Chapter 12
Shark Gillnet and Shark Hook sectors

J Woodhams and R Curtotti

FIGURE 12.1 Relative fishing intensity in (a) the Shark Gillnet Sector and (b) the Shark Hook Sector of the Southern and Eastern Scalefish and Shark Fishery, 2017–18 fishing season

(a)

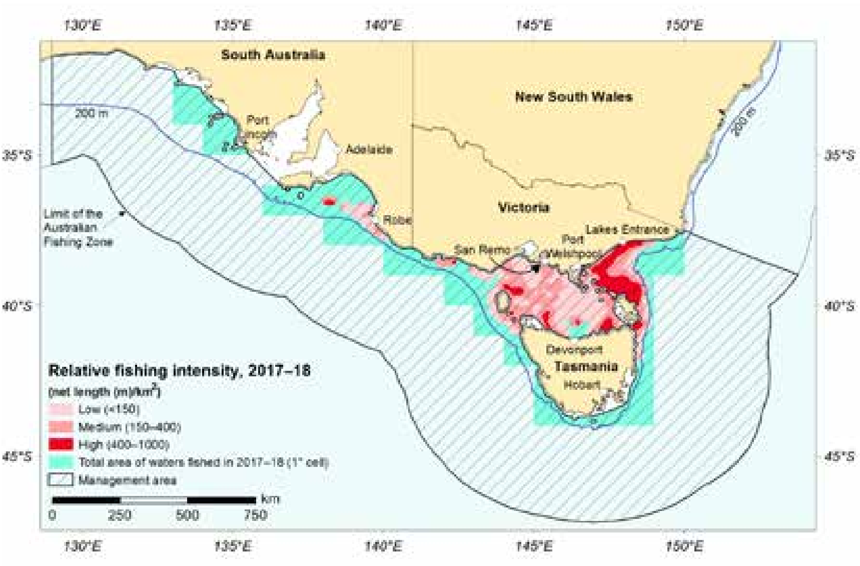
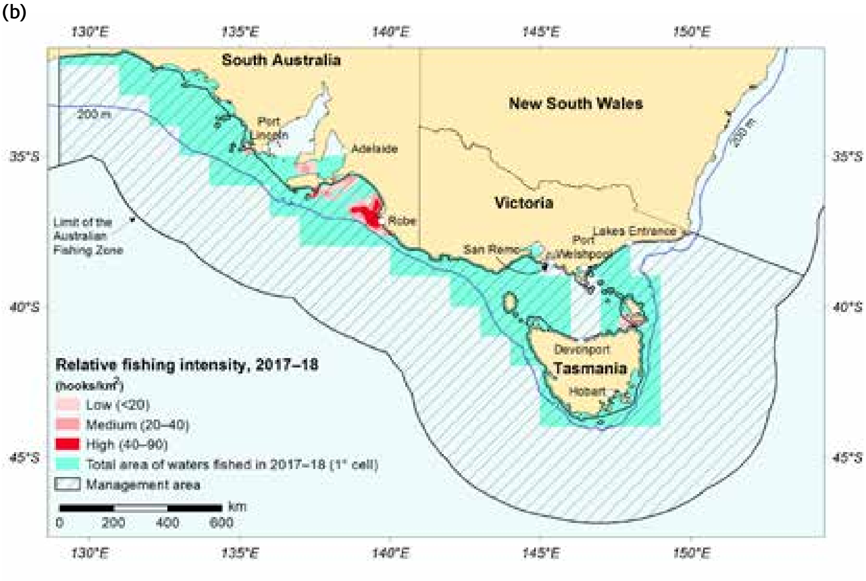


FIGURE 12.1 Relative fishing intensity in (a) the Shark Gillnet Sector and (b) the Shark Hook Sector of the Southern and Eastern Scalefish and Shark Fishery, 2017–18 fishing season continued

(b)



Gillnet vessel
AFMA

TABLE 12.1 Status of the Shark Gillnet and Shark Hook sectors

Status	2016		2017		Comments
Biological status	**Fishing mortality**	**Biomass**	**Fishing mortality**	**Biomass**	
Elephantfish (*Callorhinchus milii*)					Standardised CPUE remains relatively stable and above the limit, indicating stability in biomass and fishing mortality.
Gummy shark (*Mustelus antarcticus*)					Catch is below RBC. Estimates of pup production are close to, or above, the target.
Sawsharks (*Pristiophorus cirratus*, *P. nudipinnis*)					CPUE is above the target; catch is below RBC.
School shark (*Galeorhinus galeus*)					Uncertain if fishing mortality rate in 2017–18 will allow recovery within the specified time frame. Biomass is likely to remain below 20% of unexploited levels.
Economic status a	NER were –$3.9 million in 2014–15. Preliminary estimates for 2015–16 and 2016–17 indicate that NER are likely to become positive. Although gummy shark biomass is not constraining NER, the management of non-target species and marine mammal interactions has likely contributed to low NER in recent years.				

a NER refer to the entire Gillnet, Hook and Trap Sector; therefore, this figure includes scalefish. Shark species account for around 70% of total Gillnet, Hook and Trap Sector gross value of production.
Notes: **CPUE** Catch-per-unit-effort. **NER** Net economic returns. **RBC** Recommended biological catch.

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

12.1 Description of the fishery

Area fished

The Shark Gillnet and Shark Hook sectors (SGSHS) of the Southern and Eastern Scalefish and Shark Fishery (SESSF) extend south from the New South Wales – Victoria border, around Tasmania, and west to the South Australia – Western Australia border. Most fishing occurs in waters adjacent to the coastline and throughout Bass Strait (Figure 12.1).

Fishing methods and key species

The SGSHS uses demersal gillnet and longline to target gummy shark (*Mustelus antarcticus*). School shark (*Galeorhinus galeus*), elephantfish (*Callorhinchus milii*) and sawsharks (*Pristiophorus cirratus* and *P. nudipinnis*) are byproducts from the gummy shark fishery. School shark was historically the primary target species in the fishery, but biomass was reduced below the limit reference point around 1990. It remains an important byproduct species and is the second most economically important species in the fishery.

Other important byproduct species (by weight) are snapper (*Chrysophrys auratus*), whiskery shark (*Furgaleus macki*), broadnose sevengill shark (*Notorynchus cepedianus*), bronze whaler (*Carcharhinus brachyurus*), draughtboard shark (*Cephaloscyllium laticeps*) and blue morwong (*Nemadactylus valenciennesi*).

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 to gummy shark catch). The four principle commercial stocks taken in the SGSHS are managed under the SESSF harvest strategy framework (AFMA 2009). The harvest strategy is summarised in Chapter 8. School shark is subject to an incidental catch limit, and other measures to reduce targeting and catch. There are also a number of spatial closures across the fishery to protect and recover school shark.

