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Western Australia.*

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DRAFT
Western Australian
Small Pelagic Scalefish Resource
Harvest Strategy

2025

Version control

Version	Change description	Date
1.0	Small Pelagic Scalefish Resource of Western Australia Harvest Strategy	

Important disclaimer

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List of acronyms

AHL	Allowable harvest level
AMM	Annual management meeting
CDR	Catch and disposal record
CEO	Chief Executive Officer (DPIRD)
DPIRD	Department of Primary Industries and Regional Development
EPBC Act	<i>Environment Protection and Biodiversity Conservation Act 1999</i>
EBFM	Ecosystem based fisheries management
ERA	Ecological risk assessment
ESD	Ecologically sustainable development
ETP	Endangered, threatened and protected
FRMA	<i>Fish Resources Management Act 1994</i>
FRMR	<i>Fish Resources Management Regulations 1995</i>
GVP	Gross value of production
HCR	Harvest control rules
MEY	Maximum economic yield
MSY	Maximum sustainable yield
NDZ	Northern development zone
OCP	Operational compliance plan
PSDZ	Purse seine development zone
RFBL	Recreational fishing from boat licence
SCB	South Coast bioregion
SCPSMF	South Coast Purse Seine Managed Fishery
SDZ	Southern development zone
SSPSR	Statewide Small Pelagic Scalefish Resource
TACC	Total allowable commercial catch
WA	Western Australia
WAFIC	Western Australian Fishing Industry Council
WCB	West Coast bioregion
WCPSMF	West Coast Purse Seine Managed Fishery

1.0 Introduction

Harvest strategies for Western Australia's (WA) aquatic resources are formal documents developed by the Department of Primary Industries and Regional Development (DPIRD, the Department) to support decision-making processes that ensure the outcomes are consistent with the principles of Ecologically Sustainable Development (ESD; Fletcher 2002a) and Ecosystem Based Fisheries Management (EBFM; Fletcher *et al.* 2012).

Harvest strategies are a key component of all contemporary fishery management systems and a requirement for certification under the Marine Stewardship Council (MSC; Marine Stewardship Council 2018). The objectives of ESD are reflected in the objects of the *Fish Resources Management Act 1994* (FRMA).

This *Statewide Small Pelagic Scalefish Resource Harvest Strategy* (Harvest Strategy) has been developed in line with the Department's Harvest Strategy Policy for Aquatic Resources (Department of Fisheries 2015; Fletcher *et al.* 2016) and is consistent with relevant national harvest strategy policies and guidelines (e.g. Sloan *et al.* 2014; Department of Agriculture and Water Resources 2018a, b). It establishes the specific set of decision rules that determine the appropriate harvest levels for sectors to meet the ecological, economic, and social objectives established for the resource.

The publication of this Harvest Strategy is intended to make the decision-making considerations and processes for the management of the Statewide Small Pelagic Scalefish Resource (SSPSR) transparent and provide a basis for informed dialogue on management actions with resource users and other stakeholders (Department of Fisheries 2015).

The Harvest Strategy provides guidance for decision-makers but does not derogate from or limit the exercise of discretion required for independent decision-making by the Minister for Fisheries, the Chief Executive Officer (CEO) of DPIRD, or other delegated decision-makers in order to meet the objects of the FRMA.

1.1 Review process

The Department's Harvest Strategy Policy recognises that management of resources may need to change over time and that a review period should be built into each harvest strategy to ensure it remains relevant (Department of Fisheries 2015). This Harvest Strategy is scheduled to be reviewed after five years but will remain in place until such time as the review occurs. If required, it may be subject to review and amendments within this five-year period.

2.0 Scope

This Harvest Strategy applies to the take of small pelagic scalefish across Western Australia. The SSPSR is primarily harvested in the West Coast and South Coast bioregions by the commercial South Coast Purse Seine Managed Fishery (SCPSMF) and West Coast Purse Seine Managed Fishery (WCPSMF).

including Purse Seine Development Zones (PSDZ). Statewide recreational catches of small pelagic species are estimated to be minor.

Consistent with the Department's Harvest Strategy Policy for Aquatic Resources (Department of Fisheries 2015), in addition to considering fishing impacts on indicator species, this Harvest Strategy also considers the impact of fishing on other retained species, bycatch species, endangered, threatened, and protected (ETP) species, and habitats and ecosystems, to ensure any risks to these elements are managed effectively.

2.1 Indicator species

Monitoring and assessment of the SSPSR is currently based on identification and sustainability evaluation of indicator species (Department of Fisheries 2011). Indicator species are determined using a risk-based approach that calculates the 'sustainability risk' of stocks (based on the inherent vulnerability and current risk to wild stock) and the current or likely future 'management risk' of the species or stock to the community (measured as a combination of the current management information requirements, and their economic and social values).

The SSPSR comprises five species of small pelagic scalefish: Australian sardine (*Sardinops sagax*), yellowtail scad (*Trachurus novaezelandiae*), Australian anchovy (*Engraulis australis*), scaly mackerel ('tropical sardine', *Sardinella lemuru*), and maray (*Etrumeus jacksoniensis*).

To efficiently manage the SSPSR several indicator species have been chosen to monitor the performance of the entire suite of species within the SSPSR (Fletcher *et al.* 2016). In the South Coast bioregion (SCB) Australian sardine is the indicator species as it comprises approximately 99% of the catch, predominantly taken by the quota managed SCPSMF. In the West Coast bioregion (WCB), Australian sardine and scaly mackerel are the indicator species, as together they comprise approximately 99% of the catch, predominantly taken by WCPSMF and PSDZ licence holders. In the north coast and Gascoyne coast bioregions the SSPSR is essentially unexploited.

2.1.1 Australian sardine

Australian sardines are distributed along the continental shelf of the southern half of the Australian mainland (Gomon *et al.* 2008). In WA they are short-lived (up to 9 years; Fletcher and Blight 1996) attaining sexual maturity their second year (Fletcher 1995). Otolith chemistry and life history characteristics show that, for management and assessment purposes, WA stocks are effectively isolated from South Australian (SA) stocks and within WA there is separation of stocks between the West and South Coast bioregions (Edmonds and Fletcher 1997, Gaughan *et al.* 2001, Izzo *et al.* 2017).

Fishery independent egg surveys showed a major collapse of spawning biomass for these stocks in 1999 immediately following a mass mortality event caused by a herpes virus (Gaughan *et al.* 2004). Ongoing surveys demonstrated a strong recovery by the mid-2000s (Gaughan *et al.* 2008). Current risk-based weight of evidence assessments, using all available lines of evidence, show the level of risk to both West and South Coast bioregion stocks is low (Appendices 2 and 3).

2.1.2 *Scaly mackerel*

Scaly mackerel are a short lived (up to seven years, attaining sexual maturity at about age two) small pelagic species (to 22 cm fork length) that feed by filtering plankton (Gaughan and Mitchell 2000). Their distribution is predominantly the tropical eastern Indian and western Pacific Oceans and northwestern WA to as far south as Geographe Bay (Whitehead 1985). In WA, where they are taken by purse seiners operating between Geraldton and Geographe Bay, they are highly mobile with a patchy distribution. Otolith chemistry showed no evidence for the existence of separate stocks between Carnarvon and Fremantle (Gaughan and Mitchell 2000). A risk-based weight of evidence assessment, using all available lines of evidence, indicates that the current level of risk to this stock is low (Appendix 2).

2.1.3 *Retained (non-indicator) species*

Catches of other species such as Australian anchovy, yellowtail scad and maray are small and infrequent. In each bioregion they collectively comprised <1% of the total reported catch for the last 10 years. These other species are early maturing, short-lived, have a high rate of natural mortality, have a large species range and occupy a low trophic level. These characteristics are associated with low vulnerability to fishing pressure. Also, purse seine catches are mostly taken in nearshore embayments close to populations centres, e.g. Cockburn Sound and King George Sound, so fish outside those areas are not susceptible to capture.

In addition to the retained (non-indicator) species above, prior to 1999, and since 2024, WA purse seine operators have been permitted to retain blue mackerel (*Scomber australasicus*) incidentally caught whilst targeting the five small pelagic species specified in SCPSMF and WCPSMF management plans.

2.2 Fishing activities

2.2.1 *Commercial fishing*

The majority of catch is taken by the SCPSMF, WCPSMF, and PSDZs using predominantly a purse seine net designed to surround a shoal of fish. The nets have a cork or float line, and a series of rings attached to the lead or ground line through which is passed a purse line which, when hauled, closes the bottom of the net.

2.2.1.1 *South Coast Purse Seine Fishery*

Commercial fishing for Australian sardines in the Albany region began in 1963-64 using drop nets, with significant growth following the adoption of purse seining in the late 1970s. By 1980-81, 80% of Australia's sardine catch was taken with purse seine nets. Expansion in the 1970s and 1980s was driven by demand from the southern bluefin tuna fleet and the pet food industry. Vessel numbers in King George Sound increased rapidly, with catches doubling between 1983-84 and 1984-85. Total south coast landings peaked at around 8,000 tonnes in 1990 and 1996.

In response, King George Sound became a restricted entry fishery in 1985. A 1986 working group recommended further controls, implemented through a limited entry system in 1988 with three licence classes ('A', 'B', and 'C') based on prior catch history and access conditions. A processing facility at Bremer Bay in 1989 spurred additional

growth, but stock declines due to mass sardine mortality events in 1995 and 1998-99 led to quota cuts, including a zero quota for Bremer Bay in 2000-01. The Esperance fleet, formally recognised in 1995, was brought under the same management framework as Albany and Bremer Bay by 1996.

The fishery was placed under formal management in 1994 through the *South Coast Purse Seine Managed Fishery Management Plan 1994*. The SCPSMF is a purse-seine net-based fishery that operates in the waters between Cape Leeuwin and the WA/South Australia border (Figure 1). It has five management zones, centred on King George Sound (Zone 1), Albany (Zone 2), Bremer Bay (Zone 3), Esperance (Zone 4), and a Developmental Zone near Augusta (Zone 5) where the recorded catch has been negligible in recent years.

The fishery is managed through a combination of input and output controls including limited entry, species restrictions, gear requirements and specifications, access to specific zones, closed areas within the fishery, and a Total Allowable Commercial Catch (TACC). There are currently 33 managed fishery licences in the fishery and the majority of the fishing effort is concentrated around the Albany area.

