Chapter 25
Heard Island and McDonald Islands Fishery

H Patterson and AH Steven

FIGURE 25.1 Area of the Heard Island and McDonald Islands Fishery, 2019

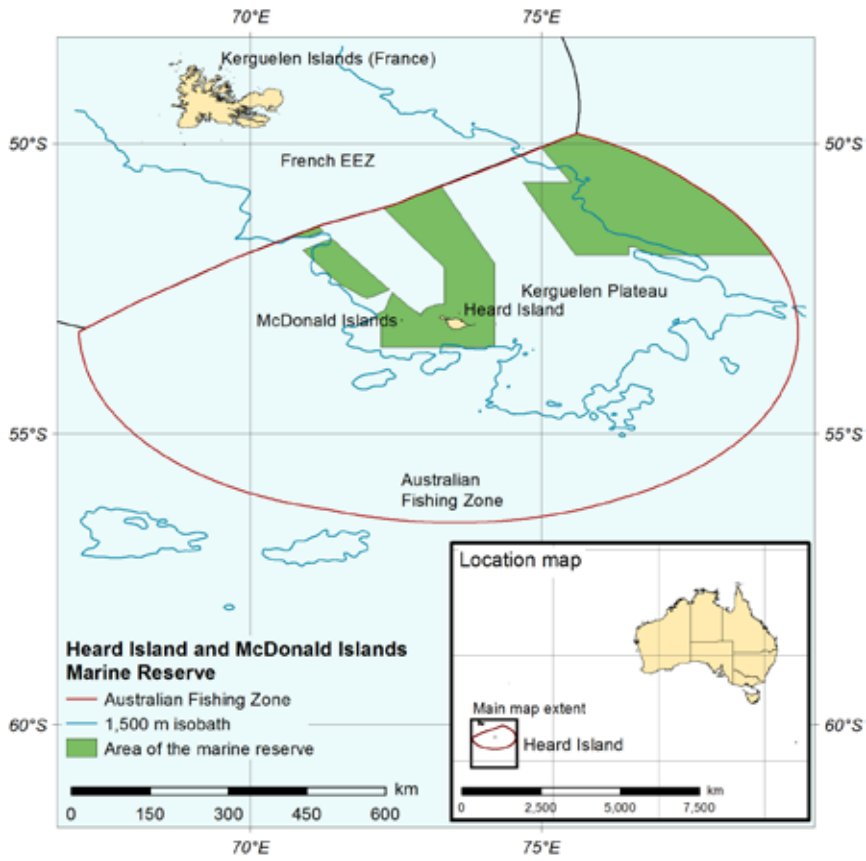


TABLE 25.1 Status of the Heard Island and McDonald Islands Fishery

Biological status					
Stock	2018		2019		Comments
	Fishing mortality	Biomass	Fishing mortality	Biomass	
Mackerel icefish (*Champsocephalus gunnari*)					TACs are set in accordance with a precautionary harvest strategy.
Patagonian toothfish (*Dissostichus eleginoides*)					TACs are set in accordance with a precautionary harvest strategy. Most recent estimates of biomass are above the limit reference point.
Economic status					
Estimates of NER are not available. Relatively low levels of latency for the 2017–18 and 2018–19 fishing seasons indicate positive NER from the fishery.					

Notes: **NER** Net economic returns. **TAC** Total allowable catch.

Fishing mortality	Not subject to overfishing	Subject to overfishing	Uncertain
Biomass	Not overfished	Overfished	Uncertain

25.1 Description of the fishery

Area fished

The Australian external territory of Heard Island and McDonald Islands (HIMI) is in the southern Indian Ocean (Figure 25.1), within the area covered by the Convention on the Conservation of Antarctic Marine Living Resources. The islands and their surrounding territorial waters (out to 12 nautical miles [nm]) are closed to fishing and regulated under the *Environment Protection and Management Ordinance 1987*, administered by the Australian Antarctic Division (AAD) of the Australian Government Department of Agriculture, Water and the Environment. A 1 nm buffer zone around the territorial waters of HIMI extends the area closed to fishing to 13 nm. The HIMI Marine Reserve was declared in October 2002 and then expanded in March 2014 by proclamation after scientific assessment. The reserve now totals 71,200 km^2. Waters between 12 and 200 nm from HIMI are part of the Australian Fishing Zone (AFZ). The *Heard Island and McDonald Islands Marine Reserve management plan 2014–2024* (AAD 2014), made pursuant to the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act), provides the management regime for the reserve.

