Chapter 8
Southern and Eastern Scalefish and Shark Fishery

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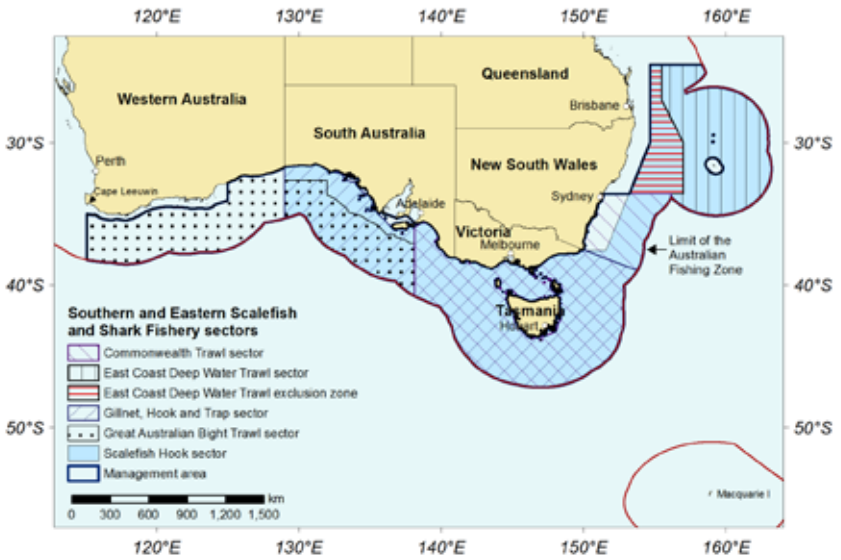
FIGURE 8.1 Area and sectors of the Southern and Eastern Scalefish and Shark Fishery



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.[1]

The SESSF remained the largest Commonwealth fishery in terms of volume caught in the 2018–19 fishing season. In 2018–19, the gross value of production (GVP) of the SESSF was $87 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 (e-monitoring) and vessel monitoring systems.

Consultation in the SESSF is undertaken through a series of Management Advisory Committees (MACs) and Resource Assessment Groups (RAGs). In the SESSF, RAGs include the South East RAG (SERAG), SharkRAG, the Great Australian Bight RAG (GABRAG) and the SESSFRAG. Members of the RAGs include Australian Fisheries Management Authority (AFMA) managers, fisheries scientists, industry members, economists and other interest groups. This group provides advice and recommendations to the MACs, AFMA managers and the AFMA Commission on stock assessments; scientific analyses; the status of fish stocks; and the impact of fishing on target, non-target and threatened, endangered and protected (TEP) species and habitats.

In the SESSF, MACs include the South East MAC (SEMAC) and the Great Australian Bight MAC (GABMAC). Members of the MACs include AFMA managers, industry members, policy analysts, conservationists, state and territory managers, economists, and recreational fishing interest groups. These committees provide advice to AFMA managers and the AFMA Commission on the formulation of management arrangements that are consistent with overarching policy and legislation using, among other things, information obtained from the RAGs on the status of fish stocks, non-target and TEP species, and the impacts of fishing on the marine environment.

1 See https://parksaustralia.gov.au/marine

The SESSF was established in 2003 by amalgamating 4 fisheries—the South East Trawl, the Great Australian Bight Trawl, the Southern Shark non-trawl and the South East non-trawl fisheries—under common management objectives. The Southern and Eastern Scalefish and Shark Fishery (SESSF) Management Plan 2003 was gazetted on 1 October 2003. Originally, each of the 4 fisheries had its own MAC. In 2009, AFMA created SEMAC to provide advice to the AFMA Commission on management measures for the entire SESSF. The Small Pelagic Fishery MAC and the Squid MAC also became part of SEMAC in 2010, whereas GABMAC remains separate.

