Chapter 11
Shark gillnet and shark hook sectors

J Woodhams, D Wright, K Davis and R Curtotti

FIGURE 11.1 Fishing intensity in the shark gillnet sector of the Southern and Eastern Scalefish and Shark Fishery, 2021–22 fishing season

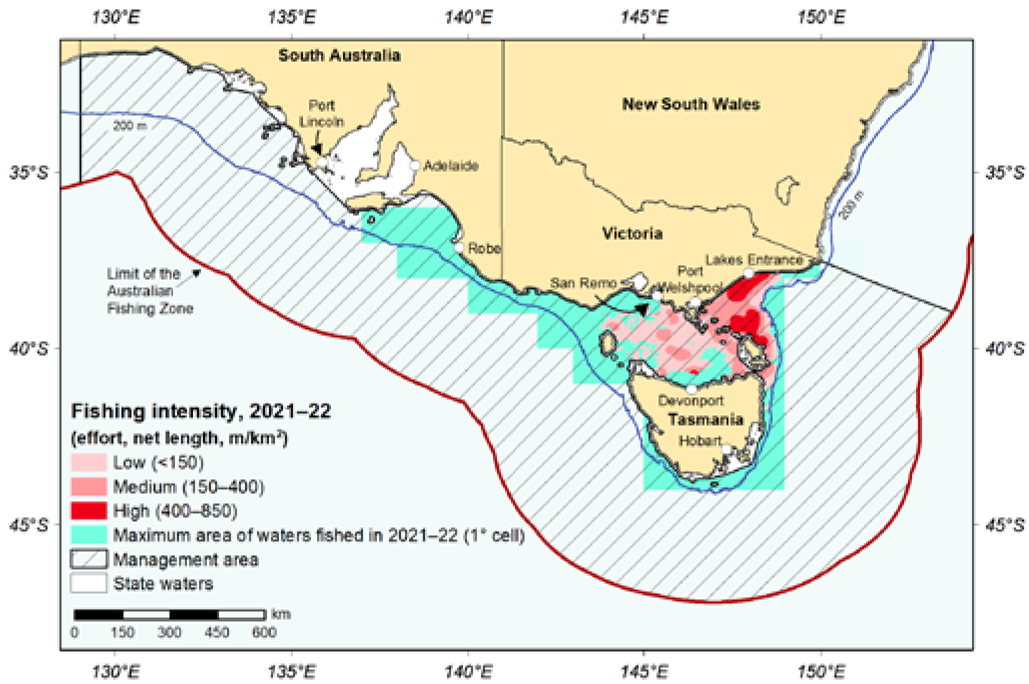
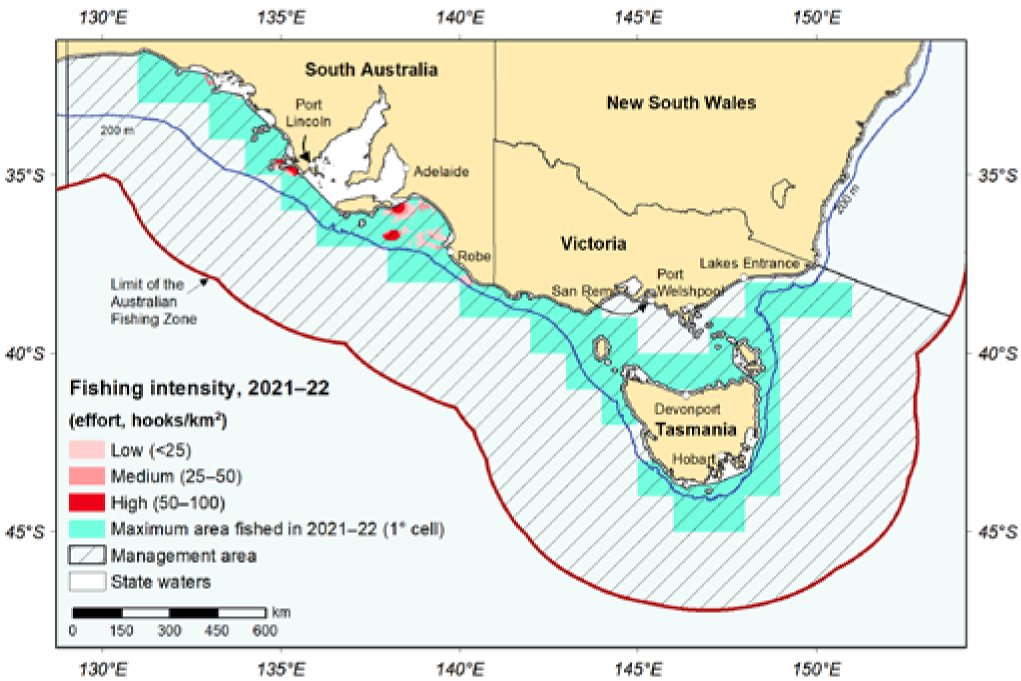


FIGURE 11.2 Fishing intensity in the shark hook sector of the SESSF, 2021–22 fishing season



Notes: **SESSF** Southern and Eastern Scalefish and Shark Fishery.

TABLE 11.1 Status of the shark gillnet and shark hook sectors

Stock	2020 Fishing mortality	2020 Biomass	2021 Fishing mortality	2021 Biomass	Comments
Biological status					
Elephantfish (*Callorhinchus milii*)					Total catches are unlikely to drive the stock into an overfished state. Stock is unlikely to be below the LRP.
Gummy shark (*Mustelus antarcticus*)					Total catches are unlikely to drive the stock into an overfished state. Estimates of pup production are at, or above, the TRP.
Sawsharks (*Pristiophorus cirratus, P. nudipinnis*)					Total catch is below the RBC. Recent CPUE is above the TRP.
School shark (*Galeorhinus galeus*)					Uncertain if fishing mortality in 2021–22 will allow recovery within the specified time frame. Biomass is likely to still be below the LRP.
Economic status					
Most recent estimates of net economic returns for 2018–19 are positive and have been on an increasing trend since 2013–14. Gummy shark stock is at or above the B_{MEY} target. Biomass of school shark requires rebuilding. ITQs have helped to facilitate improved economic productivity.					

Notes: **B_{MEY}** Biomass at maximum economic yield. **CPUE** Catch-per-unit-effort. **ITQ** Individual transferable quota. **LRP** Limit reference point. **RBC** Recommended biological catch. **TRP** Target reference point.

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

11.1 Description of the fishery

Area fished, fishing methods and key species

The shark gillnet and shark hook sectors (SGSHS) are part of the Gillnet, Hook and Trap Sector (GHTS) of the Southern and Eastern Scalefish and Shark Fishery (SESSF). Most fishing in the SGSHS using nets occurs in Bass Strait (Figure 11.1), while most fishing using hooks occurs off South Australia (Figure 11.2).

The SGSHS uses demersal gillnet and demersal longline to target gummy shark (*Mustelus antarcticus*). Sawsharks (*Pristiophorus cirratus* and *P. nudipinnis*) and elephantfish (*Callorhinchus milii*) are caught as byproducts of fishing for gummy sharks.

School shark (*Galeorhinus galeus*) was historically the primary target species in the fishery, but biomass was reduced below the limit reference point (LRP) around 1990. The Australian Fisheries Management Authority (AFMA) implemented a rebuilding strategy for school shark in 2008, and the stock was listed as conservation-dependent under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) in 2009. Although overfished, school shark is still the second most economically important stock in the fishery. School shark has been subject to catch limits and other measures to reduce catch for some time. Recent measures include the implementation of a catch ratio of 20% school shark to gummy shark – whereby a quota holder must hold 5 times more gummy shark quota than their school shark catch (introduced for the 2011–12 season) – and the requirement that all live-caught school shark be released (introduced for the 2014–15 season).

Species other than those assessed for status accounted for approximately 6% of the total landed catch using shark gillnet and shark hook gears. These species mainly comprised broadnose shark (*Notorynchus cepedianus*), boarfishes (Pentacerotidae – undifferentiated) and snapper (*Chrysophrys auratus*).

Management methods

The fishery is managed using a combination of input controls (gear restrictions and closed areas) and output controls (individual transferable quotas and limits on the proportion of school shark catch to gummy shark catch). Gummy shark, elephantfish and sawsharks are managed under the SESSF harvest strategy framework (AFMA 2021a), summarised in Chapter 7. School shark is managed under a rebuilding strategy and is subject to an incidental catch limit, and other measures to prevent targeting and reduce catches to support recovery. Spatial closures are implemented across the fishery to protect school shark breeding populations, pupping and nursery areas, school and gummy shark habitat, and to promote the recovery of upper-slope dogfish stocks.