2.2.1.2 West Coast Purse Seine Fishery and Development Zones

Fishing for Australian sardines in WA began in the Fremantle area during the 1950s. However, the fishery did not begin to expand significantly until the 1970s, following the introduction of purse seining. This new fishing method enabled greater efficiency and allowed operations to extend along the WA coastline. Initially, all vessels used in the fishery were relatively small and lacked onboard processing capabilities. As a result, the rapid deterioration of sardines meant that fishing was restricted to areas near land-based processing facilities.

By the mid-1980s, growth in the SCPSMF prompted the WA government to begin formalising management of the West Coast sector. In November 1986, a working group was established to investigate management options for what would become the WCPSMF. The group's recommendations, delivered in November 1987, proposed limited entry measures for Cockburn Sound and the surrounding areas. It also recommended the establishment of development zones on either side of Cockburn Sound to assess potential future expansion of the fishery (Moore 1989).

In September 1989, the *West Coast Purse Seine Limited Entry Fishery Notice* (WCPSMF MP) was gazetted (Figure 1). The WCPSMF MP introduced specific operational restrictions, including a maximum vessel length of 16 metres, a maximum purse seine net length of 350 metres, and a minimum mesh size of 18 mm. Furthermore, the use of mechanical hauling gear was restricted to holders of limited entry licences.

Over time, the fishery structure expanded to include two adjacent exploratory regions: the Northern Development Zone (all WA waters north of 31°00'S) and the Southern Development Zone (from 33°00'S to Cape Leeuwin). The WCPSMF (referred to as the Metropolitan Zone) and the PSDZ together encompass waters from Cape Leeuwin (115° 08.091 E) to the Northern Territory border.

Access to the WCPSMF is limited to 12 managed fishery licences. Lampara nets are also permitted to be used in the WCPSMF. A lampara net is a type of fishing net designed to surround a shoal of fish which has a cork or float line and a bottom lead line, which when hauled, closes together to trap the encircled fish.

The species captures are primarily scaly mackerel and Australian sardines, with smaller harvests of yellowtail scad, Australian anchovy and maray.

In the PSDZ, 6 licences (3 licences in each Zone) are permitted to use power hauled purse seine nets. One of the 3 licences is not permitted to take Australian sardines within the Southern PSDZ and no Australian sardines can be taken by any licences within the Northern PSDZ.

2.2.1.3 Management of small pelagic finfish through the Offshore Constitutional Settlement

The commercial take of some species of small pelagic finfish, including blue mackerel is guided by the Offshore Constitutional Settlement (1995) (OCS), whereby WA has jurisdiction over coastal waters (within three nautical miles of mainland WA), and the Australian Government has jurisdiction outside of coastal waters. The OCS is supported by a Memorandum of Understanding which sets out catch limits to address cross-jurisdictional bycatch. Prior to 1999, small volumes of blue mackerel were taken as bycatch in the WA managed SCPSMF and WCPSMF, and by commercial line fishing methods.

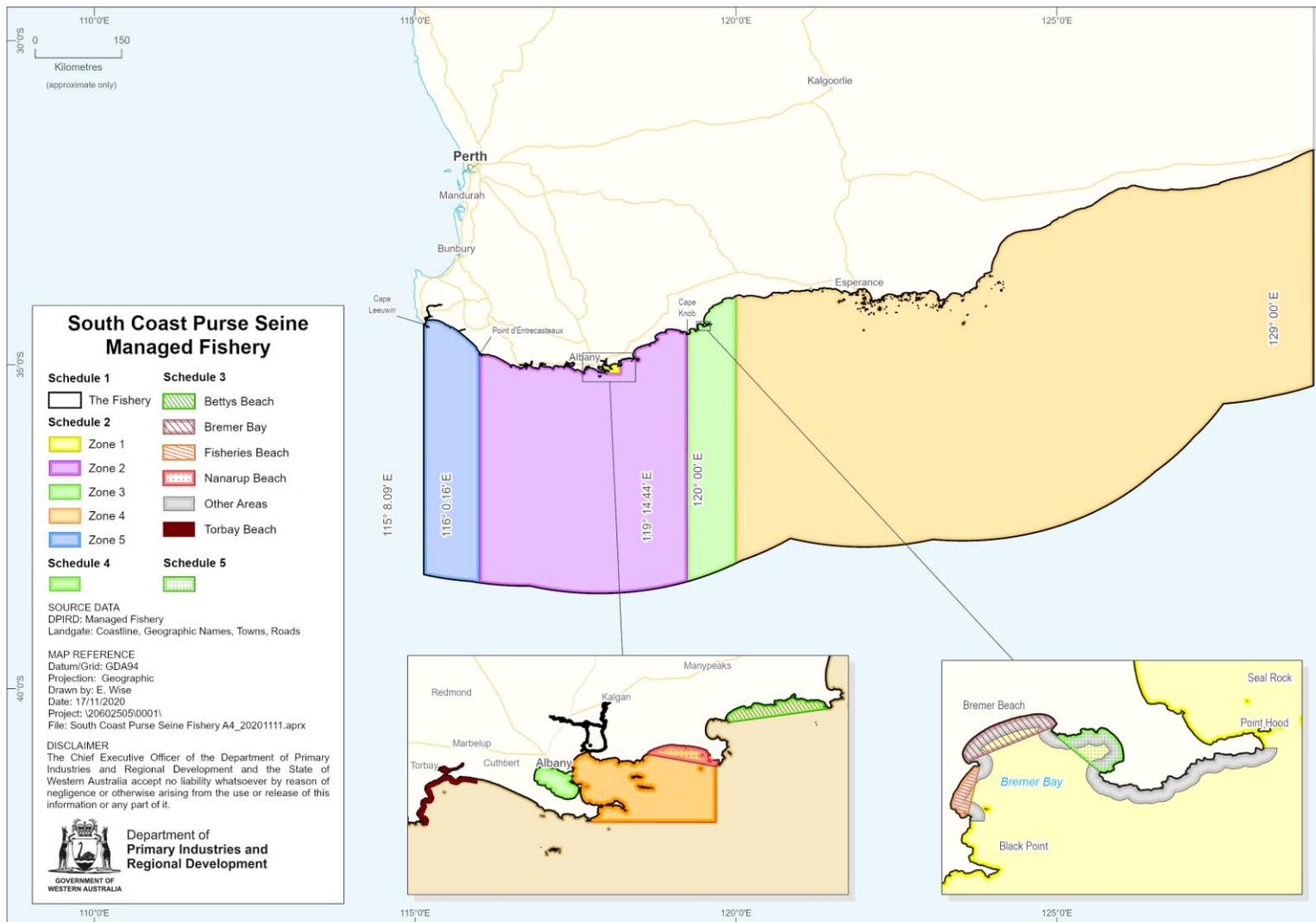
Due to practicalities of ensuring WA commercial fishers only targeted blue mackerel in coastal waters, the WA Government prohibited the commercial take of blue mackerel in 1999 through the *Prohibition on Commercial Fishing for Blue Mackerel Order 1999* (Order). In 2024, WCPSMF and SCPSMF operators were granted access to the resource in WA coastal waters only via an Instrument of Exemption. Relevant management plans will be amended to give effect to this decision.

2.2.2 Recreational fishing

Small pelagic species are not a major focus of recreational fishers although a range of input and output controls currently exist to manage recreational fishing of these species. These include a daily bag limit of 30 fish for yellowtail scad, and a combined daily bag limit of 9 litres for all baitfish in the families Clupeidae, Engraulidae, and Atherinidae, including Australian sardines and scaly mackerel. Recreational netting for baitfish using set, haul, and throw nets is permitted but requires a licence and is subject to guidelines. Additionally, a Recreational Fishing from Boat Licence is required to undertake recreational fishing activities (including harvesting small pelagic species) from a powered vessel.

A recent survey of boat-based recreational fishers estimated that the catches of Australian sardines, scaly mackerel, and yellowtail scad are minor in WA (annual catch of each species <1 t; Norriss and Moses 2024a, b).

a)



2.2.3 Customary fishing

Customary fishing is recognised under the FRMA as fishing by an Aboriginal person that:

- a) is in accordance with the Aboriginal customary law and tradition of the area being fished; and
- b) is for the purpose of satisfying personal, domestic, ceremonial, educational, or non-commercial communal needs.

Limited information is available on customary fishing for small pelagic species, however, customary catches of scaly mackerel and Australian sardines from oceanic waters are highly likely to be low in comparison to commercial and recreational catches.

3.0 Harvest strategy

The procedures used within this harvest strategy involve two interrelated decision-making processes. The first constitutes the formal review of targeted stocks and other ecological assets against defined reference levels to determine performance against management objectives relating to ecological sustainability (Section 3.5). The second process involves a fishery-level review that determines whether the current catch/effort by each of the relevant fisheries/sectors is consistent with the levels expected when ecological objectives are met (Section 3.6).

This Harvest Strategy is structured to describe, hierarchically:

- 1) the main objective for the resource (Section 3.1);
- 2) the high-level, long-term objectives of management (Section 3.2);
- 3) the short-term, operational objectives (Section 3.3); and
- 4) how these translate into the management approach used for the SSPSR (Section 3.4).

This is followed by a more detailed description of the:

- 5) processes for assessing ecological sustainability (Section 3.5);
- 6) processes for assessing fishery performance (Section 3.6); and
- 7) specific monitoring and assessment procedures used to ascertain if objectives are being met (Section 3.7).

3.1 Main objective

The long-term objective is to deliver predictable, ecologically sustainable harvest levels and allocations of small pelagic species that maintain stocks near the target. This is to optimise opportunities that generate long-term economic benefits to the state from commercial fishing and processing activities.

3.2 Long-term objectives

3.2.1 *Ecological sustainability*

- 1) To maintain spawning stock biomass of indicator species at a level where the main factor affecting recruitment is the environment.
- 2) To maintain spawning stock biomass of the other retained species (non-indicator species) at levels where the main factor affecting recruitment is the environment.
- 3) To ensure fishing impacts do not result in serious or irreversible harm to bycatch species' populations.
- 4) To ensure fishing impacts do not result in serious or irreversible harm to ETP species' populations.
- 5) To ensure fishing impacts do not result in serious or irreversible harm to habitat structure and function.
- 6) To ensure the effects of fishing do not result in an unacceptable risk of serious or irreversible harm to ecological processes.

