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Resource Assessment Framework (RAF) for Finfish Resources in Western Australia



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Introduction

The Department of Fisheries Western Australia has the responsibility to sustainably manage fishery resources (assets) and the habitats that support them for all West Australians. Within the Department of Fisheries, the role of the Finfish Branch of the Research Division, in conjunction with the Stock Assessment and Data Analysis Branch and Biodiversity and Biosecurity Branch, is to monitor and assess the finfish (scalefish, sharks and rays) stocks (assets) of the State, to assess their sustainability and risks to their sustainability and to provide this advice to management. The Division of Aquatic Management of the Department takes this sustainability advice, in addition to economic, social, political and other inputs, to generate management advice and decisions for the benefit of the State.

A major challenge faced by the Finfish Branch of the Research Division is to provide advice on the more than 3,000 species of finfish (Hutchins 2001) spread along more than 12,800 kilometres of coastline within the State. Given the large number of exploited and non-exploited species in Western Australia, a process was needed to identify which species should be the focus of monitoring. This process commenced in 2002 with the adoption of the Ecologically Sustainable Development (ESD) policy by the Department of Fisheries (Fletcher 2002). In brief, the way that the Department of Fisheries has addressed monitoring and assessment of marine fishery resources in Western Australia is to identify species within Bioregions and allocate each species into one of five suites – Estuarine, Nearshore, Inshore Demersal, Offshore Demersal and Pelagic. Then, using a risk-based approach, quantify the risks to the sustainability of the stocks based on biological and other criteria to develop a matrix of risk. From the list of species within a suite for a given Bioregion, indicator species are identified based on their vulnerability to fishing and other considerations, such as whether they are target species in the major fisheries, the value to the community, economic value, recreational value and cultural value (Lenanton et al. 2006). It is these indicator species that are monitored; the status of these indicators is assumed to represent the status of the suite and therefore the resource (asset).

Role of this document

This document outlines the process for selecting indicator species for monitoring and assessment of the status of a suite of finfish resources (assets). This document also outlines how the overall risks to sustainability of all fish stocks are determined within the Department of Fisheries. The risk to each fish stock is assigned a value (low to high) using the risk assessment methods outlined in Fletcher et al. (2005, 2010). The risk status of the indicator species then determines the risk-level to biological sustainability of a fishery resource (asset)¹ (e.g. the status of the West Coast Inshore Demersal suite of fishes). Finally, this document describes the process that determines the level of priority for the management, research, monitoring and compliance of finfish stocks in Western Australia.

The risk to the biological sustainability of a suite of fishes is only one of the inputs used to determine the overall risk and priorities to the Department using an Ecosystem Based Fisheries Management (EBFM) approach (Fletcher et al., 2010). External impacts to the stock, the risk to the commercial value (GVP) of fisheries exploiting the resource and the risks to the value of the social amenity that the resource provides are all incorporated to determine overall priority

¹ A suite of fishes within a Bioregion is a fishery resource (asset).

score; these form the essential components of the Department's EBFM system (Fletcher et al 2010) to determine the overall priorities of the Department and therefore the resourcing of all activities to reduce risk profiles (Figure 1).

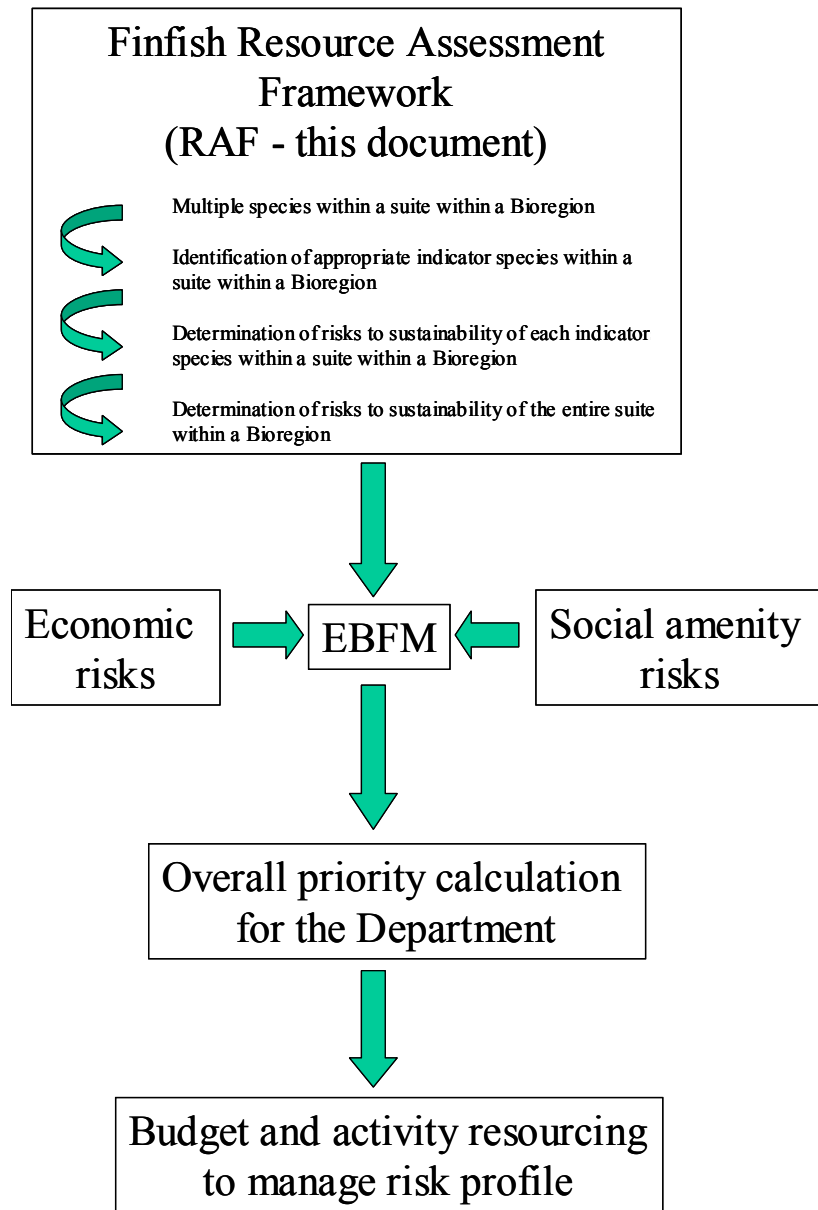


Figure 1. Relationships between the RAF and Ecosystem Based Fisheries Management process (EBFM), the Departmental risk analysis process and the setting of overall Departmental priorities and resources to reduce risks.

1.0 Bioregions and fisheries

The Western Australian coastline is approximately 12,800 km long, ranging from the Northern Territory border through to the South Australian border. The latitudinal range of Western Australia (WA) extends from approximately 10°S to 40°S. This results in a highly diverse fish fauna in the State, including tropical and temperate species. Recently, Hutchins (2001) estimated that there were at least 3,000 species of fishes in WA waters.

Within Western Australia there are more than 20 State managed finfish fisheries (Table 1), and a range of other fisheries (e.g. invertebrate fisheries), for which the Department of Fisheries is the responsible Agency for their sustainable management (Fletcher and Santoro 2010). In addition, there are recreational fisheries and a range of Commonwealth managed fisheries that operate within the waters of the Australian Exclusive Economic Zone off the coast of Western Australia, which require attention according to the Offshore Constitutional Settlement, 1995² (Brayford & Lyon, 1995).

Table 1. Commercial State managed finfish fisheries operating within each of the Bioregions of Western Australia. This list does not include recreational, indigenous or Commonwealth fisheries. No commercial fisheries operate in the Southern Inland Bioregion

Bioregion	Commercial Fishery
NORTH COAST	Kimberley Gillnet & Barramundi Northern Demersal Scalefish Pilbara Demersal Finfish Pilbara Trap Pilbara Trawl Pilbara Line Mackerel Northern Shark
GASCOYNE COAST	Gascoyne Demersal Scalefish Shark Bay Snapper Gascoyne Demersal Interim Managed Inner Shark Bay Scalefish
WEST COAST	West Coast Estuarine Cockburn Sound Fish Net Cockburn Sound Line & Pot West Coast Netting West Coast Beach Bait West Coast Purse Seine West Coast Demersal Scalefish Demersal Gillnet and Longline South West Coast Salmon
SOUTH COAST	South Coast Estuarine South Coast Netting South Coast Wetline South Coast Salmon South Coast Purse Seine Demersal Gillnet and Longline
NORTHERN INLAND	Lake Argyle Silver Cobbler

² The Offshore Constitutional Settlement (OCS) was under review and renewal as this document was being finalised.

