)
Protected species	Severe Risk (non fishing)
Ecosystem	High Risk (non fishing)
Introduced Pests & Diseases	Moderate Risk

Summary of historical research completed

The Department of Fisheries has conducted small scale holding of south-west native fish at Pemberton Freshwater Research Centre (PFRC) since the early 1990's. More recently the Department of Fisheries established a captive breeding program at PFRC in 2005 to 1) Breed the critically endangered Margaret River marron for restocking, and 2) Develop production techniques for fish species native to the south-west of WA. These fish species also offer potential for stocking wetlands and lakes for mosquito control and restocking rehabilitated water bodies.

The department has developed the expertise to remove, produce and maintain native fish and crayfish stocks during refurbishment of water reservoirs to preserve genetic lines for restocking after completion of dam remedial works (Water Corp funded)

Current Research Focus

A captive breeding program to prevent extinction of native species and conserve biodiversity by restocking waterbodies has been established at the Department's Pemberton Freshwater Research Centre and the Aquaculture & Native Fish Breeding Laboratory at Shenton Park. The key species in this program are the critically endangered Western trout minnow (*Galaxias truttaceus hesperius*), Margaret river hairy marron (*Cherax cainii*) and Balston's pygmy perch (*Nannatherina balstoni*) which is listed as vulnerable to extinction. In addition several species such as Mud minnow (*Galaxiella munda*) and Black-stripe minnow (*Galaxiella nigrostriata*) offer potential for restocking waterways as although not yet listed as critically endangered they have severely restricted and fragmented distributions due to widespread habitat degradation.

The identification of the 'hairy' marron in the Margaret River catchment as a separate species or sub-species has focused attention on Southern Inland biodiversity issues through the decline of this critically endangered species. Specific management actions that are underway to recover this unique stock involve 1) Removing competing 'smooth' marron species from the catchment, 2) Restocking the Margaret river with "hairy" marron produced by the captive breeding program at PFRC, 3) Chairing the Margaret River marron recovery team.

In 2009, the Department commenced the development of an online Native Fish Database. The database currently contains most historical records of native fish distribution in WA. The database is linked to the scientific exemption process administered by the Department that permits university researchers to collect native fish. This will enable the Department to capture all future native fish distribution data collected by universities and other agencies in WA. It will provide a valuable tool for researchers and managers to identify both changes in native fish biodiversity and introductions of feral species.

Recent Publications

De Graaf, M., Beatty, S. and Molony, B. (authors). Baxter, D. and Larsen, R. (editors) (2010). Evaluation of the recreational marron fishery against environmental change and human interaction. Final report to the Fisheries Research and Development Corporation on Project 2003/027. *Fisheries Research Report No 211. Department of Fisheries, Western Australia.* 188pp

Priority Setting Process

Research priorities for this program are developed through consultation with freshwater fisheries managers, university research groups and natural resource managers.

Review Timeline

The most recent review of Southern Inland freshwater biodiversity research was around 2008. Next review due around 2013.

Key to symbols in the matrix/summary tables:

■ Indicates that the activity is funded and planned to occur.

O Indicates that the activity is part of a proposal but is not yet funded.

Southern Inland Biodiversity Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
Broodstock collection, reproduction, larval rearing and nutrition	Ongoing	■	■	■	■	■	Develop broodstock collection, genetic fingerprinting, husbandry practices and breeding protocols to enable the large scale production of endangered species to prevent their extinction by restocking natural and artificial wetlands
Growth	Underway	■	■				Growth/time to achieve minimum size required for tagging prior to restocking
Reproduction	Ongoing	■	■	■	■		Native fish species breeding age, size, fecundity and spawning season
Diet	Possible	O					Diet evaluation for native species
1.2 Other Biology							
Restocking artificial wetlands	Ongoing	■	■	■	■	■	Replacement of gambusia with native fish for mosquito control as an alternative to chemical spraying
Restocking natural wetlands	Ongoing	■	■	■	■	■	Restocking critically endangered species to prevent extinction
1.3 Stock Assessment							
Native fish distribution stock assessment	Ongoing	■	■	■	■	■	Stock status of species of conservation concern
Native Fish Database	Ongoing	■	■	■	■	■	Management of Native Fish database for monitoring native fish distribution & decline
Tagging & identification techniques	Underway	■					Evaluate tags to determine 1) minimum size at which fish can be tagged and 2) Optimum tagging technique prior to restocking waterbodies
Reproduction (Margaret River marron)	Underway	■	■	■	■	■	Margaret river marron Captive breeding program for restocking & recollection & testing of broodstock
Stock enhancement (Margaret River marron)	Underway	■	■	■	■		Margaret river marron restocking commenced 2010
2. Habitat & Ecosystem							
2.1 Bycatch							
2.2 Listed Species							
Captive breeding program for critically endangered species	Ongoing	■	■	■	■	■	Captive breeding program for critically endangered fish species
Margaret river marron	Underway	■	■	■	■	■	Captive Breeding program for recovery of Margaret river marron