3.2.2 *Economic and social benefits*

The social and economic benefits to be generated from the utilisation of a resource should be based on achieving the longer-term objectives outlined below and are to be considered within the constraints of ecological sustainability, and while providing due consideration to other fishing sectors.

- 1) Maintain an evidence-based Maximum Economic Yield TACC setting to optimise the profitability of commercial fishing to the WA community; and
- 2) Maintain or improve cultural, recreational, and lifestyle benefits for recreational fishing participants, and maximise the overall flow of economic and social contributions from recreational fishing to the broader WA community.

3.3 Operational objectives

Long-term management objectives are typically operationalised as short-term (e.g., annual or periodic) objectives through one or more performance indicators that can be measured and assessed against pre-defined reference levels to ascertain actual performance.

Consistent with the long-term ecological, social, and economic objectives in Section 3.2, operational objectives aim to maintain each resource close to the target level, or to rebuild the resource if it has fallen below the threshold or the limit levels (Section 3.5). Operational economic and social objectives are aimed at improving fishery performance as outlined in Section 3.6.

3.4 Harvesting and management approach

The harvesting approach for the statewide SSPSR is based on a *constant catch* harvest of indicator species by the SCPSMF, the WCPSMF, and by authorisation in PSDZs. Annual catches since the mid-2000s have been very low compared to stock levels, and well below the conservative TACCs. As such, stocks have been assessed to be at a low sustainability risk (Blazeski *et al.* 2021, Norriss and Moses 2024a, b). The harvest

strategy for these fisheries reflects the low risk, with reference levels based on the expectation that if catches fluctuate below these conservative TACCs there are minimal sustainability risks (Fletcher *et al.* 2016).

3.4.1 Allowable harvest level

The allowable harvest level (AHL) is defined as the TACC of the SSPSR that could be taken in the next season by the SCPSMF, WCPSMF, and by authorisation in PSDZs. Catches by the SCPSMF are limited to annual (to 30 June, the annual licencing period) TACCs specified under the SCPSMF management plan. For the WCPSMF and PSDZs catches are limited to notional annual (to 31 March, the annual licensing period) TACCs, and reaching or exceeding these limits will trigger a management response. Note that although these TACCs are mostly multi-species (Table 1), this harvest strategy is based on catches of indicator species, which typically comprise ~99% of the total catch by these fisheries.

Table 1. TACC or notional TACC (tonnes) by management zone and species.

Management zone, species	TACC, t
South Coast bioregion¹	
Zone 1 (King George Sound)	2,162
Zone 2 (Greater Albany)	521
Zone 3 (Bremer Bay)	1,500
Zone 4 (Esperance)	1,500
West Coast bioregion (Perth metropolitan and SDZ combined)	
Australian sardine	2,328
SSPSR species ²	672
NDZ	
Scaly mackerel	2,700

1 Includes all five SSPSR species plus sandy sprat and blue sprat. 2 Includes all SSPSR species except Australian sardine, plus Perth herring.

3.5 Resource status and performance levels

The Department conducts a formal, resource-level review to assess the status of SSPSR stocks and performance in relation to each ecological objective. Based on the relevant operational objectives for the SSPSR, clear performance indicators and reference levels have been established that define acceptable from unacceptable stock performance (Figure 3):

- **Target:** is where the stock indicators should be to meet the ecological, economic and social objectives.
- **Threshold:** is where you review your position in relation to meeting the target species or other ecological objectives.
- **Limit:** is where you do not want the stock indicator to be, as it is not meeting the target species or other ecological objectives.

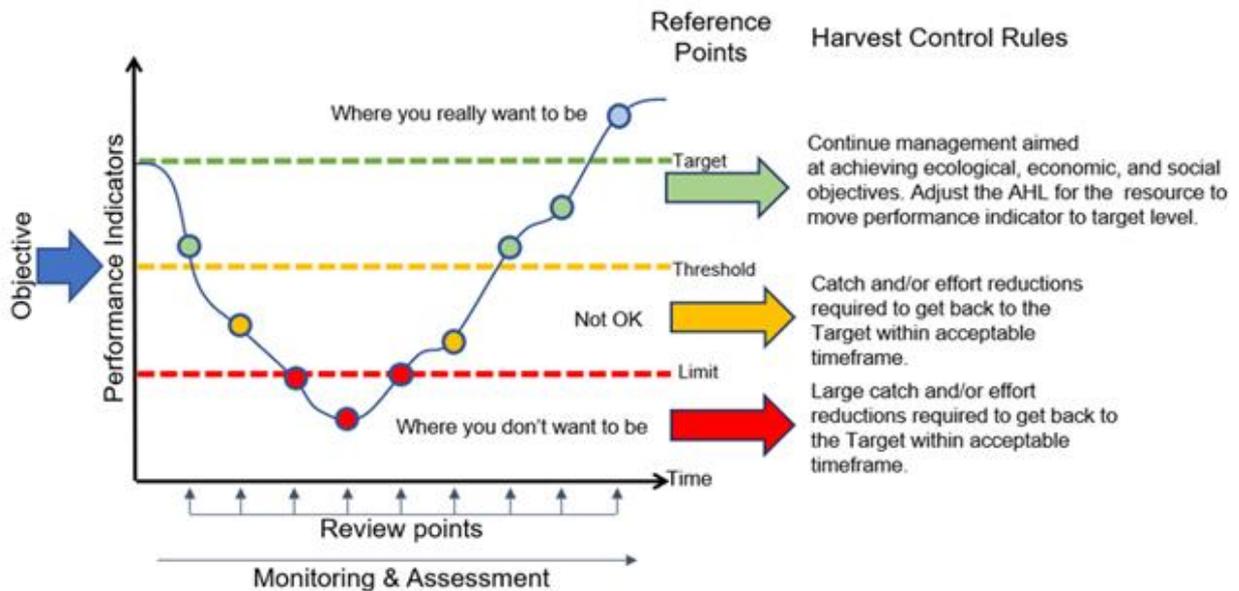


Figure 2. Relationship between performance indicators for a harvested fish stock, harvest control rules, limits, thresholds, and targets.

Harvest control rules (HCRs) define the management actions that should occur in relation to the value of each indicator compared to the reference levels (Section 3.5.1). The HCRs for the SSPSR aim to maintain the resource at its target level and return it to this level when a threshold or limit level has been breached.

The performance indicator for the SSPSR is annual catch, which often fluctuates below conservative TACCs due to low fishing effort, not because of a sustainability risk to stocks (Blazeski *et al.* 2021). Thus, annual catch is not a direct performance indicator for stock status in the way a biomass performance indicator would be, as a breach of a biomass limit reference level is unlikely.

A summary of the operational objectives and associated performance indicators, reference levels, and HCRs are provided in Appendix 1.

3.5.1 *Performance indicators and reference levels*

3.5.1.1 *Target species*

3.5.1.1.1 *Target reference level*

The performance indicator used to evaluate the status of the SSPSR is based on the annual catch of indicator species, which if below a conservative TACC, indicates a low sustainability risk (using all available lines of evidence).

- **Target:** maintain overall annual catch, and catch within each management area at or above 75% of the TACC.

This target reference level is regarded as the optimum value to deliver economic and/or social objectives within the biologically conservative TACC (Fletcher *et al.* 2016).

3.5.1.1.2 Threshold and limit reference level

A threshold reference level has been identified for the SSPSR to monitor performance based on annual catch relative to the TACC. This threshold serves as an indicator of potential changes in stock changes and are used to guide management responses.

- **Threshold:** annual catch being below 50% of the TACC for at least two consecutive years.

3.5.1.1.3 Limit reference level

In addition to the threshold, a limit reference level has been introduced to provide a more precautionary safeguard. While the TACC is considered conservatively set, it may not fully account for unforeseen events or the emergence of other critical indicators such as environmental anomalies, prolonged recruitment failure or disease outbreaks.

- **Limit:** annual catch at or below 20% of TACC for two consecutive years, or evidence of serious declines in productivity (e.g. sharp declines in catch per unit effort, abnormal environmental indicators).

Breaching the limit may indicate a severe risk to the biological sustainability of the stock and triggers an immediate management review. This may include additional monitoring, stock assessment, or implementation of emergency measures such as significant catch reductions or temporary closures.

Table 2. Summary of reference levels (annual catch (tonnes) and as a percentage of TACC) by bioregion and management zone. Catch year is to 30 June for SCPSMF, and to 31 March for WCPSMF.

Performance indicator	Reference level		
	Target (≥75%)	Threshold (<50% in two consecutive years)	Limit (≤20% in two consecutive years)
South Coast bioregion¹			
Zone 1 (King George Sound)	1,622	1,081	324
Zone 2 (Greater Albany)	391	261	78
Zone 3 (Bremer Bay)	1,125	750	225
Zone 4 (Esperance)	1,125	750	225
West Coast bioregion (Perth metropolitan and SDZ combined)			
Australian sardine	1,746	1,164	349
SSPSR species ²	504	336	101
NDZ			
Scaly mackerel	2,025	1,350	405

1 Includes all five SPSR species plus sandy sprat and blue sprat. 2 Includes all SPSR species except Australian sardine, plus Perth herring.

3.5.1.2 Other ecological assets

Other ecological assets incorporated in this Harvest Strategy include other retained species, bycatch, ETP species, habitats, and ecosystem processes that may be affected by fishing activities (Appendix 1). For all ecological components, reference levels have been set to differentiate acceptable fishery impacts from unacceptable fishery impacts according to the risk levels defined in Fletcher (2015).

3.5.2 Application of harvest strategy control rules

For each ecological performance indicator and reference level, the accompanying HCR directs the management needed to meet sustainability objectives (Appendix 1). These HCRs are designed to maintain the SPSR at the target level or rebuild it where it has fallen below the threshold (undesirable) or the limit levels.

HCR are based on the annual catch for the year to 30 June for the SCPSMF and its associated PSDZ, and the year to 31 March for the WCPSMF and its associated PSDZs. Reference levels consist of a target, threshold and limit level (Figure 3).

3.5.2.1 At target

- If the performance indicator is at the target, this is considered both biologically sustainable and economically acceptable in the context of the conservative TACC. Continue managing the resource to achieve social and economic objectives.
- If the performance indicator is trending above 90% of the TACC for at least 2 consecutive years, with catch rates trending in a positive direction, an increase in TACC can be considered.
- TACC will not be increased until a comprehensive stock assessment is undertaken.

