

Pipi (2023)

Donax deltoides



Greg Ferguson: South Australian Research and Development Institute, **Daniel Johnson:** New South Wales Department of Primary Industries, **Harry Gorfine:** Victorian Fisheries Authority

STOCK STATUS OVERVIEW

Jurisdiction	Stock	Stock status	Indicators
New South Wales	New South Wales	Sustainable	Catch, Standardised catch rates, estimated biomass, spawning potential ratio
Victoria	Victoria	Undefined	
South Australia	South Australia	Sustainable	Fishery-independent relative abundance and size structures

STOCK STRUCTURE

Pipi is common on high-energy sandy beaches from southern Queensland to the mouth of the Murray River in South Australia [Murray-Jones and Ayre 1997] and the distribution may extend further westwards. High genetic variation between populations on either side of Bass Strait indicates at least two biological stocks, with the East Australian and South Australian Currents acting as key drivers of gene flow on the east and south coasts of Australia respectively [Miller et al. 2013]. A study of Pipi from Fraser Island, Queensland, to southern New South Wales, indicated a single biological stock over this area, with genetic mixing driven by ocean currents associated with the East Australian Current [Murray-Jones and Ayre 1997]. For locations west of Bass Strait in South Australia and western Victoria, no evidence of genetic structuring has been detected [Miller et al. 2013]. The degree of larval mixing is thought to be related to spawning and larval duration, although these are poorly understood [King 1976, Ferguson 2013; Gluis and Li 2014; Miller et al. 2013]. Although no genetic differences were detected among Pipi populations on beaches along the east coast of Australia, in any given year, most recruits are likely to be self-seeded or to come from nearby, adjacent beaches [Murray-Jones and Ayre 1997]. This is also likely the case for the fisheries located to the west of Bass Strait. Despite the work outlined above, the biological stock delineation of Pipi remains unclear.

Here, assessment of stock status is presented at the jurisdictional level—New South Wales,

Victoria, and South Australia.

STOCK STATUS

New South Wales The harvest of Pipi in New South Wales is shared between the commercial sector, recreational fishers and for at least 10,000 years Pipi have provided a source of food for Indigenous people in this region [Murray-Jones 1999]. Steeply declining commercial catches over a six-year period (568 tonnes (t) in 2004–05 to 9 t in 2010–11) suggested that New South Wales Pipi stocks were depleted. Input controls were implemented which aimed to stabilise catches. These included: (1) spatial closures (i.e. within-beach closures), (2) temporal closures of the commercial fishery (i.e. 6 months per year), and (3) a minimum legal size limit (i.e. 45 mm total length) to allow spawning to occur at least once before recruitment to the fishery [Murray-Jones 1999], as well as a daily catch limit of 40 kg per fisher. Annually, harvest is reported from a small proportion (< 20%) of the total number of beaches from which harvest is permitted. From 2010–11 to 2015–16, catches increased from 9 t to 176 t (26% of historical peak), likely resulting from these management measures. Reported commercial landings in 2021–22 declined to 78.7 t.

The primary indicators for biomass and fishing mortality are commercial catch and standardised commercial catch rate. Standardised commercial catch rate (in mean catch per unit effort (CPUE kg per hour) is likely to be the most reliable index of relative abundance for Pipi in NSW. Generalised linear models (GLM) provided estimates of standardised mean catch rates, corrected for differences among fishing years, months, management regions, individual fishing operations, and their transformed fishing effort. Mean daily catch rates (2009–10 to 2021–22), for all regions combined have remained stable, and above average from 2012–13 to 2020–21 [Johnson 2023].

