

INTEGRATED FISHERIES MANAGEMENT REPORT

West Coast Demersal Scalefish Resource

*Prepared by the
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INTRODUCTION

This report on the West Coast Demersal Scalefish fishery is the third in a series of Integrated Fisheries Management (IFM) resource reports required under the Government policy on IFM. Under this policy, the Chief Executive Officer of the Department of Fisheries is required to approve a sustainability report for each fishery, which includes a clear statement on the recommended harvest level.

IFM is a policy aimed at making sure that Western Australia's fisheries continue to be managed in a sustainable way in the future. In essence, this involves setting the total sustainable harvest level of fish, then sharing this potential harvest between the commercial, recreational (including charter boats) and customary fishers by means of an allocation process that meets community needs. Each sector is then managed within the allocated share.

It is not the purpose of this paper to set out which sector will get what share of the resource.

For each resource addressed through IFM, a report must be prepared to provide information on at least the following aspects of the resource and associated fishing activity:

- the current management practices within the fishery;
- historical catch levels, and estimates of catch, by sector;
- the biology of the fish species involved;
- an appropriate harvest level of the resource; and
- other relevant data, such as regional employment, economic and social/lifestyle issues.

This report has been prepared to provide the Integrated Fisheries Allocation Advisory Committee (IFAAC) with a summarised, factual account of the resource and current and historical trends in its exploitation.

The Minister for Fisheries established IFAAC to consider all the information on a resource and its users and to consult widely in order to make recommendations on how the resource should be allocated. This process will be documented by IFAAC after its deliberations and submitted in a report to the Minister to assist him in determining these initial allocations. The Minister may choose to publicly release IFAAC's final report to him to the public.

There have been several recently published management and research reports on the west coast demersal scalefish resource, which are listed in the reference section at the back of this report.

This report takes its information on the state of the fishery from these papers and should be read in conjunction with these papers and the annual *State of the Fisheries* report.

In addition, the Commonwealth Department of the Environment and Water Resources published a number of volumes on the South West Marine Bioregional Plan in May 2006.

2005/06 is the last year where comparative data are available before substantial changes in management were introduced in both the commercial and recreational sectors. It is therefore considered appropriate that the 2005/06 data are considered the primary source of data for allocation purposes.

1.0 WEST COAST DEMERSAL SCALEFISH RESOURCE – BIOLOGY

All scalefish that have been reported in catches from the West Coast Bioregion (Kalbarri to Augusta) over recent years by the different catching sectors have been assigned to different habitats (estuarine, nearshore, inshore demersal, offshore demersal and pelagic) on the basis of their biology, their preferred habitat, particularly the location of the breeding stock, and the distribution of the principal catch. The habitat types essentially reflect different water depths, as follows:

- Estuarine – comprises estuaries;
- Nearshore – represents habitats in coastal waters of less than 20 metres deep;
- Inshore demersal – represents demersal habitats in waters between 20 and 250 metres deep;
- Offshore demersal – comprises demersal habitats in waters between 250 metres deep and the boundary of the Australian Fishing Zone (AFZ); and

Pelagic – comprises the water column between the 20-metre bathymetric contour and the Australian Fishing Zone (AFZ) but not including the demersal habitats.

“Demersal” scalefish species are those that live on or near the ocean floor, but do not include sharks, rays and other cartilaginous species, which are not “scalefish”. The “suite” of these species that comprise the demersal scalefish resource of the West Coast Bioregion include the inshore and offshore demersal species.

The suite of inshore and offshore demersal scalefish used in this report have been chosen because generally:

- spawning individuals and adults occur in demersal habitats, e.g. associated with reef and reef structure; and
- the adult spawning stock are caught in these waters.

There are some species, such as King George whiting, which may fall into this category, but are not considered to be demersal scalefish for management purposes and for this report. At some future date, this and other species may be included in the suite of demersal scalefish.

In the process of managing for sustainability, it is not possible to assess the status of all species in the demersal suite. Instead, key indicator species are chosen that are judged, through a process of risk assessment, to be indicative of the status of the whole suite. The criteria used in the risk assessment include inherent biological vulnerability and the importance of the species to the different catching sectors.

The primary target demersal scalefish species within the West Coast Bioregion include endemic Western Australian dhufish (*Glaucosoma hebraicum*), pink snapper (*Pagrus auratus*), endemic baldchin groper (*Choerodon rubescens*), redthroat emperor (*Lethrinus miniatus*), breaksea cod and redfish (primarily bight redfish *Centroberyx gerrardi*). On the basis of the outcome of the risk assessment, Western Australian dhufish, pink snapper and baldchin groper (in the Mid-West and the Abrolhos Islands), were chosen as the key indicator species for the fishery and are discussed in detail below.

1.1 Western Australian Dhufish

1.1.1 Distribution

Western Australian dhufish (*Glaucosoma hebraicum*) – or simply “dhufish” as they are commonly referred to – are endemic to the south-west coast of Western Australia, generally between Shark Bay and the Recherche Archipelago, but are most abundant between the Abrolhos Islands and Cape Naturaliste. They are not found anywhere else in the world.

Oxygen isotope analyses indicate that dhufish are lifetime residents of their particular geographical location and any movement of juveniles and adults is limited. Juveniles live in close association with rocky reefs and are not known to undergo any significant movement.

1.1.2 Life history

Western Australian dhufish are relatively slow-growing and long-lived, with female dhufish growing slower than males. Dhufish reach the minimum legal size limit (500 millimetres) at six to seven years of age and can live for at least 41 years.

Dhufish appear to exhibit social behaviour that implies some form of hierarchical social/mating system during spawning. The majority spawn between December and March. The size of the male gonads indicates that they probably undergo pair spawning. Anecdotally, aggregations of 50 to 100 dhufish have been observed but this has yet to be empirically substantiated. Anecdotal evidence suggests that aggregations in recent years are rarer and/or comprise smaller numbers of individuals.

They reach sexual maturity at lengths of between 300 and 350 millimetres fork length at around four years of age. Recent research has found that the smaller, younger mature female dhufish do not effectively spawn throughout the entire spawning season, which results in a significantly lower level of egg production for these smaller, younger mature fish.

In contrast, the older, larger fish are very important to the reproductive dynamics of the population. Larger (older) females produce more eggs, more frequently and over a longer period. They produce a substantially greater number of eggs per spawning season than younger, smaller fish. These larger dhufish may become more vulnerable to fishing during the summer as they aggregate in groups.

1.1.3 Recruitment and release mortality

Western Australian dhufish recruitment appears to be relatively consistent between years, but does show some variability in the more southerly latitudes of the West Coast Bioregion. A strong recruitment pulse of dhufish, consisting of four consecutive year-classes that originated between 1993 and 1996, comprised the bulk of the older fish in the population at the time of the initial formal assessment (2002-2006). These fish were mostly found in the southern areas of the bioregion.

Thus, variable recruitment, particularly in the southern areas of the bioregion, can lead to gaps in the age distribution of the population, and contributes to making this species more vulnerable to over-fishing.

Here, there appears to be a strong positive relationship between successful recruitment years for dhufish and the wind speeds, and to a lesser extent salinity. These factors are currently the best estimator of the proximal annual strength of the Capes Current, which flows northwards during the summer and autumn coinciding with the dhufish spawning season. It is suspected

that dhufish larvae from the Capes area can be transported by the Capes Current as far north as Kalbarri within 21 of the estimated 48-day larval duration.

As adults and juveniles are sedentary, and dhufish populations effectively represent separate 'fishable' stocks, dispersal of the eggs and larvae, with the aid of oceanographic currents, appears to be the only method that facilitates the mixing of populations of dhufish.

Most dhufish live at depths between approximately 20 and 90 metres of water. Thus, dhufish are susceptible to barotrauma (the effects of gas expansion in the body caused by capture at depth and being brought to the surface rapidly during capture). This means that fish captured and released are susceptible to post-release mortality and that this post-release mortality rate is known to increase with depth of capture.

1.2 Pink Snapper

1.2.1 Distribution

Pink snapper (*Pagrus auratus*) has a continuous distribution in Australia around the southern coastline of mainland Australia, from Gladstone in Queensland to Barrow Island in Western Australia. They inhabit the coastal marine waters from the shallows out to waters deeper than 200 metres.

In Western Australia, most of the pink snapper are caught from the oceanic waters off Shark Bay and the Kalbarri Area of the West Coast Demersal Scalefish Fishery (WCDSF). There are two known major spawning aggregation areas, the waters off Carnarvon, in the Gascoyne Bioregion (the largest concentration of spawning aggregations) and Cockburn/Warnbro Sounds. There is no evidence of significant larval dispersal from either spawning ground.

While there is evidence of seasonal inshore-offshore migrations of adults, there is little evidence to indicate that adult pink snapper migrate along the coast. However, juvenile fish (less than 450 millimetres) may intermix throughout waters of the West Coast Bioregion.

1.2.2 Life History

Pink snapper spawn between October and January in Cockburn Sound and form large spawning aggregations (Cockburn Sound is the most significant spawning area on the lower west coast.)

In the north of the bioregion, pink snapper reach sexual maturity and the minimum legal size limit of 410 millimetres total length at approximately four years of age, and they can live for at least 26 years (and to at least 33 years in the south of the bioregion).

The legal minimum length for pink snapper of 410 millimetres was set following biological research on pink snapper stocks off Carnarvon. This research indicated that approximately 50 per cent of the stock was mature at 410 millimetres. However, further biological studies have indicated that the size at maturity is approximately 100 to 200 millimetres larger in the cooler waters of the lower west coast. This demonstrates pink snapper in the lower west coast grow faster and mature at a larger size. It was for this reason that the minimum size limit was increased to 450 millimetres on 1 January 2009 for those waters of the West Coast Bioregion south of Lancelin and will be further increased to 500 millimetres in December 2010.

It is likely that pink snapper in the Kalbarri Area of the West Coast Bioregion are part of the same stock as those fish in the Gascoyne Bioregion.

1.2.3 Recruitment and release mortality

Cockburn Sound/Warnbro Sound is currently the only recognised location in the West Coast Bioregion where pink snapper consistently aggregate to spawn. The eggs and larvae spawned in Cockburn Sound are retained within the Sound by a gyre and juveniles remain in the Sound until approximately 18 months of age before they migrate offshore. Recruitment into the west coast fishery is highly variable over years.

Cockburn Sound is a highly industrialised area and associated environmental degradation may affect the viability of the spawning aggregations including reductions in spawning biomass, egg and larval quality and growth of juveniles as it also serves as an important nursery habitat. Cockburn Sound is also very accessible to fishers (recreational, charter and commercial). Post-release mortality increases from an average of four per cent in shallow water to 66 per cent in deeper waters, with pink snapper becoming much more susceptible to barotrauma at depths between 30 and 45 metres.

Alongshore dispersal of pink snapper off the lower west coast is likely to be dependent upon movement of juveniles out of Cockburn Sound, and on rare occasions via the southwards movement from the northern spawning aggregations off Carnarvon. However, it is more likely that juveniles from the Carnarvon region may more frequently contribute to populations in the Kalbarri Area. There is also the possibility of dispersal (through passive drift or active swimming of larvae) of the pelagic life history stages of pink snapper spawned elsewhere in the West Coast Bioregion.

Until further studies are undertaken on the source of recruitment of pink snapper on the west coast, the populations within each area of the fishery (see map of the Fishery in Figure 1) will be treated as if it is a separate fishable stock.

1.3. Baldchin Groper

1.3.1 Distribution

Baldchin groper (*Choerodon rubescens*) is endemic to Western Australia. It is found from Coral Bay to Cape Naturaliste and is most abundant in the Abrolhos Islands area. Juveniles and adults typically occur on, or in the vicinity of, benthic reef habitat. They are common in shallow reef environments and commercial catches have been reported in depths down to 100 metres. But, around the Abrolhos Islands they are typically caught down to a maximum depth of approximately 40 metres.

There is limited information on the movement of this species. Of the few adults that were recaptured (by diving) following a research tagging and release study (13 of approximately 150 tagged and released) in the Abrolhos Islands, all were caught close (< 250 metres) to their release sites.

1.3.2 Life history

Baldchin groper is a slow-growing species that reaches a maximum age of 20 years or more. Around the Abrolhos Islands they reach the current legal minimum length of 400 millimetres at five to seven years. Baldchin groper are also known to be protogynous hermaphrodites, meaning they mature as females, then change sex to males. Thus, most of the fish in the retained catch are males, and this makes the species highly vulnerable to fishing. They mature first as females at about 290 millimetres in total length and three to four years of age and then change sex to become

males when between 450 millimetres and 550 millimetres, at about 10 to 12 years.

Baldchin groper around the Abrolhos Islands spawn on a number of occasions over an extended spawning season from September to January.

1.3.3 Recruitment and release mortality

There have been no studies on the recruitment of this species. Anecdotal reports from recreational and charter fishers suggest that baldchin groper are highly susceptible to barotrauma injuries. In the recent Fisheries and Research Development Corporation (FRDC) funded barotrauma study¹, no released tagged baldchin groper were recaptured, meaning that the barotrauma risk is potentially extreme.

1.4 Physical Environment and External Inputs

In comparison to the rest of Western Australia, the West Coast Bioregion has the highest concentration of commercial, recreational and charter fishing boats, leaving demersal species highly exposed to fishing pressure from all sectors. Anecdotal evidence suggests that fishers targeting Western Australian dhufish have moved to ‘new’ areas in response to localised depletions.

In addition, the only known pink snapper spawning area in the West Coast Bioregion, Cockburn Sound, is a highly industrialised area, with the associated environmental degradation potentially affecting the viability of the spawning aggregations found in the area.

The levels of exploitation of dhufish and pink snapper are above international benchmark standards (see Appendix 1 for benchmark standards) across all of the West Coast Bioregion, as they are for baldchin groper in the Mid-West and around the Abrolhos Islands. This indicates that these stocks are being over-fished and are being depleted to levels below those necessary to ensure their long-term sustainability.

¹ Lenanton, R, St John, J (Project PI 2000-2007), Wise, B, Keay, I and Gaughan, D (2009) “*Maximising survival of released undersize west coast reef fish. Final Report to Fisheries Research and Development Corporation of Project No. 2000-194*”, Fisheries Research Report No. 191, Department of Fisheries, Western Australia.130p

2.0 SECTORS OF THE WEST COAST DEMERSAL SCALEFISH FISHERY

The Minister for Fisheries and the Department of Fisheries have a statutory obligation under section 3 of the *Fish Resources Management Act 1994* (FRMA) to conserve, develop and share fish resources of the State for the benefit of present and future generations.

2.1 The Commercial Fishery

The major commercial demersal scalefish fishery on the west coast is the West Coast Demersal Scalefish (Interim) Managed Fishery (WCDSFIMF). The WCDSFIMF extends from north of Kalbarri (26° 30' south latitude – around Steep Point) to Black Point (115° 30' east longitude), east of Augusta (Figure 1, Page 12) and seawards from the coastline to the 200-nautical mile boundary of the Australian Fishing Zone. It incorporates the habitats of the major demersal species targeted in the fishery.

The fishery comprises five management areas² (with the Abrolhos Islands as a sub-area of the Mid-West Inshore Area) and each area has a suite of demersal fish that are typically caught within its waters. These are:

Area ³	Typical catch
• Kalbarri Inshore Area	Western Australian dhufish, pink snapper, sweetlip emperor
• Mid-West Inshore Area	Western Australian dhufish, pink snapper, sweetlip emperor
• Abrolhos (sub-zone)	Baldchin groper, pink snapper
• Metropolitan Inshore Area	Western Australian dhufish, pink snapper
• South-West Inshore Area	Western Australian dhufish, pink snapper, bight redfish
• Offshore Area	Hapuku, bass grouper, ruby snapper, blue eye trevalla and grey banded cod.

There are four other commercial fisheries also landing these species in the West Coast Bioregion. These are, the West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery (WCDGDLF) and the Joint Authority Southern Demersal Gillnet and Demersal Longline Managed Fishery (JASDGDLF), the South West Trawl Managed Fishery (SWTMF) and the Commonwealth managed Western Deepwater Trawl Fishery (WDTF). In addition, the Western Rock Lobster Fishery takes a small catch of these fish as a bycatch in their rock lobster pots.

Table 1 sets out the commercial fisheries that either target demersal scalefish or take it as part of their by-catch. As the WCDSFIMF is the main fishery targeting scalefish, a map, setting out the different management areas is presented in Figure 1.

Further information is available from individual management plans, or the fisheries management papers and fisheries research papers listed in the references section.

² The WCDSFIMF Management Plan refers to the zones in the fishery as ‘Areas’, and to avoid confusion, this report refers to the zones as ‘Areas’.

³ Kalbarri Area (26°30'South latitude to 28°South latitude), Mid-West Area (28°South latitude to 31°South latitude), Metropolitan Area (31°South latitude to 33°South latitude), South-West Area (33°South latitude to 115°30' east longitude). All inshore areas extend between the coastline and the 250 metre depth contour. The Offshore Area extends south from 26°30' South latitude to 115°30' East longitude between the 250 metres depth contour and the 200 nautical mile boundary of the Australian Fishing Zone.

2.1.1 Management objectives

The current management goal is to reduce the catch of demersal scalefish (across all sectors and by individual management areas of the commercial fishery) on the west coast by at least 50 per cent of the 2005/06 levels, with a complete closure to pink snapper fishing within Cockburn Sound from 1 October to 31 January each year.

To address the over-fishing situation, significant and comprehensive management actions are required, and are being undertaken. Moreover, a holistic approach to the management of these resources is being taken to effectively deal with the implications of the complex biological attributes of these species, the variety of species in the fishery and overlapping nature of the various commercial and recreational fisheries involved.

Once the management goal has been achieved, the management objective for the fishery into the future will be to ensure that the fishery continues to be managed on a sustainable basis and that over-fishing does not occur. This may be by ensuring that fishing mortality is kept within internationally acceptable target limits (see Appendix 1). However, until catches (for all sectors and individual commercial fisheries) are effectively capped by at least 50 per cent of the 2005/06 levels and stock assessments are completed, the current management goal remains in place.