3.5.2.2 Breaching the threshold

- If the performance indicator is at or below the threshold, the fishery is reviewed. The review determines if the breach was due to sustainability, economic or social issues.
- If the issue is sustainability related, a 10-50% TACC reduction will be implemented prior to the next fishing season.
- If it is identified that there are economic or social issues impacting on the proportion of the TACC taken, consider any changes to management that may improve economic viability or social acceptance prior to the next season.

3.5.2.3 Breaching the limit

- If the performance indicator is at or below the Limit, a review of the reasons for this breach is undertaken.

- If the review indicates that there is a sustainability issue, a 50-100% TACC reduction will be implemented prior to the next fishing season.
- If the review identifies that the breach is not sustainability related (e.g., economic or social reasons), consider management changes that could be implemented prior to the next season to increase catches to the target level.

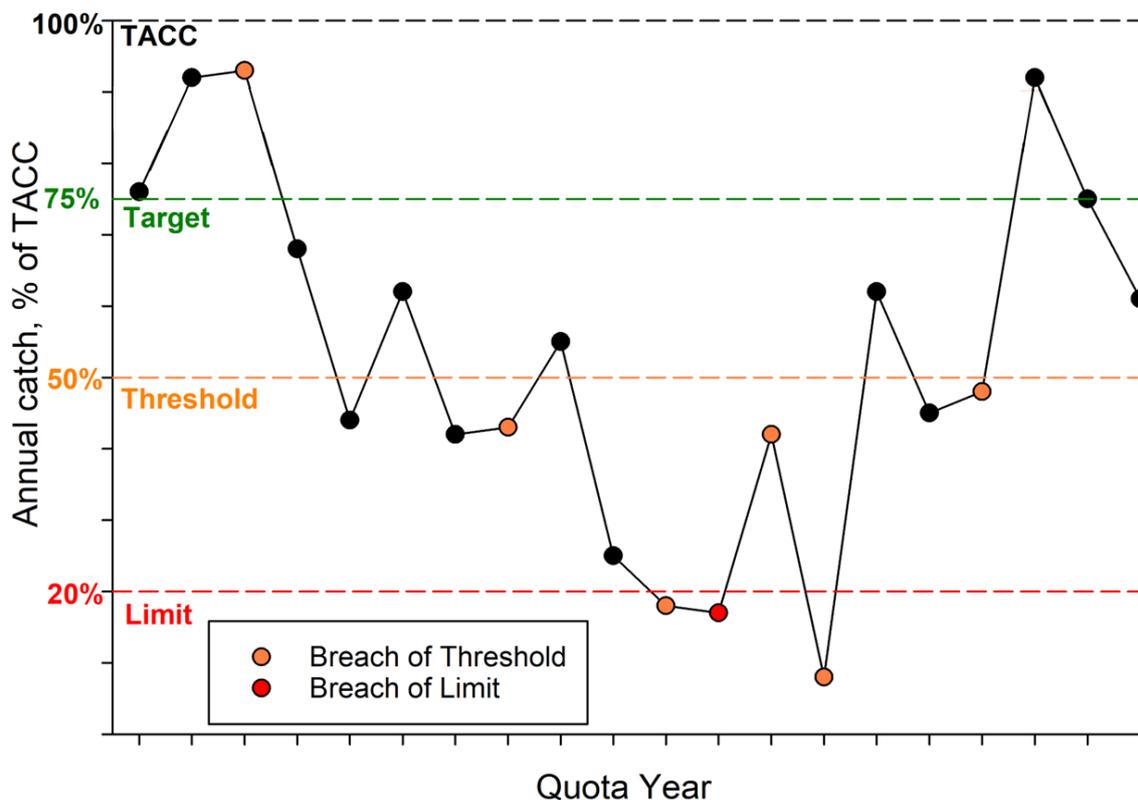


Figure 3. Hypothetical time series of annual catch of the indicator species as a proportion of the TACC and consequent harvest strategy response.

3.5.2.4 Control rules for other ecological assets

Ecological Risk Assessment (ERA) (described in Section 3.7.2.2) are used to determine when additional management actions may be required for other ecological assets such as other retained species, bycatch, ETP species, habitats, and ecosystem processes that may be affected by commercial and recreational fishing activities.

Reference levels for these assets differentiate acceptable fishery impacts (low/moderate risk levels) from unacceptable fishery impacts (high/severe risk levels) according to the calculated risk levels as defined in Fletcher (2015).

An ERA for the SSPSR was undertaken in 2021 (Blazeski *et al.* 2021).

3.6 Fishery performance

Defining periodic tolerance levels for fisheries provides a formal and efficient basis to evaluate the effectiveness of current management arrangements in delivering the levels of catch and/or effort specified by the HCRs and, where relevant, any sectoral allocation decisions (Fletcher *et al.* 2016). In line with the principles of ESD, this fishery-level

review process can also consider the performance against any objectives relating to the economic and social amenity benefits of fishing. Where possible, and in due consideration of ecological sustainability, fisheries management arrangements can be adjusted or reformed to help meet these economic and/or social objectives.

3.6.1 Economic and social benefits

SSPSR catches have been much lower since at least 2008 compared to previous periods. The decline was mainly due to reduced effort, particularly after Australian sardine suffered a virus generated mass mortality event in 1998/99. Those earlier catches appeared ecologically sustainable, suggesting that achieving historical levels of economic and social benefits are feasible. The harvest strategy sets a pathway to achieve this objective, subject to ecological sustainability. Specific performance indicators and reference levels to evaluate economic and social benefits have been developed for some of the economic and social operational objectives (see below).

3.6.1.1 Commercial sector

The economic and social benefit objectives for the commercial fishing sector are to:

- 1) Optimise the economic performance of the SCPSMF, the WCPSMF, and associated Development Zones through consideration of fishery operations and markets to determine the TACC that provides optimum long term economic returns and greater amenity.
- 2) Maintain the flow of economic and social commercial fishing benefits, through accessible and reliable local supply of the SSPSR to the WA community, including providing quality bait to the recreational fishing sector.

An economic performance indicator that could be optimised is the annual Gross Value of Production (GVP), being the landed value of the catch (kilograms of fish multiplied by average beach price per kilogram).

It is important to note that management actions relating to these objectives are applied within the constraints of ecological sustainability. The economic and social objectives for the commercial sector do not currently have explicit performance measures within the Harvest Strategy. Rather, it is through formal consultation processes that regulatory impediments to maintaining or enhancing economic return, and maximising social benefits of fishing, are discussed. Where possible, and in due consideration of ecological sustainability, fisheries management arrangements can be adjusted to help meet these objectives.

3.6.1.2 Recreational sector

A recent survey of boat-based recreational fishers estimated that the catches of Australian sardines, scaly mackerel, and yellowtail scad are minor in WA (annual catch of each species in each bioregion <1 t; Norriss and Moses 2024a, b). The SSPSR is an important source of bait for recreational fishers in WA, with bait often sourced from the local commercial catch.

The economic and social benefit objectives for the recreational fishing sector are to:

- 1) Maintain or improve cultural, recreational and lifestyle benefits for recreational fishing participants and maximise the overall flow of economic and social contributions from recreational fishing to the broader WA community.

No performance indicators or reference levels currently exist to evaluate the cultural and recreational experiences. These could be developed in future as more information becomes available.

3.7 Monitoring and assessment procedures

3.7.1 Information and monitoring

3.7.1.1 Commercial fishing information

There is a statutory obligation for commercial fishers to report catch information on Catch and Effort Monthly Returns within 1° x 1° reporting blocks. Information recorded includes species, catch weight, effort (boat days), block, and zone. In addition, commercial fishers must also report any interactions with ETP species as part of the statutory reporting.

SCPSMF fishers must also lodge a Catch and Disposal Record (CDR) for each landed catch, comprising reporting species, catch (weight), and ETP species interactions (e.g., seabirds) at a finer scale, using irregularly shaped blocks based on local geographic features. CDRs are primarily a compliance tool to track a fisher's catch against quota entitlement but are also useful for ETP monitoring.

The information from these statutory returns provides the basis for calculating the annual catch for retained species, which inform the broader weight-of-evidence assessments of stocks.

3.7.1.2 Recreational monitoring

Recreational fishing surveys are conducted approximately every three years for boat-based fishing (e.g., Ryan *et al.* 2022) as well as intermittent shore-based surveys (e.g., Tate and Smallwood 2021).

3.7.1.3 Fishery-independent information

At sea observers on fishing vessels have recorded ETP interactions (Norriss *et al.* 2020, Blazeski *et al.* 2021) as well as discards of non-ETP species, recording their release condition as alive and unharmed, injured, or dead. Results inform risk assessments and can be compared with fishery dependent records.

Limited understanding of seabird bycatch in purse seine fisheries had been highlighted as a key information gap in assessments of seabird bycatch in fisheries globally. This was investigated in Norriss (2020), documenting the bycatch of breeding flesh footed shearwaters (FFS) in the SCPSMF. Understanding the temporal patterns of FFS bycatch in the SCPSMF, and the factors that affect these patterns, was important to inform the timing of observer monitoring programmes and bycatch mitigation initiatives, and to calculate annual mortality estimates for the SCPSMF.

The study of FFS bycatch in the SCPSMF demonstrated large temporal variability in mortalities that is closely linked to the breeding cycle of the species. As mortality events

on fishing trips in King George Sound were a relatively rare occurrence for much of the year, and with most recorded during the late stage of chick provisioning in March and April, this study highlighted the importance of accounting for such temporal variation in the estimation of total annual bycatch mortalities of this species.

Another explanation for the seasonal peak in the mortality rate per fishing trip may be the simultaneous increase in the inshore abundance of sardines, including inside King George Sound, which results in increased purse seine fishing effort from March to May. Australian sardines are a key prey species for many higher trophic level predators including the western Australian salmon (*Arripis truttaceus*), which undertakes a westward nearshore spawning migration along the WA south coast around the same time. Similarly, flesh-footed shearwaters appear to have timed chick rearing to exploit the increased nearshore abundance of sardines, and may forage closer to shore and fishing operations at this time.