Statewide catches and catch rates have generally increased since 2010–11. For the three main regions of the fishery (Region 1, adjacent to the Queensland border and Regions 3 and 4, located to the south), annual catches have increased, and annual catch rate has been stable since 2010–11. In each of these regions, from 2012–13 to 2018–19, monthly catch rate has generally remained stable across the six-month fishing season. For the years in which simple stock depletion models were applied (i.e. when within-season declines in catch rate occurred, estimated exploitation rates in Region 1 and Region 4 were less than 30% [Johnson 2023]. In Region 3, which includes the greatest number of accessible beaches and highest number of endorsed fishers, within-season exploitation rates ranged from 28–73% [Johnson 2023]. For individual beaches, estimates of exploitation rate from 2009–10 to 2021–22 ranged between 20 and 83%. In 2018, reported landings of 73.2 t from Stockton Beach were estimated to remove 40–46% of the biomass of Papis (45 mm or larger) during the fishing season (June - December). For the most recent fishing period (2021–22), estimates of exploitation rate on individual beaches ranged from 20–53% [Johnson 2023].

Using the length composition of commercial catches estimates of the size of selectivity (SL₅₀ approximately 51 mm) relative to the size of maturity (L₅₀ approximately 34 mm) indicates that a high level of spawning potential of the Pipi stock is protected from fishing mortality [Johnson 2023]. Despite estimates of relative fishing mortality (F/M) from length-based spawning potential ratio analyses [Hordyk et al. 2015, 2016] being high (2.7–4.2), moderate levels of

spawning potential ratio (0.43–0.45) are being conserved [Johnson 2023].

Estimates of state-wide recreational catches are available from the National Recreational and Indigenous Fishing Survey and New South Wales state-wide surveys completed in 2000–01 [Henry and Lyle 2003], 2013–14 [West et al. 2015] and 2017–18 [Murphy et al. 2020] financial years. The estimated recreational catch in 2000–01 was 7 t, and in 2017–18 was 1.1 t, representing less than 1% of the combined recreational and commercial harvest in each survey period. Although Indigenous fishers harvest Pipi throughout New South Wales, there are no state-wide estimates of Indigenous harvest. Onsite interviews of Indigenous fishers in the Tweed Heads region (Northern New South Wales) estimated an annual Pipi harvest in that region of 3 056–7 380 individuals [Schnierer 2011]. Using a regional weight multiplier estimated at 14.81 g per Pipi (Murphy et al. 2020), Indigenous harvest was estimated to be less than 0.12 t.

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, Pipi in NSW is classified as a **sustainable stock**.

South Australia

Indigenous Australians have occupied the Coorong region in south eastern South Australia for at least 16,000 years and have harvested Pipi (also known as Goolwa Cockles in South Australia) for the past 10,000 years [Godfrey 1989]. Middens in the vicinity of the Murray River mouth in South Australia are composed almost exclusively of adult Pipi shells [Luebbers 1978].

The commercial fishery for Pipi has been managed under an individual transferable quota system with an annual total allowable commercial catch (TACC) since 2007–08, following fishery-dependent information indicating that Pipi had declined during the mid to late 2000s [Ferguson and Mayfield 2006, Ferguson 2013, Ferguson et al. 2015]. Fishers with quota for Pipi from the Lakes and Coorong Fishery (LCF) and the Marine Scalefish Fishery (MSF) operate mainly on the ocean beaches of Youngusband Peninsula, adjacent to the Coorong. Since 2012, the TACC has been determined under the harvest strategy for Pipi, which is described in the *Management Plan for the Lakes and Coorong Fishery* [PIRSA 2022] and a minimum legal length of 35 mm is in place to allow spawning to occur at least once before recruitment to the fishery [Ferguson 2013]. The recreational and commercial Pipi fisheries are spatially separated onto beaches that are, respectively, west and east of the River Murray mouth. Estimates of statewide recreational catches are available from telephone-based surveys in 2000–01 [Jones and Doonan 2005] and 2007–08 [Jones 2009] financial years and from targeted, on-site surveys in 2013–14 [Giri and Hall 2015], and 2020–21 [Durante et al. 2022]. The estimated state-wide recreational catch of Pipi in 2000–01 was 23 t [Jones and Doonan 2005] and 5 t in 2007–08 [Jones 2009]. Recent, targeted on-site surveys estimated catches of 33 t in 2013–14 and 68 t in 2020–21, an increase of 51%, [Giri and Hall 2015, Durante et al. 2022]. Recreational catches represented 1.8%, 0.8%, 7% and 13% of the combined recreational and commercial harvests in 2000–01, 2007–08, 2013–14 and 2020–21, respectively.

