

Australian Sardine (2018)

Sardinops sagax



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STOCK STATUS OVERVIEW

Jurisdiction	Stock	Fisheries	Stock status	Indicators
Commonwealth, New South Wales	Eastern Australia	OHF, SPF	Sustainable	Spawning biomass, exploitation rate, catch
Commonwealth, New South Wales, Victoria	South Eastern Australia	CIF, GLBF, GLF, ITF, OHF, OPSF, OTF, PPBWPF, PPBWPF CIF GLBF OPSF ITF GLF, SESSF (CTS), SPF	Sustainable	Spawning biomass, exploitation rate, catch
Western Australia	South Western Australia	FBLC93, FBLC93 SBPMF WCPSMF, SBPMF, SCPSMF, WCPSMF	Sustainable	Spawning biomass, exploitation rate, catch
South Australia	Southern Australia	SASF	Sustainable	Spawning biomass, exploitation rate, catch

SESSF (CTS) Southern and Eastern Scalefish and Shark Fishery (Commonwealth Trawl Sector) (CTH), SPF Small Pelagic Fishery (CTH), OHF Ocean Hauling Fishery (NSW), OTF Ocean Trawl Fishery (NSW), SASF South Australian Sardine Fishery (SA), CIF Corner Inlet Fishery (VIC), GLBF Gippsland Lakes Bait Fishery (VIC), GLF Gippsland Lakes Fishery (VIC), OPSF Ocean Purse Seine Fishery (VIC), PPBWPF Port Phillip Bay and Western Port Bay Fishery (VIC), ITF Inshore Trawl Fishery (VIC), SBPMF Shark Bay Prawn Managed Fishery (WA), SCPSMF South Coast Purse-Seine Managed Fishery (WA), WCPSMF West Coast Purse-Seine Managed Fishery (Condition) (WA), FBLC93 Fishing Boat Licence Conditions (WA), FBLC93 || SBPMF || WCPSMF Various Fisheries combined due to 3 boat rule (WA), PPBWPF || CIF || GLBF || OPSF || ITF || GLF Port Phillip Bay and Western Port Bay Fishery, Corner Inlet Fishery, Gippsland Lakes Bait Fishery, Ocean Purse Seine Fishery, Inshore Trawl Fishery, Gippsland Lakes Fishery (VIC)

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, Sexton et al. 2018]. New evidence has resulted in the separation of the new South Eastern Australia stock from the Eastern Australia stock. 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, Sexton et al. 2018]. 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 2018 using fishery data for 2016 [Ward and Grammer 2018] and a Daily Egg Production Method (DEPM) survey undertaken in 2014 [Ward et al. 2015a]. The primary biological performance indicators are spawning biomass and exploitation rate.

Surveys conducted in 1997, 1998 and 2004 using the DEPM indicated that the spawning biomass of the Eastern Australia stock was at least 25 000–30 000 tonnes (t) [Staunton Smith and Ward 2000, Ward et al. 2011, Ward and Rogers 2011]. A survey conducted in 2014 that covered the entire spawning area (Sandy Cape to just south of Newcastle) 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. 2015b].

The total annual catch from the eastern stock was 601 t in 2016–17, up from 526 t in 2015–16 [Ward and Grammer 2018]. Recent catches from the eastern stock of Australian Sardine have been <2 per cent of the 2014 estimate of spawning biomass, which is well below the 30 per cent level considered safe for this species [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 has not been assessed previously. Spawning biomass and exploitation rate are used as the primary biological performance indicators in the current assessment because some information on these measures is available from DEPM surveys undertaken primarily to assess 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. 2015c]. 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. Neither of these surveys covered the entire spawning area, including parts of Bass Strait; 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 a vessel operating out of Lakes Entrance in Victoria have increased in recent years [Ward and Grammer 2016]. In Victoria, commercial netting is being phased out in Port Phillip Bay. Since 2016, 34 of the 43 licences have been bought out by the Victorian government. Commercial net fishing in Port Phillip Bay will cease by 2022. A developmental fishery was established in Tasmania in 2015, but no catches have yet been taken.

The highest annual catch from the South-eastern Australia stock of approximately 5 000 t in 2009 was approximately 20 per cent of the minimum estimate of spawning biomass of around 30 000 t [Ward and Grammer 2016]. The catch from this stock in 2016 was approximately 2 150 t. Recent catches equate to exploitation rates of less than 10 per cent [Ward and Grammer 2016], which is well below the level considered safe for this species (30 per cent) [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 managed in two separate management units: Western Australia West Coast, and Western Australia South Coast. These were previously reported as separate biological stocks. Here, evidence to assess the status of both management units of the South Western Australia stock is presented.