A number of gear and area closures have been implemented (primarily off South Australia) to reduce the risk of interactions with Australian sea lions and dolphins. These have changed the fishing areas and targeting behaviour of fishers, influenced the take of target species and consequently affected catch-per-unit-effort (CPUE). These and other key wildlife bycatch issues are discussed further in Chapter 8.

From 1 July 2015, electronic monitoring (e-monitoring) has been mandatory for all full-time vessels in the SGSHS. Video footage of at least 10 per cent 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 per cent review of video footage to detect interactions with protected species. The deployment of physical observers ceased with the commencement of e-monitoring. However, this was found to have stopped the collection of some important data from the fishery, and physical observers were deployed again between September 2017 and July 2018.

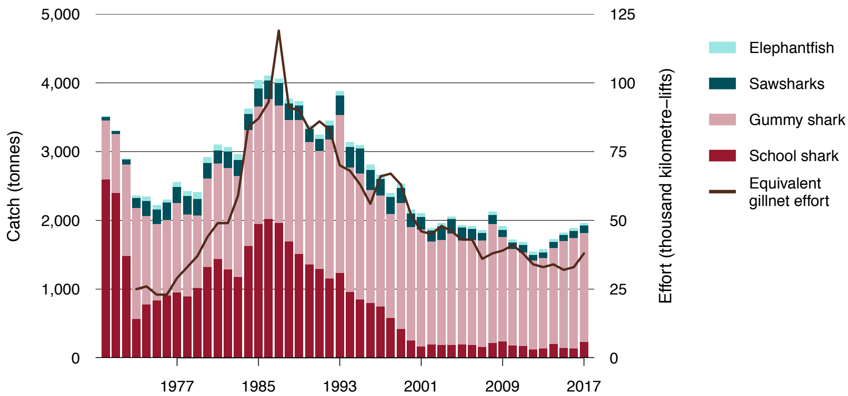
Fishing effort

Before spatial closures, which have been progressively implemented since 2003, effort in the SGSHS was spread across the waters of South Australia and eastern Victoria. However, the spatial closures outlined above have resulted in gillnet effort being concentrated off Victoria (Figure 12.1). Effort in the gillnet sector peaked in 1987 at 99,000 km of gillnet hauled, but has decreased to around one-third of this level in recent years. Hook effort has been variable in recent years, ranging between 1.1 million and 2.3 million hooks per season.

Catch history

Fishing for sharks in the waters off southern Australia began in the 1920s, using longlines. During the 1970s and 1980s, the sector mainly targeted school shark (Figure 12.2). 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 12.2 and 12.3). This transition occurred in the early 1970s in Bass Strait, and later in the waters off South Australia and Tasmania. Recent catch records indicate that trawl operations in the SESSF are now landing as much sawshark as gillnet operations. Most of the landed catch of elephantfish is taken using gillnets in eastern Bass Strait.

FIGURE 12.2 Annual landings and effort in the SGSHS, by species, 1970–2017



Note: 'Equivalent gillnet effort' is an estimate of total effort after converting hook effort to the equivalent gillnet effort using the methods in Walker et al. (1994).

FIGURE 12.3 Annual landings in the CTS, by species, 2001–2017

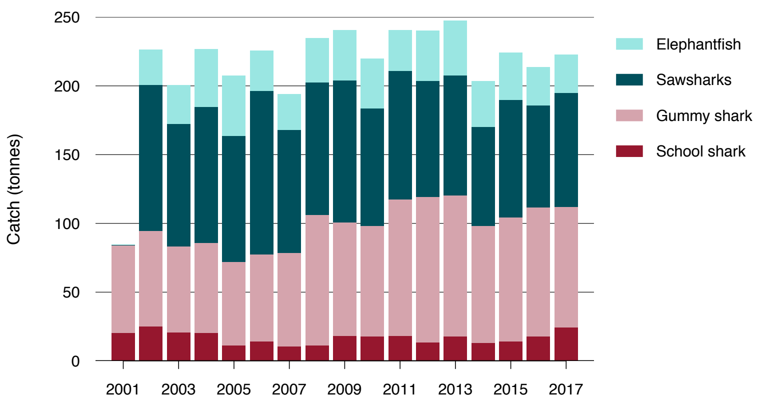


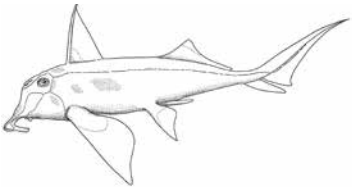
TABLE 12.2 Main features and statistics for the SGSHS

Fishery statistics a	2016–17 fishing season			2017–18 fishing season	
Stock	**TAC (t)**	**Catch (t) (GHTS, CTS)**	**Real value (2016–17) (GHTS, CTS)**	**TAC (t)**	**Catch (t) (GHTS, CTS)**
Elephantfish	163	76 (45, 31)	<$0.10 million (<$0.10 million, <$0.10 million)	122	62 (27, 34)
Gummy shark	1,836	1,669 (1,526, 143)	$17.93 million ($16.89 million, $1.04 million)	1,916	1,744 (1,604, 140)
Sawsharks	482	200 (112, 88)	$0.52 million ($0.27 million, $0.25 million)	481	205 (98, 107)
School shark	215 **b**	173 (149, 24)	$1.70 million ($1.51 million, $0.19 million)	215 **b**	206 (181, 25)
Total	**2,696**	**2,118 (1,832, 286)**	**$20.23 million ($18.70 million, $1.54 million)**	**2,734**	**2,216 (1,910, 306)**
Fishery-level statistics					
Effort	Gillnet: 31,827 km of net hauled Hook: 1,099,962 hooks set			Gillnet: 36,493 km of net hauled Hook: 2,094,897 hooks set	
Fishing permits **c**	Gillnet: 61 Hook: 13			Gillnet: 61 Hook: 13	
Active vessels	Gillnet: 36 Hook: 27			Gillnet: 38 Hook: 38	
Observer coverage **d**	Gillnet: 10% Hook: 10%			Gillnet: 10% Hook: 10%	
Fishing methods	Demersal gillnet, demersal longline, dropline, mechanised handline, auto-longline				
Primary landing ports	Adelaide, Port Lincoln, Robe (South Australia); Devonport, Hobart (Tasmania); Lakes Entrance, San Remo, Port Welshpool (Victoria)				
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: Melbourne, Adelaide 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. Fishing season is 1 May – 30 April. Real-value statistics are by financial year and were not available for the 2017–18 financial year at the time of publication. Components of catch may not sum to total due to rounding. **b** Incidental catch allowance. **c** In the GHTS, additional permit types limit gear use and access to state waters. **d** Numbers of hooks observed relate only to the Shark Hook Sector. Since 1 July 2015, e-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. **GHTS** Gillnet, Hook and Trap Sector. **ITQ** Individual transferable quota. **TAC** Total allowable catch (for the entire Southern and Eastern Scalefish and Shark Fishery).