Southern Inland Biodiversity Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
Restocking Critically endangered fish species	Ongoing	■	■	■	■	■	Restocking of species listed as critically endangered to prevent extinction
2.3 Habitat							
Water Corp Dam biological remediation	Ongoing	■	■	■			Provide advice to Water Corp on removal, transport, breeding and maintaining native fish and crayfish during draining & refurbishment of water reservoirs to 1) prevent major fish kills and 2) preserve genetic lines for restocking after completion of dam remedial works (Water Corp funded)
Water Corp advice							Provide scientific and technical advice to Water Corp
2.4 Ecosystem/Environment							
Environmental monitoring	Ongoing	■	■	■	■	■	Investigation of environmental factors affecting decline in native fish stocks
Impacts of introduced species	Proposed	O	O	O	■	■	Quantify the impacts of trout & redfin perch on native fish species
Fish Kills	Ongoing	■	■	■	■	■	Respond to reports and investigate cause of fish kills coordinated through Fisheries Research (Fish Health)
3. Management Analysis							
3.1 Socio-economic							
Social assessment	Proposed	O	O	O	■	■	Involving community & school groups in native fish conservation and restocking programs
3.2 Resource Access (Shares)							
3.3 Compliance Research							
3.4 Management Systems							
Native Fish Strategy	Underway	■	■	■	■	■	Management of database using research permits to record distribution of native & feral freshwater fish
4. Industry Development							
4.1 Production Technology							
Large scale production techniques	Ongoing	■	■	■	■		Development of large scale production technology for native fish species to enable successful restocking programs to be implemented
5. Priority Review							
6. Science Review							

Southern Inland – Freshwater Aquaculture

Description and Scope of Issues

The Southern Inland Bioregion contains suitable land, water and climate conditions to farm a range of species including marron (*Cherax tenuimanus*), silver perch (*Bidyanus bidyanus*), rainbow trout (*Oncorhynchus mykiss*), brown trout (S*almo trutta*), yabbies (*Cherax albidus*) and a variety of ornamental fish species. Farming occurs in tanks, earthen ponds and farm dams located between Esperance to Hutt River, north of Geraldton, however the bulk of farms are concentrated in the higher-rainfall south-west coastal areas. Potential exists to expand aquaculture production in the Southern Inland Bioregion, particularly on the south-west coastal plain, by using irrigation dam water for aquaculture, prior to reuse on agricultural farms. In addition, some farmers located in salt-affected regions have constructed ponds to trial trout production in saline groundwater.

There are around 180 licensed marron farms in the Southwest bioregion and they currently represent the majority of aquaculture licences in WA. There are around 12 licensed silver perch farms in WA. Silver perch production has increased rapidly over the past few years, mainly due to improved hatchery supply of juveniles. There are around 10 licensed trout farms in WA. There are around 15 licensed yabby processors in WA, who receive animals harvested from around 4000 farm dams. To protect endemic marron populations in the southwest of the state, yabby farming is restricted to east of the Albany Highway. There are around 25 licensed ornamental fish farms in WA. A wide range of both native and non-native ornamental fish species are produced in WA.