With the large number of species interacting with a range of diverse method-fisheries, monitoring and assessing finfish species and fisheries within the State waters is an ongoing challenge. In order to address this challenge, the Department has divided the coastline into four marine Bioregions (Figure 2);

- The North Coast Bioregion (from the Northern Territory Border south to west of Onslow), which includes both the Pilbara and Kimberley regions;
- The Gascoyne Coast Bioregion, (from Onslow south to south of Shark Bay);
- The West Coast Bioregion, (from south of Shark Bay to east of Augusta); and
- The South Coast Bioregion, (from east of Augusta to the South Australian border).

There are also two Inland Bioregions; Northern Inland and Southern Inland. A single commercial fishery operates within the Northern Inland Bioregion. There are no commercial wild harvest fisheries in the Southern Inland Bioregion.



Figure 2. The Bioregions of Western Australia, defining the extent of the four marine Bioregions and the two inland Bioregions. Source: Fletcher and Santoro 2010.

2.0 Suites of species

The four marine Bioregions divide the marine waters of the State into broad ecological areas (see Fletcher et al. 2010). Nonetheless, the total number of fish species within each Bioregion is in the order of hundreds of species. To further refine approaches to the monitoring and assessment of fishery resources, the Department has identified five ecological suites within each Bioregion based on broad habitat and depth criteria (Figure 3);

- Estuarine suite, defined as estuarine waters up to the mouth of a river;
- Nearshore suite, from the beach to a depth of 20 metres;
- Inshore Demersal suite, between depths of 20 metres and 250 metres;
- Offshore Demersal suite, from the 250 metre isobath to the edge of the Exclusive Economic Zone (200 nautical miles);
- Pelagic suite, which includes the pelagic fishes ‘above’ the Inshore Demersal and Offshore Demersal suites.

These suites are not only applicable to finfish species but to other asset categories too, such as invertebrate resources and habitats.

These ecological suites are broadly consistent with areas where major fisheries operate within a Bioregion. Therefore, the sub-division of a Bioregion into these suites categorises fish species into ecological groups that are vulnerable to similar fisheries. For example, in each of the four marine Bioregions there are multiple gears (fisheries) that target and capture inshore demersal scalefish (i.e. in depths of 20–250 m). Similarly, multiple fisheries within the West Coast Bioregion operate in depths of less than 20 m, targeting fish within the nearshore suite. Thus assigning each fish species within each Bioregion to a single suite allows multiple species, and the fisheries that they support, to be readily considered, assessed, monitored and managed by the Department.

Nonetheless, experience in the West Coast Integrated Fisheries Management (IFM) process included negotiations with stakeholders about the assignment of species to a single suite. This is a result of the suites being broadly representative of habitats; however catches of a single species may be reported from multiple habitats. Thus the allocation of a species to a single suite within a Bioregion was made based on the suite where most of the catches of a species were reported. While there were some exceptions, a large majority of species assigned to a single suite in the West Coast Bioregion were immediately acceptable to all stakeholders.

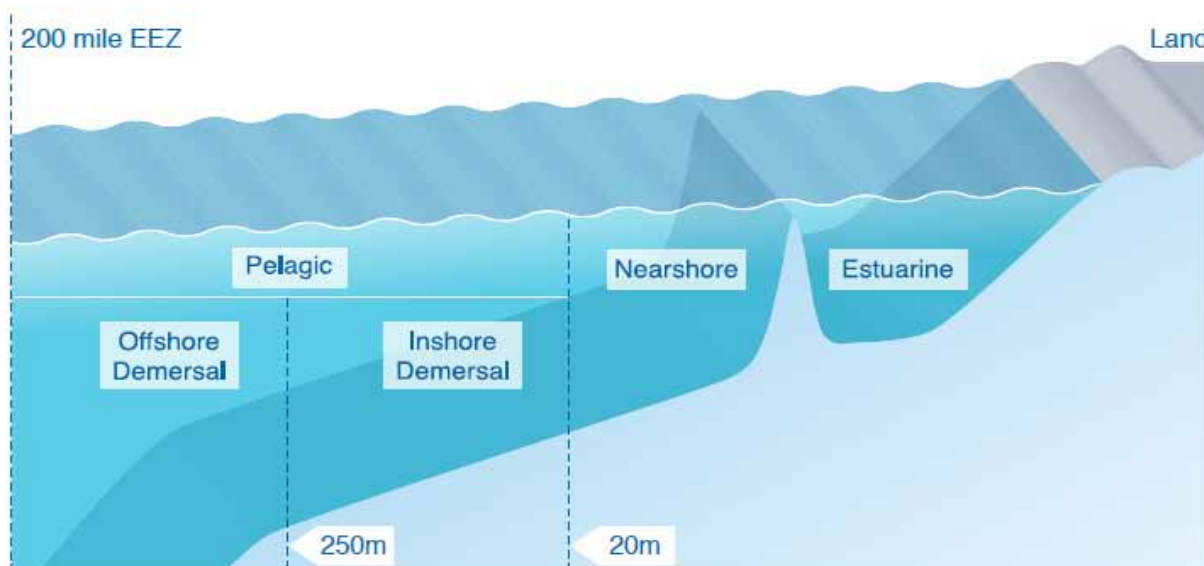


Figure 3. Schematic representation of the five suites of finfish species within each marine Bioregion of Western Australia.

3.0 Identification of indicator species

Within a given Bioregion there are often multi-sector fisheries operating on a similar resource. For example, there is often a commercial sector, a recreational sector (including charter operators) and an indigenous sector. While the actual catch shared among these sectors varies, in some cases the catch is almost 50/50 split between recreational and commercial interests (Wise et al, 2007).

Despite dividing the state into four marine Bioregions, and each Bioregion into five suites, each individual suite still contains a large number of species, typically more than 20-100. The challenge for the Department of Fisheries and the Finfish Branch is how to monitor and assess the status of each suite and provide advice on the risks to sustainability. Monitoring each individual species is logistically and fiscally impossible. Species need to be identified that are indicative of the status of the entire suite; these are termed **Indicator Species**.

An Indicator Species is a species, for which the status of its fished stock(s) can be used as a robust indicator of the sustainability status and risks within a suite. Typically, more than one indicator species is identified to reduce the risk that single species may not adequately represent an entire suite³.

The methods to identify what are appropriate as indicator species has developed by the Department over several years (Lenanton et al, 2006) and uses a number of criteria within 3 broad groups;

1. The inherent vulnerability of a species to the impacts of fishing, which is based on knowledge of their biology (Appendix 1). An indicator species must be at the more-vulnerable end of the spectrum for the suite based on;
 - **Longevity**: typically, the longer a species lives the more likely it is to be of relatively low productivity (e.g. low growth rate over much of its life; population replenishment rates are relatively low). Thus, relatively long-lived species are commonly used as indicator species.
 - **Age at maturity and reproduction characteristics**: the longer it takes for a species to mature, the more vulnerable it is, especially if it becomes vulnerable to fishing before it matures. In addition, some targeted species undergo sex change (e.g. baldchin groper), resulting in differential fishing mortality between sexes and increasing vulnerability to fishing impacts. Species that form spawning aggregations can be more easily targeted and over-fished.
 - **Recruitment patterns**: some species display high levels of recruitment variability among years (e.g. pink snapper). While the actual mechanisms are uncertain (e.g. low reproductive success, low larval or juvenile survival), the result can be that relatively few age classes support an entire fishery.
 - **Stock structure**: If larval dispersal and/or adult movement are limited, smaller reproductively isolated stocks could exist within a single Bioregion. Small stocks are typically more vulnerable to fishery impacts than large stocks.
 - **Survival after interactions with fisheries**: there are high rates of barotrauma reported for some species, especially if captured and subsequently released from depths greater than 30–40 m. This makes these species more vulnerable to fishing impacts, even if not retained.

³ This is part of a weight of evidence approach to the consideration of all relevant information to determine the status of a stock and suite (Wise, et al, 2007).

