Chapter 9

Commonwealth Trawl and Scalefish Hook sectors

T Emery, N Marton, J Woodhams and R Curtotti

FIGURE 9.1 Fishing intensity in the Commonwealth Trawl Sector for (a) otter board trawl and (b) Danish-seine, 2019–20 fishing season
FIGURE 9.2 Fishing intensity in the Scalefish Hook Sector, 2019–20 fishing season

Note: Some effort data are not shown on this map for confidentiality reasons.

Redfish
Tamre Sarhan, AFMA
## TABLE 9.1 Status of the Commonwealth Trawl and Scalefish Hook sectors

<table>
<thead>
<tr>
<th>Stock</th>
<th>2018</th>
<th>2019</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fishing mortality</td>
<td>Biomass</td>
<td>Fishing mortality</td>
</tr>
<tr>
<td></td>
<td>Fishing mortality</td>
<td>Biomass</td>
<td>Fishing mortality</td>
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<td>Fishing mortality</td>
<td>Biomass</td>
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<td>Fishing mortality</td>
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<td></td>
<td>Fishing mortality</td>
<td>Biomass</td>
<td>Fishing mortality</td>
</tr>
</tbody>
</table>
### Table 9.1: Status of the Commonwealth Trawl and Scalefish Hook sectors

<table>
<thead>
<tr>
<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Gemfish, western zone (<em>Rexea solandri</em>)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fishing mortality has remained low and the recent indication of biomass suggests that it is unlikely to deplete stock below the limit reference point. CPUE-based proxy for biomass is above the target reference point.</td>
</tr>
<tr>
<td>Gulper sharks (<em>Centrophorus harrissoni, C. moluccensis, C. zeehaani</em>)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>There are no reliable indicators to determine whether current fishing mortality will allow stock to rebuild despite protection from closures. Estimated spawning biomass is below the limit reference point.</td>
</tr>
<tr>
<td>Jackass morwong (<em>Nemadactylus macropterus</em>)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fishing mortality is below the most recent RBC in both the east and west. Estimated spawning biomass is above the limit reference point (east) and above the target reference point (west).</td>
</tr>
<tr>
<td>John dory (<em>Zeus faber</em>)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fishing mortality is below the most recent RBC. Estimated fishing mortality has been below the target fishing mortality reference point for some time.</td>
</tr>
<tr>
<td>Mirror dory (<em>Zenopsis nebulosa</em>)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fishing mortality is below the most recent RBC. CPUE-based proxy for biomass is above the limit reference point for both east and west management units.</td>
</tr>
<tr>
<td>Ocean jacket (<em>Nelusetta ayraud</em>)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>History of stable CPUE, increasing in recent years.</td>
</tr>
<tr>
<td>Ocean perch (<em>Helicolenus barathri, H. percoides</em>)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fishing mortality is estimated to be below the most recent RBC for both species. CPUE-based proxy for biomass is above the target reference point for both species.</td>
</tr>
<tr>
<td>Orange roughy, Cascade Plateau (<em>Hoplostethus atlanticus</em>)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fishing mortality is below the long-term historical RBC. Estimated historical spawning biomass is above the target reference point.</td>
</tr>
</tbody>
</table>
### TABLE 9.1 Status of the Commonwealth Trawl and Scalefish Hook sectors

<table>
<thead>
<tr>
<th>Stock</th>
<th>2018</th>
<th>2019</th>
<th>Comments</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Fishing mortality</td>
<td>Biomass</td>
<td>Fishing mortality</td>
</tr>
<tr>
<td>Orange roughy, eastern zone (<em>Hoplostethus atlanticus</em>)</td>
<td></td>
<td></td>
<td>Fishing mortality is below the most recent RBC. Estimated spawning biomass is above the limit reference point.</td>
</tr>
<tr>
<td>Orange roughy, southern zone (<em>Hoplostethus atlanticus</em>)</td>
<td></td>
<td></td>
<td>There are no reliable indicators to determine whether current fishing mortality will allow stock to rebuild. Estimated historical spawning biomass is below the limit reference point.</td>
</tr>
<tr>
<td>Orange roughy, western zone (<em>Hoplostethus atlanticus</em>)</td>
<td></td>
<td></td>
<td>There are no reliable indicators to determine whether current fishing mortality will allow stock to rebuild. Estimated historical spawning biomass is below the limit reference point.</td>
</tr>
<tr>
<td>Smooth oreodory, Cascade Plateau (<em>Pseudocyttus maculatus</em>)</td>
<td></td>
<td></td>
<td>Fishing mortality on the Cascade Plateau was zero. Fishing mortality outside Cascade Plateau was below the RBC. Estimated historical spawning biomass is above the target reference point.</td>
</tr>
<tr>
<td>Smooth oreodory, non–Cascade Plateau (<em>Pseudocyttus maculatus</em>)</td>
<td></td>
<td></td>
<td>Fishing mortality is below the most recent RBC. Further protection is provided by closure of most areas deeper than 700 m. Spawning biomass is considered to be at the target reference point.</td>
</tr>
<tr>
<td>Other oreodories (<em>Allocyttus niger, Neocyttus rhomboidalis, A. verrucosus, Neocyttus spp.</em>)</td>
<td></td>
<td></td>
<td>Fishing mortality is above the most recent RBC but there are uncertainties in the reliability of the discard estimate and CPUE series used to derive the RBC. CPUE-based proxy for biomass is above the limit reference point.</td>
</tr>
<tr>
<td>Pink ling (<em>Genypterus blacodes</em>)</td>
<td></td>
<td></td>
<td>Fishing mortality is below the most recent RBC in both the east and west. Estimated spawning biomass is above the limit reference point (east) and above the target reference point (west).</td>
</tr>
</tbody>
</table>

continued...
### TABLE 9.1 Status of the Commonwealth Trawl and Scalefish Hook sectors

#### Biological status

<table>
<thead>
<tr>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Redfish <em>(Centroberyx affinis)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>There are no reliable indicators to determine whether current fishing mortality will allow stock to rebuild within the specified time frame. Estimated spawning biomass is below the limit reference point.</td>
</tr>
<tr>
<td>Ribaldo <em>(Mora moro)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fishing mortality is below the most recent RBC. CPUE-based proxy for biomass is above the target reference point.</td>
</tr>
<tr>
<td>Royal red prawn <em>(Haliporoides sibogae)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fishing mortality is below the most recent RBC. CPUE-based proxy for biomass is above the target reference point.</td>
</tr>
<tr>
<td>Silver trevally <em>(Pseudocaranx georgianus)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fishing mortality is below the most recent RBC. CPUE-based proxy for biomass is above the limit reference point.</td>
</tr>
<tr>
<td>Silver warehou <em>(Seriolella punctata)</em></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>Fishing mortality is below the most recent RBC. Estimated spawning biomass is above the limit reference point.</td>
</tr>
</tbody>
</table>

#### Economic status

NER in the CTS rose to $4.0 million in 2016–17, largely driven by lower operating costs. Preliminary estimates from the survey suggest that NER were −$0.17 million in 2017–18 and −$1.07 million in 2018–19. These negative results are driven by lower forecast income and higher forecast operating costs.

Notes: CPUE Catch-per-unit-effort. CTS Commonwealth Trawl Sector. NER Net economic returns. RBC Recommended biological catch.

Fishing mortality
- Not subject to overfishing
- Subject to overfishing
- Uncertain

Biomass
- Not overfished
- Overfished
- Uncertain
9.1 Description of the fishery

Area fished

The Commonwealth Trawl Sector (CTS) of the Southern and Eastern Scalefish and Shark Fishery (SESSF) extends south from Fraser Island off Queensland to east of Kangaroo Island off South Australia. The Scalefish Hook Sector (SHS) is managed as part of the Gillnet, Hook and Trap Sector (GHTS) of the SESSF but is reported in this chapter because it shares many target species with the CTS. The SHS extends around south-eastern Australia to the border of South Australia and Western Australia (Figure 9.2). The CTS and the SHS are major domestic sources of fresh fish for the Sydney and Melbourne markets. In contrast to several other Commonwealth fisheries, CTS and SHS landings are rarely exported to overseas markets.

Many CTS and SHS stocks extend across Commonwealth and state waters. Offshore Constitutional Settlement (OCS) arrangements allow the Australian, state and Northern Territory governments to reach agreement on jurisdictional arrangements for fish species. Under OCS arrangements, some states have passed management of SESSF quota-managed species inside 3 nautical miles (nm) from the coastline (coastal waters) to the Commonwealth; outside coastal waters, the Commonwealth has passed management of some SESSF quota-managed species to the states. In general, catches of SESSF quota species by Commonwealth-endorsed vessels across all waters are debited against their SESSF total allowable catch (TAC) limits.

However, New South Wales has retained jurisdiction for all species and methods inside coastal waters. North of Barrenjoey Head, under OCS arrangements, New South Wales has jurisdiction out to about 80 nm for SESSF quota species taken by all methods except purse seining and pelagic longlining (which are not SESSF methods). South of this location, the Commonwealth has retained jurisdiction over SESSF species that are taken by trawl or Danish-seining, whereas New South Wales has jurisdiction for these species out to about 80 nm if taken by other SESSF methods. An additional OCS arrangement that could transfer jurisdiction to the Commonwealth for SESSF species taken by fish trawl methods inside coastal waters south of Barrenjoey Head is under discussion with New South Wales.

Fishing methods and key species

The CTS and the SHS are multigear and multispecies fisheries, targeting a variety of fish and shark species. Effort in these fisheries is widely distributed, but, since 2005—after the closure to trawling of most SESSF waters deeper than 700 m—effort has become increasingly concentrated on the shelf rather than on the slope.

The CTS predominantly uses demersal otter trawl and Danish-seine fishing methods. Pair trawling and midwater trawling methods are also permitted under the SESSF management plan but are rarely used. The SHS uses a variety of longline and dropline hook fishing methods, some of which are automated. The primary difference between manual longline and automatic longline is that the hooks are baited by a machine rather than by hand when using automatic longline.
Management arrangements

The CTS and the SHS operated under the SESSF harvest strategy framework (HSF) (AFMA 2019a) and the Southern and Eastern Scalefish and Shark Fishery Management Plan 2003 in the 2019–20 fishing season (see Chapter 8). Stocks in both the CTS and the SHS are managed under TACs and individual transferable quotas (ITQs) for commercial species with TACs determined by the Australian Fisheries Management Authority (AFMA) Commission each year. To help reduce assessment and management costs, and create greater certainty for industry, use of multiyear TACs (MYTACs) has been increasing since 2009–10. A formal ‘decision tree’ approach (previously ‘break-out rules’) is in place to review stocks under MYTACs each year to allow for management intervention if indicators of stock size or stock response to fishing deviate from predicted trends (AFMA 2018d). A total of 22,757 t of quota was available across the stocks assessed in this chapter for the 2019–20 fishing season (1 May 2019 to 30 April 2020). This was an increase of 3,711 t from 2018–19 (Table 9.2). A small proportion of this quota (359 t) was allocated as ‘incidental catch allowances’ to allow unintentional catches of overfished stocks: eastern gemfish (*Rexea solandri*), blue warehou (*Seriolella brama*), orange roughy (*Hoplostethus atlanticus*—southern and western zones¹) and redfish (*Centroberyx affinis*). Most of the overall quota increase between 2018–19 and 2019–20 resulted from increased TACs for blue grenadier (*Macruronus novaezelandiae*; +3,373 t), john dory (*Zeus faber*; +132 t) and orange roughy—eastern zone (+202 t). These increases were partially offset by TAC decreases for silver warehou (*Seriolella punctata*; –150 t) and mirror dory (*Zenopsis nebulosa*; –65 t).

Fishing effort

In 2019–20, otter board trawlers reported 52,510 hours of fishing effort—a slight decrease from 54,550 hours in 2018–19 (Figure 9.3; Table 9.2). The number of active trawlers declined slightly from 32 in 2018–19 to 30 in 2019–20 (Table 9.2). Danish-seine effort slightly increased from 10,449 shots in 2018–19 to 10,895 shots in 2019–20, while the number of vessels declined from 20 in 2018–19 to 19 in 2019–20. Fishing effort in the SHS increased from 3.7 million hooks in 2018–19 to 3.9 million hooks in 2019–20 (Figure 9.4; Table 9.2).

Catch

Total landed catch (from catch disposal records [CDRs]) for quota stocks and non-quota stocks (gulper shark—*Centrophorus* spp., and ocean jacket—*Nelusetta* spp.) for both sectors (CTS and SHS) was 13,084 t in the 2019–20 fishing season, which was the largest reported catch since 2008. The total landings of stocks under quota in the CTS in the 2019–20 fishing season were 12,346 t, which was a considerable increase from the 7,574 t landed in the 2018–19 fishing season, and was the largest catch reported from this sector since 2006. The total landings of stocks under quota in the SHS in the 2019–20 fishing season were 564 t, which was a decrease from the 740 t landed in the 2018–19 fishing season and the lowest catch reported from this sector since CDRs were introduced.

¹ The orange roughy southern zone TAC contains both ‘incidental’ catch allowance and ‘target’ quota because quota is apportioned in accordance with the orange roughy eastern zone stock assessment. Orange roughy from Pedra Branca in the southern zone is included as part of the assessed eastern stock.
The main species landed in the 2019–20 fishing season in the CTS included blue grenadier (7,037 t), flathead (tiger flathead—Neoplatycephalus richardsoni; 1,952 t), orange roughy—eastern zone (619 t), pink ling (Genypterus blacodes; 576 t) and eastern school whiting (Sillago flindersi; 526 t). In the CTS, the landings of blue grenadier were the highest since the early 2000s. The main species landed in the 2019–20 fishing season in the SHS included pink ling (259 t), blue-eye trevalla (Hyperoglyphe antarctica; 200 t) and ribaldo (Mora moro; 58 t). In the SHS, the landings of blue-eye trevalla were the lowest since the introduction of CDRs.

The term ‘landed catch’ refers to catch that is reported at port in CDRs; it excludes discards. Data on discards are collected for the SESSF as part of the Integrated Scientific Monitoring Program, and data on state catches are provided by jurisdictions. Discards and state catch data collected over the previous 4 years are converted into a weighted average to estimate total state catch and discards for the calendar year (see table 41 in Burch, Althaus & Thomson 2019). AFMA use this 4-year weighted average when determining a TAC from the recommended biological catch (RBC) in the SESSF (AFMA 2017b) and, for consistency, the same estimates are included when reporting on stock status. A higher weighting is applied to the most recent year—the ratio used is 8:4:2:1 (Burch, Althaus & Thomson 2019).

Information on gross value of production (GVP) for the 2019–20 season was not available at the time of publication. During 2018–19, scalefish catches in the CTS and the SHS combined accounted for 57% of the GVP of the SESSF. Scalefish GVP in the CTS increased by 13%, from $37.09 million in 2017–18 to $41.96 million in 2018–19. The GVP in the SHS increased by 57%, from $4.78 million in 2017–18 to $7.51 million in 2018–19. Overall, the total scalefish GVP in 2018–19 for both sectors was $42.93 million (Table 9.2).

Flathead (tiger flathead and other flathead species) contributed $13.16 million to GVP in 2018–19, the most of any scalefish (Table 9.2); this was a decrease of 17% from $15.78 million in 2017–18. The value of orange roughy (eastern zone) more than tripled, to $7.15 million in 2018–19. The value of pink ling increased by 26% in 2018–19 to $6.38 million. The value of blue-eye trevalla (largely caught in the SHS) increased by 58% in 2018–19 to $4.65 million. Blue grenadier accounted for $4.55 million in 2018–19, which was 63% higher than in 2017–18 ($2.80 million).
FIGURE 9.3 Total catch and fishing effort for the CTS, 1985 to 2019

Source: AFMA logbook records

FIGURE 9.4 Total catch and fishing effort for the SHS, 2000 to 2019

Source: AFMA logbook records
### Table 9.2 Main features and statistics for the CTS and the SHS

<table>
<thead>
<tr>
<th>Stock</th>
<th>TAC (t)</th>
<th>Catch (t) (CTS, SHS)</th>
<th>GVP (2018–19)</th>
<th>TAC (t)</th>
<th>Catch (t) (CTS, SHS)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Blue-eye trevalla</td>
<td>462</td>
<td>373.6 (31.3, 342.3)</td>
<td>$4.65 million</td>
<td>458</td>
<td>215.5 (15.5, 200.0)</td>
</tr>
<tr>
<td>Blue grenadier</td>
<td>8,810</td>
<td>1,808 (1,804, 4)</td>
<td>$4.55 million</td>
<td>12,183</td>
<td>7,044.5 (7,037.4, 71)</td>
</tr>
<tr>
<td>Blue warehou</td>
<td>118</td>
<td>54.2 (54.2, &lt;1)</td>
<td>$0.17 million</td>
<td>118</td>
<td>10.1 (9.6, &lt;1.0)</td>
</tr>
<tr>
<td>Deepwater sharks, eastern zone</td>
<td>23</td>
<td>19.8 (19.8, 0.8)</td>
<td>na</td>
<td>24</td>
<td>20.9 (20.2, &lt;1.0)</td>
</tr>
<tr>
<td>Deepwater sharks, western zone</td>
<td>264</td>
<td>78.7 (78.7, 0.7)</td>
<td>na</td>
<td>235</td>
<td>85.2 (84.2, 1.0)</td>
</tr>
<tr>
<td>Eastern school whiting</td>
<td>820</td>
<td>537 (537, 0)</td>
<td>$1.37 million</td>
<td>788</td>
<td>526.0 (525.9, &lt;1.0)</td>
</tr>
<tr>
<td>Flathead (tiger flathead and several other species)</td>
<td>2,507</td>
<td>2,036 (2,034.9, 0.9)</td>
<td>$13.16 million</td>
<td>2,468</td>
<td>1,955.4 (1,951.7, 3.7)</td>
</tr>
<tr>
<td>Gemfish, eastern zone</td>
<td>100</td>
<td>39.1 (33.8, 5.3)</td>
<td>$0.09 million</td>
<td>100</td>
<td>70.0 (61.9, 8.1)</td>
</tr>
<tr>
<td>Gemfish, western zone</td>
<td>200</td>
<td>78.5 (78.5, &lt;1)</td>
<td>$0.21 million</td>
<td>200</td>
<td>90.2 (95.8, &lt;1.0)</td>
</tr>
<tr>
<td>Jackass morwong</td>
<td>505</td>
<td>186 (183.9, 2.3)</td>
<td>$0.64 million</td>
<td>469</td>
<td>109.1 (107.1, 2.0)</td>
</tr>
<tr>
<td>John dory</td>
<td>263</td>
<td>61.8 (61.8, &lt;1)</td>
<td>$0.50 million</td>
<td>395</td>
<td>68.3 (68.1, &lt;1.0)</td>
</tr>
<tr>
<td>Mirror dory</td>
<td>253</td>
<td>117.5 (117.5, &lt;1)</td>
<td>$0.37 million</td>
<td>188</td>
<td>116.6 (116.6, &lt;1.0)</td>
</tr>
<tr>
<td>Ocean perch</td>
<td>241</td>
<td>195 (168.7, 26.3)</td>
<td>$0.43 million</td>
<td>241</td>
<td>169.1 (148.7, 20.4)</td>
</tr>
<tr>
<td>Orange roughy, Cascade Plateau</td>
<td>500</td>
<td>0</td>
<td>0</td>
<td>500</td>
<td>23.6 (23.6, 0)</td>
</tr>
<tr>
<td>Orange roughy, eastern zone</td>
<td>698</td>
<td>855.8</td>
<td>$7.15 million</td>
<td>900</td>
<td>618.5 (618.5, 0)</td>
</tr>
<tr>
<td>Orange roughy, southern zone</td>
<td>84 f</td>
<td>78.5</td>
<td>$0.69 million</td>
<td>94 f</td>
<td>91.1 (911, 0)</td>
</tr>
<tr>
<td>Orange roughy, western zone</td>
<td>60</td>
<td>19</td>
<td>$0.21 million</td>
<td>60 d</td>
<td>24.0 (24.0, 0)</td>
</tr>
<tr>
<td>Smooth oreodory, Cascade Plateau</td>
<td>150</td>
<td>0</td>
<td>0</td>
<td>150</td>
<td>0</td>
</tr>
<tr>
<td>Smooth oreodory, non–Cascade Plateau</td>
<td>90</td>
<td>80.8</td>
<td>$0.33 million</td>
<td>90</td>
<td>75.5 (75.5, 0)</td>
</tr>
<tr>
<td>Other oreodories</td>
<td>185</td>
<td>163 (161.3, 1.7)</td>
<td>$0.35 million</td>
<td>185</td>
<td>169.7 (168.3, 1.4)</td>
</tr>
<tr>
<td>Pink ling</td>
<td>1,117</td>
<td>952 (645.5, 306.9)</td>
<td>$6.38 million</td>
<td>1,288</td>
<td>834.8 (575.9, 258.9)</td>
</tr>
<tr>
<td>Redfish</td>
<td>100</td>
<td>30.8 (30.8, &lt;1)</td>
<td>$0.11 million</td>
<td>50 d</td>
<td>29.4 (29.2, &lt;1)</td>
</tr>
<tr>
<td>Ribaldo</td>
<td>430</td>
<td>107.3 (60.3, 47.3)</td>
<td>$0.25 million</td>
<td>422</td>
<td>128.6 (70.4, 58.2)</td>
</tr>
<tr>
<td>Royal red prawn</td>
<td>381</td>
<td>147 (147, 0)</td>
<td>$0.56 million</td>
<td>409</td>
<td>163.8 (163.8, 0)</td>
</tr>
<tr>
<td>Silver trevally</td>
<td>307</td>
<td>8.3 (8.3, &lt;1)</td>
<td>$0.01 million</td>
<td>292</td>
<td>21.0 (20.9, &lt;1)</td>
</tr>
<tr>
<td>Silver warehou</td>
<td>600</td>
<td>352 (352, &lt;1)</td>
<td>$0.37 million</td>
<td>450</td>
<td>306.5 (306.4, &lt;1)</td>
</tr>
</tbody>
</table>

continued ...
### TABLE 9.2 Main features and statistics for the CTS and the SHS a continued