The most recent stock assessment was completed in 2021 and reported up to the conclusion of the 2019–20 season [Ferguson and Hooper 2021]. The primary

measures for biomass and fishing mortality are fishery-independent estimates of mean annual relative biomass [Ferguson et al. 2015] and population size structure. From 2009–10, increasing mean annual relative biomass and increasing complexity of size structures indicated recovery of the resource following a decade of declining relative abundance [Ferguson 2013, Ferguson et al. 2015] and subsequent conservative TACCs from 2009–10. From 2015–16 to 2017–18, following several, successive years of successful recruitment, estimates of mean annual relative biomass were the highest on record and ranged from 44–61% above the previous ten-year average (2008–09 to 2017–18). From the peak in 2017–18, relative biomass declined to slightly below (1%) the trigger reference point in the harvest strategy in 2020–21 [PIRSA 2022]. Poor recruitment in 2018–19 (16% contribution to size structure) likely contributed to the lower relative biomass in 2020–21, however consistent annual recruitment occurred in 2019–20 (40%) and 2020–21 (58%). 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, Pipi in South Australia is classified as a **sustainable stock**.

Victoria

In Victoria, Pipi support commercial, recreational and Indigenous fisheries. Pipi shells present in middens along the Victorian coastline suggest that they have been harvested by indigenous communities for the past 10,000 years [Godfrey, 1989].

The commercial fishery has operated since 1990 and transitioned to quota management in April 2020 with an annual total allowable commercial catch (TACC) for each of three management zones and a specific Pipi Fishery Access Licence required for fishers. From 2020, a Pipi fishery-specific catch/effort logbook was introduced, and fishing has been limited to two fishers per licence per day.

Commercial catches remained low from the early 1990s until 2010, then increased seven-fold in 2011 as the fishery transitioned from bait to human consumption markets, with most catches originating from Discovery Bay [Gorfine and Talman, 2023]. In 2013–14, the commercial Pipi catch increased to 86 t, then declined to 54 t in 2019–20. The TACC for the 2021–22 season was set at 10 t in Discovery Bay Western Zone, 40 t in Discovery Bay Eastern Zone and 2 t in the Venus Bay Commercial Zone.

Commercial catch rates (CPUE) provide the only available spatio-temporal index of relative abundance for Pipi. Uncertainty exists around CPUE as an index of abundance due to changes in fishing practices and reporting over time, but this may be reduced in future with improved logbook reporting [Gorfine and Talman 2023].

Recreational fishers harvest Pipi for food and bait, primarily in the summer months, with the impacts of recreational harvesting thought to be localised around beach access points [Lewis et al. 2012]. Although recreational Pipi fishing occurs throughout the State, most occurs in Venus Bay, and the magnitude of catches is currently unknown [Bell et al. 2023]. Anecdotal information suggests that increased recreational fishing has occurred at Discovery Bay and elsewhere. A recent fishery-independent survey of Venus Bay provided information on abundances and sizes of Pipi and found that fishing

pressure across 2015–18 impacted biomass in summer and autumn, but not in the remaining seasons, with a further meta-analysis across 2009–17 suggesting that variable biomass among summers was likely due to a combination of effort, environmental conditions, growth and survival [Morrongiello, 2021].

For Pipi in Victoria, there is limited knowledge of recruitment, temporal and spatial trends in harvestable biomass, and no formal harvest strategy with defined target and limit reference points. As such, TACC have remained unchanged since their relatively recent introduction, and there is insufficient information available to classify the status of this stock.