Landings in the SESSF have generally decreased over time because of reductions in fishing effort, although in the 2019–20 fishing season, total landings increased to their highest level since the 2011–12 fishing season, mainly due to a large increase in the catch of blue grenadier (*Macruronus novaezelandiae*) in the Commonwealth Trawl Sector (CTS). This increase in catches of blue grenadier was partially offset by a decline in the catches of both pink ling (*Genypterus blacodes*) and blue-eye trevalla (*Hyperoglyphe antarctica*), which have historically had relatively stable catches. In the 2019–20 fishing season, total landings in the CTS, the Gillnet, Hook and Trap Sector (GHTS), the Great Australian Bight Trawl Sector (GABTS) and the East Coast Deepwater Trawl Sector (ECDTS) were 14,920.1 t, 2,707.0 t, 1,600.0 t and 7.8 t, respectively, for a total 19,234.8 t.

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 (principally Chapter 9 and Chapter 12).

Gillnet vessel
AFMA

8.2 Sectors of the fishery

Current management arrangements are structured around the 4 primary sectors of the fishery: the CTS, the ECDTS, the GABTS and the GHTS.

The status of the stocks taken in these sectors are 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 the 2017–18 fishing season, both increased, with 8,759 shots undertaken and 36 t of hagfish (class Myxini) landed (that is, based on catch disposal record data). In 2018–19, catch and effort again increased, to 19,402 shots and 85 t landed. A similar amount of catch and effort was witnessed in the 2019–20 fishing season, with 23,030 shots recorded and 84 t landed.

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 release of the inaugural Commonwealth Fisheries Harvest Strategy Policy (HSP) in 2007, and since the release of an updated HSP in 2019 (Department of Agriculture and Water Resources 2019b). The current SESSF HSF applies to all sectors, and each stock under quota is assigned to 1 of 3 '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. Under the SESSF HSF, an RBC recommendation can also be made using alternative assessment methods if: (i) it is considered more appropriate for a quota species than the traditional 3 'tiers' for assessment and; (ii) it meets the intent of the HSP. A variety of 'tier 5' approaches, such as catch at maximum sustainable yield (MSY) and age-structured stock reduction analysis approaches have been used recently to inform RBC recommendations (for example, blue-eye trevalla).

Harvest control rules (HCRs), target and limit reference points, and the tiers 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 HCRs, with the HCRs intended to move a stock away from a limit reference point and towards the target reference point (AFMA 2019a). Several 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 unavoidable catches of these stocks when fishers are targeting other stocks. The HSF provides guidance on the various considerations under such circumstances. These stocks are also typically subject to rebuilding strategies that articulate rebuilding targets and time frames, and place controls on catch.

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 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 of 48% of the unfished biomass ($0.48B_0$) 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 2018b) assessed across the SESSF in 2019 (Figure 8.2):

- 27 stocks (73%) were classified as not subject to overfishing
- 0 stocks (0%) were classified as subject to overfishing
- 10 stocks (27%) 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. No SESSF stock was subject to overfishing in 2019. However, 10 stocks were classified as uncertain for fishing mortality status in 2019, 7 of which were classified as overfished.

A stock is considered to be overfished where biomass (or its proxy) is estimated to be below the limit reference point. Typically, the limit reference point is set at the HSP proxy level of 20% of unfished levels ($0.2B_0$). The SESSF includes 7 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 2 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 2019 are blue warehou, eastern gemfish, gulper sharks, orange roughy southern and western, school shark and redfish. It is important to note that the change to an uncertain fishing mortality status for orange roughy in the southern and western zones in 2019 was not brought about through additional information or new data. It stemmed from the need to ensure consistency in the status applied to stocks that have no recent validation of biomass and therefore no reliable indicators to determine whether the current level of fishing mortality will allow the stock to rebuild to above the limit reference point within a biologically reasonable time frame.

