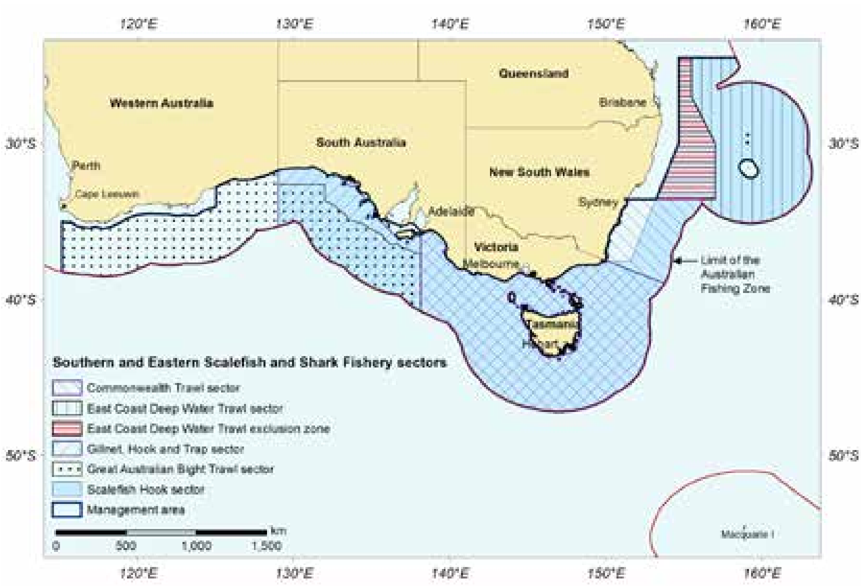
Chapter 8

Southern and Eastern Scalefish and Shark Fishery

F Helidoniotis, T Emery, J Woodhams and R Curtotti

FIGURE 8.1 Area and sectors of the Southern and Eastern Scalefish and Shark Fishery



8.1 Description of the fishery

The Southern and Eastern Scalefish and Shark Fishery (SESSF) is a multisector, multigear and multispecies fishery, targeting a variety of fish and shark stocks. The management area covers almost half the area of the Australian Fishing Zone (Figure 8.1), and spans both Commonwealth waters and the waters of several Australian states under Offshore Constitutional Settlement arrangements. A number of marine parks established by the Australian Government fall within the SESSF management area (for more information, see https://parksaustralia.gov.au/marine/).

The SESSF remained the largest Commonwealth fishery in terms of volume caught in the 2017–18 fishing season. In 2017–18, the gross value of production (GVP) of the SESSF was $76 million, accounting for 20% of the GVP of Commonwealth fisheries.

The primary mechanism for controlling the harvest of stocks in the SESSF is through the allocation of annual total allowable catches (TACs). TACs are determined for all key commercial stocks, along with some secondary or byproduct stocks. The TAC for each stock is distributed among fishers as individual transferable quotas for the fishing season. In addition to TACs, management arrangements in the SESSF include limited entry, gear restrictions (for example, restrictions on mesh size, setting depth, number of hooks and trap dimensions), spatial closures, prohibited species (for example, black cod—*Epinephelus daemelii*), trip limits for certain species (for example, snapper—*Chrysophrys auratus*), codes of conduct, move-on rules, and requirements for observers, electronic monitoring and vessel monitoring systems.

The SESSF was established in 2003 by amalgamating four fisheries—the South East Trawl, Great Australian Bight Trawl, Southern Shark Non-trawl and South East Non-trawl fisheries—under common management objectives. The 2003 management plan for the SESSF came into operation on 1 January 2005 (amended in 2016). Originally, each of the four fisheries had its own management advisory committee. In 2009, the Australian Fisheries Management Authority (AFMA) created the South East Management Advisory Committee (SEMAC) to provide advice to the AFMA Commission on management measures for the entire SESSF. The Small Pelagic Fishery Management Advisory Committee and the Squid Management Advisory Committee became part of SEMAC in 2010, whereas the Great Australian Bight Trawl Sector (GABTS) Management Advisory Committee remains separate.

Landings in the SESSF have generally decreased over time as a result of reductions in fishing effort, although catches for some key target species (for example, pink ling—*Genypterus blacodes*, and blue-eye trevalla—*Hyperoglyphe antarctica*) have remained relatively stable. In 2017–18 and 2018–19, landings in the Commonwealth Trawl Sector (CTS) and the Gillnet Hook and Trap Sector (GHTS) were 10,847 t and 10 580 t, respectively, representing around 49% of available quota. Landed catches for other sectors of the SESSF are reported in the respective chapters of *Fishery status reports*.

The SESSF was one of the fisheries targeted by the Securing our Fishing Future structural adjustment package (2006–07), which was intended to halt overfishing, improve economic conditions and efficiency of fishers, and recover overfished stocks. The package reduced the number of fishing vessels by purchasing fishing endorsements. Although this contributed to lower landings and GVP, net economic returns (NER) improved in the years immediately after implementation of the SESSF harvest strategy framework (HSF) and the Securing our Fishing Future structural adjustment package (George & New 2013; Ward et al. 2013). After implementation, other factors came into play, and NER for some sectors of the SESSF declined. Since 2013–14, NER have improved for the CTS and the GHTS. Trends in NER are reported in the relevant chapters.

8.2 Sectors of the fishery

Current management arrangements are structured around the four primary sectors of the fishery: the CTS, the East Coast Deepwater Trawl Sector (ECDTS), the GABTS and the GHTS.

The status of the stocks taken in these sectors is presented in Chapters 9, 10, 11 and 12, respectively. The GHTS includes the Scalefish Hook Sector (SHS), the Shark Gillnet and Shark Hook sectors (SGSHS), and the Trap Sector. In this report, the SHS is reported with the CTS (Chapter 9) because most stocks are shared. The SGSHS is reported separately (Chapter 12). The Trap Sector is not reported in detail because of its low historical fishing effort and landings; however, in 2016–17, both increased, with 8,178 shots undertaken and 15.8 t of hagfish (class Myxini) caught. In 2017–18, effort again increased, to 20,452 shots, but only 610 kg of hagfish was caught. This suggests that future landings of hagfish should be closely monitored.