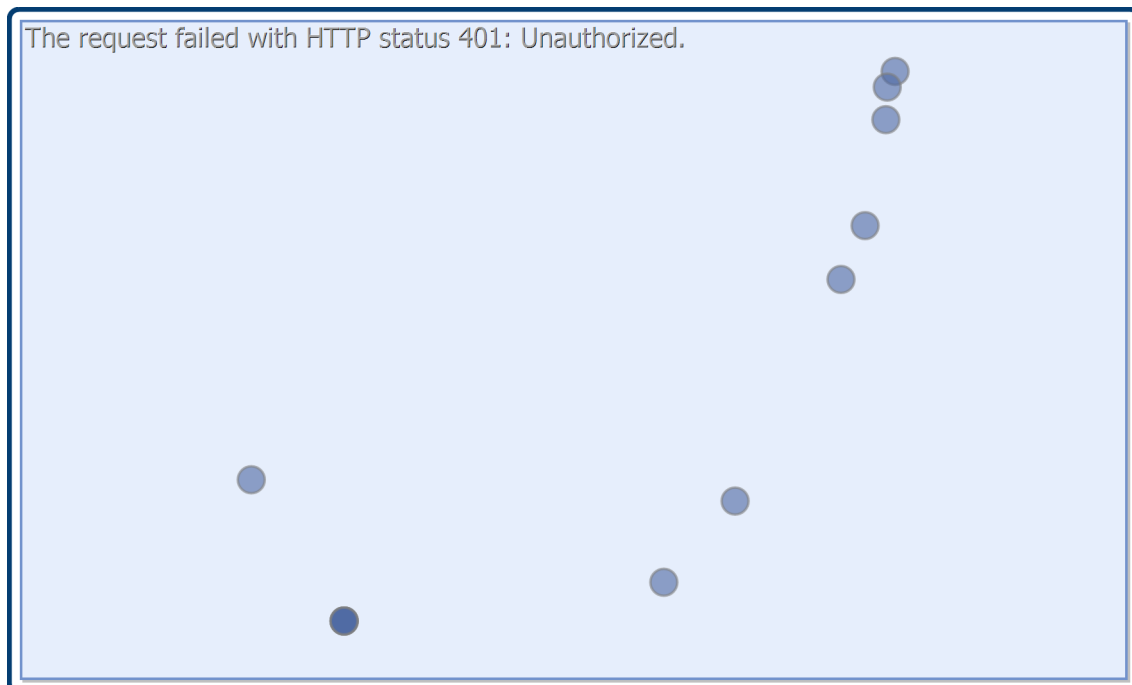
On the basis of the evidence provided above, Pipi in Victoria is classified as an **undefined stock**.

BIOLOGY

Pipi biology [King 1976; Murray-Jones 1999; Ferguson 2013; Ferguson et al. 2021]

Species	Longevity / Maximum Size	Maturity (50 per cent)
Pipi	South Australia: 4–5 years, 58 mm SL. New South Wales: 1–2 years, 75 mm SL	South Australia: approximately 16 months, 50% mature at 28 mm SL. New South Wales: 1 year, 37 mm SL

DISTRIBUTION



Distribution of reported commercial catch of Pipi

TABLES

STATUS OF AUSTRALIAN FISH STOCKS REPORT
Pipi (2023)

Fishing methods			
	New South Wales	South Australia	Victoria
Commercial			
Hand collection	✓		
Hand held-Implements			✓
Net			✓
Rake		✓	
Unspecified			✓
Various	✓		
Recreational			
Hand collection	✓	✓	
Hand held-Implements			✓
Rake		✓	

Management Methods			
	New South Wales	South Australia	Victoria
Commercial			
Bag limits			✓
Catch limits	✓	✓	
Effort limits			✓
Gear restrictions	✓	✓	✓
Licence			✓
Limited entry	✓	✓	✓
Size limit	✓	✓	✓
Spatial closures	✓	✓	✓
Temporal closures		✓	
Recreational			
Bag limits	✓	✓	✓
Gear restrictions	✓	✓	✓
Licence			✓
Possession limit	✓	✓	

