

SOUTHERN INLAND BIOREGION

ABOUT THE BIOREGION

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

Across the remainder of the Southern Inland Bioregion, rivers flow primarily during the 3 months of winter rainfall, with very occasional summer flows from inland, rain-bearing depressions, resulting from decaying cyclones. Most large fresh water bodies are man-made irrigation water supply dams or stock-feeding dams. There is a diverse variety of natural water bodies in this region ranging from numerous small springs and billabongs, up to Lake Jasper, the largest permanent freshwater Lake in the South West region, with 440 ha of open water up to 10 m deep. In combination, these diverse natural and man-made permanent waterbodies provide valuable habitat for fish and freshwater crustaceans during the summer months. Some natural salt lakes also occur but these generally dry out over summer each year.

The few natural freshwater rivers and man-made lakes support native fish and crustaceans and create an environment, particularly in forest areas, which is highly valued by the community for a variety of recreational pursuits.

SUMMARY OF ACTIVITIES POTENTIALLY IMPACTING THE BIOREGION

Commercial Fishing

There are currently no commercial fisheries in the Southern Inland Bioregion.

Recreational Fishing

The Southern Inland Bioregion provides significant recreational fishing opportunities. The major species fished recreationally are native marron, trout (both rainbow and brown trout) stocked by the Department of Fisheries into public dams and rivers, and feral redfin perch, an introduced, self-perpetuating stock. The native freshwater cobbler is

also taken in small numbers, as are the estuarine black bream which are artificially stocked into some inland impoundments that have become saline.

Aquaculture

Aquaculture development in the Southern Inland Bioregion is dominated by the farm-dam production of yabbies, which can reach about 200 t annually depending on rainfall and market demand. Semi-intensive culture of marron in purpose-built pond systems provides around 60 t per year and has the potential to expand significantly.

Trout have historically been the mainstay of finfish aquaculture production in this region, originating from heat-tolerant stock maintained at the Department's Pemberton Freshwater Research Centre. Silver perch are also grown in purpose-built ponds to supply local markets.

Tourism

The bioregion is a popular tourist destination with known for its national parks and wineries. Recreational fishing in the regions lakes, rivers is also important for both residents and tourists.

BIOREGIONAL SPECIFIC ECOSYSTEM MANAGEMENT

Within each Bioregion there are a range of management measures that have been implemented to manage the potential impact of activities (See the Ecosystem Management Section for an overview). Management measures specific to the South Inland Bioregion are detailed below.

The conservation of the 11 species of obligate freshwater native fish in freshwater ecosystems in the South-West of WA is a growing issue for the Department of Fisheries. Many of these species are endemic to WA, and are under pressure through climate change, increasing salinity, feral fish populations, infrastructure (bridges and dams) and adjacent land-use development.

The Department works with representatives from the Department of Water, the Department of Parks and Wildlife and other stakeholders, to facilitate information exchange and identify research projects

and associated funding sources to mitigate environmental impacts and so better protect native fish species. This is being facilitated by the recent establishment of the Freshwater Ecosystem Working Group which aims to coordinate a whole-of-Government approach to the management of freshwater ecosystems in the State.