8.3 Harvest strategy performance

A tiered HSF has been applied in the SESSF since 2005. The framework has evolved since its introduction, particularly after the inaugural Commonwealth Fisheries Harvest Strategy Policy (HSP) was released in 2007 and again after the HSP was updated in 2018 (Department of Agriculture and Water Resources 2018b). The current SESSF HSF applies to all sectors, and each stock under quota is assigned to one of three 'tiers' for assessment and calculation of a recommended biological catch (RBC) (AFMA 2019a). The assessment tiers have been developed to accommodate different levels of data quantity, data quality and knowledge about stocks.

The harvest control rules, target and limit reference points, and tier for each stock are described in the HSF (AFMA 2019a). Each tier in the HSF generates an RBC through the assessment and subsequent application of associated harvest control rules (HCRs), with HCRs intended to move a stock away from a limit reference point and towards the target reference point (AFMA 2019a). A number of post-assessment rules (referred to as meta rules) are applied to RBCs to account for discarding, recreational catches, state catches and discount factors for the assessment tier (AFMA 2019a). The SESSF HSF has undergone a management strategy evaluation test to ensure that the HCRs are robust to model structure and parameter uncertainties (Fay, Punt & Smith 2009; Little et al. 2011; Wayte 2009). Rules are also in place to prevent large changes in TACs between years (a large change–limiting rule) and to implement multiyear TACs.

For overfished stocks, the HCRs in the SESSF HSF recommend a zero RBC. AFMA allocates incidental catch allowances to permit small catches of these stocks when fishers are targeting other stocks and some level of catch is unavoidable. The HSF provides guidance on the various considerations under such circumstances.

Key commercial stocks under quota in the SESSF are currently managed towards a B_{MEY} (biomass at maximum economic yield) target, although only a few of these targets are estimated using a bio-economic model because of the data requirements and complexity of such models. For stocks that have had a maximum sustainable yield (MSY) estimated, a $1.2B_{MSY}$ proxy for B_{MEY} may be used as the target. For other stocks, a target that is equivalent to the proxy $0.48B_0$ (48% of the unfished biomass) is applied. It may be possible to improve the economic performance of the fishery by optimising targets across a combination of the more economically important stocks, acknowledging the complexities associated with targeting in this fishery.

Some relatively less economically important stocks in this fishery, often referred to as secondary commercial stocks, also have designated targets. These are often associated with MSY or $0.40B_0$.

8.4 Biological status

The number of stocks in the SESSF assessed for fishing mortality and biomass status increased from 24 in 2004 to 37 since 2009.

For fishing mortality status, of the 37 stocks (34 under quota; AFMA 2018) assessed across the SESSF in 2018 (Figure 8.2):

- 29 stocks (78%) were classified as not subject to overfishing
- 0 stocks (0%) were classified as subject to overfishing
- 8 stocks (22%) were classified as uncertain.

For biomass status (Figure 8.3):

- 27 stocks (73%) were classified as not overfished
- 7 stocks (19%) were classified as overfished
- 3 stocks (8%) were classified as uncertain if overfished.

Controlling fishing mortality is the primary management method used by AFMA. The year 2013 was the first year since 2006 that no stocks had been classified as subject to overfishing. This has continued for subsequent years.

A stock is overfished if it is estimated to be below the limit reference point of 20% of unfished levels ($0.2B_0$). The SESSF includes several stocks that are classified as overfished (that is, the current biomass is estimated to be below the limit reference point). These overfished stocks are blue warehou (*Seriolella brama*), eastern gemfish (*Rexea solandri*), gulper sharks (*Centrophorus harrissoni*, *C. moluccensis*, *C. zeehaani*), school shark (*Galeorhinus galeus*), redfish (*Centroberyx affinis*), and orange roughy (*Hoplostethus atlanticus*) in two zones (southern and western). AFMA continues to work with stakeholders to control the level of fishing mortality applied to these stocks. Overfished stocks with an uncertain fishing mortality status in 2018 are blue warehou, eastern gemfish, gulper sharks, school shark and redfish.

FIGURE 8.2 Fishing mortality status for all stocks assessed in the SESSF, 2004–2018

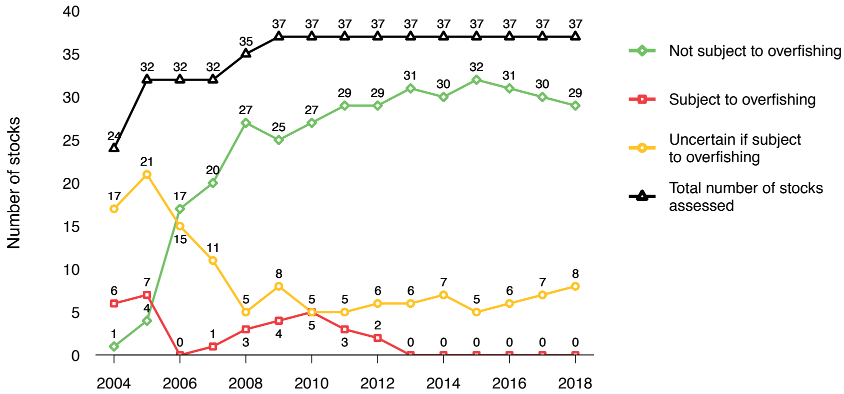
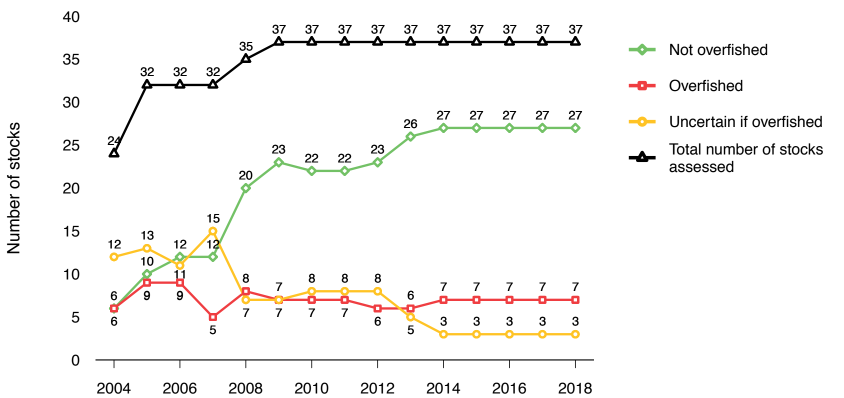