FIGURE 8.2 Fishing mortality status for all stocks assessed in the SESSF, 2004 to 2019

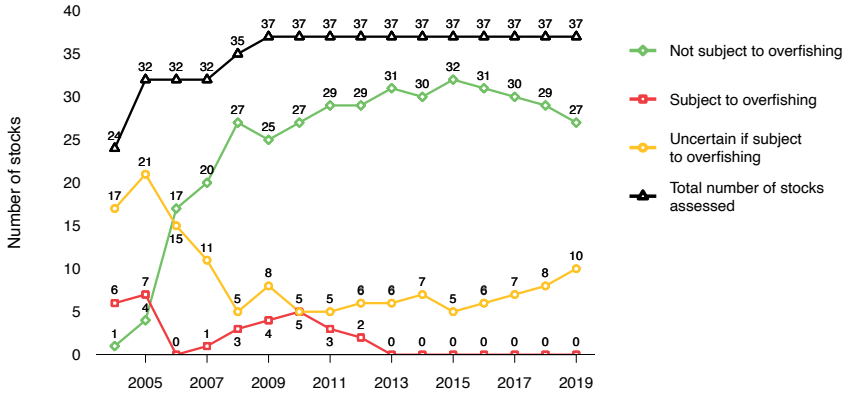
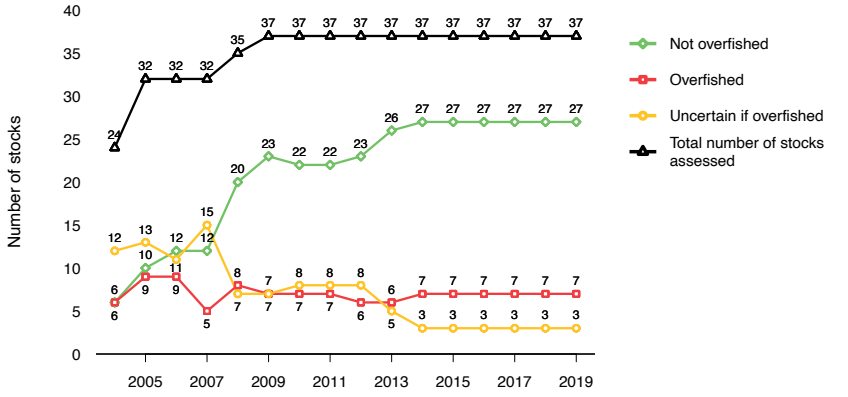


FIGURE 8.3 Biomass status for all stocks assessed in the SESSF, 2004 to 2019



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 57% of SESSF GVP in 2018–19 (Figure 8.4). These sectors are therefore key drivers of economic performance in the SESSF. Of these 2 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 peak at $7.8 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 declined in 2017–18 and 2018–19, by $5.0 million over the 2 years, to –$1.1 million. A negative NER indicates that the fishery is not covering the full economic cost of inputs, including an adequate economic return to capital and labour resources employed, and the full cost of management resources expended. The decline in NER in these years was driven by lower catch volume (affecting revenue), higher unit fuel prices and higher fishing effort, combining to increase costs.

The estimated biomass for 2 of the most valuable species within the CTS (blue grenadier and tiger flathead—*Neoplatycephalus richardsoni*), together contributing 38% of catch volume and 35% of GVP in 2018–19, 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).