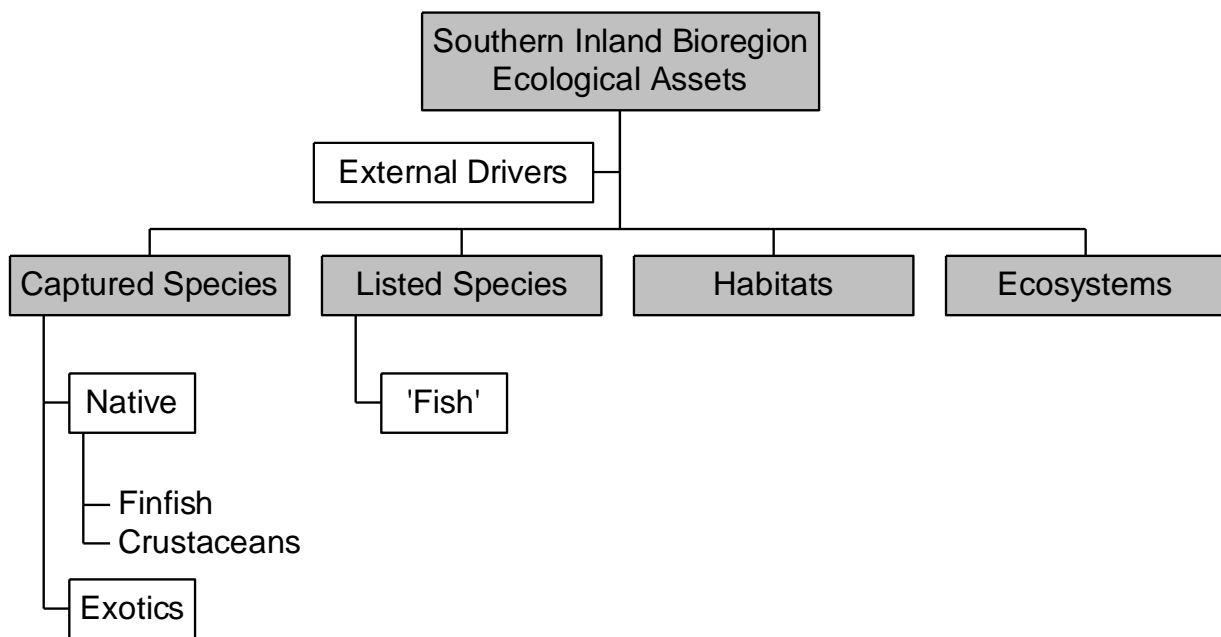
The Department undertakes a risk-based approach to managing the spread of feral fish in the bioregion. To support this, it has developed a community based reporting tool and education program to support its own routine surveillance activity. Information on aquatic pest distribution is used to prioritise management actions aimed at limiting the impact and preventing the spread of high risk pest fish within the State's freshwater ecosystems.

A key element of reducing the risk of feral fish is the approval process that the Department has in place for assessing proposals to translocate live non-endemic fish species into and within Western Australia, so as to minimise the environmental risks

to freshwater ecosystems associated with this activity.

ECOSYSTEM MONITORING AND STATUS

In order to assess the adequacy of management arrangements aimed at ensuring sustainability of the ecological assets within the Southern Inland Bioregion, the Department must identify and monitor trends in the condition of these resources. This is achieved through application of an Ecosystem Based Fisheries Management (EBFM) framework (Fletcher, *et al.*, 2010) to identify, in a hierarchical manner, the key ecological resources that require ongoing monitoring and assessment. (See How to Use section for more details). These key ecological assets identified for the Southern Inland Bioregion are identified in Southern Inland Overview Figure 1 and their current risk status reported on in the following sections.



SOUTHERN INLAND ECOSYSTEM MANAGEMENT FIGURE 1

Component tree showing the ecological assets identified and separately assessed for the Southern Inland Bioregion.

External Drivers

External drivers include factors impacting at the bioregional-level that are likely to affect the ecosystem as whole and may not fall within the direct control of Fishery legislation (e.g. climate change). An understanding of these factors, which are typically environmental (e.g. floods and

droughts) is necessary to fully assess the performance of the ecological resource. The main external drivers identified with potential to affect the Southern Inland Bioregion include climate (i.e. a drying climate) and introduced pests and diseases.

Climate

External Drivers	Current Risk Status
Climate	MODERATE

Climate effects are likely to be generated with reduced rainfall expected for this region.

Introduced Pests and Diseases

External Drivers	Current Risk Status
Introduced Pests	HIGH
Introduced Diseases	LOW

A high number of other exotic fish species have been released into the South West catchments e.g. red fin and cichlids. There is an assessment program underway to determine the extent of this and which of these events can be addressed by eradication.

Captured Species

Native Finfish

Captured Species	Aquatic zone	Ecological Risk
Native Finfish	Freshwater	HIGH (non-fishing)

The abundance and distribution of most native fish have been severely impacted due to reduced rainfall and land management practices. This has led to widespread fragmentation of native fish populations (i.e. regional extinctions, which without restocking will be permanent as there is no migration between lakes or catchments).

Native Crustaceans

Captured Species	Aquatic zone	Ecological Risk
Native Crustaceans	Freshwater	HIGH (non-fishing)

The abundance of smooth marron (*C. cainii*) has been monitored at regular intervals for a number of decades. The fishery arrangements have been through a number of significant updates to ensure that the catch is sustainable. The biggest threat to these stocks is from non-fishing causes.

