Australian Sardine (2020)

Sardinops sagax

Tim Ward: South Australian Research and Development Institute, **Jeff Norriss**: Department of Primary Industries and Regional Development, Western Australia, **John Stewart**: Department of Primary Industries, New South Wales, **Rocio Noriega**: Australian Bureau of Agricultural and Resource Economics and Sciences, **VFA**: Victorian Fisheries Authority

STOCK STATUS OVERVIEW

Jurisdiction	Stock	Stock status	Indicators
Commonwealth, New South Wales	Eastern Australia	Sustainable	Spawning biomass, exploitation rate, catch
Commonwealth, New South Wales, Victoria	South Eastern Australia	Sustainable	Spawning biomass, exploitation rate, catch
Western Australia	South Western Australia	Sustainable	Spawning biomass, exploitation rate, catch
South Australia	Southern Australia	Sustainable	Spawning biomass, exploitation rate, catch

STOCK STRUCTURE

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]. Recent evidence has confirmed the separation of the South Eastern Australia stock from the Eastern Australia stock [Sexton et al. 2018]. There is some evidence that the South-western and Eastern biological stocks each include two separate sub-components [Gaughan et al. 2002, Izzo et al. 2017]. The two sub-components off Western Australia were previously reported as two separate biological stocks, but these have now been merged into a single South Western Australia stock, which is managed as two management units.

Stock status for Australian Sardine is presented at the biological stock level—South Western Australia, Eastern Australia, South Eastern Australia and Southern Australia.

STOCK STATUS

Eastern Australia

The most recent assessment of the Eastern Australia stock of Australian Sardine was completed in 2020 using fishery data for 2019-20 [Grammer and Ward

2018, 2021] and a Daily Egg Production Method (DEPM) survey undertaken in 2019 [Ward et al. 2021]. The primary biological performance indicators are spawning biomass and exploitation rate.

A survey conducted in 2014 that extended from Sandy Cape to Bateman's Bay during the peak spawning season (August–September) estimated that the spawning biomass of the eastern stock was approximately 49 600 t (95 per cent confidence interval 24 000–213 000 t) [Ward et al. 2015a]. A survey conducted in the same region in 2019 suggested that spawning biomass was 42 724 (95 per cent confidence interval 15 487–69 962 t).

The total annual catch from the eastern stock was 515 t in 2019, up from 292 t in 2018 (Ward and Grammer 2021). Recent catches from the eastern stock of Australian Sardine have been <2 per cent of the 2019 estimate of spawning biomass, which is well below the 30 per cent level considered safe for this species by Smith et al. [2015].

The above evidence indicates that the biomass of this stock is unlikely to be depleted and that recruitment is unlikely to be impaired. Furthermore, the above evidence indicates that the current level of fishing mortality is unlikely to cause the stock to become recruitment impaired.

On the basis of the evidence provided above, the Eastern Australia biological stock of Australian Sardine is classified as a **sustainable stock**.

South Eastern Australia

The South-eastern Australia stock of Australian Sardine was first assessed in 2018. Spawning biomass and exploitation rate are the primary biological performance indicators in the current assessment because some information on these measures is available from DEPM surveys undertaken primarily to assess Common Jack Mackerel.

A DEPM survey conducted during 2014 from eastern Tasmania, through eastern Bass Strait and eastern Victoria to southern NSW suggested that the spawning biomass in the eastern portion of the South Eastern Australia stock was approximately 11 000 t [Ward et al. 2015b]. A DEPM survey conducted during 2016–17 between western Kangaroo Island and south-western Tasmania suggested that the spawning biomass in the western portion of the South Eastern Australia stock was at least 30 000 t (Ward et al. 2020c). Neither of these surveys covered the entire spawning area, including parts of Bass Strait and both are likely to have under-estimated the total spawning biomass of the South Eastern Australia stock of Australian Sardine.

Catches of Australian Sardine from southern New South Wales have averaged approximately 120 t per annum since 2011–12, after a fire destroyed the processing factory in Eden during late 2010. Catches from eastern Victoria have increased but also fluctuated over the past decade with statewide landings peaking at 2628 t in 2010–11 and 2344 t in 2016–17. Commercial net fishing in Port Phillip Bay, where sardine have been taken historically, will cease by 2022. A developmental fishery was established in Tasmania in 2015 but catches to date have been limited.

Recent catches equate to exploitation rates of less than 20 per cent of the estimate of spawning biomass for the eastern component of this stock of 11,000 t, which is below the level considered safe for this species (i.e. 30 per cent) by Smith et al. [2015].