12.2 Biological status

Elephantfish (*Callorhinchus milii*)



Line drawing: Karina Hansen

Stock structure

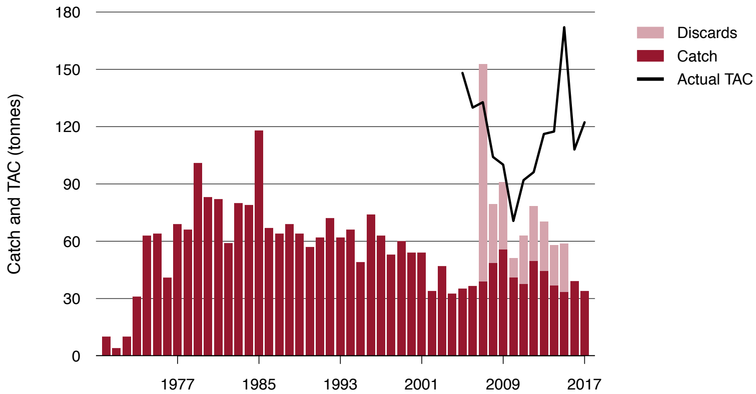
Stock structure of elephantfish is not known, and populations are considered to constitute a single stock for management purposes.

Catch history

Elephantfish are a small component (~3 per cent) of landed catch of the four stocks assessed in this chapter. Catch of elephantfish in the SGSHS increased during the 1970s and peaked at almost 120 t in 1985 (Figure 12.4). Catch has since declined, and has been relatively stable at around 70 t in recent years. Reported catch in 2017–18 in the Gillnet, Hook and Trap Sector (GHTS) and the Commonwealth Trawl Sector (CTS) combined decreased slightly in 2017–18 to 62 t (Table 12.2). The level of discarding of elephantfish in the SGSHS is variable and uncertain. Castillo-Jordán, Althaus & Thomson (2018) provide an estimated discard rate of 9.1 per cent for 2016 using data from the Independent Scientific Monitoring Program (ISMP).

Castillo-Jordán, Althaus & Thomson (2018) report state catch for elephantfish from Western Australia, South Australia, Victoria, Tasmania and New South Wales. Estimated total catch of elephant fish from all states during 2012–2016 averaged around 4 t (excluding Western Australia). Recreational catch of elephantfish can be significant (tens of tonnes) in some states (particularly Victoria), which presents an uncertainty in assessing this stock.

FIGURE 12.4 Annual elephantfish catch and fishing season TAC in the SGSHS, 1970–2017



Notes: **TAC** Total allowable catch. Actual TAC includes carryover of undercatch or overcatch from the previous season. Discard data are only available by calendar year and for 2007–2016.

Stock assessment

Elephantfish has been managed as a tier 4 stock under the SESSF harvest strategy framework since 2009. The tier 4 harvest strategy framework uses standardised CPUE as an index of abundance.

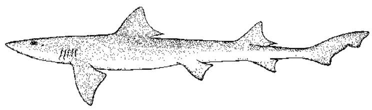
The Shark Resource Assessment Group (SharkRAG) did not agree to apply the harvest control rule for elephantfish in 2018 (RBC to apply for the 2018–19 season) and recommended rolling over the total allowable catch (TAC) from the 2017–18 season. The main reasons were the high and sometimes variable levels of discarding of the stock, and the challenges this presents for the application of the harvest control rule.

The CPUE standardisations performed for the stock (both including and excluding discards) show relative stability in recent CPUE when compared with CPUE at the start of the series. The recent average CPUE was above the target for the series including discards and slightly below the target (but above the limit) for the series excluding discards. In making its TAC recommendation, the RAG recorded that ‘it felt that it did not have any concerns about stock status’. Improved estimation of discarding across the fishery should assist with reducing uncertainty in the CPUE series into the future.

Stock status determination

While it was not possible to output a reliable RBC through a harvest control rule for this stock in 2018, the standardised CPUE series, albeit variable, show relative stability and are above the limit reference point. This indicates that the fishery is not applying an unsustainable level of fishing mortality to the stock. On this basis, the stock is classified as **not overfished** and **not subject to overfishing**.

Gummy shark (*Mustelus antarcticus*)



Line drawing: Karina Hansen

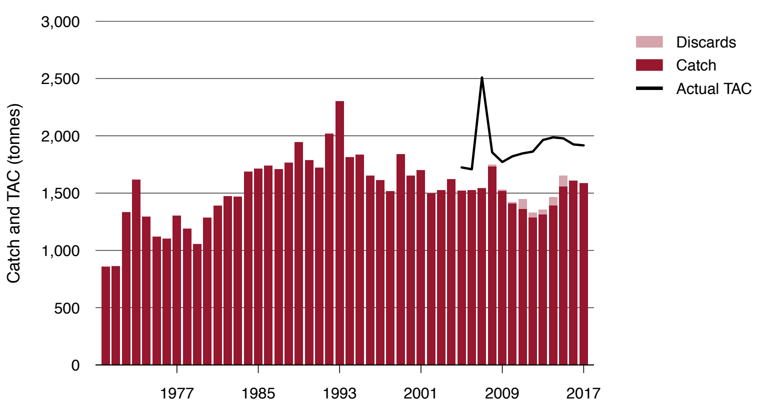
Stock structure

The most recent research on stock structure for gummy shark indicates that there are most likely two 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 four populations for modelling purposes. The first three are assessed together by the Commonwealth (Punt, Thomson & Sporcic 2016) and are reported here. The fourth is assessed and reported separately by Western Australia (Braccini, McAuley & Rowland 2013).

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 1986 (Figure 12.5). Catch in the SGSHS reached a peak of around 2,300 t in 1993. It dropped to a low of 1,288 t in 2012, before increasing to around 1,700 t in recent years (Figure 12.5). Total Commonwealth catch (including from the CTS) in 2017–18 was 1,744 t. Castillo-Jordán, Althaus & Thomson (2018) provide an estimated discard rate of 1.1 per cent for 2016 using ISMP data. Castillo-Jordán, Althaus & Thomson (2018) report state catch for gummy shark for Western Australia, South Australia, Victorai, Tasmania and New South Wales. Reported state catch of gummy shark during 2012–2016 averaged around 580 t (around 155 t excluding Western Australia).