<table>
<thead>
<tr>
<th>Fishery statistics b</th>
<th>2018–19 fishing season</th>
<th>2019–20 fishing season</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-quota species</strong></td>
<td>TAC (t) c</td>
<td>Catch (t) (CTS, SHS)</td>
</tr>
<tr>
<td>Gulper sharks</td>
<td>na</td>
<td>0.38 (0.38, 0)</td>
</tr>
<tr>
<td>Ocean jacket</td>
<td>na</td>
<td>140 g</td>
</tr>
<tr>
<td><strong>Total fishery</strong></td>
<td>19,268</td>
<td>8,454</td>
</tr>
</tbody>
</table>

**Fishery-level statistics**

<table>
<thead>
<tr>
<th>Effort</th>
<th>2018–19</th>
<th>2019–20</th>
</tr>
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<tbody>
<tr>
<td>Otter trawl</td>
<td>54,550 trawl-hours</td>
<td>52,510 trawl-hours</td>
</tr>
<tr>
<td>Danish-seine</td>
<td>10,449 shots</td>
<td>10,895 shots</td>
</tr>
<tr>
<td>Scalefish hook</td>
<td>3.733 million hooks</td>
<td>3.890 million hooks</td>
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<table>
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<tr>
<th>Boat statutory fishing rights</th>
<th>2018–19</th>
<th>2019–20</th>
</tr>
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<tbody>
<tr>
<td>57 trawl; 37 scalefish hook</td>
<td>57 trawl; 37 scalefish hook</td>
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<table>
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<tr>
<th>Active vessels</th>
<th>2018–19</th>
<th>2019–20</th>
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</thead>
<tbody>
<tr>
<td>32 trawl; 20 Danish-seine; 21 scalefish hook</td>
<td>30 trawl; 19 Danish-seine; 24 scalefish hook</td>
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<table>
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<tr>
<th>At-sea observer coverage CTS</th>
<th>2018–19</th>
<th>2019–20</th>
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<tbody>
<tr>
<td>Trawl: 193 fishing days</td>
<td>Trawl: 277 fishing days</td>
<td></td>
</tr>
<tr>
<td>Danish-seine: 27 fishing days</td>
<td>Danish-seine: 24 fishing days</td>
<td></td>
</tr>
<tr>
<td>26 sea-days</td>
<td>5 sea-days</td>
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<tr>
<th>Fishing methods</th>
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<th>2019–20</th>
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<tbody>
<tr>
<td>Otter trawl, Danish-seine, hook (dropline, demersal longline), trap (minor)</td>
<td>Otter trawl, Danish-seine, hook (dropline, demersal longline), trap (minor)</td>
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<table>
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<tr>
<th>Primary landing ports</th>
<th>2018–19</th>
<th>2019–20</th>
</tr>
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<tbody>
<tr>
<td>Eden, Sydney and Ulladulla (New South Wales); Hobart (Tasmania); Lakes Entrance and Portland (Victoria)</td>
<td>Eden, Sydney and Ulladulla (New South Wales); Hobart (Tasmania); Lakes Entrance and Portland (Victoria)</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Management methods</th>
<th>2018–19</th>
<th>2019–20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Input controls: limited entry, gear restrictions, area closures</td>
<td>Input controls: TACs, ITQs, trip limits</td>
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</table>

<table>
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<th>Primary markets</th>
<th>2018–19</th>
<th>2019–20</th>
</tr>
</thead>
<tbody>
<tr>
<td>Domestic: Sydney, Melbourne—fresh, frozen</td>
<td>International: minimal</td>
<td></td>
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</tbody>
</table>

<table>
<thead>
<tr>
<th>Management plan</th>
<th>2018–19</th>
<th>2019–20</th>
</tr>
</thead>
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a The Scalefish Hook Sector is managed as part of the GHTS. b Fishery statistics are provided by fishing season, unless otherwise indicated. c Fishing season is 1 May to 30 April. Value statistics are provided by financial year and were not available for the 2019–20 financial year at the time of publication. d TACs shown are the ‘agreed’ TACs. These may differ from ‘actual’ TACs, which may include undercatch or overcatch from the previous fishing season. Consequently, catch for some stocks may slightly exceed agreed TACs. e Incidental catch allowance. f Not including the Great Australian Bight Trawl Sector. g Total catch includes a 31 t incidental catch allowance and 63 t of target quota, resulting from apportioning quota from the orange roughy eastern zone stock to the Pedra Branca area, which is part of the southern zone but included in the eastern zone assessment. h Catch figures are combined for the trawl and non-trawl sectors. i Notes: CTS Commonwealth Trawl Sector. GHTS Gillnet, Hook and Trap Sector. ITQ Individual transferable quota. na Not available. SHS Scalefish Hook Sector. TAC Total allowable catch.
9.2 Biological status

Blue-eye trevalla (*Hyperoglyphe antarctica*)

**Stock structure**

Blue-eye trevalla is managed as a single biological stock in the SESSF; however, stock structuring has been reported based on phenotypic variation in age and growth, otolith chemistry and potential larval dispersal between regions around south-eastern Australia (Williams et al. 2017). Four geographically distinct subpopulations have been proposed in the SESSF, with 3 in the CTS. These 3 subpopulations are interconnected through regional exchange of larvae (Williams et al. 2017). The results of the study by Williams et al. (2017) led to separate RBCs being determined for the slope and seamount stocks, but a global TAC applied (AFMA 2018c) and catch restrictions introduced for the seamount stock for the 2019–20 fishing season.

**Catch history**

Blue-eye trevalla catch peaked at more than 800 t in 1997 and has generally declined since then (Figure 9.5a). Commonwealth-landed catch in 2019–20 was 215.5 t, based on CDRs (Figure 9.5b). Discards and state catches are not yet available for 2019–20. However, the weighted average of the previous 4 calendar years (2015 to 2018) was calculated and used to estimate discards and state catches of 0.1 t and 27.4 t, respectively (Burch, Althaus & Thomson 2019). For the 2019–20 fishing season, total catch and discards were estimated to be 243.0 t.
**FIGURE 9.5a** Blue-eye trevalla annual annual catches (CTS, SHS and states) and discards, 1997 to 2017

![Graph showing annual catches and discards, 1997 to 2017](image)

Source: Sporcic 2018

**FIGURE 9.5b** Blue-eye trevalla seasonal landings (SESSF) and TACs, 2006–07 season to 2019–20 season

![Graph showing seasonal landings and TACs](image)

Note: TAC total allowable catch. Source: AFMA catch disposal records

**Stock assessment**

Blue-eye trevalla in Commonwealth fisheries is managed as a tier 4 and 5 stock under the SESSF HSF (AFMA 2019a). Analyses by Sporcic (2018) and Haddon and Sporcic (2018a, b) informed the management of the stock for the 2019–20 fishing season.

Based on the recent evidence of stock structuring (Williams et al. 2017), the 2018 analysis split the stock into 2 regions (slope and seamount populations) for the first time, with each analysed separately to inform the determination of an RBC for the 2019–20 fishing season. A tier 4 analysis was completed for the slope stock and a tier 5 analysis for the seamount stock (due to unreliable catch-per-unit-effort [CPUE] data) (AFMA 2018b).
The tier 4 slope analysis (Sporcic 2018) suggested that the previous steep decline in CPUE (2013 to 2016) had levelled out and remained between the target and limit reference points as defined by the SESSF HSF (AFMA 2017a). As previously noted by Haddon (2016) this analysis has various sources of uncertainty. Two factors that could influence catch rates and fishing behaviour, resulting in a low bias for CPUE, include the presence of killer whales (orcas—Orcinus orca) near fishing operations and resulting depredation, and exclusions from historical fishing grounds following closures implemented to rebuild gulper shark stocks (AFMA 2014b). The previous analysis by Haddon (2016) did not detect large effects on CPUE due to the closures, but uncertainty remains about the effect of killer whale depredation on CPUE.

The tier 5 age-structured stock reduction analysis of the seamount population predicted that constant catches of around 25 t for lower productivity scenarios and 48 t for higher productivity scenarios would lead to relative stability in depletion (Haddon & Sporcic 2018b). Although highly uncertain, a maximum sustainable yield (MSY) analysis of the seamount catch generated an MSY of about 46–50 t, with a depletion estimate of about 33% of the unfished biomass (0.33B0) (Haddon & Sporcic 2018a). It was predicted, based on the catch MSY, that constant catches of 40 t or less would lead to relative stability in depletion (AFMA 2018c, d).

The application of the SESSF tier 4 harvest control rule to the outputs of the standardised CPUE series for the slope stock generated a single-year RBC of 439 t. The South East Resource Assessment Group (SERAG) agreed to an RBC of 36 t for the seamount stock, based on the output of the age-structured stock reduction analysis and catch-MSY analysis for the 2019–20 fishing season (AFMA 2018c, d).

**FIGURE 9.6** Standardised auto-longline and dropline CPUE index for blue-eye trevalla to the east and west of Tasmania, 1997 to 2017

![Figure 9.6](image-url)

**Note:** CPUE Catch-per-unit-effort.
**Source:** Sporcic 2018
Stock status determination

The 2018 analyses (Haddon & Sporcic 2018a, b; Sporcic 2018) estimated that the recent average standardised CPUE was between the target and limit reference points for the slope stock and that constant catches of 40 t or less would see biomass maintained at around 0.33B₀ for the seamount stock. The stock is therefore classified as not overfished.

For the 2019–20 fishing season, total catch and discards were estimated to be 243.0 t, which is below the combined RBC of 475 t. This indicates that the fishing mortality in 2019–20 would be unlikely to deplete the stock to a level below its biomass limit reference point. The stock is therefore classified as not subject to overfishing.

Blue grenadier (*Macruronus novaezelandiae*)

Stock structure

Blue grenadier is assessed as a single stock. There are 2 discernible subfisheries: the localised winter spawning fishery off western Tasmania and the widespread activities of the non-spawning fishery.

A stock structure study using otolith chemistry and otolith shape (Hamer et al. 2009) has proposed that more than 1 stock of blue grenadier is fished in the SESSF. Specifically, the otolith indicators provided support for separate stocks of blue grenadier being fished by the Great Australian Bight Trawl Sector (GABTS) and the CTS of the SESSF. The study also indicated that blue grenadier from the western Tasmanian and eastern Bass Strait regions of the CTS were unlikely to be part of 1 highly mixed south-eastern Australian stock. However, this stock structure hypothesis has not been incorporated into management.

Catch history

The blue grenadier fishery started in the early 1980s, and between 1985 and 1995 mainly targeted non-spawning fish. From 1995 onwards, a fishery developed on spawning aggregations, and total catches increased to around 8,000 t from 1999 to 2003 (Figure 9.7a). Catches since then have varied in response to changes in the TAC and the influence of market conditions, with a large increase in the 2019–20 fishing season.

Commonwealth-landed catch in 2019–20 was 7044.5 t, based on CDRs (Figure 9.7b). Discards and state catches are not yet available for 2019–20. However, the weighted average of the previous 4 calendar years (2015 to 2018) was calculated and used to estimate discards and state catches of 540.1 t and 0.1 t, respectively (Burch, Althaus & Thomson 2019). For the 2019–20 fishing season, total catch and discards were estimated to be 7,584.7 t.
**Figure 9.7a** Blue grenadier annual catches (CTS and SHS) and fishing season TACs, 1979–2017

![Graph showing blue grenadier annual catches (CTS and SHS) and fishing season TACs, 1979–2017.](image)

Source: Castillo-Jordán & Tuck 2018

**Figure 9.7b** Blue grenadier seasonal landings (SESSF) and TACs, 2006–07 season to 2019–20 season

![Graph showing blue grenadier seasonal landings (SESSF) and TACs, 2006–07 season to 2019–20 season.](image)

Note: TAC total allowable catch.
Source: AFMA catch disposal records

**Stock assessment**

Blue grenadier in Commonwealth fisheries is managed as a tier 1 stock under the SESSF HSF (AFMA 2019a).

The 2018 assessment (Castillo-Jordán & Tuck 2018) informed the management of the stock for the 2019–20 fishing season. It estimated the spawning stock biomass at the start of 2018 to be 83% (or 0.83SB0), which was above the target reference point of 48% (0.48SB0). The biomass was estimated to have increased in recent years because of above-average recruitment between 2010 and 2014. This led to an RBC of 13,260 t and a 3-year-average RBC of 12,183 t. AFMA recommended using the 3-year-average RBC to set the first of a 3-year TAC for the 2019–20 fishing season.
FIGURE 9.8 Estimated female spawning biomass for blue grenadier, 1973 to 2017

Notes: $B_{\text{CURRENT}}$ Current biomass. $B_{\text{REF}}$ Unfished biomass.
Source: Castillo-Jordán & Tuck 2018

Stock status determination

Since the 2018 spawning stock biomass estimate of 83% of the unfished level ($0.83SB_0$) was above the target reference point of $0.48SB_0$, the stock is classified as **not overfished**.

For the 2019–20 fishing season, total catch and discards were estimated to be 7,584.7 t, which is below the 3-year-average RBC of 12,183 t calculated in the 2018 assessment (Castillo-Jordán & Tuck 2018). This indicates that the fishing mortality in 2019–20 would be unlikely to deplete the stock to a level below its biomass limit reference point. The stock is therefore classified as **not subject to overfishing**.
Blue warehou (*Seriolella brama*)

**Stock structure**

Blue warehou is assumed to have separate eastern (southern New South Wales to eastern Tasmania) and western (western Tasmania to western Victoria) stocks (Morison et al. 2013). Although these stocks are assessed separately, status is reported for a combined stock, reflecting the unit of management.

**Catch history**

Landings of blue warehou peaked in 1991 at 2,478 t before declining to less than 500 t in the first half of the 2000s (Figure 9.9a). Blue warehou was classified as overfished in 2008, and a rebuilding strategy that established blue warehou as an incidental catch-only species was implemented in the same year. The TAC decreased from 365 t in 2008–09 to 183 t in both 2009–10 and 2010–11. The TAC has fallen less abruptly since then—being 133 t in 2011–12 and 118 t since 2012–13. This has seen landings reduce to 2 t in 2015–16 before increasing slightly in recent years.

Commonwealth-landed catch in 2019–20 was 10.1 t, based on CDRs (Figure 9.9b). Based on logbook data, around 29% of the catch was from the east and 71% from the west. Discards and state catches are not yet available for 2019–20. However, the weighted average of the previous 4 calendar years (2015 to 2018) was calculated and used to estimate discards and state catches of 83.2 t and 7.5 t, respectively (Burch, Althaus & Thomson 2019). For the 2019–20 fishing season, total catch and discards were estimated to be 100.8 t.
FIGURE 9.9b Blue warehou seasonal landings (SESSF) and TACs, 2006–07 season to 2019–20 season

Note: TAC total allowable catch.
Source: AFMA catch disposal records

Stock assessment

Blue warehou in Commonwealth fisheries was managed as a tier 4 stock under the SESSF HSF (AFMA 2019a), but is currently managed under a rebuilding strategy (AFMA 2014a) with an incidental catch allowance of 118 t.

The last tier 4 assessment, in 2013 (Haddon 2013), used standardised CPUE to determine RBCs and indicated that both the eastern and western stocks were below their limit reference points. For the eastern stock, CPUE has been below the limit reference point since 1998. For the western stock, CPUE has been below the limit reference point for most years since 1995, except for 1998 and 2005 (Figures 9.10 and 9.11). There has been no recent tier 4 assessment because CPUE is no longer considered to be a reliable indicator of abundance for this species. Other complications include the apparent sporadic availability of blue warehou, its short life span and schooling behaviour.

In 2008, a rebuilding strategy was implemented for blue warehou (subsequently revised in 2014) with the goal of rebuilding stocks to, or above, the limit reference point by or before 2024 (1 mean generation time plus 10 years). Initially, the 2008 strategy implemented a rebuilding time frame of 1 mean generation time only, which is approximately 6 years to 2014 (AFMA 2014a). However, when assessed in 2013, the standardised CPUE remained below the CPUE limit reference point, suggesting that the stock was not likely to rebuild by 2014. In February 2015, the species was listed as conservation-dependent under the Environment Protection and Biodiversity Conservation Act 1999 (EPBC Act) (DoE 2015).
Under the rebuilding strategy, targeted fishing for blue warehou is not permitted. AFMA has set an incidental catch allowance of 118 t since the 2012–13 fishing season, based on a statistical analysis by CSIRO that determined that 118 t of the 154 t of blue warehou caught in 2010 was unavoidable (AFMA 2014a). The incidental catch allowance includes triggers of 27 t in the east and 91 t in the west. These triggers are intended to alert AFMA if the ratio of catches in the east and the west change substantially, resulting in increased reporting requirements for commercial fishers (AFMA 2014a). An alternative index of abundance with which to assess status is a priority for blue warehou, with new genetic approaches (for example, close kin) not reliant on CPUE being considered (AFMA 2018d). AFMA also introduced a move-on provision for the 2019–20 fishing season to reduce the risk of large catches of blue warehou. If an operator catches more than 200 kg of blue warehou in a shot (retained or discarded), the operator must not fish within 3 nm of the location of the previous shot for 24 hours.