Gear and area closures have been implemented (primarily off South Australia) to reduce the risk of interactions with Australian sea lions (*Neophoca cinerea*) and dolphins (family Delphinidae). These have changed the fishing areas and targeting behaviour of fishers, and influenced the catch of target species.

From 1 July 2015, electronic monitoring (EM) has been mandatory for all full-time vessels in the SGSHS. The management aim is to review at least 10% of all recorded hauls to verify the accuracy of logbooks. In addition, 100% of video footage is reviewed for gillnet boats operating off South Australia's Australian Sea Lion Management Zones to monitor interactions with protected species. The deployment of physical observers ceased with the commencement of EM. This meant that there was no longer an avenue to collect biological data to support stock assessments, and alternative arrangements had to be made. AFMA implemented an industry-coordinated data collection program in October 2018, to collect biological data needed to support stock assessments (SIDaC). Physical observers were deployed again for a brief period between September 2017 and July 2018.

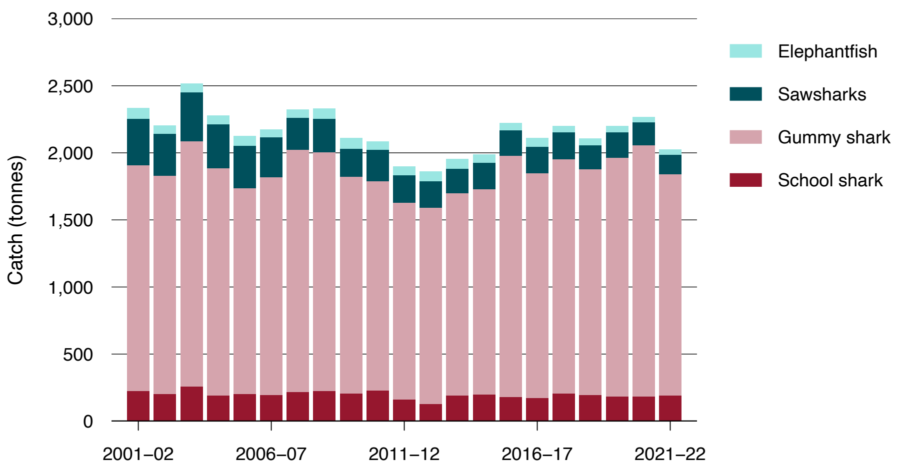
Fishing activity

Fishing for sharks in the waters off southern Australia began in the 1920s, using longlines (Figures 11.6a and 11.10a). During the 1970s and 1980s, the sector mainly targeted school shark (Figure 11.10a). Adoption of monofilament gillnets and concern about mercury content in large school sharks, coupled with declining school shark catches, resulted in gummy shark becoming the principal target species from around 1986 (Figures 11.6a). This transition occurred in the early 1970s in Bass Strait, and later in the waters off South Australia and Tasmania. Additional information on catch and catch history is provided below for each of the key stocks.

Catch of the 4 species assessed for status in this chapter have been relatively stable in recent years (Figure 11.3). Gummy shark continues to be the dominant species in terms of catch and value, and remains the principal driver of fishing activity.

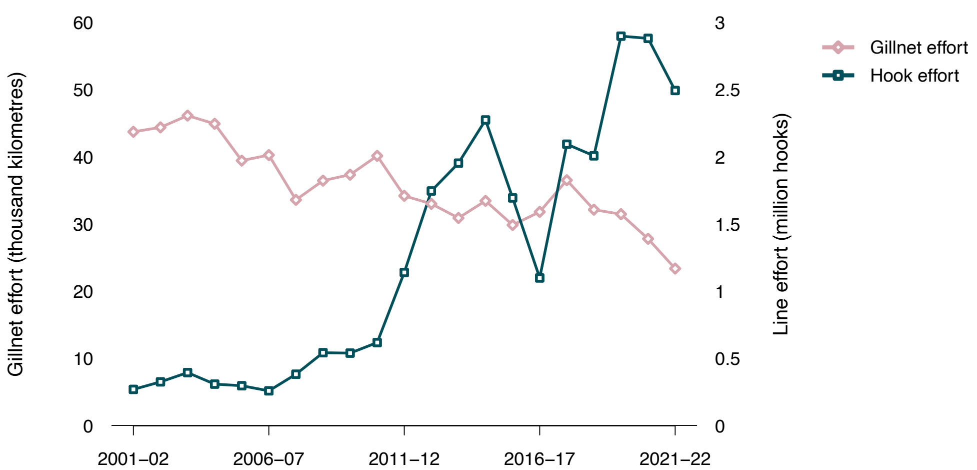
Before spatial closures, which have been progressively implemented since 2003, effort in the SGSHS was spread across the waters off South Australia and eastern Victoria. However, the spatial closures outlined above have resulted in gillnet effort being concentrated off Victoria more recently (Figure 11.1), along with an increase in hook effort to replace gillnet effort off South Australia (Figure 11.2). Effort in the gillnet sector peaked in 1987 at 99,000 km of gillnet hauled but has decreased to around one-quarter of this level in 2021–22 (23,393 km of gillnet hauled) (Figure 11.4). Hook effort in 2021–22 was 2.49 million hooks. This is a decrease from around 2.88 million hooks in the 2020–21 season but remains a significant increase when compared with historical levels.

FIGURE 11.3 Annual landings in the SESSF, by species, 2001–02 to 2021–22



Source: AFMA catch disposal records

FIGURE 11.4 Annual gillnet and hook effort, 2001–02 to 2021–22



Source: AFMA logbooks

TABLE 11.2 Main features and statistics for the SGSHS

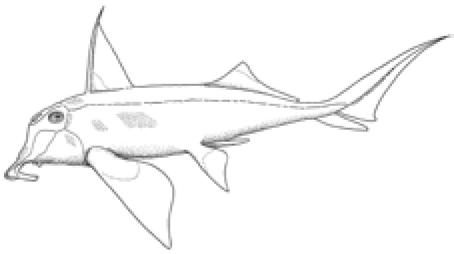
Fishery statistics a	2020–21 fishing season			2021–22 fishing season	
Stock	**TAC (t)**	**Catch (t) (GHTS, CTS + GABTS)**	**GVP (2020–21) (GHTS, CTS)**	**TAC (t)**	**Catch (t) (GHTS, CTS + GABTS)**
Elephantfish	114	37 (26, 11)	$0.07 million ($0.05 million, $0.02 million)	114	38 (22, 16)
Gummy shark	1,775	1,874 (1,695, 179)	$22.25 million ($20.53 million, $1.72 million)	1,672	1,649 (1,489, 159)
Sawshark	432	172 (94, 78)	$0.56 million ($0.38 million, $0.18 million)	509	147 (77, 70)
School shark	195 **b**	184 (155, 30)	$1.96 million ($1.65 million, $0.31 million)	194 **b**	192 (156, 36)
Total	**2,516**	**2,268 (1,970, 297)**	**$24.84 million ($22.61 million, $2.23 million)**	**2,489**	**2,026 (1,744, 281)**
Other spp.	n/a	147 (147, 0 **c**)	–	n/a	124 (124, 0 **c**)
Total fishery	**n/a**	**2,415**	**$24.84 million ($22.61 million, $2.23 million)**	**n/a**	**2,150**
Fishery-level statistics					
Effort	Gillnet: 27,820 km of net hauled Hook: 2,881,959 hooks set			Gillnet: 23,393 km of net hauled Hook: 2,493,920 hooks set	
Fishing permits **d**	Gillnet: 61 Shark hook: 13			Gillnet: 60 Shark hook: 13	
Active vessels	Gillnet: 31 Shark hook: 38			Gillnet: 27 Shark hook: 40	
Observer coverage **e**	Gillnet: 10% Hook: 10%			Gillnet: 10% Hook: 10%	
Fishing methods	Demersal gillnet, demersal longline, auto-longline				
Primary landing ports	Lakes Entrance, Port Welshpool, San Remo (Victoria); Adelaide, Port Lincoln, Robe (South Australia); Devonport, Hobart (Tasmania)				
Management methods	Input controls: gear restrictions, closed areas Output controls: ITQs, school shark / gummy shark catch ratio restriction, size limits, trip limits				
Primary markets	Domestic: Adelaide, Melbourne and Sydney – fresh and frozen				
Management plan	Southern and Eastern Scalefish and Shark Fishery Management Plan 2003				

a Fishery statistics are provided by fishing season, unless otherwise indicated. Undercatch and overcatch provisions are provided for in the harvest strategy for this fishery, and this mechanism explains catches that exceed the agreed TAC. Fishing season is 1 May to 30 April. Value statistics are by financial year and were not available for the 2021–22 financial year at the time of publication. Components of catch may not sum to totals due to rounding. **b** Incidental catch allowance. **c** All 'other species' catch from the GABTS is recorded in Chapter 10, and all 'other species' catches from the CTS and the Scalefish Hook Sector are recorded in Chapter 8. **d** In the GHTS, additional permit types limit gear use and access to state waters. **e** Numbers of hooks observed relates only to the shark hook sector. Since 1 July 2015, electronic monitoring has been mandatory for all full-time vessels in the SGSHS. Video footage of at least 10% of all recorded hauls is reviewed to verify the accuracy of logbooks. In addition, gillnet boats operating off South Australia's Australian Sea Lion Management Zones are subject to 100% review of video footage for interactions with protected species.