FIGURE 12.5 Annual gummy shark catch and fishing season TAC in the SGSHS, 1970–2017



Notes: **TAC** Total allowable catch. Actual TAC includes carryover of undercatch or overcatch from the previous season. Discard data are only available by calendar year and for 2007–2015.

Stock assessment

The most recent update of the integrated stock assessment model for gummy shark was in 2016, using data to the end of 2015 (Punt, Thomson & Sporcic 2016). Updated inputs to the assessment included landings data from 2013 to 2015, revisions to earlier catch and length-frequency data, new age-frequency data and updated CPUE indices. Some changes to the model structure were also made: catches by the different gear types are now assumed to occur simultaneously, rather than sequentially; the 'hook fleet' has been separated into subfleets; and allowances have been made for age-reading errors. The 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 were treated as separate populations in the model, with no movement of animals between these regions and no density-dependent effects of one population on another. The model assumes commonality in biological parameters, including age–length and length–weight relationships, fecundity, gear selectivity, and overall availability as a function of age.

The gillnet closures off South Australia have influenced catch and CPUE of gummy shark in this area. When the 2014 assessment was run, there was concern that the South Australian CPUE data were less reliable as an index of abundance in recent years (Thomson & Sporcic 2014). Consequently, South Australian CPUE data after 2009 were not included in the 2014 or 2016 assessments.

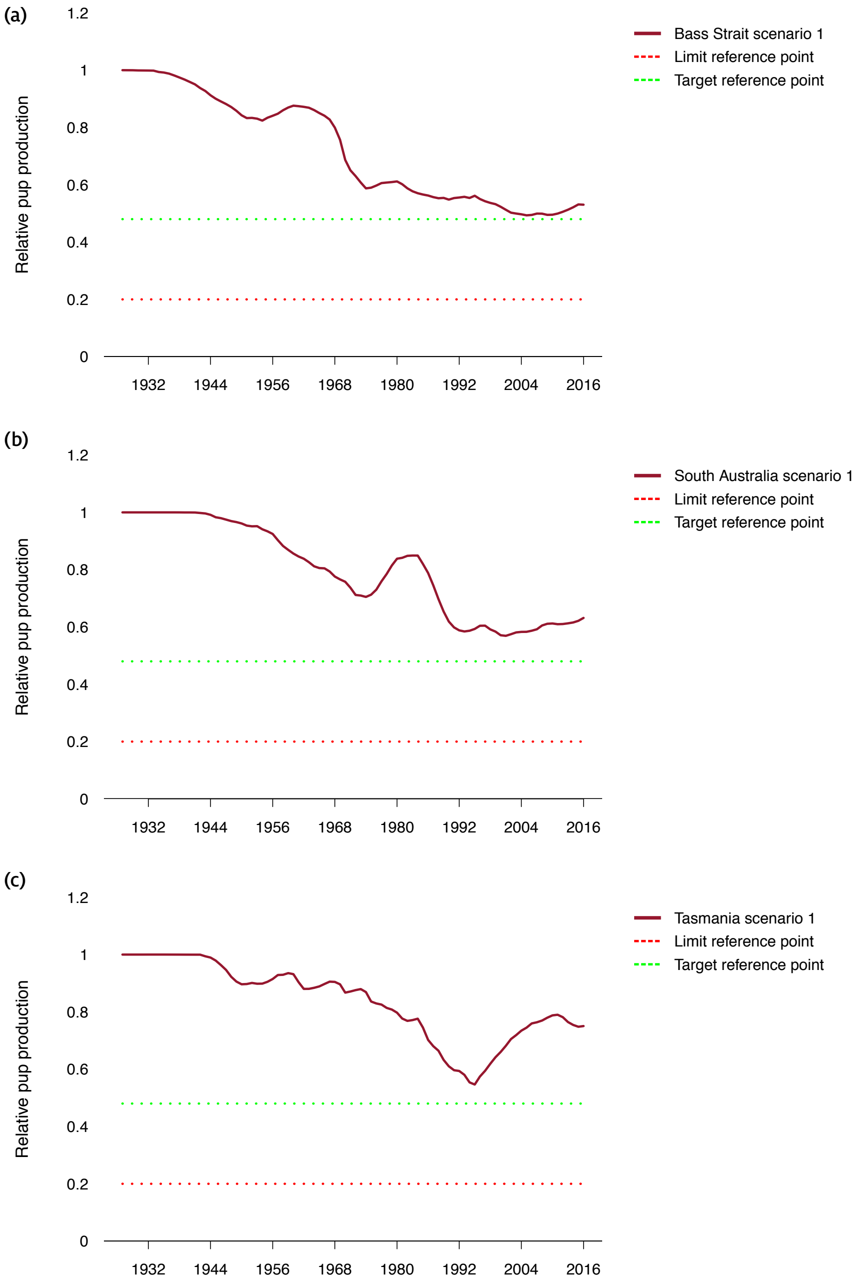
The model estimated recommended biological catches (RBCs) and relative pup production for each population. The RBCs were then summed to give a stock-level RBC for the fishery. In addition, different gear types are known to have different selectivities, which result in differences in the average size of sharks caught. Consequently, a range of RBCs were calculated, based on different catch proportions taken by line and gillnet, which were assessed against their impact on pup production at a regional level (Punt et al. 2016).

The base-case assessment estimated 2016 pup production as a proportion of the unfished level of pup production (P_0; 1,927) to be above $0.48P_0$ (48 per cent of virgin pup production) for all three populations modelled: $0.53P_0$ for Bass Strait (Figure 12.6a), $0.63P_0$ for South Australia (Figure 12.6b) and $0.75P_0$ for Tasmania (Figure 12.6c). These are all slightly lower than those estimated by the 2014 assessment (Thomson & Sporcic 2014).

Stock status determination

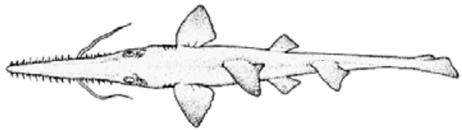
The 2016 stock assessment estimated pup production in the most recent year (2015) to be above the target for each of the three populations modelled. As a result, gummy shark in the SGSHS is classified as **not overfished**. Given that recent catches have been less than the RBC, indicating that current fishing mortalities are below the level that would deplete the population below the target or limit biomass reference points, the stock is classified as **not subject to overfishing**.