Population modelling based on spawning biomass estimates obtained using the DEPM, catch-at-age and catch data, showed that, by the mid-2000s, the West Coast management unit of the South Western Australia biological stock had recovered from the 1998–99 mass mortality caused by a herpes virus [Gaughan et al. 2008]. By that time, the annual exploitation rate was 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 and are unlikely to cause the stock to become recruitment overfished.

For Western Australia's South Coast management unit, 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 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 to the extent that recruitment is impaired, and the current level of fishing mortality is also unlikely to lead to recruitment impairment.

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 2017 using the DEPM [Ward et al. 2017a] and population modelling of estimates of

spawning biomass, catch and catch-at-age data [Ward et al. 2017b].

Recent estimates of spawning biomass obtained using both the DEPM and population modelling have been above 200 000 t [Ward et al. 2017a, b], which is above the target reference point of 190 000 t identified in the management plan for the SASF [Primary Industries and Regions South Australia 2014]. The current exploitation rate is <22.5 per cent (that is, 42 750 t landed from an estimated spawning biomass of >200 000 t), which is below the 30 per cent level considered safe for this species [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 2017]

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

Commercial Catch Methods	Commonwealth	New South Wales	South Australia	Victoria	Western Australia
Beach Seine					✓
Danish Seine	✓				
Gillnet					✓

Hand held- Implements				✓	
Haul Seine					✓
Hook and Line				✓	
Net		✓		✓	
Otter Trawl	✓				✓
Purse Seine	✓	✓	✓	✓	✓
Unspecified		✓			✓
Various				✓	

Fishing methods					
	Commonwealth	New South Wales	South Australia	Victoria	Western Australia
Commercial					
Danish Seine	✓				
Net		✓			
Otter Trawl	✓				✓
Purse Seine	✓	✓	✓	✓	✓
Unspecified		✓			✓
Various				✓	
Indigenous					
Handline		✓			
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	✓		✓		✓
Indigenous					
Bag limits		✓			
Customary fishing permits				✓	
Native Title		✓			
Section 37 (1d)(3)(9).		✓			

Aboriginal cultural fishing authority					
Recreational					
Bag limits		✓		✓	✓
Gear restrictions				✓	
Licence				✓	
Licence (Recreational Fishing from Boat License)					✓
Possession limit					✓
Spatial closures		✓		✓	✓

Active Vessels	Commonwealth	New South Wales	South Australia	Victoria	Western Australia
	3 Vessels in SESSF (CTS), 2 Vessels in SPF,	52 Fishing Business in EGF, 10 Fishing Business in EPTF, 9 Fishing Business in OHF, 12 Fishing Business in OTF,	14 Licences in SASF,	1 Licence Holders in CIF, 1 Licence Holders in GLBF, 1 Licence Holders in GLF, 1 Licence Holders in OPSF, 1 Licence Holders in PPBWPF, 2 Licence Holders in ITF,	<3 in SBPMF, 10 in SCPSMF, <3 in WCPSMF, <3 in Charter, <3 in FBLC93,

SESSF (CTS) Southern and Eastern Scalefish and Shark Fishery (Commonwealth Trawl Sector)(CTH)

SPF Small Pelagic Fishery(CTH)

EGF Estuary General Fishery(NSW)

EPTF Estuary Prawn Trawl Fishery(NSW)

OHF Ocean Hauling Fishery(NSW)

OTF Ocean Trawl Fishery(NSW)

SASF South Australian Sardine Fishery(SA)

CIF Corner Inlet Fishery(VIC)

GLBF Gippsland Lakes Bait Fishery(VIC)

GLF Gippsland Lakes Fishery(VIC)

OPSF Ocean Purse Seine Fishery(VIC)

PPBWPF Port Phillip Bay and Western Port Bay Fishery (VIC)

ITF Inshore Trawl Fishery(VIC)

SBPMF Shark Bay Prawn Managed Fishery(WA)

SCPSMF South Coast Purse-Seine Managed Fishery(WA)

WCPSMF West Coast Purse-Seine Managed Fishery (Condition)(WA)

Charter Tour Operator(WA)

FBLC93 Fishing Boat Licence Conditions(WA)

Catch	Commonwealth	New South Wales	South Australia	Victoria	Western Australia
Charter					Confidential
Commercial	0.46t in SESSF (CTS), 101.673t in SPF,	445.113t in OHF,	40632t in SASF,	1.835t in PPBWPF CIF GLBF OPSF ITF GLF,	331.639t in FBLC93 SBPMF WCPSMF, 1602.96t in SCPSMF,
Indigenous	No catch	Unknown	Unknown	Unknown (No catch under permit)	Unknown
Recreational	No catch	Unknown	No catch	Unknown	Gascoyne Coast: 46 fish ±45 s.e. South Coast: 11 ±10 Boat based 2015–16, Clupeidae and Pristigasteridae – undifferentiated