**FIGURE 9.10** Standardised CPUE for blue warehou, western stock, 1986 to 2012

![Graph showing standardised CPUE for blue warehou, western stock, 1986 to 2012](image1)

Notes: CPUE Catch-per-unit-effort. CPUE outside the reference period (1986–1995) is unlikely to accurately reflect biomass.
Source: Haddon 2013

**FIGURE 9.11** Standardised CPUE for blue warehou, eastern stock, 1986 to 2012

![Graph showing standardised CPUE for blue warehou, eastern stock, 1986 to 2012](image2)

Notes: CPUE Catch-per-unit-effort. CPUE outside the reference period (1986 to 1995) is unlikely to accurately reflect biomass.
Source: Haddon 2013
**Stock status determination**

The most recent indicators of biomass (Haddon 2013) identified that the stock had been reduced to below the limit reference point of 0.20SB₀. There is no evidence to suggest that the stock has rebuilt to above this level. The stock is therefore classified as **overfished**.

For the 2019–20 fishing season, total catch and discards were estimated to be 100.8 t, which is below the incidental catch allowance of 118 t. There are 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. The stock is therefore classified as **uncertain**.

**Deepwater sharks, eastern and western zones (multiple species)**

![Line drawing: FAO and Anne Wakefield](image)

**Stock structure**

The deepwater shark stock comprises multiple species of deepwater sharks, including dogfish (Squalidae), brier shark (*Deania calcea*), platypus shark (*D. quadrispinosa*), Plunket’s shark (*Centroscymnus plunketi*), roughskin shark (species of *Centroscymnus* and *Deania*), 'pearl shark' (*D. calcea* and *D. quadrispinosa*), black shark (*Centroscymnus* species) and lantern shark (*Etmopterus* spp.) (Klaer et al. 2014). Identification of some sharks is difficult. Black shark and Plunket's shark are both possibly confounded with the roughskin shark group. The pearl shark group is a combination of the brier and platypus sharks (Haddon 2013).

Little is known about the stock structure of these deepwater sharks. They are bentholopelagic species that have been sampled in oceanic environments over the abyssal plains, and are distributed widely across ocean basins, and along the middle and lower continental shelves. The eastern zone extends from New South Wales, around the Tasmanian east coast and up the Tasmanian west coast to 42°S, including Bass Strait to 146°22'E. The western zone includes the remainder of the SESSF, around to Western Australia. This boundary cuts across deepwater shark trawl grounds. The most likely biological boundary for these species is the biogeographical boundary between the 2 systems dominated by the Eastern Australian Current and the Leeuwin Current off the south coast of Tasmania (Morison et al. 2013). For the purposes of these status reports, the eastern zone is treated as 1 stock, and the western zone is treated as another stock.
Chapter 9: Commonwealth Trawl and Scalefish Hook sectors

Catch history

Eastern

The eastern deepwater shark fishery started around 1990. Landed catches increased steadily to around 200 t in 1998, with a single higher peak of about 330 t in 1996, before decreasing steadily to around 25 t in recent years (Figures 9.12a and 9.12b). In 2019–20, platypus sharks (mixed), roughskin sharks (mixed) and longsnout dogfish (*D. quadrispinosa*) accounted for most of the catch in the east.

Commonwealth-landed catch in 2019–20 was 20.9 t, based on CDRs (Figure 9.12b). Discards and state catches are not yet available for 2019–20. However, the weighted average of the previous 4 calendar years (2015 to 2018) was calculated and used to estimate discards of 38.7 t (Burch, Althaus & Thomson 2019). State catches are unknown. For the 2019–20 fishing season, total catch and discards were estimated to be 59.6 t.

Western

The western deepwater shark fishery started in 1993. Landed catches increased to a peak of about 400 t in 1998, before decreasing steadily to less than 10 t in 2007 (Figure 9.13a). In recent years, landed catches have fluctuated around 50 to 75 t (Figure 9.13b). In 2019–20, platypus sharks (mixed), roughskin sharks (mixed) and longsnout dogfish accounted for most of the catch in the west.

Commonwealth-landed catch in 2019–20 was 85.2 t, based on CDRs (Figure 9.13b). Discards and state catches are not yet available for 2019–20. However, the weighted average of the previous 4 calendar years (2015 to 2018) was calculated and used to estimate discards and state catches of 82 t and 7.3 t, respectively (Althaus & Thomson 2019). For the 2019–20 fishing season, total catch and discards were estimated to be 174.5 t.
FIGURE 9.12a Deepwater shark annual catches (CTS and SHS), eastern zone, 1992 to 2017

Source: Sporicic 2018

FIGURE 9.12b Deepwater shark seasonal landings (SESSF) and TACs, eastern zone, 2006–07 season to 2019–20 season

Note: TAC total allowable catch.
Source: AFMA catch disposal records
Stock assessment

Both eastern and western deepwater shark stocks are managed as tier 4 stocks under the SESSF HSF (AFMA 2019a). Analyses by Sporcic (2018) informed the management of the eastern and western stocks for the 2019–20 fishing season.

The tier 4 analysis for eastern deepwater sharks (Sporcic 2018), which was based on data up to 2017, identified that CPUE was close to the limit reference point. The 2019–20 RBC for the eastern stock was 9 t (AFMA 2018c). Because catches have consistently been around 24 t, AFMA implemented a TAC of 24 t for the 2019–20 fishing season as the first year of a 3-year MYTAC (AFMA 2019b).
The tier 4 analysis for western deepwater sharks (Sporcic 2018), which was based on data up to 2017, identified that CPUE was above the target reference point. The 2019–20 RBC for the western stock was 235 t (AFMA 2018c). AFMA implemented a TAC of 235 t for the 2019–20 fishing season as the first year of a 3-year MYTAC (AFMA 2019b).

Deepwater closures may differentially affect the CPUE of deepwater sharks in the eastern and western zones because of the different fishing conditions between the 2 areas. In the western zone, the CPUE remains high; however, in the eastern zone, CPUE has declined (Sporcic 2018).

There have been ongoing issues with producing reliable standardised CPUE series for these stocks to support the tier 4 harvest control rule of the harvest strategy, and currently there is limited scope to improve these data. The lack of historical data, together with the multispecies nature of the stock and difficulties in species identification by fishers, mean that the standardised CPUE series is unlikely to be a reliable index of abundance for the stock or its component species.

Deepwater sharks are mobile animals that cover a broad range of depths (Morison et al. 2013). A significant area of the fishery—around 54% of the area where catch of this stock was previously taken—has been closed as part of the 700 m depth closures to manage orange roughy stocks. Recently, part of the closure was reopened to allow deepwater trawling for western stocks. However, if 25 t of orange roughy is taken, then the closure is reinstated (AFMA 2017c). These closures may offer a level of protection to the deepwater shark stocks, if they are similarly distributed across the open and closed areas.

**Stock status determination**

The deepwater shark stocks are both multispecies stocks, and robust data on historical catch composition and discards are lacking. Further, CPUE is unlikely to provide a reliable index of abundance for these stocks or their component species. As a result, the biomass levels of these stocks are classified as uncertain.

For the 2019–20 fishing season, total catch and discards were estimated to be 59.6 t for the eastern stock and 174.5 t for the western stock, which is above the RBC in the east (9 t) but below in the west (235 t). Although large areas are closed to fishing, which could provide some protection to the deepwater shark stocks, there is no reliable indication of biomass and therefore little confidence in a comparison of catch or fishing mortality with the RBC. On this basis, fishing mortality of the eastern and western deepwater shark stocks is classified as uncertain.
Eastern school whiting (*Sillago flindersi*)

**Stock structure**

Eastern school whiting occurs from southern Queensland to western Victoria. Genetic studies have suggested 2 stocks in this range, with Dixon et al. (1987) observing a discontinuity in the relatedness between samples near Forster and Coffs Harbour, indicating a possible separation between fish from northern and southern New South Wales. The authors also noted that a significant amount of gene flow would likely occur between them (Dixon et al. 1987). Nevertheless, the current SESSF management and stock assessment assume a single stock because the evidence for the 2-stock hypothesis was not conclusive (Morison et al. 2013).

**Catch history**

Catch of eastern school whiting increased markedly from around 500 t in the mid 1970s to a peak of around 2,500 t in the early 1990s (Figure 9.14a). In recent years, most of the total catch of eastern school whiting has come from New South Wales state waters.

Commonwealth-landed catch in 2019–20 was 526.0 t, based on CDRs (Figure 9.14b). Discards and state catches are not yet available for 2019–20. However, the weighted average of the previous 4 calendar years (2015 to 2018) was calculated and used to estimate discards and state catches of 191.8 t and 1,153.5 t, respectively (Burch, Althaus & Thomson 2019). For the 2019–20 fishing season, total catch and discards were estimated to be 1,871.3 t.

**FIGURE 9.14a** Eastern school whiting annual catches (CTS, SHS and states) and discards, 1947 to 2016

Source: Day 2017a
School whiting in Commonwealth fisheries is managed as a tier 1 stock under the SESSF HSF (AFMA 2019a).

While the 2017 assessment (Day 2017a) informed the management of the stock for the 2019–20 fishing season, the assessment was updated in 2019 (Day 2019a).

The 2017 tier 1 stock assessment (Day 2017a) predicted the spawning stock biomass at the start of 2018 would be 47% (0.47SB0), which was below the target reference point of 48% (0.48SB0) and above the limit reference point of 20% (0.20SB0) (Figure 9.15). SERAG noted that the stock had dropped below the target reference point under the previous long-term RBC due to below-average recruitment, before increasing to 47% at the start of 2018 (AFMA 2017d). SERAG also noted that the estimate of spawning stock depletion was sensitive to assumptions about stock structure, which led to SERAG supporting research (currently underway) into stock structure and spawning season of school whiting (AFMA 2017d, 2018c). The 2017 assessment led to an RBC of 1,606 t and a 3-year-average RBC of 1,615 t. AFMA recommended using the 3-year-average RBC to set the second of a 3-year MYTAC for the 2019–20 fishing season (AFMA 2018d).

In 2019, the school whiting stock assessment from 2017 was updated with recent (2017 and 2018) Commonwealth and New South Wales catch and Commonwealth CPUE data (Day 2019a). This led to a revised estimated spawning stock biomass of 36% (0.36SB0) at the start of 2018. This reduction in the estimate of spawning stock biomass, when compared with the 2017 assessment, was driven by declining Commonwealth CPUE in 2018 and revisions to the New South Wales catch data from 2017 and 2018 (actual catches were substantially higher than those used for projections in the 2017 assessment). In 2019, projections were made using predicted combined Commonwealth and New South Wales catch data for 2019, with the stock estimated to be at 35% (0.35SB0) at the start of 2020. This led to a revised RBC of 1,165 t for 2020–21, and a 3-year-average RBC of 1,318 t (AFMA 2019d).
SERAG requested a range of fixed catch (RBC, 1,600 t, 1,800 t and 1,900 t) projections for 2020 and 2021 to examine the effect of the increase in total catch in recent years (on biomass) (Day 2019a). This was because the model had estimated periods of below-average recruitment (mid 1990s and late 2000s), but SERAG believed there was no evidence of long-term shift in recruitment and considered it reasonable to consider the projections under average recruitment (AFMA 2019c). Such projections indicated that if the RBC was caught in 2020 (1,165 t) and 2021 (1,357 t), the stock would recover to 44% ($0.44SB_0$) at the start of 2022. If 1,800 or 1,900 t was caught, then the spawning stock biomass would remain relatively stable at 36% and 34%, respectively, at the start of 2022.

Under the low recruitment scenario, the stock was projected to decline under all catch scenarios, reaching 22% ($0.22SB_0$) at the start of 2022 with a catch of 1,900 t. These scenarios were provided to the AFMA Commission to assist in their determination of the TAC for the 2020–21 fishing season.

A new stock assessment is expected in late 2020, which is expected to provide insight into total fishing mortality in recent years, recruitment post-2013 and overall spawning stock biomass.

**FIGURE 9.15** Spawning stock biomass for eastern school whiting, 1945 to 2016

Notes: $B_{\text{CURRENT}}$, Current biomass. $B_{\text{REF}}$, Unfished biomass.
Source: Day 2017a
Stock status determination

The 2019 update (Day 2019a) to the 2017 assessment (Day 2017a) estimated the spawning stock biomass to be at 36% of the unfished level ($0.36SB_0$) at the beginning of 2018. Since this was below the target reference point of $0.48SB_0$ but above the limit reference point of $0.20SB_0$, the stock is classified as not overfished.

While total fishing mortality ($F$) in recent years relative to the fishing mortality limit reference point ($F_{lim}$) is uncertain, it is evident that there has been a substantial decline in spawning stock biomass between the assessment undertaken in 2017 and the update in 2019. For the 2019–20 fishing season, total catch and discards were estimated to be 1,871.3 t, which is above the 3-year-average RBC of 1,615 t calculated in the 2017 assessment (Day 2017a). However, based on Day's (2019a) projections, the spawning stock biomass does not appear to be at risk of further substantial declines if catches remain below 1,900 t and the stock experiences average recruitment. On this basis, the stock is classified as not subject to overfishing. However, caution should be taken, and the stock monitored closely to see if average recruitment was indeed the correct assumption.

Flathead ($Neoplatycephalus richardsoni$ and 4 other species)

Stock structure

Flathead catch in the SESSF is almost entirely tiger flathead ($Neoplatycephalus richardsoni$). For SESSF management purposes, ‘flathead’ refers to a group of species that also includes southern sand flathead ($Platycephalus bassensis$), toothy flathead ($P. aurimaculatus$), bluespotted flathead ($P. caeruleopunctatus$) and southern bluespotted flathead ($P. speculator$).

Tiger flathead is endemic to Australia. It is found on sandy or muddy substrates in continental-shelf and upper-slope waters from Coffs Harbour in northern New South Wales through Bass Strait and around Tasmania to south-east South Australia (Kailola, FRDC & BRS 1993). Most of the Australian commercial catch comes from depths between 50 and 200 m. The stock structure of tiger flathead is poorly understood. There is some evidence of morphological variation across the distribution range, with observed regional differences in growth, appearance and the timing of reproduction, especially off eastern Tasmania. No stock identification studies using genetic or other techniques have been undertaken. For assessment and management purposes, a single stock has been assumed throughout all zones of the SESSF.
Catch history

Flathead catch has been historically variable, generally fluctuating between 1,500 and 4,000 t per year (Figure 9.16a). Catch in more recent years has declined to around 2,000 t after fluctuating around 3,000 to 4,000 t per year in the 2000s.

Commonwealth-landed catch in 2019–20 was 1,955.4 t, based on CDRs (Figure 9.16b). Discards and state catches are not yet available for 2019–20. However, the weighted average of the previous 4 calendar years (2015 to 2018) was and used to estimate discards and state catches of 82.5 t and 160.3 t, respectively (Burch, Althaus & Thomson 2019). For the 2019–20 fishing season, total catch and discards were estimated to be 2,198.2 t.

**FIGURE 9.16a** Flathead annual catches (CTS, SHS and states) and discards, 1915 to 2018

![Graph showing annual catches and discards](source)

**FIGURE 9.16b** Flathead seasonal landings (SESSF) and TACs, 2006–07 season to 2019–20 season

![Graph showing seasonal landings and TACs](source)

Note: TAC total allowable catch.
Source: AFMA catch disposal records
Stock assessment

Flathead in Commonwealth fisheries is managed as a tier 1 stock under the SESSF HSF (AFMA 2019a). While the 2016 assessment (Day 2016) and subsequent amendment (Day 2017b) informed the management of the stock for the 2019–20 fishing season, a new flathead assessment was undertaken in 2019 (Day 2019b). The flathead assessment is based on biological parameters for tiger flathead, which accounts for about 95% of the catch (Morison et al. 2013).

The amendment to the 2016 assessment (Day 2017b) predicted that the spawning stock biomass for the 2019–20 fishing season, based on a step-down TAC, would be 41% (0.41SB0), which was just above the target reference point of 40% (0.40SB0) and above the limit reference point of 20% (0.20SB0). The assessment (Day 2016) indicated that there had been better than average recent recruitment. The 2017 amendments to the assessment (Day 2017b) produced RBCs for the 2018–19 (2,837 t) and 2019–20 fishing seasons (2,826 t). AFMA recommended an RBC of 2,826 t for the 2019–20 fishing season (AFMA 2018d).

The 2019 flathead assessment (Day 2019b, c) estimated the spawning stock biomass to be 32% (0.32SB0) in 2018. This reduced estimate was driven by below-average recruitment in 2013 and 2014 (particularly 2013) and a downwards revision to the 2012 estimate (which still remained above average) (Day 2019b). SERAG noted that the poor recruitment in 2013 was supported by both length and age data (AFMA 2019d). On advice from SERAG, several fixed catch (current RBC and 3 levels below that) and recruitment scenarios (high, average and low) were projected for 3 years (2020, 2021 and 2022) to support advice for TAC setting. Despite a number of years of below-average recruitment, there was uncertainty associated with the persistence of this trend, particularly given that the most recent estimates from 2015 were above average (AFMA 2019c, 2020). Consequently, SERAG agreed to base its RBC advice on the average recruitment scenario, with the aim of returning the spawning stock biomass to 0.40SB0. This led to an RBC of 2,334 t for 2020 and a 3-year-average RBC of 2,563 t (Day 2019c). SERAG noted that if a 3-year-average RBC was applied, the spawning stock biomass was expected to increase to 37% (0.37SB0) by 2023 (AFMA 2020; Day 2019c).
Figure 9.17 Biomass: flathead SESSF

Current status
Initial reference point
Limit reference point
Target reference point

Spawning biomass ($B_{\text{current}}$)

Notes: $B_{\text{current}}$, Current biomass. $B_{\text{ref}}$, Unfished biomass.
Source: Day 2019c

Stock status determination

The 2019 tier 1 assessment (Day 2019b, c) estimated the spawning stock biomass to be 32% of the unfished level (or $0.32S_{B_0}$) in 2018. Since this was below the target reference point of $0.40S_{B_0}$ and above the limit reference point of $0.20S_{B_0}$, the stock is classified as not overfished.

For the 2019–20 fishing season, total catch and discards were estimated to be 2,198.2 t, which is below the 2019–20 RBC of 2,826 t calculated in the amendment to the 2016 assessment (Day 2017b). This indicates that the fishing mortality in 2019–20 would be unlikely to deplete the stock to a level below its biomass limit reference point. The stock is therefore classified as not subject to overfishing.

Gemfish, eastern zone (*Rexea solandri*)

Stock structure

There are 2 biologically distinct stocks of gemfish in Australia: an eastern stock and a western stock, separated by a boundary on the western side of Bass Strait (Colgan & Paxton 1997; Moore, Ovenden & Bustamante 2017).
Catch history

Catch of gemfish in the eastern zone peaked in 1978 at more than 6,000 t. Catch decreased rapidly after 1987, decreasing to between 50 and 100 t between 2000 and 2012 (Figure 9.18a). Eastern gemfish has been classified as overfished since 1992, with TACs consistently being reduced. A rebuilding strategy that established eastern gemfish as an incidental catch-only species was first implemented in 2008. Landed catch in recent years has been below 50 t, increasing to 70 t in the 2019–20 fishing season (Figure 9.18b).