Exotics

Captured Species	Aquatic zone	Ecological Risk
Exotics (stocked)	Freshwater	MODERATE (non-fishing)

Trout have been stocked into a limited number of streams in WA for decades. The trout are produced from the Pemberton Hatchery and are heat tolerant. Research activities are aimed at improving growth rate by increasing the volume of spawnless fish produced at the hatchery.

Listed Species

Fish *Crustaceans are classified as fish under the FRMA 1994

Listed species	Ecological Risks
Western minnow	SIGNIFICANT (non-fishing)
Hairy marron*	SIGNIFICANT (fishing)
Hairy marron*	SIGNIFICANT (non-fishing)

Western minnow (*G. occidentalis*) were successfully bred in captivity by the department.

Poaching of hairy marron (*C. tenuimanus*) from the upper reaches of Margaret River has been observed despite a ban on all marron fishing.

A new recovery plan has been developed to guide hairy marron recovery activities. This includes population monitoring, control of threatening processes, a captive breeding program, and increased community awareness through a zoo display and collaborating with regional NRM groups.

Habitats and Ecosystems

Habitat/Ecosystem	Aquatic zone	Current Risk Status
Habitat	Freshwater	HIGH (non-fishing)
Ecosystems	Freshwater	HIGH (non-fishing)

The community structure of most river and lake systems in this bioregion are substantially altered from historical levels. A survey of the main areas has been completed through a state NRM funded project. In addition there is concern that climate change may lead to a drying climate that could potentially alter the habitats and ecosystems in the bioregion.

SOUTH-WEST RECREATIONAL FRESHWATER RESOURCE STATUS REPORT 2016

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OVERVIEW

The Southern Inland Freshwater Fishery (SIFF) Resource incorporates the Marron Fishery and the South West Recreational Freshwater Angling (SWRFA) fishery. Both fisheries are managed with

separate recreational licenses and rules around seasons, bag limits, size limits and area closures. Combined, the license fees have a value of approximately \$1 million.

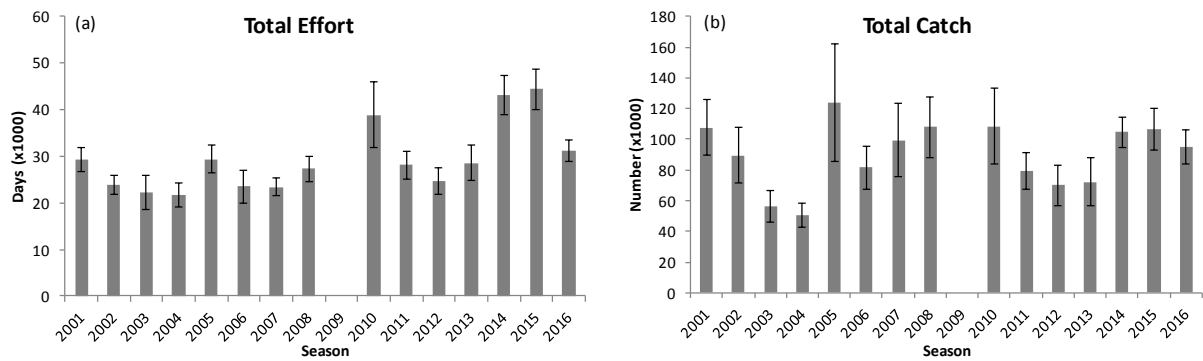
SUMMARY FEATURES 2016

Fishery Performance		Commercial	Recreational
Total Catch 2015	NA		Marron: 56,155 ($\pm 5,817$ s.e.) Marron SWRFA: 94,972 ($\pm 11,043$ s.e.) Fish
Fishing Level	NA		Acceptable
Stock/Resource Performance		Stock Status	Assessment Indicators
Marron	Sustainable - Adequate		Annual: Recreational Catch, Effort, CPUE; Fishery Independent Stock Assessment
Trout	Sustainable - Adequate		Annual: Number Stocked
EBFM Performance			
Asset	Level	Asset	Level
Bycatch	Low Risk	Listed Species	Severe Risk
Habitat	Medium Risk	Ecosystem	Low Risk
Social	High Amenity	Economic	NA
	Medium Risk		
Governance	Stable	External Drivers	Severe Risk

CATCH AND LANDINGS

Marron (*Cherax cainii*): The total catch for the 2016 season was estimated to be 56,155 ($\pm 5,817$) marron. This was substantially lower than the catch in 2015 of 70,807 ($\pm 5,650$ s.e.). The overall catch per unit effort (CPUE) of 3.41 (± 0.24 s.e.) in 2016 was not significantly different from the CPUE of 3.44 (± 0.20 s.e.) in 2015. Lower catch can be attributed to fewer active fishers in 2016 vs 2015 (5,688 vs 7,161). Serious fires occurred during the 2016 marron season that severely restricted access to a number of marroning sites, explaining the drop in fisher participation.