2. The contribution of species to commercial and recreational catches and the wider community. Indicator species must be captured frequently enough, and/or in large enough quantities to allow sufficient data to be collected relatively easily and cost-effectively. These targeted and regularly captured fishes may also be culturally important or ‘iconic’ species (e.g. West Australian dhufish). These iconic species are also ideal to encourage the engagement of stakeholders in research and monitoring efforts (e.g. collection and supply of fish frames).
 - **For commercial fisheries:** the current or likely annual Gross Value of Production (GVP) (Fletcher et al 2010) provides an index for the value of a given species to a commercial fishery. The value of a species is allocated to one of six categories [0 - no commercial value; 1 - less than \$0.5 million; 2 - \$0.5–1.0 million; 3 - \$1.0–5.0 million; 4 - \$5.0–20.0 million; 5 - greater than \$20.0 million].
 - **For recreational fisheries:** the importance or relative priority is assigned to one of six classes [0 - not relevant (i.e. not a recreational species); 1 - small incidental take only; 2 - a secondary species (e.g. flathead in the West Coast); 3 - highly targeted but only by a few (e.g. billfishes); 4 - a popularly caught species but not one of the primary species; 5 - one of the three-four primary target species in a suite within a Bioregion (e.g. pink snapper, West Australian dhufish, tailor, Australian herring)].
3. The management information needs. This is based on the level of information required to support the current management arrangements. This considers more than the stock monitoring, and includes consideration of the required timeliness of ongoing data and inputs to support the management regime. This is considered under five categories; [1 - no data are used within a season or even between most years to manage activities; 2 - little or no data used within a season and only minor levels of data are needed for assessments between seasons (Catch and effort data analyses only); 3 - some data may be used within a season and between seasons but not very sophisticated (Catch and effort data, daily logbooks, some ancillary biological data); 4 - some data are needed within a season and/or high levels are needed between seasons because management can alter greatly depending upon results (e.g. Age structure data for models); 5 – a large amount of data needs to be collected to enable the fishery management regime to operate each year due to real time management needs (e.g. Shark Bay and Exmouth gulf prawns)]. Managers also consider the customary and cultural significance of a species.

The attached matrices (Appendices 2 – 7) summarise the most recent (September 2010) review of major finfish species reported from each suite for each Bioregion. The species included in each appendix are not an exhaustive list of all reported species for a Bioregion or suite; instead, they reflect the commonly captured species of each suite. The lists are larger for some individual suites due to the greater amount of information available (e.g. Gascoyne creel surveys) and the high profile nature of some fisheries (e.g. West Coast Demersal)

The information summarised in Appendices 2–7 was used to identify indicator species for each suite within each Bioregion (Table 2). In brief, the current risk to the wild stock, GVP, recreational importance and management information needs were determined, and highly ranked species selected as indicators. The only exception were in the inner Gulf stocks of pink snapper in the inshore demersal suite of the Gascoyne Bioregion (Appendix 3); these stocks are currently closed to commercial fishing but their historical value was relatively high and their current recreational and cultural value is very high.

The number of indicator species per suite varies within and among Bioregions (Table 2). This is a result of the need to have more species due to multiple fisheries using different gears and/

or multiple sectors harvesting within a single suite. For example, the North Coast inshore demersal suite is represented by five indicator species. This is due to the fishery operating in two discrete areas – Kimberley and Pilbara – and that multiple gears are used in the Pilbara commercial sector (trawl, trap and line).

There are some apparent repetitions of species across different Bioregions (e.g. goldband snapper). This is due to there being multiple distinct stocks (based on best-available genetic information) of this species among and within Bioregions (e.g. separate stocks of goldband snapper in the Kimberley, Pilbara and Gascoyne). It may also result due to different characteristics of fishing impacts on parts of the same stocks in different areas of a single Bioregion. It is likely that new information on stock structure may be generated in the future that will require ongoing review of stock boundaries and indicator species. In addition, there are likely to be changes in fishing patterns and activities as a result of management changes that may result in previously rarely captured species becoming more prominent in the catches of some sectors. This will also require reassessment of risks and indicator species and will be monitored by catch compositions.

4.0 Status of indicator species and suites

The identification of suitable indicator species allows monitoring and assessment resources to be focussed on a small number of species, providing a more focussed approach to monitoring and data collection while still allowing the status of the indicator species, and therefore the condition of the entire suite (i.e. the resource or asset), to be assessed. Risks to the sustainability of each indicator species, and the entire resource, can then be developed into research advice for consideration by fishery managers and stakeholders for the ongoing sustainability of the resource.

The status of indicator species is presumed to be indicative of the biological status (‘condition’, ‘state’ or ‘health’ of a resource) of the entire suite. However, indicator species may not necessarily be indicative of the status of the fishery in terms of the economic viability or social value to individual sectors within a fishery. For example, while we may have sustainable fish stocks that support a commercial fishery, these may not be entirely appropriate indicators of the economic viability of charter operators.

Finally, one assumption is that most of the risks to sustainability of the suite (resource) are due to the effects of fishing; thus the risks to sustainability can be managed with fishery legislation. While this may be true for many demersal resources, currently the major risk to sustainability of the estuarine suite of fishes in the West Coast Bioregion is associated with declining habitat quality (e.g. water quality, water diversion, pollution etc). This issue – ecosystem indicators – is addressed in section 6.

Table 2. Current and proposed finfish indicator species for assessing the status for each suite and Bioregion. Shaded colours represent the current level of risk to sustainability of these resources. **Blue = low risk; yellow = moderate risk; pink = medium high risk; red= high risk.** * Proposed Indicator species.

Bioregion	Suite				
	Pelagic	Offshore demersal	Inshore demersal	Nearshore	Estuarine
North Coast	Spanish mackerel ¹ Grey mackerel	Ruby snapper* Eightbar grouper*	Red emperor Goldband snapper ⁹ Rankin cod Blue spotted emperor Brownstripe snapper	King Threadfin Blue threadfin	Barramundi
Gascoyne Coast	Spanish mackerel ¹ Grey mackerel	Ruby snapper* Eightbar grouper*	Pink snapper ² Goldband snapper ¹⁰ Spangled emperor	Pink snapper ² Tailor* Whiting sp*	NA ³
West Coast	Samson fish Spanish mackerel ¹	Hapuku* Blue-eye trevalla* Eightbar grouper*	West Australian dhufish Pink snapper Baldchin groper	Australian herring Tailor Whitebait* Whiting sp* Garfish*	Black bream ⁴ Cobbler ⁴ Perth herring
South Coast	Pilchard* Blue mackerel* Samson fish* Yellowtail scad*	Hapuku* Blue-eye trevalla* Eightbar grouper*	Bight redfish* Blue groper* Blue morwong* Pink snapper*	Australian herring Australian salmon Sea mullet* Whiting sp*	Black bream ⁴ Cobbler ⁴ (Wilson Inlet)
Statewide	Under review ⁵ ; pelagic species (e.g. Spanish mackerel ¹) may have distributions across multiple Bioregions	Under review ⁶ ; offshore demersal species may have distributions across multiple Bioregions	Sandbar shark Dusky whaler shark Whiskery shark	NA ⁷	NA ⁸
Northern Inland	Silver Cobbler				

¹ Spanish mackerel occur in multiple Bioregions and likely represent a single stock throughout West Australian waters. Monitoring may therefore only be needed in the North Coast Bioregion as this is where the highest catches are recorded and where the breeding stock is mainly located;

² There are four genetically distinct stocks of pink snapper in the Gascoyne Bioregion (offshore, eastern Gulf, Denham Sound, Freycinet) and each is monitored separately.

³ There are no true estuarine systems in the Gascoyne Bioregion;

⁴ Black Bream and cobbler are represented by distinct, isolated stocks in each estuary within the West Coast and South Coast Bioregions;

^{5,6} Indicator species for pelagic and offshore demersal suites may be more appropriately considered as part of a Statewide suite;

^{7,8} There are no Statewide nearshore or estuarine species.

⁹ Currently, two goldband snapper stocks are assumed to occur in the North Coast Bioregion, in the Kimberley and Pilbara areas.

¹⁰ Goldband snapper in the Gascoyne Bioregion are a separate stock to those in other Bioregions.