Commonwealth-landed catch in 2019–20 was 70 t, based on CDRs (Figure 9.18b). Discards and state catches are not yet available for 2019–20. However, the weighted average of the previous 4 calendar years (2015 to 2018) was calculated and by used to estimate discards and state catches of 45.3 t and 4 t, respectively (Burch, Althaus & Thomson 2019). For the 2019–20 fishing season, total catch and discards were estimated to be 119.3 t.

FIGURE 9.18a Gemfish annual catches (CTS, SHS and states) and discards, eastern zone, 1968 to 2008

![Graph of Gemfish annual catches (CTS, SHS and states) and discards, eastern zone, 1968 to 2008](image)

Source: Little & Rowling 2010

FIGURE 9.18b Gemfish seasonal landings (SESSF) and TACs, eastern zone, 2006–07 season to 2019–20 season

![Graph of Gemfish seasonal landings (SESSF) and TACs, eastern zone, 2006–07 season to 2019–20 season](image)

Note: TAC total allowable catch.
Source: AFMA catch disposal records
Stock assessment

Eastern gemfish in Commonwealth fisheries was managed as a tier 1 stock under the SESSF HSF (AFMA 2019a). The stock is currently subject to a rebuilding strategy (AFMA 2015a) with an incidental catch allowance of 100 t.

The last tier 1 assessment in 2010 used catch and length-frequency data up to 2009 (Little & Rowling 2010). The base-case model estimated that the spawning stock biomass in 2009 was 16% of the unfished level (0.16SB0) (Figure 9.19). The assessment highlighted that most of the recruitment over the past 25 years had been relatively weak except for 1996 and 2002. The 2010 assessment (Little & Rowling 2010) included projections of eastern gemfish biomass that were based on 2 scenarios: total catches of zero and 100 t each year. The projections for catches of zero and 100 t indicated that the spawning stock biomass may reach the limit reference point of 0.2SB0 by 2017 and 2025, respectively, assuming average recruitment.

A preliminary update of the 2010 assessment in 2016 (Little 2016), while not accepted by SERAG, indicated that the spawning stock biomass in 2015 had decreased to 8% (0.08SB0), due to a prolonged period of below-average recruitment (AFMA 2016c; Little 2016).

Moore, Ovenden & Bustamante (2017) and Ovenden, Davenport & Moore (2020) estimated the effective population sizes for both the eastern and western stocks of gemfish using molecular markers. The results suggest that genetic drift is occurring in the eastern stock but not in the western stock. This suggests that the spawning biomass in the eastern stock has fewer effective genetically successful contributors each generation or that there is differential selection against recruits. Recent research has confirmed that there is no successful hybridisation and introgression occurring (Ovenden, Davenport & Moore 2020). There was no evidence of gene flow between eastern and western populations, though there is a clear overlap zone between western Bass Strait and Portland. Ovenden, Davenport & Moore. (2020) hypothesise that the genetic differences between eastern and western stocks is maintained by spatial and temporal separation during spawning. It is unclear what is contributing to the decreased effective population size of eastern gemfish.

Knuckey et al. (2018) examined which factors may be contributing to the lack of recovery in overfished species, such as eastern gemfish, despite significant management changes under relevant rebuilding strategies. A workshop with SESSF fishers and other stakeholders identified climate and oceanographic conditions as a potential factor in declining CPUEs, and that climate change would have a major impact on the recovery of overfished species due to changes in productivity, abundance, distribution or species sensitivity.

In 2008, a rebuilding strategy was implemented for eastern gemfish (subsequently revised in 2015) with the goal of rebuilding stocks to, or above, the limit reference point by or before 2027 (1 mean generation time plus 10 years) (AFMA 2015a). Projections to support this time frame from the 2010 assessment (Little & Rowling 2010) assume that total removals are limited to the 100 t incidental catch allowance and rely on at least average levels of recruitment (Morison et al. 2013), but all indications are that recruitment has been below average. In 2009, the species was listed as conservation-dependent under the EPBC Act. An alternative index of abundance with which to assess status is a priority for eastern gemfish, with new genetic approaches (for example, close kin) being considered (AFMA 2019c).
**FIGURE 9.19** Estimated spawning stock biomass of gemfish, eastern zone, 1965 to 2008

![Graph showing estimated biomass over time](image)

Notes: $B_{\text{CURRENT}}$ Current biomass. $B_{\text{REF}}$ Unfished biomass.

Source: Little & Rowling 2010

**Stock status determination**

The most recent indicators of biomass (Little 2016; Little & Rowling 2010) identified that the stock had been reduced to below the limit reference point of 0.20$SB_{REF}$. There is no evidence to suggest that the stock has rebuilt to above this level. The stock is therefore classified as **overfished**.

For the 2019–20 fishing season, total catch and discards were estimated to be 119.3 t, which is above the incidental catch allowance of 100 t. There are 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. The stock is therefore classified as **uncertain**.
Gemfish, western zone (Rexea solandri)

Stock structure

The eastern and western gemfish stocks in Australia are separated by a boundary on the western side of Bass Strait (Colgan & Paxton 1997; Moore, Ovenden & Bustamante 2017). Genetic studies indicate that gemfish throughout the western zone, including in the CTS and in the GABTS, is 1 biological stock (Moore, Ovenden & Bustamante 2017).

Catch history

Western gemfish is fished in both the GABTS and the CTS; however, the TAC applies only to the CTS (AFMA 2018b). Western gemfish is targeted in the CTS, whereas incidental catches are more common in the GABTS. Western gemfish was targeted in the GABTS from 2004 to 2007, with catches reaching 532 t. In 2008, targeted fishing for western gemfish in the GABTS ceased and catches became largely incidental, partly due to low prices for gemfish and a key vessel leaving the fishery (AFMA 2010).

Commonwealth-landed catch in 2019–20 was 96.2 t, based on CDRs (Figure 9.20b). Discards and state catches are not yet available for 2019–20. However, the weighted average of the previous 4 calendar years (2015 to 2018) was calculated and used to estimate discards of 41.7 t (Burch, Althaus & Thomson 2019). There is no state catch. For the 2019–20 fishing season, total catch and discards were estimated to be 137.9 t.

**FIGURE 9.20a** Gemfish annual catches (CTS and SHS) and discards, western zone, 1992 to 2018

Source: Sporicia 2019b
Stock assessment

Western gemfish in Commonwealth fisheries is managed as a tier 4 stock under the SESSF HSF (AFMA 2019a). Management arrangements for western gemfish currently differ between the CTS and the GABTS. Western gemfish catch in the CTS is currently managed under a 3-year MYTAC. The GABTS has not moved to implement quota for western gemfish, instead relying on a catch trigger, which would manage the stock as a tier 1 stock under the SESSF HSF (AFMA 2017a) if catch exceeds 1,000 t over 3 years (AFMA 2018d).

A weight-of-evidence approach based on the results of a tier 1 stock assessment (Helidoniotis & Moore 2016) and a tier 4 analysis (Haddon & Sporcic 2017b) was used to inform the management of the stock for the 2019–20 fishing season. In 2019, a new tier 4 analysis was undertaken (Sporcic 2019b).

The tier 1 stock assessment by Helidoniotis and Moore (2016) estimated that the spawning stock biomass in 2015 was 43% (0.43SB0), which is below the target reference point (0.48SB0; Figure 9.21). This was based on data from both the CTS (zone 50) and the GABTS (zone 80), and led to an RBC of 200 t for the CTS and 38 t for the GABTS. The Great Australian Bight Resource Assessment Group (GABRAG) noted several issues with the assessment, including (1) the paucity of data on length-frequency and biology (for example, growth parameters and size at maturity), the latter of which was assumed to be similar to eastern gemfish in the assessment; (2) biases in the CPUE data caused by the aggregating nature of gemfish and high discard rates, and (3) the lack of targeting in the GABTS (zone 80) underestimating the productivity of the overall stock. The high level of uncertainty led to GABRAG not accepting the tier 1 assessment (AFMA 2016b).

Two tier 4 analyses by Haddon and Sporcic (2017b) in 2016 used data solely from the CTS (zone 50 and half of zone 40) up to 2015. GABRAG noted that when discards were included in the analysis CPUE improved dramatically, leading to a significant increase in the RBC. The RBCs for western gemfish were 423 t (including discards) and 139 t (without discards). Like tier 1, GABRAG agreed that there were issues with the CPUE data in the tier 4 analysis caused by the aggregating nature of gemfish and high discard rates.
Given deficiencies in the data and the uncertainties with respect to both tier 1 assessment and tier 4 analyses for western gemfish, GABRAG agreed to take a weight-of-evidence approach in recommending an RBC (AFMA 2016b, 2018c). GABRAG noted that there was insufficient evidence to assess the likelihood of western gemfish declining below the limit reference point; however, given the results of the tier 1 assessment for the CTS component and low catches relative to the TAC, it was agreed that there was little risk of the stock declining below the limit reference point (AFMA 2016b). GABRAG therefore recommended an RBC of 200 t for the CTS, and AFMA set a 3-year MYTAC of 200 t.

In 2019, a new tier 4 analysis used data solely from the CTS (zone 50) up to 2018 (Sporcic 2019b). The analysis estimated that the 4-year average CPUE (2015 to 2018), including discards, was above the target reference point. This led to an RBC of 423 t.

**FIGURE 9.21** Estimated spawning stock biomass of gemfish, western zone, for the CTS and the GABTS, 1992 to 2018

![Figure 9.21](image)

Notes: \(B_{\text{CURRENT}}\) Current biomass. \(B_{\text{REF}}\) Unfished biomass.

Source: Sporcic 2019b

**Stock status determination**

The 2019 tier 4 analysis (Sporcic 2019b) estimated that the recent average standardised CPUE-based proxy for biomass was above the target reference point. The stock is therefore classified as **not overfished**.

For the 2019–20 fishing season, total catch and discards were estimated to be 137.9 t, which is below the RBC of 200 t calculated using a weight-of-evidence approach. There is little confidence in a direct comparison of catch or fishing mortality with the RBC, given the deficiencies in the data used in the 2016 assessments. However, given recent indications of biomass from the 2019 analysis, it is unlikely that the recent catches would deplete the stock below its biomass limit reference point. The stock is therefore classified as **not subject to overfishing**.
Gulper sharks (*Centrophorus harrissoni, C. moluccensis, C. zeehaani*)

**Stock structure**

Gulper sharks are assessed as a multispecies stock comprising Harrisson’s dogfish (*Centrophorus harrissoni*), southern dogfish (*C. zeehaani*) and endeavour dogfish (*C. moluccensis*). Harrisson’s dogfish is endemic to south-eastern Australia, from southern Queensland to south-eastern Tasmania, and adjacent seamounts. Southern dogfish is endemic to southern Australia, from Shark Bay in Western Australia to Forster in New South Wales (Williams et al. 2013). Endeavour dogfish has a broader range than Harrisson’s and southern dogfish, extending beyond the boundaries of the SESSF and Australia. Within Australia, endeavour dogfish occurs along the west and east coasts, but is uncommon off the south coast (Last & Stevens 2009).

To support the revision of the AFMA *Upper-slope dogfish management strategy* (AFMA 2012), Williams et al. (2013) investigated the relative carrying capacity and depletion of subpopulations of Harrisson’s and southern dogfish. Results indicated different depletion levels in different areas, suggesting the separation of gulper sharks into several populations: a continental margin and a seamount population for Harrisson’s dogfish; and eastern, central and western populations for southern dogfish.

**Catch history**

Estimated landings of gulper sharks (derived from liver oil production from 1994 to 2001) averaged about 20 t (trunk weight) from 1994 to 1998, with a peak of 40 t in 1995. Catches averaged about 10 t from 2002 to 2005 and have since declined. Despite gulper sharks being a no-take multispecies stock, landings for the trawl fishery have been recorded in recent years (Figure 9.22). This may reflect reporting errors. There is also the potential for unreported or underestimated discards, based on the large degree of overlap of current fishing effort with the core range of the species. Low levels of mortality can pose a risk for such depleted populations. The reported landings in the 2018–19 and 2019–20 fishing seasons were 0.38 t and 0.20 t, respectively.
FIGURE 9.22 Gulper shark annual catch and discards for the SESSF (all sectors), 1994 to 2019

Notes: Estimated catch of upper-slope gulper sharks from 1994 to 2001 is based on liver oil quantity. Catch history is compiled using data from various sources.

Stock assessment

Gulper sharks have very low productivity due to a slow growth rate, late age at maturity and low fecundity. These life-history characteristics place them at relatively higher risk of depletion from low levels of fishing effort, and also make their recovery slow once stocks are depleted (Daley, Stevens & Graham 2002; Simpfendorfer & Kyne 2009; Williams et al. 2013). Williams et al. (2013) have shown that gulper sharks undertake day–night migrations across their depth range, from relatively deep daytime residence depths (to 1,000 m) to shallower night-time feeding depths (up to 200 m), rendering them susceptible to capture over a wide depth range. Williams et al. (2013) also found that the geographic distribution of fishing during periods of high fishing effort in the CTS (1984 to 2011), demersal and auto-longline fisheries (1992 to 2010), Commonwealth gillnet fisheries (1997 to 2010), and New South Wales state fisheries coincided with the most depleted areas of Harrison's and southern dogfish. Post-capture survival of gulper sharks in the trawl sector is low; most gulper sharks are dead when the net is hauled. In the auto-longline sector, post-capture survival is potentially higher (subject to fishing gear soak time and handling practices); a preliminary study by CSIRO estimated the post-capture survival rate at 60–93% for the 70 southern dogfish tagged and released in the study (Williams et al. 2013).
Gulper sharks were historically targeted because they have high squalene (liver oil) content. The resulting historical depletion of gulper sharks off the east coast is well documented (Graham, Andrew & Hodgson 2001; Wilson et al. 2009). Graham, Andrew & Hodgson (2001) reported declines in CPUE of 95.8–99.9% between research trawl surveys conducted in 1976–77 and 1996–97 for endeavour, Harrisson's and southern dogfish on the New South Wales upper slope. Williams et al. (2013) derived depletion estimates for the identified subpopulations of Harrisson's and southern dogfish, expressed as a percentage of the initial relative carrying capacity.

For Harrisson's dogfish, the continental margin population was estimated to be at 11% of carrying capacity (range 4–20%) and the seamount population at 75% (range 50–100%). For southern dogfish, the eastern population was estimated to be at 11% of carrying capacity (range 6–19%) and the central population at 16% (range 8–33%). No estimate could be derived for the western population of southern dogfish because of limited data availability. Williams et al. (2013) confirmed that, in some areas, large reductions in abundance had resulted from quite low levels of fishing effort.

AFMA released the Draft upper slope dogfish management strategy in 2009, which protected several areas of known occurrence of dogfish, and implemented daily catch and trip limits (AFMA 2009). The strategy was reviewed by Musick (2011) and found to be inadequate to ensure recovery of Harrisson’s, southern and endeavour dogfish, and greeneye spurdog (Squalus chloroculus), with fishing mortality still exceeding estimated sustainable levels. The strategy was subsequently revised in 2012 (AFMA 2012), following research on depletion rates of upper-slope dogfish subpopulations (Williams et al. 2013) with a recovery objective of rebuilding Harrisson’s and southern dogfish stocks to 25% of their original carrying capacity. Williams et al. (2013) examined the core habitat area for Harrisson’s and southern dogfish that would be protected under a proposed closure network designed to meet this objective. Under the closure network, it is estimated that, in AFMA-managed waters, 25% of the core habitat of Harrisson's dogfish on the continental shelf and slope, 16.2% of the core habitat of the eastern population of southern dogfish and 24.3% of the core habitat of the central population of southern dogfish would be protected (from trawling and/or demersal longline fishing). These closures were implemented in February 2013. Additional closures were subsequently implemented on the Tasmanian seamounts (Britannia, Derwent Hunter and Queensland) overlaying the Murray and Freycinet Commonwealth marine reserves (areas that allow access to line fishing) (AFMA 2014c).

On 30 May 2013, the then Minister for Sustainability, Environment, Water, Population and Communities listed Harrisson's dogfish and southern dogfish under the EPBC Act as threatened species in the conservation-dependent category. The minister noted that both species have experienced severe historical declines following overfishing and are subject to recovery plans that provide for management actions to stop their decline and support their recovery. To further reduce fishing mortality there is a zero-retention limit for Harrisson’s, southern and endeavour dogfish, and guidelines for handling practices. In 2014, a research and monitoring workplan was developed to establish methods for monitoring the rebuilding of dogfish abundance.

AFMA is currently undertaking a review of the Upper-slope dogfish management strategy and will consult broadly with stakeholders to inform the review.
**Stock status determination**

In the absence of any evidence of recovery to above the specified limit reference point, gulper sharks remain classified as **overfished** because of the substantial depletion of Harrison's and southern dogfish in areas of southern and eastern Australia.

Although it has been estimated that the closures implemented in 2013 will protect 16.2–25% of the core distribution areas of these species, no evidence has yet been obtained showing rebuilding, and the effect of the closures is expected to take some time. As a result, the level of fishing mortality of gulper sharks is classified as **uncertain**. Resolution of stock structure may result in 1 or more of the subpopulations being classified as not subject to overfishing.

**Jackass morwong (Nemadactylus macropterus)**

Jackass morwong is distributed around the southern half of Australia (including Tasmania), New Zealand, and St Paul and Amsterdam islands (Indian Ocean); and off south-eastern South America and southern Africa. It occurs to depths of 450 m and, in Australian waters, is most abundant between 100 and 200 m. Genetic studies have shown no evidence of separate stocks in Australian waters, but found that New Zealand and Australian stocks are distinct (Elliot & Ward 1994). Although analysis of otolith microstructure found differences between jackass morwong from southern Tasmania and those off New South Wales and Victoria, it is unclear whether such differences indicate separate stocks (Morison et al. 2013). Nonetheless, it is assumed for the purposes of the stock assessment that there are separate stocks of jackass morwong in the eastern (New South Wales and eastern Victoria) and western zones (western Tasmania and western Victoria) (Morison et al. 2013). Catches of jackass morwong are also reported from the GABTS (Chapter 11) but it is not known whether they form a separate stock, so are currently managed separately.
Catch history

Catches of jackass morwong peaked at more than 2,500 t in the mid 1960s and have declined since the 1980s. Since the late 2000s, catches have continued to decline and have been less than 500 t per year (Figure 9.23a).

Commonwealth-landed catch in 2019–20 was 109.1 t, based on CDRs (Figure 9.23b). Based on logbook data, around 86% of the catch was from the east and 14% from the west. Discards and state catches are not yet available for 2019–20. However, the weighted average of the previous 4 calendar years (2015 to 2018) was calculated and used to estimate discards and state catches of 12.9 t and 7.4 t, respectively, for the eastern stock and 3.8 t and 1.6 t, respectively for the western stock (Burch, Althaus & Thomson 2019). For the 2019–20 fishing season, total catch and discards combined were estimated to be 134.8 t.