SWRFA: The estimated number of licensed fishers in 2016 (9,918) was down slightly on 2015 (10,759), however it remained around the long-term average (Recreational Fishery Figure 1a). Fishing effort was lower in 2016 compared to 2015 (31,106 days in 2016 vs. 44,387 days). The estimated total recreational catch from SWRFA across all species for 2016 was 94,972 ($\pm 11,043$ s.e.) fish of which 52,794 ($\pm 7,873$ s.e.) were kept and 42,178 ($\pm 6,673$ s.e.) were released. This was a decrease from 2015, where the estimated total recreational catch was 106,612 fish (Recreational Fishery Figure 1b).



RECREATIONAL FISHERY FIGURE 1. Estimated total effort in days (a) and total number of fish caught (b) from 2001 to 2016 for the SWRFA fishery.

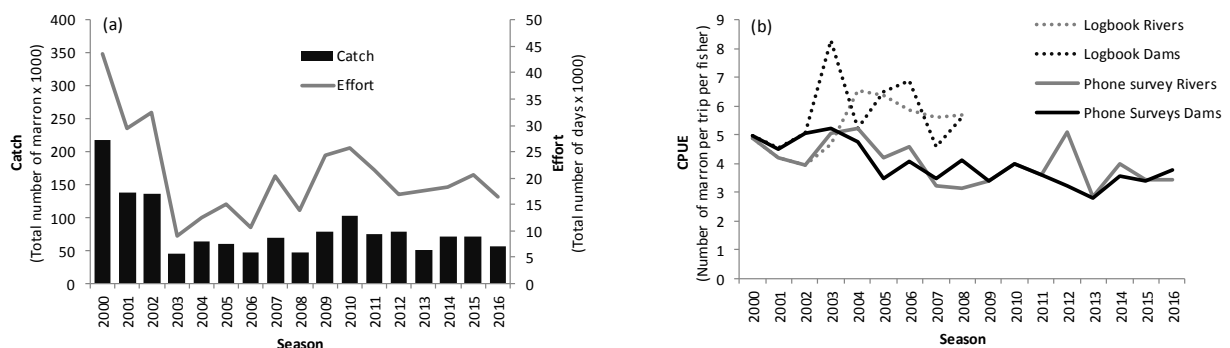
INDICATOR SPECIES ASSESSMENTS AND STOCK STATUS

Marron (Sustainable-Adequate)

Smooth marron (*Cherax cainii*), are the third largest crayfish in the world and endemic to Western Australia (Beatty *et al.* 2016). The Marron Fishery is composed of many discrete populations (Beatty *et al.* 2016) that exhibit biological and life history traits that differ among systems (Beatty *et al.* 2011), including fecundity (Beatty *et al.* 2016) and growth (Lawrence 2007). Refer to Southern Inland Freshwater Fishery Resource Assessment Report (RAR) for further information.

The total number of licensed fishers in 2016 (14,006) was slightly lower than 2015 (14,357). The number of license holders and the proportion that actually fished for marron in 2016 (5,688 active fishers, 39% of license holders) was lower than

