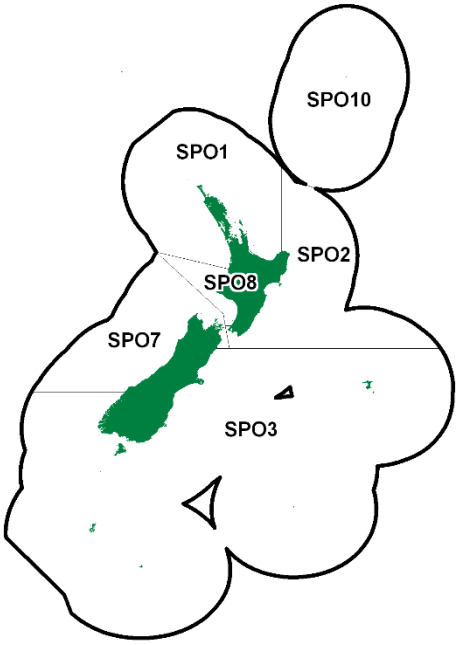
# RIG (SPO)

*(Mustelus lenticulatus)*
Pioke, Makoo




## 1. FISHERIES SUMMARY

Rig was introduced into the Quota Management System on 1 October 1986. Table 1 gives the TACs, TACCs, and allowances that were applicable to the 2018–19 fishing year.

**Table 1: TACs (t), TACCs (t), and allowances (t) for rig in 2019–20.**

| Fishstock | Recreational allowance | Customary non-commercial allowance | Other sources of mortality | TACC | TAC |
|---|---|---|---|---|---|
| SPO 1 | 25 | 20 | 15 | 692 | 752 |
| SPO 2 | 10 | 5 | 7 | 108 | 130 |
| SPO 3 | 60 | 20 | 30 | 600 | 710 |
| SPO 7 | 33 | 15 | 27 | 298 | 373 |
| SPO 8 | – | – | – | 310 | 401 |
| SPO 10 | – | – | – | 10 | 10 |

### 1.1 Commercial fisheries

Rig are caught in coastal waters throughout New Zealand. Most of the set net catch is taken in water less than 50 m deep during spring and summer, when rig aggregate inshore. Before the introduction of the QMS in 1986, 80% of the commercial catch was taken by bottom set net and most of the remainder by trawl. Total reported landings of rig increased rapidly during the 1970s and averaged about 3200 t per year during the late 1970s and early 1980s (Table 2, Table 3). Since then, a larger proportion has been taken by trawlers as bycatch. The most important bottom set net fisheries are at Ninety Mile Beach, Kaipara Harbour, Manukau Harbour, South Taranaki Bight–Tasman Bay/Golden Bay, Canterbury Bight, Kaikoura, and Hauraki Gulf.

Following the introduction of rig into the QMS in 1986, landings declined to less than half those of the previous decade in response to TACCs which were set at levels that were lower than previous catches. The total TACCs were subsequently increased to a maximum of 2098 t from 1994–95 to 1996–97, allowing landings to rise to 1888 t in 1996–97. Total landings subsequently declined steadily to a minimum of 1186 t during the fishing year 2008–09, before increasing to an annual average of just under 1400 t in more recent years (fishing years 2010–11 to 2018–19, Table 4).

**Table 2: Reported total New Zealand landings (t) of rig for the calendar years 1965 to 1985. Sources: MAF and FSU data.**

| Year | Landing | Year | Landing | Year | Landing | Year | Landing | Year | Landing |
|---|---|---|---|---|---|---|---|---|---|
| 1965 | 723 | 1970 | 930 | 1975 | 1 841 | 1980 | 3 000 | 1985 | 3 222 |
| 1966 | 850 | 1971 | 1 120 | 1976 | 2 610 | 1981 | 3 006 | | |
| 1967 | 737 | 1972 | 1 011 | 1977 | 3 281 | 1982 | 3 425 | | |
| 1968 | 677 | 1973 | – | 1978 | 3 300 | 1983 | 3 826 | | |
| 1969 | 690 | 1974 | 2 040 | 1979 | 2 701 | 1984 | 3 562 | | |