FIGURE 12.6 Estimated pup production as a proportion of unfished level of pup production for gummy shark in (a) Bass Strait, (b) South Australia and (c) Tasmania, 1927–2016



Source: Punt et al. 2016

Sawshark (*Pristiophorus cirratus, P. nudipinnis*)



Line drawing: FAO

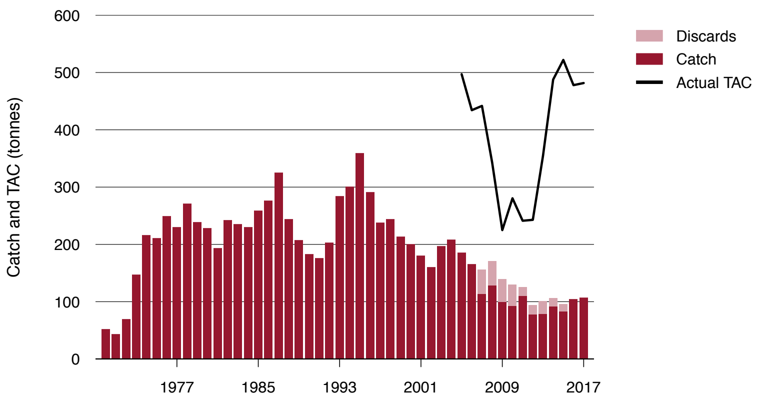
Stock structure

Three species of sawshark (common sawshark—*Pristiophorus 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 sawshark. 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 2014d). Around 90 per cent of the total sawshark catch from southern Australia is taken from Bass Strait (AFMA 2011a). All sawshark catch in the SESSF is managed under a single TAC, and status is reported for the multispecies stock.

Catch history

Catch of sawshark in the SGSHS increased in the early 1970s to around 200 t by 1974, and then fluctuated between about 170 and 350 t per year until the early 2000s. Combined catch in the SGSHS and the CTS in 2017–18 was 205 t (Figure 12.7; Table 12.2), which is approximately 9 per cent of the total catch across the four stocks assessed in this chapter. The level of discarding in the SGSHS is uncertain. Castillo-Jordán, Althaus & Thomson (2018) provide an estimated discard rate of 15.5 per cent for 2016 using ISMP data. Castillo-Jordán, Althaus & Thomson (2018) report state catch for sawshark from Western Australia, South Australia, Victoria, Tasmania and New South Wales. Estimated total catch of sawshark from all states during 2012–2016 averaged around 20 t (around 11.5 t excluding Western Australia).

FIGURE 12.7 Sawshark catch and TAC in the SGSHS, 1970–2017



Notes: TAC Total allowable catch. Actual TAC includes carryover of undercatch or overcatch from the previous season. Discard data are only available by calendar year and for the period 2007–2016.

Stock assessment

Sawshark has been managed as a tier 4 stock under the SESSF harvest strategy framework since 2009. 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 2015c) for application of the tier 4 harvest control rule.

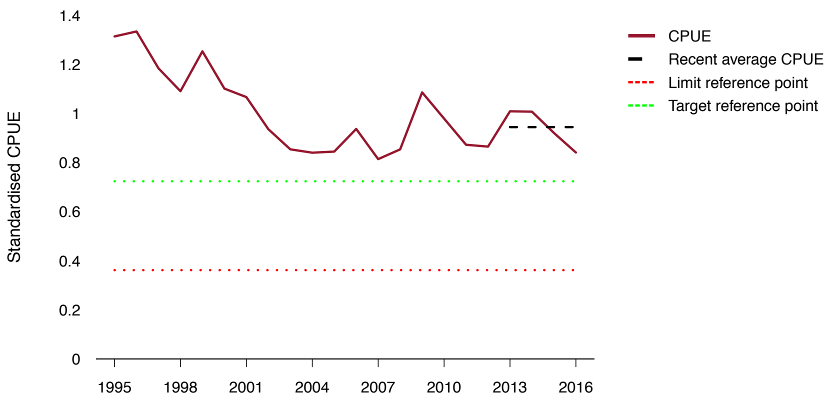
The most recent CPUE analyses of sawshark (four alternative CPUE series were constructed) were conducted in 2018, using SESSF trawl data to 2016 (Haddon & Sporcic 2018). The 2018 analyses indicated that current CPUE was above the target reference point. The adopted tier 4 analyses produced an RBC of 519 t.

In 2014, SharkRAG recommended a decrease in the biomass target (B_{TARG}) from 48 per cent to 40 per cent of unfished biomass. Since sawshark is currently a byproduct species in the gillnet sector, SharkRAG noted that commercial catch largely depends on effort targeted at gummy shark (AFMA 2014b).

Stock status determination

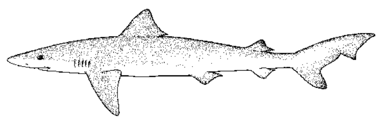
The average recent CPUE for sawshark was estimated to be above the target reference point (Figure 12.8). On this basis, the stock is assessed as **not overfished**. Catch in the 2017–18 season was below the TAC and below the RBC, indicating that current fishing mortalities are below the level that would deplete the population below the target or limit biomass reference points. On this basis, the stock is assessed as **not subject to overfishing**.

FIGURE 12.8 Standardised CPUE index for sawshark in the CTS, 1997–2016 (trawl)



Note: **CPUE** Catch-per-unit-effort.
Source: Haddon & Sporcic 2018

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. A single genetic stock exists in Australian waters, and school shark is managed as a single stock in the SESSF area.

Catch history

Catch of school shark in the SGSHS peaked at more than 2,500 t in 1970 and then declined rapidly to around 500 t in 1973. Catch in the sector again increased, 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 (Figure 12.9). In 2009, the species was listed as conservation-dependent under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) and has been subject to other measures to reduce catch. These include the implementation of a catch ratio of 20 per cent school shark to gummy shark—whereby a quota holder must hold five times more gummy shark quota than their school shark catch (2011–12 season)—and the requirement that all live-caught school shark be released (2014–15 season).

The reported landed catch in the SGSHS in 2017–18 was 206 t. The level of discarding in the SGSHS is uncertain. Castillo-Jordán, Althaus & Thomson (2018) provide an estimated discard rate of 15.1 per cent for school shark in 2014 using ISMP data. There have been limited data to update this number since 2014.