5.0 Monitoring and assessment of indicator species

While indicator species for each suite and Bioregion have been identified, the monitoring and assessment methods vary among indicators. This is driven by several factors including;

- **The ecological risk to the indicator species** – this is the current risk to sustainability of an indicator species, determined by the latest assessment for the suite.
- **The population dynamics of the indicator species** – for example, there is minimal value in annual assessments of a long-lived species (i.e. those with longevities of 20–25 years or greater). Many of the demersal species identified in Table 2 have longevities exceeding 35 years.
- **The size and value of the fishery exploiting the indicator species, data availability and the historical level of monitoring** – the catch and effort of all fisheries is the minimum information annually collected, assessed and reported in the *State of the Fisheries and Aquatic Resources Report*. However, some fisheries receive higher levels of monitoring due to ecological, economic, social, or compliance/enforcement risks. Broadly, there are five levels of monitoring and assessment of suites of fishes in Western Australia;
 - Level 1 – Catch data only.
 - Level 2 – Level 1 plus effort data.
 - Level 3 – Level 2 plus F-based approaches (fishing mortality estimated from representative age structures).
 - Level 4 – Level 3 plus fishery-independent estimates of fishing mortality or exploitation rate, from tagging studies for example.
 - Level 5 – Level 3 and/or 4 within an integrated statistical stock assessment model.
- **Other factors influencing the feasibility of alternative sampling approaches.** For example, if a species is identified at high risk via the risk assessment process but captured in very low numbers, then alternative methods may need to be considered. This is the case for many protected species that interact with fisheries. Observer programmes may be considered in some cases.

The level of resourcing for all fisheries is reviewed periodically and levels of risk re-assessed which may alter the level of monitoring and assessment in the future. The risk levels to the sustainability of a suite (asset) identified in this document are used as one input in determining the level of monitoring and assessment in the future for each suite in the Department of Fisheries' EBFM system.

6.0 Other considerations

Non-fishery impacts on estuarine and nearshore suites of fishes

The monitoring and assessment of indicator species as indicators of the status of a suite will generally be a robust approach if extractive fishing is the major risk and impact to sustainability. This is generally the case in marine systems where stocks generally occur over extensive spatial scales.

However, in nearshore systems, and particularly in estuarine systems, monitoring indicator species and managing fisheries may have less relevance to monitoring the risks to sustainability of these suites due to the wide range of different pressures impacting in these habitats. For example, in nearshore areas, point impacts due to developments (e.g. marinas, harbours, breakwaters) may impact on fishery resources, albeit typically at small spatial scales relative to the distribution of a stock. Dredging activities may cause impacts over wider areas.

In contrast, many estuarine systems are highly modified, especially around major urban centres (e.g. the Swan River Estuary, the Peel-Harvey Estuary). This is due to a range of habitat modifications (e.g. canalisation), water diversion, developments close to the banks of estuaries, water quality issues (e.g. pollution, runoff, etc) and extraction or impoundment of water in upstream reaches (including damming rivers). In highly modified estuarine systems, non-fishery impacts are likely to greatly exceed the impacts of extractive fisheries on the status of fishery resources. This is especially the case for estuarine systems where commercial fishing has been greatly reduced or removed and where recreational fishing may also be declining due it being less attractive to stakeholders (e.g. a result of excessive blowfish abundance or algal blooms).

For example, in the Swan River estuary there have been massive changes in water allocation, salinisation of upstream waters in the catchment, availability of fish habitat (e.g. snags) in the river and presence of riparian vegetation along the banks. Many of these factors are now likely to have a larger impact on the sustainability of fishery resources than do extractive fisheries. There are now almost annual reports of fish kills, typically related to changes in water quality (especially declining oxygen levels) during early or late summer, which often correlate to large influxes of rain.

In these situations, actions within fisheries management legislation may have little influence in reducing the risks to the sustainability of fishery resources. This is clearly recognised within the EBFM system in the prioritisation process that accounts for social and economic values in determining overall risks and priorities (Fletcher et al., 2010). However, resulting impacts (e.g. declines in abundance or quality of fishes, fish kills, change in community composition) are perceived as fishery management issues. This raises the question of whether the Department of Fisheries should monitor beyond indicator species in 'higher risk' estuarine and nearshore systems. The Department has already closed commercial fisheries in some estuarine systems (e.g. the Swan River Estuary) and is working with other Agencies responsible for catchment management to influence outcomes that result in improvements in water quality (Fletcher et al. 2010).

Commonwealth managed fisheries operating within the waters of WA

In accordance with the Offshore Constitutional Settlement (OCS) (Brayford & Lyons 1995) and a formal arrangement between the Commonwealth and the State, the Western Australian Department of Fisheries is responsible for the management of the majority fish resources and fisheries between three nautical miles (nmi) and 200 nmi from the Western Australian coastline.

However, there are still a number of Commonwealth managed fisheries that operate in the marine waters off Western Australia (see www.afma.gov.au). The main Commonwealth fisheries operating off the Coast of Western Australia are:

- Western Deepwater Trawl Fishery off the West Coast and Gascoyne Coast Bioregions;
- North West Slope Trawl Fishery off the Pilbara and Kimberly Coasts of the North Coast Bioregion;
- Great Australian Bight Trawl Fishery off the South Coast Bioregion
- Small Pelagic Fishery off the South Coast Bioregion
- Western Tuna and Billfish Fishery off the entire Coast

While a seemingly large number of fisheries, the actual effort recently expended in the trawl and tuna and billfish fisheries have been very low. Nonetheless, these fisheries interact with the demersal (including species of shark) and pelagic suites of resources in all marine Bioregions. The Commonwealth managed fisheries do report catches of indicator and other species.

Arrangements for formal data sharing and allocation of catch shares between fisheries under State and Commonwealth interests are currently being discussed. This is expected to lead to a better determination of risks to sustainability for consideration by managers. In the meantime, the best estimates of catches (reported on the AFMA website www.afma.gov.au) are considered in the determination of risks to sustainability and status of the relevant suite.

7.0 How frequently will the information in the RAF updated?

While the indicator species in Table 2 are assumed to be indicative of the status of an entire suite, it is unlikely that 2 or 3 species of a suite of more than 20 – 100 species will always be indicative of the status of every species at every time. If the relative abundance of a species within a suite changes, if targeting of a species changes, or if a species requires higher levels of protection (e.g. it becomes listed as a protected species), it is likely that indicator species and the scope of fishery monitoring will also need to be reviewed. It is therefore important to review indicator species and risks periodically to ensure the Department is monitoring the most appropriate indicator species. These reviews will also be reliant on input from Departmental stakeholders.

The monitoring and assessment of resources varies among suites and Bioregions based on the population dynamics of individual species, the risk to sustainability of each resource and Departmental priorities and resources. Information within this RAF will therefore be updated as new assessments are completed and new information becomes available. Thus, the RAF will be a ‘living’ document. It is anticipated that formal review and publication of updated versions of the RAF will occur on a 3–5 year basis in the future in addition to annual, internal reviews.

8.0 Acknowledgments

This document represents the collective inputs of Finfish Research Scientists (Research Division) and Fishery Managers (Division of Aquatic Management) of the Department of Fisheries, Western Australia. Valuable inputs and comments from Dr Rick Fletcher and Dr Daniel Gaughan contributed to the final version of this document.

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10.0 Appendices

Appendix 1: Assessing inherent vulnerability of finfish indicator species of resource status for each suite based on life history traits.

a). Biological inherent vulnerability

Level	Description	Longevity	Onset of Maturity	Growth rate (k)	Reproductive strategy/investment	Recruitment
1 Low	Exceptionally Short/Low/Young/Fast	< 10 yr	< 2yr	K > 0.25 (e.g. <i>A. georgiana</i>)	Broadcast spawning in small groups throughout distribution, or year round spawning with high fecundity	Year round (relatively consistent)
2 Minimal	Short/Low/Young/Fast	10-20 yr	2-4 yr	K = 0.20-0.25 (e.g. <i>A. japonicus</i>)	Spawning period 4-8 months	Restricted annually with wide broadcast distribution of progeny
3 Moderate	Intermediate	20-30 yr	4-8 yr (e.g. <i>P. auratus</i> , <i>G. hebraicum</i>)	K = 0.15-0.20 (e.g. <i>H. octofasciatus</i>)	Spawning period 3-4 months	Subject to equal periods of poor and strong (e.g. <i>G. hebraicum</i>)
4 High	Long/High/Old/Slow	30-45 yr (e.g. <i>L. sebae</i> , <i>P. auratus</i> , <i>G. hebraicum</i>)	8-12 yr	K = 0.10-0.15 (e.g. <i>P. auratus</i> , <i>G. hebraicum</i>)	Complex hierarchy (sex change & high atresia mid season) Relatively small GSI of male and/or female (e.g. <i>G. hebraicum</i>) or spawning period 1-2 months	Poor with few occasional strong years (e.g. 2 per 10 yr, <i>P. auratus</i>)
5 Extreme	Exceptionally Long/High/Old/Slow	> 45 yr (e.g. <i>A. gouldii</i> , <i>Polyprion</i> sp.)	> 12 yr (e.g. <i>A. gouldii</i>) (e.g. many elasmobranchs)	K < 0.10 (e.g. <i>B. frenchii</i>)	Spawning aggregations every > 500 km (e.g. <i>P. auratus</i> , <i>A. japonicus</i>), Short spawning period < 30 d High parental care, low fecundity (e.g. <i>C. macrocephalus</i>)	Exceptionally low fecundity (e.g. many elasmobranchs)

b). Ecological inherent vulnerability

Level	Description	Species distribution	Breeding stock structure
1 Low	Exceptionally Short/Low/Young/Fast	Circum-global	One population over many Bioregions
2 Minimal	Short/Low/Young/Fast	Indo-Pacific	Multiple populations throughout Indo-Pacific
3 Moderate	Intermediate	Endemic Australia	One population with restricted range within WA (endemic)
4 High	Long/High/Old/Slow	Endemic W.A.	Multiple populations with restricted range within WA (endemic)
5 Extreme	Exceptionally Long/High/Old/Slow	Strong habitat association during one or many life stages with such habitat limited in W.A. (e.g. <i>P. auratus</i> & <i>C. macrocephalus</i>)	Multiple discreet populations within a single Bioregion

