



# Australian Sardine

## *Sardinops sagax*

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## STOCK STATUS OVERVIEW

### Stock status determination

Jurisdiction	Stock	Fisheries	Stock status	Indicators
Commonwealth, New South Wales, Victoria	Eastern Australia	SESSF (CTS), SPF, OHF, OPSF	Sustainable	Spawning biomass, exploitation rate
Victoria, South Australia	Southern Australia	PPBPSF, SASF	Sustainable	Exploitation rate, catch data
Western Australia	Western Australia South Coast	SCPSMF	Sustainable	Spawning biomass, catch-and-effort data
Western Australia	Western Australia West Coast	SBPMF, WCPSMF	Sustainable	Spawning biomass, catch-and-effort data

**OHF** Ocean Hauling (NSW)

**OPSF** Ocean Purse Seine Fishery (VIC)

**PPBPSF** Port Phillip Bay Purse Seine Fishery (VIC)

**SASF** South Australian Sardine Fishery (SA)

**SBPMF** Shark Bay Prawn Managed Fishery (WA)

**SCPSMF** South Coast Purse-Seine Managed Fishery (WA)

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

**SPF** Small Pelagic Fishery (CTH)

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

## STOCK STRUCTURE

For the purposes of fisheries management, the Australian Sardine population is currently considered to be comprised of four separate biological stocks<sup>1,2</sup>. Bass Strait separates the biological stock that occurs off eastern Australia<sup>3</sup> from three biological stocks to the west. One stock occurs off South Australia and western Victoria<sup>1</sup>, and the other two occur off the south and west coasts of Western Australia<sup>4</sup>. Some evidence is beginning to emerge to suggest that two stocks may occur off eastern Australia, but this requires further investigation<sup>2</sup>.

As stock delineation for Australian Sardine is reasonably well known, here assessment of stock status is presented at the biological stock level—Eastern Australia, Western Australia west coast, Western Australia south coast and Southern Australia.

## STOCK STATUS

The maximum sustainable yield for species at low trophic levels (forage species), such as Australian Sardine, is typically achieved at a depletion level of approximately 60 per cent, equivalent to 40 per cent of unfished biomass<sup>5</sup>. However, harvest strategies for these species also need to achieve a balance between exploitation and protecting ecosystem function and biodiversity<sup>5,6</sup>.

The south-east Australian ecosystem, including the Great Australian Bight, has been shown to be less sensitive to harvesting of low-trophic level species than other pelagic systems worldwide<sup>7</sup>. A recent study using ecosystem models indicates that maintaining biomasses of small pelagic fishes above 50 per cent of the unfished level will maintain the biodiversity and health of Australia's marine ecosystems<sup>8–12</sup>. Exploitation rates (that is, catch as a proportion of spawning biomass), based on estimates of spawning biomass obtained using the daily egg production method (DEPM)<sup>13–15</sup>, were used for setting total allowable commercial catches. Management strategy evaluations estimate that exploitation rates of less than around 30 per cent of current biomass will maintain the spawning biomass of Australian Sardine above 50 per cent of the unfished level<sup>9</sup>, at levels that take into account the ecological importance of Australian Sardine<sup>5–8</sup>.

The information available to assess stock status and the frequency of formal assessments varies among jurisdictions, largely determined by recent catch levels. Catch-and-effort data are monitored annually in all jurisdictions; estimates of spawning biomass have been obtained using the DEPM for each of the four biological stocks; and population modelling has been undertaken for the Southern Australian biological stock and the two Western Australian biological stocks.

### Eastern Australia

Biomass estimates obtained in 1997, 1998 and 2004 using the daily egg production model indicated that the spawning biomass of Australian Sardine off eastern Australia was at least 25 000–30 000 tonnes (t)<sup>14–16</sup>. 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 Australian Sardine off the east coast was around 49 600 t (95 per cent confidence interval [CI] = 24 200–213 300 t)<sup>17</sup>. Another survey conducted during 2014 suggested that a spawning biomass of approximately 6825 t (95 per cent CI = 78 854–287 533) was present off northern Tasmania and in Bass Strait during summer, suggesting the potential for separate spawning stocks along the east coast<sup>18</sup>. However, the level of separation or linkage of these northern and southern spawning groups is poorly understood<sup>19–21</sup>.