The observer data from 2017 and 2018 indicated that the majority of bycatch mortalities occurred when a large number of FFS were present at the fishing observations. FFS bycatch in King George Sound arises when birds are trapped by purse seine net folds. Although the large majority of net deployments run smoothly, with little risk of bycatch, the loss of net control resulting in substantial folds appears to occur sporadically despite the best effort of skilled fishers. If this occurs at a time when birds are more likely to pursue sardines inside the net to meet the increased food requirements of their chicks, an unusually high mortality count may result.

Following this study, bycatch mitigation measures have been voluntarily implemented within the SCPSMF in recent years. In 2023, Zone 1 SCPSMF operators and the Western Australian Fishing Industry Council (WAFIC) were successful in obtaining an Australian Government Threatened and Migratory Species Fisheries Bycatch Mitigation Program grant, to assist in the provision of ongoing mitigation measures for incidental bycatch of ETP species, namely FFS.

The grant supported the purchase of new purse seine nets, designed to reduce seabird interactions, hydraulic upgrades on three vessels operating within Zone 1, of the SCPSMF, and independent observer programs during the 2024 and 2025 special management periods when FFS bycatch risk is highest.

Results from the observer programs are currently undergoing analysis, however preliminary results suggest that the mortality rate was amongst the lowest recorded for any year (noting considerable variation in number of trips).

3.7.2 Assessment procedures

The different methods used by DPIRD to assess the status of aquatic resources in WA have been categorised into five broad levels, ranging from relatively simple analysis of annual catch levels and catch rates, through to the application of more sophisticated analyses and models that involve estimation of fishing mortality and levels of spawning stock biomass (Newman *et al.* 2024). Irrespective of the types of assessment methodologies used, all stock assessments undertaken by DPIRD use a risk-based, weight of evidence approach that considers all the available (fishery-dependent and fishery-independent) information (Fletcher 2015).

3.7.2.1 *Indicator species*

The overall status of Australian sardine and scaly mackerel stocks is determined based on a weight of evidence assessment of all available information (Blazeski *et al.* 2021). Lines of evidence include catch, effort, catch rates, biology, vulnerability, and estimates of spawning biomass. The risk to sustainability is rated by the likelihood of several potential levels of depletion of breeding stock compared to unfished levels: minor (>40%), moderate (30% - 40%), high (20% - 30%) or major (<20%).

3.7.2.2 *Risk assessments*

The Department uses a risk-based EBFM framework to assess the impacts of fishing on all parts of the marine environment, including the sustainability risks of other retained species, bycatch, ETP species, habitats, and the broader ecosystem. This framework has led the development of the periodic risk assessment process, which is used to prioritise research, data collection, monitoring needs, and management actions to ensure that fishing activities are managed both sustainably and efficiently.

In July 2021, an ERA for the SSPSR (Blazeski *et al.* 2021) was undertaken to consider the ecosystem impacts of the fishing activities targeting the SSPSR, assessed both individually and cumulatively. Risk scores were determined based on the available scientific monitoring, research information and expert knowledge on species, fishing activities, fishery regulations, and management. The assessment conforms to the AS/NZS ISO 31000 risk management standard and the methodology adopted by DPIRD, which relies on a likelihood-consequence analysis for estimating risk.

Thirty-four ecological components were scored cumulatively for risk. The majority (32) of the components were evaluated as low or negligible risks, which do not require any specific control measures.

Within the South Coast bioregion, sandy sprat are permitted to be retained by purse seine, however, catches are extremely rare (and possibly misidentified) with no recent recorded catches. Within the West Coast bioregion, taking sandy sprat by the WCPSMF is prohibited. A high risk was given to sandy sprat based on available evidence presented in the 2019-20 State of Fisheries Report (Duffy and Blay 2020). FFS was scored a medium/high risk. A medium risk rating reflected potential interactions with purse seine nets, but due to uncertainty in population modelling and reliance on fishery-dependent data, a high rating was considered. Consistent with ERA methodology, the higher of two ratings is carried forward, so FFS was ultimately assigned a high risk.

Risk assessments will continue to be undertaken periodically (approximately every 5 years) to reassess any current or new issues that may arise from fishing activities targeting the resource. However, a new risk assessment can also be triggered if there are significant changes identified in fishery operations or management activities or controls that are likely to result in a change to previously assessed risk levels.

4.0 Management framework

4.1 Governance

The commercial, recreational, and customary fishing sectors are managed by the Department in accordance with, but not limited to, the following legislation:

- *Fish Resources Management Act 1994*
- *Fish Resources Management Regulations 1995 (FRMR)*
- *West Coast Purse Seine Limited Entry Fishery Notice 1989*
- *South Coast Purse Seine Managed Fishery Management Plan 1994.*

Fishers must also comply with the requirements of the:

- *Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act).*
- *Marine Safety (Domestic Commercial Vessel) National Law Act 2012.*
- *Western Australian Marine Act 1982.*
- *Western Australian Biodiversity Conservation Act 2016.*
- *Western Australian Conservation and Land Management Act 1984.*
- *Any other legislation governing the use of the marine environment which impacts on fishing.*

4.2 Management measures

Management measures are outlined in Table 3. These measures can be amended as needed to meet ecological, social, or economic objectives and does not preclude the consideration of other options.

Table 3. Management measures and instrument of implementation for the SSPSR

Measure	Description	Instrument
Licences	Commercial fishing licence.	FRMR
	Recreational netting licence	FRMR
	Recreational Fishing from Boat Licence	FRMR
Output-controls	Total Allowable Commercial Catch (TACC)	<i>South Coast Purse Seine Managed Fishery Management Plan 1994</i>
	Max vessel size (WCPS)	<i>West Coast Purse Seine Limited Entry Fishery Notice 1989.</i>
Gear restrictions	Commercial – max net length of 350m and minimum mesh size of 18mm (WCPS)	<i>South Coast Purse Seine Managed Fishery Management Plan 1994</i> <i>West Coast Purse Seine Limited Entry Fishery Notice 1989 .</i>
	Recreational - Recreational netting for baitfish using set, haul and throw nets	FRMR 1995

Measure	Description	Instrument
	is permitted but requires a licence and is subject to guidelines.	
Spatial closures	Marine protected areas include fish habitat protection areas, other fishing closures such as wreck sites and marine reserves which include marine nature reserves, marine parks and marine management areas. Most of these areas are subject to additional rules.	EPBC Act FRMA (Section 43 Orders) <i>Closed Waters Netting (Preston Beach to Dunsborough) 1990</i> <i>Closed Waters Netting (Cape Naturaliste to Windy Harbour) Notice 1990</i> <i>Closed Waters Netting (Esperance Area) Notice 1992</i> <i>Prohibition on Fishing (Purse Seining) Order 2017</i>
Temporal Closures	Special Management Period (SCPS Zone 1 only) No fishing is to be undertaken during the following times: 1 - 31 March from 5:00am - 9:00am 1 - 30 April from 5:30am - 9:00am	South Coast Purse Seine Managed Fishery – Commercial Fishing Industry Code of Practice for Responsible Fishing
Recreational Bag and Boat Limits	Daily bag limit of 30 fish for yellowtail scad, and a combined daily bag limit of 9 litres for all baitfish in the families Clupeidae, Engraulidae and Atherinidae, including Australian sardines and scaly mackerel.	FRMR
Reporting	Catch and Effort Monthly Returns, Catch and Disposal Record.	FRMR
Monitoring	At sea observers record ETP interactions and discards of non-ETP species.	N/A

4.3 Management procedures for implementing changes

Decision-making processes can be triggered following the identification of new or potential issues as part of an ERA (generally reviewed every ~ 5 years), results of research, management, or compliance projects or investigations, monitoring, or assessment outcomes (including those assessed as part of the Harvest Strategy) and/or expert workshops and peer review of aspects of research and management.

There are two main processes for making decisions about the implementation of management measures and strategies for the resource:

- Annual decision-making processes that may result in measures to meet the operational objectives (driven by the harvest strategy); and

- Longer-term decision-making processes that result in new measures and/or strategies to achieve the long-term fishery objectives (i.e., changes to the management system).

If there is an urgent issue, stakeholder meetings may be called as needed to provide input for determining appropriate management actions.

Management changes are generally given effect through amendments to legislation, such as the management plan, regulations, and orders. These changes generally require consultation with all affected parties and the approval of the Minister for Fisheries and/or the CEO (or appropriate delegates). In making decisions relevant to fisheries, the Minister for Fisheries may choose to receive advice from any source, but has indicated that:

- 1) The Department is the primary source of management advice; and
- 2) WAFIC and Recfishwest are the primary source of advice and representation from the commercial sector and recreational (including charter) sector, respectively.

4.3.1 Commercial sector

WAFIC is the peak sector body dedicated to representing the interests of the commercial purse seine fishing industry.

Under its funding agreement with DPIRD, WAFIC has been funded to undertake statutory consultation functions related to fisheries management and the facilitation of management meetings for the West Coast and South Coast Purse Seine Fisheries.

Annual Management Meetings (AMMs) between DPIRD, WAFIC, and licence holders in the SCPSMF and WSPSMF are an important forum to discuss the annual stock assessment and management of the resource. During these meetings, current and future management issues that may have arisen during the previous fishing season and any proposed changes to the management arrangements are discussed. Follow-up meetings may be held as required.

4.3.1.1 TACC review

The review of the TACC is a process that will take place annually which ensures ongoing engagement and consultation with commercial fishers on stock trends - prior to any management action being taken, to help identify operational, market and/or environmental factors affecting catch and effort. The steps are outlined in Figure 4.