Table 1. Commercial Fisheries which take west coast demersal scalefish

Commercial Fishery 2009/10	Main Area of Fishery 2009/10	Season /Licencing year 2009/10	Number of licence/ permit holders 2009/10	Main fishing method 2009/10	*Tonnes caught (2005-06)	GVP (\$ million) 2005/06	Status of Stock (as at 2009/10)
West Coast Demersal Scalefish (Interim) Managed Fishery	Kalbarri Inshore Area Mid-west Area Metropolitan Inshore Area South-west Inshore Area Offshore Area (Kalbarri – Augusta between 250 m to AFZ) No commercial fishing permitted in Metropolitan Inshore Area.	1 January – 31 December Permits/entitlement fully transferable	61 permit holders across 3 Inshore Areas Kalbarri Inshore Area Maximum 34 boats Mid-west Inshore Area maximum 54 boats South-west Inshore Area maximum 13 boats All permits provide access to a limited number of fishing hours in the Offshore Area	Maximum of 10 handlines or dropines, with maximum of 30 hooks each. Individually transferable effort (ITE) units of fishing hours. Anticipated catch 2009 429t for Inshore Areas comprising: S-W Area 82 tonnes M-W Area 197 tonnes Kalbarri Area 150 tonnes 20-40 tonnes from the Offshore Area determined to deliver at least 50% reduction in catch (based on 2005/06 figures) All boats are monitored by VMS	Total demersal scalefish 936t Largest catches are : Pink snapper 303 Western Australian dhufish 182 Baldchin groper 35 Breaksea cod 8 Bight redfish 83	\$ 6.7 likely to be an under-estimation	Overfished Must be reduced by 50% on 2005/06 levels
**Joint Authority Southern Demersal Gillnet and Demersal Longline Managed Fishery	Augusta (longitude 116° East) to Mandurah	1 June – 31 May Licences fully transferable. During 2006, 2007 and 2008 Zone 1 of the fishery was closed 16 Aug – 15 October.	20 licences	Demersal Gillnet and Demersal Longline ITEs Zone 1 unit = 288 hrs of 27 metres of demersal gillnet or 9 hooks on demersal longline Monitored by VMS	Total demersal scalefish 52t Largest catches are : Western blue groper 17 Blue morwong 15 Pink snapper 6 WA dhufish 10 Bight redfish 3	Approx \$0.53	Overfished, demersal scalefish catch must be reduced by 50% on 2005/06 levels
West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery	Lancelin to Kalbarri (Fishery extends south to 33°S but the area between 33°S and 31°S has been closed to commercial fishing since 15 November 2007)	1 June – 31 May During 2006, 2007 and 2008, the fishery was closed 16 Aug – 15 October. Licences fully transferable	24 licences	Demersal Gillnet and Demersal Longline ITEs 1 unit = 288 hrs of 27 metres of demersal gillnet or 9 hooks on demersal longline Monitored by VMS	Total demersal scalefish 57 t Largest catches are: Pink Snapper 13 Western Australian dhufish 15	Approx \$0.4	Overfished, demersal scalefish catch must be reduced by 50% on 2005/06 levels

Table 1. Continued.

Commercial Fishery 2009/10	Main Area of Fishery 2009/10	Season /Licensing year 2009/10	Number of licence/ permit holders 2009/10	Main fishing method 2009/10	*Tonnes caught (2005-06)	GVP (\$ million) 2005/06	Status of Stock (as at 2009/10)
South West Trawl Managed Fishery	From 31°43'27" south latitude and 115°08' east longitude where it intersects at Cape Leeuwin and on the landward side of the 200m isobath.	Zone A & B 1 January to 15 November Zone D 1 January	Zone A 3 boats Zone B 12 boats Zone C closed Zone D 3 boats	Otter trawls	All demersal scalefish species caught were less than 1 tonne	Minimal	Overfished, Demersal scalefish catch must be reduced by 50% on 2005/06 levels
Western Deepwater Trawl Fishery (Commonwealth managed)	Commonwealth waters from Cape Leeuwin to North West Cape	Permits issued for five years Fully transferable	11 permits (as at Jan 2006)	Otter trawl	Mixed fish species 67.48 tonnes taken in 2004 – 2005 5.04 tonnes taken in 2005-2006	\$0.83 (2004-2005) \$0.003 (2005-2006)	Uncertain
West Coast Rock Lobster Fishery (By-catch in pots)	Cape Leeuwin to North West Cape	C Zone 25 November B Zone 15 November A Zone 15 March Season ends 30 June Fully transferable	Approx 300 boats	Rock lobster pots (fish caught as by-catch)	(2006-07) around 45 tonnes Largest catches are Western Australian dhufish 3 Pink snapper 2 Baldchin groper 12 (possibly more) Sweetlip emperor 9 Chinaman cod 3.5 Breaksea cod 15	Unknown	Overfished must be reduced by 50% on 2005/06 levels

*Note the reported commercial sector tonnes caught are the most up to date catch figures from the Research Division.

** Note: For JASDGLF, 17t of demersal scalefish and 2t of other fish was caught in blocks 34160 & 35160, which was reported in State of the Fisheries as part of the zone 1 catch. However these catches were excluded in the above table in order to be consistent throughout the document.

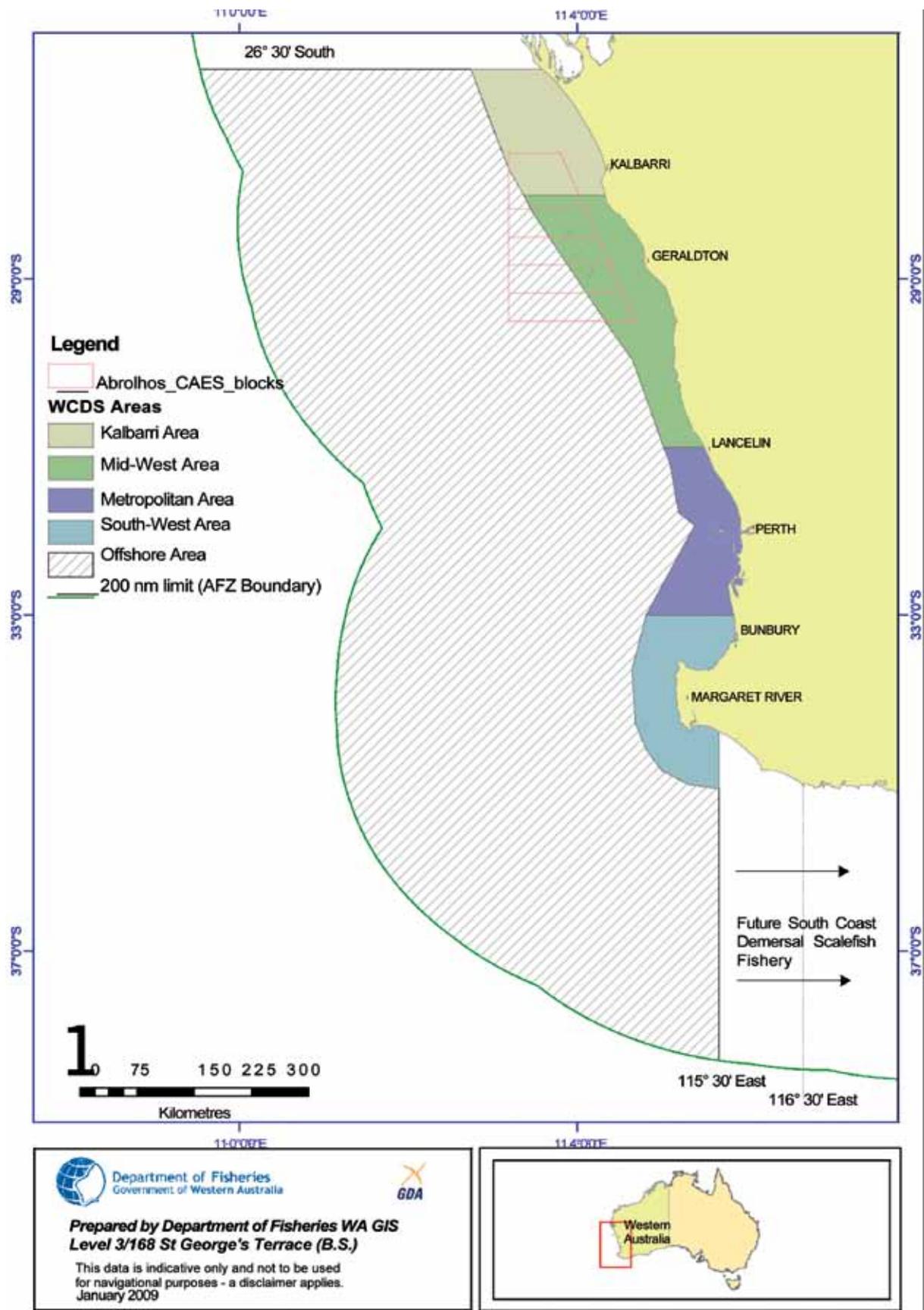


Figure 1.

2.1.2 Historical development of management

Only major changes to the commercial management arrangements have been noted in this report. If further information is required, the Department of Fisheries' State of the Fisheries Report is on the Department's website, www.fish.wa.gov.au, to check on specific management changes in specific years.

2.1.2.1 West Coast Demersal Scalefish Fishery (WCDSF)

The WCDSF was an open-access fishery until January 2008. The 'wetline fishery', as it was commonly known, was managed primarily through size limits, some gear limits and closed seasons for some species (such as a baldchin groper spawning closure at the Abrolhos Islands). The open-access nature of the fishery meant that there was the potential for up to 1,250 fishing boats to 'wetline' on the west coast.

A review of wetline fishing commenced in 2003 to examine the issues relating to, and to develop a policy for, the future management of wetline fishing. Two independent panels were established – the Commercial Access Panel⁴ (CAP) and the Management Planning Panel (MPP) to undertake these tasks and their final recommendations were released for public comment in early 2006.

The former Minister for Fisheries released his proposed decisions for a final round of consultation in late 2006.

In May 2007, the then Minister announced his final Wetline Review decisions for the future management arrangements for the WCDSFIMF (see Figure 1 for the area covered by the fishery). These significant changes to management arrangements were implemented in two stages.

- The first stage was implemented in late 2007 and, on commencement of the Interim Managed Fishery on 1 January 2008, access criteria were introduced that had to be satisfied in order for a holder of a Fishing Boat Licence to be granted a Permit for the fishery. This effectively closed the wetline fishery and reduced access on the west coast from a potential 1,250 boats to 61.
- In the second stage, which commenced on 1 January 2009, capacities (maximum effort limits) were introduced for each of the areas of the fishery (noting that the Metropolitan Area is closed to commercial fishing). A scheme allocating entitlement to permits, and provisions to allow for transferability of entitlements (in the form of units that provide entitlement in hours of fishing) for each area was introduced. The capacity settings (in the form of effort hours) introduced on 1 January 2009 were determined to deliver a reduction of at least 50 per cent in catch (for each area of the fishery) based on 2005/06 catches.

On 15 November 2007, the former Minister for Fisheries introduced the Metropolitan Area commercial fishing closure. The closure, which applies to the WCDSFIMF and the West Coast Demersal Gillnet and Demersal Longline (Interim) Managed Fishery (WCDGDLF), delivered explicit commercial catch reductions, while allowing recreational fishing to continue. Ideally, it allowed for catches to remain static, pending the finalisation of management objectives and the introduction of new management arrangement for the recreational sector.

⁴ Commercial Access Panel, (2006) "*Recommended Access and Allocation Criteria for the West Coast and Gascoyne Commercial 'Wetline' Fisheries*", Fisheries Management Paper No. 207, Department of Fisheries, Western Australia.

Department of Fisheries (2007) "Outcomes of the Wetline Review – The Minister for Fisheries' decisions in relation to the future management of the West Coast and Gascoyne commercial "wetline" fisheries", Fisheries Management Paper No. 224, Department of Fisheries, Western Australia.

2.1.2.2 West Coast Demersal Gillnet and Demersal Longline Managed Fishery (WCDGDLF) and Joint Authority Southern Demersal Gillnet and Demersal Longline Fishery (JASDGDLF)

Scalegfish is an important component of the catch of temperate demersal gillnet and demersal longline fisheries, historically accounting for around 15 - 20 per cent of their total catch by weight. Commonly caught scalegfish species include queen snapper, blue groper, pink snapper, Western Australian dhufish and boarfish.

The JASDGDLF was declared a limited entry (or managed) fishery in 1988 and is managed jointly by the State and Commonwealth Governments. The fishery is managed primarily through effort controls in the form of time/gear units that allow fishers to use a specified length of demersal gillnet or number of hooks on a longline for a limited period of time. In response to concerns about the sustainability of key shark stocks the fishery has undergone a number of significant changes designed to reduce effort by around 40 per cent. These changes have also had the effect of reducing catches of demersal scalegfish stocks in Zone 1 of the fishery.

The WCDGDLF is currently managed as an interim managed fishery, under a management plan introduced in 1997. Consistent with the JASDGDLF, the fishery is managed using effort controls in the form of time/gear units and significant changes have been introduced to reduce catches of shark by around 40 per cent from a 2001/02 benchmark.

Effort and area closures are monitored through VMS, which was introduced in 2008 in the WCDGDLF and in 2009 in the JASDGDLF.

Other input controls such as size limits and gear restrictions also apply. For instance, the minimum legal size for pink snapper south of Lancelin was increased from 450 millimetres to 500 millimetres in 2009.

In addition to the 40 per cent effort reduction the Metropolitan Area commercial fishing closure has closed an area of the fishery that has traditionally produced approximately 33 per cent of the total WCDGDLF catch. As a result, entitlement to fish in the fishery has been reduced by approximately 35 per cent through a voluntary buy-back scheme. Combined, these effort reductions are expected to deal with the latent effort in the fishery and also benefit demersal scalegfish stocks by reducing catches of these species. The impact of these reductions will be monitored to ensure that west coast demersal scalegfish catches are reduced by 50 per cent on the 2005/06 catches.

2.1.2.3 Western Deepwater Trawl Fishery

This fishery started in the mid-1980s in the deep waters (outside the 200-metre isobath) off Fremantle and Geraldton. It is an opportunistic fishery, without a specific target species. Therefore the main species taken has changed over time, alternating between finfish and bugs⁵. Since being brought under management, the number of boats participating in the fishery has gone from 102 boats in 1987-1988 to 11 fishing permits currently. The Commonwealth does not release detailed catch information, but only 5.04 tonnes of scalegfish was caught in 2005-06, compared to 243 tonnes caught in 2001-02.

⁵ Australian Fisheries Management Authority, *Western Deepwater Trawl Fishery – Data Summary 2006*, Australian Fisheries Management Authority, 2007

2.1.3 Current commercial fishery management arrangements

2.1.3.1 West Coast Demersal Scalefish (Interim) Managed Fishery (WCDSIMF)

Although the commercial fisheries that retain west coast demersal scalefish are listed in Table 1, the WCDSIMF is the main commercial fishery targeting scalefish on the west coast. It is therefore important to be clear about the following significant elements of the WCDSF Interim Management Plan:

Limited number of permits - To remain active a permit must hold units of entitlement in the fishery. There are 61 permits in the fishery.

Total commercial catch (TCC) for each area - The WCDSFIMF is managed under an Individual Transferable Effort system that specifies a Total Commercial Catch (TCC) setting for each area of the fishery. The total number of hours allocated for each area has been determined using the relevant TCC and Catch Per Unit Effort (CPUE) figures for each area provided by the Department of Fisheries' Research Division.

The TCC and CPUE settings for the Fishery will be reviewed annually and adjusted as required by the Minister. Because the managed fishery commenced on 1 January 2009, the first review will be based on catches until 30 June 2009, and will be conducted at the nine-month mark of the fishing year. Entitlement is calculated in 'units' and unit values are determined on the basis of the relevant TCC and CPUE. The value of a unit of entitlement is determined by dividing the capacity of the area of the fishery by the number of units in that area and expressed as hours. The number of hours allocated for each area (the capacities) has been set to deliver a 50 per cent reduction in catch from each area (based on 2005/06 catches of 975 tonnes). In 2008 the catch for all areas for the WCDSFIMF was 413 tonnes and in 2009 the expected catch is 429 tonnes (excluding the Offshore Area).

The management arrangements for the Offshore Area of the Fishery are as follows:

- effort in the area is currently limited to 100 'boat fishing days' (2,400 hours);
- access to the area operates through a shared 'pool' of entitlement and is available to permit holders through a 'first-in,-best-dressed' arrangement;
- operators wishing to access the offshore area are required to hold unexhausted inshore area entitlement;
- any boats that choose to fish the Offshore Area must utilize access from the pool of entitlement;
- the size of the pool (which is in fact the capacity set by the Minister) can be adjusted as appropriate (on the basis of research advice, catch and effort in the area and the impacts on the relevant demersal scalefish stocks).

This approach provides a conservative means of managing the Offshore Area. However, it is also likely that more formal arrangements will need to be developed for this area in the future.

Effort and area closures are monitored through VMS.

Other input controls such as size limits and gear restrictions also apply. For instance, the minimum legal size for pink snapper south of Lancelin was increased from 450 millimetres to 500 millimetres in 2009. A requirement to carry a release weight for assisting in the return of unwanted demersal scalefish to the seabed was introduced in 2009.

- *Area closures*

The Metropolitan Area has been closed to commercial fishing since 15 November 2007. The current baldchin spawning closure within the Abrolhos Islands Fish Habitat Protection Area, over the period 1 November to 31 January, was put in place in 2003.

2.1.3.2 *West Coast Demersal Gillnet and Demersal Longline Managed Fishery (WCDG-DLF) and Joint Authority Southern Demersal Gillnet and Demersal Longline Fishery (JASDGDLF)*

The significant elements of the management plans are listed in Table 1. In addition during 2006, 2007 and 2008 a two-month closure has operated from 15 August to 16 October in the waters between Steep Point (north of Kalbarri) and Albany (which is in the JASDGDLF) inshore of the 200-metre isobath to aid the recovery of whiskery shark stocks. The Metropolitan Area of the WCDSFIMF has also been closed to operators in the WCDGDLF since 15 November 2007. Effort and area closures are monitored through VMS.

Other input controls such as size limits and gear restrictions also apply. For instance, the minimum legal size for pink snapper south of Lancelin was increased from 450 millimeters to 500 millimeters in 2009.

2.1.3.3 *Western Deepwater Trawl Fishery*

A summary of the arrangements is provided in Table 1.