Notes: **CTS** Commonwealth Trawl Sector. **GABTS** Great Australian Bight Trawl Sector. **GHTS** Gillnet, Hook and Trap Sector. **GVP** Gross value of production. **ITQ** Individual transferable quota. **n/a** Not applicable. **TAC** Total allowable catch (for the entire SESSF). **–** Not available.

11.2 Biological status

Elephantfish (*Callorhinchus milii*)



Line drawing: Karina Hansen

Stock structure

Stock structure of elephantfish is not known, and populations are considered to constitute a single stock for management purposes. A single fishery-level stock is assumed for status determination purposes.

Catch history

Elephantfish is a small component of landed catch of the 4 stocks assessed in this chapter. Catch of elephantfish in the SGSHS increased during the 1970s and peaked at almost 120 t in 1985 (for catch since 1997, see Figure 11.5a). Landed catch has since declined, and has been relatively stable at around 40–50 t in recent seasons (Figure 11.5b).

Combined landed catch (from catch disposal records – CDRs) from the GHTS, the Commonwealth Trawl Sector (CTS) and the Great Australian Bight Trawl Sector (GABTS) in 2021–22 was 38 t, up slightly from that taken in 2020–21 (37 t) and down from the 46.6 t taken in 2019–20 (Figure 11.5b; Table 11.2).

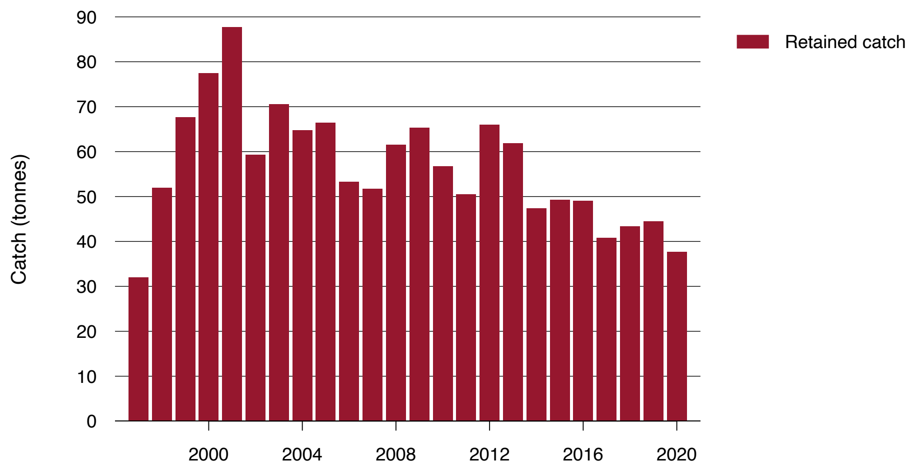
Reliable estimates of elephantfish discards are currently unavailable. Additionally, post-release survival of discarded elephantfish is uncertain, meaning that the fishing mortality associated with these discards is also uncertain. For the purposes of status determination, all discards for this stock are assumed to be dead. There are no recent estimates of recreational take of this stock.

In an analysis of congruence between EM and logbook reporting in the GHTS, Emery et al. (forthcoming) concluded that discarded elephantfish within the gillnet sector displayed low congruence at the fleet level. On average, 9.35 individuals were reported by EM for every 5.85 individuals reported by logbook across the period examined (2016–17 to 2019–20). The work by Emery et al. (forthcoming) indicates that current logbook estimates of discards for this stock cannot be relied on. However, these analyses may provide insights into discarding behaviour of the fleet that may help to refine the standardisation of catch-per-unit-effort (CPUE), which has previously been used as an index of abundance for the stock and as a proxy for biomass.

Althaus, Thomson & Sutton (2021) estimated the 4-year weighted average for state catches and discards for 2017 to 2020. These numbers were 3.1 t and 114 t, respectively.

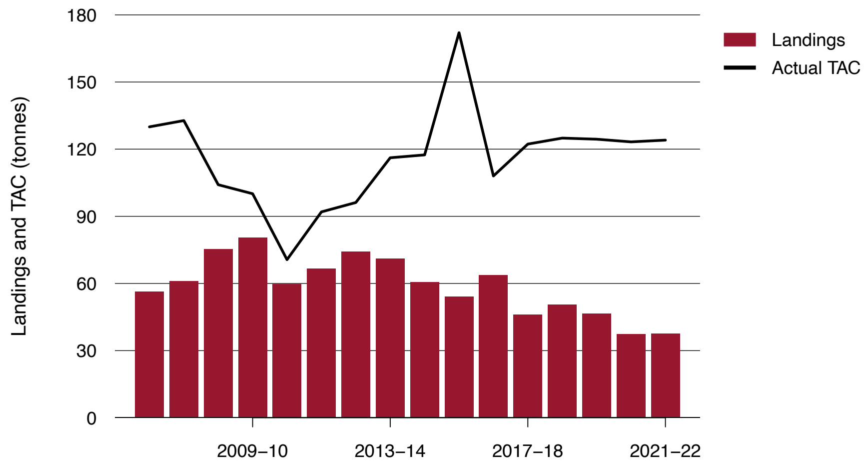
Using the combined landed catch from CDRs (38 t), and the 4-year weighted averages for state catch (3.1 t) and discards (114 t), total catch and discards for the 2021–22 fishing season is estimated to be 155.1 t.

FIGURE 11.5a Elephantfish catch in the SGSHS, 1997 to 2020



Source: Sporcic 2021

FIGURE 11.5b Annual elephantfish landings and TAC in the SGSHS, 2006–07 season to 2021–22 season



Notes: **TAC** Total allowable catch. Actual TAC includes carryover of undercatch or overcatch from the previous season.

Source: AFMA catch disposal records

Stock assessment

Elephantfish was managed as a tier 4 stock under the SESSF harvest strategy framework until 2017. The tier 4 harvest strategy uses standardised CPUE as an index of abundance for the stock and as a proxy for biomass. At its February 2018 meeting, the Shark Resource Assessment Group (SharkRAG) considered that both tier 4 analyses presented (that is, including or excluding discards) were unsuitable for providing advice on the recommended biological catch (RBC) (AFMA 2020a), because of the lack of a time series of robust discard data, difficulties in factoring discard data into the tier 4 analyses and uncertainty in estimates of recreational catch. SharkRAG felt that both tier 4 analyses would produce prohibitively low total allowable catches (TACs), driven by assumptions about discards and recreational catch, whereas the CPUE itself suggested little cause for concern (AFMA 2018b).

In 2018, SharkRAG recommended rolling over the TAC from the previous season (114 t) to the 2019–20 season (AFMA 2018b). In 2019, the Southern and Eastern Scalefish and Shark Fishery Resource Assessment Group recommended setting the 2020–21 TAC for elephantfish using a weight-of-evidence approach, based on a review of recent catches and the outcomes of the most recent ecological risk assessment (ERA) (Sporcic, Bulman & Fuller 2021b).

At its January 2020 meeting, SharkRAG discussed the issues underlying the generation of an RBC using the tier 4 analyses and recommended rolling over the TAC from the previous season (114 t) to the 2020–21, 2021–22 and 2022–23 fishing seasons. In making its recommendation, SharkRAG noted the low-risk rating of the stock from the recent ERA (AFMA 2020b; Sporcic, Bulman & Fuller 2021b). However, SharkRAG also expressed concerns about its ability to provide robust recommendations on the RBC for the stock because of limited reliable information.