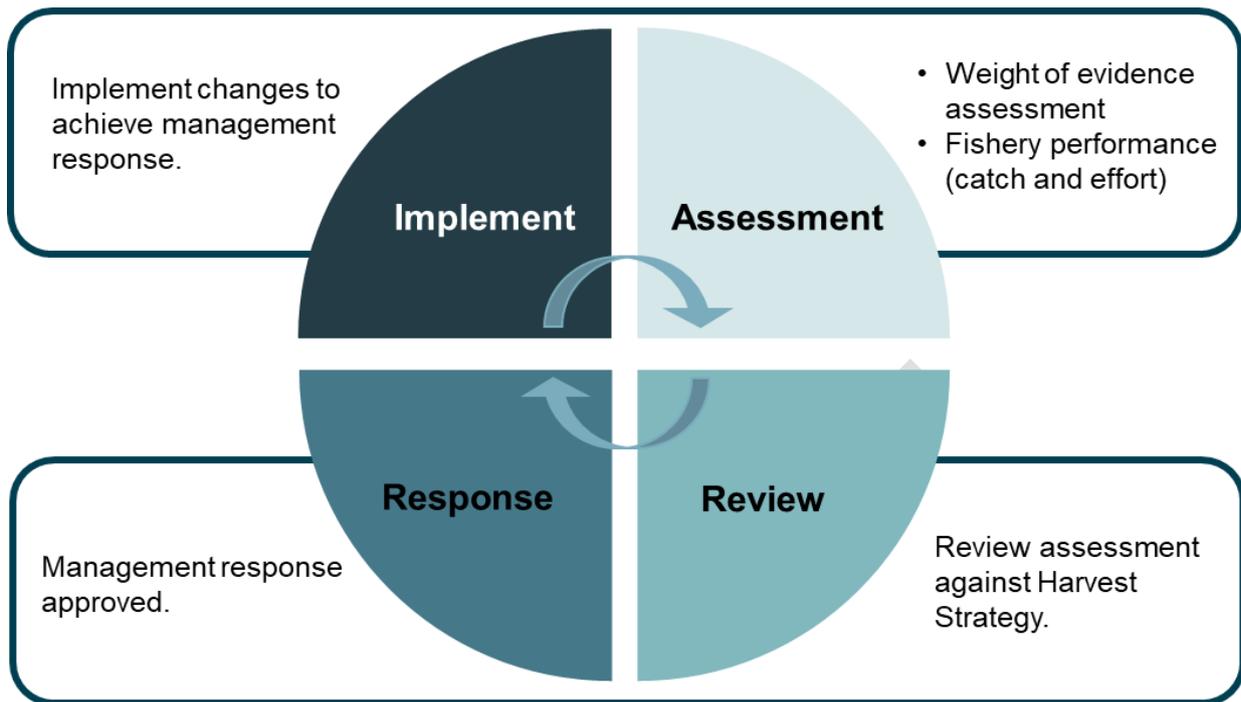


Figure 4: Annual review process for SCPSMF and WCPSMF.

4.3.2 Recreational sector

Under the funding agreement with Recfishwest, the Department is required to consult with Recfishwest, as the recognised peak body for recreational fishing in WA. Recfishwest is required to engage and consult with recreational fishers as necessary to meet its obligations. Charter operators are also represented by Recfishwest and Marine Tourism WA.

4.3.3 Consultation with other groups

Consultation on management of small pelagic species with customary fishers and non-fishing stakeholders, including Government agencies, conservation sector, non-government organisations, and other affected/interested parties is undertaken in accordance with the Departmental Stakeholder Engagement Guideline (Department of Fisheries 2016). DPIRD's approach to stakeholder engagement is based on a framework designed to assist with selecting the appropriate level of engagement for different stakeholder groups and includes collaborating with and involving key stakeholders, seeking input from interested parties through a public consultation process and keeping all parties fully informed through the provision of balanced, objective, and accurate information.

5.0 Compliance and enforcement

As the key regulatory agency, the Department's compliance role is to achieve sustainability, economic, and social objectives by addressing:

- our ability and capacity to influence compliance with the rules; and
- the effectiveness, capacity, and credibility of the compliance program.

The WA Fisheries Compliance Strategy (the Strategy; Department of Primary Industries and Regional Development 2018) was published in 2018. The purpose of the Strategy is to provide an understanding of the principles underlying the Department's compliance role and how its compliance services are delivered to the WA community. The Strategy aligns with, and complements, the Department's Compliance Framework and Risk Assessment Policy, which informs the risk-based model, compliance planning, and the governance structure applied to fisheries compliance services.

The Department's compliance model is based on the Australian Fisheries National Compliance Strategy 2022-2026 (the National Strategy). Department's compliance program is aligned to support the three key compliance strategies recommended by the National Strategy:

- maximising voluntary compliance
- effective deterrence
- organisational capability and capacity.

5.1 Operational compliance plans

Management arrangements for SSPSR are enforced under Operational Compliance Plans (OCPs) that are informed and underpinned by a compliance risk assessment, which is reviewed every two years. These OCPs have the following objectives:

- to provide clear and unambiguous direction and guidance to Fisheries and Marine Officers for the yearly delivery of compliance
- to protect the fisheries' environmental values, while providing fair and sustainable access to the fisheries commercial and social values
- to encourage voluntary compliance through education, awareness, and consultation activities.

5.2 Compliance strategies

Compliance strategies and activities that are used in the fisheries targeting the resource include:

- land and on-water patrols
- catch, licence, gear, and vessel inspections
- wholesale and retail inspection
- monitoring of fishing through fishing nominations
- covert surveillance of persons of interest under approved operations.

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Appendix 1 – Harvest strategy summary

Table A1-1 – Harvest strategy performance indicators, reference levels and control rules for the SSPSR and other ecological assets that may be impacted by fishing activities while targeting the resource.

Component	Operational objective	Resource/ asset	Performance indicators	Reference levels	Control rules
Indicator species	Maintain spawning stock at a level where the main factor affecting recruitment is the environment.	Statewide small pelagic scalefish resource	Total annual catch to 30 June for SCPSMF or 31 March for WCPSMF	Target: 75% of the TACC	<p>In the performance indicator is at the target, there will be no change to AHL (TACC). Continue to monitor catch and continue management aimed at achieving ecological, economic and social objectives.</p> <p>If the performance indicator is trending above 90% of the TACC for at least 2 consecutive years, with catch rates trending in a positive direction, an increase in TACC can be considered.</p> <p>TACC will not be increased until a comprehensive stock assessment is undertaken.</p>
				Threshold: Below 50% of the TACC for at least 2 consecutive years	<p>If the performance indicator is at or below the threshold, the fishery is reviewed. If issue is not stock related (e.g., low effort), this assessment is reported in the Harvest Strategy section of the Status Reports of the Fisheries and Aquatic Resources of Western Australia (State of the Fisheries) that corresponds to the year the threshold was breached.</p> <p>If stock related, a 10-50% TACC reduction will be implemented prior to the next fishing season.</p>
				Limit (20%): Below 20% of the TACC for at least 2 consecutive years. Or evidence of serious declines in productivity (e.g. sharp declines in catch per unit effort, abnormal	<p>If the indicators for the target species is at or below the limit, review fishery economics, catch and catch rates to determine if a reduction in TACC is warranted (if limit breach is linked to sustainability).</p> <p>If the review identifies that the breach is not stock related (e.g., economic or social reasons), consider management changes that could be implemented prior to the next season to increase catches to the target level.</p> <p>If stock related, a 50-100% TACC reduction will be implemented prior to the next fishing season.</p>

Component	Operational objective	Resource/ asset	Performance indicators	Reference levels	Control rules
				environmental indicators).	
Retained (non-indicator) species	To maintain catch levels of non-target species that are consistent with harvest strategies for these species (if applicable) and at acceptable risk levels based on ERA.	All other retained non-indicator species (e.g., blue mackerel, anchovy)	Assessed level of risk for each retained non-indicator SSPSR fishing activities from periodic risk assessments incorporating: <ul style="list-style-type: none"> • current management arrangements, • annual fishing effort and catch (including discards), • species information, and, • other available research. 	Target: Acceptable risk level (<i>i.e.</i> medium risk or lower).	Maintain current management settings.
				Threshold: High risk level	Review the reasons for this variation within six to twelve months and implement an appropriate management response to reduce risk to an acceptable level as soon as is practicable.
				Limit: Severe risk level	Initiate an immediate management response to reduce the risk to an acceptable level as soon as is practicable.
Bycatch (non-ETP) species	To conduct fishing activities in a manner that does not result in an unacceptable risk of serious or irreversible harm to bycatch species populations.	All (non-ETP) bycatch species	Periodic risk assessments for each bycatch species/group from purse seine fishing activities incorporating: <ul style="list-style-type: none"> • current management arrangements, 	Target: Purse seine fishing impacts are expected to generate an acceptable risk level to all non-ETP bycatch species' populations (<i>i.e.</i> medium risk or lower).	Continue management aimed at achieving ecological, economic, and social objectives.

Component	Operational objective	Resource/ asset	Performance indicators	Reference levels	Control rules
			<ul style="list-style-type: none"> annual fishing effort and catch (including discards), review of alternative measures to minimise unwanted catch, species information, and, other available research. 	Threshold: High risk level	Review the reasons for this variation and develop a management response within six to twelve months. Implement an appropriate management response to reduce risk to an acceptable level as soon as is practicable.
				Limit: Severe risk.	Initiate an immediate management response to reduce the risk to an acceptable level as soon as is practicable.
ETP species	To conduct fishing activities in a manner that does not result in an unacceptable risk of serious or irreversible harm to ETP species populations.	All ETP species	Assessed level of risk for each ETP species/group from fishery activities from periodic risk assessments incorporating: <ul style="list-style-type: none"> current management arrangements, annual fishing effort and catch (including discards), species information and number of reported ETP species interactions, and, 	Target: Acceptable risk level (<i>i.e.</i> medium risk or lower).	Continue management aimed at achieving ecological, economic, and social objectives.
				Threshold: High risk level.	Review the reasons for this variation and develop a management response within six to twelve months. Implement an appropriate management response to reduce risk as soon as is practicable.
				Limit: Severe risk level.	Initiate an immediate management response to reduce the risk as soon as is practicable.

Component	Operational objective	Resource/ asset	Performance indicators	Reference levels	Control rules
			<ul style="list-style-type: none"> other available research. 		
Habitats	To conduct fishing activities in a manner that does not result in an unacceptable risk of serious or irreversible harm to habitat structure and function.	Benthic habitats	<p>Assessed level of risk for benthic habitats from purse seine fishery activities from periodic risk assessments incorporating:</p> <ul style="list-style-type: none"> current management arrangements, annual fishing effort, extent of fishing area annually, and, other available research. 	<p>Target: Acceptable risk level (<i>i.e.</i> medium risk or lower).</p>	Continue management aimed at achieving ecological, economic, and social objectives.
				<p>Threshold: High risk level.</p>	Review the reasons for this variation and develop a management response within six to twelve months. Implement an appropriate management response to reduce risk to an acceptable level as soon as is practicable.
				<p>Limit: Severe risk level.</p>	Initiate an immediate management response to reduce the risk to an acceptable level as soon as is practicable.
Ecosystem	That the overall effects of purse seine fishing do not result in an unacceptable risk of serious irreversible harm to ecological processes.	West Coast Bioregion and South Coast Bioregion	<p>Assessed level of risk for ecosystem processes from lobster fishery activities from periodic risk assessments incorporating:</p> <ul style="list-style-type: none"> current management arrangements, catch levels, number of reported ETP 	<p>Target: Acceptable risk level (<i>i.e.</i> medium risk or lower).</p>	Continue management aimed at achieving ecological, economic, and social objectives.
				<p>Threshold: High risk level.</p>	Review the reasons for this variation and develop a management response within six to twelve months. Implement an appropriate management response to reduce risk to an acceptable level as soon as is practicable.
				<p>Limit: Severe risk level.</p>	Initiate an immediate management response to reduce the risk to an acceptable level as soon as is practicable.