Catches off eastern Australia reached almost 5000 t in 2008–09, but declined to 1097 t in 2012–13 as a result of a reduction in fishing effort; this was partly caused by the destruction of a processing plant in Eden, New South Wales<sup>20</sup>. Catches from a vessel operating out of Lakes Entrance in Victoria have increased in recent years<sup>20</sup>. A developmental fishery was established in Tasmania in 2015, but no catches have yet been taken. The highest annual catch (around 5000 t in 2009) was around 10 per cent of the best estimate of spawning biomass (around 49 600 t)<sup>20</sup>. The catch in 2014–15 was only 854 t<sup>20</sup>. Recent catches equate to exploitation rates of less than 10 per cent<sup>20</sup>, which is well below the level considered safe for this species (30 per cent)<sup>8</sup>. The above evidence indicates that the biomass of this stock is unlikely to be recruitment overfished and that this level of fishing pressure is unlikely to cause the stock to become recruitment overfished.

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

### **Western Australia West Coast**

Population modelling, based on spawning biomass estimates (obtained using the daily egg production model), catch-at-age and catch data<sup>22</sup>, suggested that by the mid-2000s the stock had recovered from a mass mortality event in 1998–99 caused by a herpes virus. The mid-2000s exploitation rate for the Western Australian west coast stock was less than five per cent (around 400 t from an estimated spawning biomass of approximately 25 000 t)<sup>22</sup>. Since 2007, the total annual catch has never exceeded 100 t, as the West Coast Purse-seine Fishery has transitioned to take mostly Tropical Sardine *Sardinella lemuru*. The above evidence indicates that the biomass of this stock is unlikely to be recruitment overfished and that this level of fishing pressure is unlikely to cause the stock to become recruitment overfished.

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

### **Western Australia South Coast**

Population modelling, based on spawning biomass estimates (estimated using the daily egg production model), catch-at-age and catch data<sup>22</sup>, showed that by the mid-2000s the stock had recovered from a mass mortality event in 1998–99 caused by a herpes virus. The mid-2000s exploitation rate for the Western Australian south coast stock was around three per cent (less than 3000 t from an estimated spawning biomass of approximately 97 000 t), and the total annual catch has not exceeded 3000 t since then. The nominal catch rate (tonnes per boat day) in the South Coast Purse-seine Fishery since 2008–09 has been consistently close to record highs. The above

evidence indicates that the biomass of this stock is unlikely to be recruitment overfished and that this level of fishing pressure is unlikely to cause the stock to become recruitment overfished.

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

## Southern Australia

The majority of the catch from the southern Australian stock is taken from South Australia, with much smaller catches from Port Phillip Bay, Victoria. Assessment of the South Australian Sardine Fishery has involved annual and, more recently, biennial daily egg production models surveys, as well as population modelling based on spawning biomass estimates, catch and catch-at-age data <sup>23,24</sup>. The most recent estimate of spawning biomass have been above 150 000 t <sup>11,23,24</sup>, which is well above the limit reference point of 75 000 t identified in the management plan for this fishery <sup>11</sup>. The above evidence indicates that the biomass of this stock is unlikely to be recruitment overfished. The current exploitation rate is around 23 per cent (that is, 38 000 t landed from a minimum estimate of spawning biomass of approximately 166 000 t), which is below the level considered safe for this species (30 per cent <sup>9</sup>). The above evidence indicates that this level of fishing pressure is unlikely to cause the stock to become recruitment overfished.