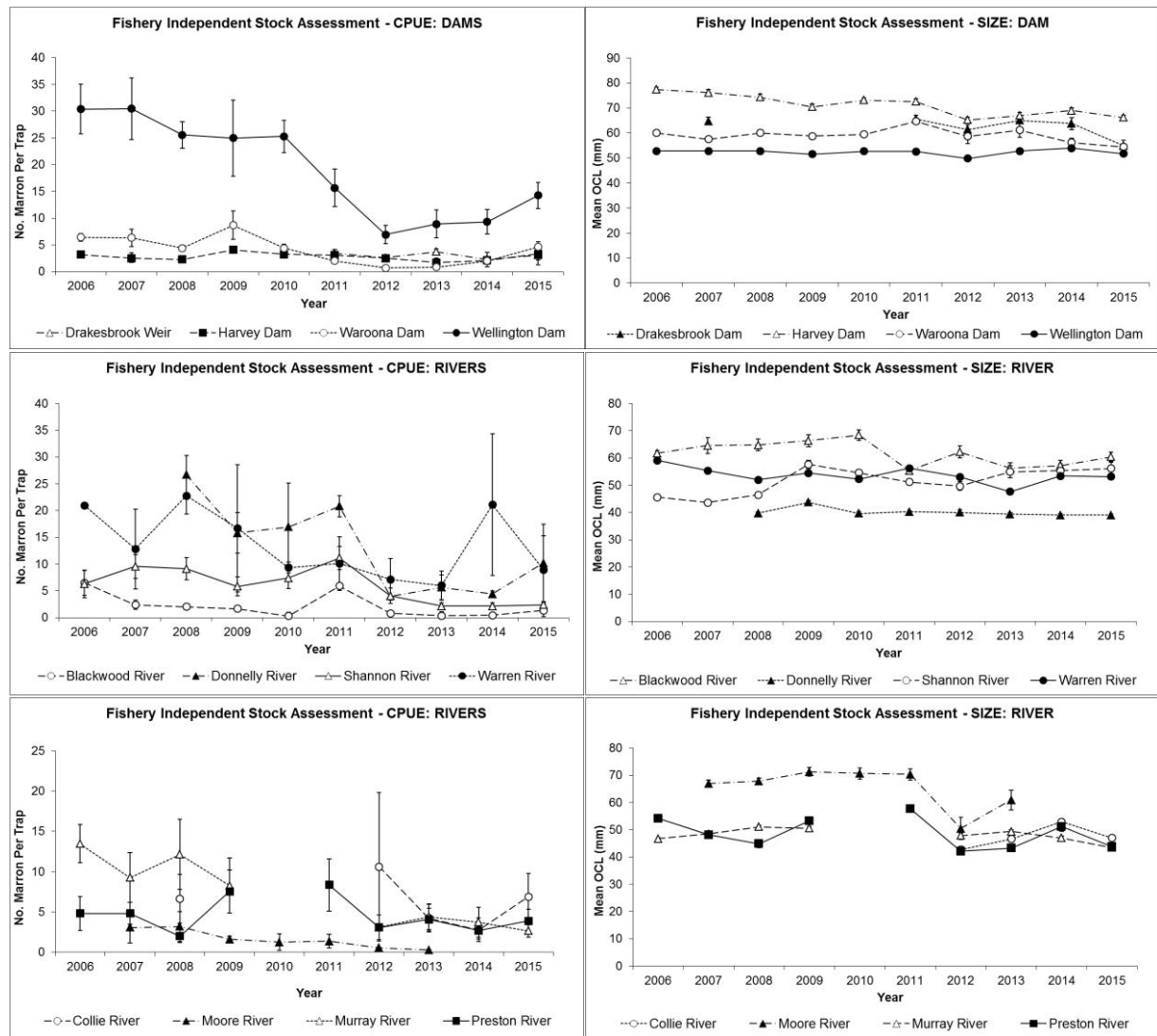
2015 (7,161 active fishers, 48% of license holders). As a result, total effort was also less in 2016 (16,433 days ±949 s.e.) compared to 2015 (20,609 days ±1,182 s.e.) but similar to effort levels since 2011. The number of days fished per fisher was similar between 2016 (2.89 days ±0.17 s.e.) and 2015 (2.88 days ±0.17 s.e.). The estimated total recreational catch in 2016 (56,155 marron ±5,817 s.e.) was lower than 2015 (70,807 marron ±5,650 s.e.), however the overall catch per unit effort (CPUE) in 2016 (3.41 ±0.24 s.e.) was similar to 2015 (3.44 ±0.20 s.e.) (Recreational Fishery Figure 2). Therefore the reduction in catch was due to less people fishing, rather than people undertaking fewer fishing trips, or catching fewer animals. Distribution of fishing effort across particular rivers and dams is largely consistent across years, although some fluctuations occur. (Refer to RAR for further information.)



RECREATIONAL FISHERY FIGURE 2. Estimated a.) recreational catch (numbers), effort (days), and b.) nominal CPUE of marron from 2000 to 2016 from phone surveys.