FIGURE 9.23a Jackass morwong annual catches (CTS, SHS and states) and discards, 1915 to 2017

![Graph showing catch history from 1915 to 2017.](source)

Sources: Day & Castillo-Jordán 2018a, b

FIGURE 9.23b Jackass morwong seasonal landings (SESSF) and TACs, 2006–07 season to 2019–20 season

![Graph showing seasonal landings and TACs from 2006 to 2019.](source)

Note: TAC total allowable catch.
Source: AFMA catch disposal records
Stock assessment

Jackass morwong in Commonwealth fisheries is managed as a tier 1 stock under the SESSF HSF (AFMA 2019a). Separate integrated stock assessment models have been developed for the eastern (southern New South Wales to eastern Tasmania) and western (western Tasmania to western Victoria) stocks. The 2018 assessments (Day & Castillo-Jordán 2018a, b) informed the management of the stock for the 2019–20 fishing season.

For the eastern stock, a new assessment in 2011 involved a change in productivity (a ‘regime shift’), attributed to long-term oceanographic changes (Wayte 2012). Compared with previous assessments, the new assessment provided a better fit to the data, but remained sensitive to natural mortality, the last year of recruitment estimation and the stock–recruitment relationship (Wayte 2012, 2013). Wayte’s (2013) analyses, which provide evidence for a regime shift, have now been accepted as influencing jackass morwong productivity (AFMA 2018b). The acceptance of a recruitment shift in the assessment resulted in a decrease in the estimate of recent depletion from closer to the limit reference point (0.20SB0) to closer to the target reference point (0.48SB0). However, SERAG has acknowledged that the regime shift contributes to considerable uncertainty in the jackass morwong assessment and that in the future there is a need to consider how best to fit regime/productivity shifts in models for non-recovering species (AFMA 2018a, b). The latest tier 1 stock assessment in 2018 (Day & Castillo-Jordán 2018a) estimated that the spawning stock biomass at the start of 2018 was 30% (0.30SB0) in the east (Figure 9.24). This led to an RBC of 261 t and a 3-year-average RBC of 270 t.

For the western stock, assessments are uncertain because only sporadic age data are available, length compositions are based on a very low number of sampled fish and the quality of the CPUE data is questionable (AFMA 2015c, 2018b). The latest tier 1 stock assessment in 2018 (Day & Castillo-Jordán 2018b) estimated that the spawning stock biomass at the start of 2018 was 0.66% (0.66 SB0) in the west (Figure 9.24). This led to an RBC of 235 t and a 3-year-average RBC of 223 t.

**FIGURE 9.24** Estimated spawning stock biomass for eastern (1988 to 2017) and western (1984 to 2017) stocks of jackass morwong

Notes: $B_{\text{CURRENT}}$, current biomass. $B_{\text{REF}}$, unfished biomass. Biomass estimates are available for the eastern stock from 1915 to 1987. However, pre-1988 estimates are not presented for the eastern stock because the new regime shift base case resets the reference biomass to the biomass in 1988.

Sources: Day & Castillo-Jordán 2018a
Stock status determination

The 2018 assessments (Day & Castillo-Jordán 2018a, b) estimated the spawning stock biomass at the beginning of 2018 to be 30% (0.30SB0) and 66% of the unfished level (0.66SB0), in the east and west, respectively. This was below the target reference point of 0.48SB0, and above the limit reference point of 0.20SB0, in the east, and above the target reference point of 0.48SB0, in the west. The stocks in both the east and west are therefore classified as not overfished.

For the 2019–20 fishing season, total catch and discards combined were estimated to be 134.8 t, which is below the combined 3-year-average RBC of 505 t calculated from the 2018 assessments (Day & Castillo-Jordán 2018a,b). Based on the catch ratio from the logbook data, around 114.1 t was caught in the east and 20.7 t in the west, both of which were below respective RBCs. This indicates that the fishing mortality in 2019–20 would be unlikely to deplete the stock to a level below its biomass limit reference point. The stock is therefore classified as not subject to overfishing.

John dory (Zeus faber)

Stock structure

John dory inhabits coastal and continental-shelf waters of Australia, the western Indian Ocean, the eastern Atlantic Ocean, the Mediterranean Sea, Japan and New Zealand. In southern Australia, its distribution stretches from Moreton Bay in southern Queensland to Cape Cuvier in Western Australia, with a limited distribution in eastern Bass Strait. In recent years, most of the SESSF john dory catch has been taken off New South Wales and eastern Victoria (Morison et al. 2013). John dory in the SESSF is considered to constitute a single stock for assessment and management purposes.

Catch history

The catch of john dory averaged between 200 and 300 t from 1986 to 1995, peaking at about 400 t in 1993. Catches have since decreased and have been below 200 t per year since 2012 (Figure 9.25a).

Commonwealth-landed catch in 2019–20 was 68.3 t, based on CDRs (Figure 9.25b). Discards and state catches are not yet available for 2019–20. However, the weighted average of the previous 4 calendar years (2015 to 2018) was calculated and used to estimate discards and state catches of 1.8 t and 6.7 t, respectively (Burch, Althaus & Thomson 2019). For the 2019–20 fishing season, total catch and discards were estimated to be 76.8 t.
John dory is infrequently targeted in the SESSF. Most of the catch was historically taken as byproduct by trawlers targeting other shelf species, such as redfish and flathead. Because most john dory catches are not targeted, it is considered a ‘secondary species’ and is managed to a biomass target 0.4SB0 (proxy for MSY).

**Figure 9.25a** John dory annual catches (CTS, SHS and states) and discards, 1986 to 2013

![Graph showing annual catches and discards from 1986 to 2013](source: Haddon 2014)

**Figure 9.25b** John dory seasonal landings (SESSF) and TACs, 2006–07 season to 2019–20 season

![Graph showing landings and TACs from 2006–07 to 2019–20](source: AFMA catch disposal records)

**Stock assessment**

John dory in Commonwealth fisheries is managed as a tier 3 stock under the SESSF HSF (AFMA 2019a). The tier 3 analysis (Castillo-Jordán 2017) informed the management of the stock for the 2019–20 fishing season. The analysis accounted for catches in zones 10–80 of the SESSF (Castillo-Jordán 2017), which comprise the GABTS, the CTS and the East Coast Deepwater Trawl Sector. The analysis consisted of a yield-per-recruit model and a catch-curve analysis, and was an update to the yield analyses presented in Thomson (2014).
Total mortality was estimated from catch curves constructed from length-frequency information. The assessment estimated an equilibrium fishing mortality rate \( (F_{\text{C cris}}) \) of 0.036, which was below the target fishing mortality reference point \( (F_{\text{spr40}} = 0.126) \) that would achieve a target biomass of 0.4SB0. There is no historical evidence to suggest that the stock has previously fallen below the target. Application of the tier 3 harvest control rule to the outputs of the 2017 assessment, and using the 0.4SB0 target, generated an RBC of 485 t for the 2019–20 season (AFMA 2018c; Castillo-Jordán 2017). This is higher than the RBC estimated by the 2014 assessment, largely because of the new ageing data. Sporcic and Haddon (2018) analysed standardised CPUE for the stock. The results indicated that the CPUE for the john dory stock in zones 10–20 had stabilised. The 2019–20 TAC was 395 t, the second year of a 3-year MYTAC.

**Stock status determination**

The 2017 tier 3 analysis (Castillo-Jordán 2017) estimated that the fishing mortality rate was below the target fishing mortality rate that would achieve a spawning biomass of 0.4SB0, and there is no evidence to suggest the stock has ever been reduced to below the limit reference point. The stock is therefore classified as **not overfished**.

For the 2019–20 fishing season, total catch and discards were estimated to be 76.8 t, which is below the RBC of 485 t calculated in the 2017 analysis (Castillo-Jordán 2017). This indicates that the fishing mortality in 2019–20 would be unlikely to deplete the stock to a level below its biomass limit reference point. The stock is therefore classified as **not subject to overfishing**.

**Mirror dory (Zenopsis nebulosa)**

Stock structure

Mirror dory is found throughout the southern Pacific Ocean at depths of 30–800 m. A single stock of mirror dory in the SESSF area is assumed for management purposes (Morison et al. 2013). To make it easier to assess, the stock has been split into eastern and western units of assessment.

Catch history

Mirror dory is predominantly a byproduct species in the CTS and is mainly caught east of Bass Strait. The catch has ranged between 200 and 700 t per year (Figure 9.26a).
Commonwealth-landed catch in 2019–20 was 116.6 t, based on CDRs (Figure 9.26b). Discards and state catches are not yet available for 2019–20. However, the weighted average of the previous 4 calendar years (2015 to 2018) was calculated and used to estimate discards of 2.4 t in the east and 0.1 t in the west, and state catches of 1.1 t in the east and zero in the west (Burch, Althaus & Thomson 2019). For the 2019–20 fishing season, total catch and discards combined were estimated to be 120.2 t.

**FIGURE 9.26a** Mirror dory annual catches (CTS, SHS and states) and discards, 1986 to 2018

![Graph showing mirror dory annual catches and discards from 1986 to 2018.](source: Sporcic 2019a)

**FIGURE 9.26b** Mirror dory seasonal landings (SESSF) and TACs, 2006–07 season to 2019–20 season

![Graph showing mirror dory seasonal landings and TACs from 2006–07 to 2019–20.](source: AFMA catch disposal records)

Note: TAC total allowable catch.
Stock assessment

Mirror dory in Commonwealth fisheries is managed as a tier 4 stock under the SESSF HSF (AFMA 2019a). The tier 4 analyses (Sporcic 2018) for both the eastern and western units informed the management of the stock for the 2019–20 fishing season. In 2019, new tier 4 analyses were undertaken (Sporcic 2019a).

The tier 4 analyses in 2018 included discards only for the eastern unit, given the low level of discards from the western unit. CPUE for the eastern unit generally declined from 2009 to 2016 and increased in 2017 (the latest year of data) (Figure 9.27). This increase may be linked to a change in fishing area, since there is some indication that the empirical analysis is more closely reflecting stock availability to the fishery rather than biomass (Sporcic 2018; Sporcic & Haddon 2018). CPUE for the western unit follows a cyclical pattern and, similar to the eastern unit, shows a slight increase in 2017 (Figure 9.28), which may in part be driven by a change in fishing area to shallower waters (Sporcic 2018; Sporcic & Haddon 2018).

For the eastern unit, applying the tier 4 harvest control rule to the standardised CPUE series with discards resulted in an RBC of 140 t (Sporcic 2018). For the western unit, applying the tier 4 harvest control rule to the standardised CPUE series resulted in an RBC of 95 t (Sporcic 2018). The total RBC for the eastern and western units combined for the 2019–20 season was 235 t.
Stock status determination

The 2019 tier 4 analyses (Sporcic 2019a) estimated the recent average standardised CPUE to be between the target and limit reference points for both the eastern and western assessment units. The stock is therefore classified as not overfished.

For the 2019–20 fishing season, total catch and discards combined were estimated to be 120.2 t, which is below the combined RBC of 235 t calculated from the tier 4 analyses. This indicates that the fishing mortality in 2019–20 would be unlikely to deplete the stock to a level below its biomass limit reference point. The stock is therefore classified as not subject to overfishing.
Ocean jacket (predominantly *Nelusetta ayraud*)

**Stock structure**

The ocean jacket stock comprises chinaman leatherjacket, which makes up most of the catch, and unspecified leatherjackets. Little is known about the biological structure of this multispecies stock. Ocean jacket taken in the GABTS is assessed separately (Chapter 11). Ocean jacket is a relatively short-lived species reaching maturity within 2–3 years and exhibiting large cyclical changes in abundance (Miller & Stewart 2009).

**Catch history**

Ocean jacket is caught in the CTS (zones 10–50), and in zones 82 and 83 in the Great Australian Bight. Only trawl-caught catches from the CTS are considered here. Historical catch data indicate substantial variations in ocean jacket abundance off south-eastern Australia in the 1920s and 1950s (Miller & Stewart 2009). Total catch of ocean jacket remained stable, at around 50 t, between 1986 and 2001 (Figure 9.29a). Since then, ocean jacket has been an important non-quota byproduct species in the SESSF, with current landings of around 150–200 t exceeding those of many quota species.

Commonwealth-landed catch in 2019–20 was 173.6 t, based on CDRs (Figure 9.29b). Discards and state catches are not yet available for 2019–20. However, the weighted average of the previous 4 calendar years (2015 to 2018) was calculated and used to estimate discards and state catches of 219.8 t and 339.9 t, respectively (Burch, Althaus & Thomson 2019). For the 2019–20 fishing season, total catch and discards were estimated to be 733.3 t.
FIGURE 9.29a Ocean jacket annual catches (CTS and SHS) and discards, 1986 to 2017

Note: Catch includes chinaman leatherjacket and unspecified leatherjackets.
Source: Sporcic & Haddon 2018

FIGURE 9.29b Ocean jacket seasonal landings (SESSF), 2006–07 season to 2019–20 season

Source: AFMA catch disposal records

Stock assessment

There is no formal stock assessment for ocean jacket. A standardised CPUE series shows a similar trend to landings, suggesting that abundance of ocean jacket increased after 2003. Following a gradual decline since 2013, the CPUE increased in 2017 (Sporcic & Haddon 2018) (Figure 9.30). There continues to be uncertainty over discarding of this species in the CTS and the GHTS.
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FIGURE 9.30 Standardised CPUE for ocean jacket, 1986 to 2017

Note: CPUE Catch-per-unit-effort. There is no tier 4 assessment for ocean jacket, and so there are no target and limit reference points.
Source: Sporcic & Haddon 2018

Stock status determination
The standardised CPUE series increased substantially between 2003 and 2007, and remains relatively high despite declining slightly from 2007 to 2016 (Sporcic & Haddon 2018). The stock is therefore classified as not overfished.

For the 2019–20 fishing season, total catch and discards were estimated to be 733.3 t, which is a decrease from 2018–19. CPUE remains relatively high compared with historical levels and has remained fairly stable for the past decade, meaning that the fishing mortality is unlikely to have driven the stock below the limit reference point. The stock is therefore classified as not subject to overfishing.

Ocean perch (Helicolenus barathri, H. percoides)

Stock structure
Ocean perch is managed as a single stock that includes 2 species: the inshore reef ocean perch (Helicolenus percoides) and the offshore bigeye ocean perch (H. barathri). Ocean perch stock structure is uncertain, but there is probably an east–west structuring of stocks (Morison et al. 2013). Reef ocean perch and bigeye ocean perch have been assessed separately since 2009, but a single TAC is set for the 2 species. Based on the depth of capture in logbook records, most of the landed ocean perch is considered to be bigeye ocean perch.
Catch history

Bigeye ocean perch has been a significant part of trawl catches since the continental-slope trawl fishery developed in the late 1960s (Morison et al. 2013). Total landed catch (both species) of ocean perch since the 1970s has generally been between 200 and 400 t, peaking at 475 t in 1997. Most (inshore) reef ocean perch are discarded because of their smaller size (Figure 9.31a).

Commonwealth-landed catch in 2019–20 was 169.1 t, based on CDRs (Figure 9.31b). Based on logbook data, around 15% of the catch was inshore reef ocean perch and 85% was offshore bigeye ocean perch. Discards and state catches are not yet available for 2019–20. However, weighted averages of the previous 4 fishing seasons (2015–16 to 2018–19) were calculated and used to estimate discards and state catches of 111.2 t and 3.6 t, respectively, for inshore reef ocean perch, and 39.9 t and 14.4 t, respectively, for offshore bigeye ocean perch (Burch, Althaus & Thomson 2019). For the 2019–20 fishing season, total catch and discards combined were estimated to be 338.2 t.

**FIGURE 9.31a** Total ocean perch (reef and bigeye) annual catches (CTS, SHS and states) and discards, 1986 to 2016

![Graph showing total ocean perch catches from 1986 to 2016](image)

Source: Haddon & Sporcic 2017b

**FIGURE 9.31b** Total ocean perch (reef and bigeye) seasonal landings (SESSF) and TACs, 2006–07 season to 2019–20 season

![Graph showing total ocean perch landings and TACs from 2006 to 2019](image)

Note: **TAC** total allowable catch.

Source: AFMA catch disposal records
Stock assessment

Both inshore reef and offshore bigeye ocean perch in Commonwealth fisheries are managed as a tier 4 stock under the SESSF HSF (AFMA 2019a). The tier 4 analyses by Haddon and Sporcic (2017b) informed the management of the stock for the 2019–20 fishing season. A 40% (0.40SB₀) target reference point is applied to both species (Morison et al. 2013).

The tier 4 analyses in 2017 estimated that both species were above their respective target reference points (Figure 9.32), producing an RBC of 248 t for inshore reef ocean perch and 345 t for offshore bigeye ocean perch (Haddon & Sporcic 2017b). SERAG noted that the high discard rate for inshore reef ocean perch had made the standardisation and associated tier 4 analyses uncertain, and, given the amount of discards required to be deducted, would have resulted in a TAC of zero (AFMA 2018d). SERAG recommended that inshore reef ocean perch be removed from the ocean perch quota basket and that a catch trigger be set for the species instead (AFMA 2018d). Accordingly, the TAC was determined based on the RBC for offshore bigeye ocean perch only and was set at 241 t for 2019–20, the second year of a 3-year MYTAC (AFMA 2018d).

**FIGURE 9.32** Standardised CPUE for bigeye (offshore) ocean perch, 1986 to 2016

![Graph showing Standardised CPUE for bigeye ocean perch from 1986 to 2016]

Note: CPUE Catch-per-unit-effort.
Source: Haddon & Sporcic 2017b

Stock status determination

Since the standardised CPUE for inshore reef ocean perch is no longer accepted by SERAG and is no longer being used to recommend an RBC, future status for the ocean perch stock (following the expiry of the current MYTAC) will likely be based only on information for offshore bigeye ocean perch.

While noting uncertainties in the CPUE series for inshore reef ocean perch, the 2017 tier 4 analyses (Haddon & Sporcic 2017b) estimated that the recent average standardised CPUE was above the target reference point for biomass for both species. The stock is therefore classified as **not overfished**.
Noting uncertainties in the CPUE series for inshore reef ocean perch and the resulting uncertainties in the RBC that was derived from the tier 4 harvest control rules, the total fishing mortality for inshore reef ocean perch was estimated (using the catch ratio from the logbook data) to be 140.2 t, which is below the RBC of 248 t. The total fishing mortality for offshore bigeye ocean perch was estimated (using the catch ratio from the logbook data) to be 198.0 t, which is below the RBC of 345 t. Total fishing mortality of ocean perch was estimated to be 338.2 t, which is below the combined RBC of 593 t. This indicates that the fishing mortality in 2019–20 would be unlikely to deplete the stock (or its component stocks) to a level below its biomass limit reference point. The stock is therefore classified as **not subject to overfishing**.

**Orange roughy** (*Hoplostethus atlanticus*)

Line drawing: Rosalind Poole

**Stock structure**

Orange roughy in the CTS is currently broken up into 7 management zones: Cascade Plateau, eastern zone, southern zone, western zone, South Tasman Rise, north-east remote zone and southern remote zone (Figure 9.33). An orange roughy stock also occurs in the Great Australian Bight, reported in Chapter 11.