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

## BIOLOGY

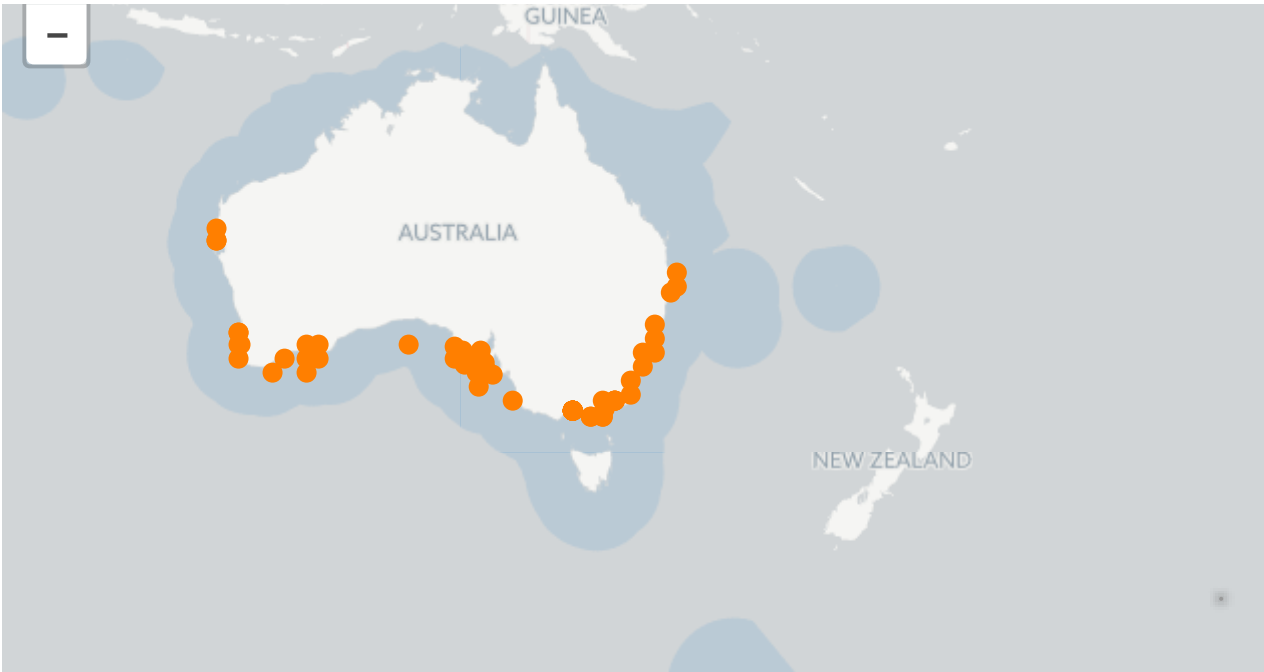
Australian Sardine biology <sup>19,20</sup>

### Biology

Species	Longevity / Maximum Size	Maturity (50 per cent)
Australian Sardine	9 years; 200–250 mm Standard Length	1–2 years; 145 mm Standard Length

## DISTRIBUTIONS





Distribution of reported commercial catch of Australian Sardine

**TABLES**

**Fishing methods**

	Commonwealth	Western Australia	New South Wales	Victoria	South Australia
<b>Commercial</b>					
Purse Seine	✓		✓	✓	✓
Otter Trawl	✓				
Various		✓			
<b>Indigenous</b>					
Hand Line, Hand Reel or Powered Reels			✓		
<b>Recreational</b>					
Hand Line, Hand Reel or Powered Reels			✓		

## Management methods

Method	Commonwealth	Western Australia	New South Wales	Victoria	South Australia
<b>Commercial</b>					
Effort limits		✓		✓	
Gear restrictions	✓		✓		✓
Limited entry	✓	✓	✓	✓	✓
Spatial closures		✓	✓	✓	
Total allowable catch	✓	✓			✓
<b>Indigenous</b>					
Bag limits			✓	✓	
Section 31 (1)(c1), Aboriginal cultural fishing authority			✓		
Spatial closures			✓	✓	
<b>Recreational</b>					
Bag limits		✓	✓	✓	
Spatial closures		✓	✓	✓	

**Active vessels**

	Commonwealth	Western Australia	New South Wales	Victoria	South Australia
	3 in SESSF (CTS), 3 in SPF	13 in SCPSMF, 3 in WCPSF	8 in OHF, 10 in OTF	1 in OPSF	14 in SASF

OHF Ocean Hauling (NSW)

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## Catch

	Commonwealth	Western Australia	New South Wales	Victoria	South Australia
<b>Commercial</b>	117.92t in SPF	18.31t in SBPMF, 1.85Kt in SCPSMF, 44.51t in WCPSMF	374.73t in OHF	295.91t in PPBPSF	36.11Kt in SASF
<b>Indigenous</b>	No catch	Unknown	Unknown	No catch	Unknown
<b>Recreational</b>	No catch	No catch	Negligible	No catch	No catch

**OHF** Ocean Hauling (NSW)

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**SASF** South Australian Sardine Fishery (SA)

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**a 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.