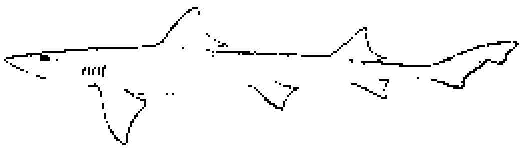
In 2021, preliminary CPUE standardisations for the stock used updated methods and data (Sporcic 2021). Sporcic (2021) indicated that standardised CPUE (where effort was the number of shots) was flat and noisy, and below the long-term average since about 2013. An exploratory CPUE standardisation using net length as the unit of effort (in place of the number of shots) indicated that CPUE had remained below the long-term average since about 2013 and had been essentially flat since 2017, despite a slight increase in 2018 relative to 2017. The 2021 standardisations were not used to produce RBC advice.

Stock status determination

Recent catches have been relatively stable, and the most recent ERA outcome for the stock indicated that the species was at low risk from fishing. None of the available lines of evidence indicate that the biomass of this stock is likely to have been reduced to below the LRP or that current catches are likely to drive the stock into an overfished state. On this basis, the stock is classified as **not overfished** and **not subject to overfishing**.

While the stock is classified as not overfished and not subject to overfishing in 2021, the information that underpins this determination is increasingly uncertain. Analyses by Emery et al. (forthcoming) may provide some insights into discarding behaviour that may facilitate refinement to CPUE standardisation for this stock, noting uncertainties associated with recreational catch and post release survival likely remain.

Gummy shark (*Mustelus antarcticus*)



Line drawing: Karina Hansen

Stock structure

The most recent research on stock structure for gummy shark indicates that there are most likely 2 stocks in Australian waters: one in southern Australia, extending from Bunbury in Western Australia to Jervis Bay in New South Wales, and another in eastern Australia, extending from Newcastle to the Clarence River in New South Wales (White & Last 2008). The southern Australian biological stock is split into 4 populations for modelling purposes: the continental shelf of Bass Strait, Tasmania, South Australia and Western Australia. The first 3 are assessed together by the Commonwealth (Thomson 2020) and are reported here. The fourth is assessed and reported separately by Western Australia (Braccini, McAuley & Rowland 2013). A single biological stock is assumed for status determination purposes.

Catch history

Catch of gummy shark in the SGSHS increased after 1970, initially as byproduct in the school shark fishery, and then increasingly as a target as school shark catches decreased from around 1986 (Figure 11.6a). Catch in the SGSHS reached a peak of around 2,500 t in 2000.

Combined landed catch (from CDRs) of gummy shark for the GHTS, the CTS and the GABTS in 2021–22 was 1,649 t, down from 1,874 t in 2020–21 and 1,781 t in 2019–20 (Figure 11.6b).[1]

In an analysis of congruence between EM and logbook reporting in the GHTS, Emery et al. (forthcoming) concluded that discarded gummy shark within the gillnet sector displayed low congruence, with the logbook on average reporting higher numbers than EM across the period examined (2016–17 to 2019–20). Congruence between EM and logbook improved when gummy

1 Undercatch and overcatch provisions are provided for in the harvest strategy for this fishery, and this mechanism may explain catches that exceed the agreed TAC.

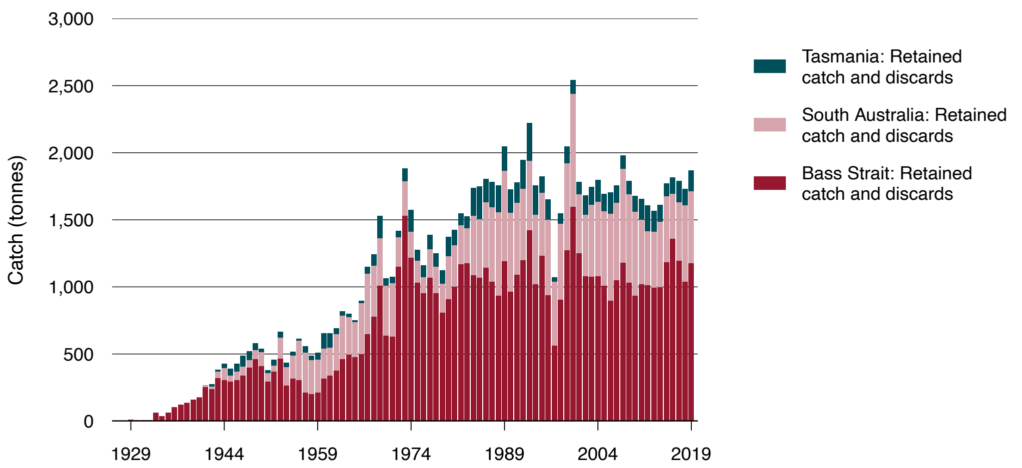
shark was examined at a higher taxonomic level (that is, houndsharks – Triakidae), suggesting the EM analysts were having difficulty in identifying discarded gummy shark to species level. Consequently, the logbook records at the fleet level were considered a more accurate indication of discarded gummy shark than EM. The work by Emery et al. (forthcoming) indicates that it would be reasonable to use the current logbook estimates of discards at the fleet level to understand total mortality for this stock.

Logbook-reported discards in the GHTS for gummy shark in 2021–22 were 27.2 t (24.8 t in 2020–21, 28 t in 2019–20, 34.3 t in 2018–19 and 27.2 t in 2017–18). Post-release survival of discards is uncertain, meaning that the fishing mortality associated with discarded catch is also uncertain. For the purposes of status determination, all discards for this stock are assumed to be dead.

Althaus, Thomson & Sutton (2021) estimated the 4-year weighted average of state catches to be 113.5 t for 2017 to 2020. They also provided estimates of trawl discards for 2017 to 2020. ABARES calculated a 4-year weighted average of those discard estimates for 2017 to 2020 to derive a 4-year weighted average of trawl discards of 24.6 t. There are no recent estimates of recreational take of this stock.

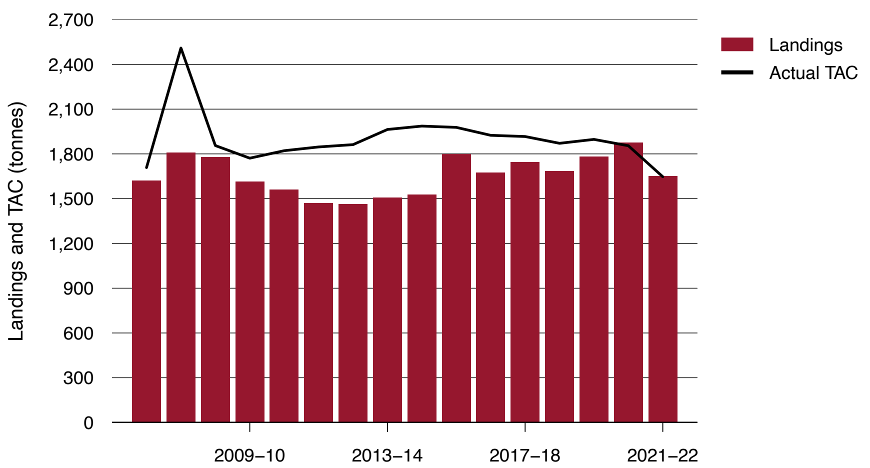
Using the combined landed catch from CDRs (1,649 t), the 4-year weighted average of state catch (113.5 t), logbook discards for the Gillnet, Hook and Trap Sector (27.2 t), and the 4-year weighted average of trawl discards (24.6 t), the total of catch and discards for the 2021–22 fishing season is estimated to be 1,814.3 t.

FIGURE 11.6a Annual gummy shark catch in the SGSHS, 1927 to 2019



Source: Thomson 2020

FIGURE 11.6B Annual gummy shark landings and TAC in the SGSHS, 2006–07 season to 2021–22 season



Notes: **TAC** Total allowable catch. Actual TAC includes carryover of undercatch or overcatch from the previous season.

Source: AFMA catch disposal records

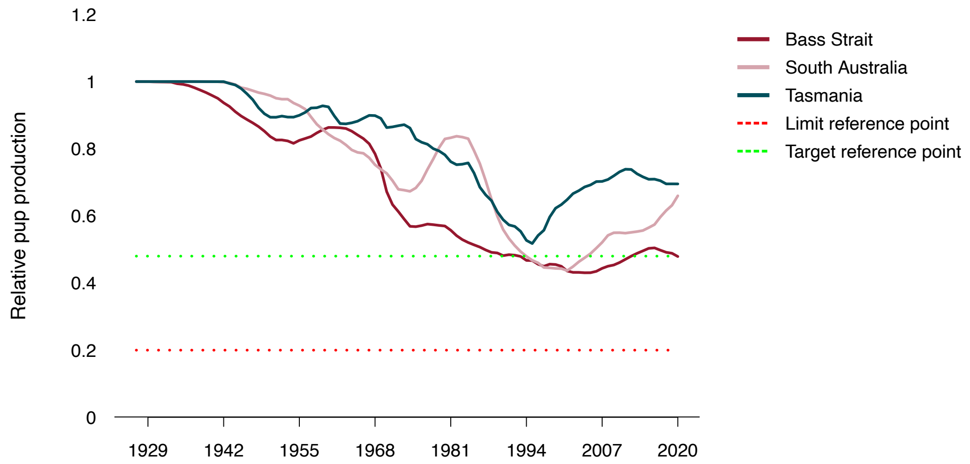
Stock assessment

The most recent stock assessment for gummy shark was in 2020 (Thomson 2020). As in previous assessments, the 2020 assessment uses estimated pup production as a proxy for biomass because of the expected close relationship between pup production and female spawning biomass.