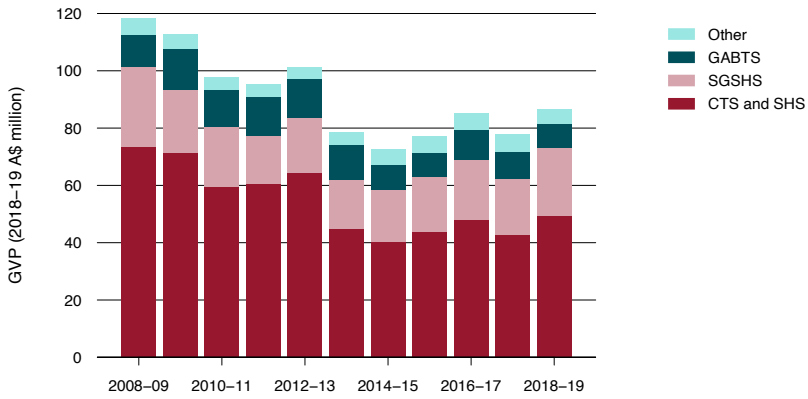
Historically, orange roughy has contributed substantially to GVP of the CTS. The rebuilding of orange roughy stocks over the longer term should improve the economic status of the sector, although sustainable catch levels are likely to be much lower than peak historical levels. The recommencement of fishing for orange roughy in the eastern zone boosted GVP from 2015–16 to 2018–19. Orange roughy has become a significant proportion of the catch volume and value of the CTS sector, accounting for 9% of volume caught and 17% of value in 2018–19. The blue grenadier catch remained substantially lower than the TAC between 2014–15 and 2018–19, 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 80% of GVP in the GHTS in 2018–19. 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, a species attributed to the CTS and the SHS. Preliminary estimates for 2018–19 indicate a recovery in NER to an estimated $5.6 million, which is the highest level since 2008–09, largely driven by a significant increase in fishing revenue from higher catch volumes and lower overall fishing costs. 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 most recent stock assessments for bight redfish (*Centroberyx gerrardi*) and deepwater flathead (*Platycephalus conatus*) (Chapter 11) indicate spawning biomass in 2020–21 for these species to be above the target reference point, with catch in recent seasons well below the RBC. This indicates potential for increased profits to be made if the stock is fished down to its MEY target reference point. 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.

FIGURE 8.4 Real GVP in the SESSF by sector, 2008–09 to 2018–19



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. 'Real' indicates that value has been adjusted for inflation. 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.

Overall, the economic status of the SESSF has been mixed in recent years. The deterioration 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, and non–survey based estimates indicate a significant improvement in NER for 2018–19. This change offsets an emerging negative trend in NER in the CTS in this period; meanwhile, the GABTS continues to pursue estimated B_{MEY} targets for its key species.

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

The Commonwealth Fisheries Bycatch Policy defines bycatch as species that are either taken in a fishery and returned to the sea, or killed or injured through interaction with fishing equipment in a fishery, but not taken (Department of Agriculture and Water Resources 2018a). The policy identifies 2 types of bycatch: general bycatch, and species listed under the *Environment Protection and Biodiversity Conservation Act 1999* (EPBC Act) that are afforded a higher level of protection.

Tuck, Knuckey & Klaer (2013) evaluated bycatch and discards in 6 Commonwealth fisheries, including the SESSF, and concluded that trawling in the south-east CTS and the GABTS, and Danish-seining in the CTS 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 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. A study examining bycatch from different gear configurations in the Danish-seine sector confirmed that bycatch of smaller fish, notably small flathead and eastern school whiting (*Sillago flindersi)*, while targeting tiger flathead could be reduced by moving to a larger mesh size (Koopman et al. 2010). Industry, through the South East Trawl Fishing Industry Association (SETFIA), requested an increase in minimum mesh size in Danish-seine codends when fishing for flathead from 70 mm to 75 mm. This was implemented through changes to concession conditions for the start of the 2019–20 fishing season. 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.

Fishing in the SESSF can be broken into 2 categories: targeted fishing and general 'market fishing'. Bycatch (and therefore discarding) is minimal when target fishing (such as for orange roughy or blue grenadier); however, discards can be up to 50% of catch (by weight) in the market fishery of the CTS, 40–50% in the GABTS (Koopman et al. 2017; Tuck, Knuckey & Klaer 2013) and more than 30% of catch in the GHTS (Braccini, Walker & Gason 2009). Management measures were introduced in the 2014–15 season that require the release of live school shark. The post-release survival of live school shark (and other sharks in the sector) remains a key uncertainty and is expected to be a priority for research funding in coming years. The GHTS is subject to e-monitoring, with trials recently completed for the CTS (AFMA 2019b). The effect of increased levels of e-monitoring, particularly on protected species, is discussed further below.

