

Assessment Authors and Year

Stewart, J. 2021. NSW Stock Status Summary 2021/22 – Australian Sardine (*Sardinops sagax*). NSW Department of Primary Industries, Fisheries. 7 pp.

Stock Status

Current stock status	On the basis of the evidence contained within this assessment, Australian Sardine is currently assessed as sustainable .
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Stock structure & distribution

The population structure in Australian waters is complex, with evidence of broad separation between sardines in Western Australia, South Australia and eastern Australia. These areas comprise smaller size dependent shoals that effectively create a single semi-continuous Australian meta-population. Australian Sardine off southern Australia is a meta-population (Whittington et al. 2008), with effective isolation of four separate biological stocks: the South-western (off Western Australia); Southern (off South Australia); South-Eastern (off Victoria, Tasmania and southern NSW) and Eastern (off northern New South Wales and southern Queensland) Australian stocks (Izzo et al. 2017, Sexton et al. 2019).

While east coast Australian Sardine is currently assessed through the Status of Australian Fish Stocks (SAFS) framework at the biological stock level— Eastern Australia and South Eastern Australia, the Commonwealth assesses and manages Australian Sardine as a single east coast stock. The NSW Ocean Hauling (Purse Seine) quota fishery for Australian Sardine (*Sardinops sagax*) is similarly managed as a single stock.

This stock status summary details stock assessment results (Stewart, 2021) and relevant fisheries statistics to inform the setting of a Total Allowable Catch (TAC) for the NSW purse seine Australian sardine quota fishery for the 2022/23 fishing season. Assessment of stock status for Australian sardine is principally from the Commonwealth Small Pelagic Fishery (SPF) derived assessment that utilizes estimates of spawning biomass from periodic egg surveys using the Daily Egg Production Method (DEPM).

Biology

Australian Sardine (*Sardinops sagax*) is distributed around the entire southern half of the continent where it inhabits continental shelf waters and the lower reaches of estuaries. The main spawning ground is located at the Queensland/New South Wales border during late winter and early spring, with a smaller summer spawning ground off eastern Tasmania and Victoria, extending into southern NSW (Sexton et al., 2019). Peak spawning of east coast sardines is reported to occur in water temperatures between 18-22°C. Australian Sardine in NSW matures at around 14 cm fork length (FL). Sardines grow rapidly, reaching a maximum length of 23 cm FL and maximum age of 8 years.

FISHERY STATISTICS

Catch information

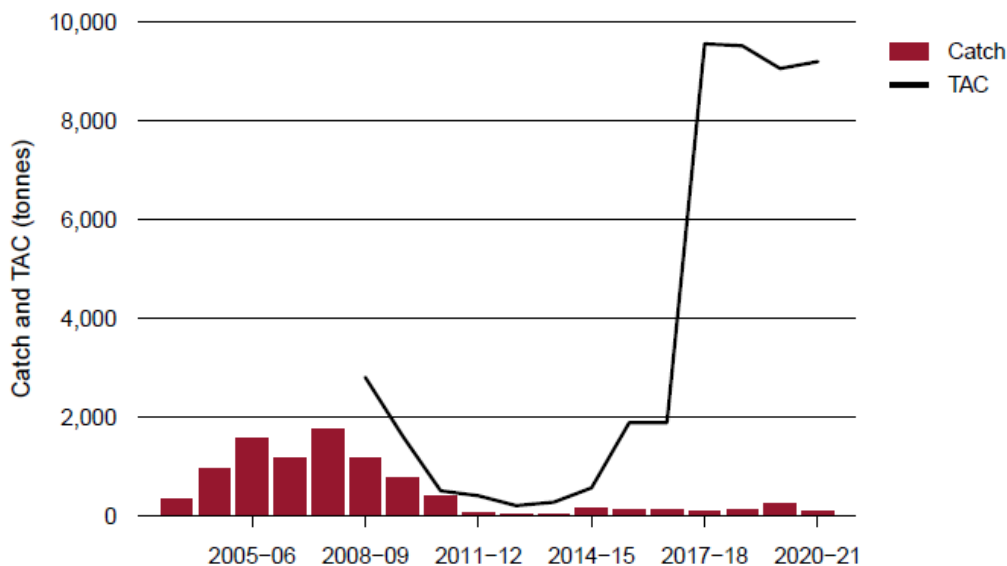
Commercial

The sardine subarea off eastern Australia is the only area of the SPF that is fished, Australian sardine in the SPF is therefore assessed and managed as a single east coast stock. As such the data presented do not separate the Eastern and South Eastern Australia stocks.

State catches of Australian Sardine comprise most of the total catch. State catches increased substantially from 2001/02 to 2009/10. Commonwealth catches peaked through 2005/06 to 2008/09 when a state-based dual endorsed vessel operated, but declined substantially (along with state catches) when the vessel departed during 2010. The total combined catch (state and Commonwealth, excluding Victorian catches because they were confidential) for 2019/20 was 727 t, comprising 232 t of Commonwealth catch and 495 t of state catch. Commonwealth catch for 2020/21 was only 86 t (Figure 1); noting that state catches were not available when the report was compiled (Patterson et al., 2021). Currently Commonwealth catches approximately 1% of the TAC set for 2021/22 of 7,980 t.