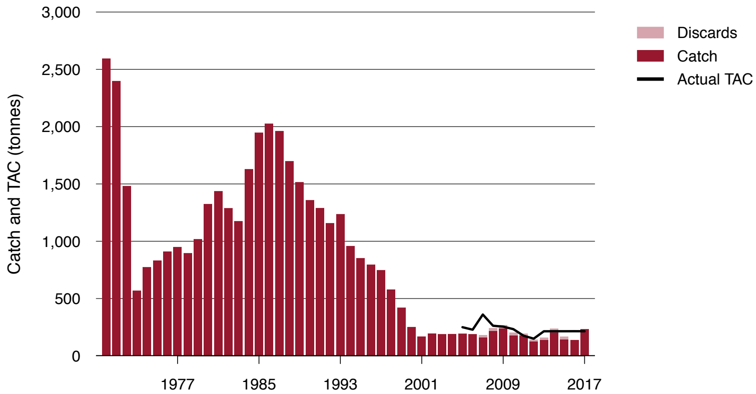
Application of a discard rate from 2014 to the Commonwealth commercial catch of 206 t would result in an estimated 31 t of additional school shark catch by the commercial fishery in 2017–18, assuming 100 per cent mortality. We do not currently know with certainty what the level of post-release survival for these discarded sharks is, but it is unlikely to be zero.

Walker et al. (2008) estimated a mortality rate from tag-recapture data. This rate was 44 per cent for school shark taken using gillnets. Braccini et al. (2009) report a similar rate (41 per cent) in their study of gillnet-caught school shark. We do not have a comparable number for line-caught school shark. Rogers et al. (2017) examined survival of relatively large discarded female school shark from line fishing using satellite popup tags. The authors indicate that their results are skewed towards healthy/lively individuals and that survival of injured individuals remains a gap in the knowledge. Further, the study did not use fishing methods (or gear) completely consistent with that used by the commercial fleet; this will further distance the results from what we can expect to occur in the commercial fishery. That said, all sharks tagged in this study (10 animals) survived for at least five days post-release (longest time frame recorded is 44 days). We do not have a current survival rate for discarded sharks from the trawl fleet, but it is reasonable to assume that survivability of discarded trawl-caught school shark would be low due to the restricted movement of catch within the nets (particularly in the cod end) and the crushing that often occurs in trawl nets.

Application of a 40 per cent mortality rate to gillnet discards estimated for the 2017–18 fishing season will reduce overall mortality on the stock. It would be unreasonable to apply the mortality rate produced by Rogers et al. (2017) to line discards, but given the likelihood of at least this survival rate (but more likely higher), application of the same mortality rate to line discards as that estimated for gillnet-caught fish will further reduce the overall mortality of the stock in 2017–18. Mortality rate for trawl discards was assumed to be 100 per cent.

An estimate of state catch for the 2017–18 fishing season is not available. However, Castillo-Jordán, Althaus & Thomson (2018) report state catches up to and including 2016. The state catches they report show relative stability over the past five years. Pending evidence of any significant changes in activity in state fisheries, catch in 2017–18 is likely to be at similar levels to that reported for the previous five years for each state. The average during 2012–2016 was approximately 24 t, across South Australia, Victoria, Tasmania and New South Wales. The discard rate (or post-release survival) for state catches is unknown, so no rate is applied to these catches. Total mortality in state fisheries is uncertain as a result.

FIGURE 12.9 Annual school shark catch and fishing season TAC in the SGSHS, 1970–2017



Notes: **TAC** Total allowable catch. Actual TAC includes carryover of undercatch or overcatch from the previous season. Discard data are only available by calendar year and for 2007–2016.

Stock assessment

Assessments for school shark indicate that the stock has been overfished since approximately 1990, and the stock has been classified as such since the commencement of status reporting by ABARES in 1992. The most recent full assessment was undertaken in 2009 using data to 2008 (Thomson & Punt 2009). At that time, the base-case model estimated biomass to be at $0.12B_0$. 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 2009–2012 (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 $0.2B_0$ limit reference point in the specified recovery time frame (in this case, set at three times the estimated generation time or 66 years) (AFMA 2015b).

There are indicators that school shark biomass may be increasing. These include a preliminary index of abundance based on trawl CPUE, which estimates a generally increasing trend (Sporcic 2016). However, it is unclear how reliable trawl CPUE is as an index of abundance for school shark. Data from the ISMP show an increase in the catch of small school sharks (Thomson et al. 2015). Preliminary results of survey work by the Institute for Marine and Antarctic Studies (IMAS) in school shark pupping areas off Tasmania indicate higher numbers of pups than during the 1990s (McAllister et al. 2015). Industry participants on SharkRAG have reported signs of increasing availability of school shark, including increasing presence of juvenile school shark and increasing difficulty in avoiding school shark (AFMA 2013; 2014b, d).

A project to develop a fishery-independent index of abundance using close-kin genetic approaches is almost finalised. By the end of 2018, this work is expected to produce an estimate of absolute abundance in 2017, a new index of abundance, and predictions of sustainable fishing mortality rates. These processes could be used to inform rebuilding targets and time frames.

Stock status determination

Biomass status in 2018 is determined based on the most recent estimate of population size (0.12B_0) and the likely level of catch in recent years. Given that recovery to 0.2B_0 was estimated to take 23 years from 2012 under a zero catch scenario, it is unlikely that biomass has recovered to above 0.2B_0, given that catches have been greater than zero in recent years. As a result, the stock remains classified as **overfished**.

Combining commercial catch, discards and state catches amounts to an estimate of total mortality for the stock in 2017–18 of around 244 t. This is above the incidental catch allowance (215 t) and above the maximum level (225 t) reported to allow recovery in the time frame specified in the rebuilding strategy, noting that discards from state fisheries are unknown. This level of catch is below the highest level (250 t) forecast to allow for recovery in the modelling undertaken in 2012 (assuming gear selectivity, and spatial and temporal distribution of catches remain similar to those in 2011). Total mortality of school shark since the implementation of the rebuilding strategy (2015) is estimated to be 217 t in 2015–16 and 211 t in 2016–17, with a similar treatment of state catch and discard information. The average total mortality over the past three years (since the implementation of the rebuilding strategy) was 224 t.

It is important to note that the discard mortality rate applied to the estimate of discards for this stock has been a key aspect in the calculation of total mortality. Mortality rates up to (and including) 60 per cent would result in total mortality below 250 t for 2017–18. Rates in excess of 60 per cent would see total mortality in 2017–18 rise to above 250 t. Discard mortality rates higher than that applied for 2017–18 would also increase the total mortality for previous years, with flow-on effects to the average mortality since the rebuilding strategy took effect.

There are indications that the stock may have stabilised and may even be recovering (for example, trawl CPUE, IMAS surveys, ISMP data and anecdotal reports from industry). Further, new information is expected later in 2018 from the close-kin work that will provide an estimate of absolute biomass in 2017, an index of abundance and predictions of sustainable fishing mortality rates going forward. Given the above information, school shark is classified as **uncertain** with regard to the level of fishing mortality in 2017–18.