SESSF (CTS) Southern and Eastern Scalefish and Shark Fishery (Commonwealth Trawl Sector) (CTH), SPF Small Pelagic Fishery (CTH), OHF Ocean Hauling Fishery (NSW), OTF Ocean Trawl Fishery (NSW), SASF South Australian Sardine Fishery (SA), CIF Corner Inlet Fishery (VIC), GLBF Gippsland Lakes Bait Fishery (VIC), GLF Gippsland Lakes Fishery (VIC), OPSF Ocean Purse Seine Fishery (VIC), PPBWPF Port Phillip Bay and Western Port Bay Fishery (VIC), ITF Inshore Trawl Fishery (VIC), SBPMF Shark Bay Prawn Managed Fishery (WA), SCPSMF South Coast Purse-Seine Managed Fishery (WA), WCPSMF West Coast Purse-Seine Managed Fishery (Condition) (WA), FBLC93 Fishing Boat Licence Conditions (WA), FBLC93 || SBPMF || WCPSMF Various Fisheries combined due to 3 boat rule (WA), PPBWPF || CIF || GLBF || OPSF || ITF || GLF Port Phillip Bay and Western Port Bay Fishery, Corner Inlet Fishery, Gippsland Lakes Bait Fishery, Ocean Purse Seine Fishery, Inshore Trawl Fishery, Gippsland Lakes Fishery (VIC),

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.

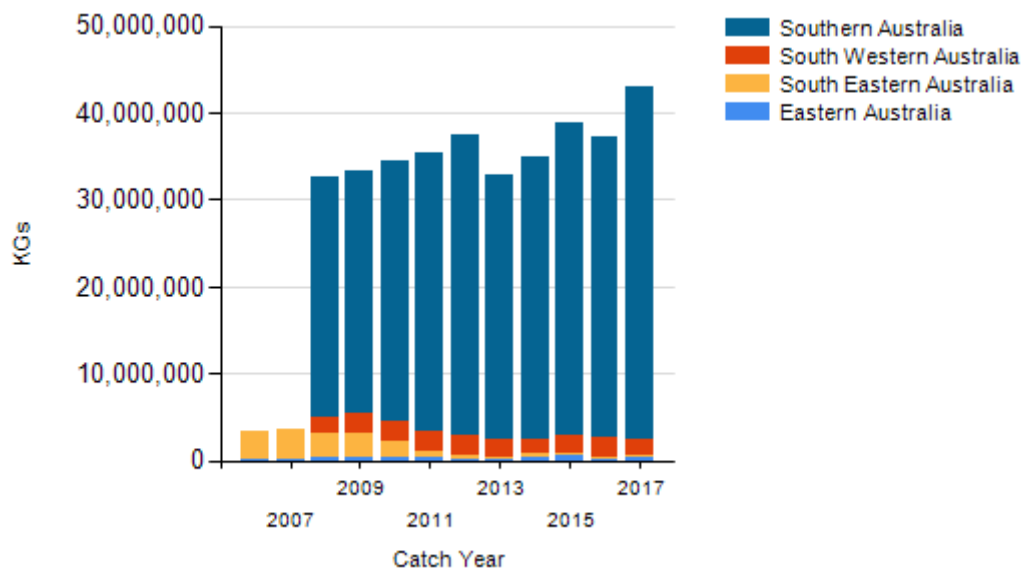
Western Australia – Recreational (management methods) a Recreational Fishing from Boat License is required for use of a powered boat to fish or to transport catch or fishing gear to or from a land-based fishing location.

New South Wales – Indigenous (management methods) (a) Aboriginal Cultural Fishing Interim Access Arrangement—allows an Indigenous fisher in New South Wales to take in excess of a recreational bag limit in certain circumstances; for example, if they are doing so to provide fish to other community members who cannot harvest for themselves; (b) The Aboriginal cultural fishing authority is the authority that Indigenous persons can apply to take catches outside the recreational limits under the *Fisheries Management Act 1994* (NSW), Section 37 (1d)(3)(9), Aboriginal cultural fishing authority; and (c) In cases where the *Native Title Act 1993* (Cth) applies fishing activity can be undertaken by the person holding native title in line with S.211 of that Act, which provides for fishing activities for the purpose of satisfying

their personal, domestic or non-commercial communal needs. In managing the resource where native title has been formally recognised, the native title holders are engaged with to ensure their native title rights are respected and inform management of the State's fisheries resources.