Bass Strait, South Australian and Tasmanian regions are treated as separate stocks in the model, with no movement of animals between these populations.

Pup depletion in 2020 is estimated to be above the 20% LRP for all 3 stocks (Figure 11.7). Depletion is estimated to be 66% (range across sensitivities 66–107%) in South Australia and 69% (range across sensitivities 62–86%) in Tasmania. For Bass Strait, the base-case model estimated depletion at 48%, with the range across all sensitivities being 32–53%. The combined RBC (across the 3 stocks) for 2020 was 1,899 t, and the estimated long-term RBC for the stock was 1,757 t (Thomson 2020).

FIGURE 11.7 Estimated pup production as a proportion of unfished level of pup production for gummy shark in Bass Strait, South Australia and Tasmania, 1927 to 2020

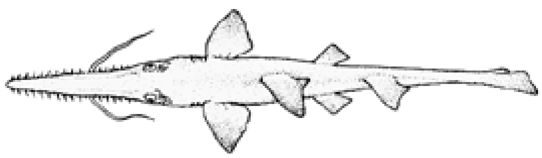


Source: Thomson 2020

Stock status determination

The 2020 stock assessment estimated pup production in the most recent year (2020) to be at or above the target reference point (TRP) for each of the 3 stocks modelled. Recent catches have been in accordance with the harvest strategy and unlikely to drive the stock into an overfished state. On this basis, gummy shark in the SGSHS is classified as **not overfished** and **not subject to overfishing.**

Sawshark (*Pristiophorus cirratus, P. nudipinnis*)



Line drawing: FAO

Stock structure

Three species of sawshark (common sawshark – *P. cirratus*, southern sawshark – *P. nudipinnis*, and eastern sawshark – *P. peroniensis*) are caught in southern Australian waters. Little is known about the stock structure or movements of these species. Two species dominate reported sawshark catches in this sector: common sawshark and southern sawshark. For assessment purposes, all sawsharks found south of the Victoria – New South Wales border are assumed to be common or southern sawshark, and those found north of that border are assumed to be eastern sawshark (AFMA 2014b). Around 90% of the total sawshark catch from southern Australia is understood to be taken from Bass Strait (AFMA 2011). All sawshark catch in the SESSF is managed under a single TAC. A single fishery-level stock is assumed for status determination purposes.

Catch history

Catch of sawshark in the SGSHS increased in the early 1970s to around 200 t by around 1974, and then fluctuated between about 170 t and 350 t per year until the early 2000s (Figure 11.8a).

Combined landed catch (from CDRs) from the GHTS, the CTS and the GABTS in 2021–22 was 147 t, down from 172 t in 2020–21 and 189 t in 2019–20 (Figure 11.8b; Table 11.2).

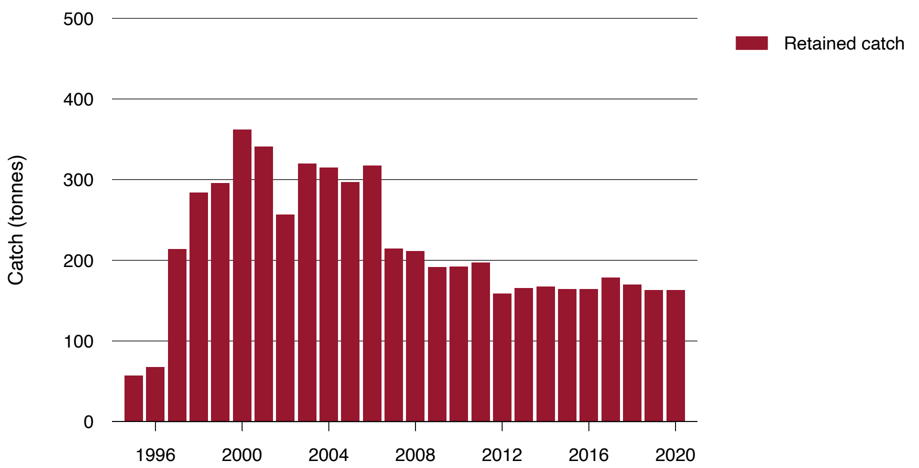
Reliable estimates of discards of sawshark are currently unavailable. Additionally, post-release survival of discarded sawshark is uncertain, meaning that the fishing mortality associated with these discards is also uncertain. For the purposes of status determination, all discards for this stock are assumed to be dead. There are no recent estimates of recreational take of this stock.

In an analysis of congruence between EM and logbook reporting in the GHTS, Emery et al. (forthcoming) concluded that discarded sawshark (grouped codes) within the gillnet sector displayed low congruence at the fleet level, with EM on average reporting 3.65 individuals for every 2.55 individuals reported by logbook across the period examined (2016–17 to 2019–20). The work by Emery et al. (forthcoming) indicates that current logbook estimates of discards for this stock should not be relied on.

Althaus, Thomson & Sutton (2021) estimated the 4-year weighted average for state catches and discards for 2017 to 2020. These numbers were 10.1 t and 26.4 t, respectively.

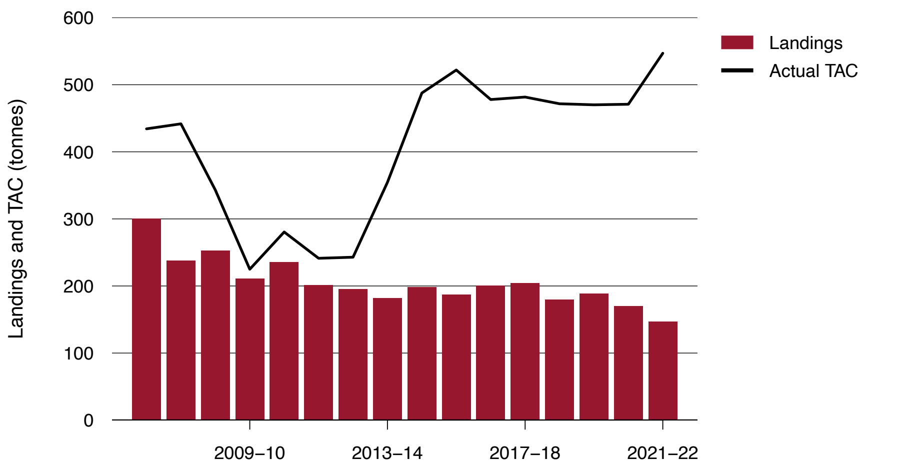
Using the combined landed catch from CDRs (147 t), and the 4-year weighted averages for state catch (10.1 t) and discards (26.4 t), total catch and discards for the 2021–22 fishing season is estimated to be 183.5 t.

FIGURE 11.8a Sawshark catch in the SGSHS, 1995 to 2020



Source: Sporcic 2021

FIGURE 11.8b Sawshark landings and TAC in the SGSHS, 2006–07 season to 2021–22 season



Notes: **TAC** Total allowable catch. Actual TAC includes carryover of undercatch or overcatch from the previous season.

Source: AFMA catch disposal records

Stock assessment

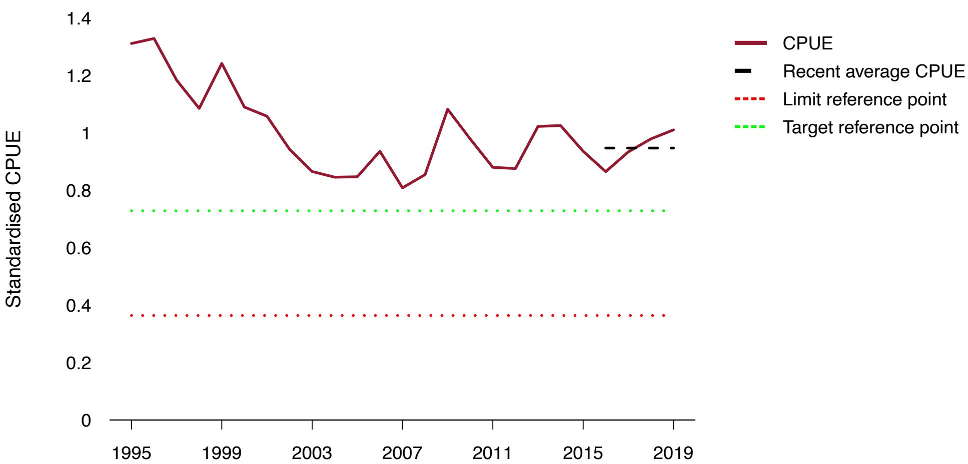
Sawshark has been managed as a tier 4 stock under the SESSF harvest strategy framework since 2009. In 2014, SharkRAG recommended a decrease in the biomass TRP (or target biomass – B_{TARG}) for sawshark from 48% to 40% of unfished biomass to reflect the byproduct nature of the stock (AFMA 2014a).