The above evidence indicates that the biomass of this stock is unlikely to be depleted and that recruitment is unlikely to be impaired. Furthermore, the above evidence indicates that the current level of fishing mortality is unlikely to cause the stock to become recruitment impaired.

On the basis of the evidence provided above, the South Eastern Australia

biological stock is classified as a **sustainable stock**.

South Western Australia

The South Western Australia stock of Australian Sardine off Western Australia is comprised of two separate management units with some biological separation: West Coast and South Coast. Here, stock status assessments are presented for both units.

For the WA's West Coast, population modelling based on spawning biomass estimates obtained using the DEPM, catch-at-age and catch data, showed that by the mid-2000s the stock had recovered from the 1998–99 mass mortality caused by a herpes virus [Gaughan et al. 2008]. The annual exploitation rate in the mid-2000s was low at less than 5 per cent (around 400 t) of the estimated spawning biomass of approximately 25 000 t. Since then annual catches have remained below this level due to low fishing effort and are unlikely to cause the stock to become recruitment overfished.

For WA's South Coast, population modelling based on spawning biomass estimates obtained using the DEPM, catch-at-age and catch data showed a recovery from the 1998–99 mass mortality had been achieved by the mid-2000s [Gaughan et al. 2008]. The annual exploitation rate at that time was low at around 3 per cent (less than 3 000 t from an estimated spawning biomass of approximately 97 000 t), and the total annual catch has not exceeded 3 000 t since then.

The above evidence indicates that the biomass of this stock is unlikely to be depleted and that recruitment is unlikely to be impaired. Furthermore, the above evidence indicates that the current level of fishing mortality is unlikely to cause the stock to become recruitment impaired.

On the basis of the evidence provided above,
the South Western Australia biological stock is classified as a **sustainable stock.**

Southern Australia

The Southern Australia stock of Australian Sardine is fished by the South Australian Sardine Fishery (PIRSA 2014). The stock was last assessed in 2020using the DEPM [Ward et al. 2020a] and population modelling of estimates of spawning biomass, catch and catch-at-age data [Ward et al. 2020b].

Recent estimates of spawning biomass obtained using both the DEPM and population modelling have been above 230 000 t [Ward et al. 2019, 2020], which is above the target reference point of 190 000 t identified in the management plan for the SASF [PIRSA 2014]. The current exploitation rate is <20 per cent (that is a Total Allowable catch of 42 750 t from an estimated spawning biomass of >230 000 t), which is below the 30 per cent level considered safe for this stock by Smith et al. [2015].

The above evidence indicates that the biomass of this stock is unlikely to be depleted and that recruitment is unlikely to be impaired. Furthermore, the above evidence indicates that the current level of fishing mortality is unlikely to cause the stock to become recruitment impaired.

On the basis of the evidence provided above, the Southern Australia biological stock is classified as a **sustainable stock**.

BIOLOGY

Australian Sardine biology [Stewart et al. 2010, Ward and Grammer 2018]

Species	Longevity / Maximum Size	Maturity (50 per cent)

Australian Sardine	9 years; 200–250 mm SL	1–2 years; 145 mm SL

DISTRIBUTION

Distribution of reported commercial catch of Australian Sardine

TABLES

Fishing methods					
	Commonwealth	New South Wales	South Australia	Victoria	Western Australia
Commercial					
Beach Seine					✓
Danish Seine	✓				
Net		✓		✓	
Otter Trawl					✓
Purse Seine	✓		✓		✓
Various		✓			
Recreational					
Handline		✓			

Management Methods					
	Commonwealth	New South Wales	South Australia	Victoria	Western Australia
Commercial					
Effort limits				✓	
Gear restrictions	✓	✓	✓	✓	✓
Licence				✓	

Limited entry	✓		✓	✓	✓
Spatial closures		✓		✓	✓
Total allowable catch	✓	✓	✓		✓
Recreational					
Bag limits		✓		✓	✓
Gear restrictions				✓	✓
Licence				✓	
Licence (Recreational Fishing from Boat License)					✓
Possession limit					✓
Spatial closures		✓		✓	✓

Catch					
	Commonwealth	**New South Wales**	**South Australia**	**Victoria**	**Western Australia**
Commercial	124.648 t	496.472 t	37115 t	1004.34 t	1092.15 t
Indigenous	No catch	Unknown	Unknown	Unknown (No catch under permit)	Unknown
Recreational	No catch	Unknown	No catch	Unknown	Insufficient data

Commonwealth – Recreational The Australian Government does not manage recreational fishing in Commonwealth waters. Recreational fishing in Commonwealth waters is managed by the state or territory immediately adjacent to those waters, under its management regulations.