A study on genetic variation in orange roughy (Gonçalves da Silva, Appleyard & Upston 2012) examined the variation of many loci, using genetic techniques that have the power to detect low levels of genetic differentiation. The study concluded that orange roughy in the Australian Fishing Zone form a single genetic stock, but identified some differentiation between Albany/Esperance, Hamburger Hill (in the Great Australian Bight) and south-eastern Australia. It was noted that the amount of genetic exchange needed to maintain genetic homogeneity is much less than the amount needed for demographic homogeneity, and that residency or slow migration may result in separate demographic units despite genetic similarity (Morison et al. 2013). Orange roughy on the Cascade Plateau has distinct morphometrics, parasite populations, size and age composition, and spawning time, and is a separate management unit within the southern remote zone (AFMA 2014d).
Overall catch history

Orange roughy was historically targeted in aggregations around seamounts, mainly at depths from 600 m to about 1,300 m. The first aggregation was discovered off Sandy Cape, western Tasmania, in 1986 (Smith & Wayte 2004). Several other non-spawning aggregations were discovered in 1986 and 1988, producing annual landings ranging from 4,600 to 6,000 t. The discovery of a large spawning aggregation on St Helens Hill and elsewhere off eastern Tasmania in 1989 resulted in significant growth of the fishery, with declared catches exceeding 26,000 t in 1989 and 40,000 t in 1990, making this the largest and most valuable finfish fishery in Australia at the time (Morison et al. 2013). Catches declined steadily after 1990, reaching low levels between 2000 and 2005. Following indications of decreasing CPUE and availability, the introduction of management zones and TACs prevented further increases in catches of orange roughy (Smith & Wayte 2004). Individual catch histories for the Cascade Plateau, eastern, southern and western orange roughy zones are shown in Figures 9.34, 9.35a, 9.37 and 9.38, respectively.

In October 2006, orange roughy was listed as conservation-dependent under the EPBC Act and placed under the Orange Roughy Conservation Programme (ORCP) (AFMA 2006). The ORCP was replaced by the Orange Roughy Rebuilding Strategy (ORRS) in 2014 (AFMA 2015b), the primary objective of which is to return all orange roughy stocks to levels at which the species can be harvested in an ecologically sustainable manner. Management actions to minimise fishing mortality and support rebuilding include deepwater closures, targeted fishing for orange roughy stocks that are above the limit reference point of 0.20SB0, restricting effort by limiting entry to existing fisheries, and ongoing research and monitoring to support stock assessments.
Orange roughy, Cascade Plateau

Catch history

Catch of orange roughy on the Cascade Plateau peaked at 1,858 t in 1990. No catch was taken between 1991 and 1995. While catches have been zero in recent years, 23.6 t was taken in 2019–20. The TAC has remained at 500 t (Figure 9.34).

Commonwealth-landed catch in 2019–20 was 23.6 t, based on CDRs (Figure 9.34). Discards and state catches are not yet available for 2019–20. The weighted average of the previous 4 fishing seasons (2015–16 to 2018–19) is calculated by Burch et al. (2019a). However, for orange roughy on the Cascade Plateau both discards and state catches are not known. For the 2019–20 fishing season, total catch and discards were estimated to be 23.6 t.

FIGURE 9.34 Orange roughy seasonal landings (CTS), and TACs, Cascade Plateau, 2006–07 season to 2019–20 season

Note: TAC total allowable catch.
Source: AFMA catch disposal records

Stock assessment

Orange roughy on the Cascade Plateau in Commonwealth fisheries is managed as a tier 1 stock under the SESSF HSF (AFMA 2019a).

The last tier 1 assessment in 2006 used acoustic survey abundance indices to assess spawning aggregations on the Cascade Plateau (Wayte & Bax 2007). These assessments rely on the single largest acoustic estimate of biomass each year, rather than trends in time series, because spawning aggregations on the Cascade Plateau are highly variable and have shown no discernible trends in volume or estimated biomass over time (Morison et al. 2013). The base-case model from the 2006 assessment estimated that the spawning stock biomass in 2006 was 73% of the unfished level (0.73SB0) (Wayte & Bax 2007). Because the stock was assessed to be above the 0.6B0 reference point, application of the SESSF HSF tier 1 harvest control rules allowed the setting of TACs to enable fish-down towards the target reference point.
An update to this assessment in 2009 used an alternative acoustic biomass estimate for 2005, with the addition of landed catch from 2007 to 2009 (Wayte 2009). The updated assessment estimated that the spawning stock biomass would be 0.64SB0 in 2011 if the RBC of 315 t was taken or 0.63SB0 in 2011 if the TAC of 500 t was fully caught in 2010 (Wayte 2009).

Low fishing effort for orange roughy on the Cascade Plateau has continued since 2009 and therefore there has been no new data with which to update the assessment. Although updates to the assessment were scheduled for both 2012 and 2014, both were postponed because no new catch or acoustic data (that is, from a new survey) were available. Consequently, due to the low risk to the stock, AFMA has continued to roll over the TAC of 500 t.

**Stock status determination**

The most recent indicators of biomass identified that the stock was above the target reference point of 0.60SB0 (Wayte 2009). Since the last stock assessment update, catches have remained significantly below the long-term RBC, so the stock is expected to be rebuilding. There is no evidence to suggest that the stock has been reduced to below the limit reference point of 0.20SB0. The stock is therefore classified as **not overfished**.

For the 2019–20 fishing season, total catch and discards were estimated to be 23.6 t, which is below the long-term RBC of 315 t calculated in the 2009 stock assessment update (Wayte 2009). This indicates that the fishing mortality in 2019–20 would be unlikely to deplete the stock to a level below its biomass limit reference point. The stock is therefore classified as **not subject to overfishing**.

**Orange roughy, eastern zone**

**Catch history**

The eastern, southern and western orange roughy fisheries show similar historical catch trends. The eastern zone has supported higher cumulative catches than the southern and western zones, producing a reported catch of 76,714 t from 1989 to 1992 (Figure 9.35a). Following the institution of the ORCP in 2006, orange roughy catch in the eastern zone was limited to incidental catch allowances, to allow for unavoidable catches while targeting other species. Most of the historical fishing grounds for orange roughy deeper than 700 m were closed to trawling in January 2007 (AFMA 2006, 2015b). Targeted fishing for orange roughy in the eastern zone recommenced in the 2015–16 fishing season following acoustic surveys and an updated stock assessment that showed the stock was recovering and above the limit reference point of 0.20SB0.

Commonwealth-landed catch in 2019–20 was 618.5 t, based on CDRs (Figure 9.35b). Discards and state catches are not yet available for 2019–20. However, the weighted average of the previous 4 fishing seasons (2015–16 to 2018–19) was calculated and used to estimate discards of 2.6 t and state catches were zero (Burch, Althaus & Thomson 2019). For the 2019–20 fishing season, total catch and discards were estimated to be 621.1 t.
FIGURE 9.35a Orange roughy annual catches (CTS), eastern zone, 1985 to 2016

Source: Haddon 2017

FIGURE 9.35b Orange roughy seasonal landings (SESSF) and TACs, eastern zone, 2006–07 season to 2019–20 season

Note: TAC total allowable catch.
Source: AFMA catch disposal records

Stock assessment

Eastern orange roughy in Commonwealth fisheries is managed as a tier 1 stock under the SESSF HSF (AFMA 2019a). The 2017 assessment (Haddon 2017) informed the management of the stock for the 2019–20 fishing season. The assumed stock structure is a combination of eastern zone (primarily St Helens Hill and St Patricks Head) and Pedra Branca from the southern zone.

Two models were developed and outlined by Haddon (2017). The first model (base case) used a natural mortality of 0.04 and steepness of 0.75 \((M = 0.04; h = 0.75)\), with an estimated spawning biomass of 34\% \((0.34SB_0)\) at the start of 2017. A second, less productive, model was also considered, which used a natural mortality of 0.036 and steepness of 0.6 \((M = 0.036; h = 0.6)\), which resulted in an estimated spawning biomass of 30\% \((0.30SB_0)\) at the start of 2017.
The consequences of selecting an incorrect model were tested by a risk evaluation. The risk evaluation took the projected catches generated from 1 model and substituted them into the other model—that is, catches from the more productive base-case model were substituted into the less productive model to test the consequences of erroneously selecting overestimated catches (overestimated catch scenario). Catches from the less productive model were also substituted into the more productive base-case model to test the consequences of erroneously underestimating catches (underestimated catch scenario). Results from the overestimated catch scenario indicated a cessation of recovery and ongoing depletion from about 2027. In the underestimated catch scenario, the stock would gradually recover and possibly reach the target of 0.48B₀ by 2050 (Haddon 2017). Upon consideration of catch projections, SERAG noted that there was little risk of the stock falling below the limit reference point when adopting an RBC from either model in the short term (that is, the typical 3-year MYTAC period) (AFMA 2017d, 2020).

The 2017 base-case assessment (Haddon 2017) estimated that the spawning stock biomass at the start of 2017 was 34% of the unfished spawning stock biomass (0.34SB₀) (Figure 9.36). Forward projection of the base-case assessment led to an RBC of 1,347 t for the 2019–20 fishing season and a 3-year-average RBC of 1,345 t (AFMA 2020; Haddon 2017). AFMA agreed to set the RBC for the 2019–20 fishing season based on the base case of 1,347 t, with an agreement from industry to limit their catches to 900 t in the eastern zone (note this does not include Pedra Branca) (AFMA 2020).

**FIGURE 9.36** Estimated female spawning stock biomass for orange roughy, eastern zone, 1980 to 2016

Notes: B_{CURRENT} Current biomass. B_{REF} Unfished biomass.
Source: Haddon 2017
Stock status determination

The 2017 assessment (Haddon 2017) estimated the spawning stock biomass to be 34% of the unfished level (0.34SB₀) at the start of 2017. This was below the target reference point of 0.48SB₀ but above the limit reference point of 0.20SB₀. The stock is therefore classified as not overfished.

For the 2019–20 fishing season, total catch and discards were estimated to be 621.1 t, which is below the RBC of 1,347 t calculated from the 2017 assessment and below the 900 t TAC. This indicates that the fishing mortality in 2019–20 would be unlikely to deplete the stock to a level below its biomass limit reference point. The stock is therefore classified as not subject to overfishing.

Orange roughy, southern and western zones

Catch history

The southern and western orange roughy fisheries show similar catch trends to the eastern zone fishery, with a brief period of high catches when fishing first commenced (1989 to 1992 for the eastern and southern zones; 1986 to 1988 for the western zone) and low catches thereafter (Figures 9.36 to 9.38). The peak catch in the southern zone was 35,430 t in 1990, with subsequent catches of 14,426 t in 1991 and 16,054 t in 1992 (Figure 9.37). The western zone produced a peak historical catch of 5,128 t in 1987 (Figure 9.38).

Following the institution of the ORCP in 2006, orange roughy catch in the southern and western zones was limited to incidental catch allowances, to allow for unavoidable catches while targeting other species. Most of the historical fishing grounds for orange roughy deeper than 700 m were also closed to trawling in January 2007 (AFMA 2006, 2015b).

Commonwealth-landed catch in 2019–20 was 115.1 t, based on CDRs, with 91.1 t caught in the southern zone (Figure 9.37) and 24.0 t caught in the western zone (Figure 9.38). Discards and state catches are not yet available for 2019–20.

The weighted average of the previous 4 calendar years (2015 to 2018) was calculated by Burch et al. (2019a). Using this method, discards for the 2019–20 season were estimated to be 29.9 t in the west and unknown in the south. State catches are unknown for both west and south. For the 2019–20 fishing season, total catch and discards were estimated to be 145 t.
FIGURE 9.37 Orange roughy seasonal landings (SESSF), southern zone, 2006–07 season to 2019–20 season

Source: AFMA catch disposal records

FIGURE 9.38 Orange roughy seasonal landings (SESSF), western zone, 2006–07 season to 2019–20 season

Source: AFMA catch disposal records
Stock assessment

The southern and western orange roughy stocks are currently managed under the ORRS (AFMA 2015b) with an incidental catch allowance of 94 t and 60 t, respectively.

The last assessment of southern orange roughy in 2000 used standardised catch-per-shot abundance indices from vessels that had regularly fished this zone to estimate abundance in 2001 to be below the limit reference point, at 7% of unfished levels \(0.07SB_0\) (Wayte 2002).

The last accepted assessment of western orange roughy was in 2002. It projected that there was a greater than 90% probability that the 2004 biomass would be less than 30% of the 1985 biomass (Wayte & Bax 2002). A comparison of the age composition in 1994 to 1996 with that in 2004 showed a marked reduction in the modal age, indicating a heavily fished stock, although it is uncertain whether all the otolith samples were from the same stock. In 2017, a preliminary age-based surplus production model was applied to the stock (Haddon 2018), which indicated a potential recovery in the stock, with a spawning biomass depletion of 32% \(0.32SB_0\) estimated for 2015. This preliminary model was not recommended for use in management, but the improvement in spawning biomass it indicated suggested the potential for further sampling and exploration of the condition of the stock. In 2020, a Western Orange Roughy Research Plan (WORRP) was approved by the AFMA Commission. The WORRP provides a 200 t research catch allowance for the 2020–21 fishing season to support adequate data collection to inform a tier 1 assessment of the stock to determine if rebuilding has occurred.

Noting recovery of the eastern zone orange roughy stock, and a long period of low TACs in the southern and western zones, SERAG considered that the southern and western zones may be showing some level of recovery (AFMA 2015d, 2019c). Under the ORRS, targeted fishing for both southern and western orange is not permitted, and SERAG continues to advise an RBC of zero. Consequently, AFMA set an incidental catch allowance of 31 t for the 2019–20 fishing season for southern orange roughy, with an additional 63 t allocated for the Pedra Branca area (assessed as part of orange roughy eastern stock described above). AFMA also set an incidental catch allowance of 60 t for the 2019–20 fishing season for western orange roughy.

Stock status determination

The most recent indicators of biomass (Wayte 2002; Wayte & Bax 2002) identified that both the southern and western orange roughy stocks were depleted and had been reduced to below their limit reference point of \(0.20SB_0\). There is no conclusive evidence to suggest that the stock(s) have rebuilt above this level and therefore they remain classified as overfished.

However, given the time that has passed since both stocks were fished and the recovery that has been detected in the eastern stock, it is possible that similar rebuilding has occurred in the southern and western zones. This suggests increasing uncertainty around the biomass status of the southern and western orange roughy stocks, and the preliminary age-based surplus production model for the western stock supports this. In the absence of additional information on stock status, it is possible that future biomass status may be classified as uncertain.
For the 2019–20 fishing season, total catch and discards were estimated to be 91.1 t in the south and 53.9 t in the west, which are below the 2019–20 target quota and incidental catch allowance of 94 t and the incidental catch allowance of 60 t, respectively. Spatial closures to trawling of most areas deeper than 700 m are expected to provide an extra layer of protection to both stocks. While in previous years both stocks have been classified as not subject to overfishing, this is inappropriate when (similar to other rebuilding species) there are 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. To ensure consistency in status across similar stocks, the fishing mortality of both the southern and western orange roughy stocks is classified as uncertain.

**Smooth oreodory (Cascade Plateau and non–Cascade Plateau) (Pseudocyttus maculatus)**

Line drawing: FAO

**Stock structure**

Little is known about the stock structure of smooth oreodory. For assessment and management purposes, smooth oreodory is treated as a single stock throughout the SESSF, excluding the Cascade Plateau and South Tasman Rise, which are managed as separate stocks.

**Catch history**

Smooth oreodory is targeted in aggregations around seamounts below 600 m, in the same areas as orange roughy. Oreodories have a lower value than orange roughy and historically were not the preferred species. This resulted in some discarding during the 1990s and 2000s, coinciding with the period of peak orange roughy fishing.

Catches of smooth oreodory on the Cascade Plateau reached maximum levels of 275–300 t in 1997, 2000, 2001 and 2002, but have otherwise generally remained below 100 t (Figures 9.39a, b). In recent years there has been zero landings. In contrast, catches of smooth oreodory outside the Cascade Plateau exceeded 500 t per year from 1990 to 1995, reaching almost 1,000 t in 1991 and peaking at 2,390 t in 1992 (Figure 9.40a). Catches have been low in the intervening period; however, the recent opening of the Pedra Branca area to orange roughy fishing meant that landings of smooth oreodory have increased (Figure 9.40b) (AFMA 2018b).
Commonwealth-landed catch in 2019–20 was 75.5 t, based on CDRs (Figure 9.39b and Figure 9.40b). Discards and state catches are not yet available for 2019–20. However, the weighted average of the previous 4 calendar years (2015 to 2018) was calculated and used to estimate zero discards for the Cascade Plateau stock and 3.9 t for the non–Cascade Plateau stock (Burch, Althaus & Thomson 2019). State catches are unknown. For the 2019–20 fishing season, total catch and discards were estimated to be 79.4 t.

**FIGURE 9.39a** Smooth oreodyry annual catches (CTS), Cascade Plateau, 1989 to 2011

![Smooth oreodyry annual catches (CTS), Cascade Plateau, 1989 to 2011](source)

Source: Haddon 2012

**FIGURE 9.39b** Smooth oreodyry seasonal landings (SESSF) and TACs, Cascade Plateau, 2006–07 season to 2019–20 season

![Smooth oreodyry seasonal landings (SESSF) and TACs, Cascade Plateau, 2006–07 season to 2019–20 season](source)

Note: TAC total allowable catch.
Source: AFMA catch disposal records
Figure 9.40a Smooth oreodory annual catches (CTS), non–Cascade Plateau, 1987 to 2011

Source: Haddon 2012

Figure 9.40b Smooth oreodory seasonal landings (SESSF) and TACs, non–Cascade Plateau, 2006–07 season to 2019–20 season

Note: TAC total allowable catch.
Source: AFMA catch disposal records

Stock assessment

Smooth oreodory (Cascade and non–Cascade Plateau) in Commonwealth fisheries were previously managed as tier 4 stocks under the SESSF HSF (AFMA 2019a). However, due to low catches, the CPUE standardisations in the tier 4 analyses are no longer considered reliable.

The last tier 4 assessment for the Cascade stock in 2010 (using data up to 2009) estimated that the recent average CPUE was above the target reference point; however, the CPUE was extremely variable and considered not indicative of changes in stock status (AFMA 2020). For the 2019–20 fishing season, no RBC was set for the Cascade Plateau stock. The current low effort and catches (less than 10 t per year since 2009) meant that any new tier 4 analysis would be unreliable (AFMA 2018d). Instead, a TAC of 150 t was implemented until catches reach the 10 t trigger (AFMA 2020).
A 2015 tier 5 analysis by CSIRO (Haddon et al. 2015) underpinned the management of non–Cascade Plateau stock for the 2019–20 fishing season. Updating the tier 5 analysis in 2018 was delayed by SERAG, pending work from a subgroup of the Southern and Eastern Scalefish and Shark Fishery Resource Assessment Group to examine ‘difficult to assess’ stocks, and so the 90 t RBC was rolled over for another year. The tier 5 analysis used a depletion-based stock reduction analysis (DBSRA) and a weight-of-evidence approach to develop an RBC. Using this method, the yield level predicted to be sustainable is dependent on the median value selected for the expected state of depletion in the final year of the analysis. Using the DBSRA in this manner for the non–Cascade Plateau smooth oreodory stock, and assuming it to be at the target depletion level of $0.48B_0$, it was determined that a catch of 90 t should prevent the stock from falling below the limit reference point of 20% ($0.2B_0$) and would keep the stock above $0.35B_0$ at least 90% of the time. It was considered plausible that the stock was not below a depletion level of $0.48B_0$, because almost all the stock is deeper than 700 m, which has been closed to fishing since 2007.