The NSW Ocean Hauling Purse Seine catch has averaged around 504 t p.a. since 2009, substantially less than the TAC (Fig. 2).

Figure 1. Commonwealth Australian Sardine catch and TAC in the SPF, 2003/04 to 2020/21 (from Patterson et al. 2021).



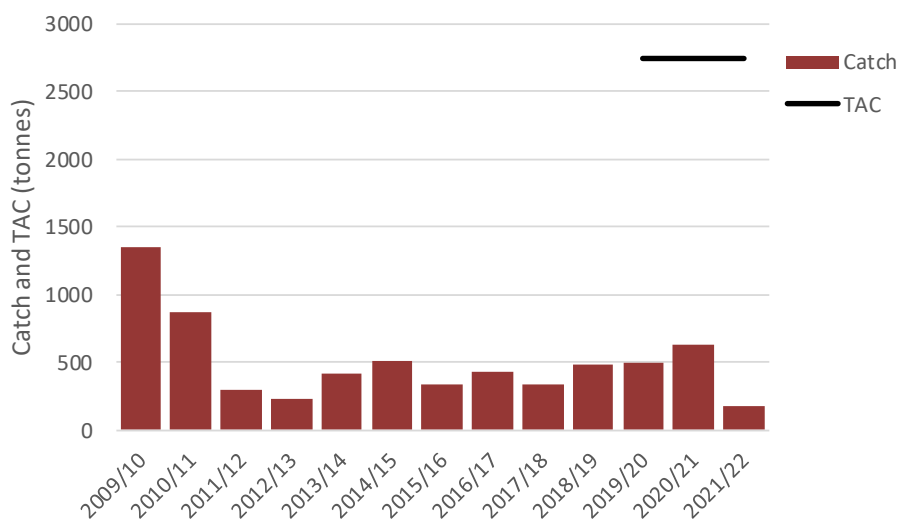
Note: TAC Total allowable catch.

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Figure 2. New South Wales Ocean Hauling Purse Seine landings of Australian Sardine and TAC 2009/10 to 2021/22. Note that the 2020/21 fishing season was only 6 months completed when these data were collated.



Recreational & Charter boat

The recreational catch of Australian Sardine is considered to be minor and is not considered in the assessment.

Indigenous

There is no information available on the Aboriginal catch of Australian Sardine in NSW waters.

Illegal, Unregulated and Unreported

The level of Illegal Unregulated and Unreported (IUU) fishing is unknown.

Fishing effort information

Fishing effort is not a consideration for the stock assessment.

Catch Rate information

Catch rate is not a consideration for the stock assessment.

STOCK ASSESSMENT

Australian Sardine is assessed in terms of biomass through Daily Egg Production Method (DEPM) surveys. Sustainable levels of fishing are assessed through catch as a percentage of biomass. Management Strategy Evaluation (MSE) of the Commonwealth SPF Harvest Strategy (Smith et al., 2015) established that an exploitation rate of up to 33% was suitable for Eastern Australian

Sardine under the Commonwealth SPF harvest strategy. The current harvest strategy exploitation rate following a Tier 1 assessment is only 20%, ensuring a very low probability of the stock falling below 20% of unfished levels.

Stock Assessment Methodology

Year of most recent assessment:

2021

2019 - Daily Egg Production Method (DEPM) biomass estimate Eastern Australian Stock

2014 - Daily Egg Production Method (DEPM) biomass estimate South Eastern Australian Stock

2015 - Management Strategy Evaluation (MSE) of the Commonwealth SPF Harvest Strategy

Assessment method:

Daily Egg Production Method (DEPM) spawning biomass estimate (Ward et al., 2021; Ward et al., 2015).

Main data inputs:

Egg survey during September 2019 between Sandy Cape, Queensland and Ulladulla, NSW. The survey produced estimates of Sardine egg abundance, egg age and spawning area.

Egg survey during January 2014 around northern Tasmania and southern Victoria. The survey produced estimates of Sardine egg abundance, egg age and spawning area.

Adult reproductive parameters: average weight, sex ratio, batch fecundity, spawning fraction.

Catch data.

MSE: Growth, maturity, weight and selectivity by age. Natural mortality and stock-recruitment relationship.

Key model structure & assumptions:

N/A for DEPM.

MSE operating model is age-structured, and recruitment is driven by spawning stock biomass and uses values for biological parameters (natural mortality, growth, maturity, stock-recruitment and selectivity).

Sources of uncertainty evaluated:

Considerable uncertainty exists around key input data for the Australian Sardine DEPM assessment. Sensitivity analyses were done for all parameters to determine which had the largest influence on estimated spawning biomass. These were done by varying each individual parameter whilst keeping the others constant at the value used to calculate spawning biomass.