Commonwealth – Indigenous The Australian Government does not manage non-commercial Indigenous fishing in Commonwealth waters, with the exception of the Torres Strait. In general, non-commercial Indigenous fishing in Commonwealth waters is managed by the state or territory immediately adjacent to those waters.

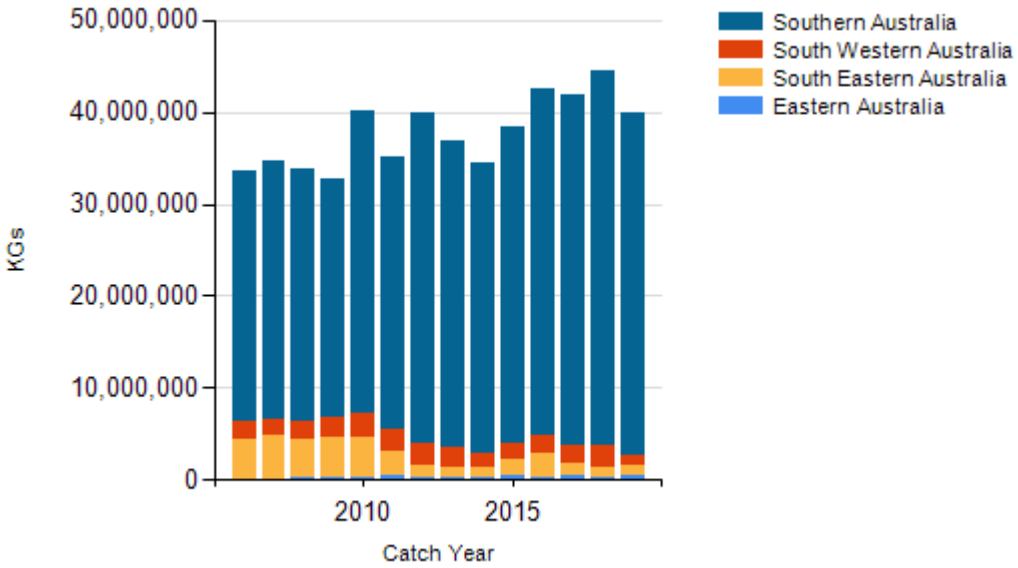
Western Australia – Recreational (management methods) a Recreational Fishing from Boat License is required for use of a powered boat to fish or to transport catch or fishing gear to or from a land-based fishing location.

New South Wales – Indigenous (management methods)
https://www.dpi.nsw.gov.au/fishing/aboriginal-fishing

Victoria – Indigenous (Management Methods) A person who identifies as Aboriginal or Torres Strait Islander is exempt from the need to obtain a Victorian recreational fishing licence, provided they comply with all other rules that apply to recreational fishers, including rules on equipment, catch limits, size limits and restricted areas. Traditional (non-commercial) fishing activities that are carried out by members of a traditional owner group entity under an agreement pursuant to Victoria's *Traditional Owner Settlement Act 2010* are also exempt from the need to hold a recreational fishing licence, subject to any conditions outlined in the

agreement. Native title holders are also exempt from the need to obtain a recreational fishing licence under the provisions of the Commonwealth's *Native Title Act 1993*.