Potential avoidance of this species by operators using gillnets suggests that the corresponding standardised CPUE may not adequately reflect stock abundance. As a result, SharkRAG recommended using standardised trawl CPUE as an index of abundance (AFMA 2015b) when applying the tier 4 harvest control rule. Two species (common sawshark and southern sawshark) and 2 species-group codes (*Pristiophorus* spp. and Pristiophoridae) comprise the catch data used in the tier 4 analyses for sawshark.

The most recent CPUE standardisation (using trawl data) and tier 4 analysis was in 2020 (Sporcic 2020). These analyses indicated that recent average CPUE (2015 to 2019) was above the TRP (Figure 11.9). The estimated RBC for 2020 was 653.4 t, an increase of 135 t from the previous (2017) estimated RBC (Sporcic 2021).

Noting the multispecies nature of the stock and the tier 4 analysis, SharkRAG, at its meeting in 2020, discussed the value of monitoring the species composition of the catch, to enable a response to any changes that would have implications for future assessment (AFMA 2020a). SharkRAG also discussed the value of collecting life-history data for the species taken (AFMA 2020a).

FIGURE 11.9 Standardised CPUE index for sawshark in the CTS – trawl, 1995 to 2019



Note: **CPUE** Catch-per-unit-effort. **CTS** Commonwealth Trawl Sector.

Source: Sporcic 2020

Stock status determination

The recent average CPUE for sawshark was estimated to be above the TRP. On this basis, the stock is classified as **not overfished**. Total catch in 2021–22 was below the RBC. On this basis, the stock is classified as **not subject to overfishing**.

School shark (*Galeorhinus galeus*)

Line drawing: Karina Hansen

Stock structure

School shark has a broad distribution throughout temperate waters of the eastern North Atlantic, western South Atlantic, and north-eastern and south-eastern Pacific oceans, and temperate waters off South Africa, New Zealand and southern Australia. There is some uncertainty about the stock structure for school shark; however, a recent genetic study found no genetic differences between Australia and New Zealand (Hernández et al. 2015). Although a single biological stock in Australia has been assumed for assessment and management purposes, emerging information suggests that multiple stocks may exist (or may have existed) in the SESSF (Thomson et al. 2019). A single biological stock is assumed for status determination purposes.

Catch history

Catch of school shark in the SGSHS peaked at more than 2,500 t around 1969 and then declined rapidly to around 700 t in 1973 (Figure 11.10a). Catch in the sector increased again to around 2,000 t in 1986 before declining steadily through the late 1980s and 1990s, stabilising at around 200 t per year from 2000 onwards.

Combined landed catch (from CDRs) for the GHTS, the CTS and the GABTS in 2021–22 was 192 t, up from 184 t in both 2020–21 and 2019–20 (Figure 11.10b).

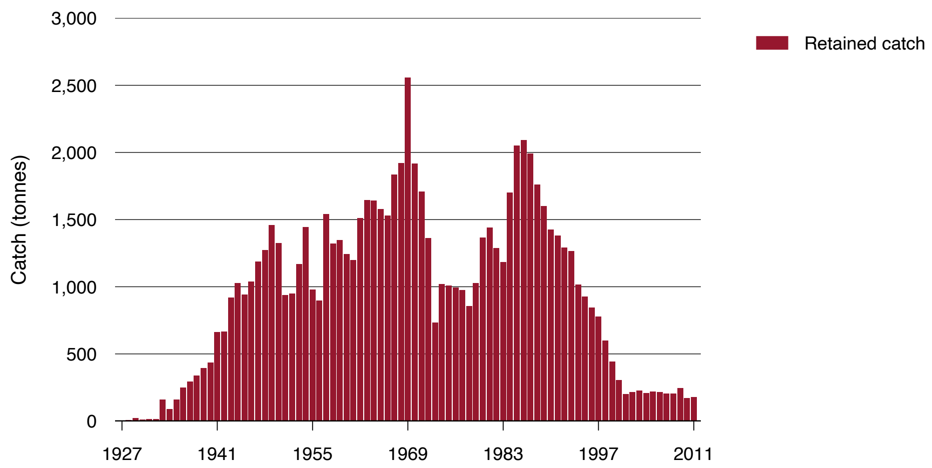
In an analysis of congruence between EM and logbook reporting in the GHTS, Emery et al. (forthcoming) concluded that discarded school shark within the gillnet sector displayed high congruence at the fleet level, with EM on average reporting 2.6 individuals for every 2.8 individuals reported by logbook across the period examined (2016–2017 to 2019–20). The work by Emery et al. (forthcoming) indicates that it would be reasonable to use the current logbook estimates of discards at the fleet level to understand total mortality for this stock. There are no recent estimates of recreational take of this stock.

Logbook-reported discards in the GHTS for school shark in 2021–22 was 46.7 t, down from 52.4 t in 2020–21 and 74.1 t in 2019–20. Post-release survival of discards is uncertain, meaning that the fishing mortality associated with discarded catch is also uncertain. For the purposes of status determination, all discards for this stock are assumed to be dead.

Althaus, Thomson & Sutton (2021) estimate the 4-year weighted average for state catches to be 25.5 t for 2017 to 2020. They also provide estimates of trawl discards for 2017 to 2020. ABARES calculated a 4-year weighted average of those discard estimates for 2017 to 2020 to derive a 4-year weighted average of trawl discards of 9.3 t.

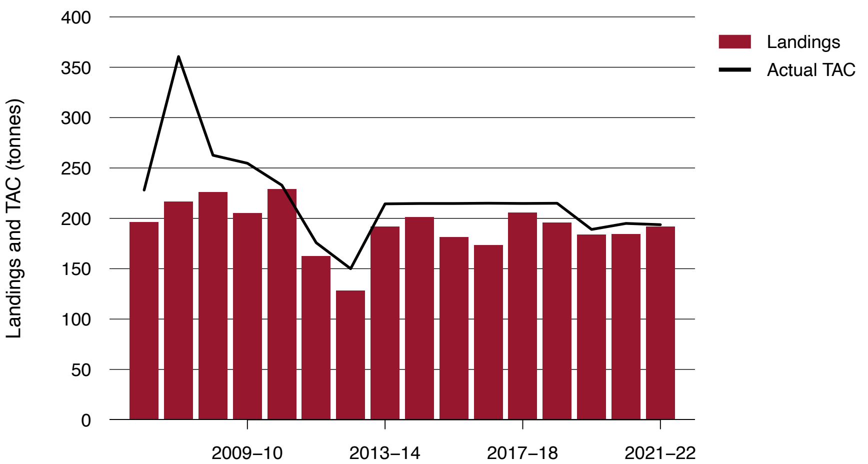
Using the combined landed catch from CDRs (192 t), the 4-year weighted average of state catch (25.5 t), logbook discards for the GHTS (46.7 t), and the 4-year weighted average of trawl discards (9.3 t), total catch and discards for the 2021–22 fishing season is estimated to be 273.5 t.

FIGURE 11.10a Annual school shark catch in the SGSHS, 1927 to 2011



Source: Thomson 2012

FIGURE 11.10b School shark landings and TAC in the SGSHS, 2006–07 season to 2021–22 season



Notes: **TAC** Total allowable catch. Actual TAC includes carryover of undercatch or overcatch from the previous season.
Source: AFMA catch disposal records

Stock assessment

Assessments for school shark indicate that the stock has been overfished since approximately 1990, and it has been classified as such since ABARES began status reporting in 1992. The most recent integrated stock assessment was in 2009, using data to 2008 (Thomson & Punt 2009). At that time, the base-case model estimated biomass to be at 12% of the unfished biomass ($0.12B_0$). The catch data from 1998 to 2008 used in the assessment comprised low (per vessel) catch levels, and the CPUE derived was considered unlikely to accurately reflect the underlying stock dynamics.