TACCs for all Fishstocks except SPO 10 were increased by 20% for the 1991–92 fishing year under the Adaptive Management Programme (AMP). Another TACC increase (from 454 t to 600 t) was implemented in SPO 3 for the 2000–01 fishing year. The TACCs for SPO 1, SPO 2, and SPO 8 reverted to the pre-AMP levels in the 1997–98 fishing year, when these Fishstocks were removed from the AMP in July 1997. All AMP programmes ended on 30 September 2009. The TACC for SPO 2 was increased from 72 t to 86 t from 1 October 2004 under the low knowledge bycatch framework (Table 4). In 2011–12 the SPO 2 TACC was further increased to 108 t. The SPO 7 TACC was raised to 246 t for 1 October 2015 based on increased abundance. The TACC for SPO 7 was decreased to 221 t on 1 October 2006, as a result of a stock assessment based on a declining CPUE. SPO was introduced into Schedule 6 on 1 May 2012, which means that rig that are alive and likely to survive can be released (but must be reported as Destination "X"). Figure 1 shows the historical landings and TACC values for the main SPO stocks.

In October 1992, the conversion factors for headed and gutted, and dressed, rig were both reduced from 2.00 to 1.75. They were each further reduced to 1.55 in 2000–01. Landings and TACCs prior to 2000–01 have not been adjusted for the changes in the conversion factor in the accompanying tables.

The Banks Peninsula Marine Mammal Sanctuary was established in 1988 by the Department of Conservation under the Marine Mammal Protection Act 1978, for the purpose of protecting Hector's dolphins. The sanctuary extends 4 nautical miles from the coast from Sumner Head in the north to the Rakaia River mouth in the south. Before 1 October 2008, no set nets were allowed within the sanctuary from 1 November to the end of February. For the remainder of the year, set nets were allowed, but could only be set from an hour after sunrise to an hour before sunset, be no more than 30 metres long, with only one net per boat which was required to remain tied to the net while it was set.

Voluntary set net closures were implemented by the SEFMC from 1 October 2000 to protect nursery grounds for rig and elephant fish and to reduce interactions between commercial set nets and Hector's dolphins in shallow waters. The closed area extended from the southernmost end of the Banks Peninsula Marine Mammal Sanctuary to the northern bank of the mouth of the Waitaki River. This area was closed for the entire year for a distance of 1 nautical mile offshore and for 4 nautical miles offshore for the period 1 October to 31 January.

From 1 October 2008, a suite of regulations intended to protect Māui and Hector's dolphins was implemented for all of New Zealand by the Minister of Fisheries.

For SPO 1, there have been three changes to the management regulations affecting set net fisheries which target school shark off the west coast of the North Island. The first was a closure to set net fishing from Maunganui Bluff to Pariokariwa Point for a distance of 4 nautical miles on 1 October 2003. This closure was extended by the Minister to 7 nautical miles on 1 October 2008. An appeal was made by affected fishers who were granted interim relief by the High Court, allowing set net fishing beyond 4 nautical miles during daylight hours between 1 October and 24 December during three consecutive years: 2008–2010. The west coast North Island set net closure to 7 nautical miles offshore was extended around Cape Egmont to Hawera in 2012, with fishing allowed between 2 and 7 nautical miles if an Observer was on board the vessel.