Summary of historical research completed

Marron: The marron farming industry developed from research commenced by the Department of Fisheries in the 1970's that developed techniques to breed, feed and grow marron at PFRC (Pemberton Freshwater Research Centre) and transferred this technology to industry in the late 1980's. More recently, from 2000-05 Department researchers used selective breeding to increase the growth rate of marron and developed improvements in husbandry and farm management strategies.

Silver Perch: Techniques for breeding, feeding and farming silver perch were developed by researchers in New South Wales in the late 1980's. In the early 1990's Department of Fisheries researchers in Western Australia developed extension material to facilitate the adoption of this technology by local farmers.

Trout: Trout farming is well established internationally and as a consequence considerable research on breeding, feeding and rearing these species has been conducted overseas. Since trout were introduced to WA in the late 1800's the Department of Fisheries strain at PFRC have evolved to tolerate warmer water temperatures than those farmed overseas. Selective breeding to increase this temperature tolerance could result in WA becoming a major supplier of fertilised trout eggs to the northern hemisphere.

Yabbies: Research conducted by the Department of Fisheries from 1994-2000 resulted in improved methods for stocking, feeding, harvesting, managing and farming yabbies. It also developed a hybrid yabby that grows twice as fast as the most commonly farmed species.

Ornamental fish: Techniques for farming non-native ornamentals, such as goldfish and koi, are well established overseas. A pilot program was run by UWA to develop improved stocks

of koi for export based upon selective breeding of local genetic lines. In addition the department provides technical support to producers of high value ornamental species. The Department, with cooperation from AQIS, has been monitoring the disease status of ornamental fish entering Australia through Perth and which die in quarantine. This is part of the Departments ongoing biosecurity surveillance activity.

Current Research Focus

Marron

No current research

Silver Perch

No current research.

Trout

Selective breeding to increase temperature tolerance and growth of PFRC trout population.

The cause of a 60% decline in egg viability of brown trout needs to be identified.

Improved production of triploids by pressure shock.

Control of inbreeding in PFRC population.

Production of trout fingerlings for both aquaculture and freshwater angling

Yabbies

No current research. But should investigate eradication techniques for feral yabby populations within the marron region.

Ornamental Fish

Provision of disease surveillance on imported fish.

Priority Setting Process

Research priorities for this program are developed through consultation with industry associations and key producers and involve a strategic approach to address industry problems as they arise.

Review Timeline

The most recent review of Freshwater Aquaculture research was around 2007/08.

Next review due around 2013.

Key to symbols in the matrix/summary tables:

■ Indicates that the activity is funded and planned to occur.

O Indicates that the activity is part of a proposal but is not yet funded.

Southern Inland Freshwater Aquaculture Research	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
Marron Biology	Completed						Completed in WA in 1980s – 1990s
Yabby Biology	Completed						Completed in WA in 1990s
Silver perch biology	Completed						Completed in NSW
Trout biology	Completed						Completed in WA
Ornamental Fish (native) – growth and reproduction	Underway	■	■	■			Growth rates and spawning techniques of native fish species
Genetic improvement of marron	Ongoing	■					PFRC repository stock.
Temperature tolerance & Climate change of trout	Underway	■	■	■	■		Trout in WA appear to have a higher temperature tolerance than stocks elsewhere in the world.
1.2 Other Biology							
Disease diagnostic service	Ongoing	■	■	■	■	■	Ongoing surveillance and monitoring.
Brown trout reproduction	Underway		■	■			The cause of a decline in egg viability from 70% - 10% is being identified.
Triploid production	Underway	■	■	■			Improved production of triploids
2. Habitat & Ecosystem							
Fish Kills	Ongoing	■	■	■	■	■	Respond to reports of fish kills
3. Management Analysis							
3.1 Socio-economic							
Economic evaluation (marron)	Complete						Completed in 2000-05 on commercial farms
4. Industry Development							
4.1 Production Technology							
Production technology marron	Complete						Developed in 1980's, validated in 2000-05
Hatchery production (trout)	Ongoing	■	■	■	■	■	Production of trout fingerlings & yearlings for aquaculture & recreational stocking
Non-Native Ornamental fish	Proposed	O	O				Hormonal control of reproduction
Native Ornamental fish	Proposed	O	O				Induced spawning protocols
4.2 Post Harvest							
Post harvest handling marron	Proposed	O					Mortality in purging systems requires investigation.
4.3 Marketing	Not needed						
5. Priority Review							
6. Science Review							