2.1.4 Managing for sustainability

The current management goal is to reduce the total 2005/06 catch of demersal scalefish across all sectors by at least 50 per cent. The reductions need to be managed and achieved in each of the five management areas of the fishery and the total allowable commercial catch (TACC) for the fishery (including the Offshore Area), is determined as 50 per cent of the 2005/06 catch based on the mean from catches in the decade 1990 to 2000. For the WCDSFIMF, the catch has been calculated at around 460 tonnes (including the Offshore Area), with the potential catch for each of the areas based on 2005/06 catches, being:

- South-West Area 82 tonnes
- Mid-West Area 197 tonnes
- Kalbarri Area 150 tonnes
- Offshore Area 2400 hrs fishing permitted (approx 30 tonnes)

The WCDSFIMF catches were below these levels in 2008 and 2009.

As advised in Section 2.1.2.2, there has been a 40 per cent effort reduction in both the WCDGDLF and JASDGDLF. This will also lead to reductions in the size of the scalefish component. The closure of the Metropolitan area to commercial fishing (and the related voluntary buy-back), where an estimated 35 per cent of the scalefish in this fishery has been caught, will also reduce commercial fishing of scalefish along the west coast.

The impacts of these reductions in effort/catch across the fishery need to be carefully monitored to evaluate whether the management package has produced the necessary reductions in commercial sector catch and effort. Furthermore, the recruitment levels to the stocks will also need to be monitored on an annual basis.

In the Western Deepwater Trawl Fishery, the demersal scalefish catch was historically dominated by six main commercial species or species groups: orange roughy (*Hoplostethus atlanticus*), oreos (Oreosomatidae), big spined boarfish (*Pentaceros decacanthus*), eteline snapper or jobfish (Lutjanidae Etelinae), apsiline snapper (Lutjanidae:Apsilinae) and sea bream (Lethrinidae). But in 2006-07 catches were dominated by ruby snapper.⁶ Records indicate demersal scalefish catches are highly variable, there is a risk that this fishery is putting additional pressure on demersal fish stocks.

According to the Australian Fisheries Management Authority (AFMA), although biological information on the stock is limited, effort levels are well below those considered to be sustainable for the Fishery. The lack of a formal stock assessment group and limited research funding has constrained stock assessment activities in this fishery. There is considerable latent effort in the Western Deepwater Trawl Fishery and harvest trigger levels should incorporate State-managed fishery catches if the fishery is to be sustainably managed into the future.

2.2 The Recreational Fishery

2.2.1 Management objectives

There are two management objectives for the recreational sector of the fishery. These are:

- to reduce the catches of demersal scalefish by at least 50 per cent across the entire west coast in order to ease pressure on the stocks and enable them to replenish; and
- once this has occurred, to improve individual and community support for a sustainable recreational ‘fishing experience’.

The ‘fishing experience’ varies between fishers, and includes factors such as the diversity of opportunities available (i.e. the different species of fish taken) and social aspects. In general, the value to the individual and the community of the fishing experience are key goals for recreational fisheries management.

2.2.2 Management history

Recreational fishing and boating has always been a popular Western Australian past-time. In the early 1990s a major review of recreational fishing was undertaken that set the direction of recreational fishing management into the future.

The first 12-month survey of recreational boat fishing in the West Coast Bioregion, including the metropolitan area, was conducted during 1996/97. This survey provided comprehensive data on the recreational boat-based catch for the West Coast Bioregion.

Limited entry was introduced for licensed fishing tour (charter) operators in 2001 and the west coast has the highest number of charter operators in the State. Logbooks became compulsory in 2002/03 and these show that there has been an overall contraction in total charter effort and operational area of charter activity in the west coast since then. However, charter effort has been consistently high off Perth, Kalbarri and around the Abrolhos Islands. In 2005/06 the charter sector took about 10 per cent of the total recreational catch of Western Australian dhufish and about 30 per cent of the pink snapper catch.

⁶ Larcombe, J & Begg, G Eds. “*Fishery Status Reports, 2007, Status of Fish Stocks managed by the Australian Government*”, Bureau of Rural Sciences, 2008

⁷ http://www.afma.gov.au/fisheries/northern_trawl/deepwater/at_a_glance.htm

A repeat of the recreational creel survey was undertaken in 2005/06. These survey results show changes in the level and distribution of recreational fishing effort; people are now traveling greater distances to fish over a far wider area. There are still peaks in fishing effort around key launching sites and there is now considerable fishing pressure being exerted out to the 200-metre isobath. This trend is due to the growth in ownership of larger, faster boats and people willing to travel greater distances to catch fish.

A further creel survey was undertaken in 2007/08 in the Metropolitan Area of the fishery. These results are not yet available. Another west coast survey was undertaken in 2008/09, with a further west coast survey underway for 2009/10.

In October 2008, the Minister for Fisheries announced changes to the management arrangements for the recreational fishery, including reduced mixed bag limits for Category 1 fish, reduced species limits for pink snapper, and increased minimum legal size for pink snapper and boat possession limits for Category 1 fish. He also announced a baldchin groper spawning closure within the Abrolhos Islands Fish Habitat Protection Area over the period 1 November to 31 January, and a finfish possession limit within the Abrolhos Islands Fish and Fish Habitat Protection Area of 10kg of fillets or one day's bag limit of whole fish per person – this possession limit can be transported back to the mainland. This possession limit was to remain in place for at least two years while a review to assess the option of managing the Abrolhos Islands as a wilderness 'no take away' fishing area is undertaken. These changes came into effect in January 2009.

The minimum legal size for pink snapper south of Lancelin was increased from 450 millimetres to 500 millimetres in 2009⁸.

The Minister also commissioned independent scientific and management reviews of the recreational fishery. Mr Peter Neville reviewed the management arrangements⁹, Mr Michael O'Neill carried out the scientific review¹⁰, and Dr Aldo Steffe undertook a creel survey review¹¹. These independent reviews confirmed departmental advice that stocks of west coast demersal scalefish were being over-fished and that a catch reduction of at least 50 per cent was required by the recreational fishing sector.

In July 2009 the Minister announced significant new rules to protect west coast demersal scalefish, including new licences and further restrictions, but these rules were amended in September 2009 (see Section 2.2.6 below).

2.2.3 Boundaries

These are the same as the WCDSFIMF. The Metropolitan Inshore Area is a recreational fishing-only area.

⁸ Note: this also applies to commercial fishers and as such will impact on both the WCDSF, the Cockburn Sound Line & Pot Fishery, WCDGDLF and the JASDGLF.

⁹ Neville, P J, "A Review of Management Arrangements for the Recreational Fishery for Demersal Scalefish in the West Coast Bioregion", Fisheries Occasional Publication No. 65, 2009

¹⁰ O'Neill, M, "Scientific review of the West Coast Demersal Scalefish Fishery, Western Australia", Fisheries Occasional Publication No. 55, 2009-07-03

¹¹ Steffe, A, "Review of Fisheries Research Report (177)", Fisheries Occasional Publication No. 67, 2009

2.2.4 Main fishing method

Recreational fishing for demersal scalefish is mainly from boats. Anglers typically use rods and reels or handlines, although a very small proportion is taken by spear-fishers. Charter fishing using these same methods is also popular.

2.2.5 Fishing season

A two-month seasonal closure on the take of demersal scalefish by recreational fishers on the west coast from 15 October to 15 December inclusive commenced in 2009 (see below).

2.2.6 Current and future management arrangements

In September 2009, the Minister, the Hon. Norman Moore, MLC, announced modified management arrangements for recreational fishing in the recreational WCDSF fishery. These were:

- A daily mixed bag limit in the West Coast Bioregion of two ‘high risk’ demersal scalefish species per (licensed) person, of which only one (1) may be a Western Australia dhufish;
- A boat limit of two dhufish (six for charter boats);
- A two-month seasonal closure on the take of ‘high risk’ demersal scalefish (see Table 2 below) by recreational fishers in the West Coast Bioregion (between Kalbarri and Augusta) from 15 October to 15 December inclusive (boat and shore fishing);

Table 2. The take of these species by recreational fishers is prohibited during the recreational demersal scalefish closure on the west coast (15 October to 15 December, inclusive).

SPECIES	SCIENTIFIC NAME
Coral trout and coronation trout	<i>Plectropomus</i> spp. and <i>Variola louti</i>
Cods	Family Serranidae
Western Australian dhufish	<i>Glaucosoma hebraicum</i>
Emperors (“nor’ west snapper”)	Family Lethrinidae
Baldchin groper and tuskfish	<i>Choerodon</i> spp.
Western blue groper	<i>Achoerodus gouldii</i>
Hapuku/bass groper/trevella and grey banded rock cod	<i>Polyprion</i> spp., Family Centrolophidae and <i>Ephinephelus octofasciatus</i>
Parrot fish	Family Scaridae
Pink snapper	<i>Pagrus auratus</i>
Queen snapper (blue morwong)	<i>Nemadactylus valenciennesi</i>
Red emperor	<i>Lutjanus sebae</i>
Red snapper – bight redfish, nannygai and swallowtail	<i>Centroberyx</i> spp.
Tropical snappers and sea perch (mangrove jack, fingermark, job fish, stripey sea perch etc.)	Family Lutjanidae
Foxfish and pigfish	<i>Bodianus</i> spp

Note: all species with the exception of foxfish and pigfish (*Bodianus* spp) are already identified as “high risk” species for the West Coast Bioregion.

- Fish in the current ‘high risk’ group (‘Category 1’) will be divided into two new categories – demersal scalefish and pelagic species;
- Combined bag limit changes to ‘lower risk’ (30) and ‘medium risk species’ (12) in the West Coast Bioregion;

- A requirement to carry a release weight for assisting in the return of unwanted demersal scalefish to the seabed;
- Introduction of a State-wide Recreational Fishing From Boat Licence (\$30);
- Limiting the Recreational Fishing From Boat Licence to fishing conducted from a “powered” boat only (not kayaks or other not powered boats [e.g. dinghy with no motor]);
- Allowing any fisher not holding a Recreational Fishing From Boat Licence to fish from a boat in the company of a licensed boat fisher within the licensed fisher’s bag limit;
- Charter boat passengers not already holding a Recreational Fishing From Boat Licence pay a small fee (\$15) per trip;
- Removal of the recreational ‘umbrella’ licence, but a 10 per cent discount when more than one licence is purchased at the same time, together with a 50 per cent discount for seniors, pensioners and children under 16 years of age (except for Charter Fishing Licences);
- All money raised by licensing is held in a special trust fund to be used only for recreational fishing;
- An additional \$2 million annually from the Consolidated Account for 13 Fisheries and Marine Officers for recreational compliance and education;
- A voluntary logbook program for high risk classified fish to provide additional catch and effort information will be introduced; and
- The Recreational Fishing Fund will be reviewed with a view to provide recreational fishing stakeholders more meaningful input into recreational fishing spending priorities.

The following elements of the recreational fishing arrangements announced in late 2008 remain in place:

- The baldchin grouper spawning closure within the Abrolhos Islands Fish Habitat Protection Area that occurs over the period 1 November to 31 January. The finfish possession limit within the Abrolhos Islands Fish and Fish Habitat Protection Area is 10 kilogram of fillets or one day’s bag limit of whole fish per person – this possession limit can be transported back to the mainland. This possession limit to remain in place for at least two years while a review to assess the option of managing the Abrolhos Islands as a wilderness ‘no take away’ fishing area is undertaken.
- The minimum legal size for pink snapper south of Lancelin was increased from 450 millimetres to 50 millimetres in December 2009¹².
- Fishing competitions will be discouraged from targeting ‘high risk’ fish.

Limited entry was introduced for licensed fishing tour (charter) operators in 2001 and the west coast region has the highest number of charter operators in the State. Logbooks became compulsory in 2002/03 and recent analysis of logbook data show that there has been an overall contraction in total charter effort and operational area of charter activity in the west coast since then. However, charter effort has been consistently high off Perth, Kalbarri and at the Abrolhos Islands. In 2005/06 the charter sector took about 10 percent of the total recorded recreational catch of WA dhufish and about 30 per cent of the pink snapper catch.

¹² Note: this also applies to commercial fishers and as such will impact on both the WCDSFIMF, the Cockburn Sound Line & Pot Fishery, WCDGDLF and the JASDGLF.

2.2.7 Managing for sustainability

The management arrangements described in the previous section are primarily aimed at ensuring that management objectives for the recreational WCDSF fishing sector are met. Biological research for sustainability for the recreational sector is focused on the Metropolitan Inshore Area, where recreational fishing is concentrated. It is expected that the new management arrangements will achieve their aim of a reduction in catch of at least 50 per cent across the whole area of the fishery, deemed necessary to ensure the stocks' sustainability into the future. These arrangements will be reviewed after 12 months.

2.3 Customary Fishing

Indigenous people engage in commercial, recreational and customary fishing. It is only in recent times that customary fishing has begun to be identified as a separate activity to recreational and commercial fishing. The Department of Fisheries is moving to amend the *Fish Resources Management Act (1994)* to recognise customary fishing in line with a set of nationally agreed principles and consistent with the provisions of the *Native Title Act (1993)*. Amendments to the legislation will mean that the Department can implement management arrangements that specifically apply to customary fishers.

The intent of the fishing activity is what distinguishes customary fishing. It applies to persons of Aboriginal descent, fishing in accordance with the traditional law and custom of the area being fished with fishing for the purpose of satisfying non-commercial personal, domestic, ceremonial, educational or communal needs. Customary fishers are not limited to 'traditional' fishing gear, species or methods; boats, modern methods and gear are used in fishing for customary purposes, however, customary fishing is subject to a sustainable fisheries management framework and limits will apply in this context.

Indigenous people currently fishing for west coast demersal scalefish are accessing the fishery either as recreational, commercial or customary fishers. The amount of customary fishing effort in the fishery is unknown due to a lack of data collection in this area.

The National Native Title Tribunal's Research Report of April 2005 indicated that there was shore-based fishing for "schnapper" (sic) in the Swan River, whereby schools of the fish were driven into the mouth of the Swan River and speared. Based on this, Customary fishing for WCDSF should be considered very small. The Department of Fisheries believes that the customary catch is likely to be a very small proportion of the total catch in the fishery, as no evidence of boat-based demersal scalefish fishing has been found¹³. It is not anticipated that customary fishing would occur around the Abrolhos Islands.

Management arrangements for customary fishing are being developed through the Aboriginal Fishing Strategy, which is currently under consideration by Government.

2.4 Conservation Areas

A number of WCDSF populations are managed within conservation areas. These are summarized in Table 3 below:

¹³ Wright, G (2005) "An overview of the evidence for Indigenous Fisheries on the west and south coasts of Western Australia", National Native Title Tribunal

Table 3. Conservation Areas in the West Coast Bioregion.

Area	Restriction
Abrolhos Islands Fish Habitat Protection Area	All line fishing is prohibited within Reef Observation Areas
Busselton Jetty	All fishing is prohibited in the waters within 50 metres of the Busselton Jetty Observatory
Shoalwater Marine Park	Commercial and recreational fishing restricted to varying degrees within special purpose sites; all fishing prohibited within sanctuary zones
Cottesloe Reef Fish Habitat Protection Area	All commercial fishing is prohibited
Dive Sites	No fishing is permitted around the wrecks of <i>HMAS Swan</i> (Geographe Bay), <i>Saxon Ranger</i> (Shoalwater)
Jurien Bay Marine Park	Commercial and recreational fishing restricted to varying degrees within special purpose sites; all fishing prohibited within sanctuary zones
Kalbarri Blue Holes Fish Habitat Protection Area	All fishing prohibited
Lancelin Island Lagoon Fish Habitat Protection Area	All fishing prohibited
Marmion Marine Park	Commercial and recreational fishing restricted to varying degrees within special purpose sites; all fishing prohibited within sanctuary zones
Rottneest Island	All commercial fishing is prohibited. All marine life is protected in two conservation areas near the island. These are near Pocillopora Reef and part of the Transit Reefs. There are three other sanctuary zones in which shore based line fishing is permitted

3.0 FACTORS THAT INFLUENCE NET BENEFIT FROM USE OF THE RESOURCE

3.1 Economic Environment

3.1.1 Commercial fishery environment

The estimated value of the demersal scalefish taken in the WCDSF in 2005/06 is \$6.6 million. Western Australian dhufish accounted for 37 per cent of the total value, followed by pink snapper (24 per cent), the lethrinids (16 per cent), bight redfish (6 per cent), baldchin groper (5 per cent) and hapuku (2 per cent).

In addition, scalefish account for between 15 – 20 per cent of the JASDGDLF and WCDGDLF. In 2005/06, this group on the west caught 25 tonnes of dhufish and 19 tonnes of pink snapper.

Wholesale prices used to calculate the value of the fishery were dhufish, \$13.5/kilogram, pink snapper, \$5.24/kilogram and baldchin groper \$10/kilogram. These prices are not reflective of the current market prices for these and many other species of demersal scalefish.

As demand for popular fish species varies seasonally their prices fluctuate greatly and the average prices used here are considered to be conservative.

Almost all the fish taken in this fishery is sold to the Western Australian domestic wholesale, retail and restaurant markets. The remainder is sent to the eastern states.

3.1.2 Recreational fishing environment

A survey undertaken by Economic Research Associates (Lindner and McLeod, 1991) estimated that recreational fishing activity across the State had a direct expenditure of \$205 million in 1989/90, and an indirect impact of \$184 million, giving an aggregate impact of \$389 million and an employment impact of 5,700 full-time jobs.

A repeat survey in 1998 estimated direct expenditure at \$299 million in 1995/96, with an aggregate impact of \$569 million and an employment impact of 7,000 full-time jobs.

Although it is of interest to know how much is spent by recreational fishers, expenditure on recreational fishing and the gross value of commercial fisheries may not be the most appropriate economic values to use to properly compare allocation options between these sectors (see McLeod and Nicholls, 2004 and Hundloe, 2002 for an explanation of appropriate economic values).

McLeod and Nicholls (McLeod and Nicholls, 2004) demonstrate the application of appropriate socio-economic valuation methodologies that should be used for evaluating resource allocation options between commercial and recreational users, using three case studies (see Part Four, the West Coast Wetline Fishery case study). Their study put the marginal net benefit of the recreational west coast demersal scale fish fishery at between \$1.9 and \$2.1 million, which was the aggregate willingness to pay for a daily catch limit of five fish.