Appendix 2: Inherent vulnerability and current risks to the sustainability of major finfish species for each suite within the North Coast Bioregion.

[Key to commercial fisheries: KGBF – Kimberley Gillnet and barramundi Fishery; NDSF – Northern Demersal Scalefish Fishery; PDSF – Pilbara Demersal Scalefish Fishery].

Appendix 2 - Resource Assessment Framework - August 2010 - Northern Bioregion														
Suite	Species	Scientific name	Fishery	Inherent Vulnerability	Current Risk to Wild Stock	Overall risk to sustainability	Current Management requirements	GVP	Recreational Significance	Customary Significance	Cultural	Management + Recreational + GVP significance	Indicator attributes	Indicator species
Estuarine	Barramundi	Lates calcarifer	KGBF, Recreational	4	4	16	2	2	5	4	4	9	13	Yes
Estuarine	Mangrove jack	Lutjanus argentimaculatus	Recreational, NDSF	5	3	15	2	1	3	4	1	7	9	No
Estuarine	Blackspotted cod	Epinephelus malabaricus	Recreational, NDSF	4	3	12	2	1	2	3	1	6	8	No
Estuarine	Goldspotted rockcod	Epinephelus coioides	Recreational, NDSF	4	3	12	2	1	3	3	1	6	9	No
Estuarine	Trevallies	Family Carangidae	Recreational, NDSF	3	2	6	1	2	3	5	1	6	8	No
Nearshore	Sawfish	Family Pristidae	KGBF, Indigenous, Recreational	5	4	20	1	0	1	4	5	1	0	No
Nearshore	King threadfin	Polydactylus macrochir	KGBF, Recreational	2	4	8	2	2	5	4	3	9	13	Yes
Nearshore	Blue threadfin	Eleutheronema tetradactylum	KGBF, Recreational	3	3	9	1	0	3	3	1	1	0	No
Nearshore	Grass emperor	Lethrinus laticaudis	Recreational, NDSF	2	3	6	2	1	3	4	1	6	9	Yes
Nearshore	Golden snapper	Lutjanus johnii	Recreational, NDSF	4	4	16	1	0	3	4	1	1	0	No
Nearshore	Blackspot tuskfish	Choerodon schoenleinii	Recreational, NDSF	4	3	12	1	0	3	4	1	1	0	No
Nearshore	Stripey snapper	Lutjanus carponotatus	Recreational, NDSF	3	3	9	1	0	4	4	1	1	0	No
Nearshore	Black jew	Protonibea diacanthus	Recreational, KGBF	3	3	9	2	1	2	4	0	5	8	No
Nearshore	Black tip sharks	Carcharhinus limbatus/tlilstoni	Northern Shark Fishery	4	4	16	1	3	1	1	5	5	9	No
Inshore demersal	Red emperor	Lutjanus sebae	PDSF, NDSF, Recreational	4	4	16	4	3	3	0	2	10	14	Yes
Inshore demersal	Spangled emperor	Lethrinus nebulosus	PDSF, NDSF, Recreational	4	3	12	3	1	3	0	2	7	10	No
Inshore demersal	Rankin cod	Epinephelus multinotatus	PDSF, NDSF, Recreational	4	3	12	4	2	3	0	1	9	12	Yes
Inshore demersal	Duskytail grouper	Epinephelus bleekeri	PDSF, NDSF, Recreational	4	3	12	4	2	2	0	1	8	11	No
Inshore demersal	Crimson snapper	Lutjanus erythropterus	PDSF, NDSF, Recreational	4	3	12	2	2	3	0	1	7	10	No
Inshore demersal	Scarlet snapper	Lutjanus malabaricus	PDSF, NDSF, Recreational	4	3	12	2	2	3	0	1	7	10	No
Inshore demersal	Blue spotted emperor	Lethrinus punctulatus	PDSF, NDSF, Recreational	3	3	9	4	3	3	1	0	10	13	Yes

Appendix 2 - Resource Assessment Framework - August 2010 - Northern Bioregion														
Suite	Species	Scientific name	Fishery	Inherent Vulnerability	Current Risk to Wild Stock	Overall risk to sustainability	Current Management requirements	GVP	Recreational Significance	Customary Significance	Cultural	Management + Recreational significance	Indicator attributes	Indicator species
Inshore demersal	Coral trout (bar cheeked)	<i>Plectropomus maculatus</i>	PDSF, NDSF, Recreational	3	3	9	2	1	3	1	2	6	9	No
Inshore demersal	Coral trout (common)	<i>Plectropomus leopardus</i>	PDSF, NDSF, Recreational	3	3	9	2	1	3	1	2	6	9	No
Inshore demersal	Flagfish	<i>Lutjanus vitta</i>	NDSF, Recreational	3	3	9	4	2	2	0	0	8	11	No
Inshore demersal	Rosy threadfin bream	<i>Nemipterus furcosus</i>	PDSF	2	2	4	4	2	1	0	0	7	9	No
Inshore demersal	Cobia	<i>Rachycentron canadum</i>	PDSF, Recreational	3	3	9	1	1	3	1	1	4	8	No
Inshore demersal	Goldband snapper	<i>Pristipomoides multidens</i>	PDSF, NDSF, Recreational	4	4	16	4	3	1	0	0	8	12	Yes
Inshore demersal	Potato cod	<i>Epinephelus tukula</i>	PDSF, NDSF, Recreational	4	4	16	1	1	1	0	4	3	7	No
Inshore demersal	Queenland grouper	<i>Epinephelus lanceolatus</i>	PDSF, NDSF, Recreational	4	4	16	1	1	1	0	4	3	7	No
Inshore demersal	Brownstripe Snapper	<i>Lutjanus vitta</i>	PDSF	3	3	9	4	3	3	1	0	10	13	Yes
Inshore demersal	Humphead maori wrasse	<i>Cheilinus undulatus</i>	PDSF, NDSF, Recreational	4	4	16	1	1	1	0	4	3	7	No
Offshore demersal	Ruby snapper	<i>Etelis carbunculus</i>	PDSF, NDSF	4	4	16	2	1	1	0	0	4	8	Yes
Offshore demersal	Flame snapper	<i>Etelis coruscans</i>	PDSF, NDSF	4	4	16	2	1	1	0	0	4	8	No
Offshore demersal	Eightbar grouper	<i>Hyporthodus octofasciatus</i>	PDSF, NDSF	5	4	20	2	1	1	0	0	4	8	Yes
Pelagic	Spanish mackerel	<i>Scomberomorus commerson</i>	Mackerel, Recreational	3	4	12	2	3	5	0	2	9	14	Yes
Pelagic	Grey mackerel	<i>Scomberomorus semifasciatus</i>	Recreational, Mackerel, Northern Shark	3	3	9	2	1	1	0	0	4	7	Yes

Appendix 3: Inherent vulnerability and current risks to the sustainability of major finfish species for each suite within the Gascoyne Coast Bioregion. There are no riverine estuary systems in the Bioregion.

[Key to commercial fisheries: SBBSMNMF – Shark Bay Beach Seine and Mesh Net Managed Fishery; SBMF – Shark Bay Managed Fishery].