FIGURE 8.3 Biomass status for all stocks assessed in the SESSF, 2004–2018



8.5 Economic status

The SESSF HSF provides a framework to assess the economic status of the fishery. Indicators of stock biomass are used to assess the current biomass of stocks relative to their B_{MEY} target (or its proxy, $1.2B_{MSY}$ or $0.48B_0$). When this information is combined with indicators of profitability and efficiency, the economic status of SESSF sectors can be assessed in terms of whether they are moving towards or away from MEY.

Scalefish catches in the CTS and the SHS accounted for 55% of SESSF GVP in 2017–18 (Figure 8.4). These sectors are therefore key drivers of economic performance in the SESSF. Of these two sectors, only the CTS is surveyed as an individual sector by ABARES as part of its fishery economic surveys program; the SHS is surveyed as part of the GHTS. NER for the CTS followed a positive trend from 2005–06 to a peak of $7.7 million in 2010–11. NER declined from 2010–11 to 2013–14, and then followed an increasing trend from 2013–14 to 2016–17. Based on preliminary estimates, NER for the sector are estimated to have declined in 2017–18, as a result of lower catch volume affecting revenue and higher unit fuel prices increasing fishing costs.

The estimated biomass for two of the most valuable species within the sector (blue grenadier—*Macruronus novaezelandiae*, and tiger flathead—*Neoplatycephalus richardsoni*), together contributing 37% of catch volume and 42% of gross value of fisheries production in 2017–18, remained above or close to their respective B_{MEY} targets (Chapter 9). However, TACs are significantly undercaught for some quota species in the fishery, possibly indicating that some stock-specific targets do not reflect the actual economic conditions in the fishery (for example, costs and prices).

Fish bins
Dylan Maskey, AFMA

Historically, orange roughy has contributed substantially to GVP of the CTS. The rebuilding of orange roughy stocks over the longer term should improve the economic status of the sector, although sustainable catch levels are likely to be much lower than peak historical levels. The recommencement of fishing for orange roughy in the eastern zone boosted GVP from 2015–16 to 2017–18. Likewise, the blue grenadier catch remained substantially lower than the TAC between 2014–15 and 2017–18, suggesting that increased catch of this species could increase the GVP and overall economic performance of the sector in future seasons.

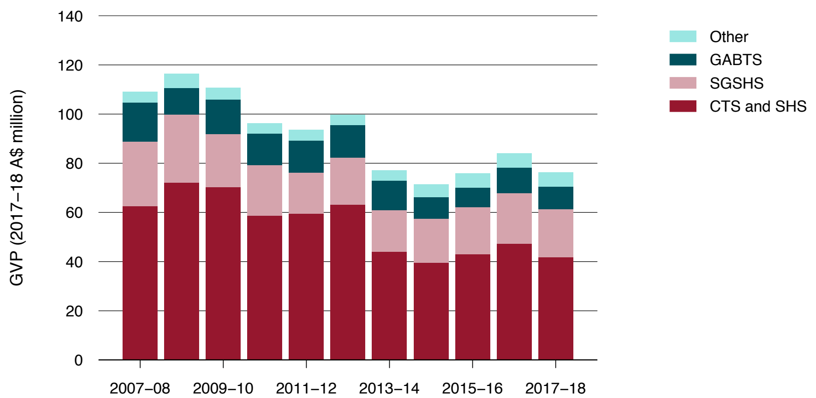
Economic indicators for the GHTS were used to assess the economic status of the SGSHS, which accounted for 84% of GVP in the GHTS in 2017–18. For the decade preceding 2009–10, estimates of NER in the GHTS had been positive. Estimates were negative from 2009–10 to 2014–15 before recovering to above zero in 2015–16 and 2016–17. Based on preliminary estimates, NER for the sector are estimated to have again become negative in 2017–18, with lower catch volumes of gummy shark (*Mustelus antarcticus*) and blue eye-trevalla (*Hyperoglyphe antarctica*), a species attributed to the CTS and the SHS, contributing to lower estimated NER. This is despite biomass levels of gummy shark, the main target species of the sector, being close to or above the target reference (Chapter 12). Recent spatial closures aimed at reducing marine mammal interactions and controls on the take of school shark are likely to have contributed to low NER in recent years. A key challenge for the sector is rebuilding the school shark stock, potentially resulting in NER increasing over time. However, the rebuilding of the stock is likely to be associated with adjustment costs that stem from avoiding the species during the rebuilding process.

The development of a bio-economic model for the two key commercial stocks in the GABTS (deepwater flathead—*Neoplatycephalus conatus*, and bight redfish—*Centroberyx gerrardi*) has improved the ability of the sector to target B_{MEY} (Kompas et al. 2012). The most recent stock assessments for bight redfish projected biomass levels at the start of 2014–15 to be above the B_{MEY} target (Haddon 2015), potentially allowing increased profits to be made if the stock is fished down to its MEY target reference point. The most recent stock assessment for deepwater flathead suggests that biomass has rebuilt towards the B_{MEY} target (Chapter 11). Hence, fishery profitability is unlikely to be constrained by stock status.

In the ECDTS, levels of fishing effort have been low in recent years. Low expected profit in the sector appears to have discouraged activity in the fishery. As a result, the sector has generated minimal NER.