STATUS OF AUSTRALIAN FISH STOCKS REPORT
Pipi (2023)

Seasonal closures		✓	
Size limit		✓	
Spatial closures		✓	

Catch			
	New South Wales	South Australia	Victoria
Commercial	80.4797 t	416.897 t	31.7064 t
Indigenous	Unknown	Unknown	Unknown
Recreational	1.3 t	22.9 t (2000), 5 t (in 2007), 33 t (in 2013), 68 t (in 2021)	Unknown

Active Vessels. Pipi are collected from beaches and ‘vessels’ are not used. Hence, numbers of licences and fishers are presented here instead of vessel numbers. Licences refer to the number of licence holders with an endorsement to take Pipi for sale.

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*.

New South Wales – Indigenous (Management Methods).
(<https://www.dpi.nsw.gov.au/fishing/aboriginal-fishing>)

New South Wales – Recreational (Catch). Murphy et al. [2022].

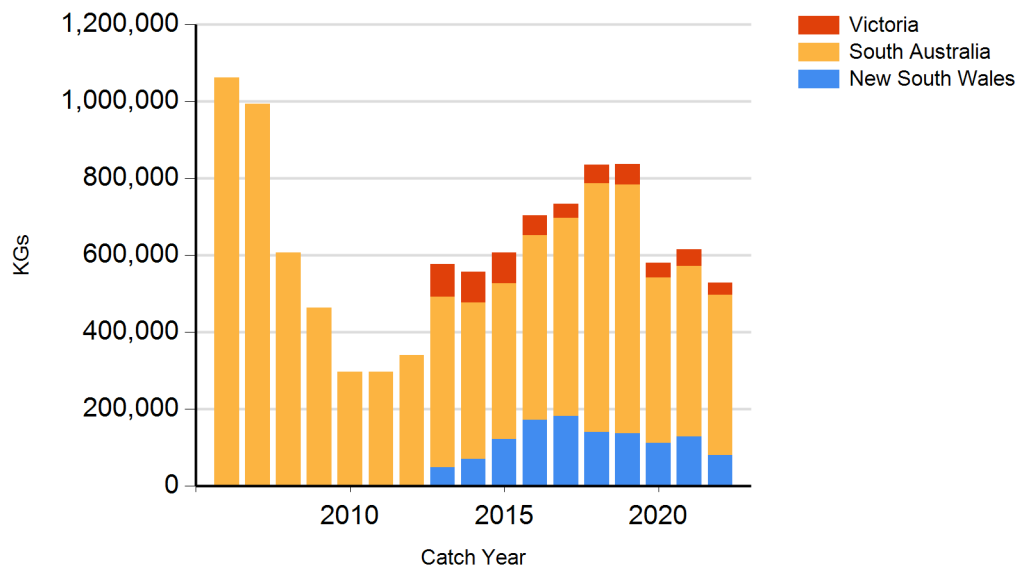
South Australia and Victoria - Commercial (Catch). Catches from the MSF in South Australia, and the BF and OF in Victoria cannot be reported separately for confidentiality reasons as there are fewer than five licences.

South Australia – Indigenous (Management Methods). In South Australia, regulations for managing recreational fishing may not apply to fishing activities by Indigenous people. South Australian 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.