Trawling impacts

Demersal trawling can cause significant physical disturbance to benthic habitats. The extent of disturbance typically depends on a range of factors, including gear design, the frequency of trawling and habitat type, and the biological characteristics of the organisms exposed to the gear (Hiddink et al. 2019; Kaiser 2019).

Pitcher et al. (2016, 2018) looked at trawl operations in the SESSF and estimated the swept area by habitat type for the CTS and the GABTS. They used various biophysical datasets to characterise 20 habitat assemblages for the CTS and 13 for the GABTS. They found that actual swept area is low relative to the full extent of areas where trawling is permissible, but that trawling activity is concentrated in certain locations and habitat assemblages.

Pitcher et al. (2016) estimated that 7.7% of the CTS is trawled annually (9.5% combined area over all years considered) and that 3.8% of the GABTS is trawled annually (4.9% over all years considered). Certain areas of the fishery (and therefore habitat assemblages) are targeted by repeated trawling (up to ~1.75 times per year in both that CTS and GABTS areas). Habitat characterisation for benthic assemblages is limited in south-east Australia, but the habitat assemblages in these fishing areas associated with the shelf edge are typically composed of habitat-forming benthos such as sponges, ascidians, stalked crinoids, bryozoans, black corals and octocorals (Pitcher et al. 2016; Ward et al. 2006; Williams et al. 2018).

Protected and conservation-dependent species

The SESSF interacts with various species listed as protected or conservation-dependent under the EPBC Act. Six species previously targeted 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 managed under stock rebuilding or recovery strategies. With the exception of Harrison's dogfish and southern dogfish (which are no-take species), these species are subject to incidental catch allowances to provide for incidental catch when fishers are targeting other species. Additional management arrangements include closed areas, gear restrictions and/or trip limits.

Interactions are known to occur with other 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 typically rare, they can have a significant impact on some species that have small populations (Komoroske & Lewison 2015).

Historically, it has been difficult to obtain robust estimates of interactions and/or interaction rates with listed species. (Komoroske & Lewison 2015; Martin, Stohs & Moore 2015). The introduction of e-monitoring 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 2 years of the program (Emery et al. 2019). Trials of e-monitoring have recently been completed in the CTS, with the final report pending at the time of drafting (AFMA 2019b).

In accordance with accreditation under the EPBC Act (see Chapter 1, 'Protected species interactions') AFMA publishes and reports quarterly on interactions with protected species on behalf of Commonwealth fishing operators to the Department of Agriculture, Water and the Environment (DAWE). These reported interactions with protected species form a part of the ongoing monitoring by DAWE of the performance of fisheries within their accreditation under the EPBC Act.

Gillnet
Mike Gerner, AFMA

Pinnipeds (seals and sea lions)

The areas fished by sectors in the SESSF overlap with the distributions of the Australian fur seal (*Arctocephalus pusillus doriferus*), long-nosed fur seal (formerly New Zealand fur seal) (*A. forsteri*), Antarctic fur seal (*A. gazella*) and Australian sea lion (ASL) (*Neophoca cinerea*), all of which are protected under the EPBC Act. These seals were hunted extensively in the 18th and 19th centuries, resulting in substantial decreases in numbers.

The recovery of species, since hunting was discontinued in the 1920s and protections were put into place, has been mixed. Fur seal populations have largely recovered (Evans, Rogers & Goldsworthy 2017) to the point where key colonies of Australian fur seal, for example, are believed to have reached carrying capacity, although there was a ~4% reduction in pups from 2007 to 2013 (McIntosh et al. 2018). On the other hand, ASL numbers have not returned to pre-exploitation levels (DSEWPC 2013). Abundance in the Great Australian Bight (the broader area of the Great Australian Bight as distinct from the area of operation of the GABTS), where 93% of ASL are currently found, is understood to be decreasing (Evans, Rogers & Goldsworthy 2017). In the Great Australian Bight, numbers are understood to have declined by 76% over the past 38 years, resulting in the listing of this species as 'endangered' under International Union for Conservation of Nature criteria (Evans, Rogers & Goldsworthy 2017).