3.2 Social Environment

3.2.1 Commercial fishing participation

- *The West Coast Demersal Scalefish (Interim) Managed Fishery*

Sixty-one boats are currently able to operate in the interim managed fishery, and during 2005/06 these particular boats fished on average 47 days in the fishery and employed, on average, two crew members. Most of the boats that gained access to the fishery fished in more than one area and this is reflected in the numbers of boats that gained access to each area, which are as follows:

- Kalbarri Area 34 boats
- Mid-West Area 54 boats
- South-West Area 13 boats

- *West Coast Demersal Gillnet and Demersal Longline Managed Fishery (WCDGDLF) and Joint Authority Southern Demersal Gillnet and Demersal Longline Fishery (JASDGDLF)*

There are 24 Zone 1 licence holders in the JASDGDLF, but only seven operators reported fishing during 2005/06. In the WCDGDLF there are 24 permit holders, but only 10 reported fishing in 2005/06.

Between 11 per cent and 17 per cent of the total demersal gillnet and longline catch is composed of scalefish species and in 2005/06 52 tonnes in the JASDGDLF and 57 tonnes in the WCDGDLF.

- *The Western Deepwater Trawl Fishery*

There are 11 permit holders in the Western Deepwater Trawl Fishery, with the main effort concentration off the mid-west coast of WA. Each boat has an average of four to six crew members for each trip. (AFMA, “Western Trawl Fisheries Statement of Management Arrangements”, November 2004). The fishery caught 67.48 tonnes in 2003 and at that date was worth around \$83,000. The scalefish catches fell to only five tonnes in 2005/06.

3.2.2 Recreational fishing participation

State-wide, recreational boat-based line fishing effort increased from 269,600 days in 1996/97 to 311,400 days in 2005/06.

Boat registration information from the Department for Planning and Infrastructure shows a steady increase in the number of new boats registered. In 2002, 69,166 boats were registered in WA. By 2006 this number had increased to 81,417 with over 50 per cent of these based in the metropolitan area. This represents an average growth in new boat registrations of approximately 2,450 per year, although it is recognised that not all boats are used for recreational fishing. As a result of this growth, additional boat launching facilities are being considered. Both the growth in boat numbers and the additional launching facilities are likely to place further pressure on fish stocks.

3.2.3 Charter participation

Employment in this sector has not been assessed, but during 2005/06, 61 per cent of the 161 licensed operators, able to work in the west coast area, operated in the area, reporting 62,000 clients making use of their services.

3.3 Key Socio-economic Statistics

The table below sets out recent changes in key socio-economic indicators for each of the regions of Western Australia where west coast demersal scalefish are taken. These provide a limited framework within which to view commercial and recreational fishing and the socio-economic trends that may influence participation in these fishing activities in a particular region. Increased domestic tourism and employment will have economic flow-on and economic multiplier effects for the supply of local fish in regional areas.

Table 4.

Region	Annual Population (10-year trend) 1997-2007	Employment (4-year trend) Sep 2005 – March 2008	Unemployment (4-year trend) Sep 2005 – March 2008	Average taxable income (from 2002 to 2005) (5-year trend)	Overnight domestic visitor expenditure 2007
Mid-West	+0.5% (↑)	+6.5% (↑)	-10% (↓)	+2% (↑)	\$42
Perth metro	+1.6% (↑)	+6.2% ¹⁴ (↑)	-6.8% ¹⁵ (↓)	19.2% (↑)	\$182
Peel	+2.4% (↑)	+9.1% (↑)	-33.2% (↓)	+20.2% (↑)	\$127
South-West	+3.5% (↑)	+7.8% (↑)	-23.1% (↓)	+13.4% (↑)	\$127

Source : Department of Local Government and Regional Development www.dlgrd.wa.gov.au, Tourism Research Australia, www.tra.australia.com, Australian Bureau of Statistics www.abs.gov.au, Department of Employment Education and Workplace Relations, www.workplace.gov.au

4.0 INDIRECT FISHERY MANAGEMENT INFLUENCES ON FISHING

There are a number of external influences that affect why, how and where commercial and recreational fishers fish and hence have relevance to any decision on allocation of access to fish resources.

4.1 Marine Planning

A number of agencies, both State and Federal have legislative responsibility for aspects of marine planning and resource-use. Many of these can affect fishing activities or impact on fish habitats. For example, port and marina developments, and sanctuary zones can create areas partially or totally closed.

Marine Protected Areas created through marine planning initiatives can be partially or totally closed to fishing activity and therefore have the potential to impact on both commercial and recreational fishing activity, in particular ‘no-take’ sanctuary zones. Marine planning initiatives should therefore be considered as part of any resource allocation decision-making process and will be addressed through Ecosystem Based Fisheries Management initiatives.

4.1.1 National marine planning

Marine Bioregional Planning (MBP) initiatives are undertaken by the Australian Government, via the Department of Environment, Water, Heritage and the Arts (DEWHA) in accordance with the Commonwealth Environment and Biodiversity Conservation Act 1999 (EPBC Act) to identify areas within Commonwealth waters (from State waters to the 200-nautical mile Economic Exclusion Zone) worthy of inclusion within the ‘National Representative System of Marine Protected Areas’ (NRSMPA).

The primary goal of the NRSMPA is “to establish and manage a comprehensive, adequate and representative system of marine-protected areas to contribute to the long-term ecological viability of marine and estuarine systems, to maintain ecological processes and systems, and to protect Australia’s biological diversity at all levels” (DEH, 2004).

The planning framework for NRSMPA is based on the ‘Interim Marine and Coastal Regionalisation for Australia’ (IMCRA) ecosystem classification. In line with this objective, 60 bioregions have been identified to cover Australia’s waters, 16 of which are within Western Australia’s coastal waters.

A bioregion is defined by a combination of biological, social and geographic criteria, rather than by geopolitical considerations and is, generally, a system of related interconnected ecosystems. Two bioregions have been identified within Commonwealth waters off the Western Australian Coast – the South West Bioregion (to include waters between Kangaroo Island, South Australia and Shark Bay), and the North West Bioregion (to include waters between Shark Bay and the Northern Territory border). Other MBPs are also being prepared for Commonwealth waters surrounding Australia, including the North, East and the now completed South-East.

The MBPs will:

- describe each region’s conservation values, including mapping sites of importance for protected species and communities, and ecological processes;
- identify regional priorities for action, based on an assessment of threats to conservation values and long-term policy goals;

- identify a number of multiple-use Marine Protected Areas within the bioregion, which will include within them a number of zones which may restrict fishing to varying degrees, including ‘no-take’ sanctuary zones; and
- develop strategic guidance for proponents and decision-makers. Plans will include the types of information that should be included within referrals under the EPBC Act or monitoring requirements that may be required for certain activities or locations within a region.

A ‘Bioregional Profile’ for the South West was released by DEWHA in October 2007. This is the first stage of the MBP planning phase and describes the socio-economic characteristics (including fishing activity) and goals for the development of marine protected areas (publicly available on DEWHA website ciu@environment.gov.au). The Department of the Environment, Water, Heritage and the Arts have subsequently held discussions with key stakeholders on areas for further assessment.

A draft south-west MBP was released during 2009, which identifies the location of the proposed marine protected areas. A final document will then be prepared following consideration of issues raised within public submissions.

4.1.2 State marine planning

4.1.2.1 Marine Conservation Reserves

Multiple-use marine protected areas, referred to as Marine Conservation Reserves may be created under the provisions of the *Conservation and Land Management Act 1984*. The lead agency for implementing this legislation is the Department of Environment and Conservation.

A key element of this process is the establishment and management of a State-wide system of Marine Conservation Reserves, which may have the ability to restrict fishing activity to varying degrees in accordance with a zoning scheme outlined within the plan of management for a particular area. Partial or total restrictions (within ‘no-take’ sanctuary zones) to fishing activity are required to be reflected in an order under the *Fish Resources Management Act 1994* (FRMA). The zones obviously have a direct effect on fish resource allocation.

Existing marine conservation reserves along the west coast include Jurien Bay Marine Park, Marmion Marine Park and Shoalwater Islands Marine Park. A proposed marine conservation reserve between Cape Leeuwin and Cape Naturaliste is currently under consideration by the State Government.

- *Fish Habitat Protection Areas*

Fish Habitat Protection Areas (FHPAs) are another form of marine protected area and may be created under the provisions of s. 115 of the FRMA to meet a number of objectives, including fish protection, fish habitat protection, human use and resource sharing, or observation and education.

FHPAs are most commonly community-initiated proposals to protect relatively small areas of the aquatic environment and rely on community stewardship for on-going management. A notable exception to this is the Abrolhos Islands FHPA, which is significant (2,794 square kilometres in area) and managed by the Department in consultation with the Abrolhos Islands Management Advisory Committee.

Fishing activities within an FHPA may be partially or totally restricted and therefore have an impact on fish resource allocation.

FHPAs have been created along the west coast around the Abrolhos Islands, Cottesloe Reef, and the Kalbarri Blue Holes Lancelin Island Lagoon.

- *Reef Observation Areas*

Reef Observation Areas (ROAs) are able to be created under s. 43 of the FRMA for a variety of purposes and can include a total or partial; spatial and or temporal restriction to fishing. ROAs are currently in place along the west coast within the Abrolhos Islands FHPA, and at Yallingup Reef, Cowaramup Bay, the Busselton Underwater Observatory and around the wrecks of the Saxon Ranger (Shoalwater Bay) and Swan (Geographe Bay).

- *Regional marine planning*

The Department of Environment and Conservation (DEC) has been progressing Regional Marine Planning (RMP) initiatives in accordance with State Cabinet direction (September 2006). A State Marine Policy Stakeholder Group (SMPSG) was formed in late 2006 to provide advice through the chairman direct to the Minister for the Environment on regional marine planning and the development of a State-wide policy framework for regional marine planning, and advice on strategic cross-sectoral issues relating to the development of new State marine conservation reserves policy.

The preparation of a RMP for the south coast between the Western Australian and South Australian border to Augusta is being progressed as a pilot RMP exercise. A draft South Coast Regional Marine Strategic Plan (SCRMSP) has been prepared by a community-based Planning Advisory Group (PAG), assisted by relevant State Government agencies through a Planning Working Group (PWG).

The SCRMSP is a high level strategic plan to integrate cross-sectoral marine planning issues, and does not contain specific management actions such as detailed management arrangements for marine protected areas which will have a direct impact on fish resource allocation. However further, more detailed marine planning following the release of the final SCRMSP may result in closures to fishing activity.

The draft SCRMSP is under consideration by State Government, which has also to make a decision as to whether further regional marine plans will be prepared for other areas of State waters in Western Australia.

- *Ecosystem Based Fisheries Management*

The Department is developing an Ecosystem Based Fisheries Management (EBFM) approach to deal with the ecological, social and environmental implications of fishing activity. EBFM embraces the concept of Ecosystem Based Management, as well as Ecologically Sustainable Development principles, and the resource-sharing principles of Integrated Fisheries Management at a bioregional scale.

It is the next step in sustainable fisheries management for the Department of Fisheries and deals with regional level interactions, rather than by single fishery. The process identifies and prioritises issues within an ecosystem using a transparent risk assessment approach. It identifies gaps and overlaps and can be used as a tool to justify management changes for issues of high risk.

EBFM involves the assessment of ecological and socio-economic issues using a transparent 'risk-based' approach and allows for effective and strategic input into natural resource management initiatives within both the marine and freshwater environments. The west coast has been trialled as the first region in the State for EBFM.

4.2 Coastal Development

Over 80 per cent of the State's population lives within 30 kilometres of the coast (WAPC,

2003). The implications of urban expansion for coastal development are significant and include residential sprawl and demand for coastal infrastructure, which in turn, puts pressure on available fishing grounds.

Although there is also demand for maintenance of some wilderness coastal areas, those areas may not be significant to fishery ecosystems, such as breeding grounds or nursery areas.

A new harbour (referred to as the Fremantle Outer Harbour) is currently being considered by the Fremantle Port Authority and will be subject to full environmental impact assessment by the WA Environmental Protection Authority. If such a development does proceed, there is potential for it to have direct and indirect impacts on the only known spawning area for pink snapper in the west coast, which provides a significant role in spawning recruitment for the west coast pink snapper stocks.

The Western Australian Planning Commission administers the State Coastal Planning Policy, gazetted in June 2003 (WAPC, 2003), which is intended to provide an integrated approach to coastal planning.

4.3 The World Economy

As the fish taken by the commercial sector in this fishery are almost exclusively sold to the local market, the effect of the global financial crisis on the market price of fish has not been felt, particularly as the 50 per cent reduction in the commercial sector's catch has anecdotally led to higher prices of fish in local shops and restaurants. Retail prices of up to \$60 per kilogram or more for Western Australian dhufish have been reported. Fuel and labour costs have also risen over recent years.

4.4 National and International Reporting Requirements

4.4.1 Environmental Protection and Biodiversity Conservation (EPBC) Act 1999

The Commonwealth *EPBC Act 1999* promotes the conservation of biodiversity by providing strong protection for listed species and communities in Commonwealth areas, Commonwealth waters and waters around our External Territories. Species and communities listed for protection include threatened species, marine species, migratory species and threatened ecological communities. Where possible these threatened marine species and communities will be included within Commonwealth Marine Protected Areas, as part of the Commonwealth MBP process described in Section 4.1.1.

The *EPBC Act 1999* requires a fishery management regime to be assessed against the Australian Government's *Guidelines for the Ecologically Sustainable Management of Fisheries* – Part 13 and Part 13A.

The JASDGLF, the WCDGLF and the Western Deepwater Trawl Fishery are subject to assessment under the EPBC Act.

4.4.2 National Competition Policy

The method and level of restriction on commercial fisheries have an impact on the environment, the fishing industry and consumers. The National Competition Policy legislation review process involves governments reviewing and, where appropriate, reforming legislation that restricts competition. However, governments may retain restrictions if they show that these are in the public interest.

More information about National Competition Policy can be found at: www.ncc.gov.au

5.0 INSTITUTIONAL ARRANGEMENTS

5.1 Governing Legislation/Fishing Entitlement

Both commercial and recreational fishing are managed through the provisions of the *Fish Resources Management Act 1994* and the *Fish Resources Management Regulations 1995*. This legislation provides for the management and licensing of commercial and recreational fishing.

The Department of Fisheries manages the commercial sector of the WCDSF in accordance with the relevant Management Plan and fishers have to hold a WCDSFIMF Permit, or a WCDGDLF or JASDGDLF licence. In the offshore areas they must hold a permit to fish in the Commonwealth-managed Western Deepwater Trawl Fishery.

After March 2010, a State-wide Recreational Fishing From Boat Licence will be required to fish in the fishery. However, a person fishing with a licensed person does not require a Recreational Boat Fishing Licence, provided the bag limit of the licensed person is not exceeded. The rules governing recreational fishing are found in the *Fish Resources Management Regulations 1995*.

Revenue raised from the new recreational fishing licensing system will be quarantined in a recreational fishing trust and only spent on matters related to recreational fishing. The Minister for Fisheries has said that the Government will not reduce its current level of funding for recreational fishing to offset the rise in funding from the new fishing licences.

At the time of going to press Government and WAFIC are negotiating the adoption of a new funding model that sets out how industry pays for access to fish resources.

5.2 Consultation Processes

5.2.1 Commercial consultation

- *West Coast Demersal Scalefish (Interim) Managed Fishery*

The WCDSFIMF Plan sets out that, prior to the plan being amended or revoked, consultation must be undertaken with permit holders. Consultation generally occurs through correspondence and meetings on an ‘as needs’ basis. An annual management meeting will be held for all permit holders and other interested parties that incorporates both area-specific and general fishery components.

There are currently no permit holder associations and permit holders are generally represented by the peak commercial fishing body, WAFIC, during management discussions. WAFIC have advised that formal arrangements for an association for the WCDSFIMF are being put in place at the time of going to print.

- *West Coast Demersal Gillnet and Demersal Longline Managed Fishery (WCDGDLF) and Joint Authority Southern Demersal Gillnet and Demersal Longline Fishery (JASDGDLF)*

The WA Demersal Net and Hook Fishery Management Advisory Committee is no longer operational and consultation is undertaken with authorisation holders through correspondence and ‘as needed’ meetings and/or on an annual basis.

In addition to being represented by the WA Demersal Gillnet and Longline Association, authorisation holders are generally represented by the peak commercial fishing body, WAFIC, during management discussions.

5.2.2 Charter consultation

There is no formal consultation mechanism with the Charter sector, with consultation taking place directly with fishing tour operators. At time of print, the Department is considering a review of the Charter sector.

5.2.3 Recreational consultation

Recfishwest is the peak State recreational fishing body representing recreational fishers. The Department of Fisheries has a service level agreement with Recfishwest which outlines Recfishwest's formal consultation roles.

6.0 RESEARCH AND MONITORING

6.1 Stock Assessment

The measures used to determine the levels of exploitation of Western Australian dhufish, pink snapper and baldchin groper within the West Coast Bioregion, including the Abrolhos Islands, show that these stocks were being exploited at levels above international benchmark standards. While management changes have been implemented to reduce the level of exploitation, it is too early to determine how successful these changes have been with respect to the status of these stocks.

The current reliance of the dhufish catch on a single recently recruited year class (that originated in 1999), and the remainder of the recruitment pulse that originated between 1993 and 1996, together with the extremely truncated age distribution of pink snapper, indicates that both these stocks are particularly vulnerable. The level of fishing mortality of baldchin groper at the Abrolhos Islands, combined with declining catch rates, indicate that localised overfishing is occurring.

Stock assessments have not been done on any of the deepwater, long-lived, demersal species in this fishery. Off the lower west coast, the dominant deepwater species are primarily hapuku and blue-eye trevalla, while further north in the bioregion, grey-banded cod, hapuku, bass groper and ruby snapper are the dominant deepwater species. Over recent years, the State-based commercial catch of each of these species has peaked then declined. This, together with the known biological attributes of these species, suggests that the sustainable catch of each species is likely to be relatively low. Thus care needs to be taken to ensure that the ongoing exploitation of these species by all sectors is sustainable.

6.1.1 Harvest strategy assessment model

The total level of fishing for all sectors has been unacceptably high and reductions of at least 50 per cent of 2005/06 levels are required. This view has been independently endorsed by two comprehensive external reviews. The new management measures for the commercial, charter and recreational sectors are intended to achieve the required reductions in catch.

The recreational sector's new management arrangements will be reviewed 12 months after the implementation of the new management arrangements to ensure that they are achieving their objectives.

The capacity settings for the commercial West Coast Demersal Scalefish Interim Managed Fishery are currently being reviewed. In addition, the rock lobster fishery finfish exemption arrangements will be reviewed at the end of the 2009/10 rock lobster season.