Fishing methods and key species

The key target species are Patagonian toothfish (*Dissostichus eleginoides*) and mackerel icefish (*Champsocephalus gunnari*). The fishery also has catch limits for bycatch species, such as deep-sea skates (Rajidae) and grey rockcod (*Lepidonotothen squamifrons*), based on assessments of long-term annual yield (Constable, Williams & de la Mare 1998). The catch limits for unicorn icefish (*Channichthys rhinoceratus*) and grenadiers (*Macrourus* spp.), another group of bycatch species, were updated in 2015 based on assessments undertaken by the AAD (Dell et al. 2015; Maschette & Dell 2015). The catch limits are regularly reviewed by the Australian Fisheries Management Authority's (AFMA's) Sub-Antarctic Resource Assessment Group and by the Commission for the Conservation of Antarctic Marine Living Resources (CCAMLR) Scientific Committee and the CCAMLR Commission, and are considered precautionary. Recent updates of the ecological risk assessments have lowered the risk of fishing to finfish bycatch species (see section 25.4). Demersal longline is the main method used in the fishery, with some catch taken by demersal trawl. Trawl has declined rapidly in favour of longline as the main method used to target toothfish. Mackerel icefish are taken exclusively using demersal and midwater trawl.

Management methods

The AAD, in collaboration with AFMA observers and industry, regularly conducts fisheries-independent, random-stratified trawl surveys for target species (Patagonian toothfish and mackerel icefish) to collect relative abundance data, particularly of juvenile age classes. Harvest strategies for the target species are consistent with the precautionary approach implemented by the CCAMLR and have been used to set catch limits since the mid 1990s. The harvest strategies developed for the Heard Island and McDonald Islands Fishery (HIMIF) are consistent with the guidelines of the Commonwealth Fisheries Harvest Strategy Policy (Department of Agriculture and Water Resources 2018). For mackerel icefish, the target reference point dictates that the spawning stock biomass be maintained at 75% of the level that would occur in the absence of fishing at the end of a 2-year model projection. For Patagonian toothfish, the target reference points dictate that median escapement of the spawning biomass at the end of a 35-year projection period is 50% of the median pre-exploitation level and that the probability of the spawning biomass dropping below 20% of its pre-exploitation median level is less than 10% over the projection.

The importance of the target species (especially mackerel icefish) as prey in the subantarctic ecosystem is taken into account, and catch limits must be sufficiently precautionary to ensure that the abundance of these species meets the ecological needs of dependent species (for example, seabirds and marine mammals). The HIMIF mackerel icefish fishery was initially certified as sustainable by the Marine Stewardship Council (MSC) in March 2006 and was recertified in July 2016. Patagonian toothfish in the HIMIF, originally certified in 2012, was recertified as sustainable by the MSC in July 2017.

Illegal, unreported and unregulated (IUU) longline fishing within the HIMI AFZ, targeting Patagonian toothfish, was a significant problem from the mid 1990s. However, following Australian surveillance and enforcement activities in the area (in cooperation with adjoining nations in the CCAMLR region, notably France), no IUU fishing vessels have been detected since 2004 inside the Australian Exclusive Economic Zone (EEZ) adjacent to HIMI or the French EEZ surrounding the Kerguelen Islands.

Fishing effort

Effort in the HIMIF has been fairly stable, with 2–4 vessels active at any one time since a total allowable catch (TAC) was first set in the mid 1990s, with the exception of the 2014–15 season when the TAC was very high and 7 vessels fished. Five vessels were active in the 2018–19 fishing season.

Catch

Catches of mackerel icefish have been variable over time because it is a short-lived species, exhibiting periodic, large, dominant year-classes that contribute to high catches for a year or two. Once a strong year-class dies out and the next cohort is growing, catches are reduced because less biomass is available to the fishery.