Overall, the economic status of the SESSF has shown some improvement in recent years. The negative change in economic performance in the GHTS that occurred in the period 2010–11 to 2013–14 has reversed. Surveys by ABARES show positive NER for this sector between 2015–16 and 2016–17. This change reinforces the positive NER in the CTS in this period; meanwhile, the GABTS continues to pursue estimated B_{MEY} targets for its key species. For 2017–18, it is estimated, based on non-survey methods, that the economic performance of both the GHTS and CTS sectors of the SESSF has deteriorated, with negative returns estimated for both sectors. Given this, the future trend of NER for these sectors is uncertain.

FIGURE 8.4 Real GVP in the SESSF by sector, 2007–08 to 2017–18



Notes: **CTS** Commonwealth Trawl Sector. **GABTS** Great Australian Bight Trawl Sector. **GVP** Gross value of production. **SGSHS** Shark Gillnet and Shark Hook sectors. **SHS** Scalefish Hook Sector. GVP for the SGSHS includes only gummy shark, school shark and sawshark, and elephantfish caught in the gillnet and hook sectors. GVP for other sectors includes non-scalefish product caught in the CTS and the SHS, non-shark product caught in the SGSHS, and product caught in the Victorian Inshore Trawl and East Coast Deepwater Trawl sectors of the SESSF.

The SESSF HSF will continue to make an important contribution to the economic performance of the fishery by guiding management decisions that explicitly aim to maximise NER. The HSF also offers the opportunity to adjust management settings (for example, to re-examine proxy settings where TACs are continually not met or to move the fishery closer to its economic potential).

8.6 Environmental status

General bycatch and discards

Bycatch is defined in the updated Commonwealth Fisheries Bycatch Policy (Department of Agriculture and Water Resources 2018a) as a species that is either taken in a fishery and returned to the sea or a species that is killed or injured as a result of interacting with fishing equipment in a fishery, but not taken. Under the policy, there are two bycatch categories: 'general bycatch' (non-target species taken in a fishery and returned to the sea) and 'EPBC listed' bycatch (species listed under the *Environment Protection and Biodiversity Conservation Act 1999* [EPBC Act] and afforded a higher level of protection).

Tuck, Knuckey & Klaer (2013) evaluated bycatch and discards in six Commonwealth fisheries, including the SESSF, and concluded that trawling in the South East Trawl (SET) Sector and the GABTS, and Danish-seining account for the greatest volume of bycatch in the Commonwealth fisheries examined. This largely reflects the high level of fishing activity in these sectors and fisheries. Bycatch and discards largely comprise small fish species with little or no commercial value, but also include crustaceans, sharks, molluscs and, more rarely, marine mammals, reptiles and seabirds.

Data collected by the Integrated Scientific Monitoring Program (ISMP) over 20 years have shown a reduction in the volume of trawl discards since the mid 2000s. This reduction is probably a result of a one-third decrease in trawling effort in the SESSF during this time, combined with changes in mesh types and increased mesh sizes used in trawl net codends. Tuck, Knuckey & Klaer (2013) found that discard rates for quota species have been variable, and dependent on market prices, availability of quota and sporadic influxes of small fish. However, data for bycatch and discards of rarer commercial species are often lacking, because observer coverage is often focused on key commercial species.

A distinction can be made between highly targeted shots on single-species aggregations (such as orange roughy or blue grenadier) and general shots for multiple species in the SET and GABT sectors of the SESSF. General shots may be referred to as 'market fishing', and are associated with higher levels of byproduct, and discarding of target and non-target species (Tuck, Knuckey & Klaer 2013). ISMP data show that up to 50% of catch weight is caught and discarded in the 'market fishery' of the CTS, and 40–60% in the GABTS (Tuck, Knuckey & Klaer 2013). Commercial species are discarded for various reasons, but most discards are small fish species with little or no commercial value. In comparison, bycatch in more targeted fishing can be extremely low. For example, bycatch levels were less than 1% when orange roughy was targeted in the GABTS.

A key change in the SET Sector was setting the minimum codend mesh size at 90 mm; this was introduced in 1965 to reduce the catch of small tiger flathead (Tuck, Knuckey & Klaer 2013). Studies have shown an escapement rate of around 70% of all species swept into the codend that are able to fit through the mesh, equating to around 30% of the catch weight (Tuck, Knuckey & Klaer 2013). Animals passing through this mesh size were mainly small finfish. Other changes that have helped reduce bycatch in both the SET Sector and the GABTS include the use of 'T-90 panels' or 'T-90 lengtheners', bycatch reduction devices and 110 mm diamond mesh. Trials of mesh size and type led to mandatory requirements for bycatch reduction in the CTS in 2006 and the GABTS in 2007. Tuck, Knuckey & Klaer (2013) reported that the level of bycatch reduction achieved through these measures has not been formally tested.

Introduction of new bycatch mitigation measures in the Danish-seine component of the fishery has been limited, despite trials showing that a change from 75 mm mesh to T-90 in codends did not affect the catch weight of targeted species but reduced the catch weight of non-commercial species by around 27% (across the study). Reasons for the lack of uptake include limited spatial and temporal coverage of the trials, and concern from industry about the use of the T-90 codend at certain times of the year (Tuck, Knuckey & Klaer 2013).

In the GHTS, which includes the SGSHS, discarding of target species is minimal, with 2% of teleosts and 3% of chondrichthyans discarded (Walker et al. 2005), noting that management measures are now in place that require fishers to release live school shark. Trials to estimate discards for non-target species have reported that discards can account for more than 30% of catch weight in commercial nets (6 inch mesh—that is, 15 cm or 150 mm). The most commonly discarded species were draughtboard shark (*Cephaloscyllium laticeps*), Port Jackson shark (*Heterodontus portusjacksoni*) and spikey dogfish (*Squalus megalops*). Discards in the trials increased to 40%, on average, for 5 inch mesh (127 mm) and almost 80% for 4 inch mesh (101.6 mm) (Braccini, Walker & Gason 2009).

Trawling impacts

Pitcher et al. (2015) used modelling to quantify and assess cumulative threats, risks to benthic biodiversity and the effects of management actions in the south-east marine region, which covers a large part of the SESSF management zone. The research indicated that, from around 1985, when consistent logbook records were available, all 10 benthic taxa types declined in abundance in trawled areas until the mid 2000s. Around this time, fishing effort decreased as a result of economic conditions and the Securing our Fishing Future structural adjustment package, and large areas were closed to trawling.