Fishery independent survey data showed relative abundance of marron varied greatly among indicator sites (Recreational Fishery Figure 3). Size however, is relatively stable at all sites, although there has been a slight decrease in mean size of marron in Harvey Dam. Harvey Dam, in conjunction with Wellington Dam, receives more than 70% of all effort in dams (refer to RAR). Overall marron stocks are considered **adequate** due to stable recreational catch and CPUE,

although fishery independent survey data suggests they are under pressure from environmental conditions, i.e. CPUE in the Shannon River, a system completely closed to fishing, shows a similar pattern to rivers where fishing occurs. However, there is also some evidence of site specific abundance reductions from fishery independent CPUE data. For more information refer to RAR (in prep.).

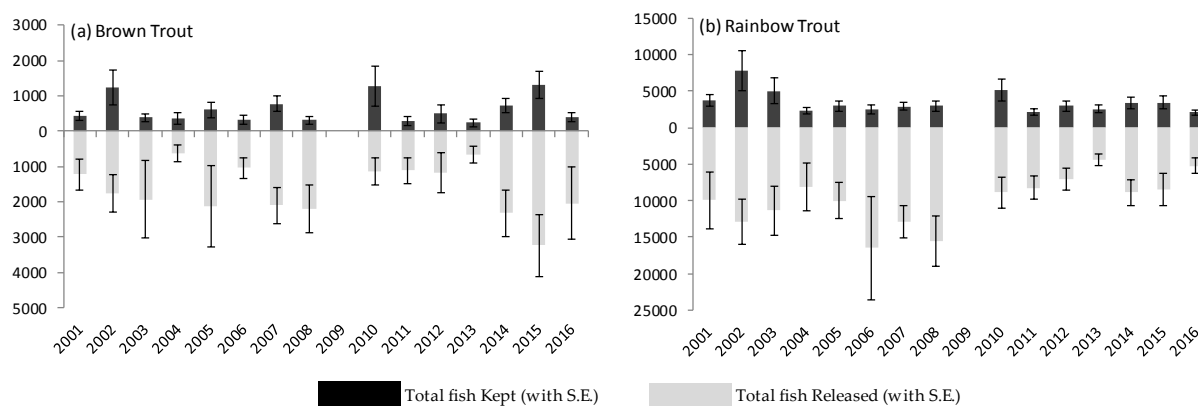


RECREATIONAL FISHERY FIGURE 3. The relative abundance (CPUE) and size (mm OCL) of marron in four dams and eight rivers as determined by the fishery-independent stock assessment. Note: Missing values occur in years a site was not sampled.

Trout (Annually Stocked)

Rainbow trout (*Oncorhynchus mykiss*) and Brown trout (*Salmo trutta*) are produced at the Pemberton Freshwater Research Centre Facility and released into rivers and dams of south-west WA. Wild self-sustaining populations are thought to be limited; therefore stock levels are dependent on release rates and are supplemented annually.

The total estimated recreational catch of each species in 2016, was generally lower than 2015, due in part to reduced effort. Overall, catches were within historical levels (Recreational Fishery Figure 4). For information on other freshwater fish species, refer to RAR (in prep.).



RECREATIONAL FISHERY FIGURE 4. Total kept and released by species (a) Brown trout (b) Rainbow trout for 2001 to 2016 seasons.

BYCATCH AND PROTECTED SPECIES INTERACTIONS

Bycatch: The Marron Fishery also reports captures of small quantities of non-target species, principally gilgies (*Cherax quinquecarinatus*, *C. crassimanus*) and koonacs (*C. plebejus*, *C. glaber*). Although little is known about their biology, the impact of the Marron Fishery on these species is thought to be low as gilgies and koonacs are smaller than marron and are not targeted by recreational marron fishers. The introduced yabby also composes a small part of the fishery and carry some disease risks. There is little to no bycatch in the SWRFA due to the small size of non-target native species. Therefore the impact of the fishery on bycatch is a **low risk**.

Protected Species: Trout stocking occurs only in waterways where protected species are absent, therefore the fishery has no impact on protected species. Anecdotal evidence suggests that Redfin Perch, despite being feral, are still stocked and spread by fishers. Therefore they have the potential to negatively impact protected species through direct predation.

A second species of marron, the critically endangered hairy marron, *Cherax tenuimanus*, occurs only in Margaret River. In late 2002, recreational marron fishing within Margaret River, upstream of Ten Mile Brook Junction was prohibited to remove the impacts of fishing on the remaining hairy marron stocks. Illegal fishing is still recorded in this reach of the Margaret River by the Department, and combined with the small population size is considered a **severe risk**.