In 2012, the 2009 assessment was re-run with additional catch data for 2009 to 2012 (Thomson 2012), specifically to estimate recovery time frames for the stock under a range of future incidental catch levels and to investigate the impact of a proposed auto-longline shark fishery in South Australia. Under a zero-catch scenario, the stock was projected to rebuild to $0.2B_0$ within 23 years. At a constant catch of 250 t, the stock was projected to rebuild to $0.2B_0$ in 80 years, and a constant catch of 275 t was projected to collapse the stock. These projections were based on assumptions that the gear selectivity, and spatial and temporal distribution of catches remain similar to those in 2011. Uncertainties around these median projections were not provided by the assessment. The school shark rebuilding strategy was revised in 2015 using the outputs of these analyses. It specifies a maximum catch of 225 t, which would allow recovery to the $0.2B_0$ LRP in the specified recovery time frame (in this case, set at 3 times the estimated generation time or 66 years) (AFMA 2015a). Consistent with prescribed review time frames, the rebuilding strategy is currently under review again.

In 2018, a close-kin mark–recapture (CKMR) study, which uses a population dynamics model to interpret those data (termed a 'close-kin model' [CKM]) provided an estimate of current absolute abundance and recent population trend (2000 to 2017) from a single region and population (that is, assuming 1 mixed stock) (Thomson et al. 2019). In contrast to previous assessments, the CKM does not provide an estimate of biomass depletion compared with unfished biomass. The abundance of school shark (in numbers) estimated by the CKM (about 50,000 adults; Thomson et al. 2019) was lower than the 2012 assessment model projections (about 250,000 adults; Thomson 2012).

Thomson et al. (2019) undertook projections based on 4 constant exploitation scenarios (zero, 2016 rate, 2017 rate and mean exploitation rate for 2013 to 2017). All 4 exploitation rates resulted in a long-term upward trend in median population size. Of the 4 exploitation rate scenarios explored, SharkRAG agreed to base its advice for future incidental catch allowances (up to the 2021–22 fishing season) on 'the mean exploitation rate for 2013 to 2017', because this scenario provided for consistent recovery (AFMA 2018a).

The median trend for the stock response to the 2013 to 2017 mean exploitation rate was upwards; however, the confidence interval was wide enough to allow a downward trend in the stock, and Thomson et al. (2019) noted that there was no guarantee of the sustainability of these catches. Thomson et al. (2019) noted that the collection of close-kin samples for an additional 3 years is expected to greatly reduce the spread of these confidence intervals. The 2013 to 2017 exploitation rate resulted in total mortality recommendations of 256 t in 2019–20, 263 t in 2020–21 and 270 t in 2021–22.

The CKM considers the period 2000 to 2017, because this was the period over which the juveniles sampled would have been born. The approach did not evaluate biomass relative to an unfished state, as required under the school shark rebuilding strategy (AFMA 2015a). Thomson et al. (2019) proposed that there are likely to be at least 2 school shark stocks (that is, units that are reproductively isolated, at least to some degree, but almost certainly have – possibly completely – overlapping spatial distributions), at least one of which is severely depleted. Such cryptic stocks are understood not to compromise the abundance estimate, provided the stocks sampled are the ones fished, and their key population parameter values are similar. In aggregate, Thomson et al. (2019) expected the close-kin estimate to be unbiased by the presence of cryptic stocks.

Before completion of the close-kin assessment, SharkRAG discussed the difficulties associated with updating the 2009 school shark stock assessment and including the recent close-kin information in an update of that assessment model; it agreed to recommend not pursuing such an update.[2] In December 2018, SharkRAG supported continued close-kin sampling (for 3 years) and use of the CKM for estimating abundance of school shark (AFMA 2018a).

In 2020, SharkRAG supported the engagement of a third party to review the results of the CKMR assessment for school shark. The review was undertaken by domestic and international experts in the CKMR method, statistics and shark biology, and a draft final report was delivered to AFMA in February 2021. The expert panel considered the CKMR to be a suitable method for making management decisions for the stock, and made a number of recommendations to improve the analyses. These recommendations are expected to be considered in the lead-up to, and during, the update to the CKMR assessment scheduled for 2024.

At its meeting in March 2021, SharkRAG agreed that updating the CKMR assessment with 1 further year of catch data would not produce substantially different results (AFMA 2021b). Instead, SharkRAG recommended that the métier analysis (by CSIRO) be used to determine the minimum take of school shark and that the trawl CPUE could be used to inform the TAC until the CKMR assessment is updated (AFMA 2021b). At its meeting in November 2021, SharkRAG agreed to recommend a bycatch TAC of 225 t, based on the best estimate of total, unavoidable mortality (both retained and discarded), the reduction in gummy shark TAC and the projected increase in biomass estimated from the CKMR model (AFMA 2021c). The AFMA Commission determined a 250 t TAC for 2022–23, noting that it equates to the best estimate of true bycatch that will result from maintaining the gummy shark TAC at 1,672 t (AFMA 2022).

Stock status determination

Since the recent CKM work does not provide an estimate of biomass depletion compared with unfished biomass, biomass status in 2021–22 is determined using the information provided by Thomson and Punt (2009) and Thomson (2012). Thomson and Punt (2009) estimated school shark biomass to be $0.12B_0$ in 2008. There are no reliable indications that biomass has recovered to above the LRP. On this basis, the stock remains classified as **overfished**.

There is currently no reliable indicator to determine whether catch in 2021–22 will allow the stock to recover to the LRP within the time frame specified in the 2015 rebuilding strategy. On this basis, fishing mortality status for the stock remains **uncertain**.

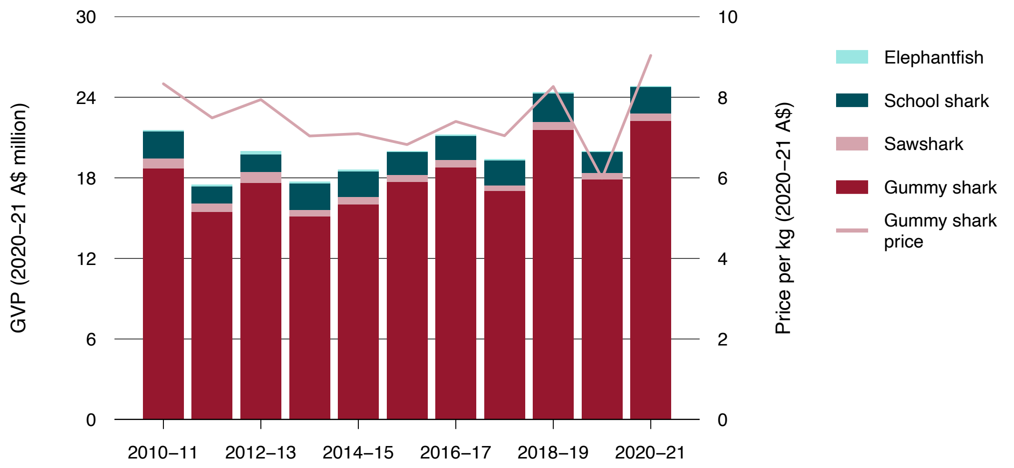
11.3 Economic status

Key economic trends

The gross value of production (GVP) for the 4 shark species taken in the GHTS fluctuated during the decade to 2020–21. The 4 shark species that make up the SGSHS – gummy shark, school shark, sawshark and elephantfish – accounted for around 79% of the GHTS GVP in 2020–21, with scalefish species making up the remainder. Real GVP (in 2020–21 dollars) trended up from a low of $17.7 million in 2013–14 to $24.8 million in 2020–21 (Figure 11.11). This recent positive trend is primarily the result of higher volumes caught and higher prices for gummy shark catch. Gummy shark accounts for the majority of GVP in the SGSHS (90% in 2020–21).

2 Somewhat relatedly, a new CSIRO-led project (FRDC project 2022-006) has just commenced, which is aiming to develop a harvest control rule to use in situations where depletion can no longer be calculated relative to unfished levels.