These reviews will incorporate stock assessment information and increased levels of biological information on Western Australian dhufish and other target species from the current research programs, and may result in further changes to management arrangements.

Fisheries Research Report 163 recommends an unambiguous (explicit and quantitative) harvest strategy, that incorporates how the catch or effort will be adjusted from year-to-year, depending on the size of the stock, the economic or social conditions of the fishery, conditions of other interdependent stocks, and the uncertainty regarding the biological knowledge of the stock. The strategy should indicate the data requirements and the assessment approaches to be used. Without a harvest strategy, management decisions tend to be ad hoc.

The Department of Fisheries phone diary surveys indicated an average catch (in numbers) of the predominant (10) key species in the West Coast Demersal Scalefish Fishery of around 20 per cent greater than that reported in Fisheries Research Report No. 177, with confidence intervals of between 13 – 26 per cent. Dr Aldo Steffe, in his review of Fisheries Research Report No. 177, also indicated that levels of total catch (recreational catch) were under-estimated, and the measures of precision associated with the estimates have been greatly under-estimated. In addition, the catches of the diving sector were not included in Fisheries Research Report No. 177. These catches are difficult to estimate, but could be around five per cent of the total recreational sector's catches.

6.2 Biological Research Projects

As Western Australian dhufish, pink snapper and baldchin groper are the key indicator species for the west coast, they form the basis for planned research to evaluate the impacts on fish stocks of recreational and commercial management measures.

- Representative West Coast Bioregion age-structure data is collected annually.
- Data for dhufish, pink snapper and baldchin groper collected in 2007/08 has been used in the most recent assessment, the results of which have been subjected to independent external review.
- The next formal assessment is scheduled for 2012, and will be based on data collected up to, and including, 2010/11. The sampling strategy will focus on the indicator species in areas and sectors where they make an important contribution to the catch.
- Methods that will enable the detection of meaningful levels of change in dhufish recruitment continue to be reviewed.
- The ongoing status of the Cockburn Sound snapper breeding stock is being monitored.
- The stock structure of each of the indicator species is being investigated using genetic and otolith microchemistry techniques. This will allow the monitoring program to be refined, depending on, for example, the determination of important sources or sinks of recruits.

Due to the emphasis on the west coast demersal scalefish stocks, recreational surveys have been refocussed into the metropolitan and west coast areas.

Ongoing surveys to measure the size of the recreational catch on the west coast are necessary to understand whether recreational management measures to reduce the catch by 50 per cent have been effective.

- A Metropolitan Area-only boat-based creel survey was conducted in 07/08.
- A West Coast Bioregion creel survey was conducted in 2008/09. A further creel survey will be conducted in this bioregion during 2009/10.
- The results of the earlier surveys will be reported in conjunction with those of the 2009/10 creel survey.
- Some form of 'recreational survey' will be run frequently in the West Coast Bioregion each year to determine the magnitude of the recreational catch in order to measure fishing responses to changing rules and to manage catch shares.

6.3 Socio-economic Research

The West Coast Demersal Scalefish Fishery (WCDSF) was a case study in the Economic Research Associates research project “*A Socio-Economic Valuation of Resource Allocation Options between Commercial and Recreational Use*” (McLeod and Nicholls, 2004).

The analysis was based on certain assumptions, i.e:

- The combined existing commercial and recreational catch is all that is sustainable and available for inter-sectoral allocation. All recreational participants are subject to binding constraints (catch limits, fishing days and fishing times, etc.) so that there is no unused or spare capacity.
- For all commercial operators it is optimal to take the current total allowable catch, that is so there is no spare capacity.
- All commercial operators were internally structured to maximise producer surpluses from catches in the West Coast ‘Wetline’ Fishery.

The model showed that, assuming the combined commercial and retained recreational catch (850 tonnes in 2001/02) was sustainable and represented the defined Total Allowable Catch (TAC), then the theoretically optimal shares would be around 310 tonnes retained recreational catch and 540 tonnes commercial catch, including Western Australian dhufish, pink snapper and baldchin groper. At that point, the marginal benefit from the commercial and recreational take was the same (around \$5.50/kilograms of whole fish). This would mean a reduction of 40 tonnes in the recreational take.

Since this survey was completed, there have been major changes to the management of the fishery, including allocating the Metropolitan area to the recreational sector. In addition, the price of demersal scalefish has increased substantially.

6.4 Compliance and Education

6.4.1 Compliance

The West Coast Demersal Scalefish Fishery (WCDSF) compliance program may involve:

- inspections of commercial operators when landing catches;
- checking that Catch and Effort records have been completed correctly and accurately and submitted in a timely manner;
- inspections of processing and wholesale/retail facilities;
- inspections of recreational catches for adherence to size limits, bag limits, possession limits and closures etc;
- covert surveillance and targeted operations to detect and apprehend illegal operators undertaking black market activities; and
- VMS monitoring of commercial vessels.

6.4.2 Education

Fisheries and Marine Officers and Fisheries Volunteers conduct a wide variety of education and extension services, formally and informally, directed at commercial and recreational fishers, fishing organisations, schools and the general community.

There are a number of comprehensive brochures setting out the rules for the fishery that are available from Department of Fisheries offices, tackle shops and are available to download on the Department's website. The brochures are updated annually, or whenever significant rule changes take place, and are an up-to-date source of information for fishers.

Most rule changes are also publicised by media releases and newspaper advertisements.

The degree of community stewardship – community support for the sustainability of fish resources – is a crucial factor in successful recreational fisheries management. Community education is the key process for the development of effective community stewardship.

7.0 CATCH AND EFFORT

Fisheries Research Report No.163, (which was independently reviewed and its outcomes and recommendations supported) provides extensive information on catch and effort statistics for the key indicator species of the West Coast Demersal Scalefish Fishery (WCDSF). It is not proposed to duplicate that information here, except to say that historical data available for the WCDSF are largely limited to monthly catch and effort data provided by the various commercial fishing operations that caught these species.

Other studies that have been undertaken into catch and effort in this fishery are listed below:

- With the increasing concerns regarding the status of Western Australian dhufish stocks in the late 1990s and in early 2000, a number of Fisheries Research and Development Corporation (FRDC) and other funded projects were undertaken to gather more data on this and other West Coast demersal species.
- A survey of boat-based recreational fishing in the West Coast Bioregion was undertaken in 1996/97¹⁴, and another, more extensive survey that incorporated the catches of the charter sector was undertaken during 2005-06^{15, 16}, and an assessment of the finfish catch by fishers in the Abrolhos Islands was made in 2006.¹⁷
- Recreational phone diary surveys were carried out.
- More detailed commercial catch information is available from a study into wetline fishing¹⁸ undertaken in the late 1990s and through Departmental *State of the Fisheries Reports*.

The data from Research Report 163 and other reports were extensively analysed for changes in fishing efficiency and fleet dynamics, however, a reliable index of abundance could not be generated. Despite the substantial increase in information generated over the past five years, the limited availability of useful historical data meant it was not possible to develop stock assessment models that could reliably estimate biomass. The current assessment for the WCDSF, with the limited availability of useful historical data where it was not possible to develop stock assessment models that reliably estimate biomass, has been based on a 'weight-of-evidence' approach.

7.1 Commercial

The West Coast Demersal Scalefish (Interim) Managed Fishery (WCDSFIMF), the Joint Authority Southern Demersal Gillnet and Demersal Longline Fishery (JASDGDLF) and the West Coast Demersal Gillnet and Demersal Longline Managed Fishery (WCDGDLF) have changed from

¹⁴ Sumner, N R, and Williamson P.C, "A 12-month survey of coastal recreational boat fishing between Augusta and Kalbarri on the west coast of Western Australia during 1996-97", Fisheries Research Report No. 117, 1999

¹⁵ Sumner, N R, Williamson, P C, Blight, S J & Gaughan, D J, "A 12-month survey of coastal recreational boat fishing between Augusta and Kalbarri on the west coast of Western Australia during 2005-06", Fisheries Research Report No. 177, 2008

¹⁶ Sumner, N R, Williamson, P C, Blight, S J & Gaughan, D J, "A 12-month survey of coastal recreational boat fishing between Augusta and Kalbarri on the west coast of Western Australia during 2005-06", Fisheries Research Report No. 177, 2008

¹⁷ Sumner, N R, "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 Paper No. 175, 2008

¹⁸ Crowe, F, Lehre, W & Lenanton, R, "A study into Western Australia's open access and wetline fisheries", Fisheries Research Report No. 118, 1999

providing statutory fishing returns based on monthly catch records to daily/trip catch records. In addition to the increased reporting frequency, the blocks used to define the fishery have decreased in size from 60 x 60 nautical miles (one degree) blocks to 10 x 10 nautical miles. This has significantly increased the accuracy of the catch and effort information submitted by these fishers.

7.2 Charter Fishing

Since 2002/03 when logbooks became compulsory, there has been an overall contraction in the total effort and operational area of charter activity in the West Coast Bioregion.

7.3 Recreational

The first 12-month survey of recreational boat fishing in the West Coast Bioregion, including the Metropolitan area, was conducted during 1996/97. This survey provided comprehensive data on the recreational boat-based catch for the West Coast Bioregion (Sumner & Williamson, 1999). A repeat of the creel survey was undertaken in 2005/06 (Sumner et al, 2008). Further creel surveys took place in 2007/08 (Metropolitan Area only), 2008/09, and will continue through 2009/10.

The metropolitan area has the greatest number of registered boats. This indicates a higher level of fishing pressure is being exerted on stocks within this area.

Recreational fishing at the Abrolhos Islands zone was not fully covered by the boat-ramp survey since boats fishing at these offshore islands are often too large to be 'trailer' boats, i.e. larger vessels not encountered at boat ramps. However, such vessels were included in the phone diary survey (refer to Wise et al., 2007).

A separate recreational fishing survey was conducted in the Abrolhos Islands for the 2006 calendar year¹⁹. This survey estimated the recreational catch at 17.3 tonnes. The results for the main species from this 2006 survey were similar to those in the phone diary survey; because the phone diary survey results for the entire West Coast Bioregion were used to scale-up the results from the boat-ramp survey, the phone diary results were used to provide the estimates of recreational catch from the Abrolhos Islands. In addition, the phone diary results will provide a better basis for future comparisons since this is the method expected to be used in future surveys.

7.4 Customary Fishing

The Department of Fisheries recognises that there is very little information available to estimate the customary fishing catch and effort in the WCDSF.

Anthropological studies indicate that there is no evidence that demersal species were taken by boat on the west coast at times by traditional Aboriginal people (Wright, G, 2005). More than 1,200 Aboriginal people currently hold 'umbrella' recreational fishing licences in Western Australia, even though they are not required to hold a licence. This suggests it is likely that Aboriginal people participate in the fishery and that fishing effort may now be undertaken.

The Department is aware of the need to improve the collection of catch statistics for the customary fishing sector in order to improve the management of the sector and of the fishery as a whole.

¹⁹ 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 Paper No. 175, Department of Fisheries, Western Australia

7.5 Illegal Catch

There are no reliable estimates of the illegal and unreported catch of west coast demersal scalefish. Some will come from ‘shamateur’ (recreational fishers illegally selling their catch) activity and, with the fishery moving to management, some commercial operators may illegally take fish for sale, gain or reward.

People caught with illegal catch are subject to severe mandatory penalties in keeping with their commercial-level activities.

7.6 Comparison between Commercial and Recreational Catches

From 1996/97 to 2005/06, the catches of the key indicator species by the commercial fishery have generally increased but the patterns for the species have been variable among years, especially among the different regions. The catches of the three key species in the two years where both commercial and recreational data were available are shown in Table 5 below.

It should be noted that the 1996/97 recreational data shown in Table 5 is boat-based recreational catch-only and does not include any catch taken from what were then unlicensed charter vessels.

In the intervening years commercial catches were above 2005/06 levels (Western Australian dhufish – 254 tonnes in 2002/03; pink snapper – 356 tonnes in 2003/04; baldchin groper – 44 tonnes in 2002/03)²⁰. These catches are taken from the statutory fishing returns provided by commercial fishers.

The 2005/06 recreational data is from both private boat-based recreational fishing and licensed charter operators.

Table 5. Key indicator West Coast Demersal Scalefish species taken by the sectors in 1996/97 and 2005/06.

Year & Species		*Commercial Catch (tonnes)	*Estimated Recreational Catch (tonnes)	Total Catch (tonnes)	% Commercial Catch to total catch	% Recreational Catch to total catch
1996/97	Dhufish	191	125	316	60.4%	39.6%
2005/06	Dhufish	207	206	413	50.1%	49.9%
1996/97	Pink Snapper	286	25	311	92.0%	8.0%
2005/06	Pink Snapper	323	57	380	85.0%	15.0%
1996/97	Baldchin Groper	37	19	56	66.1%	33.9%
2005/06	Baldchin Groper	38	37	75	51.1%	48.9%

*Commercial sector : WCDSFIMF, JASDGLF, WCDGLF, Cockburn Sound Line & Pot Fishery

Recreational sector: recreational creel survey and charter sector

Note : These figures are not the same as those in Fisheries Research Report No. 163, as they cover a different geographic area and this paper includes the most up to date catch figures available at the time of print.

As indicated in Section 6.1.1 (Harvest Strategy Assessment Model), the Department of Fisheries phone diary surveys indicated the catch estimates (in numbers) of key species in the west coast demersal scalefish recreational fishery were 20 per cent higher than those obtained using the creel survey.

²⁰ Fairclough, D., Keay, I., Johnson, C. & Lai, E. (In press) *West Coast Demersal Scalefish Fishery Status Report*. In: *State of the Fisheries Report 2008/09*, eds W. J. Fletcher & K. Santoro, Department of Fisheries, Western Australia,

The 2005/06 data are broken down further in Appendix 2, to show the areas in which the catches of the key indicator species were taken, by which sector and by which component of each sector. It also shows the recreational catch data, estimated from both the phone diary and creel surveys that was carried out in that year. With three exceptions, the phone diary data for individual strata is higher than the creel survey data. However, overall, the catch (in weight) of these indicator species recorded by the phone diary survey is 23 per cent higher than that recorded by the creel survey.

As noted in Section 7.3, recreational fishing at the Abrolhos Islands zone was not fully covered by the boat-ramp survey since boats fishing around these offshore islands are often too large to be 'trailer' boats, i.e. larger vessels were not encountered at boat-ramps. However, such vessels were included in the phone diary survey and a survey of recreational and other catches undertaken in 2006, which estimated boat-based recreational catches of west coast demersal scalefish taken at the Abrolhos Islands at 17.3 tonnes.

Estimates of the total weight of demersal scalefish taken by each sector from each area are needed in order to explore the trends in weight of the catch of indicator species, relative to the total weight of demersal scalefish taken in the West Coast Bioregion. However, while the catch in weight of all demersal species retained by the commercial sector is reported, comparable data are not available from the recreational sector, where creel survey and charter catches are reported in numbers. While length-weight relationships that are needed to convert numbers to weight are not available for all of the demersal species that comprise the recreational and charter catches, they are available for the prominent species in these catches (FRP No. 177, 2008). On the basis of a detailed investigation of these data, the most accurate and representative estimate of the total catch weight is provided by the predominant 10 demersal species taken by each sector (for which length-weight relationships are available), and which in reality, will end up comprising a total of 15 species across all sectors, representing in excess of 93 per cent of the catch retained by each sector (Table 6[a]).

The Chief Executive Officer of the Department of Fisheries believes that the predominant 15, as representative of the whole suite of west coast demersal scalefish could be considered as an appropriate suite for any allocation process in the West Coast Demersal Scalefish Fishery (WCDSF).

The list of demersal scalefish species for which the recreational fishing closure applies is presented in Table 2. This list is also representative of the suite of demersal species taken by commercial fisheries, the recreational sector and the charter sector. The area catches of the recreational closure species are presented in Appendix 3. If this group of demersal species to which the recreational fishing closure applies are considered as representative of the total catch of demersal species, then this group comprises 99.3 per cent of the weight of demersal scalefish species taken by the commercial sector, and 93.1 per cent of the number of fish kept by the recreational sector (Table 6[b]).

The catch (in weight) of the key indicator species as a percentage of the predominant 15 representative total catch of each sector of the WCDSF during 2005/06 is presented in Table 7 and the full suite of west coast demersal scalefish is at Appendix 4.

Table 6 (a). Commercial and recreational catch of the predominant 15 species in 2005/06 based on the commercial and charter sectors' fishing returns and the 2005/06 Recreational Fishing Creel Survey.

Common name	Commercial sector (tonnes)	Recreational sector (tonnes)	Recreational sector (number of fish kept)
Baldchin Groper	38.5	36.9	12870
Bass Groper	8.9	0	0
Blue Morwong	26.6	15.8	6395
Blue-Eye Trevalla	11.3	0	0
Breaksea Cod	7.8	20.2	21131
Eightbar Grouper (Grey Banded Cod)	13.0	0	0
Emperors	232.4	13.1	13518
Foxfish	0	2.4	2859
Hapuku	18.5	0.1	11
Pink Snapper	322.5	57.5	27658
Bight Redfish	86.5	7.5	5708
Ruby Snapper	12.1	0	0
Sergeant Baker	0	3.4	4331
Sweep, Sea	0.6	5.5	4229
Western Australian Dhufish	207.2	206.5	38387
Total	985.9	368.9	137097
	94.3%		93.2%
Other demersal species	59.4		10015
	5.7%		6.8%

Commercial sector : WCDSFIME, JASDGDLF, WCDGDLF, Cockburn Sound Line & Pot Fishery. Recreational sector: recreational creel survey and charter sector

Table 6(b). Catch of West Coast demersal scalefish in the Recreational fishing closure list within sectors 2005/06, based on the commercial and charter sectors' fishing returns and the 2005/06 Recreational Fishing Creel Survey.