**Table 3: Reported landings (t) for the main QMAs from 1931 to 1982.**

| Year | SPO 1 | SPO 2 | SPO 3 | SPO 7 | SPO 8 | Year | SPO 1 | SPO 2 | SPO 3 | SPO 7 | SPO 8 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1931–32 | 28 | 0 | 0 | 0 | 0 | 1957 | 115 | 69 | 60 | 108 | 28 |
| 1932–33 | 30 | 0 | 0 | 0 | 0 | 1958 | 106 | 73 | 87 | 119 | 34 |
| 1933–34 | 29 | 0 | 0 | 0 | 0 | 1959 | 136 | 76 | 98 | 105 | 30 |
| 1934–35 | 33 | 0 | 0 | 0 | 0 | 1960 | 118 | 77 | 141 | 153 | 26 |
| 1935–36 | 31 | 0 | 0 | 0 | 0 | 1961 | 118 | 98 | 160 | 158 | 27 |
| 1936–37 | 73 | 0 | 8 | 0 | 0 | 1962 | 126 | 100 | 269 | 124 | 40 |
| 1937–38 | 56 | 1 | 5 | 0 | 0 | 1963 | 142 | 81 | 193 | 126 | 27 |
| 1938–39 | 32 | 1 | 70 | 0 | 0 | 1964 | 157 | 78 | 243 | 132 | 24 |
| 1939–40 | 10 | 1 | 12 | 0 | 0 | 1965 | 145 | 90 | 360 | 98 | 30 |
| 1940–41 | 13 | 1 | 54 | 1 | 0 | 1966 | 171 | 118 | 386 | 141 | 38 |
| 1941–42 | 18 | 0 | 32 | 0 | 0 | 1967 | 129 | 108 | 266 | 200 | 33 |
| 1942–43 | 49 | 1 | 33 | 1 | 0 | 1968 | 147 | 89 | 236 | 173 | 31 |
| 1943–44 | 42 | 6 | 44 | 5 | 1 | 1969 | 145 | 83 | 299 | 141 | 21 |
| 1944 | 60 | 10 | 14 | 7 | 4 | 1970 | 167 | 97 | 436 | 192 | 38 |
| 1945 | 56 | 5 | 24 | 10 | 8 | 1971 | 183 | 95 | 603 | 203 | 37 |
| 1946 | 71 | 12 | 8 | 19 | 9 | 1972 | 139 | 69 | 629 | 138 | 36 |
| 1947 | 73 | 27 | 28 | 45 | 7 | 1973 | 189 | 105 | 775 | 133 | 54 |
| 1948 | 51 | 26 | 51 | 43 | 7 | 1974 | 417 | 134 | 1 118 | 249 | 126 |
| 1949 | 57 | 33 | 60 | 49 | 9 | 1975 | 390 | 146 | 896 | 255 | 157 |
| 1950 | 87 | 48 | 62 | 73 | 17 | 1976 | 629 | 230 | 906 | 610 | 233 |
| 1951 | 94 | 46 | 101 | 68 | 22 | 1977 | 723 | 307 | 1 327 | 541 | 382 |
| 1952 | 115 | 41 | 132 | 63 | 21 | 1978 | 701 | 330 | 1 225 | 638 | 404 |
| 1953 | 117 | 56 | 95 | 45 | 20 | 1979 | 614 | 232 | 1 138 | 349 | 368 |
| 1954 | 103 | 68 | 40 | 58 | 39 | 1980 | 499 | 252 | 2 667 | 470 | 387 |
| 1955 | 93 | 49 | 42 | 84 | 47 | 1981 | 618 | 188 | 1 443 | 413 | 343 |
| 1956 | 106 | 54 | 38 | 77 | 29 | 1982 | 840 | 210 | 1 255 | 629 | 399 |

Notes:

1. The 1931–1943 years are April–March but from 1944 onwards are calendar years.
2. Data up to 1985 are from fishing returns: data from 1986 to 1990 are from Quota Management Reports.
3. Data for the period 1931 to 1982 are based on reported landings by harbour and are likely to be underestimated as a result of under-reporting and discarding practices. Data include both foreign and domestic landings. Data were aggregated to FMA using methods and assumptions described by Francis & Paul (2013).

**Table 4: Reported landings (t) of rig by Fishstock from 1985–86 to present and actual TACCs (t) from 1986–87 to present. QMS data from 1986–present. [Continued on next page]**