Victoria – Indigenous In Victoria, regulations for managing recreational fishing may not apply to fishing activities by Indigenous people. Victorian traditional owners may have rights under the Commonwealth's *Native Title Act 1993* to hunt, fish, gather and conduct other cultural activities for their personal, domestic or non-commercial communal needs without the need to obtain a licence. Traditional Owners that have agreements under the *Traditional Owner Settlement Act 2010* (Vic) may also be authorised to fish without the requirement to hold a recreational fishing licence. Outside of these arrangements, indigenous Victorians can apply for permits under the *Fisheries Act 1995* (Vic) that authorise fishing for specific indigenous cultural ceremonies or events (for example, different catch and size limits or equipment). There were no indigenous permits granted in 2017 and hence no indigenous catch recorded.

CATCH CHART



Commercial catch of Australian Sardine - note confidential catch not shown

EFFECTS OF FISHING ON THE MARINE ENVIRONMENT

ENVIRONMENTAL EFFECTS on Australian Sardine

References	
193	Whittington, RJ, Crockford, M, Jordan, D and Jones, B 2008, Herpesvirus that caused epizootic mortality in 1995 and 1998 in pilchard, <i>Sardinops sagax neopilchardus</i> (Steindachner), in Australia is now endemic, <i>Journal of Fish Diseases</i> , 31: 97–105.
194	Izzo, C, Gillanders, BM and Ward, TM 2012, Movement patterns and stock structure of Australian Sardine (<i>Sardinops sagax</i>) off South Australia and the east coast: implications for future stock assessment and management, final report to the Fisheries Research and Development Corporation, South Australian Research and Development Institute (Aquatic Sciences) publication F2011/000487-1, SARDI research report series 611, SARDI, Adelaide.
195	Gaughan, DJ, Fletcher, WJ and McKinlay, JP 2002, Functionally distinct adult assemblages within a single breeding stock of the Sardine, <i>Sardinops sagax</i> : management units within a management unit, <i>Fisheries Research</i> , 59: 217–231.
196	Gaughan, DJ, Craine, M, Stephenson, P, Leary, T and Lewis, P 2008, Regrowth of pilchard (<i>Sardinops sagax</i>) 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.
197	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.
198	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.
199	Staunton Smith, J and Ward, TM 2000, Stock assessment of pelagic bait fishes in Southern Queensland, with special reference to pilchards (<i>Sardinops sagax</i>), final report to the Fisheries Research and Development Corporation, Projects 95/043 and 98/130, Department of Primary Industries, Queensland, Australia.
200	Sexton, S.C., Ward, T.M., Stewart, J., Swaddling, K.M., and Huveneers, C. 2018 Spawning patterns provide further evidence for multiple stocks of sardine (<i>Sardinops sagax</i>) off eastern Australia. Fisheries Oceanography DOI: 10.1111/fog.12383
201	Stewart, J, Ballinger, G and Ferrell, D 2010, Review of the biology and fishery for Australian Sardines (<i>Sardinops sagax</i>) in New South Wales—2010, Industry and Investment New South Wales, Cronulla.
202	Ward, TM, Burch, P, McLeay, LJ and Ivey, AR 2011, Use of the daily egg production method for stock assessment of Sardine, <i>Sardinops sagax</i> : lessons learned over a decade of application off southern Australia, Reviews in Fisheries Science, 19: 1–20.
203	Ward, TM and Rogers, PJ 2007, Development and evaluation of egg-based stock assessment methods for Blue Mackerel <i>Scomber australasicus</i> in southern Australia, final report to the Fisheries Research and Development Corporation, project 2002/061, SARDI Aquatic Sciences, Adelaide.
204	Ward, TM, Whitten, AR and Ivey, AR 2015, South Australian Sardine (<i>Sardinops sagax</i>) Fishery: stock assessment report 2015, report to Primary Industries and Regions South Australia (Fisheries and Aquaculture), South Australian Research and Development Institute (Aquatic Sciences) publication F2007/000765-5, SARDI research report series 877, SARDI, Adelaide.
205	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.
206	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.
207	Ward, T.M., Ivey, A.R. and Smart, J.J . 2017, Spawning biomass of Sardine, <i>Sardinops sagax</i> , in waters off South Australia in 2017. Report to PIRSA Fisheries and Aquaculture (PDF 2.0 MB). South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. F2007/000566-8. SARDI Research Report Series No. 965. 27pp.
208	Ward, T.M., Smart, J. and Ivey, A. (2017). Stock assessment of Australian Sardine (<i>Sardinops sagax</i>) off South Australia 2017. Report to PIRSA Fisheries and Aquaculture. South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. F2007/000765-6. SARDI Research Report Series No. 971. 107pp.
209	Ward, TM and Grammer, GL 2016, Commonwealth Small Pelagic Fishery: Fishery Assessment Report 2015, report to the Australian Fisheries Management Authority, SARDI publication F2010/000270-7, SARDI Research Report Series 900, South Australian Research and Development Institute (Aquatic Sciences), Adelaide.
210	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