Species	Commercial sector (tonnes)*	Recreational sector (tonnes)	Recreational sector (number of fish kept)
Baldchin Groper	38.5	36.9	12870
Barcheek Coral Trout	5.1	3.3	1293
Bass Groper	8.9	0	0
Blackspotted Rockcod	0.1	0	0
Blue Morwong	26.6	15.8	6395
Blue-Eye Trevalla	11.3	0	0
Breaksea Cod	7.8	20.2	21131
Chinaman Rockcod	1.6	NA	282
Cod, General	4.0	NA	174
Cod, Spotted	0.3	0	0
Convict Grouper	0	NA	33
Coral Rockcod	0	NA	1
Crimson Snapper	0	0	0
Eightbar Grouper (Grey Banded Cod)	13.0	0	0
Emperors	232.4	13.1	13518
Flagfish / Spanish Flag	0.1	0	0
Foxfish	0	2.4	2859
Fusiliers, Jobfishes	0	NA	6
Goldband Snapper	4.8	0	0
Goldspotted Rockcod	0.2	NA	245
Hapuku	18.5	0.1	11
Harlequin Fish	0	NA	2105
Jobfish	0.1	0	0
Leopard Wirrah	0	NA	2
Parrotfish	5.0	NA	1
Pigfishes, General	0.1	NA	205
Potato Rockcod	0	NA	1
Radiant Rockcod/Comet Grouper	0.4	0	0
Rankin Cod	1.3	NA	90
Red Emperor	5.4	NA	27
Bight Redfish	86.5	7.5	5708
Rosy Snapper	0.7	NA	2
Ruby Snapper	12.1	0	0
Saddleback Pigfish	0	NA	13
Saddletail Snapper	0	0	0
Snapper, Pink	322.5	57.5	27658
Snappers, Other	0	0	0
Swallowtail	0	2.3	2773
Tang's Snapper	0.1	0	0

Species	Commercial sector (tonnes)*	Recreational sector (tonnes)	Recreational sector (number of fish kept)
Tomato Rockcod	0.1	NA	9
Tuskfish	0	NA	2
Western Australian Dhufish	207.2	206.5	38387
Western Blue Groper	23.1	0.1	8
Western Pigfish	0	NA	62
Western Wirrah	0	NA	50
Wirrahs, General	0	NA	2
Yellowedge Coronation Trout	0	NA	21
Yelloweye Redfish	0.6	0.7	1045
Total	1038.4	366.5	136990
	99.3%		93.1%
Non-closure species	6.8		10122
	0.7%		6.9%

* Weight less than 50 kg is presented as 0.0 in the above table.
NA - means Not Available

Table 7. Key indicator species by sectors in 2005/06 as a percentage of the total of the predominant 15 species catch

Species	Commercial (Comm) catch (tonnes)	Total Comm catch (tonnes)	% Total Comm catch	Estimated Recreational (Rec) catch (tonnes)	Estimated total Rec catch (tonnes)	% Total Rec catch	Total catch (tonnes)	% Comm to Total catch	% Rec to Total catch
WA Dhufish	207	986	21.0%	206	369	56.0%	1355	15.3%	15.2%
Pink Snapper	323	986	32.7%	57	369	15.6%	1355	23.8%	4.2%
Baldchin Groper	38	986	3.9%	37	369	10.0%	1355	2.8%	2.7%
Total	568	986	57.6%	300	369	81.6%	1355	41.9%	22.1%

Commercial sector : WCDSFIME, JASDGDLF, WCDGDLF, Cockburn Sound Line & Pot Fishery
Recreational sector: recreational creel survey and charter sector

In 2007, the former Minister for Fisheries closed the Metropolitan Area (from Lancelin to south of Mandurah) to commercial fishing for west coast demersal scalefish. As the catch from this Area is no longer available to the commercial sector, the sectoral shares of the 2005/06 catches are shown below (Tables 8[a] and 8[b]), without the commercial sector's Metropolitan Area catches.

Table 8 (a). The predominant 15 species taken by the sectors in 2005/06 as a percentage of the total West Coast demersal scalefish catch, not including the commercial catch in the Metropolitan Area.

Area	Total commercial catch (tonnes)	Total estimated recreational catch (tonnes)	Total Catch	% Commercial catch to total catch	% Recreational catch to total catch
All areas	986	369	1355	72.8%	27.2%
Total commercial catch excluding Metropolitan Area	871	369	1240	70.2%	29.8%

Table 8(b). The species subject to the recreational fishing closure by the sectors in 2005/06, as a percentage of the total west coast demersal scalefish catch, not including the commercial catch in the Metropolitan Area

Area	Total commercial catch (tonnes)	Total estimated recreational catch (tonnes)	Total Catch	% Commercial catch to total catch	% Recreational catch to total catch
All areas	1038	366	1404	73.5%	26.5%
Total commercial catch excluding Metropolitan Area	918	366	1284	71%	29%

*Commercial sector: WCDSFIME, JASDGDLE, WCDGDLE, Cockburn Sound Line & Pot Fishery

*Recreational sector: recreational creel survey and charter sector

When examining the west coast demersal scalefish catch of each sector, from each area of the fishery (Tables 9 and 10), the differences in catches between areas becomes apparent. For ease of understanding and accuracy purposes, only the predominant species catches have been used to illustrate these points.

Table 9. Recreational catch of the predominant 15 West Coast demersal scalefish species by area in 2005/06.

Area	Estimated recreational creel survey catch (tonnes)	Estimated charter catch (tonnes)	Total (tonnes)
Kalbarri	7.2	4.5	11.7
Abrolhos*	-	17.9	17.9
Midwest	107.5	2.8	110.3
Metro	100.9	28.5	129.4
South	84.9	4.5	89.4
No zone **		10.1	10.1
Total	300.5	68.3	368.8

* Note that Fisheries Research Report No. 175 puts the recreational boat based catch at the Abrolhos Islands at 17.3 tonnes

**Data within the sub-bioregions does not include the entire catch for the west coast bioregion, because of incomplete returns provided by operators i.e. failing to provide a block locations, so these catches cannot be included in the sub-bioregions, however these catches are put under "No zone".

Table 10. Commercial catch of the predominant 15 west coast demersal scalefish species by Area in 2005/06.

Area	WCDSIMF (tonnes)	JASDGDLF (tonnes)	WCDGDLF (tonnes)	CSLP (tonnes)	Total commercial catch (tonnes)
Kalbarri	198.7		5.9		204.6
Abrolhos	281.6		8.0		289.6
Mid-west	147.9		18.8		166.7
Metropolitan	99.2		15.9	0.7	115.6
South	175.0	34.5			209.3
Total	902.3	34.5	48.6	0.7	985.8

Commercial sector : WCDSFIMF, JASDGDLF, WCDGDLF, Cockburn Sound Line & Pot Fishery

7.7 Harvest Level for the West Coast Demersal Scalefish Fishery

7.7.1 Western Australian dhufish

The measures of the levels of fishing mortality for dhufish are above international benchmarks in all three areas. In particular the fishing mortality for dhufish in the Metropolitan and Mid-west Areas is above the limit reference point. In the South-west Area the estimate of fishing mortality is between the threshold and the limit reference point (Fairclough *et al*, *in press*). Integrating these results against the background of the biological attributes of dhufish indicates that the overall level of fishing effort and catch of dhufish in the West Coast Bioregion needs to be reduced by at least 50 per cent of the 2005/06 levels.

7.7.2 Pink snapper

The measures of the levels of fishing mortality for pink snapper are above international benchmark standards (i.e. above the limit reference point) within all areas of the West Coast Bioregion (Fairclough *et al*, *in press*). Integrating these results with the biological attributes of pink snapper suggests there needs to be a high reduction in the overall level of fishing effort and catch in the West Coast Bioregion by at least 50 per cent of the 2005/06 levels, and a continuation of a complete closure to all pink snapper fishing within Cockburn Sound from 1 October to 31 January given that this area has the only known major spawning aggregation in the West Coast Bioregion.

7.7.3 Baldchin groper

The examination of the available data for baldchin groper reveals that the measures of the level of fishing mortality across the entire Mid-west Area is above the limit reference point, including the Abrolhos Islands (Fairclough *et al*, *in press*).

7.7.4 General

The assessments of the status of the key demersal finfish stocks in the West Coast Bioregion were independently reviewed with the methods considered best practice for the circumstances and the conclusions considered valid and appropriate.

There remains, however, a level of uncertainty with regard to the precise status of the stocks of Western Australian dhufish, pink snapper and baldchin groper due to the nature of the data and the resulting assessments. The available data do not allow estimates of the un-fished or

remaining breeding stock biomass to be generated. Without an integrated stock biomass model, it is not possible to generate precise estimates of the level of reduction in catch/effort needed to achieve acceptable stock levels.

Instead, the data and methods available here can only provide a guide to the level of effort/catch reductions that should achieve sufficient reductions in the level of fishing mortality to generate acceptable stock recoveries. Nonetheless, the assessments clearly indicate that the level of fishing mortality for both species are well above international standards for sustainable exploitation and that significant over-fishing is occurring.

Comprehensive and effective management restrictions/limitations of all sectors are required to have a reasonable chance of rebuilding stocks. Levels of catch across the entire fishery need to be reduced by at least 50 per cent. Any reduction in effort and/or catch (including a complete closure), however, may not result in a recovery of dhufish in the short-term due to the inconsistent nature of dhufish recruitment.

Therefore, the most appropriate strategy is to adopt an adaptive approach to determine if the initial reduction in effort and/or catch is at least achieving the desired reduction in the level of fishing mortality. Furthermore, the restrictions in catch for each sector must encompass all key indicator species and consider their biological attributes. For example, any measures that could result in the increased release of captured fish (e.g. tags, changes to minimum legal sizes, changes to bag/boat limits) may not achieve their goals if post-capture mortality is significant and are inappropriate for dhufish and pink snapper in deeper waters. Hence, for west coast demersal scalefish the primary goal for all sectors must be to limit the total numbers of dhufish and pink snapper that are captured.

7.7.5 Allowable harvest levels

Given all of the above, the harvest levels that the Department of Fisheries is seeking for west coast demersal scalefish are a reduction of at least 50 per cent of the 2005/06 harvest levels, that is, approximately 715 tonnes.

The catches by sector for the three approaches that could be taken to determine allocations are provided in Table 11 below. (These catches are taken from the tables presented in Appendix 5.)

Table 11. 2005/06 Catches²¹ of west coast demersal scalefish stocks (Kalbarri to Augusta).

SECTOR	Predominant. 15 (tonnes)	Recreational Closure species (tonnes)	Total Demersal (tonnes)
*Commercial sector (now WCDSFIMF)	902.0	929.5	935.8
+JASDGDLF	34.5	51.3	51.7
+WCDGDLF	48.6	56.8	56.9
CSLP	0.7	0.7	0.7
Recreational Creel	300.5	297.0	311.0
Charter	68.3	69.5	74.4
Total	1,354.6	1,404.8	1,430.5

²¹ Note: Length-weight relationships that are needed to convert numbers to weight are not available for all of the demersal species that comprise the recreational and charter catches. The most accurate and representative estimate of the total catch weight taken by both sectors is provided by the predominant 10 demersal species taken by that sector (for which length-weight relationships are available). This comprises a total of 15 species across sectors, representing in excess of 93 per cent of the total catch in weight retained by each sector (Section 7.6 above).

*Note: Not all the catch of the commercial sector are demersal scalefish. As gear-based fisheries, managed by units of effort they also take small amounts of non-demersal scalefish. However, their total catches have been reduced to less than 50 per cent, and catches of dhufish, pink snapper and baldchin groper will be closely monitored to ensure they remain within acceptable limits ie. less than 50 per cent of 2005/06 levels.

+Note: Both the JASDGDLF and WCDGDLF are managed on the basis of the sustainability of four shark (not demersal scalefish) indicator species. However, the policy of reducing the catches of west coast demersal scalefish species by 50 per cent on the 2005/06 catches (taken from State of the Fisheries 2006/07) also applies to these fisheries.

As set out in Section 6.1.1, the Department of Fisheries phone diary surveys indicated an average catch (in numbers) of the predominant (10) key species in the West Coast Demersal Scalefish Fishery of around 20 per cent greater than that reported in Fisheries Research Report No. 177, with a confidence intervals of between 13 – 26 per cent. Dr Aldo Steffe, in his review of Fisheries Research Report No. 177, also indicated that levels of total catch (recreational catch) were under-estimated, and the measures of precision associated with the estimates have been greatly under-estimated. In addition, the catches of the diving sector were not included in Fisheries Research Report No. 177. These catches are difficult to estimate, but could be around five per cent of the total recreational sector's catches. In addition, the boat-based recreational sector's catches at the Abrolhos Islands were estimated at 17.3 tonnes in Fisheries Research Report No. 175.

8.0 IMPACTS OF FISHING

8.1 Ecological Impacts

Scalefish comprise the entire catch of the West Coast Demersal Scalefish Fishery. The contribution of non-retained fish to total removals by the fishery is probably negligible because the total quantities of non-retained fish are likely to be low.

The total removals of the key indicator species by the fishery may disrupt trophic dynamics in the region. The key indicator species are generalist carnivores and top order predators, that consume a wide range of fish and invertebrate prey across a diverse range of benthic habitats. Therefore, the impact of any reduction in scalefish predator abundance would be spread across many prey species throughout the ecosystem.

It is unlikely that non-target species play a similar trophic role to targeted species or would compensate for the effect of removals by the fishery.

At present, there is no evidence that any lower order species are increasing in abundance as a result of effort on the key indicator species. In a review of scientific studies on the effects of fishing on marine ecosystems, Jennings and Kaiser (1998) concluded that “where the functional and species diversity of fishes is relatively high, the indirect effects of fishing on the abundance of unfished prey species appears to be minor”.

8.2 Socio-economic Impacts

8.2.1 Commercial, charter and recreational fisheries

See Section 4.3 and Section 6.3 of this report for a discussion of the socio-economic impacts of fishing for the WCDSF.

8.2.2 Social impacts

The recreational fishery provides a major social benefit to sectors of the community and anecdotally is often a family activity in the Perth metropolitan portion of the fishery.

Apart from fishing and boating being recreational activities and providing enjoyment from that perspective, they provide members of the public who want to access fresh fish as a food an alternative to buying fish.

The commercial sector provides fresh local seafood for that section of the community which wishes to buy local product.

9.0 GLOSSARY OF TERMS

AFMA	Australian Fisheries Management Authority
Barotrauma	Injuries resulting from the expansion of gases in the swim bladder and other organs when fish do not have time to adjust to rapid changes in water pressure as they are pulled to the surface
Bioregion	A geographic area characterised by a combination of physical and biological characteristics, for example, terrain, climate and ecological communities.
CPUE	Catch per unit of effort
CSLP	Cockburn Sound Line & Pot Managed Fishery
Demersal	Found on or near the bottom of the sea.
DEWHA	Department of Environment, Water, Heritage and the Arts
EBFM	Ecosystem Based Fisheries Management
EPBC Act	The Commonwealth's <i>Environment and Biodiversity Conservation Act 1999</i>
Endemic	Confined in occurrence to a local region
Gyre	A large body of water, moving in a circle
JASDGDLF	Joint Authority Southern Demersal Gillnet and Demersal Longline Fishery
IMCRA	Interim Marine and Coastal Regionalisation for Australia
LWR	Length-weight relationship
Mortality	The rate of deaths (usually in terms of proportion of the stock dying annually) from various causes
MBP	Marine Bioregional Planning
NRSMPA	National Representative System of Marine Protected Areas
PAG	Planning Advisory Group
Pelagic	Associated with surface or middle depths of a body of water, rather than the seafloor. This term is usually applied to free-swimming species, such as mackerels.
PWG	Planning Working Group
Recruitment	A fish that has just become susceptible to a fishery; e.g. a recruit to the WA dhufish fishery is six to seven years old, whereas a recruit to the pink snapper fishery is four years old.
RMP	Regional Marine Planning
SCRMSP	South Coast Regional Marine Strategic Plan
SMPSG	State Marine Policy Stakeholder Group
TAC	Total Allowable Catch
TACC	Total Allowable Commercial Catch
TCC	Total Commercial Catch
Trophic	Predator-prey relationships. Connected with nutrition and feeding.
Unitised	A description of how a fishery is managed. A unit of measurement in a fishery is, for example, a number of gear hours per unit in a time/gear fishery, or kilograms per unit in a quota managed fishery.
WCDGDLF	West Coast Demersal Gillnet and Demersal Longline Managed Fishery
WCDSF	The West Coast demersal scalefish fishery (including all sectors)
WCDSFIMF	West Coast Demersal Scalefish Interim Managed Fishery

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Appendix 1 International Benchmarks

This Appendix is taken from Fisheries Research Paper No. 163, 2007, pages 23 and 24.

- The Kalbarri zone will be managed primarily on the basis of pink snapper sustainability
- Remaining regions which includes the Midwest, Metropolitan and South zones will be managed primarily on the basis of dhufish and pink snapper sustainability
- Abrolhos subregion will be managed primarily on the basis of baldchin groper sustainability

2.1.2 Performance measures

Performance measures can be based on current resource size and current exploitation in relation to the level when the population was unfished. Performance measures are based on target, threshold and limit reference points for resource size and exploitation (Figure 2). The target is the level where the stock biomass (B) and fishing mortality (F) should be, the threshold is a trigger for additional management and research actions, and the limit is where fishing must be very restricted or cease. Over-fished and over-fishing definitions are based on target, threshold and limit reference points for resource biomass and exploitation respectively (Figure 2).

While these represent the theoretical biological/management reference points, in the majority of cases the data required to calculate these measures will not always be available so alternative proxies, for example catch rates and catch, may need to be developed. Based on the biology of the species concerned, it is proposed that the performance measures in Table 1 should apply to the West Coast Demersal Scalefish Fishery. Managing to these target, threshold and limit reference points is consistent with international best practice (Caddy and Mahon 1998, Lembo 2006 and Walters and Martell 2002).

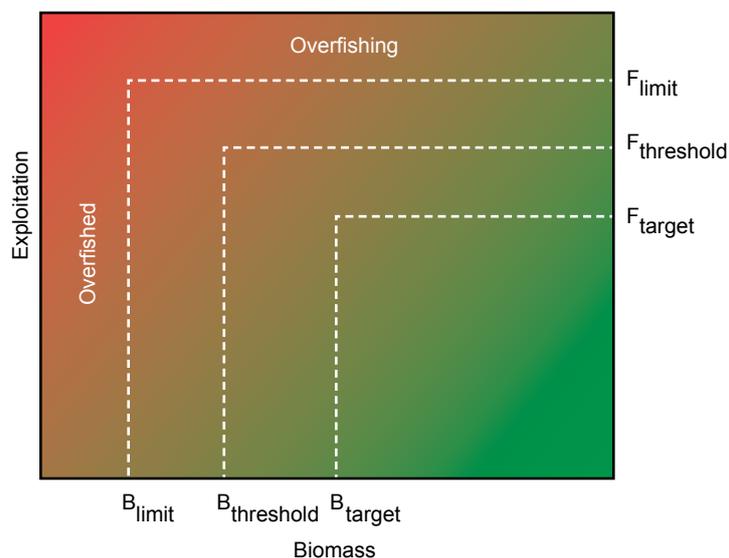


Figure 2. Over-fished and over-fishing definitions are based on target, threshold and limit reference points for resource biomass and exploitation respectively.