| Fishstock | SPO 1 | | SPO 2 | | SPO 3 | | SPO 7 | | SPO 8 | |
|---|---|---|---|---|---|---|---|---|---|---|
| FMA (s) | 1 & 9 | | 2 | | 3,4,5, & 6 | | 7 | | 8 | |
| | Landing | TACC | Landing | TACC | Landing | TACC | Landing | TACC | Landing | TACC |
| 1985–86* | 845 | – | 96 | – | 921 | – | 367 | – | 465 | – |
| 1986–87 | 366 | 540 | 55 | 60 | 312 | 330 | 233 | 240 | 125 | 240 |
| 1987–88 | 525 | 614 | 66 | 68 | 355 | 347 | 262 | 269 | 187 | 261 |
| 1988–89 | 687 | 653 | 68 | 70 | 307 | 352 | 239 | 284 | 212 | 295 |
| 1989–90 | 689 | 687 | 61 | 70 | 292 | 359 | 266 | 291 | 206 | 310 |
| 1990–91 | 656 | 688 | 63 | 71 | 284 | 364 | 268 | 294 | 196 | 310 |
| 1991–92 | 878 | 825 | 105 | 85 | 352 | 430 | 290 | 350 | 145 | 370 |
| 1992–93 | 719 | 825 | 90 | 86 | 278 | 432 | 324 | 350 | 239 | 370 |
| 1993–94 | 631 | 829 | 96 | 86 | 327 | 452 | 310 | 350 | 255 | 370 |
| 1994–95 | 666 | 829 | 88 | 86 | 402 | 454 | 341 | 350 | 273 | 370 |
| 1995–96 | 603 | 829 | 107 | 86 | 408 | 454 | 400 | 350 | 330 | 370 |
| 1996–97 | 681 | 829 | 99 | 86 | 434 | 454 | 397 | 350 | 277 | 370 |
| 1997–98 | 621 | 692 | 85 | 72 | 442 | 454 | 325 | 350 | 287 | 310 |
| 1998–99 | 553 | 692 | 86 | 72 | 426 | 454 | 336 | 350 | 235 | 310 |
| 1999–00 | 608 | 692 | 86 | 72 | 427 | 454 | 330 | 350 | 219 | 310 |
| 2000–01 | 554 | 692 | 81 | 72 | 458 | 600 | 338 | 350 | 174 | 310 |
| 2001–02 | 436 | 692 | 86 | 72 | 391 | 600 | 282 | 350 | 216 | 310 |
| 2002–03 | 477 | 692 | 86 | 72 | 417 | 600 | 264 | 350 | 209 | 310 |
| 2003–04 | 481 | 692 | 81 | 72 | 354 | 600 | 293 | 350 | 203 | 310 |
| 2004–05 | 429 | 692 | 108 | 86 | 366 | 600 | 266 | 350 | 208 | 310 |
| 2005–06 | 345 | 692 | 110 | 86 | 389 | 600 | 288 | 350 | 163 | 310 |
| 2006–07 | 400 | 692 | 101 | 86 | 423 | 600 | 265 | 221 | 176 | 310 |
| 2007–08 | 297 | 692 | 104 | 86 | 472 | 600 | 231 | 221 | 220 | 310 |
| 2008–09 | 297 | 692 | 106 | 86 | 328 | 600 | 233 | 221 | 222 | 310 |
| 2009–10 | 302 | 692 | 114 | 86 | 371 | 600 | 229 | 221 | 246 | 310 |
| 2010–11 | 311 | 692 | 106 | 86 | 395 | 600 | 229 | 221 | 220 | 310 |
| 2011–12 | 328 | 692 | 119 | 108 | 433 | 600 | 227 | 221 | 198 | 310 |
| 2012–13 | 369 | 692 | 106 | 108 | 463 | 600 | 226 | 221 | 120 | 310 |
| 2013–14 | 349 | 692 | 125 | 108 | 489 | 600 | 230 | 221 | 192 | 310 |
| 2014–15 | 324 | 692 | 117 | 108 | 556 | 600 | 235 | 221 | 181 | 310 |
| 2015–16 | 316 | 692 | 106 | 108 | 557 | 600 | 248 | 246 | 180 | 310 |
| 2016–17 | 318 | 692 | 101 | 108 | 543 | 600 | 258 | 246 | 197 | 310 |
| 2017–18 | 317 | 692 | 89 | 108 | 648 | 600 | 247 | 246 | 159 | 310 |
| 2018–19 | 238 | 692 | 105 | 108 | 615 | 600 | 265 | 271 | 142 | 310 |
| 2019–20 | 217 | 692 | 117 | 108 | 651 | 600 | 273 | 298 | 118 | 310 |