Catches of Patagonian toothfish have been more stable over time, with little variation between the 2000–01 and 2013–14 fishing seasons. Catch in the 2014–15 fishing season increased in response to the increased TAC. Catches over the past 2 seasons have been closer to the TACs.

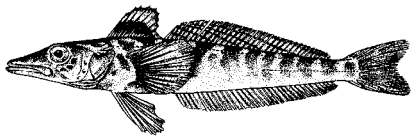
TABLE 25.2 Main features and statistics for the HIMIF

Fishery statistics a	**2017–18 fishing season**			**2018–19 fishing season**		
Stock	**TAC (t)**	**Catch (t)**	**GVP (2017–18)**	**TAC (t)**	**Catch (t)**	**GVP (2018–19)**
Mackerel icefish	526	401	Confidential	443	443	Confidential
Patagonian toothfish	3,525	3092	Confidential	3,525	3,390	Confidential
Fishery-level statistics						
Effort	61 trawl-days 16,415,948 hooks 0 pots hauled			64 trawl-days 17,745,965 hooks 0 pots hauled		
Fishing permits	4 quota SFR holders			4 quota SFR holders		
Active vessels	4			5		
Observer coverage **b**	100% vessel coverage			100% vessel coverage		
Fishing methods	Demersal longline, demersal trawl, midwater trawl, pot (fish traps)					
Primary landing ports	Port Louis (Mauritius)					
Management methods	Input controls: limited entry, gear restrictions, temporal and spatial closures Output controls: TACs, ITQs Other: move-on provisions if bycatch thresholds are reached					
Primary markets	International: China, eastern Europe, Japan, United States—frozen					
Management plan	Heard Island and McDonald Islands Fishery Management Plan 2002 (amended 2011)					

a Fishery statistics are pro vided by fishing season, unless otherwise indicated. Season is 1 December to 30 November. Value statistics are by financial year. **b** All vessels carry 2 observers on each trip; 100% of hauls are observed, but generally less than 100% of each haul.
Notes: **GVP** Gross value of production. **ITQ** Individual transferable quota. **SFR** Statutory fishing right. **TAC** Total allowable catch.

25.2 Biological status

Mackerel icefish (*Champsocephalus gunnari*)



Line drawing: FAO

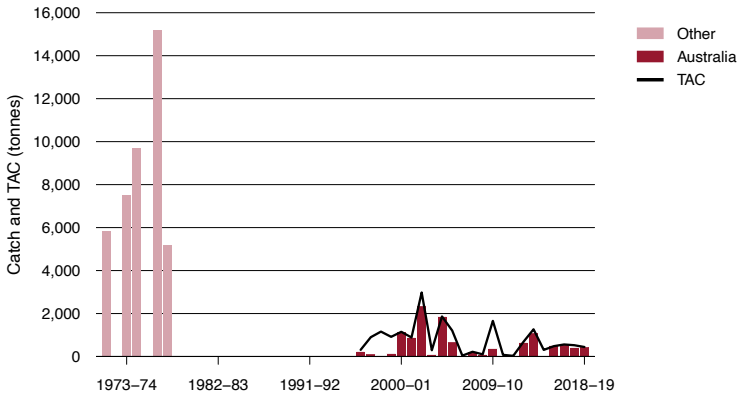
Stock structure

A single stock of mackerel icefish is considered to exist at HIMI; no genetic variation among sites around HIMI has been found (Williams, Smolenski & White 1994). Genetic studies have indicated that the population at HIMI is distinct from other icefish populations in the southern Atlantic Ocean (Kuhn & Gaffney 2006). Mackerel icefish at HIMI and the Kerguelen Plateau in the French EEZ are considered distinct stocks because of their different spawning seasons and growth rates (Williams et al. 2001).