Conclusions were drawn based on the most precautionary parameter estimates, resulting in the spawning biomass likely to be under-estimated.

MSE testing of various potential SPF harvest strategy control rules to examine the probability of the biomass falling below the limit reference point of 20% of unfished levels with a less than 10% chance.

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(*Sardinops sagax*)

Status Indicators - Limit & Target Reference Levels

Biomass indicator or proxy	DEPM derived estimate of spawning biomass.
Biomass Limit Reference Point	20% of unfished levels with a less than 10% chance.
Biomass Target Reference Point	50% of unfished levels
Fishing mortality indicator or proxy	Catch as a proportion of spawning biomass.
Fishing mortality Limit Reference Point	<p>Annual catch is less than 20% of the DEPM derived estimate of spawning biomass. This is the Tier 1 exploitation rate in the Commonwealth SPF Harvest Strategy for setting a Recommended Biological Catch (RBC) for each of five fishing seasons following a DEPM assessment.</p> <p>Five years after a Tier 1 assessment, the RBC is set at the Tier 2 level that is 10% of the DEPM derived estimate of spawning biomass.</p> <p>Five years after a Tier 2 assessment, if no updated DEPM is done, the RBC is set at the Tier 3 level that is 5% of the DEPM derived estimate of spawning biomass.</p>
Fishing Mortality Target Reference Point	N/A

Stock Assessment Results

Recent harvests of east coast Australian Sardine have been well below the reference level of 20% of the 2019 derived DEPM estimate of spawning biomass (~ 42,724 t) (Ward et al., 2021) with the RBC calculated as 20% x 42,724 t ~8,454 t. Total landings (Commonwealth and state combined – noting Victorian catches have not been made available) in recent years have been < 2% of the estimated spawning biomass in 2019.

Stock Assessment Result Summary

Biomass status in relation to Limit	Smith et al. (2015) reported an exploitation rate of up to 33% was suitable for Eastern Australian Sardine under the Commonwealth SPF harvest strategy. The current harvest strategy exploitation rate following a Tier 1 assessment is only 20%, ensuring a very low probability of the stock falling below 20% of unfished levels. Catches have always been low relative to the estimated spawning biomass and as a result, fishing is not believed to have substantially reduced spawning biomass.
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Biomass status in relation to Target	As above
Fishing mortality in relation to Limit	Recent harvests of east coast Australian Sardine have been well below the reference level of 20% of the 2019 derived DEPM estimate of spawning biomass (~ 42,724 t) (Ward et al., 2021). Total landings (Commonwealth and state combined – noting Victorian catches have not been made available) in recent years have been < 2% of the estimated spawning biomass in 2019.
Fishing mortality in relation to Target	As above
Current SAFS stock status	Sustainable in 2020
Current Commonwealth stock status	Not overfished and not subject to overfishing

Fishery interactions

Commonwealth Small Pelagic Fishery – purse- seine and midwater trawl, interacts with the NSW commercial fishery. The SPF has TACs based on RBCs derived from the SPF harvest strategy rules and then subtracting state catches. Several NSW endorsed fishers also hold Commonwealth SPF endorsements.

NSW Estuary General Fishery – only minor landings of Australian Sardines.

Recreational fishers - only minor landings of Australian Sardines; however a very large user of sardines as bait.

Qualifying Comments

Whilst the MSE testing suggests that fishing has never been large enough to substantially reduce the spawning biomass of Eastern Australian Sardine, and that the SPF harvest strategy is precautionary and appropriate for maintaining stocks, on average, within the defined reference levels, there exists uncertainty around the risks of harvesting Australian Sardines. Firstly, many exploitation scenarios examined during MSE testing suggested quite high depletion levels, well below the target level of 50%. Secondly, small pelagic species are characterized globally by huge fluctuations in abundance as a result of environmental factors beyond the control of fishery managers. As an example, Australian Sardines suffered two mass mortality events during 1995 and 1998, during which time the biomass was substantially reduced. The MSE model results may, therefore, under-estimate the risks associated with low stock sizes.

The DEPM-based estimates of Eastern Australian Sardine spawning biomass are highly likely to be under-estimates, due to any potential biases in terms of key parameters (such as spawning area and the assumption that surveys are done at the peak spawning time) always leading to under-estimating spawning biomass.

Given the existence of two biological stocks within the NSW management area, there is potential for excessive local depletions to occur if a significant proportion of the allocated quota (state and Commonwealth) was to be fished on one of these. The Commonwealth also do not consider the effect of fishing on separate stocks in their TAC determinations. Under the current management

arrangements and fishery operations within southern NSW, Victoria, Tasmania and the Commonwealth there is the potential for the combined harvest to approach biologically acceptable limits on the South Eastern biological stock, noting too that the albeit conservative estimate of spawning biomass of ~11,000 t in this region was derived in January 2014.

References

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