**Table 4 [Continued]: Reported landings (t) of rig by Fishstock from 1985–86 to present and actual TACCs (t) from 1986–87 to present. QMS data from 1986–present. [Continued on next page]**

| Fishstock | SPO 10 | | | |
|---|---|---|---|---|
| FMA (s) | 10 | | Total | |
| | Landings | TACC | Landings§ | TACC |
| 1985–86* | 0 | – | 2 906 | – |
| 1986–87 | 0 | 10 | 1 091 | 1 420 |
| 1987–88 | 0 | 10 | 1 395 | 1 569 |
| 1988–89 | 0 | 10 | 1 513 | 1 664 |
| 1989–90 | 0 | 10 | 1 514 | 1 727 |
| 1990–91 | 0 | 10 | 1 467 | 1 737 |
| 1991–92 | 0 | 10 | 1 770 | 2 070 |
| 1992–93 | < 1 | 10 | 1 650 | 2 072 |
| 1993–94 | 0 | 10 | 1 619 | 2 097 |
| 1994–95 | 0 | 10 | 1 769 | 2 098 |
| 1995–96 | 0 | 10 | 1 848 | 2 098 |
| 1996–97 | 0 | 10 | 1 888 | 2 098 |
| 1997–98 | 0 | 10 | 1 760 | 1 888 |
| 1998–99 | 0 | 10 | 1 635 | 1 888 |
| 1999–00 | 0 | 10 | 1 670 | 1 888 |
| 2000–01 | 0 | 10 | 1 607 | 2 034 |
| 2001–02 | 0 | 10 | 1 411 | 2 034 |
| 2002–03 | 0 | 10 | 1 453 | 2 034 |
| 2003–04 | 0 | 10 | 1 412 | 2 034 |
| 2004–05 | 0 | 10 | 1 377 | 2 048 |
| 2005–06 | 0 | 10 | 1 295 | 2 048 |
| 2006–07 | 0 | 10 | 1 365 | 1 919 |
| 2007–08 | 0 | 10 | 1 324 | 1 919 |
| 2008–09 | 0 | 10 | 1 186 | 1 919 |
| 2009–10 | 0 | 10 | 1 262 | 1 919 |
| 2010–11 | 0 | 10 | 1 260 | 1 919 |
| 2011–12 | 0 | 10 | 1 305 | 1 941 |
| 2012–13 | 0 | 10 | 1 283 | 1 941 |
| 2013–14 | 0 | 10 | 1 386 | 1 941 |
| 2014–15 | 0 | 10 | 1 413 | 1 941 |
| 2015–16 | 0 | 10 | 1 406 | 1 966 |
| 2016–17 | 0 | 10 | 1 417 | 1 966 |
| 2017–18 | 0 | 10 | 1 459 | 1 966 |
| 2018–19 | 0 | 10 | 1 364 | 1 991 |
| 2019–20 | 0 | 10 | 1 376 | 2 018 |

*FSU data.
§Includes landings from unknown areas before

For SPO 3, commercial and recreational set netting was banned in most areas from 1 October 2008 to 4 nautical miles offshore from the east coast of the South Island, extending from Cape Jackson in the Marlborough Sounds to Slope Point in the Catlins. Some exceptions were allowed, including an exemption for commercial and recreational set netting to only one nautical mile offshore around the Kaikoura Canyon, and permitting set netting in most harbours, estuaries, river mouths, lagoons, and inlets except for the Avon-Heathcote Estuary, Lyttelton Harbour, Akaroa Harbour, and Timaru Harbour. In addition, trawl gear within 2 nautical miles of shore was restricted to flatfish nets with defined low headline heights. Commercial and recreational set netting was banned in most areas to 4 nautical miles offshore, extending from Slope Point in the Catlins to Sandhill Point east of Fiordland and in Te Waewae Bay. An exemption permitted set netting in harbours, estuaries, and inlets. In addition, trawl gear within 2 nautical miles of shore was restricted to flatfish nets with defined low headline heights.

For SPO 7, both commercial and recreational set netting were banned to 2 nautical miles offshore from the South Island west coast, with the recreational closure effective for the entire year and the commercial closure restricted to the period 1 December to the end of February. The closed area extends from Awarua Point north of Fiordland to the tip of Cape Farewell at the top of the South Island. Both sides of Farewell Spit were voluntarily closed to set nets, beginning in October 2006, to protect large females in a known pupping area. The net effect of these set net area closures was to greatly reduce the importance of the SPO 7 set net fishery, particularly off the west coast. Fifty-six percent of the average 2000–01 to 2002–03 annual set net catch came from the combined west coast statistical areas, and 36% came from Tasman Bay/Golden Bay. The equivalent percentages from 2015–16 to 2017–18 are 3% for the west coast areas and 96% from Tasman Bay/Golden Bay. Over the same period, the overall set net catch has declined from 64% of the catch to 31%, with the balance taken up by bottom trawl and (in the most recent three years) Danish seine nets.