Catch history

The catch history of icefish has been sporadic, with very high and unregulated catches taken by Soviet and Polish fleets across the Kerguelen Plateau in the 1970s, before the declaration of the EEZ around the Kerguelen Islands by France and the AFZ around HIMI. It is uncertain where these earlier catches were taken relative to the current maritime boundaries, although charts from this period indicate that the fishing fleet was aware of some of the banks where icefish currently form aggregations within the Australian EEZ. The initial TAC for icefish was set by the CCAMLR in 1995 following a demersal survey by the AAD. Since then, catches have generally followed the TAC, which takes into account the large natural fluctuations in abundance of the fish (Figure 25.2), except for 2014–15, when catches were well under the TAC because fishers concentrated their efforts on the more valuable Patagonian toothfish (for which the TAC was higher than in previous years). The full TAC was taken in 2018–19.

FIGURE 25.2 Catch and TAC of mackerel icefish in the HIMIF, 1971–72 season to 2018–19 season



Note: **TAC** Total allowable catch.
Source: AFMA

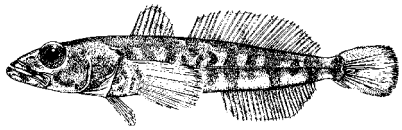
Stock assessment

A random stratified trawl survey in late March to early April 2019 provided information on the abundance and age structure of the mackerel icefish stock (Nowara, Lamb & Ziegler 2019). The age classes up to 3+ were estimated to account for 67% of the biomass, with the 4+ class accounting for 33% (Maschette, Nowara & Welsford 2019). The stock assessment estimated the current biomass at 5,539 t (Maschette, Nowara & Welsford 2019). Yields of 527 t for the 2019–20 season and 406 t for the 2020–21 season were estimated to satisfy the CCAMLR decision rules and maintain the stock at 75% of the level that would occur in the absence of fishing. These TACs were endorsed by the CCAMLR (CCAMLR 2019a, b).

Stock status determination

Based on the level of catch, the harvest rate relative to the stock biomass estimate (which, under the harvest strategy, allows for a high rate of escapement) and the robust nature of the assessment (which includes fisheries-independent data), the stock is determined to be **not overfished** and **not subject to overfishing**.

Patagonian toothfish (*Dissostichus eleginoides*)



Line drawing: FAO

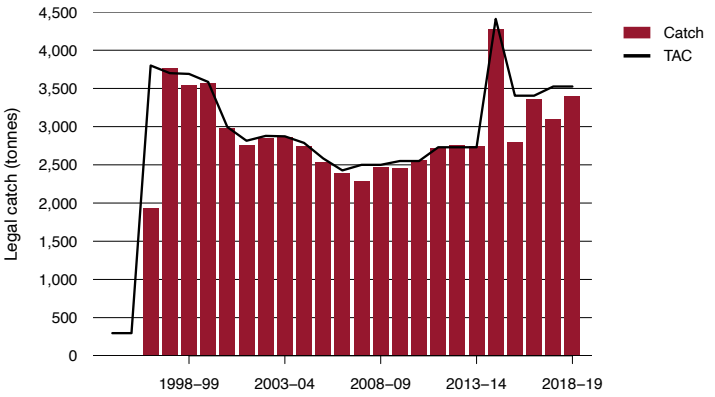
Stock structure

The Patagonian toothfish stock at HIMI is considered to comprise a population distinct from other regional toothfish populations in the south-west Pacific and Atlantic oceans (Appleyard, Ward & Williams 2002). However, limited genetic variation has been found among populations in the western Indian Ocean sector of the Southern Ocean—that is, HIMI, Crozet Islands, Kerguelen Islands, Marion Island and Prince Edward Islands (Appleyard, Williams & Ward 2004; Toomey et al. 2016). Data from tagging studies (for example, Welsford et al. 2011; Williams et al. 2002) indicate that, although adult toothfish at HIMI are relatively sedentary and usually recaptured within 15 nm of their point of release, in some cases they travel significant distances. For example, toothfish tagged at HIMI have been recaptured approximately 800 nm and 1,000 nm away on the Kerguelen and Crozet plateaus, respectively. Thus, toothfish in the Indian Ocean sector of the Southern Ocean may form a metapopulation, with some limited connectivity between the populations. The stock structure of toothfish on the Kerguelen Plateau is being further investigated in collaboration with French scientists so that population models of toothfish in the area can be refined and management can be improved across the Kerguelen Plateau (Péron et al. 2016; Welsford et al. 2011). For the purposes of the assessment, the HIMI toothfish population is considered to be distinct.