CATCH CHART



Commercial catch of Australian Sardine - note confidential catch not shown

References

Whittington et al. 2008	Whittington, RJ, Crockford, M, Jordan, D and Jones, B 2008, Herpesvirus that caused epizootic mortality in 1995 and 1998 in pilchard, Sardinops sagax neopilchardus (Steindachner), in Australia is now endemic, Journal of Fish Diseases, 31: 97–105.
Gaughan et al. 2002	Gaughan, DJ, Fletcher, WJ and McKinlay, JP 2002, Functionally distinct adult assemblages within a single breeding stock of the Sardine, Sardinops sagax: management units within a management unit, Fisheries Research, 59: 217–231.
Gaughan et al. 2008	Gaughan, DJ, Craine, M, Stephenson, P, Leary, T and Lewis, P 2008, Regrowth of pilchard (Sardinops sagax) stocks off southern WA following the mass mortality event of 1998/99, final report to the Fisheries Research and Development Corporation, project 2000/135, Fisheries research report 176, Western Australian Department of Fisheries, Perth.
Smith et al. 2015	Smith, ADM, Ward, TM, Hurtado, F, Klaer, N, Fulton, E and Punt, AE 2015, Review and update of harvest strategy settings for the Commonwealth Small Pelagic Fishery: Single species and ecosystem considerations, final report to the Fisheries Research and Development Corporation, FRDC project 2013/028. Commonwealth Scientific and Industry Research Organisation Oceans and Atmosphere Flagship, Hobart.
PIRSA 2014	Primary Industries and Regions South Australia 2014, Management plan for the South Australian commercial Marine Scalefish Fishery. Part B: Management arrangements for the taking of sardines, PIRSA, Adelaide.
Sexton et al. 2018	Sexton, S.C., Ward, T.M., Stewart, J., Swaddling, K.M., and Huveneeers, C. 2018 Spawning patterns provide further evidence for multiple stocks of sardine (Sardinops sagax) off eastern Australia. Fisheries Oceanography DOI: 10.1111/fog.12383
Stewart et al. 2010	Stewart, J, Ballinger, G and Ferrell, D 2010, Review of the biology and fishery for Australian Sardines (Sardinops sagax) in New South Wales—2010, Industry and Investment New South Wales, Cronulla.
Ward et al. 2015a	Ward, TM, Grammer, GL, Ivey, AR, Carroll, JR, Keane, JP, Stewart, J and Litherland, L 2015, Egg distribution, reproductive parameters and spawning biomass of Blue Mackerel, Australian Sardine and Tailor off the East Coast during late winter and early spring, FRDC Project 2014/033, South Australian Research and Development Institute (Aquatic Sciences), Adelaide.
Ward et al. 2015b	Ward, TM, Burnell, O, Ivey, A, Carroll, J, Keane, J, Lyle, J and Sexton, S 2015, Summer spawning patterns and preliminary daily egg production method survey of Jack Mackerel and Australian Sardine off the East Coast, South Australian Research and Development Institute (Aquatic Sciences), Adelaide.
Ward et al. 2020a	Ward, T.M., Ivey, A.R. and Grammer, G.L.. (2020) Spawning biomass of Sardine, Sardinops sagax, in waters off South Australia in 2020. Report to PIRSA Fisheries and Aquaculture.

	South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. F2007/000566-11. SARDI Research Report Series No. 1074. 27pp.
Ward et al. 2020b	Ward, TM, Smart, J, Grammer, G, Ivey, A and McGarvey, R. 2020. Stock assessment of Australian Sardine (Sardinops sagax) off South Australia 2019. Report to PIRSA Fisheries and Aquaculture (PDF 4.4 MB). South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. F2007/000765-7. SARDI Research Report Series No. 1048. 108pp.
Ward and Grammer 2018	Ward, T. M. and Grammer, G. L. (2018). Commonwealth Small Pelagic Fishery: Fishery Assessment Report 2017. Report to the Australian Fisheries Management Authority. South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. F2010/000270-9. SARDI Research Report Series No. 982. 114pp
AFMA 2019	Small Pelagic Fishery, Resource Assessment Group, Meeting number 01 Meeting Minutes, 5 December 2019 Parkroyal, Melbourne Airport
Izzo et al. 2017	Izzo, C, Ward, TM, Ivey, AR, Suthers, IM, Stewart, J, Sexton, SC and Gillanders, BM 2017, Integrated approach to determining stock structure: implications for fisheries management of sardine, Sardinops sagax, in Australian waters. Reviews in Fish Biology and Fisheries. 1: 267–284
Ward and Grammer 2021	Ward, TM and Grammer, GL 2021. Commonwealth Small Pelagic Fishery: Status Summary Report 2020. Report to the Australian Fisheries Management Authority. South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. F2010/000270-10. SARDI Research Report Series No. 1021. 7 pp.
VFA 2018	Victorian Fisheries Authority 2018, Commercial Fish Production, Victorian Fisheries Authority, Melbourne
Ward et al. 2020c	Ward, T. M., Grammer, G. L. Ivey, A. R. and Keane, J. (2020). Spawning biomass of Jack Mackerel (Trachurus declivis) in the East sub-area of the Small Pelagic Fishery during summer 2019. Report to the Australian Fisheries Management Authority. South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. F2020/000206-01. 42pp.
Ward et al. 2021	Ward, T. M., Grammer, G. L. and Ivey, A. R. (2021). Spawning biomass of Blue Mackerel (Scomber australasicus) and Australian Sardine (Sardinops sagax) in the East sub-area of the Small Pelagic Fishery. Report to the Australian Fisheries Management Authority. South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. F2021/000047-1. SARDI Research Report Series No. 1084. 56pp