Component	Operational objective	Resource/ asset	Performance indicators	Reference levels	Control rules
			species interactions, <ul style="list-style-type: none"> • extent of fishing activities, • ecosystem information, and • other available research. 		

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Appendix 2 – Risk-based weight of evidence assessment of scaly mackerel (*Sardinella lemuru*), West Coast bioregion, WA

Assessment date: March 2021

Type of assessment: Annual review and update

Executive summary

Western Australia's scaly mackerel population from at least Carnarvon in the north to Fremantle constitute a single stock for management and assessment purposes, based on evidence from otolith chemistry. Virtually all catches are taken by commercial purse seiners operating in limited areas off Geraldton and Fremantle. The species has a high biological resilience and low vulnerability to fishing pressure, consistent with a low estimate of fishing mortality during the mid-1990s, a period of historically significant catch. Catch and effort has been much lower over the last decade, suggesting the current level of spawning stock depletion from fishing is likely to be minor. **The current risk level is therefore estimated to be Low**, with current management measures maintaining the stock at an acceptable level.

Future monitoring and assessment

Annual monitoring of catch information is ongoing.

A review/update of this assessment will be undertaken annually.

Risk-based weight of evidence table

Category	Line of evidence
Catch	Annual catches peaked at around 1,200 and 2,700 tonnes from 1999 to 2006 before declining and ranging between 300 and 1,200 tonnes in the last decade. The recent low catches are associated with lower economic returns.
Level 1. Catch	Historically low catches over the last decade are consistent with the maintenance of adequate spawning biomass.
Effort	Although fishing effort has gradually transitioned from targeting Australian sardines to scaly mackerel, it has been at historically low levels since about 2006 due in part at least to lower economic returns.
Catch rate	Due to mixed species targeting, patchy distribution of scaly mackerel and the concentration of catch among very few vessels, nominal catch rate is an unreliable index of abundance.

Level 2. Catch and fishery-dependent catch rate

Historically low fishing effort since 2006 indicates the maintenance of adequate spawning biomass.

Biology and vulnerability Biological traits such as low trophic level, short life span, a high rate of natural mortality, and sexual maturity at a young age are biological characters that make scaly mackerel resilient to fishing pressure. Vulnerability to fishing is low because although the biological stock is widespread fishing operations occur within limited areas, requiring fish to enter those areas to become vulnerable.

Age composition Tentative age estimates from catch at age sampling between 1995 and 1997 indicated a low *F/M* estimate of 0.25, well within the target reference level of 0.67 and suggesting that catch levels around that time (*i.e.*, 500-2,000 tonnes per annum) were sustainable.

Level 3: Biology and vulnerability

Evidence of high resilience and low vulnerability to fishing mortality was supported by the low estimate of fishing mortality during a period of significant catch, suggesting minimal fisheries impact on the spawning stock.

Final risk

The current risk level is estimated to be LOW.

Age based estimates of low fishing mortality during a period of significant catch were supported by evidence of high biological resilience and low vulnerability to fishing pressure. A much lower level of catch and effort in the last decade suggests current spawning stock depletion from fishing is likely to be minor.

Level 1 assessment: catch

Virtually all catches of scaly mackerel are taken by the West Coast Purse Seine Fishery (WCPSMF) and licensees in the associated purse seine Northern Development Zone, operating adjacent to Fremantle and Geraldton, respectively. The period of highest annual catches was from 1999 to 2006 when they fluctuated between 1,200 and 2,700 tonnes (Figure 1). They then declined to fluctuate between 300 and 1,200 tonnes in the last decade. The decline appears to be associated with lower economic returns as industry competed with very large increases in the catch of Australian sardines in South Australia over the same period (Ward *et al.* 2020). Catches by the recreational sector are negligible.

Level 2 assessment: effort and catch rate

Annual fishing effort (boat days) was above 890 for every year between 1978 and 1999, peaking at 2,858 in 1987. Since then it has declined and remained below 500 since 2006, associated with lower economic returns as industry competed with very large increases in the catch of Australian sardines in South Australian over the same period (Ward *et al.* 2020). Effort of just 116 days in 2009 was the lowest on record. Near Fremantle effort had gradually transitioned from targeting Australian sardines to scaly mackerel, particularly after the former suffered a mass mortality event in 1998/99. For this reason, as well as the generally patchy distribution of scaly mackerel (Gaughan and Mitchell 2000) and the concentration of most of the catch in just a small number of vessels in recent years, catch rates are not a reliable index of abundance.

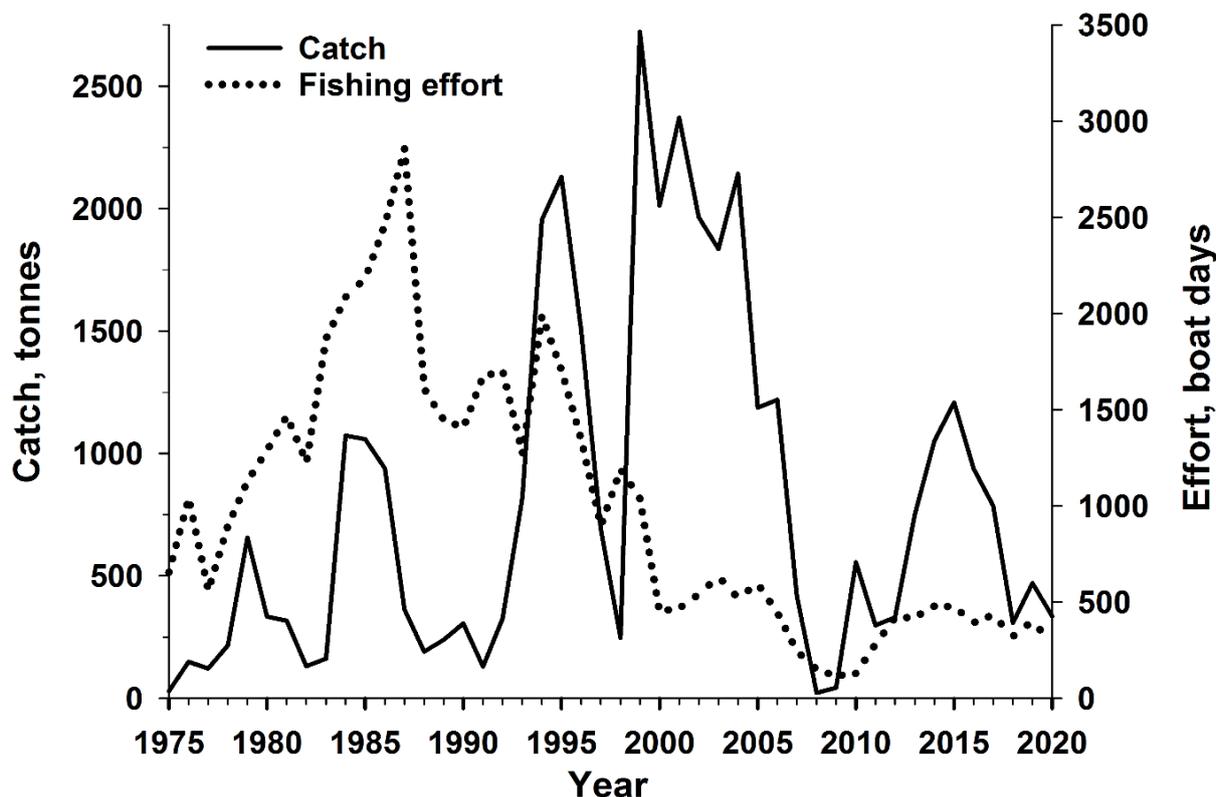


Figure 1. Annual commercial purse seine catch of scaly mackerel and fishing effort by the WCPSF and licensees in purse seine Development Zones.

Level 3 assessment: Biology, vulnerability, and age composition

Biology: Scaly mackerel are a predominantly tropical species with a natural distribution encompassing the western Pacific and eastern Indian Oceans as well as from northwestern WA to as far south as Geographe Bay (Whitehead 1985). Otolith chemistry evidence indicates a single continuous biological stock from at least Carnarvon in the north to Fremantle where the species is patchily distributed (Gaughan and Mitchell 2000). They feed by filtering plankton, making them low trophic level consumers, are short lived (up to 7 years) with an estimated high rate of natural mortality (see below), and attain sexually maturity at the age of only 2 years (Gaughan and Mitchell 2000). Thus, their biology makes them comparatively resistant to fishing pressure.

Vulnerability: Although the stock fished in WA ranges from at least Carnarvon to Fremantle based on otolith chemistry evidence (Gaughan and Mitchell 2000), almost all of the catch is taken near Geraldton and Fremantle. Thus, only when fish enter those areas do they become vulnerable to fishers.

Age composition: Tentative and unvalidated age estimates using otoliths from fish taken commercially between 1995 and 1997 showed scaly mackerel have a high estimated rate of natural mortality $M= 0.93$ (Gaughan and Mitchell 2000). The sample comprised of fish aged between 1 and 7 years, resulting in an estimated fishing mortality of $F=0.23$ and giving a low estimate of $F/M= 0.25$. This was well within the target reference level of 0.67, and suggested that catch levels around that time (*i.e.*, 500-2,000 tonnes per annum) were sustainable.