Southern Inland – Recreational Marron Fishery

Description and Scope of Issues

Marron are endemic to Western Australia and are the third largest crayfish in the world. Recreational fishing occurs in freshwater dams and rivers throughout the southern part of the State extending from as far north as Geraldton to Esperance in the east. This fishery is managed through input controls of licences, closed seasons and gear restrictions, and the output controls of size and bag limits.

The main external factors which affect the marron fishery are illegal fishing activities, degradation of freshwater habitat, winter rainfall, access to dams, and introduced species. Degradation of freshwater habitat (mainly salinisation in the upper reaches of catchments) has significantly reduced the natural range of marron. Winter rainfall plays a major role in marron reproduction, growth and survival.. Another major issue in this fishery is access to irrigation dams. Introduced species that impact on the marron fishery either through predation or competition for similar resource are redfin perch (*Perca fluviatilis*), trout (*Oncorhynchus mykiss* and *Salmo trutta*) and yabbies (*Cherax albidus*).

Relevant Resource Assets and Risks

Crustaceans Native (marron)	Severe Risk (non fishing)

Summary of historical research completed

The marron recreational fishery has historical data from the 1970's.

Additional research on improving habitat in artificial impoundments (water reservoirs) showed that rock wall can provide an important refuge for juvenile marron.

Current Research Focus

Improved annual stock assessment.

Develop long-term tagging program.

Trial large-scale artificial habitat to improve production and fishery in dams.

Improve logbook survey.

Remove, produce and maintain marron stocks during refurbishment of water reservoirs to preserve genetic lines for restocking after completion of dam remedial works (Water Corp funded)

Priority Setting Process

Marron research priorities are developed in consultation with the Recreational Freshwater Fisheries Stakeholder sub committee.

Recent Publications

Key to symbols in the matrix/summary tables:

■ Indicates that the activity is funded

O Indicates that the activity is part of a proposal but is not yet funded.

Southern Inland Recreational Marron Fishery Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
Biology	Completed						Data collected as part of FRDC 2003/027
1.2 Other Biology							
Disease Diagnostic Service	Ongoing	■	■	■	■	■	Provided as part of surveillance and monitoring of state disease status
1.3 Stock Assessment							
Annual Assessment	Ongoing	■	■	■	■	■	2006 introduced new sampling program using traps
Methods		■	■				A more accurate alternative needs to be calibrated against existing box traps, previous techniques and known population size
1.4 Fishery Monitoring							
Phone survey	Ongoing	■	■	■	■		
Logbook survey	Ongoing	■	■	■	■		Continuation with RAP program requires increased number of returns
Field Monitoring		■	■				A field based recreational angler creel survey could provide more accurate Information on the status of the fishery.
2. Habitat & Ecosystem							
2.3 Habitat							
Water Corp Dam biological remediation	Ongoing	■	■	■			Provide advice to Water Corp on how to remove, transport to PFRC, breed and maintain native fish and crayfish during draining & refurbishment of water reservoirs to 1) prevent major fish kills and 2) preserve genetic lines for restocking after completion of dam remedial works (Water Corp funded)
Fishing enhancement structures	Ongoing		■	■	■	■	Investigate purpose built fishing enhancement structures for use in dams where recreational marron fishing occurs
2.4 Ecosystem/Environment							
3. Management Analysis							
4. Industry Development							See Aquaculture
5. Priority Review							
6. Science Review							

Southern Inland – Recreational Freshwater Angling

Description and Scope of Issues

The south-west recreational freshwater fishery is focused primarily on angling for rainbow trout (*Oncorhynchus mykiss*) and brown trout (*Salmo trutta*) which are the subject of an annual controlled stocking program by the Department of Fisheries. In addition, anglers take the native freshwater cobbler (*Tandanus bostocki*) and an exotic species redfin perch (*Perca fluviatilis*). Redfin perch was previously released in the south-west and now occurs as self-breeding populations in most water bodies. Licensed anglers may only use a single rod, reel and line or single handline when targeting these species. Access to this fishery is controlled by license, seasonal closures, minimum sizes, and bag limits. People under 16 years of age are not required to hold a license to go freshwater angling.