Table 1. Performance measures for resource biomass and exploitation target, threshold and limit reference points. B is the biomass estimate either as total biomass or spawning biomass (e.g. *B*_{40%} means the current biomass level is 40% of the unfished biomass level). *M* is natural mortality.

Available information	Biomass estimates (B) (Provides for a performance measure of stock biomass and fishing pressure)	Fishing mortality (F) (Only provides for a performance measure of fishing pressure)	Catch rate and/or catch estimates (If threshold is reached management and research programs are initiated to provide estimates of biomass estimates and/or fishing mortality)
Performance measure			
Target	<i>B</i> _{40%} (F at <i>B</i> _{40%})	$M * 2/3$	Within the range of the previous 5-10 years
Threshold	<i>B</i> _{30%} (F at <i>B</i> _{30%})	<i>M</i>	Outside the range of the previous 5-10 years
Limit	<i>B</i> _{20%} (F at <i>B</i> _{20%})	$M * 2$ for short-lived species (<10 years) $M * 3/2$ for long-lived species (>10 years)	NA

Appendix 2 Catches (by weight) of key indicator species in 05/06

Zone	Common name	WCDSFIMF (tonnes)	JASGDGLF (tonnes)	WCDGDGLF (tonnes)	CSLP (tonnes)	Charter estimates (tonnes)	Recreational creel survey estimates (tonnes)	Phone diary estimates (tonnes)
Kalbarri	Baldchin Groper	2.9		0.8		1.0	1.4	1.5
Abrolhos	Baldchin Groper	18.2		0.4		4.2		6.9
Midwest	Baldchin Groper	10.7		1.4		0.6	18.7	33.5
Metro	Baldchin Groper	2.8		1.2		1.3	7.5	10.8
South	Baldchin Groper	0.0	0.1			0.0	0.1	1.8
No zone	Baldchin Groper					2.2		
Total	Baldchin Groper	34.7	0.1	3.7		9.2	27.7	54.6
Kalbarri	Pink Snapper	109.3		2.6		1.4	2.4	0.5
Abrolhos	Pink Snapper	86.5		2.7		5.1		3.6
Midwest	Pink Snapper	45.4		3.7		0.5	9.6	14.0
Metro	Pink Snapper	37.3		3.7	0.7	7.5	13.0	6.5
South	Pink Snapper	24.5	6.0			0.5	15.3	28.0
No zone	Pink Snapper					2.2		
Total	Pink Snapper	303.1	6.0	12.8	0.7	17.2	40.3	52.7
Kalbarri	Western Australian Dhufish	7.8		1.1		0.9	1.6	
Abrolhos	Western Australian Dhufish	39.1		2.0		4.8		3.0
Midwest	Western Australian Dhufish	60.5		5.9		1.2	71.0	63.5
Metro	Western Australian Dhufish	37.0		6.1		7.0	58.2	65.3
South	Western Australian Dhufish	37.7	10.0		0.0	2.8	55.2	92.1
No zone	Western Australian Dhufish				0.0	3.8		
Total	Western Australian Dhufish	182.1	10.0	15.1	0.0	20.5	186.0	223.9
Grand total	Key indicator species	519.9	16.1	31.5	0.7	46.9	253.9	331.3

The phone-diary screening process identifies non-fishers and fishers. However:

1. Some non-fishers may actually fish and
2. Some non-fisher boats may have been sold during the survey and may have been used for fishing by the new owners.

Separating non-fishers from fishers

The phone diary survey assumes that non-fishers identified in the screening survey did not fish. This analysis may understate catch and effort since some of these respondents may have fished.

Appendix 3 Zonal catches of species subject to recreational fishing closure

Species	Live Weight (tonnes)						Number Kept	
	Charter	Recreational Creel	CSLP	JASDGDLF	WCDGDLF	Wetline	Charter	Rec
ABROLHOS								
Baldchin Groper	4.2				0.4	18.2	1315	
Barcheek Coral Trout	0.4					3.3	168	
Bass Groper						0.4		
Blackspotted Rockcod						0.1		
Blue Morwong					0.2	0.1		
Blue-Eye Trevalla						1.9		
Breaksea Cod	0.1					0.6	64	
Chinaman Rockcod	0.1					1.2	205	
Cod, General	NA				0.0	1.5	6	
Cod, Spotted						0.1		
Eightbar Grouper (Grey Banded Cod)						1.1		
Emperors	3.8				2.8	130.2	3351	
Flagfish / Spanish Flag						0.1		
Foxfish	0.0						4	
Fusiliers, Jobfishes	NA						1	
Goldband Snapper						0.0		
Goldspotted Rockcod						0.0		
Hapuku						0.6		
Jobfish						0.0		
Parrotfish					1.0	0.0		
Pigfishes, General						0.0		
Potato Rockcod	NA						1	
Radiant Rockcod/ Comet Grouper						0.2		
Rankin Cod	NA					0.3	2	
Red Emperor	NA				0.0	0.6	21	
Rosy Snapper	NA					0.0	2	
Ruby Snapper						2.8		
Saddletail Snapper						0.0		
Snapper, Pink	5.1				2.7	86.5	2754	
Tang's Snapper						0.1		
Tomato Rockcod	NA					0.1	7	
Western Australian Dhufish	4.8				2.0	39.1	897	
Western Blue Groper	0.0				0.0	0.1	6	
Yellowedge Coronation Trout	NA						21	
Yelloweye Redfish						0.1		

Species	Live Weight (tonnes)						Number Kept	
	Charter	Recreational Creel	CSLP	JASDGDLF	WCDGDLF	Wetline	Charter	Rec
Total	18.5				9.1	289.4	8825	
COCKBURN								
Snapper, Pink			0.7					
Western Australian Dhufish			0.0					
Total			0.7					
KALBARRI								
Baldchin Groper	1.0	1.4			0.8	2.9	214	500
Barcheek Coral Trout	0.1	0.0				0.6	28	6
Blue Morwong		0.1						25
Breaksea Cod	0.1	0.2				0.2	57	209
Chinaman Rockcod						0.0		
Cod, General	NA					0.8	4	
Cod, Spotted						0.1		
Eightbar Grouper (Grey Banded Cod)						0.6		
Emperors	1.2	1.6			1.3	70.2	1208	1750
Goldband Snapper						4.7		
Jobfish						0.1		
Parrotfish	NA				2.2		1	
Pigfishes, General						0.0		
Radiant Rockcod/ Comet Grouper						0.1		
Rankin Cod	NA	NA				1.0	23	62
Red Emperor	NA				0.1	4.4	18	
Bight Redfish					0.0	0.1		
Rosy Snapper						0.7		
Ruby Snapper						7.6		
Saddletail Snapper						0.0		
Snapper, Pink	1.4	2.4			2.6	109.3	1085	1183
Snappers, Other						0.0		
Tang's Snapper						0.1		
Tomato Rockcod						0.0		
Western Australian Dhufish	0.9	1.6			1.1	7.8	162	303
Yelloweye Redfish						0.2		
Total	4.6	7.2			8.1	211.5	2800	4039
METRO								
Baldchin Groper	1.3	7.5			1.2	2.8	449	2624
Barcheek Coral Trout					0.0			
Bass Groper						2.9		
Blue Morwong	5.3	5.4			3.2	3.2	1899	2290
Blue-Eye Trevalla						1.5		

Species	Live Weight (tonnes)						Number Kept	
	Charter	Recreational Creel	CSLP	JASDGDLF	WCDGDLF	Wetline	Charter	Rec
Breaksea Cod	3.1	9.7			0.1	2.4	2407	10905
Chinaman Rockcod	NA						1	
Cod, General	NA				0.1	0.1	163	
Convict Grouper	NA						27	
Eightbar Grouper (Grey Banded Cod)						3.0		
Emperors	0.0	0.0			1.5	0.5	13	9
Foxfish	0.4	1.3					372	1596
Fusiliers, Jobfishes	NA						3	
Goldspotted Rockcod	NA						1	
Hapuku						1.6		
Harlequin Fish	NA	NA					67	1139
Leopard Wirrah	NA						2	
Parrotfish					0.7	0.0		
Pigfishes, General	NA					0.0	192	
Rankin Cod	NA						2	
Red Emperor					0.0			
Bight Redfish	2.1	2.6			0.1	6.8	1498	2000
Ruby Snapper						0.0		
Saddleback Pigfish	NA						11	
Snapper, Pink	7.5	13.0			3.7	37.3	4327	6393
Swallowtail	1.2	0.4					1870	301
Tuskfish	NA						2	
Western Australian Dhufish	7.0	58.2			6.1	37.0	1132	12127
Western Blue Groper					2.0	1.5		
Western Pigfish	NA						38	
Western Wirrah	NA						48	
Yelloweye Redfish	0.7					0.2	1008	
Total	28.5	98.1			18.8	100.7	15532	39382
MIDWEST								
Baldchin Groper	0.6	18.7			1.4	10.7	195	6773
Barcheek Coral Trout	0.4	2.0			0.1	1.1	140	798
Bass Groper						3.0		
Blackspotted Rockcod						0.1		
Blue Morwong	0.0	0.4			0.8	1.0	5	181
Blue-Eye Trevalla						1.6		
Breaksea Cod	0.1	2.0				2.1	66	2248
Chinaman Rockcod	NA					0.4	11	
Cod, General					0.1	1.1		
Cod, Spotted					0.0	0.0		
Crimson Snapper						0.0		

Species	Live Weight (tonnes)						Number Kept	
	Charter	Recreational Creel	CSLP	JASDGLF	WCDGLF	Wetline	Charter	Rec
Eightbar Grouper (Grey Banded Cod)						2.4		
Emperors	0.4	5.5			7.0	18.8	396	6401
Foxfish	0.0	0.0					1	24
Goldband Snapper						0.0		
Goldspotted Rockcod		NA				0.2		244
Hapuku						0.2		
Harlequin Fish	NA						3	
Jobfish						0.0		
Parrotfish					1.0	0.0		
Pigfishes, General						0.0		
Radiant Rockcod/ Comet Grouper						0.1		
Rankin Cod						0.0		
Red Emperor	NA				0.1	0.1	24	
Bight Redfish					0.0	0.3		
Ruby Snapper						1.6		
Snapper, Pink	0.5	9.6			3.7	45.4	268	4822
Swallowtail						0.0		
Western Australian Dhufish	1.2	71.0			5.9	60.5	243	13398
Western Blue Groper					0.7	0.7		
Yelloweye Redfish						0.1		
Total	3.1	109.3			20.8	151.6	1352	34889
SOUTH								
Baldchin Groper	0.0	0.1		0.1		0.0	8	36
Barcheek Coral Trout						0.0		
Bass Groper						2.5		
Blue Morwong	0.2	4.1		14.9		3.4	86	1757
Blue-Eye Trevalla						6.4		
Breaksea Cod	0.5	4.1		0.0		2.4	281	4646
Chinaman Rockcod	NA						1	
Cod, General						0.4		
Eightbar Grouper (Grey Banded Cod)						5.9		
Emperors	0.0						4	
Foxfish	0.0	0.7					25	814
Hapuku	0.1					16.1	11	
Harlequin Fish	NA	NA					19	848
Pigfishes, General						0.0		
Bight Redfish	0.1	2.4		3.4		75.8	88	1874
Ruby Snapper						0.0		
Snapper, Pink	0.5	15.3		6.0		24.5	201	5410

Species	Live Weight (tonnes)						Number Kept	
	Charter	Recreational Creel	CSLP	JASDGDLF	WCDGDLF	Wetline	Charter	Rec
Swallowtail	0.1	0.5					109	409
Western Australian Dhufish	2.8	55.2		10.0		37.7	333	9395
Western Blue Groper	0.0			17.0		1.1	1	
Western Wirrah	NA						1	
Wirrahs, General	NA						2	
Yelloweye Redfish	0.0					0.0	7	
Total	4.4	82.4		51.3		176.3	1177	25189
NOZONE								
Baldchin Groper	2.2						756	
Barcheek Coral Trout	0.4						153	
Blue Morwong	0.4						153	
Breaksea Cod	0.3						248	
Chinaman Rockcod	0.1						64	
Cod, General	NA						1	
Convict Grouper	NA						6	
Coral Rockcod	NA						1	
Emperors	0.6						386	
Foxfish	0.0						23	
Fusiliers, Jobfishes	NA						2	
Harlequin Fish	NA						30	
Pigfishes, General	NA						13	
Rankin Cod	NA						1	
Bight Redfish	0.3						247	
Saddleback Pigfish	NA						2	
Snapper, Pink	2.2						1215	
Swallowtail	0.1						84	
Tomato Rockcod	NA						2	
Western Australian Dhufish	3.8						398	
Western Blue Groper	0.0						1	
Western Pigfish	NA						24	
Western Wirrah	NA						1	
Yelloweye Redfish	0.0						30	
Total	10.4						3805	
Grand Total	69.5	297.0	0.7	51.3	56.8	929.5	33491	103499

* weight less than 50 kg is presented as 0.0 in the above table.

NA - means Not Available

Appendix 4 List of West Coast Demersal Scalefish Species

Species code	Family name	Common Name	Scientific Name
437026	Acanthuridae	Spotted unicornfish	<i>Naso brevirostris</i>
290000	Apolactinidae	Thin velvetfish	<i>Coccotropus sp.</i>
117001	Aulopidae	Sergeant Baker	<i>Aulopus purpurissatus</i>
465011	Balistidae	Starry triggerfish	<i>Abalistes stellatus</i>
465900	Balistidae	Triggerfishes, general	<i>Balistid sp.</i>
465048	Balistidae	Titan triggerfish	<i>Balistoides viridescens</i>
465014	Balistidae	Bridled triggerfish	<i>Sufflamen fraenatum</i>
258006	Berycidae	Yelloweye redfish	<i>Centroberyx australis</i>
258004	Berycidae	Bight redfish	<i>Centroberyx gerrardi</i>
258005	Berycidae	Swallowtail	<i>Centroberyx lineatus</i>
258003	Berycidae	Redfish	<i>Centroberyx sp.</i>
346018	Caesionidae	Yellowtail fusilier	<i>Caesio cuning</i>
346061	Caesionidae	Lunar fusilier	<i>Caesio lunaris</i>
346037	Caesionidae	Blue fusilier	<i>Caesio teres</i>
346050	Caesionidae	Doubleline fusilier	<i>Pterocaesio digramma</i>
346000	Caesionidae/ Lutjanidae	Fusiliers, Jobfishes	<i>Caesionidae/Lutjanidae</i>
337072	Carangidae	Black pomfret	<i>Parastromateus niger</i>
445001	Centrolophidae	Blue-eye trevalla	<i>Hyperoglyphe antarctica</i>
365066	Chaetodontidae	Western talma	<i>Chelmonops curiosus</i>
377004	Cheilodactylidae	Blue morwong	<i>Nemadactylus valenciennesi</i>
374011	Cirrhitidae	Ornate hawkfish	<i>Paracirrhites hemistictus</i>
311083	Epinephelidae	Coral rockcod	<i>Cephalopholis miniata</i>
311045	Epinephelidae	Tomato rockcod	<i>Cephalopholis sonnerati</i>
311100	Epinephelidae	Breaksea cod	<i>Epinephelides armatus</i>
311009	Epinephelidae	Yellowspotted cod	<i>Epinephelus areolatus</i>
311062	Epinephelidae	Frostback rockcod	<i>Epinephelus bilobatus</i>
311041	Epinephelidae	Duskytail groper	<i>Epinephelus bleekeri</i>
311070	Epinephelidae	Whitespotted grouper	<i>Epinephelus caeruleopunctatus</i>
311007	Epinephelidae	Goldspotted rockcod	<i>Epinephelus coioides</i>
311021	Epinephelidae	Flowery rockcod	<i>Epinephelus fuscoguttatus</i>
311061	Epinephelidae	Queensland groper	<i>Epinephelus lanceolatus</i>
311150	Epinephelidae	Blackspotted rockcod	<i>Epinephelus malabaricus</i>
311063	Epinephelidae	Birdwire rockcod	<i>Epinephelus merra</i>
311010	Epinephelidae	Rankin cod	<i>Epinephelus multinotatus</i>
311047	Epinephelidae	Camouflage grouper	<i>Epinephelus polyphekadion</i>
311042	Epinephelidae	Radiant rockcod/ Comet grouper	<i>Epinephelus radiatus/morrhua</i>
311022	Epinephelidae	Chinaman rockcod	<i>Epinephelus rivulatus</i>
311040	Epinephelidae	Potato rockcod	<i>Epinephelus tukula</i>