The lowest total regional abundance of benthic taxa types across the south-east marine region was around 80–93% of pre-trawl abundance after the peak in fishing effort between 2000 and 2005. After this time, all taxa were predicted to recover by between 1% and 3% in the following decade.

The research indicated that the reduction in fishing effort was the main factor influencing the magnitude of recovery. In some cases, spatial management that excluded trawling led to improved abundance of some benthic taxa types. Most fishery closures and Australian marine parks had little detectable influence on abundance. In other cases, closures reduced the abundance of some taxa in some areas because trawling was displaced to areas where such taxa were more abundant (Pitcher et al. 2015).

Protected species

The SESSF interacts with various species listed as protected or conservation-dependent under the EPBC Act. Six former target species in the SESSF are listed as conservation-dependent: orange roughy, eastern gemfish, Harrisson's dogfish (*Centrophorus harrissoni*), southern dogfish (*C. zeehaani*), school shark and, most recently, blue warehou. These species, discussed in Chapters 9 and 12, are under rebuilding or recovery strategies. They are currently managed under incidental catch allowances, closed areas and trip limits, to allow for incidental catch when fishers are targeting other species.

Recent reductions in interactions with protected species have been observed, to varying degrees. However, the reductions are difficult to attribute to recent measures to mitigate catch of protected species because of a lack of data. These measures have included fishery closures to protect Australian sea lions (*Neophoca cinerea*) and gulper sharks; seabird mitigation measures for longline and trawl fisheries; seal, turtle and other bycatch excluder devices; and gear modifications (Tuck, Knuckey & Klaer 2013). Trends in protected species interactions are also difficult to interpret with confidence because the ISMP was originally designed only to provide estimates of the retained and discarded proportions of fish catch in the SESSF. A review of the ISMP in 2009 sought to facilitate better estimates of interactions with protected species and bycatch of major non-quota species.

Fishers are required to take all reasonable steps to avoid interactions with EPBC-listed species (other than those listed as 'conservation-dependent') and are required to report all interactions in their logbooks. An interaction is defined as any physical contact that a person, boat or gear has with a protected species, including catching and colliding with any of these species. Every three months, AFMA reports all interactions with protected species recorded in logbooks to the Australian Government Department of the Environment and Energy. These reports (which are published on the AFMA website) provide the basis for reports of the number of interactions with protected species within the SESSF in 2018. Interactions are known to occur with species groups protected under the EPBC Act, including marine mammals (cetaceans and pinnipeds), seabirds, sharks (white shark—*Carcharodon carcharias*, grey nurse shark—*Carcharias taurus*, shortfin mako shark—*Isurus oxyrinchus*, porbeagle shark—*Lamna nasus*) and syngnathids (seahorses and pipefish). Although these interactions are rare, they can have a significant impact on some species that have small populations (Komoroske & Lewison 2015). However, it is difficult to obtain robust estimates of total interactions or interaction rates at low levels of observer coverage or monitoring, especially when such interactions are rare (Komoroske & Lewison 2015; Martin, Stohs & Moore 2015). The introduction of electronic monitoring of all fishing activity in the GHTS has improved estimates of interactions with protected species, with some evidence suggesting increases in nominal interactions per unit effort in the first two years of the program (Emery et al. 2019). Trails of electronic monitoring are currently underway in the CTS (AFMA 2019b).

Pinnipeds (seals and sea lions)

The areas fished by the SESSF overlap with the distributions of the Australian fur seal (*Arctocephalus pusillus doriferus*), New Zealand fur seal (*A. forsteri*), Antarctic fur seal (*A. gazella*) and Australian sea lion. Fur seal populations have recovered substantially following heavy harvesting in the 18th and 19th centuries. The CTS and gillnet operations in the SGSHS, in particular, are known to interact with these species, whereas interactions with the hook sectors are much rarer. Between 1993 and 2000, data collected by the ISMP and its precursor (the Scientific Monitoring Program) indicated that an average of 720 fur seals might be caught incidentally by small trawlers operating in the CTS each year (Knuckey, Earys & Bosschietter 2002). Because of their smaller vessel size and net sizes, wet-boat trawlers have reduced ability to apply mitigation methods such as seal excluder devices (SEDs), which are designed for larger nets. Trials of a flexible SED design suitable for use in smaller nets have been reasonably successful (Knuckey 2009), but reliably estimating and reducing the level of interactions between seals and wet-boats remain difficult. A trial using a shortened codend to reduce seal bycatch was completed in late 2014. The trial found no definitive proof that short trawl nets had lower interaction rates with seals, caught fewer seals or resulted in lower mortality rates of caught seals (Koopman, Boag & Knuckey 2014).

Minimising seal interactions has been a focus for the winter trawl fishery for blue grenadier off western Tasmania. SEDs have been compulsory for freezer boats in this component of the SESSF since 2005, and modifications to fishing practices seem to have substantially reduced the incidence of seal bycatch in the midwater nets of factory vessels. Observers have been deployed on factory trawlers to verify interaction rates. In 2007, the South East Trawl Fishing Industry Association (SETFIA) released an updated trawl industry code of conduct for responsible fishing. It also released an industry code of practice that aims to minimise interactions with fur seals, as well as addressing the environmental impacts of the fishery more generally.

The Australian sea lion is endemic and listed as vulnerable under the EPBC Act. Sea lion populations were reduced substantially by sealing between the 18th and early 20th centuries, and recovery has been slow (DEWHA 2010). Australian sea lions show high genetic differentiation because of the high fidelity of female sea lions to their natal sites, indicating that animals lost from a colony are unlikely to be replaced by immigrants from other colonies (DEWHA 2010). The small size of some colonies suggests that the loss of a few breeding females from a population can significantly reduce the long-term recovery prospects of that population (Goldsworthy et al. 2010).