Appendix 3 - Resource Assessment Framework - August 2010 - Gascoyne Bioregion														
Suite	Species	Scientific name	Fishery	Inherent Vulnerability	Current Risk to Wild Stock	Overall risk to sustainability	Current Management requirements	GVP	Recreational Significance	Customary Significance	Cultural Significance	Management + Recreational significance	Indicator attributes	Indicator species
Nearshore	Pink snapper (3 stocks)	<i>Pagrus auratus</i>	Recreational	4	3	12	4	0	5	1	4	4	12	Yes
Nearshore	Grass emperor	<i>Lethrinus laticaudis</i>	Recreational	3	3	9	3	1	4	1	3	8	11	No
Nearshore	Blackspot tuskfish	<i>Choerodon schoenleinii</i>	Recreational	4	3	12	1	0	5	1	3	1	0	No
Nearshore	Yellowfin bream	<i>Acanthopagrus latus</i>	SBBSMNMF, Recreational	3	2	6	2	1	3	1	1	6	8	No
Nearshore	Sea mullet	<i>Mugil cephalus</i>	SBBSMNMF, Recreational	3	2	6	2	1	2	2	2	5	7	No
Nearshore	Tailor	<i>Pomatomus saltatrix</i>	SBBSMNMF, Recreational	3	2	6	2	1	2	1	2	5	7	No
Nearshore	Yellow-finned whiting	<i>Sillago schomburgkii</i>	SBBSMNMF, Recreational	2	2	4	2	1	3	2	2	6	8	Yes
Nearshore	Mulloway	<i>Argyrosomus japonicus</i>	Recreational, SBMF, SBBSMNMF	3	2	6	1	1	3	0	1	5	7	No
Nearshore	Goldspotted rockcod	<i>Epinephelus coioides</i>	Recreational, SBMF, SBBSMNMF	4	4	16	1	1	4	1	1	6	10	No
Nearshore	Chinaman cod	<i>Epinephelus rivulatus</i>	Recreational (Ningaloo)	5	3	15	1	1	4	1	1	6	9	No
Nearshore	Western butterflyfish	<i>Pentapodus vitta</i>	Recreational	2	1	2	1	0	4	1	1	1	0	No
Nearshore	Golden trevally	<i>Gnathanodon speciosus</i>	Recreational, SBMF, SBBSMNMF	2	2	4	1	1	2	1	1	4	6	No
Nearshore	Sea garfish	<i>Hyporhamphus melanochir</i>	SBBSMNMF	3	2	6	2	1	3	1	1	6	8	Yes
Nearshore	Gold-spot trevally	<i>Carangoides fulvoguttatus</i>	Recreational, SBMF, SBBSMNMF	2	2	4	1	1	3	1	1	5	7	No
Inshore demersal	Stripsey snapper	<i>Lutjanus carponotatus</i>	Recreational, SBMF, SBBSMNMF	3	2	6	1	0	2	0	1	1	0	No
Inshore demersal	Yellow-tailed emperor	<i>Lethrinus atkinsoni</i>	Recreational	4	2	8	1	0	2	0	1	1	0	No
Inshore demersal	Pink snapper (1 stock)	<i>Pagrus auratus</i>	SBMF, Recreational	4	3	12	4	3	4	0	4	11	14	Yes
Inshore demersal	Baldchin grouper	<i>Choerodon rubescens</i>	Recreational (Shark Bay)	4	4	16	1	1	4	1	3	6	10	No
Inshore demersal	Spangled emperor	<i>Lethrinus nebulosus</i>	Recreational (Ningaloo)	3	3	9	3	1	4	1	3	8	11	Yes
Inshore demersal	Red emperor	<i>Lutjanus sebae</i>	Recreational, SBMF	3	4	12	2	1	4	0	1	7	11	No

Appendix 3 - Resource Assessment Framework - August 2010 - Gascoyne Bioregion

Suite	Species	Scientific name	Fishery	Inherent Vulnerability	Current Risk to Wild Stock	Overall risk to sustainability	Current Management requirements	GVP	Recreational Significance	Customary Significance	Cultural Significance	Management + Recreational significance	Indicator attributes	Indicator species
<i>Inshore demersal</i>	Coral trout (bar cheeked)	<i>Plectropomus maculatus</i>	Recreational	3	3	9	2	1	4	0	2	7	10	No
<i>Inshore demersal</i>	Coral trout (common)	<i>Plectropomus leopardus</i>	Recreational	3	3	9	2	1	4	0	2	7	10	No
<i>Inshore demersal</i>	Rankin cod	<i>Epinephelus multinotatus</i>	Recreational, SBMF	5	3	15	2	2	4	0	1	8	11	No
<i>Inshore demersal</i>	Redthroat emperor	<i>Lethrinus miniatus</i>	Recreational, SBMF	4	3	12	2	1	2	0	1	5	8	No
<i>Inshore demersal</i>	Blue spotted emperor	<i>Lethrinus punctulatus</i>	Recreational, SBMF	3	3	9	3	1	2	0	1	6	9	No
<i>Inshore demersal</i>	Goldband snapper	<i>Pristipomoides multidentis</i>	Recreational, SBMF	4	3	12	4	3	1	0	0	8	11	Yes
<i>Inshore demersal</i>	Rosy jobfish	<i>Pristipomoides filamentosis</i>	Recreational, SBMF	4	3	12	2	2	1	0	0	5	8	No
<i>Offshore demersal</i>	Ruby Snapper	<i>Etelis carbunculus</i>	SBMF	4	4	16	2	1	1	0	0	4	8	Yes
<i>Offshore demersal</i>	Eightbar grouper	<i>Hyporthodus octofasciatus</i>	SBMF	5	4	20	2	1	1	0	0	4	8	Yes
<i>Pelagic</i>	Spanish mackerel	<i>Scomberomorus commerson</i>	Mackerel, Recreational	3	3	9	3	1	3	0	1	7	10	Yes
<i>Pelagic</i>	Grey mackerel	<i>Scomberomorus semifasciatus</i>	Mackerel, Recreational	3	2	6	2	1	1	0	0	4	6	Yes

Appendix 4: Inherent vulnerability and current risks to the sustainability of major finfish species for each suite within the West Coast Bioregion.

[Key to commercial fisheries: WCEF – West Coast Estuarine Fishery; CSMF – Cockburn Sound Managed Fishery; WCBBF – West Coast Beach Bait fishery; SWBSF – South West Beach Seine Fishery; SWHMF – South West Haul Net Managed Fishery; WCDSF – West Coast Demersal Scalefish Fishery; TDGLF – Temperate Demersal Gillnet and Longline Fishery; WCPS – West Coast Purse Seine].

Appendix 4 - Resource Assessment Framework - August 2010 - West Coast Bioregion														
Suite	Species	Scientific name	Fishery	Inherent Vulnerability	Current Risk to Wild Stock	Overall risk to sustainability	Current Management requirements	GVP	Recreational Significance	Customary Significance	Cultural Significance	Management + Recreational significance	Indicator attributes	Indicator species
Estuarine	Black bream (Blackwood)	<i>Acanthopagrus butcheri</i>	WCEF, Recreational	3	3	9	2	1	5	1	3	8	11	Yes
Estuarine	Cobbler, all estuaries	<i>Cnidogobius macrocephalus</i>	WCEF, Recreational	5	5	25	2	1	1	1	4	4	9	Yes
Estuarine	Black bream (Swan Canning)	<i>Acanthopagrus butcheri</i>	WCEF, Recreational	3	3	9	2	1	5	1	3	8	11	Yes
Estuarine	Perth herring	<i>Nematolosa vlamingshi</i>	WCEF, Recreational	4	4	16	2	1	0	1	3	3	7	Yes
Estuarine	Black bream (other WC estuaries)	<i>Acanthopagrus butcheri</i>	WCEF, Recreational	3	3	9	1	0	4	1	3	1	0	Yes
Estuarine	Yellowtail flathead	<i>Platycephalus endrachtensis</i>	WCEF, Recreational	3	3	9	1	1	3	1	2	5	8	No
Estuarine	Trumpeter	Family Terapontidae	Recreational	2	1	2	1	1	1	1	0	3	4	No
Nearshore	Tailor	<i>Pomatomus saltatrix</i>	WCEF, Recreational	3	3	9	3	1	5	1	3	9	12	Yes
Nearshore	Mulloway	<i>Argyrosomus japonicus</i>	Recreational	4	3	12	2	1	4	1	2	7	10	No
Nearshore	Sea garfish	<i>Hyporhamphus melanochir</i>	CSMF	3	3	9	3	1	4	1	1	8	11	Yes
Nearshore	Whitebait	<i>Hyperlophus vittatus</i>	CSMF	3	3	9	3	2	0	1	3	5	8	Yes
Nearshore	Skipjack (Trevally)	<i>Pseudocaranx</i> spp.	WCEF, Recreational	3	3	9	2	1	4	1	0	7	10	No
Nearshore	Yellow-finned whiting	<i>Sillago schomburgkii</i>	WCEF, Recreational	2	2	4	3	1	4	1	1	8	10	Yes
Nearshore	Snook	<i>Sphyræna novaehollandiae</i>	Recreational	3	2	6	2	1	3	1	0	6	8	No
Nearshore	Shortfin pike	<i>Sphyræna pingis</i>	Recreational	3	2	6	2	1	3	1	0	6	8	No
Nearshore	Tanwhine	<i>Rhabdosargus sarba</i>	Recreational	2	2	4	2	1	2	1	0	5	7	No
Nearshore	Western butterflyfish	<i>Pentapodus vitta</i>	Recreational	1	1	1	2	0	1	1	0	2	0	No
Nearshore	Australian herring	<i>Arripis georgianus</i>	WCEF, CSMF, Recreational, SWHMF	2	4	8	3	1	5	1	3	9	13	Yes
Nearshore	Australian salmon	<i>Arripis truttaceus</i>	SWSMF, Recreational	2	2	4	2	1	4	2	3	7	9	No
Nearshore	Sea mullet	<i>Mugil cephalus</i>	WCEF, CSMF	3	3	9	2	2	1	2	1	5	8	No