**b 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.

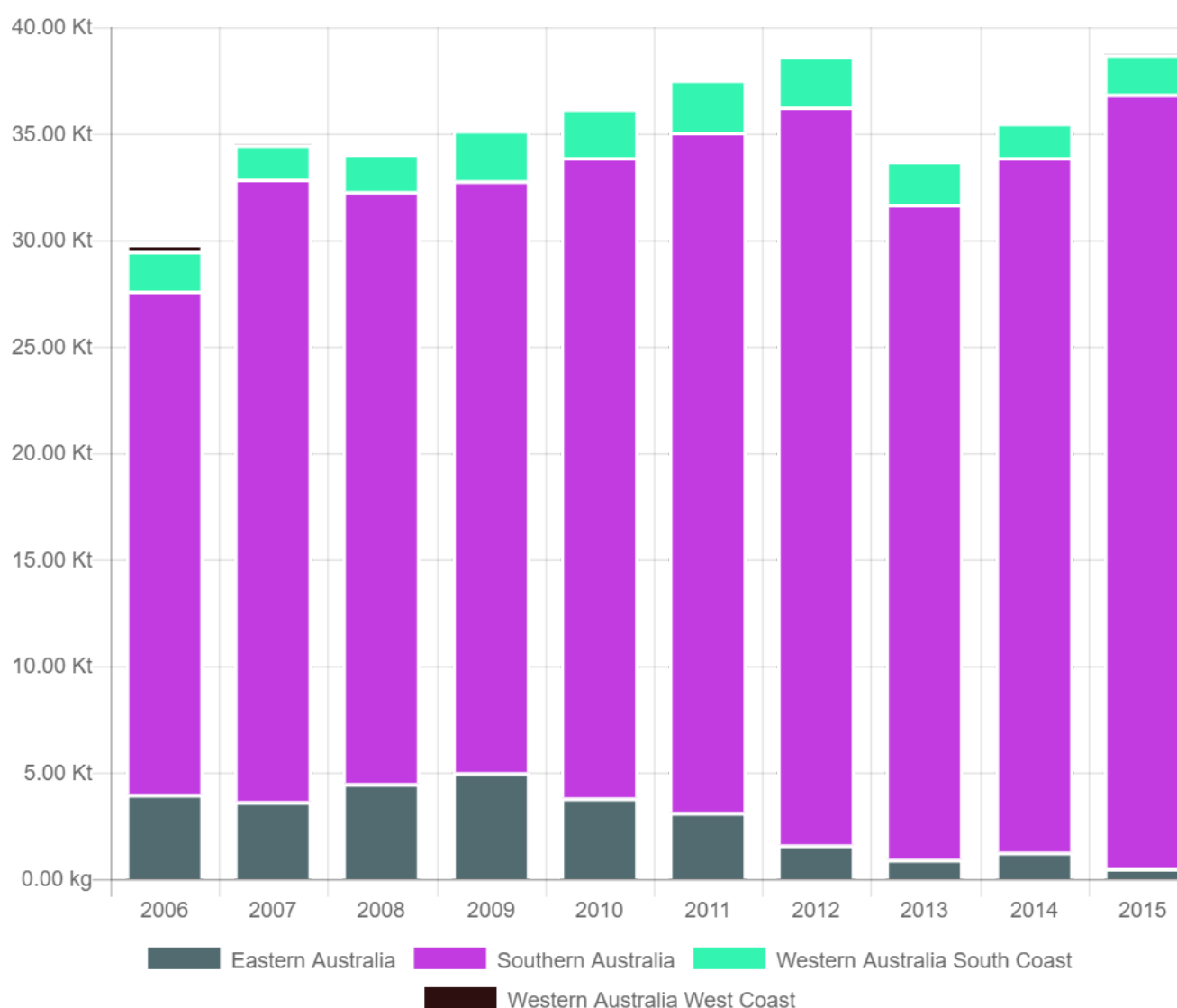
**c New South Wales – Indigenous (management methods)** Aboriginal cultural fishing authority, the authority that Indigenous persons can apply for to take catches outside the recreational limits under the Fisheries Management Act 1994 (NSW), Section 37 (1)(c1), Aboriginal cultural fishing authority