In 2003, closures were introduced around the Pages Islands (the largest sea lion colony) and around Kangaroo Island in South Australia. In December 2009, interim voluntary closures of 4 nautical miles were introduced around all colonies. The current declaration of the SESSF as an approved Wildlife Trade Operation under the EPBC Act includes a requirement to maintain management measures clearly directed towards limiting the impact of fishing activity on Australian sea lions to levels that will help the recovery of the species, including all subpopulations.

The mortality of Australian sea lions caught as bycatch in shark gillnets has been a concern. However, implementation of the Australian sea lion management strategy (AFMA 2010) reduced sea lion interactions in gillnets to close to zero. Measures taken by AFMA included spatial closures around colonies, increased observer coverage and trigger limits, with observed levels of bycatch above the trigger limits resulting in the closure of larger areas (AFMA 2010).

Warp deflector
Will Hansen, AFMA

AFMA lowered the trigger limit for sea lion mortalities in December 2011, following advice from marine mammal experts about risks to some sea lion subcolonies. The trigger limit was reduced from 52 animals to 15 animals across seven management zones in the Australian sea lion management area (AFMA 2011a). Two sea lion mortalities in the gillnet sector in the 2017–18 fishing season resulted in Australian Sea Lion Management Zone D being closed to gillnet fishing from 11 September 2017 to 9 March 2019.

Increased onboard observer coverage or electronic monitoring has obtained reliable data on interaction rates, and it is important that this monitoring continues. In the first six months of the sea lion management strategy, the prescribed level of observer coverage was not achieved. Consequently, the Australian Government funded a trial of onboard cameras to monitor Australian sea lion bycatch in 2010–11. In 2011, an expert review of the management strategy resulted in AFMA introducing a Temporary Order (six months, effective 1 May) that increased the size of closed areas around 31 colonies and required 100% observer coverage on gillnet vessels off South Australia in the Australian sea lion management area. This area consists of several zones, each with an interaction limit that triggers closure of the zone if the limit is reached. Electronic monitoring has been deployed in the fishery and is used instead of a scientific observer. The Temporary Order was replaced by a Closure Direction, which extended protection to 50 known Australian sea lion colonies. The existing closures around Australian sea lion colonies will be retained, and were incorporated into the permanent Closure Direction for the SESSF from the beginning of the 2015–16 fishing season. Observer requirements in the Australian sea lion management area off South Australia, including 100% onboard observers or electronic monitoring, have been continued under conditions attached to permits and statutory fishing rights.

The introduction of electronic monitoring in the GHTS from 1 July 2015 led to an increase in nominal reported interactions per unit effort for pinnipeds in the first two years of the program (Emery et al. 2019). In 2018, 284 pinniped interactions were reported in CTS and GHTS logbooks: 2 with an Australian sea lion, 26 with New Zealand fur seals, 177 with Australian fur seals and 79 with seals of unknown species. This is an increase from the 179 interactions reported in 2017. In the CTS, 82% of all pinniped interactions in 2018 were reported from bottom-trawling operations; the remainder (18%) were reported from Danish-seine operations. Of the pinniped interactions reported in logbooks in the GHTS in 2018, 91% were reported from gillnet operations.

Dolphins

All cetacean species are protected under the EPBC Act. Increased observer coverage in the SGSHS in 2011 highlighted interactions with dolphins and potential under-reporting in logbooks (AFMA 2011a). Two dolphin mortalities were reported in logbooks between January and September 2010 (AFMA 2011b), and 52 interactions with dolphins were reported from September 2010 to September 2011 (AFMA 2011b). In response, AFMA closed about 27,239 km^2 south-west of Kangaroo Island to gillnet fishing, where most of the interactions had been reported (dolphin gillnet closure). Observer coverage was increased to 100% (onboard observer or camera) in the area adjacent to the dolphin gillnet closure, and 10% onboard observer coverage was required across the eastern part of the fishery in Bass Strait and around Tasmania.

In 2014, AFMA worked with experts in the marine mammal working group and the fishing industry to implement the first stage of a dolphin management strategy. The objectives of the strategy are to reduce dolphin interactions in gillnets to near zero, and strengthen responsible fishing practices through electronic monitoring and individual accountability. On 8 September 2015, AFMA reopened the dolphin gillnet closure to limited gillnet fishing, with 100% electronic monitoring and individual boat-level performance standards. In May 2017, the dolphin strategy was extended to gillnet fishing across the entire SESSF. Under the strategy, fishers who do not have interactions with dolphins may continue fishing responsibly. However, there are now management responses for any dolphin bycatch in the gillnet fishery, and individual operators incur escalating management responses if they catch dolphins.

The introduction of electronic monitoring in the GHTS from 1 July 2015 led to an increase in nominal reported interactions per unit effort for dolphins in the first two years of the program (Emery et al. 2019). In 2018, interactions were reported with 56 dolphins in the GHTS, all of which were dead; 4 interactions were reported in the CTS—all dolphins were dead. This is a decrease from the 67 interactions reported in 2017.

Seabirds

In 1998, in accordance with EPBC Act requirements, the Australian Government developed a threat abatement plan for the incidental bycatch of seabirds during oceanic longline fishing operations. The plan, which was revised in 2006, 2014 and 2018 (Commonwealth of Australia 2018), applies to longline operations in all Commonwealth fisheries, including the SESSF, and is the main guide to mitigating seabird bycatch in this sector. In accordance with the threat abatement plan, SESSF longline operators are required to keep interaction rates below 0.01 interactions per 1,000 hooks set. The levels of seabird bycatch recorded by auto-longline, demersal longline, dropline and trotline operators in the SESSF are low compared with those in other pelagic longline fisheries that target tuna and billfish (Brothers 1991; Brothers et al. 2010; CCAMLR 2002).