Species code	Family name	Common Name	Scientific Name
311152	Epinephelidae	Eightbar grouper (grey banded cod)	<i>Hyporthodus octofasciatus</i>
311082	Epinephilidae	Peacock rockcod	<i>Cephalopholis argus</i>
311008	Epinephilidae	Brownbarred rockcod	<i>Cephalopholis boenak</i>
311136	Epinephilidae	Bluespotted rockcod	<i>Cephalopholis cyanostigma</i>
311138	Epinephilidae	Leopard rockcod	<i>Cephalopholis leopardus</i>
311142	Epinephilidae	Flagtail rockcod	<i>Cephalopholis urodeta</i>
311015	Epinephilidae	Banded grouper	<i>Epinephelus amblycephalus</i>
311145	Epinephilidae	Purple rockcod	<i>Epinephelus cyanopodus</i>
311014	Epinephilidae	Blacktip rockcod	<i>Epinephelus fasciatus</i>
311064	Epinephilidae	Wirenet rockcod	<i>Epinephelus hexagonatus</i>
311149	Epinephilidae	Snubnose grouper	<i>Epinephelus macrospilos</i>
311011	Epinephilidae	Highfin grouper	<i>Epinephelus maculatus</i>
311903	Epinephilidae		<i>Epinephelus Microdon/ Areolatus/ Bilobatus</i>
311058	Epinephilidae	Rankin cod	<i>Epinephelus multinotatus</i>
311904	Epinephilidae	Radiant rockcod/ Comet grouper	<i>Epinephelus radiatus/morrhua</i>
311060	Epinephilidae	Convict grouper	<i>Epinephelus septemfasciatus</i>
311057	Epinephilidae	Greasy rockcod	<i>Epinephelus tauvina</i>
311074	Epinephilidae	Plump grouper	<i>Epinephelus trophis</i>
311086	Epinephilidae	Maori rockcod	<i>Epinephelus undulatostratus</i>
311081	Epinephilidae	Passionfruit coral trout	<i>Plectropomus areolatus</i>
311079	Epinephilidae	Bluespotted coral trout	<i>Plectropomus laevis</i>
311078	Epinephilidae	Common coral trout	<i>Plectropomus leopardus</i>
311012	Epinephilidae	Barcheek coral trout	<i>Plectropomus maculatus</i>
311162	Epinephilidae	Vermicular cod	<i>Plectropomus oligacanthus</i>
311166	Epinephilidae	Yellowedge coronation trout	<i>Variola louti</i>
278000	Fistulariidae	Flutemouths	<i>Fistulariid sp.</i>
439002	Gempylidae	Gemfish	<i>Rexea solandri</i>
320001	Glaucosomatidae	Northern pearl perch	<i>Glaucosoma buergeri</i>
320000	Glaucosomatidae	Western Australian dhufish	<i>Glaucosoma hebraicum</i>
350003	Haemulidae	Painted sweetlips	<i>Diagramma labiosum</i>
350000	Haemulidae	Sweetlips	<i>Haemulidae</i>
350021	Haemulidae	Giant sweetlips	<i>Plectorhinchus albovittatus</i>
350014	Haemulidae	Spotted sweetlips	<i>Plectorhinchus chaetodonoides</i>
350007	Haemulidae	Goldspotted sweetlips	<i>Plectorhinchus flavomaculatus</i>
350020	Haemulidae	Striped sweetlips	<i>Plectorhinchus lessonii</i>
350018	Haemulidae	Manyline sweetlips	<i>Plectorhinchus multivittatus</i>
350012	Haemulidae	Brown sweetlips	<i>Plectorhinchus gibbosus</i>
261000	Holocentridae	Squirrelfishes, general	<i>Holocentrid sp.</i>
261024	Holocentridae	Samurai squirrelfish	<i>Sargocentron ittodai</i>
261027	Holocentridae	Smallmouth squirrelfish	<i>Sargocentron microstoma</i>

Species code	Family name	Common Name	Scientific Name
384002	Labridae	Western blue groper	<i>Achoerodus gouldii</i>
384054	Labridae	Saddleback pigfish	<i>Bodianus bilunulatus</i>
384045	Labridae	Foxfish	<i>Bodianus frenchii</i>
384904	Labridae	Pigfishes, general	<i>Bodianus spp.</i>
384001	Labridae	Western pigfish	<i>Bodianus vulpinus</i>
384038	Labridae	Humphead maori wrasse	<i>Cheilinus undulatus</i>
384005	Labridae	Bluespotted tuskfish	<i>Choerodon cauteroma</i>
384004	Labridae	Purple tuskfish	<i>Choerodon cephalotes</i>
384072	Labridae	Blue tuskfish	<i>Choerodon cyanodus</i>
384999	Labridae	Baldchin groper	<i>Choerodon rubescens</i>
384010	Labridae	Blackspot tuskfish	<i>Choerodon schoenleinii</i>
384901	Labridae	Tuskfish	<i>Choerodon sp.</i>
351021	Lethrinidae	Goldspot seabream	<i>Gnathodentex aureolineatus</i>
351010	Lethrinidae	Swallowtail seabream	<i>Gymnocranius elongatus</i>
351022	Lethrinidae	Paddletail seabream	<i>Gymnocranius euanus</i>
351005	Lethrinidae	Robinson's seabream	<i>Gymnocranius grandoculis</i>
351900	Lethrinidae	Seabream	<i>Gymnocranius sp.</i>
351000	Lethrinidae	Emperors, general	<i>Lethrinidae</i>
351013	Lethrinidae	Yellowtail emperor	<i>Lethrinus atkinsoni</i>
351002	Lethrinidae	Threadfin emperor	<i>Lethrinus genivittatus</i>
351006	Lethrinidae	Grass emperor	<i>Lethrinus laticaudis</i>
351007	Lethrinidae	Redspot emperor	<i>Lethrinus lentjan</i>
351009	Lethrinidae	Redthroat emperor	<i>Lethrinus miniatus</i>
351008	Lethrinidae	Spangled emperor	<i>Lethrinus nebulosus</i>
351004	Lethrinidae	Longnose emperor	<i>Lethrinus olivaceus</i>
351015	Lethrinidae	Ornate emperor	<i>Lethrinus ornatus</i>
351001	Lethrinidae	Blue-spotted emperor	<i>Lethrinus punctulatus</i>
351014	Lethrinidae	Drab emperor	<i>Lethrinus ravus</i>
351012	Lethrinidae	Spotcheek emperor	<i>Lethrinus rubrioperculatus</i>
351910	Lethrinidae	Nor-west snapper small	<i>Lethrinus sp.</i>
351911	Lethrinidae	Nor-west snapper (large/small)	<i>Lethrinus sp.</i>
351014	Lethrinidae	Variegated emperor	<i>Lethrinus variegatus</i>
351027	Lethrinidae	Mozambique bream	<i>Wattsia mossambica</i>
346001	Lutjanidae	Rusty jobfish	<i>Aphareus rutilans</i>
346027	Lutjanidae	Green jobfish	<i>Aprion virescens</i>
346014	Lutjanidae	Ruby snapper	<i>Etelis carbunculus</i>
346038	Lutjanidae	Flame snapper	<i>Etelis coruscans</i>
346058	Lutjanidae	Pale ruby snapper	<i>Etelis radiosus</i>
346031	Lutjanidae	Tang's snapper	<i>Lipocheilus carnolabrum</i>
346000	Lutjanidae	Snappers, other	<i>Lutjanidae</i>
346015	Lutjanidae	Mangrove jack	<i>Lutjanus argentimaculatus</i>
346025	Lutjanidae	Indonesian snapper	<i>Lutjanus bitaeniatus</i>

Species code	Family name	Common Name	Scientific Name
346029	Lutjanidae	Red bass	<i>Lutjanus bohar</i>
346011	Lutjanidae	Stripey snapper	<i>Lutjanus carponotatus</i>
346041	Lutjanidae	Checkered snapper	<i>Lutjanus decussatus</i>
346005	Lutjanidae	Crimson snapper	<i>Lutjanus erythropterus</i>
346034	Lutjanidae	Blackspot snapper	<i>Lutjanus fulviflamma</i>
346028	Lutjanidae	Paddletail	<i>Lutjanus gibbus</i>
346030	Lutjanidae	Golden snapper	<i>Lutjanus johnii</i>
346044	Lutjanidae	Bluestriped snapper	<i>Lutjanus kasmira</i>
346010	Lutjanidae	Darktail snapper	<i>Lutjanus lemniscatus</i>
346008	Lutjanidae	Bigeye snapper	<i>Lutjanus lutjanus</i>
346007	Lutjanidae	Saddletail snapper	<i>Lutjanus malabaricus</i>
346007	Lutjanidae	Saddletail snapper	<i>Lutjanus malabaricus</i>
346006	Lutjanidae	Fiveline snapper	<i>Lutjanus quinquelineatus</i>
346016	Lutjanidae	Maori snapper	<i>Lutjanus rivulatus</i>
346040	Lutjanidae	Yellowlined snapper	<i>Lutjanus rufolineatus</i>
346012	Lutjanidae	Moses snapper	<i>Lutjanus russelli</i>
346004	Lutjanidae	Red emperor	<i>Lutjanus sebae</i>
346910	Lutjanidae	Perch, Red, Maroon, Sea Perch	<i>Lutjanus sp.</i>
346057	Lutjanidae	Timor snapper	<i>Lutjanus timoriensis</i>
346003	Lutjanidae	Brownstripe snapper	<i>Lutjanus vitta</i>
346913	Lutjanidae	Flagfish/Spanish flag	<i>Lutjanus vitta /Quinquelineatus/ Carponototatus/Lutjanus</i>
346049	Lutjanidae	False fusilier	<i>Paracaesio xanthura</i>
346032	Lutjanidae	Rosy snapper	<i>Pristipomoides filamentosus</i>
346002	Lutjanidae	Goldband snapper	<i>Pristipomoides multidens</i>
346911	Lutjanidae	Jobfish	<i>Pristipomoides sp.</i>
346019	Lutjanidae	Sharptooth jobfish	<i>Pristipomoides typus</i>
346017	Lutjanidae	Chinamanfish	<i>Symphorus nematophorus</i>
340001	Menidae	Razor moonfish	<i>Mene maculata</i>
361002	Microcanthidae	Footballer sweep	<i>Neatypus obliquus</i>
465039	Monacanthidae	Black reef leatherjacket	<i>Eubalichthys bucephalus</i>
465003	Monacanthidae	Leatherjacket, Mosaic	<i>Eubalichthys mosaicus</i>
465005	Monacanthidae	Velvet leatherjacket	<i>Meuschenia scaber</i>
465006	Monacanthidae	Ocean jacket	<i>Nelusetta ayraudi</i>
465038	Monacanthidae	Modest leatherjacket	<i>Thamnaconus modestoides</i>
224005	Moridae	Large-tooth beardie	<i>Lotella rhacina</i>
224901	Moridae	Ribaldo	<i>Mora moro</i>
224003	Moridae	Bearded rock cod	<i>Pseudophycis barbata</i>
287003	Neosebastidae	Bighead gurnard perch	<i>Neosebastes pandus</i>
287006	Neosebastidae	Thetis fish	<i>Neosebastes thetidis</i>
228002	Ophidiidae	Pink ling	<i>Genypterus blacodes</i>
228008	Ophidiidae	Rock ling	<i>Genypterus tigerinus</i>

Species code	Family name	Common Name	Scientific Name
369002	Opleganthidae	Knifejaw	<i>Oplegnathus woodwardi</i>
466016	Ostraciidae	Western smooth boxfish	<i>Anoplocapros amygdaloides</i>
466010	Ostraciidae	Whitebarred boxfish	<i>Anoplocapros lenticularis</i>
466003	Ostraciidae	Shaw's cowfish	<i>Aracana aurita</i>
466000	Ostraciidae	Boxfish/cowfish	<i>Ostraciidae</i>
367001	Pentacerotidae	Yellowspotted boarfish	<i>Paristiopterus gallipavo</i>
367002	Pentacerotidae	Giant boarfish	<i>Paristiopterus labiosus</i>
367003	Pentacerotidae	Longsnout boarfish	<i>Pentaceropsis recurvirostris</i>
367000	Pentacerotidae	Boarfish	<i>Pentacerotidae</i>
337076	Platycephalidae	Deepwater flathead	<i>Neoplatycephalus conatus</i>
316009	Plesiopidae	Southern blue devil	<i>Paraplesiops meleagris</i>
311170	Polyprionidae	Bass groper	<i>Polyprion americanus</i>
311006	Polyprionidae	Hapuku	<i>Polyprion oxygeneios</i>
365029	Pomacanthidae	Multibar angelfish	<i>Paracentropyge multifasciata</i>
365000	Pomacanthidae	Angelfish, general	<i>Pomacanthid sp.</i>
365080	Pomacanthidae	Blue angelfish	<i>Pomacanthus semicirculatus</i>
326005	Priacanthidae	Lunartail bigeye	<i>Priacanthus hamrur</i>
326001	Priacanthidae	Spotted bigeye	<i>Priacanthus macracanthus</i>
326000	Priacanthidae	Bigeye	<i>Priacanthus sp.</i>
457001	Psettodidae	Australian halibut	<i>Psettodes erumei</i>
313003	Pseudochromidae	Lined dottyback	<i>Labracinus lineatus</i>
287040	Pteroidae	Common lionfish	<i>Pterois volitans</i>
386020	Scaridae	Steephead parrotfish	<i>Chlorurus microrhinos</i>
386030	Scaridae	Greenfin parrotfish	<i>Chlorurus sordidus</i>
386009	Scaridae	Marbled parrotfish	<i>Leptoscarus vaigiensis</i>
386000	Scaridae	Parrotfish	<i>Scaridae</i>
386001	Scaridae	Bluebarred parrotfish	<i>Scarus ghobban</i>
386022	Scaridae	Darkcap parrotfish	<i>Scarus oviceps</i>
386023	Scaridae	Greencheek parrotfish	<i>Scarus prasiognathos</i>
386027	Scaridae	Surf parrotfish	<i>Scarus rivulatus</i>
386028	Scaridae	Blackvein parrotfish	<i>Scarus rubroviolaceus</i>
287072	Scorpaenidae	Western red scorpionfish	<i>Scorpaena sumptuosa</i>
287000	Scorpaenidae	Scorpionfishes	<i>Scorpaenidae</i>
361004	Scorpididae	Sweep, Sea	<i>Scorpis aequipinnis</i>
287093	Sebastidae	Bigeye ocean perch	<i>Helicolenus barathri</i>
311132	Serranidae	Leopard wirrah	<i>Acanthistius pardalotus</i>
311133	Serranidae	Orangelined wirrah	<i>Acanthistius paxtoni</i>
311035	Serranidae	Western wirrah	<i>Acanthistius serratus</i>
311199	Serranidae	Wirrahs, general	<i>Acanthistius sp.</i>
311085	Serranidae	Whitelined rockcod	<i>Anyperodon leucogrammicus</i>
311003	Serranidae	Barber perch	<i>Caesioperca rasor</i>
310000	Serranidae	Sea perches, general	<i>Caesioperca sp.</i>

Species code	Family name	Common Name	Scientific Name
311182	Serranidae	Red-lined seaperch	<i>Caesioperca sp.</i>
311135	Serranidae	Blowhole perch	<i>Caesioscorpis theagenes</i>
311044	Serranidae	Barramundi cod	<i>Cromileptes altivelis</i>
311098	Serranidae	Red seaperch	<i>Hypoplectrodes cardinalis</i>
311037	Serranidae	Banded seaperch	<i>Hypoplectrodes nigroruber</i>
311005	Serranidae	Harlequin fish	<i>Othos dentex</i>
311000	Serranidae/ Epinephelidae	Cod, general	<i>Serranidae/Epinephelidae</i>
353006	Sparidae	Frypan bream	<i>Argyrops spinifer</i>
353002	Sparidae	Yellowback bream	<i>Dentex spariformis</i>
353001	Sparidae	Snapper	<i>Pagrus auratus</i>
353000	Sparidae	Snappers/Bream general	<i>Sparidae</i>
287022	Synanceiidae	Pacific monkeyfish	<i>Erosa erosa</i>
287049	Synanceiidae	Estuarine stonefish	<i>Synanceia horrida</i>
287089	Synanceiidae	Reef stonefish	<i>Synanceia verrucosa</i>
118028	Synodontidae	Common saury	<i>Saurida tumbil</i>
118001	Synodontidae	Largescale saury	<i>Saurida undosquamis</i>
118000	Synodontidae	Lizardfishes/grinners, general	<i>Synodontidae</i>
118004	Synodontidae	Fishnet lizardfish	<i>Synodus sageneus</i>
118023	Synodontidae	Variiegated lizardfish	<i>Synodus variegatus</i>
118002	Synodontidae	Painted grinner	<i>Trachinocephalus myops</i>
288001	Triglidae	Red gurnard	<i>Chelidonichthys kumu</i>
288010	Triglidae	Eye gurnard	<i>Lepidotrigla argus</i>
288002	Triglidae	Spiny gurnard	<i>Lepidotrigla papilio</i>
288006	Triglidae	Latchet	<i>Pterygotrigla polyommata</i>
288000	Triglidae	Gurnard	<i>Triglid sp</i>
400007	Uranoscopidae	Marbled stargazer	<i>Uranoscopus bicinctus</i>
400000	Uranoscopidae	Stargazer	<i>Uranoscopus sp.</i>
269001	Veliferidae	Common veifin	<i>Metavelifer multiradiatus</i>
264003	Zeidae	Mirror Dory	<i>Zenopsis nebulosus</i>
264004	Zeidae	John Dory	<i>Zeus faber</i>

Appendix 5 2005/06 Catches of West Coast Demersal Scalefish Stocks

Estimate total demersal species catch for the recreational sector based on the predominant 15 species (Top 15)

Fishery	Weight (tonnes)	Number kept of Top 15	Total number kept	% Top 15 (by number kept)	Estimated total weight (tonnes)
Recreational Creel	300.5	106462	111234	95.7%	314.0
Charter	68.3	30634	35878	85.4%	80.0
Total					394.0

Estimate total demersal species catch for the recreational sector based on the closure & non-closure species list

Closure species					
	Closure species (tonnes)	Number kept of closure species with weight	Total number kept	% Closure species (by number kept)	Estimated total weight (tonnes)
Recreational Creel	297.0	101206	103499	97.8%	303.7
Charter	69.5	32719	33491	97.7%	71.1
Non-closure species					
	Non closure species (tonnes)	Number kept of non-closure species with weight	Total number kept	% Non closure species (by number kept)	Estimated total weight (tonnes)
Recreational Creel	6.4	6771	7735	87.5%	7.3
Charter	2.5	1833	2387	76.8%	3.3
Closure + Non-closure species					Estimated total weight (tonnes)
Recreational Creel					311.0
Charter					74.4
Total					385.4

Harvest level for demersal species

Fishery	Predominant 15 species (tonnes)	Total demersal species (tonnes)	Closure species (tonnes)	Non closure species (tonnes)	Total demersal species (tonnes)
WCDSFIMF	902.0	935.8	929.5	6.3	935.8
JASDGDLF	34.5	51.7	51.3	0.4	51.7
WCDGDLF	48.6	56.9	56.8	0.1	56.9
CSLP	0.7	0.7	0.7		0.7
Recreational creel	300.5	314.0	303.7	7.3	311.0
Charter	68.3	80.0	71.1	3.3	74.4

Note: Sergeant Baker and sea sweep are not in the closure list.

Note: The estimated total weight was arrived at using assumptions about the “missing” weight in the recreational sector’s catches. The following formula was used:

$$\text{Total "missing" weight} = \frac{\text{Total number of demersal fish without a length-weight relationship} \times \text{total weight of demersal fish with a length-weight relationship}}{\text{Number of fish with a length-weight ratio}}$$

This approach assumes that the catch of fish without a length-weight ratio consists of a range of species with a range of length-weight ratios that is represented by the ‘global’ length-weight relationship.