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

STATUS OF AUSTRALIAN FISH STOCKS REPORT
Pipi (2023)



Commercial catch of Pipi - note confidential catch not shown

References	
Murray-Jones and Ayre 1997	Murray-Jones SE and Ayre, DJ 1997, High levels of gene flow in the surf bivalve <i>Donax deltooides</i> (Bivalvia: Donacidae) on the east coast of Australia, <i>Marine Biology</i> , 1(128): 83–89. DOI: 10.1007/s002270050071.
Miller et al. 2013	Miller, AD, Versace, VL, Matthews, TG, Montgomery, S and Bowie, KC 2013, Ocean currents influence the genetic structure of an intertidal mollusc in southeastern Australia—implications for predicting the movement of passive dispersers across a marine biogeographic barrier, <i>Ecology and Evolution</i> , 3(5): 1248–1261. DOI: 10.1002/ece3.535.
Ferguson 2013	Ferguson, GJ 2013, Pipi (<i>Donax deltooides</i>) Stock Assessment, report for Primary Industries and Regions South Australia, publication F2007/000550-1, South Australian Research and Development Institute, Adelaide.
King 1976	King, MG 1976, The life-history of the Goolwa Cockle, <i>Donax (Plebidonax) deltooides</i> , (Bivalvia: Donacidae), on an ocean beach, South Australia, South Australian Department of Agriculture and Fisheries, Adelaide.
Gluis and Li 2014	Gluis, M and Li, X 2014, Developing clam aquaculture in Australia: a feasibility study on culturing <i>Donax deltooides</i> and <i>Katelysia rhytiphora</i> on intertidal and subtidal leases in South Australia. South Australian Research and Development Institute (Aquatic Sciences), FRDC Final Report 2009/208.
Murray-Jones 1999	Murray-Jones, S 1999, Conservation and management in variable environments: the surf clam, <i>Donax deltooides</i> , PhD thesis, University of Wollongong.
Henry and Lyle 2003	Henry, GW and Lyle, JM 2003, The national recreational and Indigenous fishing survey, Fisheries Research and Development Corporation, Canberra.
West et al. 2015	West, LD, Stark, KE, Murphy, JJ, Lyle, JM and Ochwada-Doyle, FA 2015, Survey of recreational fishing in New South Wales and the ACT, 2013/14. Fisheries Final Report Series No. 149. NSW Department of Primary Industries, Wollongong.
Schnierer 2011	Schnierer, S 2011, Aboriginal fisheries in New South Wales; determining catch, cultural significance of species and traditional fishing knowledge need. Final report to Fisheries Research and development Corporation, Project No. 2009/038, Canberra.
Godfrey 1989	Godfrey, MCS 1989, Shell midden chronology in SW Victoria, <i>Archaeology in Oceania</i> , 24: 65–69. DOI: 10.1002/j.1834-4453.1989.tb00213.x.
Lewis et al. 2012	Lewis, Z, Khageswor, G, Versace, VL and Scarpaci, C 2012, Applying stock indicators for assessment of a recreational surf clam (<i>Donax deltooides</i>) fishery in Victoria, Australia, <i>Journal of the Marine Biological Association of the United Kingdom</i> , 1–7. DOI: 10.1017/S0025315412001695

STATUS OF AUSTRALIAN FISH STOCKS REPORT
Pipi (2023)