Seabirds also interact with otter-board trawling activities—they are vulnerable to injury as a result of striking the trawl warps (the trawling cables) during fishing operations, predominantly when catches are being processed and offal is discarded into the water. Analysis of observer data suggests that the number of interactions may be high, but further work is needed to understand their scale and significance (Phillips et al. 2010). Given the difficulty in documenting these interactions (birds suffering warp strike are not landed and are not easily observed), obtaining reliable estimates of seabird mortalities is difficult, even with onboard observers. The issue was investigated by a research project between AFMA and the Tasmanian Department of Primary Industries, Parks, Water and Environment. Mitigation measures, such as offal management and bird-scaring devices, have been effective in reducing seabird bycatch elsewhere. During 2011, AFMA worked with SETFIA to develop tailored seabird management plans for individual vessels, to address this issue.

As part of their boat-specific seabird management plans, vessels are required to use effective seabird mitigation devices. In late 2014, AFMA completed a trial using observers to test the effect of seabird mitigation devices on seabird interactions with otter trawlers. The trial showed that the use of warp deflectors (large floats attached in front of trawl warps to scare birds away—often called 'pinkies') reduced heavy contact between actively feeding seabirds and warp wires by around 75% (Pierre, Gerner & Penrose 2014). Based on the outcomes of the trial, AFMA mandated a minimum requirement in seabird management plans of 600 mm pinkies. SETFIA has also introduced a code of conduct and training program to improve seabird avoidance measures, and undertook a trial of alternative seabird mitigation devices, including water sprayers and bird bafflers. SETFIA reported that water sprayers and bird bafflers used in the trial reduced interactions between seabirds and the warp by 58.9% and 86.7%, respectively, when compared with the warp deflector or pinkie (Koopman et al. 2018). As a result, on 1 May 2017, AFMA required trawl boats in the SESSF to use one of the following mitigation devices: sprayers, bird bafflers, and pinkies with zero discharge of fish waste. To further reduce seabird interactions in the CTS, from 1 November 2019, AFMA will phase in a requirement for all otter-board trawl vessels to not discharge offal while fishing gear is deployed off the west coast of Tasmania, and then from 1 July when fishing south of 38°S.

Seabird interactions are under-reported for numerous reasons, including that it is difficult to observe seabirds interacting with fishing gear and vessels, particularly trawl gear, and that seabirds may not have visible injury after interactions such as warp strikes. During 2018, 161 seabird interactions were reported: 112 in the GHTS and 49 in the CTS. This is an increase from 98 seabird interactions reported in 2017. Of the 161 interactions, most were with the following groups: 5 were reported as unclassified petrels, prions and shearwaters, all of which were dead; 7 were with white-chinned petrels (*Procellaria aequinoctialis*), 4 of which were dead; 6 were with shy albatross (*Thalassarche cauta*), 4 of which were dead; 2 were with grey-headed albatross (*T. chrysostoma*), both of which were dead; 47 were with unclassified albatrosses, 39 of which were dead; 10 were with cormorants, all of which were dead; 74 were with unclassified shearwaters, 52 of which were dead; and 4 were with unclassified birds, all of which were dead.

Sharks

In 2018, 189 interactions with protected sharks were reported in logbooks: 183 in the GHTS (119 of which were dead) and 6 in the CTS (1 dead). The most prevalent shark was shortfin mako, with 119 interactions reported, 93 of which were dead. Twenty-five white sharks were reported, 20 in the GHTS and 5 in the CTS; 20 were released alive and 5 were dead. Twenty-seven porbeagle sharks were reported, of which 20 were dead and 7 were alive; 5 longfin makos (*Isurus paucus*) were reported, of which 2 were dead and 3 were alive; and 2 grey nurse sharks were reported, all of which were released in an unknown condition. The EPBC Act requires all white sharks and grey nurse sharks to be released alive, if possible.

During 2012, in view of their overfished status, a proposal was made to list Harrisson's dogfish and southern dogfish as threatened species under the EPBC Act. On 30 May 2013, the then Minister for Sustainability, Environment, Water, Population and Communities decided to list Harrisson's dogfish and southern dogfish in the conservation-dependent category, noting that both species have experienced severe historical declines after being overfished. These species are subject to recovery plans that specify management actions to stop their decline and support their recovery.

Syngnathids (seahorses and pipefish)

Syngnathids are taken as bycatch in the CTS in otter-trawl and Danish-seine nets, but they are often small and difficult to observe among large catches of fish. No interactions with syngnathids were reported in 2018 in the CTS.

8.7 References

AFMA 2010, *Australian sea lion management strategy: Southern and Eastern Scalefish and Shark Fishery (SESSF)*, Australian Fisheries Management Authority, Canberra.

—— 2011a, Fisheries Management (Southern and Eastern Scalefish and Shark Fishery Management Plan 2003) Temporary Order 2011, AFMA, Canberra.

—— 2011b, Fisheries Management (Southern and Eastern Scalefish and Shark Fishery Management Plan 2003) Temporary Order 2011 no. 2, AFMA, Canberra.

—— 2018, *Southern and Eastern Scalefish and Shark Fishery management arrangements booklet 2018*, AFMA, Canberra.

—— 2019a, *Harvest strategy framework for the Southern and Eastern Scalefish and Shark Fishery*, 2009 amended (2019), AFMA, Canberra.

—— 2019b, 'South East Management Advisory Committee (SEMAC) meeting 37, minutes, 22 May 2019', AFMA, Canberra.

Braccini, J, Walker, T & Gason, A 2009, *GHATF shark survey of population abundance and population size composition for target, byproduct and bycatch species*, final report to AFMA, project 2006/823, Queensland Department of Primary Industries, Queenscliff.

Brothers, N 1991, 'Albatross mortality and associated bait loss in the Japanese longline fishery in the Southern Ocean', *Biological Conservation*, vol. 55, pp. 255–68.

——, Duckworth, AR, Safina, C & Gilman, EL 2010, 'Seabird bycatch in pelagic longline fisheries is grossly underestimated when using only haul data', *PLoS ONE*, vol. 5, no. 8.

CCAMLR 2002, 'Incidental mortality arising from longline fishing', in *Report of the twenty-first meeting of the Scientific Committee of the Commission for the Conservation of Antarctic Marine Living Resources*, Commission for the Conservation of Antarctic Marine Living Resources, Hobart, pp. 288–331.