Catch history

Catch of Patagonian toothfish in the HIMIF has declined slightly since the late 1990s, but was relatively stable from the early 2000s to 2013–14 and has mirrored the TAC (Figure 25.3). Because of the higher TAC, catches were greater in 2014–15. Catch rates dropped in the 2015–16 fishing season, but catches in the 2017–18 (3,092 t) and 2018–19 (3,390 t) seasons were closer to the TAC.

FIGURE 25.3 Catch and TAC of Patagonian toothfish in the HIMIF, 1994–95 season to 2018–19 season



Note: **TAC** Total allowable catch.
Source: AFMA

Stock assessment

The most recent assessment for Patagonian toothfish (Ziegler 2019) was similar to the 2017 assessment, but included catch data to 2019; fishery observations, including tagging and ageing data to the 2017–18 season; estimated fishing mortality from gear loss; updated growth, length–weight and maturity-at-age parameters; and a simplification of the longline selectivity functions. The assessment was run using the agreed version of CASAL. This assessment also included catches from Williams Ridge, which is in the Southern Indian Ocean Fisheries Agreement area adjacent to the Kerguelen Plateau and the HIMI EEZ. As catches in this area are considered to be part of the same population fished in the HIMIF, they were accounted for in the stock assessment.

The 2019 estimated biomass was 51% of unfished levels ($SB_{2019}/SB_0 = 0.51$; 95% confidence interval 0.49–0.53). This decline from the 2017 estimate of 61% of unfished levels is due to the combination of 3 additional years of fishing, and updated observations and biological parameter estimates. The trajectory of the biomass is likely to decline below the target level of 50% SB_0 during the projection period because of recent weak year-classes. However, if average recruitment is assumed, the stock will rebuild to 50% by the end of the 35-year projection period. Independent of the assumed recruitment, the stock is projected to be approximately 46% of unfished biomass by the time of the next assessment in 2021. The Working Group on Fish Stock Assessment recommended additional work be presented in 2020, including updated recruitment indices from the trawl survey, and updated age-frequency and tag–recapture data. It also recommended that the Working Group on Statistics, Assessments and Modelling develop advice on alternative harvest strategies that may be more precautionary for stocks around the target reference point and where weak recent year-classes may be present.

A catch limit of 3,030 t satisfied the CCAMLR decision rules, and was the recommended TAC for the 2019–20 and 2020–21 fishing seasons (CCAMLR 2019a, b).

Stock status determination

Given the high spawning biomass, the precautionary TAC that satisfies the CCAMLR decision rules, the robust nature of the stock assessment and the extensive CCAMLR review process, the stock is classified as **not overfished** and **not subject to overfishing**.

25.3 Economic status

Key economic trends

A harvest strategy, consistent with the principles of the CCAMLR, is in place for the fishery. The primary management control uses individual transferable quotas (ITQs), in conjunction with input controls. The use of ITQs provides the best chance of achieving maximum efficiency, subject to the fishery's precautionary harvest strategy and strict operational constraints on vessels. Low levels of TAC latency for both mackerel icefish and Patagonian toothfish in the 2017–18 and 2018–19 fishing seasons are indicative of overall positive net economic returns (NER) for the fishery.

It is likely that daily operating costs increased slightly in 2018–19 compared with the 2017–18 fishing season due to a small increase in fuel price and an increase in the number of hooks used per tonne. This is despite a slight increase in overall catch per longline days in 2018–19 (60.3 t/day) compared with 2017–18 (60.0 t/day).

Patagonian toothfish has constituted, on average, more than 90% of the fishery's annual gross value of production during the past decade. Patagonian toothfish has a higher landing value than mackerel icefish, and experiences strong demand and high prices for export. As such, Patagonian toothfish is the main targeted species in this fishery and consequently drives movement of NER.