**Stock status determination**

For the Cascade Plateau stock, the low catches mean that CPUE is unlikely to be a reliable indicator of abundance. The low catches also mean that it is unlikely that there has been any substantial change in abundance. For the non–Cascade Plateau stock, the DBSRA assumed that the current depletion level is $0.48B_0$, which was considered plausible, given the recent low levels of catch and that almost all the stock is deeper than 700 m and not currently available to the fishery. The above information suggests it is unlikely that the smooth oreodory stocks have been reduced below the limit reference point, so both stocks (Cascade and non–Cascade Plateau) are classified as **not overfished**.

For the 2019–20 fishing season, there was no catch for the Cascade Plateau stock, and total catch and discards were estimated to be 79.4 t for the non–Cascade Plateau stock, which is below the 90 t RBC calculated using the DBSRA and a weight-of-evidence approach. This indicates that the fishing mortality in 2019–20 would be unlikely to deplete the stocks to a level below their respective biomass limit reference point. Both stocks are therefore classified as **not subject to overfishing**.
Other oreodories (warty—*Allocyttus verrucosus*, spikey—*Neocyttus rhomboidalis*, rough—*N. psilorhynchus*, black—*A. niger*, other—*Neocyttus* spp.)

Stock structure

Other oreodories is a multispecies stock comprising a number of species, including warty oreodory, spikey oreodory, rough oreodory and black oreodory. They are benthopelagic species, caught mainly below 600 m. Little is known about the stock structure of these species; they are treated as a single stock for assessment and management purposes (Morison et al. 2013).

Catch history

Other oreodories have historically been caught as a byproduct of fishing for orange roughy, with catch peaking at 980 t in 1990 (Figure 9.41a). Closure of substantial areas deeper than 700 m (except the Cascade Plateau) to all trawling in 2007 under the ORCP, and then the ORRS in 2014, reduced the opportunity to target oreodories. Although oreodories are generally considered to be a byproduct of other deepwater fisheries, and much of the deepwater habitat is now closed, catches of these species had declined substantially before closures were implemented. It is likely that there was substantial but unquantified discarding during the peak of the orange roughy fishery from 1989 to 1992. However, improving the basis for assessing the status of other oreodories is a low priority, given the protection afforded by current deepwater closures.

Commonwealth-landed catch in 2019–20 was 169.7 t, based on CDRs (Figure 9.41b). Discards are not yet available for 2019–20. However, the weighted average of the previous 4 calendar years (2015 to 2018) was calculated and used to estimate discards of 156 t (Burch, Althaus & Thomson 2019). It is uncertain if this estimate of discards is reliable after changes to the methodology and an inclusion of another species in the basket since the last assessment. Furthermore, on advice from SERAG, AFMA used the 2017 discard estimate when setting the TAC for the 2020–21 fishing season. State catches are unknown. For the 2019–20 fishing season, total catch and discards were estimated to be 325.7 t.
FIGURE 9.41a Other oreodories annual catches (CTS), 1986 to 2016

![Graph showing annual catches of other oreodories from 1986 to 2016.]

Source: Haddon & Sporcic 2017b

FIGURE 9.41b Other oreodories seasonal landings (SESSF) and TACs, 2006–07 season to 2019–20 season

![Graph showing seasonal landings and TACs of other oreodories from 2006–07 to 2019–20.]

Note: TAC total allowable catch. Source: AFMA catch disposal records

Stock assessment

Other oreodories in Commonwealth fisheries is managed as a tier 4 stock under the SESSF HSF (AFMA 2019a). The 2017 tier 4 analysis (Haddon & Sporcic 2017b) informed the management of the stock for the 2019–20 fishing season.

The tier 4 analysis in 2017 (Haddon & Sporcic 2017b) estimated that recent average CPUE was just below the target reference point of 0.48SB0 and produced an RBC of 256 t. In previous analyses, the majority (89%) of the catch has been reported as spikey oreodory (Sporcic 2015), so the CPUE series may largely reflect the status of spikey oreodory. There is some uncertainty about the reliability of standardised CPUE as an indicator of biomass given the highly aggregating and multispecies nature of the stock. SERAG has previously noted that this stock may also be a potential candidate for a lower target reference point (for example, B40) (AFMA 2019b).

The TAC for the 2019–20 season was set at 185 t, which was the second year of a 3-year MYTAC (AFMA 2019b).
FIGURE 9.42 Standardised CPUE for other oreodories, 1986 to 2016

Note: CPUE Catch-per-unit-effort.
Source: Haddon & Sporcic 2017b

Stock status determination

While noting uncertainties in the CPUE series, the 2017 tier 4 analysis (Haddon & Sporcic 2017b) estimated that other oreodories were just below the target reference point of 0.48SB0, but above the limit reference point. The stock is therefore classified as not overfished.

Total fishing mortality for the 2019–20 fishing season was estimated to be 325.7 t, which is above the RBC of 256 t calculated from the 2017 analysis. The estimate of discards used in the calculation of total fishing mortality is uncertain after changes to the methodology and inclusion of another species in the basket since the last assessment. When coupled with the uncertainty about the reliability of standardised CPUE as an indicator of biomass, the fishing mortality status of the stock is classified as uncertain.
Chapter 9: Commonwealth Trawl and Scalefish Hook sectors

Pink ling (*Genypterus blacodes*)

Line drawing: Rosalind Poole

**Stock structure**

Clear and persistent differences are seen between the eastern and western areas for pink ling in catch-rate trends, size and age (Morison et al. 2013). This indicates that there are either 2 separate stocks, or that exchange between eastern and western components of the stock is low and they should be managed as separate stocks. Although genetic variation between eastern and western pink ling has not been found (Ward et al. 2001), the persistent differences in other biological characteristics and catch-rate trends have resulted in pink ling being assessed as separate stocks east and west of longitude 147°E since 2013.

Catches of pink ling are managed under a single TAC. However, AFMA has management arrangements in place to constrain catches of the eastern stock to the eastern catch limit.

**Catch history**

Combined eastern and western catches of pink ling increased steadily from the start of the fishery in about 1977 to reach a peak of 2,412 t in 1997 (Figure 9.43a). Despite TACs continuing to increase from 1997 to 2001, catches declined steadily to about 1,800 t in 2004. From 2004–05 to 2013–14, pink ling catches declined and were limited by the TAC. Since 2013–14, catches have been stable at around 800 to 1,000 t.

Commonwealth-landed catch in 2019–20 was 834.8 t, based on CDRs (Figure 9.43b). Based on logbook data, around 46% of the catch was from the east and 54% from the west. Discards and state catches are not yet available for 2019–20. However, weighted averages of the previous 4 calendar years (2015 to 2018) were calculated and used to estimate discards and state catches of 22.7 t and 55.5 t, respectively, in the east and 20.8 t and 0.1 t, respectively, in the west (Burch, Althaus & Thomson 2019). For the 2019–20 fishing season, total catch and discards were estimated to be 933.9 t.
Pink ling in Commonwealth fisheries is managed as a tier 1 stock under the SESSF HSF (AFMA 2019a). Separate assessments were undertaken for the eastern (southern New South Wales to eastern Tasmania) and western (western Tasmania to western Victoria) stocks (Cordue 2018). The 2018 assessment informed the management of the stock for the 2019–20 fishing season.

Because of complexities in controlling catch of the stock, pink ling is managed under a harvest strategy that uses projections of stock response to various levels of catch and the risk that those catches may pose to breaching the limit reference point. This approach is taken while trying to pursue targets for the western stock and rebuild the eastern stock.
For the eastern stock, SERAG noted that there is considerable uncertainty around stock status, as it was heavily dependent on values adopted for natural mortality (M) and which CPUE series is used (that is, whether or not trip limits and fisher avoidance are included) (AFMA 2018a, b). Ultimately, SERAG recommended the use of the most conservative CPUE series, which did not account for management arrangements that restrict catches (for example, trip limits and fisher avoidance), and agreed to use the model-estimated M from the west instead of from the east (AFMA 2018a).

The latest assessment for the eastern stock estimated that the spawning stock biomass at the start of 2018 was 30% of the unfished spawning stock biomass (0.30SB0) (Figure 9.44). This led to an RBC of 260 t for 2019. SERAG recommended setting a notional eastern TAC based on stochastic projections from a range of constant-catch scenarios rather than the RBC (AFMA 2020). Projections of stock response to various constant-catch scenarios indicated that catches up to 550 t posed little (<5%) risk to the stock falling below the limit reference point (0.20SB0) by 2028 (Cordue 2018) (Table 9.3). The stock is expected to be rebuilt to the target reference point (0.48SB0), with at least a 50% probability, in a reasonable time frame (before 2050) for catches up to 500 t per year (Cordue 2018) (Table 9.3). This led to AFMA setting a notional eastern catch limit of 428 t for the 2019–20 fishing season.

For the western stock, SERAG noted that there were no technical difficulties with the assessment, and that both the trawl CPUE time series and spawning stock biomass continue to increase (AFMA 2018a; Cordue 2018).

The latest assessment for the western stock estimated that the spawning stock biomass at the start of 2018 was 84% of the unfished spawning stock biomass (0.84SB0) (Figure 9.45). This led to an RBC of 1,150 t for 2019. Projections of stock response to various constant-catch scenarios indicated that catches up to 1,000 t pose little (<5%) risk to the stock falling below the limit reference point (0.20SB0) by 2028 (Cordue 2018) (Table 9.4).
FIGURE 9.44 Estimated spawning stock biomass for eastern pink ling, 1970 to 2018

![Graph showing estimated spawning stock biomass for eastern pink ling from 1970 to 2018. The graph includes a 50% confidence interval, median, 48% B0, and 20% B0. The note states that B0 represents unfished biomass. Source: Cordue 2018.]

Note: B0 unfished biomass.
Source: Cordue 2018

FIGURE 9.45 Estimated spawning stock biomass for western pink ling, 1970 to 2018

![Graph showing estimated spawning stock biomass for western pink ling from 1970 to 2018. The graph includes a 50% confidence interval, median, 48% B0, and 20% B0. The note states that B0 represents unfished biomass. Source: Cordue 2018.]

Note: B0 unfished biomass.
Source: Cordue 2018
**Table 9.3** Base-case 2018 stock assessment performance indicators for eastern pink ling, showing stochastic projections at a range of future constant catches

<table>
<thead>
<tr>
<th>Annual catch (t)</th>
<th>$B_{2021}/B_0$</th>
<th>$B_{2028}/B_0$</th>
<th>Probability $B_{2021}&lt;0.2B_0$</th>
<th>Probability $B_{2028}&lt;0.2B_0$</th>
<th>Rebuild year</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>0.42</td>
<td>0.72</td>
<td>0</td>
<td>0</td>
<td>2023</td>
</tr>
<tr>
<td>300</td>
<td>0.37</td>
<td>0.53</td>
<td>0.01</td>
<td>0</td>
<td>2026</td>
</tr>
<tr>
<td>400</td>
<td>0.35</td>
<td>0.47</td>
<td>0.02</td>
<td>0.01</td>
<td>2030</td>
</tr>
<tr>
<td>450</td>
<td>0.34</td>
<td>0.44</td>
<td>0.02</td>
<td>0.01</td>
<td>2033</td>
</tr>
<tr>
<td>500</td>
<td>0.33</td>
<td>0.41</td>
<td>0.04</td>
<td>0.02</td>
<td>&gt;2040</td>
</tr>
<tr>
<td>550</td>
<td>0.32</td>
<td>0.38</td>
<td>0.05</td>
<td>0.05</td>
<td>&gt;2050</td>
</tr>
<tr>
<td>600</td>
<td>0.32</td>
<td>0.35</td>
<td>0.06</td>
<td>0.11</td>
<td>&gt;2050</td>
</tr>
<tr>
<td>650</td>
<td>0.31</td>
<td>0.31</td>
<td>0.08</td>
<td>0.18</td>
<td>&gt;2050</td>
</tr>
</tbody>
</table>

Notes: $B_0$ Unfished biomass. $B_{year}/B_0$ Predicted biomass ratio in given year. $B_{year}<0.2B_0$ Biomass below 20% $B_0$ in given year. Rebuild year is the projected year for rebuilding to 48%$B_0$.

Source: Cordue 2018

**Table 9.4** Base-case 2018 stock assessment performance indicators for western pink ling, showing stochastic projections at a range of future constant catches

<table>
<thead>
<tr>
<th>Annual catch (t)</th>
<th>$B_{2021}/B_0$</th>
<th>$B_{2028}/B_0$</th>
<th>Probability $B_{2021}&lt;0.2B_0$</th>
<th>Probability $B_{2028}&lt;0.2B_0$</th>
</tr>
</thead>
<tbody>
<tr>
<td>600</td>
<td>0.78</td>
<td>0.65</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>700</td>
<td>0.76</td>
<td>0.60</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>800</td>
<td>0.74</td>
<td>0.54</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>900</td>
<td>0.72</td>
<td>0.48</td>
<td>0</td>
<td>0.02</td>
</tr>
<tr>
<td>1000</td>
<td>0.70</td>
<td>0.43</td>
<td>0</td>
<td>0.05</td>
</tr>
</tbody>
</table>

Notes: $B_0$ Unfished biomass. $B_{year}/B_0$ Predicted biomass ratio in given year. $B_{year}<0.2B_0$ Biomass below 20% $B_0$ in given year.

Source: Cordue 2018

**Stock status determination**

The 2018 assessment (Cordue 2018) estimated the spawning stock biomass at the beginning of 2018 to be 30% (0.30SB0) and 84% (0.84SB0) of the unfished level (SB0), in the east and west, respectively. This was below the target reference point of 0.48SB0, but above the limit reference point of 0.20SB0 in the east and above the target reference point of 0.48SB0 in the west. The stocks in both the east and west are therefore classified as **not overfished**.

For the 2019–20 fishing season, total combined catch and discards were estimated to be 834.8 t, which is below the 2019 combined RBC of 1,410 t. The total fishing mortality for eastern pink ling was estimated (using the catch ratio from logbooks) to be 462.2 t, which is above the RBC of 260 t. The total fishing mortality for western pink ling was estimated (using the catch ratio from logbooks) to be 471.7 t, which is below the RBC of 1,150 t. Although total fishing mortality of eastern pink ling was above the RBC, at that mortality level the probability of the biomass being depleted to below 0.2B0 in 2021 is less than 0.04% (Table 9.3). Furthermore, the eastern stock is expected to be rebuilt to the target reference point (0.48SB0) with at least a 50% probability in a reasonable time frame (before 2050) for catches up to 500 t per year (Table 9.3). The stock is therefore classified as **not subject to overfishing**.
Redfish (*Centroberyx affinis*)

**Stock structure**

No formal stock delineation studies of redfish have been undertaken in Australia. Tagging studies suggested a single stock of redfish off New South Wales (Morison et al. 2013). However, studies of mean length-at-age suggest differences in growth rates of redfish from the ‘northern’ and ‘southern’ sectors of the fishery off eastern Australia (Morison et al. 2013). Previous redfish assessments have therefore assumed that the fishery exploits 2 separate populations, with the boundary between these ‘stocks’ being 36°S (immediately north of Montague Island in New South Wales) (Morison et al. 2013). The evidence for separate stocks was reviewed and considered to be insufficient; hence, recent assessments in 2014 and 2017 (Tuck & Day 2014; Tuck et al. 2017) assume a single stock. Status is determined for a single stock in the east coast of the SESSF (zones 10, 20 and 30).

**Catch history**

Catches of redfish peaked in the late 1970s and early 1980s, with significant discards recorded on top of landed catch. Landed catch has declined steadily since the late 1990s. TACs have been reduced in recent years, which has led to a further reduction in landings, with recent catches of less than 50 t (Figure 9.46a). A rebuilding strategy that established redfish as an incidental catch-only species was first implemented in 2016 (AFMA 2016a).

Commonwealth-landed catch in 2019–20 was 29.4 t, based on CDRs (Figure 9.46b). Discards and state catches are not yet available for 2019–20. However, the weighted average of the previous 4 calendar years (2015 to 2018) was calculated and used to estimate discards and state catches of 21.4 t and 6.9 t, respectively (Burch, Althaus & Thomson 2019). For the 2019–20 fishing season, total catch and discards were estimated to be 57.7 t.
FIGURE 9.46a Redfish annual catches (CTS, SHS and states) and discards, 1975 to 2016

![Graph showing redfish annual catches and discards from 1975 to 2016](image)

Source: Tuck et al. 2017

FIGURE 9.46b Redfish seasonal landings (SESSF) and TACs, 2006–07 season to 2019–20 season

![Graph showing redfish seasonal landings and TACs](image)

Note: TAC total allowable catch.
Source: AFMA catch disposal records
Stock assessment

Redfish in Commonwealth fisheries was managed as a tier 1 stock under the SESSF HSF (AFMA 2019a), but has been depleted to below the limit reference point since 1992 (Tuck et al. 2017) and is currently managed under a rebuilding strategy (AFMA 2016a) with an incidental catch allowance of 50 t.

The last tier 1 assessment in 2017 (Tuck et al. 2017) used catch-rate data, length data and conditional age-at-length data up to 2016. The base-case model estimated the spawning stock biomass to be 4% of the unfished level (0.04SB0) in 2016. It also projected that the spawning stock biomass in 2018 would be 0.08SB0 (assuming the same catches in 2017 as in 2016) (Figure 9.47). The assessment highlighted that estimates of recruitment since the early 2000s have been lower than average (except for 2011 and 2012), potentially due to environmental changes influencing productivity (Tuck et al. 2017). The assessment included projections of redfish biomass that were based on 2 recruitment (low and average) scenarios. Under the low recruitment scenario (recruitment from 2001 to 2010), the spawning stock biomass took a considerably long time (>40 years) to recover to the limit reference point of 0.2SB0, at average annual catches of 50 t, while catches above 150 t were unsustainable (Tuck et al. 2017). Under the average recruitment scenario (recruitment from the stock–recruitment curve), the spawning stock biomass was estimated to reach the limit reference point of 0.2SB0 by 2024, based on a zero annual catch (Tuck et al. 2017).

In 2016, a rebuilding strategy was implemented for redfish with the goal of rebuilding stocks to, or above, the limit reference point by or before 2042 (1 mean generation time plus 10 years) (AFMA 2016a). Recruitment will need to be in the order of ‘average’ to achieve this time frame.

SERAG has also noted that as fishers become more skilled in avoiding redfish, CPUE may become less informative as an index of abundance for the stock, similar to other rebuilding stocks such as blue warehou and eastern gemfish (AFMA 2019d, 2020).

FIGURE 9.47 Estimated female spawning stock biomass for redfish, 1975 to 2016

![Figure 9.47](image-url)
Stock status determination

The most recent indicators of biomass (Tuck et al. 2017) identified that the stock had been reduced to below the limit reference point of 0.20SB0. There is no evidence to suggest that the stock has rebuilt to above this level. The stock is therefore classified as overfished.

For the 2019–20 fishing season, total catch and discards were estimated to be 57.7 t, which is above the incidental catch allowance of 50 t. There is uncertainty as to what effect this level of catch will have on the recovery of the stock. Furthermore, recruitment needs to be at average levels to allow recovery of the stock within the specified time frame, which has been the exception rather than the norm over the past 2 decades. The stock is therefore classified as uncertain.

Ribaldo (*Mora moro*)

Stock structure

One stock of ribaldo is assumed for assessment and management purposes in the SESSF (Morison et al. 2013).