Luebbbers 1978	Luebbbers, RA 1978, Meals and menus: a study of change in prehistoric coastal settlements in South Australia, PhD thesis, Australian National University, Canberra.
Ferguson et al. 2015	Ferguson, G, Ward, TM and Gorman, D 2015, Recovery of a surf clam <i>Donax deltoides</i> population in southern Australia: successful outcomes of fishery-independent surveys. <i>North American Journal of Fisheries Management</i> , 35:1185–1195. DOI:10.1080/02755947.2015.1091408.
Ferguson and Mayfield 2006	Ferguson, G and Mayfield, S 2006, The South Australian Goolwa cockle (<i>Donax deltoides</i>) Fishery, fishery assessment report to Primary Industries and Resources South Australia Fisheries, South Australian Research and Development Institute (Aquatic Sciences), Report RD06/005-1, Adelaide.
Jones and Doonan 2005	Jones, K and Doonan, AM 2005, 2000–01 national recreational and Indigenous fishing survey: South Australian regional information, South Australian fisheries management series, paper 46, Primary Industries and Resources South Australia, Adelaide.
Jones 2009	Jones, K 2009, South Australian recreational fishing survey 2007/08, South Australian fisheries management series, paper 55, Primary Industries and Resources South Australia, Adelaide.
Giri and Hall 2015	Giri, K and Hall, K 2015, South Australian recreational fishing survey 2013–14. Fisheries Victoria Internal Report Series No. 62, Victoria.
Bell et al. 2023	Bell, JD, Ingram, BA, Gorfine, HK and Conron, SD 2023, Review of key Victorian fish stocks — 2022, Victorian Fisheries Authority Science Report Series No. 38, June 2023. VFA: Queenscliff. 89pp.
Murphy et al. 2020	Murphy, JJ, Ochwada-Doyle, FA, West, LD, Stark, KE and Hughes, JM 2020, The NSW Recreational Fisheries Monitoring Program - survey of recreational fishing, 2017/18. NSW DPI—Fisheries Final Report Series No. 158.
Hordyk et al. 2015	Hordyk, AR, Ono, K, Valencia, SR, Loneragan, NR and Prince, JD 2015, A novel length-based empirical estimation method of spawning potential ratio (SPR), and tests of its performance, for small-scale, data-poor fisheries. <i>ICES Journal of Marine Science</i> . 72: 217 – 231.
Hordyk et al. 2016	Hordyk, A, Ono, K, Prince, JD and Walters, CJ 2016, A simple length-structured model based on life history ratios and incorporating size-dependent selectivity: application to spawning potential ratios for data-poor stocks. <i>Canadian Journal of Fisheries and Aquatic Sciences</i> , 13: 1– 13.
Johnson 2023	Johnson, DD 2023, NSW Stock Status Summary 2022/23—Pipi (<i>Donax deltoides</i>). NSW Department of Primary Industries, Fisheries. 10 pp
Ferguson and Hooper 2021	Ferguson, GJ and Hooper, GE 2021, Pipi (<i>Donax deltoides</i>) Fishery 2020/2. Fishery Assessment Report to PIRSA Fisheries and Aquaculture. SARDI Research Report Series No. 1099. SARDI Publication No. F2007/000550-3. 43 pp.
PIRSA 2022	PIRSA 2022, Management Plan for the South Australian Commercial Lakes and Coorong Fishery. Primary Industries and Regions South Australia (Fisheries and Aquaculture), Adelaide.
Ferguson et al. 2021	Ferguson, GJ, Hooper, G and Mayfield, S 2021, Temporal and spatial variability in the life-history of the surf clam <i>Donax deltoides</i> : Influences of density dependent processes. <i>Estuarine, Coastal and Shelf Science</i> 249 (2021) 107104
Gorfine and Talman, 2023	Gorfine, H and Talman, S 2023, Victorian Pipi (<i>Donax deltoides</i>): Discovery Bay. Assessment Report 2022. Victorian Fisheries Authority Science Report Series No. 35.
Morrongiello, 2021	Morrongiello, J 2021, Assessing the sustainability of Venus Bay’s pipi fishery. Recreation Fishing Grants Program Research Report
Murphy et al. 2022	Murphy, JJ, Ochwada-Doyle, FA, West, LD, Stark, KE, Hughes, JM and Taylor, MD 2022, Survey of recreational fishing in NSW, 2019/20. NSW Department of Primary Industries, Nelson Bay, Fisheries Final Report Series No. 161. 80p.
Durante et al. 2022	Durante, LM, Bailleul, F and Beckman, CL 2022, On-site survey of recreational fishing for pipi in Goolwa, South Australia 2020–21. Final report to PIRSA Fisheries and Aquaculture. South Australian Research and Development Institute (Aquatic Sciences), Adelaide. SARDI Publication No. FF2022/000269-1. SARDI Research Report Series No. 1160. 34 pp.