25.4 Environmental status

The HIMIF is exempt from export controls under the EPBC Act until 9 October 2026. No additional recommendations apply under this exemption, beyond standard recommendations pertaining to reporting.

In 2018, 3 ecological risk assessments were completed for the HIMIF using the 'ecological risk assessment for effects of fishing' method. The assessments covered the 3 gear types used in the fishery: demersal trawl, midwater trawl and demersal longline (Bulman et al. 2018; Sporcic et al. 2018a, b). All the assessments were completed to level 1 (Scale, Intensity, Consequence Analysis). The results for the 3 assessments were all improved from the previous assessments in 2009. The 2 trawl gears did not trigger the need for a level 2 analysis because there is limited trawl effort in the fishery. For the longline fishery, although the effort has increased since the previous assessment in 2009, improved research and mitigation resulted in only 1 component (community) requiring further assessment. This was due to a paucity of data on the broader consequences to the ecosystem of removing toothfish. However, ecosystem models of the region are currently being developed and will be used to assess the wider ecosystem effects of fishing.

In accordance with accreditation under the *EPBC Act 1999* (see Chapter 1, 'Protected species interactions') AFMA publishes and reports quarterly on interactions with protected species on behalf of Commonwealth fishing operators to the Department of Agriculture, Water and the Environment (DAWE) and these are summarised below.

In the HIMI longline fishery in 2019 (calendar year), 1 porbeagle shark (*Lamna nasus*) died when it became entangled, while 1 Antarctic sleeper shark (*Somniosus antarcticus*) was released alive after being hooked. One southern elephant seal (*Mirounga leonina*) became entangled in the longline and died. Finally, 3 white-chinned petrels (*Procellaria aequinoctialis*) and 1 grey petrel (*Procellaria cinerea*) also became entangled in the longline and died, while 1 southern giant petrel (*Macronectes giganteus*) was released alive.

These reported interactions with protected species form a part of the ongoing monitoring by DAWE of the performance of fisheries within their accreditation under the EPBC Act.

25.5 References

AAD 2014, *Heard Island and McDonald Islands Marine Reserve management plan 2014–2024*, Australian Antarctic Division, Department of the Environment, Canberra.

Appleyard, SA, Ward, RD & Williams, R 2002, 'Population structure of Patagonian toothfish around Heard, McDonald and Macquarie Islands', *Antarctic Science*, vol. 14, pp. 364–73.

——, Williams, R & Ward, RD 2004, 'Population genetic structure of Patagonian toothfish in the West Indian Ocean sector of the Southern Ocean', *CCAMLR Science*, vol. 11, pp. 21–32.

Bulman, CM, Sporcic, M, Pethybridge, H & Hobday, A 2018, *Ecological risk assessment for effects of fishing. Final report for the demersal longline sub-fishery of the Heard Island and McDonald Islands Fishery 2010/11-2014/15*, report for the Australian Fisheries Management Authority, CSIRO, Hobart.

CCAMLR 2019a, *Report of the thirty-eighth meeting of the Scientific Committee*, SC-CAMLR-XXXVIII, Commission for the Conservation of Antarctic Marine Living Resources, Hobart.

——2019b, *Report of the Working Group on Fish Stock Assessment*, WG-FSA-19, Commission for the Conservation of Antarctic Marine Living Resources, Hobart.

Constable, AJ, Williams, R & de la Mare, WK 1998, 'Assessment of by-catch in trawl fisheries at Heard and McDonald Islands', *CCAMLR Science*, vol. 5, pp. 231–43.

Dell, J, Maschette, D, Woodcock, E & Welsford, D 2015, *Biology, population dynamics and preliminary assessment of the long-term yield of* Macrourus caml *by-caught by the Australian fishery at Heard Island and the McDonald Islands (CCAMLR division 58.8.2)*, WG-FSA-15/63, report to the CCAMLR Working Group on Fish Stock Assessment, Hobart.

Department of Agriculture and Water Resources 2018, *Commonwealth Fisheries Harvest Strategy Policy*, Department of Agriculture and Water Resources, Canberra.