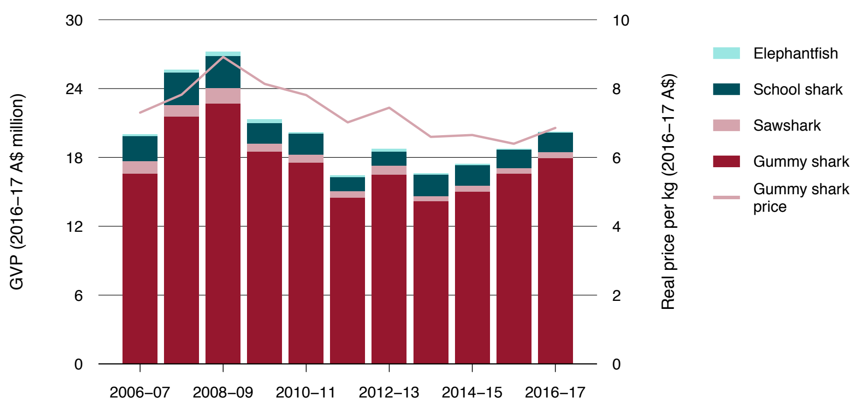
If the level of commercial catch in 2018–19 is at the same level (or larger) than that for 2017–18 and there is no reliable update to either our understanding of sustainable harvest levels (through close kin), no update to the rebuilding strategy with regard to maximum level of catch that will allow for rebuilding within the specified time frame, and/or no update to the discard rate and discard mortality, it is likely that the average catch over the period since the rebuilding strategy was implemented will be larger than that provided for in the 2015 rebuilding strategy. Without indications of the sustainability of such harvest levels, it is possible that the stock would be classified as subject to overfishing in 2018–19.

12.3 Economic status

Key economic trends

The real gross value of production (GVP) in the SGSHS, which reflects the four shark species taken in the GHTS, declined from a peak of $27.2 million in 2008–09 to $16.61 million in 2013–14 and then recovered to $20.2 million by 2016–17 (Figure 12.10). This recent recovery is primarily the result of higher volumes of gummy shark landings. Gummy shark accounts for the majority of GVP in the SGSHS (89 per cent in 2016–17).

FIGURE 12.10 Real GVP for the SGSHS, by key species, and real price for gummy shark, 2006–07 to 2016–17

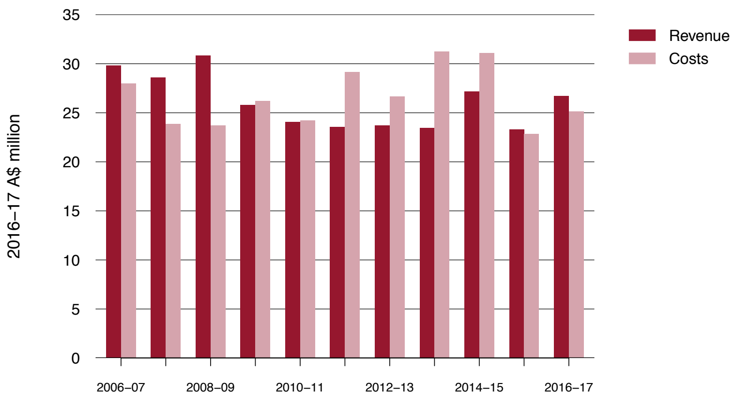


Note: **GVP** Gross value of production.

The four shark species that make up the SGSHS—gummy shark, school shark, sawshark and elephantfish—accounted for around 70 per cent of the GHTS GVP in the decade to 2016–17, with scalefish species making up the remainder. Therefore, overall economic performance in the GHTS may contribute to an understanding of the economic status of the SGSHS.

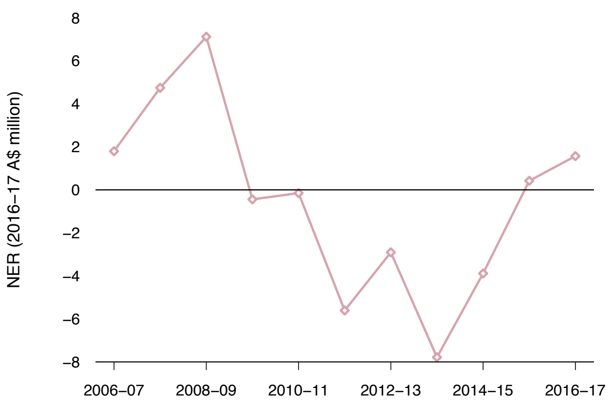
Survey-based estimates of revenue, costs and net economic returns (NER) in the GHTS are available for 2014–15, and preliminary estimates are available for 2015–16 and 2016–17 (Figure 12.11). NER in the GHTS were positive between 2006–07 and 2008–09, peaking at $7.11 million in 2008–09 (Figure 12.12). NER reached a low of –$7.78 million in 2013–14 and remained negative in 2014–15. Preliminary estimates for 2015–16 and 2016–17 indicate that NER are likely to become positive in those years. This is due to higher unit prices (increasing fishing income) and lower fuel prices (causing operating costs to decline) during 2015–16. NER are estimated to increase further in 2016–17, driven by the highest catch and GVP levels in the fishery since 2010–11 (Bath, Mobsby & Koduah 2018).

FIGURE 12.11 Real revenue and costs for the GHTS, 2006–07 to 2016–17



Note: Data for 2016–17 are preliminary.
Source: Bath, Mobsby & Koduah 2018

FIGURE 12.12 Real NER for the GHTS, 2006–07 to 2016–17



Notes: **NER** Net economic returns. NER estimates for 2013–14 are preliminary non–survey based estimates.
Source: Skirtun & Green 2015

A profit decomposition of the gillnet sector of the GHTS (Skirtun & Vieira 2012) showed that the key driver of profitability in the sector in the period 2006–07 to 2008–09 was productivity growth. This was linked to the Securing our Fishing Future structural adjustment package (completed in 2006–07), which is considered to have removed the least efficient vessels from the sector (Vieira et al. 2010). The decline in NER in recent years can be partly linked to falls in the price of fish within the fishery. Productivity improved in 2013–14 and 2014–15, providing some upward pressure on NER (Bath, Mobsby & Koduah 2018).

Management arrangements

Significant spatial closures have been implemented in recent years to reduce the catch of protected species, primarily in South Australian waters (see Chapter 8). This started with voluntary closures in 2009–10, followed by mandatory closures in 2010–11. This has led to a relocation of fishing intensity to other areas, particularly for operators for whom closures have covered the full extent of their usual fishing grounds, and a switch to use of hooks rather than gillnets in areas where gillnet closures are in place. Some South Australian gillnet fishers also operate in the South Australian Rock Lobster Fishery, which is considered to be profitable (Econsearch 2014) and could have supported some SGSHS operators affected by the closures. However, these changes would have reduced the profitability of gillnet operations in South Australia, contributing to the negative NER in the GHTS following the closures.