SETFIA promotes a code of conduct for responsible fishing, which follows an industry code of practice (2007) that aims to minimise interactions with pinnipeds and addresses the environmental impacts of the fishery more generally.

The SESSF operates under the Australian Sea Lion Management Strategy, implemented in 2010 (AFMA 2010). The strategy aims to monitor and minimise the impacts of interactions between Australian sea lions and gillnets used by Commonwealth shark fishers so as to enable breeding colonies of sea lions to recover. This strategy defines objectives and actions to be carried out within sea lion management areas (AFMA 2015a). A variety of education and fishing measures have been adopted, including closed areas around breeding colonies, 100% fishing monitoring through observers or e-monitoring, transitionary arrangements from gillnets to hooks, and trigger limits on interactions. As a result of these measures, interactions with sea lions have reduced from an estimated 300+ interactions per year, before 2010 (Goldsworthy et al. 2010), to 2 reported interactions (1 alive; 1 dead) in 2019. The reasons behind the continued decline in sea lion abundance are not clear.

In 2019, 234 pinniped interactions were reported in logbooks for the CTS (168) and GHTS (66): 2 with Australian sea lions (1 alive; 1 dead), 28 with New Zealand fur seals (5 alive; 23 dead), 133 with Australian fur seals (22 alive, 111 dead) and 71 with seals of unknown species (14 alive; 57 dead). This is a decrease from the 284 interactions reported in 2018. In the CTS, 80% of all pinniped interactions in 2019 were reported from bottom-trawling operations; 10% were reported from Danish-seine operations and 6% from midwater seine.

Dolphins and whales

All cetacean species are protected under the EPBC Act. Increased observer coverage in the SGSHS in 2011 highlighted interactions with dolphins and potential underreporting in logbooks. 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). This closure resulted in a reduction of approximately 80% of the total South Australian catch compared with the years preceding the closure (AFMA 2017). 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 e-monitoring and individual accountability. On 8 September 2015, AFMA reopened the dolphin gillnet closure to limited gillnet fishing, with 100% e-monitoring and individual vessel-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 e-monitoring in the GHTS from 1 July 2015 led to an increase in nominal reported interactions per unit effort for dolphins in the first 2 years of the program (Emery et al. 2019).

In September 2019, additional spatial management was introduced, which will require operators to cease fishing in a higher-risk area off South Australia (the South Australian Dolphin Zone) after only 1 review period if they cannot stay under the threshold interaction rate. The role of e-monitoring as a key monitoring tool was also increased at this time.

In 2019, 35 interactions (all dead) with dolphins were reported in the GHTS and 9 interactions (all dead) were reported in the CTS. Total dolphin interactions in 2019 (44) were down from the 60 interactions reported in 2018. Two interactions with killer whales (both alive) also occurred in the GHTS in 2019.

Seabirds

Seabirds are globally one of the most threatened of the bird groups, with many species showing declines in population (Gorta et al. 2019; Phillips et al. 2016). Many species exhibit long lives, delayed sexual maturity and low reproductive rates, which can result in low resilience and slow population recovery from predation and mortality (Dias et al. 2019; Phillips et al. 2016). Seabird populations are particularly affected by invasive alien species and predators, fishing, disease, and climate change, which have resulted in substantial decreases in abundance of seabirds globally (Dias et al. 2019; DSEWPC 2011); this is also the case for those found in south-eastern Australia (Gorta et al. 2019).

The SESSF interacts with a variety of seabird species, all of which are protected under the EPBC Act. In particular, seabirds are vulnerable to injury from being hooked when setting longline gear, or struck or trapped by otter trawl gear. To mitigate the risk of interactions, fishers in the SESSF are required to use seabird mitigation devices such as tori lines, sprayers, bafflers and warp deflectors ('pinkies'). The combination of these mitigation devices has reduced interactions by ~90% (Koopman et al. 2018). Seabird management plans are compulsory for all otter trawl boats in the CTS and the GABTS, and automatic longline boats in the GHTS. These plans detail boat-specific approaches to implementing seabird mitigation, including physical mitigation and handling of biological material.