The extent and success of the freshwater angling fishery in the south-west is dependent mainly upon availability of high-quality fresh waters for stocking. The degraded nature (e.g. increased salinity) of many freshwater streams and rivers coupled with the effect of climate change (e.g. reduced flow and water levels) has a strong negative effect on the future of recreational fishing. The availability of water is dependent on rainfall and access to irrigation dams. Thus low rainfall and reduced access to permanent water bodies are having a negative influence on the freshwater angling fishery.

Relevant Resource Assets and Risks from Fishing

Finfish – Exotic (trout) Moderate Risk

Finfish – Native

Summary of historical research completed

The Department has records of trout stocking locations and numbers, but there has been limited research into the impacts of stocking on native fish species.

Current Research Focus

Integration of logbooks into the RAP program.

Securing external funding to study the interaction between native fish and stocked trout.

Priority Setting Process and Review Timeline

Freshwater Angling research priorities are developed in consultation with the Recreational Freshwater Fisheries Stakeholder sub committee.

A review was completed in the late 1990's.

Key to symbols in the matrix/summary tables:

■ Indicates that the activity is funded and planned to occur if the vacant Freshwater Fisheries Scientist position is filled.

O Indicates that the activity is part of a proposal but is not yet funded.

Southern Inland Recreational Freshwater Angling Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
1. Retained Species Stock Analysis							
1.1 Basic Biology of indicator species (Growth, Reproduction, Diet, Natural mortality)							
Trout: Growth, Mortality	Proposed	O	O	■	■	■	Limited information of wild stock growth & survival. A tagging program is required
Trout: Reproduction	Proposed	O	O	O	O	■	Determine location and success of self sustaining populations
Trout: diet	Complete						Data collected as part of FRDC 2003/027; co-operation with Murdoch University
Redfin (growth, diet, mortality)	Complete						Several publications available; additional data collected as part of FRDC 2003/027
Freshwater Cobbler (growth, diet, mortality)	Complete						Several publications available; additional data collected as part of FRDC 2003/027; focus of several research projects by MU
1.3 Stock Assessment							
Annual Assessment	Ongoing	■	■	■	■	■	Catches and catch rates only
1.4 Fishery Monitoring							
Phone survey	Ongoing	■	■	■	■	■	
Logbook survey	Ongoing	■	■	■	■	■	Trial logbook program
2. Habitat & Ecosystem							
2.1 Listed Species							
Impact of trout & redfin on listed species	Proposed	O	O	O	O	■	Urgent need to determine interaction stocked trout and (protected) native fish species
2.2 Habitat							
Potential for trout stocking in artificial impoundments	Proposed	O	O	O	■	■	Evaluation of stocking trout in artificial impoundments as an alternative to streams
Artificial reef habitats to enhance fishery	Proposed	O	O	O	■	■	Install and monitor artificial reefs in impoundments to improve fishery
2.3 Ecosystem/Environment							
Impact of trout on native species	Proposed	O	O	O	O	■	Urgent need to determine interaction between stocked trout and native fish species
Impact of redfin on native species	Proposed	O	O	O	O	■	Urgent need to determine interaction of redfin on native fish species
3. Management Analysis							
3.1 Socio-economic							
Social assessment	Completed						Socioeconomic value of trout angling has been completed
Economic Analysis	Completed						Socioeconomic value of trout angling has been completed
3.2 Resource Access (Shares)							Not needed
3.3 Compliance							
Poaching	Proposed		O	■	■	■	Concerns about unlicensed fishing and illegal gear used to target stocked broodstock trout

Southern Inland Recreational Freshwater Angling Research Projects	Research Status	2011/12	2012/13	2013/14	2014/15	2015/16	Comments
3.4 Management Systems							
4. Industry Development							
5. Priority Review							
6. Science Review							