**d Victoria – Indigenous (management methods)** In Victoria, regulations for managing recreational fishing are also applied to fishing activities by Indigenous people. Recognised Traditional Owners (groups that hold native title or have agreements under the Traditional Owner Settlement Act 2010 [Vic]) are exempt (subject to conditions) from the requirement to hold a recreational fishing licence, and can apply for permits under the Fisheries Act 1995 (Vic) that authorise customary

fishing (for example different catch and size limits, or equipment). The Indigenous category in Table 3 refers to customary fishing undertaken by recognised Traditional Owners. In 2014–15, there were no applications for customary fishing permits to access Australian Sardine.

**e Victoria – Indigenous (management methods)** Subject to the defence that applies under Section 211 of the Native Title Act 1993 (Cth), and the exemption from a requirement to hold a Victorian recreational fishing licence, the non-commercial take by indigenous fishers is covered by the same arrangements as that for recreational fishing.

## CATCH CHART



Commercial catch of Australian Sardine

## EFFECTS OF FISHING ON THE MARINE ENVIRONMENT

- The rapid growth of the South Australian Sardine Fishery (SASF) led to community concerns that taking large catches could change the balance of the ecosystems in South Australia's gulfs and the Great Australian Bight, and potentially affect the region's higher-level marine predators, including Southern Bluefin Tuna (*Thunnus maccoyii*), seabirds and marine mammals. A large study was conducted to investigate the roles of Australian Sardine in the ecosystem and assess the potential ecological impacts of the fishery<sup>1</sup>. Despite the rapid growth of the fishery, negligible impacts were found on any species groups, even though several seabirds (for example, Crested Terns—*Sterna bergii*) were potentially sensitive to changes in the biomass of Australian Sardine.
- The SASF was closed for two months in 2005 because of high levels of encirclement and mortality of the Short-beaked Common Dolphin (*Delphinus delphis*)<sup>26</sup>. A Threatened, Endangered or Protected Species Code of Practice was developed during the closure period that outlined procedures for avoiding encirclements and releasing encircled animals<sup>27</sup>. Interaction rates decreased significantly following the introduction of the code of practice<sup>26,28</sup>. A working group that includes industry, fisheries managers, scientists and representatives of conservation agencies meets every quarter to review logbook and observer data, and assess the effectiveness of the code of practice in reducing interaction rates. A report on interaction rates and the effectiveness of the code of practice is published annually<sup>27</sup>.
- A code of conduct was established in 2006 to reduce Fleshy Footed Shearwater (*Ardenna carneipes*) interactions in the Western Australian South Coast Purse Seine Fishery<sup>29</sup>.
- A Purse Seine Code of Practice was established in 2008 by the Commonwealth industry operators that outlined best practice methods for minimising harmful interactions with threatened, endangered and protected species<sup>30</sup>.
- A New South Wales Purse Seine Industry Code of Practice was adopted March 2008 establishing standard practice for minimising harmful interactions with Threatened, Endangered or Protected species.

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## ENVIRONMENTAL EFFECTS ON AUSTRALIAN SARDINE

- In 1995 and 1998–99, two mass mortality events each killed more fish, over a larger area, than any other monospecific fish kill ever recorded<sup>1</sup>. These events were caused by a herpes virus to which the population had minimal or no immunity<sup>31</sup>. Rates of recovery have been different between stocks; spawning biomass increased quickly in the Southern Australian stock and strong recovery was achieved in the two Western Australian stocks by the mid 2000s<sup>13,15,22</sup>.
- Fishers in Western Australia have reported reductions in the availability of large fish on historical fishing grounds in recent years. This may reflect changes in distribution and behaviour associated with warmer oceanic conditions, dredge plumes associated with port

expansion, and increased abundance of the predatory West Australian Salmon (*Arripis truttaceus*)<sup>32,33</sup>.

- There is a relationship between fish condition and upwelling strength. Recent industry reports of increases in fat content of South Australian Sardines may reflect the occurrence of several strong upwelling seasons over the past few years<sup>24</sup>.

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