Final risk assessment

Consequence (Stock Depletion) Level	Likelihood				Risk
	L1 Remote (<5%)	L2 Unlikely (5-20%)	L3 Possible (20-50%)	L4 Likely (>50%)	
C1 Minor (above Target)				Low	4
C2 Moderate (below Target, above Threshold)		Low			4
C3 High (below Threshold, above limit)	Low				3
C4 Major (below Limit)					-

Consequence 1 – Minor depletion

Scaly mackerel is short lived with a high biological resilience to fishing pressure which has been historically low since 2006. When catches were higher in earlier years, tentative catch at age data suggested very low levels of fishing mortality. The scaly mackerel biological stock is a wide-ranging stock but is vulnerable to the fishery over a limited area. These lines of evidence suggest that **Minor** depletion is currently **Likely**.

Consequence 2 – Moderate depletion

Although the age composition analysis is dated, the lower catches in recent years for a species comparatively resilient to fishing, from a limit area of a widespread stock, suggest the prospect of a **Moderate** stock depletion is **Unlikely**.

Consequence 3 – High depletion

Catch history, biology and inherent vulnerability, together with a tentative age-based analysis during a time of higher catches, suggest that the likelihood of a **High** depletion of the stock is **Remote**.

Consequence 4 – Major depletion

Not plausible

Overall risk

The risk level for the WCB scaly mackerel stock for the next five years is estimated to be **Low**. The stock is likely maintained above target level, an acceptable level of risk under current management arrangements and ongoing level of stock status monitoring.

Appendix 3 – Risk-based weight of evidence assessment of Australian sardine (*Sardinops sagax*), West Coast bioregion, WA

Assessment date: March 2021

Type of assessment: Annual review and update

Executive summary

Western Australia's West Coast Bioregion (WCB) population of Australian sardines constitute a distinct stock for management and assessment purposes. Virtually all catches are taken by commercial purse seiners operating in limited areas between Perth and Geographe Bay. Due to continually very low exploitation rates relative to the last spawning biomass estimate in the mid-2000s, coupled with the species' inherent resilience and low vulnerability to fishing pressure, **the current risk level is estimated to be Low**, with current management measures maintaining the stock at an acceptable level.

Future monitoring and assessment

Annual monitoring of catch information is ongoing.

A review/update of this assessment will be undertaken annually.

Risk-based weight of evidence table

Category	Line of evidence
Catch	Annual catches since a strong recovery of spawning stocks in the mid-2000s have been historically very low and well below the notional quota, attributable in part to lower economic returns, suggest adequate spawning biomass has been maintained.
Level 1. Catch	
Very low exploitation rates since a strong recovery of spawning stock since the mid-2000s suggest a minimal impact on spawning biomass.	
Effort	Low effort in recent years is associated with limited economic returns, with much of it transitioned to targeting tropical sardines.
Catch rate	Due to mixed species targeting and the concentration of catch in a small number of vessels, nominal catch rate is unreliable as an index of abundance.
Level 2. Catch + Fishery-Dependent Catch Rate.	
Historically low recent catch and effort are consistent with the persistence of adequate spawning stock, providing no evidence of unacceptable stock depletion.	
Biology and vulnerability	Low trophic level, short lived, a high rate of natural mortality and sexual maturity at a young age are biological characters that make Australian sardines resilient to fishing pressure. Vulnerability to fishing is low because although Australian sardines are naturally distributed throughout the continental shelf, fishing operations occur within limited areas (adjacent to Perth and in Geographe Bay), requiring fish to enter those areas to become vulnerable.

Level 3: biology and vulnerability

High resilience and low vulnerability to fishing mortality is consistent with only minor stock depletion.

Spawning biomass

Daily egg production surveys demonstrated a strong recovery of spawning biomass in the mid-2000s following a mass mortality event in 1998/99. Since then annual catches have never exceeded 5% of those mid-2000s spawning biomass estimates.

Level 4. spawning biomass.

Although the most recent spawning biomass estimates are dated from the mid-2000s, the low rate of exploitation relative to those estimates since then indicates a remote likelihood that spawning biomass is likely to have remained above target, with a remote likelihood of falling below threshold levels.

Final risk

The current risk level is estimated to be LOW.

Continued low exploitation rates (catch) relative to the last spawning biomass estimate in the mid-2000s, coupled with the species' inherent resilience to fishing pressure.

Level 1 assessment: catch

Virtually all WCB catches of Australian sardine are taken between Perth and Geographe Bay by the West Coast Purse Seine Fishery and licensees in the associated Southern Development Zone. Annual catches peaked at around 2,000 to 4,300 t in the mid-1990s before declining precipitously due to a mass mortality event in 1998/99 caused by a herpesvirus (Figure 1). By the mid-2000s egg surveys demonstrated a strong recovery of the spawning biomass to about 25,000 tonnes (20,000 – 30,000) (Gaughan *et al.* 2008). Since then catches have remained relatively low, never above 331 t. This appears to be associated with lower economic returns as industry competed with very large increases in the South Australian catch over the same period (Ward *et al.* 2020). These recent catches were well below the conservatively set notional quota of 2,328 t.

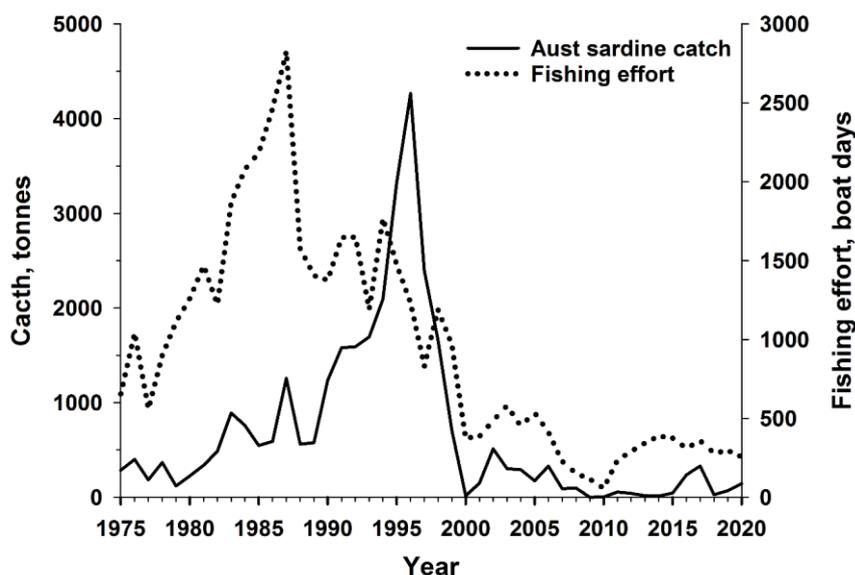


Figure 1. Annual commercial purse seine catch of Australian sardine in the WCB, and fishing effort by purse seiners in management zones where the species is taken, i.e. the Perth Metropolitan and Southern Development Zones.

Level 2 assessment: effort and catch rate

Annual fishing effort peaked at about 2,100 - 2,900 boat days between 1984 and 1987 then gradually declined through the 1990s when catches were highest (Figure 1). During this time the effort gradually transitioned to targeting scaly mackerel. The devastation of the stock by a mass mortality event in 1998/99 further redirected effort to scaly mackerel. A strong recovery of the stock by the mid-2000s (Gaughan *et al.* 2008) did not result in increased effort, partly attributed to reduced economic returns as industry competed with very large increases in the South Australian catch starting about this time (Ward *et al.* 2020). Effort fell to an all time low of just 56 vessel days in 2010. Since 2000 the fishery has been marked by historically low Australian sardine catches and overall effort. Catch rates are not a useful index of abundance due to the effort gradually transitioning to the targeting of scaly mackerel and the concentration of most of the catch in just a small number of vessels in recent years.

Level 3 assessment: Biology, vulnerability and age composition

Biology: Australian sardines are naturally distributed along the continental shelf of the southern half of the Australian mainland (Gomon *et al.* 2008). Otolith chemistry and life history characteristics show that, for management and assessment purposes, WA stocks are effectively isolated from South Australian stocks and within WA there is separation of stocks between the West and South Coast Bioregions (Edmonds and Fletcher 1997, Gaughan *et al.* 2001, Izzo *et al.* 2017). Australian sardines feed by filtering plankton, making them low trophic level consumers. In WA they are short lived, up to 9 years (Fletcher and Blight 1996), with a high rate of natural mortality ($M=0.66$ for SCB stock, Hall (2000)), attaining sexual maturity in their second year (Fletcher 1995). Thus their biology makes them comparatively resistant to fishing pressure.

Vulnerability: Although Australian sardines occur naturally in continental shelf waters, almost all of the WCB catch is taken near Perth and Geographe Bay. Therefore, only when fish enter those areas, do they become vulnerable to fishers.

Level 4 assessment: Spawning biomass

Fishery independent egg surveys showed a major collapse in spawning biomass in 1999 immediately following a mass mortality event caused by a herpes virus (Gaughan *et al.* 2004). Ongoing surveys demonstrated a strong recovery to about 20,000 – 30,000 tonnes by the mid-2000s (Gaughan *et al.* 2008). No further surveys have been conducted but annual catches on both the south and west coasts have never exceeded 5% of that mid-2000s spawning biomass estimate, suggesting only a minor level of stock depletion.

Final risk assessment

Consequence (Stock Depletion) Level	Likelihood				Risk
	L1 Remote (<5%)	L2 Unlikely (5-20%)	L3 Possible (20-50%)	L4 Likely (>50%)	
C1 Minor (above Target)				Low	4
C2 Moderate (below Target, above Threshold)		Low			4
C3 High (below Threshold, above limit)	Low				3
C4 Major (below Limit)					-

Consequence 1 – Minor depletion

Continued low exploitation rates (catch) relative to the last spawning biomass estimate in the mid-2000s, coupled with the species' inherent resilience to fishing pressure which occurs in limited areas of the stock distribution, suggest that **Minor** depletion is **Likely**.

Consequence 2 – Moderate depletion

Although spawning biomass estimates from egg surveys are dated, the lower catches in recent years for a species comparatively resilient to fishing, from a limited area of the stock, suggest the prospect of a **Moderate** stock depletion is **Unlikely**.

Consequence 3 – High depletion

A low exploitation rate since the mid-2000s when a strong recovery has been demonstrated by fishery independent (egg) surveys, together with the species' fishery resilient biology and low inherent spatial vulnerability, suggest that the likelihood of a **High** depletion of the stock is **Remote**.

Consequence 4 – Major depletion

Not plausible

Overall risk

The risk level for the WCB Australian sardine stock for the next five years is estimated to be **Low**. The stock is likely maintained above target level, an acceptable level of risk under current management arrangements and ongoing level of stock status monitoring.