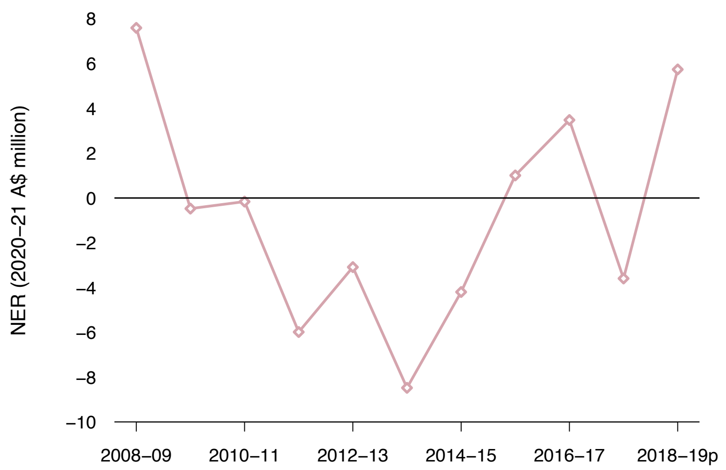
FIGURE 11.11 Real GVP for the SGSHS, by key species, and real price for gummy shark, 2010–11 to 2020–21



Notes: **GVP** Gross value of production. 'Real' indicates that value has been adjusted for inflation.

Net economic returns (NER) were variable between 2002–03 and 2018–19 (Figure 11.12). Strongly negative results were observed between 2009–10 and 2014–15, declining from $6.0 million in 2008–09 to a low of –$7.6 million in 2013–14. Since 2013–14, NER have increased and are estimated to be positive in the most recent non-survey year, 2018–19.

FIGURE 11.12 Real NER for the GHTS, 2008–09 to 2018–19



Notes: **GHTS** Commonwealth Trawl Sector. **NER** Net economic returns. **p** NER estimates for 2018–19 are preliminary non-survey-based estimates.

Source: Curtotti et al. 2022

Changes to prices and costs (terms of trade – TOT) that are outside the control of AFMA also influence NER, so it is important to consider TOT when interpreting NER. TOT declined between 2002–03 and 2016–17, driven by input prices growing faster than output prices. Most of the decline in TOT occurred from 2009 to 2014, which coincided with falling NER over this period and indicates that TOT were a strong contributing factor to declining NER. Rising TOT between 2013–14 and 2016–17 supported growth in NER.

There is a less clear relationship between productivity and NER movement in the GHTS. Fleet productivity increased from 2002–03 to 2007–08, mainly driven by a reduction in input use, and then fluctuated over the period 2007–08 to 2016–17. The number of active boats fell from 129 vessels in 2002–03 to 66 vessels in 2016–17, with almost all of this reduction occurring in the period 2002–03 to 2007–08.

Performance against economic objective

Gummy shark is the primary driver of economic performance in the SGSHS, accounting for the majority of the GVP in 2020–21. The results of the 2020 stock assessment indicate that the biomass of gummy shark stocks are at or above the TRP and that will help generate positive NER.

School shark is the second most valuable species in the sector, accounting for 8% of SGSHS GVP in 2020–21, despite being caught under an incidental catch allowance. School shark biomass remains below the LRP, and stock rebuilding measures are likely to be affecting sector profitability.

In 2010 significant spatial closures were introduced in the GHTS that prohibited the use of gillnets in the fishing grounds off the South Australian coastline. These closures were put in place to protect, and reduce interactions with, protected marine mammals, including Australian sea lions and dolphins. These closures resulted in a structural shift of gillnetting activity toward Bass Strait. This structural shift of the fleet to alternative gillnet grounds likely contributed to the decline in NER after 2008–09. Improved NER since 2013–14 suggest that fishers have adapted to the changed operating environment during this period.

11.4 Environmental status

EPBC Act approvals

The SESSF was accredited under part 13 of the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) on 11 February 2022. The SESSF also has export approval under section 13A of the EPBC Act until 12 February 2025. Additional conditions of export approval include:

- ensuring management measures are in place to meet objectives of rebuilding strategies for species listed as conservation dependent under the EPBC Act
- by 12 August 2024, investigate and develop alternative methods that will provide an index of abundance to determine the status of conservation dependent stocks
- develop a research plan under the Orange Roughy Rebuilding Strategy which identified options for monitoring stock status for all orange roughy stocks within the area of the SESSF
- continue to evaluate and report on the effectiveness of rebuilding strategies and management strategies for conservation dependent listed species
- continue regular reviews of ecological assessments in the fishery, ensuring that the cumulative impact of all Commonwealth commercial fisheries is taken into account
- continue to implement management actions to address and mitigate risks and impacts for species that are identified as high risk, including data collection for species that are assessed as high risk because of missing information
- by 12 August 2024, develop and implement a statistically robust, independent, quantitative and validating monitoring and data collection regime in the SESSF. This may involve the use of electronic monitoring, onboard observers, or other means
- continue to monitor catch and effort data and implement programs to improve the accuracy of identification and recording on all non-target shark species
- continue to refine risk assessment processes for target, byproduct and bycatch shark stocks, seeking to include all available data and to include consideration of cumulative impacts
- by 12 August 2024, finalise ecological risk assessments for all major SESSF sectors to identify high-risk shark species and develop appropriate mitigation responses. These are to be monitored annually, including fishery indicator data as a means of monitoring ongoing risk to shark species.

Ecological risk assessments

Shark gillnet subfishery

A scale, intensity, consequence analysis (SICA) of the gillnet subfishery of the GHTS in 2021 identified that one or more species in the byproduct and bycatch and protected species categories may be at moderate or higher risk from the direct impact of fishing (Sporcic, Bulman & Fuller 2021b), requiring either direct management of identified risks or further risk assessment. Habitats and communities were also assessed in 2021. Results indicate these components may be at moderate or higher risk from the direct impact of fishing.

In 2021, a productivity and susceptibility analysis (PSA) of the shark gillnet subfishery of the GHTS considered 24 bycatch and 56 protected species (Sporcic, Bulman & Fuller 2021b). Of these, 35 species (8 bycatch and 27 protected) were categorised at high risk, with the remainder at medium (29 species) and low (16 species) risk. In 2021, a residual risk assessment was also undertaken on the high-risk species, taking into account interactions with the subfishery, biological attributes and the mitigating effect of management measures, indicated that 5 marine bird species (Campbell albatross – *Thalassarche impavida*, shy albatross – *T. cauta*, wandering albatross – *Diomedea exulans*, blue petrel – *Halobaena caerulea* and soft-plumaged petrel – *Pterodroma mollis*) and 2 marine mammal species (common bottlenose dolphin – *Tursiops truncatus* and Indian Ocean bottlenose dolphin – *T. aduncus*) remained at high risk (Sporcic, Bulman & Fuller 2021a).

A base Sustainability Assessment of Fishing Effects (SAFE) of the shark gillnet subfishery in 2021 found that none of the 151 species assessed were at high risk from fishing (Sporcic, Bulman & Fuller 2021b).

Manual longline subfishery

A SICA for the manual longline subfishery of the GHTS in 2021 identified that no species were at moderate or higher risk from the direct impact of fishing (Sporcic, Bulman & Fuller 2021a) meaning no further risk assessment was required. Habitats and communities were also assessed in 2021, all of which were found to be at low risk from the direct impact of fishing. There were no further risk assessments of this subfishery.

Ecological risk management

In managing the ecological risks identified for its fisheries, AFMA implements ecological risk management (ERM) strategies for species identified as being at high risk. Fishery-specific ERM strategies can be found on the AFMA website.

Threatened, endangered and protected species interactions

In accordance with accreditation under the EPBC Act (see Chapter 1), AFMA publishes and reports quarterly on interactions with protected species on behalf of Commonwealth fishing operators to the Department of Climate Change, Energy, the Environment and Water (DCCEEW).

In 2021, 247 interactions with protected species were reported in the GHTS. These comprised 110 shortfin mako sharks (*Isurus oxyrinchus*; 1 alive, 106 dead and 3 released in an unknown condition); 12 longfin makos (*I. paucus*; 3 alive and 9 dead); 2 porbeagles (*Lamna nasus*; both dead); 12 white sharks (*Carcharodon carcharias*; 10 alive and 2 dead); 6 unspecified birds (2 alive and 4 dead); 5 unspecified albatross (all alive); 2 shy albatross (both alive); 3 wandering albatross (2 dead and 1 injured); 1 unspecified shearwater (dead); 1 flesh-footed shearwater (*Ardenna carneipes*; dead); 1 unspecified storm petrel (alive); 1 little penguin (*Eudyptula minor*; alive); 4 unspecified cormorants (all dead); 4 unspecified prions, petrels or shearwaters (1 alive, 2 dead and 1 injured); 17 unspecified seals (4 alive, 11 dead and 2 released in an unknown condition); 17 Australian fur seals (*Arctocephalus pusillus doriferus*; 1 alive and 16 dead); 1 Australian sea lion (*Neophoca cinerea*; dead); 32 unspecified dolphins (31 dead and 1 released in an unknown condition); 2 bottlenose dolphins (*Tursiops truncatus;* dead); and 12 common dolphins (*Delphinus delphis*; all dead).

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

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