HABITAT AND ECOSYSTEM INTERACTIONS

Habitat: The major habitat impacts of the Marron Fishery and the SWRFA are litter in surrounding areas, and the trampling of riparian vegetation and subsequent bank erosion. However, they can also provide an environmental benefit through the removal of large numbers of feral redfin perch (*Perca fluviatilis*). Therefore, impact on habitat is considered a **medium risk**.

Ecosystem: The removal of legal-sized marron from freshwater rivers is unlikely to have a significant effect on ecosystem function, as the bulk of the marron biomass is below legal size and marron of all sizes have similar food and habitat requirements. Marron taken from man-made dams are already living in highly modified habitats, as such their removal does not significantly impact on ecosystem function.

Stocking of trout has occurred in WA waters for over 100 years. To minimise adverse impacts of trout on native species, they are stocked only in rivers where non-native fish species are also present, and protected species are absent. SWRFA is largely a lure and fly fishery, however there is a small risk to the ecosystem through bait collection, its use, the release of unwanted live bait (mainly for redfin perch), and potential to spread disease and parasites, e.g. *Thelohania*. Therefore the resource is considered to have a **low risk** to the ecosystem.

SOCIAL AND ECONOMIC OUTCOMES

Social

The Marron Fishery in particular is iconic, whilst the SWRFA has an enthusiastic base of fishers and a dedicated angling group, the Western Australian Trout and Freshwater Angling Association (WATFAA), therefore the resource has high social amenity. Both fisheries attract tourists to regional areas and a FRDC project is underway looking at the social drivers of the Marron Fishery.

The effect of reduced rainfall on the availability of marron habitat is expected to increase awareness of changes in climate patterns in the South-West. In 2015, the drying of Cardiff Town Pool, on the south branch of the Collie River, resulted in the death of a number of large marron and gained significant media attention. The Department is investigating how these situations can be managed in the future and as such it is identified as having a **medium risk**.

Economic

Licences fees for the SIFF in 2016 had an estimated value of \$950,000 (marron licence: \$550,000; SWRFA licence: \$400,000). The SIFF fisheries are also likely to provide a significant economic boost to regional towns in the South-West. Economic risk is assessed on income from a resource. As this resource does not generate income, a risk score is not applicable.

GOVERNANCE SYSTEM

Allowable Catch Tolerance Levels (Acceptable)

Marron: In 2006, the Recreational Freshwater Fisheries Stakeholder Subcommittee (RFFSS) proposed that, based on the available science the fishery be managed to a catch range of 96,000-136,000 marron. This level of catch has rarely been achieved with the exception of 2010, a year of extremely low rainfall. Recreational catch is proportionate to effort and fishery independent surveys do not indicate negative impacts of fishing on stocks, therefore catch is considered **acceptable** but will be reviewed.

SWRFA: There are no allowable catch and tolerance levels specified as trout are stocked annually.

Harvest Strategy

There are currently no formal harvest strategies for the marron or SWRFA fishery.

Compliance

Southern Region Fisheries and Marine Officers apply compliance through the delivery of an Operational Plan. Areas of high interest have been identified and patrols are designed to frequent those, and other areas. Patrol and compliance planning focuses on out-of-season illegal fishing, illegal use of fishing gear, and a high profile presence through the marron season. Compliance activities are supported by educational activities.

Consultation

Meetings between the Department of Fisheries, Recfishwest, Freshwater Fisheries Reference Group and freshwater fishers are held annually.

Management Initiatives (Stable)

No significant changes to the management arrangements are planned.

EXTERNAL DRIVERS (*Severe Risk*)

Rainfall in the south-west of Western Australia has declined by 10-15% since 1975 according to CSIRO models and it predicts an additional 7% decrease in rainfall by 2030 (CSIRO 2009). The decline has been most noticeable in autumn and early winter rains. The impact of reduced rainfall has included a greater than 80% reduction of runoff into dams. This has negative implications for rivers and lakes in the south-west and the associated fish and crustacean assemblages. The major impact of these changes will be through a reduction in habitat availability, with negative implications for fish and crustacean abundance. Reduced river flows inhibit movement, and combined with increasing salinity, could negatively impact populations of all freshwater species. In addition, the drying climate may lead to more frequent and higher intensity bushfires that can impact the fisheries through restricting fisher access, and associated impacts of fire and fire management methods on stream fauna.

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