Appendix 4 - Resource Assessment Framework - August 2010 - West Coast Bioregion

Suite	Species	Scientific name	Fishery	Inherent Vulnerability	Current Risk to Wild Stock	Overall risk to sustainability	Current Management requirements	GVP	Recreational Significance	Customary Significance	Cultural Significance	Management + Recreational Significance	Indicator attributes	Indicator species
Nearshore	Yelloweye mullet	<i>Aldrichetta forsteri</i>	WCEF	2	2	4	2	1	2	2	0	5	7	No
Nearshore	Blue sprat	<i>Spratelloides robustus</i>	WCBBF, SWBSF	1	2	2	2	1	0	1	0	3	5	No
Inshore demersal	West Australian Dhufish	<i>Glaukosoma hebraicum</i>	WCDSF, TDGLF, Recreational	4	4	16	4	3	5	0	4	12	16	Yes
Inshore demersal	Pink snapper	<i>Pagrus auratus</i>	WCDSF, TDGLF, Recreational	3	4	12	4	3	4	0	3	11	15	Yes
Inshore demersal	Baldchin groper	<i>Choerodon rubescens</i>	WCDSF, TDGLF, Recreational	4	4	16	4	2	4	0	1	10	14	Yes
Inshore demersal	Sergeant Baker	<i>Latropis purpurissatus</i>	WCDSF, Recreational	3	3	9	2	1	2	0	1	5	8	No
Inshore demersal	Bight redfish	<i>Centroberyx gerrardi</i>	WCDSF, TDGLF, Recreational	4	4	16	2	2	4	0	1	8	12	No
Inshore demersal	Swallowtail	<i>Centroberyx lineatus</i>	WCDSF, TDGLF, Recreational	4	4	16	2	0	2	0	0	2	0	No
Inshore demersal	Yelloweyed nannygai	<i>Centroberyx australis</i>	WCDSF, TDGLF, Recreational	4	4	16	2	0	2	0	0	2	0	No
Inshore demersal	Blue monwong	<i>Nemadactylus valenciennesi</i>	WCDSF, TDGLF, Recreational	3	3	9	2	1	3	0	0	6	9	No
Inshore demersal	Coral trout (common)	<i>Plectropomus leopardus</i>	WCDSF, Recreational	4	3	12	2	2	3	0	1	7	10	No
Inshore demersal	Western blue groper	<i>Achoerodus gouldii</i>	WCDSF, TDGLF, Recreational	4	3	12	1	1	4	2	3	6	9	No
Inshore demersal	Foxfish	<i>Bodianus frenchii</i>	WCDSF, Recreational	4	3	12	1	0	2	0	1	1	0	No
Inshore demersal	Redthroat emperor	<i>Lethrinus miniatus</i>	WCDSF, TDGLF, Recreational	3	4	12	2	3	2	0	1	7	11	No
Inshore demersal	Spangled emperor	<i>Lethrinus nebulosus</i>	WCDSF, TDGLF, Recreational	3	4	12	2	2	2	0	1	6	10	No
Inshore demersal	Sea sweep	<i>Scorpius aequipinnis</i>	WCDSF, Recreational	4	3	12	2	0	2	0	0	2	0	No
Inshore demersal	Breaksea cod	<i>Epinephelides armatus</i>	WCDSF, Recreational	3	3	9	2	0	3	0	0	2	0	No
Inshore demersal	Harlequin fish	<i>Othos dentex</i>	WCDSF, Recreational	3	3	9	1	0	2	0	0	1	0	No
Inshore demersal	King George Whiting	<i>Sillaginodes punctata</i>	WCDSF, Recreational	3	3	9	2	1	4	1	3	7	10	No
Offshore demersal	Blue-eye trevalla	<i>Hyperoglyphe antarctica</i>	WCDSF, TDGLF, Recreational	4	3	12	2	1	1	0	0	4	7	Yes
Offshore demersal	Eightbar grouper	<i>Hyporthodus octofasciatus</i>	WCDSF, TDGLF, Recreational	4	3	12	2	1	3	0	0	6	9	Yes
Offshore demersal	Ruby snapper	<i>Etelis carbunculus</i>	WCDSF, Recreational	4	3	12	2	1	0	0	0	3	6	No
Offshore demersal	Bass groper	<i>Polyprion americanus</i>	WCDSF, Recreational	4	3	12	2	1	1	0	0	4	7	No
Offshore demersal	Hapuku	<i>Polyprion oxygeneios</i>	WCDSF, TDGLF, Recreational	4	3	12	2	1	3	0	0	6	9	Yes
Pelagic	Yellowtail scad	<i>Trachurus novaezelandiae</i>	WCPS	3	2	6	1	1	3	1	0	5	7	No
Pelagic	Spanish mackerel	<i>Scomberomorus commerson</i>	Mackerel, Recreational	3	2	6	2	1	2	1	1	5	7	Yes
Pelagic	Samson fish	<i>Seriola hippos</i>	Recreational	3	2	6	2	1	2	0	1	5	7	Yes

Appendix 5: Inherent vulnerability and current risks to the sustainability of major finfish species for each suite within the South Coast Bioregion.

[Key to commercial fisheries: SCEMF – South Coast Estuarine Managed Fishery; SCNF – South Coast Net Fishery; SCHMF – South Coast Haul Net Managed Fishery; TDGLF – Temperate Demersal Gillnet and Longline Fishery; SCPF – South Coast Purse Seine].