South Australian gillnet operators (subject to specific qualification criteria) are allowed to use hook methods in areas where gillnetting is prohibited (or restricted), so that fishers can continue to operate. However, anecdotal reports from industry suggest that vessel-level economic efficiency is lower using this hook method (AFMA 2011b). Anecdotal information also indicates that allowing gillnet permit holders to use hooks has had a negative impact on the value of hook permits in the sector, because rights provided by hook permits have become less exclusive.

School shark biomass remains below the limit reference point, and stock rebuilding measures are likely to be affecting sector profitability. These measures include low incidental catch allowances and the prohibition of targeted fishing. School shark is often caught incidentally with gummy shark—the main target species of the sector—and actively avoiding school shark can involve an increase in trip length, increasing the cost of catching gummy shark. Additionally, given the relatively high beach prices of school shark, changes in its catch allowance can have a relatively large influence on the revenue of the sector. Operators who do not hold quota for school shark, or actively avoid it when targeting gummy shark, are forfeiting a potential means of profit. The substantial time projected for rebuilding of the school shark stock means that it may be some time before these issues are resolved.

Trials to test the efficiency of longer gillnets (4,200–6,000 m) have been undertaken; in January 2016, SharkRAG considered the preliminary results inconclusive (AFMA 2016a). Giving fishers the option to use longer nets provides them with greater flexibility to operate under individual transferable quotas, potentially improving efficiency and NER. In 2017, AFMA removed net length restrictions in Commonwealth waters for vessels with electronic monitoring.

Performance against economic objective

Additional information on the economic status of the SGSHS is provided by a comparison of the biomass levels of key species with harvest strategy targets. Gummy shark is the primary driver of economic performance in the SGSHS, accounting for 89 per cent of SGSHS GVP in 2016–17. The target reference point for gummy shark is the B_{MEY} (biomass that corresponds to maximum economic yield) proxy of $0.48P_0$ (48 per cent of virgin pup production). The results of the 2016 stock assessment indicate that the biomass of gummy shark stocks is likely to be above the target reference point. If the proxy accurately reflects B_{MEY} for this species, the results indicate that biomass is not currently constraining NER and that there may be potential for expansion in the sector.

The SGSHS is a multispecies fishery, and its economic performance must also be interpreted in terms of the other species caught in the fishery. Despite school shark being caught under an incidental catch allowance, the species is the second most valuable in the sector, accounting for 8 per cent of SGSHS GVP in 2016–17. The school shark to gummy shark quota restriction implemented in 2011–12 may have reduced gummy shark catch and therefore current GVP (AFMA 2014c). Efforts to rebuild the school shark stock towards target levels should lead to increases in NER.

The challenge of reducing marine mammal interactions may affect the degree to which economic performance can be improved in the short term. Recent closures to mitigate interactions are likely to have contributed to the observed declines in the GHTS NER from 2009–10 to 2013–14, and may be related to increased gummy shark quota latency during this period. In 2014–15, there was a significant increase in NER, in a year of high productivity growth, indicating that the industry is actively adjusting to new operating conditions. NER are estimated to increase further in 2015–16 and 2016–17, indicating further recovery in the economic performance of the fishery.

Vessel inspection
AFMA

12.4 Environmental status

The SESSF was accredited against parts 13 and 13A of the EPBC Act in February 2016. Conditions associated with the accreditation relate to the impact of fishing on bycatch species, particularly Australian sea lions (*Neophoca cinerea*), dolphins, seals and seabirds. Further recommendations associated with the accreditation relate to requirements for ecological risk assessment, and monitoring of bycatch and discarding.

A level 2 ecological risk assessment of 329 species resulted in 21 assessed as being at high risk (16 chondrichthyans and 5 marine mammals; Walker et al. 2007). A level 3 Sustainability Assessment of Fishing Effects (SAFE) assessment was completed for all 195 chondrichthyan and teleost species identified in the shark gillnet fishery, regardless of their level 2 Productivity Susceptibility Analysis (PSA) risk score. The assessment found seven species (all chondrichthyan) to be at high risk (Zhou, Fuller & Daley 2012). One species (common sawshark) was removed during the residual risk analysis (AFMA 2014a). The remaining six species considered to be at high risk are all sharks: bronze whaler (*Carcharhinus brachyurus*), white shark, whiskery shark (*Furgaleus macki*), smooth hammerhead shark (*Sphyrna zygaena*), school shark and broadnose sevengill shark. A 2010 residual risk assessment of PSA results for non-teleost and non-chondrichthyan species identified five marine mammal species as high risk (AFMA 2010). A subsequent residual risk analysis removed two species (as a result of no interactions being recorded in the fishery) and included one further species (as a result of higher than expected interactions), resulting in four marine mammal species considered to be at high risk in the fishery: Australian fur seal (*Arctocephalus pusillus doriferus*), Australian sea lion, New Zealand fur seal (*A. forsteri*) and common dolphin (*Delphinus delphis*) (AFMA 2012). The results of the ecological risk assessments have been consolidated to form a priority list in an ecological risk assessment strategy for the SESSF (AFMA 2015a). A revised ecological risk assessment will be considered by SharkRAG in 2018.

AFMA publishes quarterly logbook reports of interactions with protected species on its website. Reports for the GHTS in the 2017 calendar year indicate 313 interactions: 105 with mammals, 75 with seabirds, 130 with sharks, 2 with seahorses and pipefish (alive), and 1 with a green turtle (dead). The mammal interactions comprised 67 interactions with dolphins (2 alive; 64 dead; 1 injured), 7 with Australian fur seals (1 alive; 6 dead), 1 with an Australian sea lion (dead), 1 with a New Zealand fur seal (alive) and 29 with seals (unclassified; 1 alive; 28 dead). In 2017, 75 seabirds (17 of which were released alive) were caught, including albatrosses, cormorants, petrels, prions and shearwaters.

Logbooks reported that 102 shortfin mako sharks (2 alive; 73 dead; 27 in unknown condition), 5 longfin mako sharks (1 dead; 4 in unknown condition), 4 porbeagle sharks (1 dead; 3 in unknown condition), 2 grey nurse sharks (1 alive; 1 in unknown condition) and 17 white sharks (14 alive; 3 dead) were caught during 2017. Measures to reduce interactions with Australian sea lions and dolphins are discussed in Chapter 8.

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