To further reduce seabird interaction with otter trawl boats, AFMA has introduced additional conditions such that otter trawl boats in the CTS must not discharge biological material when fishing gear is deployed south of 38°S unless an exemption has been provided based on proven and effective mitigation. Industry is developing new and improved approaches to mitigating the risk of seabirds interacting with trawl gear, with a number of exemptions already approved (AFMA, pers. comm., 2020).

SESSF fishers follow the *Seabird bycatch operational guidelines for Commonwealth fisheries* (AFMA 2018a), which assists fishers with following government policies and legislation relating to seabirds, and provides a consistent approach to minimising or avoiding seabird interactions. In addition, SESSF longline fishers follow the Threat Abatement Plan for the Incidental Catch (or Bycatch) of Seabirds During Oceanic Longline Fishing Operations (2018), which binds the Commonwealth and its agencies in responding to the impact of longline fishing activities on seabirds, and identifies the research, management and other actions needed to reduce the impacts of this key threatening process on affected seabird populations. In accordance with the threat abatement plan, SESSF longline operators are required, for example, to maintain minimum levels of observer or e-monitoring coverage and keep interaction rates below 0.01 interactions per 1,000 hooks set.

Seabird interactions are typically underreported 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 a visible injury after interactions such as warp strikes.

During 2019, 98 seabird interactions were reported: 39 in the GHTS and 59 in the CTS. This is a decrease from 161 seabird interactions reported in 2018. Of the 98 interactions, 3 were reported as unclassified petrels, prions and shearwaters, all of which were alive; 3 were with white-chinned petrels (*Procellaria aequinoctialis*), 2 of which were dead; 6 were with shy albatross (*Thalassarche cauta*), 3 of which were dead; 59 were with unclassified albatrosses, 46 of which were dead and 1 injured; 2 were with unclassified cormorants, both of which were dead; 8 were with unclassified shearwaters, 4 of which were dead; 10 were with unclassified birds, 4 of which were dead; and 2 were with little penguins (*Eudyptula minor*), both of which were dead. The type of seabird for 5 interactions was not reported.

Sharks

Three shark species relevant to the SESSF are listed under the EPBC Act as conservation-dependent: school shark (effective January 2009), Harrisson's dogfish (effective June 2013) and southern dogfish (effective June 2013). All 3 species have been assessed as overfished since their first inclusion in the *Fishery status reports*. School shark is subject to a rebuilding strategy (AFMA 2015b) that articulates a 66-year rebuilding time frame for the stock to the limit reference point ($0.20B_0$). The 2 gulper shark species are subject to a management strategy that notes that the time to rebuild to the limit reference point ($0.25B_0$) is expected to be around 62 years for southern dogfish and around 86 years for Harrisson's dogfish (AFMA 2012). Measures in the 2 strategies to facilitate rebuilding are discussed in the respective chapters (Chapter 12 for school shark, and Chapter 9 for gulper sharks).

Other non-commercial shark species, listed under the EPBC Act, are caught or interacted with in SESSF fisheries. These are the mako sharks (short and long-finned), grey nurse shark, scalloped hammerhead shark (*Sphyrna lewini*) and white shark. Interactions with these species must be reported annually. The EPBC Act also requires all white sharks and grey nurse sharks to be released alive, if possible.

In 2019, 136 interactions with protected sharks were reported in logbooks: 134 in the GHTS (102 of which were dead) and 2 in the CTS (1 dead). Most interactions (92) were with shortfin mako sharks and 16 were with white sharks (12 alive). No interactions with grey nurse sharks were recorded.

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 2019 in the SESSF.

Trawl catch
Gavin Kewan, AFMA

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