Commonwealth of Australia 2018, *Threat abatement plan for the incidental catch (or bycatch) of seabirds during oceanic longline fishing operations (2018)*, Department of the Environment and Energy, Canberra.

Department of Agriculture and Water Resources 2018a, *Commonwealth Fisheries Bycatch Policy 2018*, Department of Agriculture and Water Resources, Canberra.

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

DEWHA 2010, *Recovery plan for the Australian sea lion (*Neophoca cinerea*), technical issues paper*, Department of the Environment, Water, Heritage and the Arts, Canberra.

Emery, TJ, Noriega, R, Williams, AJ & Larcombe, J 2019, 'Changes in logbook reporting by commercial fishers following the implementation of electronic monitoring in Australian Commonwealth fisheries', *Marine Policy*, vol. 104, pp. 135–45.

Fay, G, Punt, AE & Smith, ADM 2009, 'Operating model specifications', in SE Wayte (ed.), *Evaluation of new harvest strategies for SESSF species*, CSIRO Marine and Atmospheric Research & AFMA, Canberra, pp. 125–33.

George, D & New, R 2013, *Australian fisheries surveys report 2012: financial and economic performance of the Eastern Tuna and Billfish Fishery, the Commonwealth Trawl Sector and the Gillnet, Hook and Trap Sector*, ABARES, Canberra.

Goldsworthy, SD, Page, B, Shaughnessy, PD & Linnane, A 2010, *Mitigating seal interactions in the SRLF and the Gillnet Sector SESSF in South Australia*, report to Fisheries Research and Development Corporation, South Australian Research and Development Institute, Research Report Series 405, SARDI Aquatic Sciences, Adelaide.

Haddon, M 2015, *Bight redfish (*Centroberyx gerrardi*) stock assessment using data to 2014/2015*, draft report, CSIRO Oceans and Atmosphere, Hobart.

Knuckey, IA 2009, *Trials of seal excluder devices (SEDs) on a South East Trawl Fishery wet boat*, final report to the Natural Heritage Trust.

——, Eayrs, S & Bosschietter, B 2002, *Options for reducing incidental catch of seals on wet-boats in the SETF: a preliminary report*, final report to AFMA, ARF project R01/0887, Marine and Freshwater Resources Institute, Queenscliff.

Komoroske, LM & Lewison, RL 2015, 'Addressing fisheries bycatch in a changing world', *Frontiers in Marine Science*, vol. 2, no. 83, pp. 1–11.

Kompas, T, Che, N, Chu, L & Klaer, N 2012, *Transition to MEY goals for the Great Australian Bight Trawl Fishery*, report to FRDC, Australian Centre for Biosecurity and Environmental Economics, Crawford School of Public Policy, Australian National University, Canberra.

Koopman, M, Boag, S & Knuckey, I 2014, *Assessment of potential mitigation of seal interactions in the SESSF using shortened cod ends*, AFMA project 2012/0828, Fishwell Consulting.

Koopman, M, Boag, S, Tuck, GN, Hudson, R, Knuckey, I & Alderman, R 2018, 'Industry-based development of effective new seabird mitigation devices in the southern Australian trawl fisheries', *Endangered Species Research*, vol. 36, pp. 197–211.

Little, LR, Wayte, SE, Tuck, GN, Smith, ADM, Klaer, N, Haddon, M, Punt, AE, Thomson, R, Day, J & Fuller, M 2011, 'Development and evaluation of a CPUE-based harvest control rule for the Southern and Eastern Scalefish and Shark Fishery of Australia', *ICES Journal of Marine Science*, vol. 68, no. 8, pp. 1699–1705.

Martin, SL, Stohs, SM & Moore, JE 2015, 'Bayesian inference and assessment for rare-event bycatch in marine fisheries: a drift gillnet fishery case study', *Ecological Applications*, vol. 25, no. 2, pp. 416–29.

Phillips, K, Giannini, F, Lawrence, E & Bensley, N 2010, *Cumulative assessment of the catch of non-target species in Commonwealth fisheries: a scoping study*, Bureau of Rural Sciences, Canberra.

Pierre, J, Gerner, M & Penrose, L 2014, *Assessing the effectiveness of seabird mitigation devices in the trawl sectors of the Southern and Eastern Scalefish and Shark Fishery in Australia*, AFMA, Canberra.

Pitcher, C, Ellis, N, Althaus, F, Williams, A & McLeod, I 2015, 'Predicting benthic impacts and recovery to support biodiversity management in the South East Marine Region', in N Bax & P Hedge (eds), *Marine Biodiversity Hub, National Environmental Research Program, final report 2011–2015*, report to the Department of the Environment, Canberra.

Tuck, GN, Knuckey, I & Klaer, NL 2013, *Informing the review of the Commonwealth Policy on Fisheries Bycatch through assessing trends in bycatch of key Commonwealth fisheries*, FRDC final report 2012/046, FRDC, Canberra.

Walker, P, Cavanagh, R, Ducrocq, M & Fowler, S 2005, 'Regional overview: northeast Atlantic (including Mediterranean and Black Sea)', in International Union for Conservation of Nature (IUCN) SSC Shark Specialist Group, S Fowler, R Cavanagh, M Camhi, G Burgess, G Cailliet, S Fordham, C Simpfendorfer & J Musick (eds), *Sharks, rays and chimaeras: the status of the chondrichthyan fishes*, IUCN, Gland, Switzerland, & Cambridge, United Kingdom, pp. 71–95.

Ward, P, Marton, N, Moore, A, Patterson, H, Penney, A, Sahlqvist, P, Skirtun, M, Stephan, M, Vieira, S & Woodhams, J 2013, *Technical reviews for the Commonwealth Fisheries Harvest Strategy Policy: implementation issues*, report prepared for FRDC, ABARES, Canberra.

Wayte, SE (ed.) 2009, *Evaluation of new harvest strategies for SESSF species*, CSIRO Marine and Atmospheric Research & AFMA, Canberra.

Hauling the catch
AFMA