Catch history

Ribaldo is largely taken as byproduct during fishing for other species, and only 5% of the catch is considered to be targeted (Klaer et al. 2013). Historical catches increased from low levels in 1990 to a peak of more than 200 t in 2003 (Figure 9.48a). Commonwealth-landed catch dropped in 2005 to about 100 t, following implementation of a TAC, and remained below 100 t until the 2018–19 fishing season.

Commonwealth-landed catch in 2019–20 was 128.6 t, based on CDRs (Figure 9.48b). Discards and state catches are not yet available for 2019–20. However, the weighted average of the previous 4 calendar years (2015 to 2018) was calculated and used to estimate discards and state catches of 5.1 t and 2.7 t, respectively (Burch, Althaus & Thomson 2019). For the 2019–20 fishing season, total catch and discards were estimated to be 136.4 t.
Stock assessment

Ribaldo in Commonwealth fisheries is managed as a tier 4 stock under the SESSF HSF (AFMA 2019a). The 2017 tier 4 analysis (Haddon & Sporcic 2017a) informed the management of the stock for the 2019–20 fishing season. For this stock a 40% (0.40SB0) target reference point is applied.

The tier 4 analysis in 2017 (Haddon & Sporcic 2017b) estimated that the recent average CPUE was above the target reference point, producing an RBC of 430 t (Figure 9.49). An updated CPUE standardisation in 2018 (with data to 2017) showed that CPUE had remained stable (Sporcic & Haddon 2018).

The TAC for the 2019–20 season was set at 422 t, which was the second year of a 3-year MYTAC.
FIGURE 9.49 Standardised CPUE for ribaldo, 1986 to 2016

Note: CPUE Catch-per-unit-effort.
Source: Haddon & Sporcić 2017b

Stock status determination

The 2017 tier 4 analysis (Haddon & Sporcić 2017b) estimated the recent average CPUE to be above the target reference point. The stock is therefore classified as not overfished.

For the 2019–20 fishing season, total catch and discards were estimated to be 136.4 t, which is below the RBC of 430 t calculated from the 2017 analysis. This indicates that the fishing mortality in 2019–20 would be unlikely to deplete the stock to a level below its biomass limit reference point. The stock is therefore classified as not subject to overfishing.

Royal red prawn (*Haliporoides sibogae*)

Stock structure

Royal red prawn is widespread, occurring in depths of 350–550 m in the Indian and western Pacific oceans. In Australia, royal red prawn is caught off New South Wales, Queensland and Western Australia between latitudes 10°S and 36°S. Little is known of the stock structure in eastern Australia. Because most of the Australian catch is taken off the New South Wales coast between Port Stephens and Ulladulla, a single stock is assumed for assessment and management purposes (Morison et al. 2013). Stocks outside the SESSF (such as those in Western Australia) are not assessed here.
Catch history

Catch of royal red prawn fluctuated around 500 t per year during the 1990s and early 2000s, before declining to stabilise at between 100 and 200 t in recent years (Figure 9.50a). Catch has not approached the TAC in recent years, which can largely be attributed to limited availability of processing facilities for this species and low market demand (Morison et al. 2013).

Commonwealth-landed catch in 2019–20 was 163.8 t, based on CDRs (Figure 9.50b). Discards and state catches are not yet available for 2019–20. However, the weighted average of the previous 4 calendar years (2015 to 2018) was calculated and used to estimate discards and state catches of 17.5 t and 9.6 t, respectively (Burch, Althaus & Thomson 2019). For the 2019–20 fishing season, total catch and discards were estimated to be 190.9 t.

FIGURE 9.50a Royal red prawn annual catches (CTS, SHS and states) and discards, 1986 to 2016

Source: Haddon & Sporcic 2017b

FIGURE 9.50b Royal red prawn seasonal landings (SESSF) and TACs, 2006–07 season to 2019–20 season

Note: TAC total allowable catch.
Source: AFMA catch disposal records
Stock assessment

Royal red prawn in Commonwealth fisheries is managed as a tier 4 stock under the SESSF HSF (AFMA 2019a). The 2017 analysis (Haddon & Sporcic 2017b) informed the management of the stock for the 2019–20 fishing season.

The tier 4 analysis in 2017 (Haddon & Sporcic 2017b) estimated that the recent average CPUE was marginally above the target reference point, producing an RBC of 431 t (Haddon & Sporcic 2017a; see Figure 9.51). Some concerns about using a standardised CPUE for this stock have been expressed by SERAG because targeting of royal red prawn is market driven (Morison et al. 2013). Such practices may influence CPUE and the application of the SESSF tier 4 harvest control rule.

The TAC set for the 2019–20 season was 409 t, which was the second year of a 3-year MYTAC.

FIGURE 9.51 Standardised CPUE for royal red prawn, 1986 to 2016

![Graph showing CPUE for royal red prawn from 1986 to 2016](image)

Note: CPUE Catch-per-unit-effort.
Source: Haddon & Sporcic 2017b

Stock status determination

The 2017 tier 4 analysis (Haddon & Sporcic 2017b) estimated that the recent average standardised CPUE was above the target reference point. The stock is therefore classified as not overfished.

For the 2019–20 fishing season, total catch and discards were estimated to be 190.9 t, which is below the RBC of 431 t calculated from the 2017 analysis. This indicates that the fishing mortality in 2019–20 would be unlikely to deplete the stock to a level below its biomass limit reference point. The stock is therefore classified as not subject to overfishing.
Silver trevally (*Pseudocaranx georgianus*)

**Stock structure**
Silver trevally is found in Australian and New Zealand waters. In Australia, it ranges from northern New South Wales, around southern Australia to Western Australia. Little is known of the stock structure, but angler tag–recapture studies on Australia's south-east coast indicate restricted post-settlement movement, potentially leading to ecological stock structuring over moderate (hundreds of kilometers) distances (Fowler, Chick & Stewart 2018). This research supports the contention that silver trevally off south-eastern Australia represents a single stock that is distinct from the fishery off the North Island of New Zealand (Rowling & Raines 2000). The growth rate of the Australian stock of silver trevally is slower than that reported for the New Zealand stock; however, it matures comparatively early, at about 2 years of age, with spawning occurring throughout summer (Morison et al. 2013).

**Catch history**
High CPUE between 1989 and 1991, corresponding with a peak catch in 1990 of 1,588 t, was the result of efficient vessels entering the fishery in 1989 (Haddon 2013). Catch has since declined (Figure 9.52a). Silver trevally is also a popular target for recreational fishers off south-eastern Australia; the recreational catch in New South Wales was estimated to be around 27 t in 2013–14 (West et al. 2015).

Commonwealth-landed catch in 2019–20 was 21.0 t, based on CDRs (Figure 9.52b). Discards and state catches are not yet available for 2019–20. However, the weighted average of the previous 4 calendar years (2015 to 2018) was calculated and used to estimate discards and state catches of 119.6 t and 35.7 t, respectively (Burch, Althaus & Thomson 2019). For the 2019–20 fishing season, total catch and discards were estimated to be 176.3 t.
Stock assessment

Silver trevally in Commonwealth fisheries is managed as a tier 4 stock under the SESSF HSF (AFMA 2019a). The 2017 analysis (Haddon & Sporcic 2017b) informed the management of the stock for the 2019–20 fishing season.

The tier 4 analysis in 2017 (Haddon & Sporcic 2017b) estimated that the recent average CPUE was below the target reference point of 0.48SB, but above the limit reference point, producing an RBC of 445 t (Figure 9.53). The TAC set for the 2019–20 season was 292 t, which was the second year of a 3-year MYTAC (AFMA 2019b).
The establishment of Batemans Marine Park in June 2007 has affected the estimation of silver trevally RBCs because historical catch data from within the park boundaries are included in the target catch range component of the RBC calculation, but the CPUE analyses do not include historical activities in this area. Analyses in 2013 (Haddon 2013) considered CPUE from both within and outside the marine park and found little difference in the RBC estimate. The RBC derived from the latest 2017 tier 4 analysis (Haddon & Sporcic 2017b) excluded all data from the marine park. SERAG recommended waiving the default tier 4 discount factor of 15% of the RBC, on the basis that the marine park provides enough precaution as a refuge for spawning adults and juveniles across a significant portion of the species’ distribution (AFMA 2013, 2018c). However, adult silver trevally are highly mobile, and the inclusion of past marine park catches in RBC calculations assumes that silver trevally in these areas are fully available to fisheries outside the park.

Before 2010, most of the silver trevally catch was taken in state waters outside the SESSF (Morison et al. 2013). The closure of silver trevally trawling grounds within Batemans Marine Park, and the New South Wales buyout of state fishing businesses before 2007, have resulted in a sharp decline in New South Wales state catch (Morison et al. 2013).

**FIGURE 9.53 Standardised CPUE for silver trevally, 1986 to 2016**

![Standardised CPUE](image)

**Note:** CPUE Catch-per-unit-effort.

Source: Haddon & Sporcic 2017b

**Stock status determination**

The 2017 tier 4 analysis (Haddon & Sporcic 2017b) estimated the recent average standardised CPUE to be between the target and limit reference points. The stock is therefore classified as **not overfished**.

For the 2019–20 fishing season, total catch and discards were estimated to be 176.3 t, which is below the RBC of 445 t calculated from the 2017 analysis. This indicates that the fishing mortality in 2019–20 would be unlikely to deplete the stock to a level below its biomass limit reference point. The stock is therefore classified as **not subject to overfishing**.
Silver warehou (*Seriolella punctata*)

**Stock structure**

A study on the stock structure of silver warehou using genetics (mitochondrial DNA), morphology, otolith shape and otolith microchemistry did not indicate the presence of separate stocks east and west of Bass Strait, although there were indications of some structuring around Tasmania (Robinson et al. 2008). This study, together with other information, suggests that silver warehou should be considered as a single biological stock in the SESSF (Morison et al. 2013).

**Catch history**

Silver warehou has been a targeted species throughout most of the history of the fishery. Silver warehou catches steadily increased from the start of the fishery to peaks of 4,450 t in 2002 and 4,435 t in 2004 (Figure 9.54a). Catches have subsequently declined to around 300 t in recent years.

Commonwealth-landed catch in 2019–20 was 306.5 t, based on CDRs (Figure 9.54b). Discards and state catches are not yet available for 2019–20. However, the weighted average of the previous 4 calendar years (2015 to 2018) was calculated and used to estimate discards and state catches of 21.4 t and 6.9 t, respectively (Burch, Althaus & Thomson 2019). For the 2019–20 fishing season, total catch and discards were estimated to be 334.8 t.

**FIGURE 9.54a** Silver warehou annual catches (CTS, SHS and states) and discards, 1980 to 2017

Source: Burch et al. 2019
FIGURE 9.54b Silver warehou seasonal landings (SESSF) and TACs, 2006–07 season to 2019–20 season

Note: TAC total allowable catch.
Source: AFMA catch disposal records

Stock assessment
Silver warehou in Commonwealth fisheries is managed as a tier 1 stock under the SESSF HSF (AFMA 2019a). The 2018 assessment (Burch et al. 2019) informed the management of the stock for the 2019–20 fishing season.

The 2018 assessment (Burch et al. 2019) estimated that the spawning stock biomass at the start of 2018 was 22% (0.22SB0), which was below the target reference point of 48% (0.48SB0) but above the limit reference point of 20% (0.20SB0). This was a reduction from the 2015 assessment (Thomson, Day & Tuck 2015), which predicted the spawning biomass to be 40% (0.4SB0) in 2016. The reduction in the spawning stock biomass between assessments was caused by recent recruitment being revised downwards (Burch et al. 2019). SERAG noted that the spawning stock biomass has been below the target reference point since 2009 and declined to near the limit reference point from 2014 to 2017, before a predicted increase in 2018 (AFMA 2020). The predicted increase through 2018 (to 0.31SB0 at the start of 2019) assumes that there will be a return to average recruitment levels (AFMA 2018a). The 2018 assessment led to a single-year RBC of 942 t for 2019.

Because previous assessments have shown a pattern of overly optimistic recent recruitments and increases in stock size, which were not realised in subsequent assessments, SERAG requested that projections be carried out using 2 scenarios of below-average recruitment, assuming stable catches of around 350 t (AFMA 2018b). This included a ‘poor’ recruitment scenario (the average of a recent 5-year period of poor recruitment) and a ‘very poor’ recruitment scenario (the average of the worst 3 of these 5 years). Under the assumption of average recruitment (base-case scenario), the return to the target reference point is estimated to occur in about 2030. Projections under the ‘poor’ recruitment scenario indicate that spawning biomass should increase, but more slowly than under the base case. Under the ‘very poor’ recruitment scenario, projections show that spawning biomass plateaus at 27% of virgin stock biomass between 2019 and 2023 (AFMA 2018b, d). SERAG agreed to use the ‘poor’ recruitment scenario to provide RBC advice, which suggested that catches below 600 t would allow the biomass to rebuild (AFMA 2018b, d). This led to AFMA setting a TAC of 450 t for the 2019–20 fishing season, the first of a 3-year MYTAC.
Stock status determination

The 2018 assessment estimated the spawning stock biomass to be 22% of the unfished level ($0.22B_0$) at the beginning of 2018. This was below the target reference point of $0.48B_0$, but above the limit reference point of $0.20B_0$. The stock is therefore classified as not overfished. Spawning stock biomass for this stock is estimated to be every close to the limit reference point, with a history of poor recruitment. Consequently, this stock should be monitored closely in the future.

For the 2019–20 fishing season, total catch and discards were estimated to be 334.8 t, which is below the 2019–20 RBC of 942 t calculated in the 2018 assessment. Furthermore, catches below 600 t were projected to allow the biomass to gradually increase towards the target reference point, with the risk of falling below the limit reference point being low. This indicates that the fishing mortality in 2019–20 would be unlikely to deplete the stock to a level below its biomass limit reference point. The stock is therefore classified as not subject to overfishing.

9.3 Economic status

Key economic trends

The CTS and the SHS contributed approximately 49% of total SESSF GVP ($86.85 million) in 2018–19. From 2008–09 to 2012–13, real GVP for the 2 sectors averaged $65.82 million (in 2018–19 dollars; Figure 9.56). By 2013–14, GVP had fallen, and has remained below $50 million since.

Since 2008–09, declines in the value of blue grenadier and silver warehou catches have been the key drivers of the reduction in scalefish GVP. In 2008–09, silver warehou catches were valued at $4.61 million, and blue grenadier catches were valued at $18.26 million. By 2018–19, the GVP of silver warehou catches had declined to $744,000, and blue grenadier catches had declined to $4.55 million. In terms of value during 2018–19, the mix of stocks caught was dominated by tiger flathead ($12.75 million; 26% of total GVP) and pink ling ($6.39 million; 13%).
FIGURE 9.56 Real GVP, by key stocks, for the CTS and the SHS, 2008–09 to 2018–19

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

Estimates of net economic returns (NER) associated with scalefish catches for the CTS and the SHS combined are not available, because ABARES undertakes economic surveys of the CTS separately from the SHS (which is surveyed as part of the GHTS). However, with respect to value, the CTS accounts for most of the scalefish catch. ABARES economic surveys of the CTS estimate that NER in the CTS in 2013–14 were −$1.21 million (Bath, Mobsby & Koduah 2018). This was the first time they had been negative since 2004–05. The low NER were driven by low fishing income in the fishery as a result of an 11% decline in catch from 2012–13, as well as lower unit prices. NER rose to reach $4.06 million by 2016–17 as a result of a fall in operating costs that exceeded a slight fall in fishing income (Mobsby forthcoming). The increase in NER in this period was supported by improvements in fishers’ terms of trade. Preliminary estimates from the survey suggest that NER were −$0.17 million in 2017–18 and −$1.07 million in 2018–19 (Figures 9.57 and 9.58). NER are estimated to have decreased in 2017–18 and 2018–19 because lower levels of income are expected and operating costs are estimated to be higher as a result of higher levels of effort (trawl-hours and shots) in the fishery combined with higher unit fuel prices.
Performance against economic objective

Under the revised Commonwealth Fisheries Harvest Strategy Policy (Department of Agriculture and Water Resources 2018), all key commercial stocks are required to be managed to a biomass level that achieves overall maximum economic yield (MEY) for the fishery, while byproduct stocks are not required to be managed to MEY. This recognises that it is not feasible to set MEY targets for all species caught in multispecies fisheries and allows management to focus its efforts on optimising the returns gained from key commercial stocks.
The Commonwealth Fisheries Harvest Strategy Policy allows for biomass at MEY (B_{MEY}) targets to be set for key commercial stocks (most often 0.48B_{0}). Tiger flathead, blue grenadier, pink ling and blue-eye trevalla were key commercial stocks caught in 2018–19, and accounted for 57% of total scalefish GVP in both sectors in 2018–19. The biomass of these stocks, relative to the respective B_{MEY} targets, therefore provides an indication of performance against the objective of maximising NER.

Of the 4 key stocks, only tiger flathead has a quantitatively estimated stock-specific MEY target, at 0.38B_{0}. This was adjusted to 0.40B_{0} to take a more precautionary approach (Morison et al. 2013; Figure 9.17). In 2019, a new flathead assessment (Day 2019b, c) estimated spawning stock biomass to be declining to 32% (0.32SB_{0}) in 2018, down from 0.42SB_{0} in the 2016 assessment. As a result, the estimated biomass of tiger flathead in 2018 was below the MEY target. In contrast, the estimated spawning stock biomass for blue grenadier at the start of 2018 was 0.83SB_{0}, which was well above the target reference point of 0.48SB_{0}. In 2018, an updated stock assessment estimated that the western pink ling stock was 0.84B_{0}, which is significantly above the target reference point; however, in the east, the stock was 0.30B_{0}, which is below the target reference point. The stock of blue-eye trevalla is between the limit and target reference points. Except for blue grenadier and western pink ling, it can be concluded that economic returns can be increased for the fishery by rebuilding stocks of tiger flathead, eastern pink ling and blue eye trevalla toward the economic target. Improvement in economic returns is also possible if blue grenadier is fished down towards B_{MEY}. However, for blue grenadier, lower prices in recent years are likely discouraging participation by the factory vessels best suited to exploiting the stock. Quota latency for blue grenadier increased from 32% in the 2013–14 fishing season to 81% in the 2018–19 fishing season. Latency reduced to 46% in the 2019–20 fishing season. High quota latency in recent years partly reflects a higher TAC for the stock, but may also reflect changed incentives for fishers. Additionally, the availability of the large New Zealand blue grenadier fishery (where the TAC is close to 150,000 t) provides an alternative to those vessels endorsed to fish in New Zealand (Bath, Mobsby & Koduah 2018). The disinclination of fishers to significantly fish-down blue grenadier suggests that the 0.48B_{0} proxy may not be aligned with MEY during recent years.

The TAC of some key commercial stocks and many byproduct stocks remained undercaught in the 2018–19 and 2019–20 seasons. Exploring the reasons for undercaught TAC in the fishery has been the focus of recent research for the SESSF fishery. Knuckey et al. (2018) provide a range of potential contributing factors to undercaught TAC for the fishery. The study provides an important reference for management to better understand undercaught TACs in the management context for the fishery.

Improvements in efficiency would likely improve NER, as the median vessel operated at only 64% efficiency in 2012–13 (Green 2016). The same research indicates that potential productivity of the fishery has also declined since 2008–09; more research is required to determine the reasons for this. If it is the result of management changes, the management objectives served by these changes must be assessed against any associated fall in NER.
9.4 Environmental status

The environmental status of these fisheries is discussed in Chapter 8.

9.5 References


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