Appendix 5 - Resource Assessment Framework - August 2010 - Southern Bioregion														
Suite	Species	Scientific name	Fishery	Inherent Vulnerability	Current Risk to Wild Stock	Overall risk to sustainability	Current Management requirements	GVP	Recreational Significance	Customary Significance	Cultural Significance	Management + Recreational significance	Indicator attributes	Indicator species
Estuarine	Black bream (all estuaries)	<i>Acanthopagrus butcheri</i>	SCEMF, Recreational	3	3	9	2	2	4	2	2	8	17	Yes
Estuarine	Cobbler (Wilson Inlet)	<i>Cnidogobius macrocephalus</i>	SCEMF, Recreational	5	3	15	2	1	1	3	3	4	19	Yes
Estuarine	Cobbler (other estuaries)	<i>Cnidogobius macrocephalus</i>	SCEMF, Recreational	5	2	10	1	1	1	3	0	3	13	No
Nearshore	Sea garfish	<i>Hyporhamphus melanochir</i>	Recreational, SCNF	3	2	6	1	1	4	1	1	6	12	No
Nearshore	Southern school whiting	<i>Sillago bassensis</i>	Recreational, SCNF	2	2	4	1	1	3	1	1	5	9	No
Nearshore	Skipjack (Trevally)	<i>Pseudocaranx</i> spp.	SCEMF, Recreational	3	2	6	1	0	4	1	0	1	0	No
Nearshore	Leather jackets	Family Monacanthidae	SCEMF, Recreational	2	2	4	1	1	2	0	0	4	8	No
Nearshore	Flathead (Bluespot)	<i>Platycephalus speculator</i>	SCEMF, Recreational	2	2	4	1	0	2	1	1	1	0	No
Nearshore	Australian herring	<i>Arripis georgianus</i>	SCHMF, Recreational	2	3	6	2	1	5	1	3	8	14	Yes
Nearshore	Australian salmon	<i>Arripis truttaceus</i>	SWSMF, Recreational	2	2	4	2	3	4	1	3	9	13	Yes
Nearshore	Sea mullet	<i>Mugil cephalus</i>	SCEMF, Recreational	3	3	9	1	2	1	1	1	4	13	No
Nearshore	Yellow-eye mullet	<i>Aldrichetta forsteri</i>	SCEMF, Recreational	2	2	4	1	1	2	1	0	4	8	No
Inshore demersal	Pink snapper	<i>Pagrus auratus</i>	Wetline, TDGLF, Recreational	3	4	12	2	3	3	1	1	8	20	Yes
Inshore demersal	Bight redfish	<i>Centroberyx gerrardi</i>	Wetline, TDGLF, Recreational	4	3	12	2	3	4	0	1	9	21	Yes
Inshore demersal	Swallowtail	<i>Centroberyx lineatus</i>	Wetline, TDGLF, Recreational	4	3	12	1	0	1	0	0	1	0	No
Inshore demersal	Yellow eyed nannygai	<i>Centroberyx australis</i>	Wetline, TDGLF, Recreational	4	3	12	1	1	1	0	0	3	15	No
Inshore demersal	West Australian Dhufish	<i>Glaucosoma hebraicum</i>	Wetline, TDGLF, Recreational	4	3	12	1	1	3	0	1	5	17	No
Inshore demersal	Foxfish	<i>Bodianus frenchii</i>	Wetline, Recreational	4	3	12	1	0	1	0	0	1	0	No
Inshore demersal	Breaksea cod	<i>Epinephelides armatus</i>	Wetline, TDGLF, Recreational	3	3	9	1	1	2	0	0	4	13	No
Inshore demersal	Harlequin fish	<i>Othos dentex</i>	Wetline, TDGLF, Recreational	3	3	9	1	1	2	0	0	4	13	No

Appendix 5 - Resource Assessment Framework - August 2010 - Southern Bioregion

Suite	Species	Scientific name	Fishery	Inherent Vulnerability	Current Risk to Wild Stock	Overall risk to sustainability	Current Management requirements	GVP	Recreational Significance	Customary Significance	Cultural Significance	Management + GVP + Recreational significance	Indicator attributes	Indicator species
<i>Inshore demersal</i>	King George Whiting	<i>Sillaginodes punctata</i>	Wetline, TDGLF, Recreational	3	3	9	2	1	4	1	3	7	16	No
<i>Inshore demersal</i>	Sea sweep	<i>Scorpius aequipinnis</i>	Wetline, TDGLF, Recreational	4	3	12	2	1	1	1	1	4	16	No
<i>Inshore demersal</i>	Long-snouted boarfish	<i>Pentacerospis recurvirostris</i>	Wetline, TDGLF, Recreational	4	3	12	2	1	1	0	0	4	16	No
<i>Inshore demersal</i>	Deepwater flathead	<i>Neoplattycephalus conatus</i>	Wetline, TDGLF, Recreational	3	3	9	2	1	0	0	0	3	12	No
<i>Inshore demersal</i>	Gummy shark	<i>Mustelus antarcticus</i>	TDGLF	5	2	10	5	2	1	0	2	8	18	No
<i>Inshore demersal</i>	Ocean jacket	<i>Nelusetta ayraud</i>	Wetline, TDGLF, Recreational	2	2	4	1	1	1	0	0	3	7	No
<i>Inshore demersal</i>	Yellow spotted boarfish	<i>Paristioperus gallipavo</i>	Wetline, TDGLF, Recreational	4	3	12	1	1	1	0	0	3	15	No
<i>Inshore demersal</i>	Gemfish	<i>Rexea solandri</i>	Wetline, TDGLF, Recreational	3	3	9	1	1	1	0	0	3	12	No
<i>Inshore demersal</i>	Jackass morwong	<i>Nemadactylus macropterus</i>	Wetline, TDGLF, Recreational	4	3	12	1	1	1	0	0	3	15	No
<i>Inshore demersal</i>	Knifejaw	<i>Oplegnathus woodwardi</i>	Wetline, TDGLF, Recreational	3	3	9	1	1	1	0	0	3	12	No
<i>Inshore demersal</i>	Western blue groper	<i>Achoerodus gouldii</i>	Wetline, TDGLF, Recreational	5	3	15	2	2	2	2	3	6	21	Yes
<i>Inshore demersal</i>	Blue morwong (Queen snapper)	<i>Nemadactylus valenciennesi</i>	Wetline, TDGLF, Recreational	4	3	12	2	2	3	2	0	7	19	Yes
<i>Offshore demersal</i>	Bass groper	<i>Polyprion americanus</i>	Wetline, TDGLF, Recreational	4	3	3	2	1	2	0	0	5	8	No
<i>Offshore demersal</i>	Eightbar grouper	<i>Hyporthodus octofasciatus</i>	Wetline, TDGLF, Recreational	4	3	12	1	2	3	0	0	6	18	Yes
<i>Offshore demersal</i>	Hapuku	<i>Polyprion oxygeneios</i>	Wetline, TDGLF, Recreational	4	3	12	1	2	3	0	0	6	18	Yes
<i>Offshore demersal</i>	Blue-eye trevalla	<i>Hyperoglyphe antarctica</i>	Wetline, TDGLF, Recreational	4	3	12	1	1	1	0	0	3	15	Yes
<i>Pelagic</i>	Yellowtail scad	<i>Trachurus novaezelandiae</i>	SCPS	4	3	12	1	1	1	1	0	3	15	Yes
<i>Pelagic</i>	Sardine (pilchard)	<i>Sardinops sagax</i>	SCPS	2	2	4	2	3	0	0	0	5	9	Yes
<i>Pelagic</i>	Blue mackerel	<i>Scomber australasicus</i>	SCPS	2	2	4	1	1	0	0	0	2	6	Yes
<i>Pelagic</i>	Samson fish	<i>Seriola hippos</i>	Wetline, Recreational	3	2	6	1	1	1	0	0	3	9	Yes

Appendix 6: Inherent vulnerability and current risks to the sustainability of major finfish species for each suite within the 'Statewide' Bioregion.

[Key to commercial fisheries: MAF – Marine Aquarium Fish Fishery; TDGLF – Temperate Demersal Gillnet and Longline Fishery; NSF – Northern Shark Fishery].

Appendix 6 - Resource Assessment Framework - August 2010 - Statewide														
Suite	Species	Scientific name	Fishery	Inherent Vulnerability	Current Risk to Wild Stock	Overall risk to sustainability	Current Management requirements	GVP	Recreational Significance	Customary Significance	Cultural Significance	Management + GVP + Recreational significance	Indicator attributes	Indicator species
Nearshore	Syngnathids	Family:Syngnathidae	MAF	5	3	15	1	1	0	1	1	2	17	No
Inshore demersal	Whiskery shark	<i>Furgaleus macki</i>	TDGLF	5	2	10	5	3	0	0	0	8	18	Yes
Inshore demersal	Sandbar shark	<i>Carcharhinus plumbeus</i>	TDGLF, NSF	5	5	25	4	3	0	0	0	7	32	Yes
Inshore demersal	Dusky whaler shark	<i>Carcharhinus obscurus</i>	TDGLF, NSF	5	4	20	4	3	0	0	0	7	27	Yes
Pelagic	Sailfish	<i>Istiophorus platypterus</i>	Recreational	3	3	9	1	0	3	0	3	1	0	No

Appendix 7: Inherent vulnerability and current risks to the sustainability of major finfish species for each suite within the Northern Inland Bioregion.

Appendix 7 - Resource Assessment Framework - August 2010 - Northern Inland Bioregion														
Suite	Species	Scientific name	Fishery	Inherent Vulnerability	Current Risk to Wild Stock	Overall risk to sustainability	Current Management requirements	GVP	Recreational Significance	Customary Significance	Cultural Significance	Management + GVP + Recreational significance	Indicator attributes	Indicator species
Inland	Sooty grunter	<i>Hephaestus jenkinsi</i>	Recreational, LASC	3	2	6	1	1	4	4	3	6	12	No
Inland	Silver cobbler	<i>Arius midleyi</i>	Recreational, LASC	4	3	12	2	2	1	1	1	5	17	Yes