Kuhn, KL & Gaffney, PM 2006, 'Preliminary assessment of population structure in the mackerel icefish (*Champsocephalus gunnari*)', *Polar Biology*, vol. 29, pp. 927–35.

Maschette, D & Dell, J 2015, *An updated assessment of unicorn icefish (*Channichthys rhinoceratus*) in division 58.5.2, based on results from the 2015 random stratified trawl survey*, WG-FSA-15/50, report to the CCAMLR Working Group on Fish Stock Assessment, Hobart.

—— , Nowara, G & Welsford, DC 2019, *A preliminary assessment for mackerel icefish (*Champsocephalus gunnari*) in division 58.5.2, based on results from the 2019 random stratified trawl survey*, WG- FSA-2019/02, report to the CCAMLR Working Group on Fish Stock Assessment, Hobart.

Nowara, GB, Lamb, TD & Ziegler, P 2019, *Estimates of abundance of* Dissostichus eleginoides *and* Champsocephalus gunnari *from the random stratified trawl survey in the waters surrounding Heard Island in Division 58.5.2 for 2019*, WG-FSA-2019/03, report to the CCAMLR Working Group on Fish Stock Assessment, Hobart.

Péron, C, Welsford, DC, Ziegler, P, Lamb, TD, Gasco, N, Chazeau, C & Duhamel, G 2016, 'Modelling spatial distribution of Patagonian toothfish through life-stages and sex and its implications for the fishery on the Kerguelen Plateau', *Progress in Oceanography*, vol. 141, pp. 81–95.

Sporcic, M, Pethybridge, H, Bulman, CM, Hobday, A & Fuller, M 2018a, *Ecological risk assessment for effects of fishing. Final report for the Heard Island and McDonald Islands Fishery: demersal trawl sub-fishery 2010/11 to 2014/15*, report for the Australian Fisheries Management Authority, CSIRO, Hobart.

——, Pethybridge, H, Bulman, CM, Hobday, A & Fuller, M 2018b, *Ecological risk assessment for effects of fishing. Final report for the Heard Island and McDonald Islands Fishery: midwater trawl sub-fishery 2010/11 to 2014/15*, report for the Australian Fisheries Management Authority, CSIRO, Hobart.

Toomey, L, Welsford, D, Appleyard, SA, Polanowski, A, Faux, C, Deagle, BE, Belchier, M, Marthick, J & Jarman, S 2016, 'Genetic structure of Patagonian toothfish populations from otolith DNA', *Antarctic Science*, vol. 28, pp. 347–60.

Welsford, DC, Candy, SG, Lamb, TD, Nowara, GB, Constable, AJ & Williams, R 2011, 'Habitat use by Patagonian toothfish (*Dissostichus eleginoides* Smitt 1898) on the Kerguelen Plateau around Heard Island and the McDonald Island', in G Duhamel & DC Welsford (eds), *First symposium on the Kerguelen Plateau: marine ecosystems and fisheries*, Societe Francaise d'Ichtyologie, Paris, pp. 125–36.

Williams, R, Smolenski, AJ & White, RWG 1994, 'Mitochondrial DNA variation of *Champsocephalus gunnari* Lonnberg (Pisces: Channichthyidae) stocks on the Kerguelen Plateau, southern Indian Ocean', *Antarctic Science*, vol. 6, pp. 347–52.

——, van Wijk, E, Constable, A & Lamb, T 2001, *The fishery for* Champsocephalus gunnari *and its biology at Heard Island (Division 58.5.2)*, WAMI-01/04, report to the CCAMLR Workshop on Assessment Methods for Icefish, Hobart.

——, Tuck, GN, Constable, AJ & Lamb, T 2002, 'Movement, growth and available abundance to the fishery of *Dissostichus eleginoides* Smitt, 1898 at Heard Island, derived from tagging experiments', *CCAMLR Science*, vol. 9, pp. 33–48.

Ziegler, P 2019, *Draft integrated stock assessment for the Heard Island and McDonald Islands Patagonian toothfish (*Dissostichus eleginoides*) Fishery in Division 58.5.2*, WG-FSA-2019/32, report to the CCAMLR Working Group on Fish Stock Assessment, Hobart.