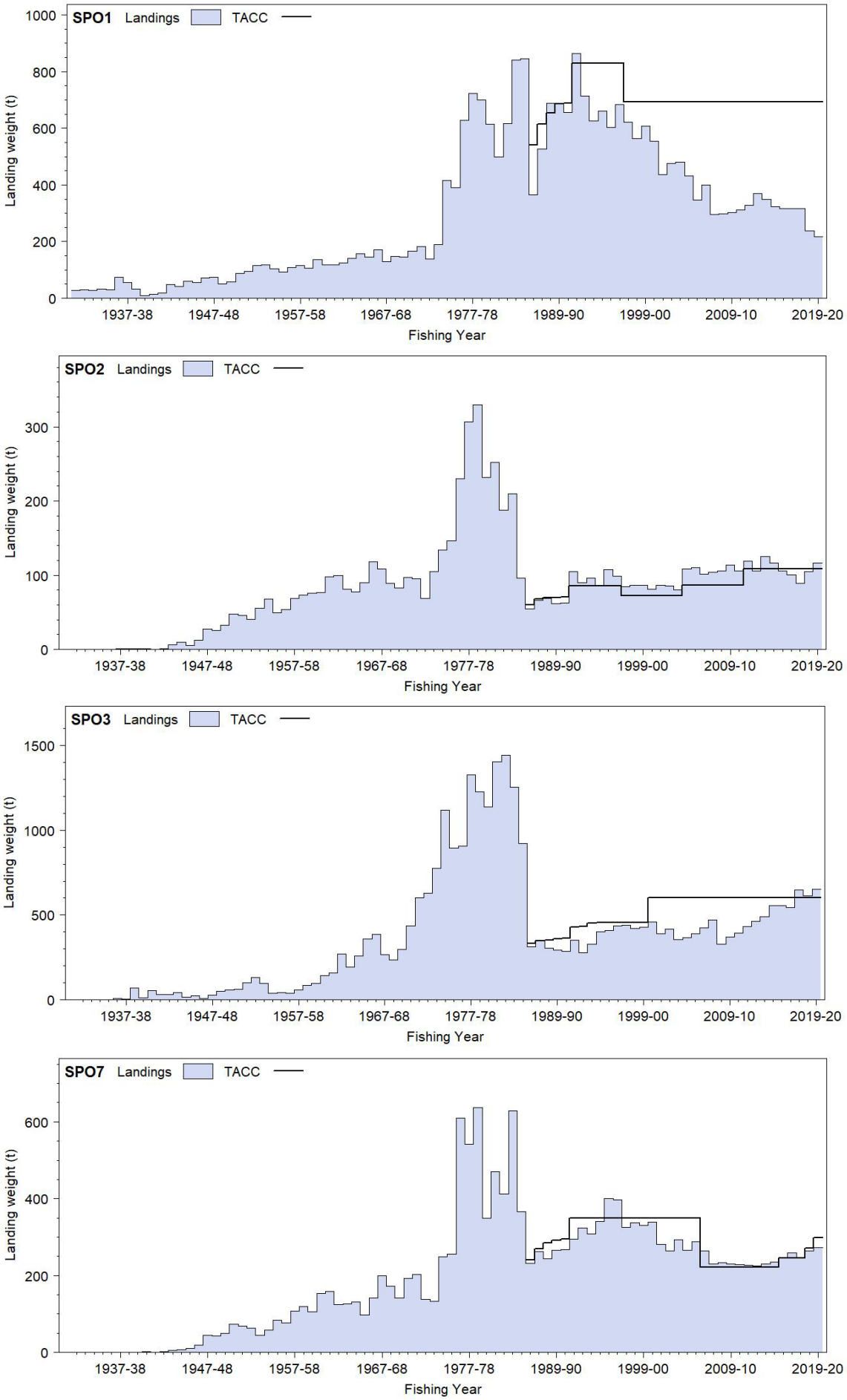



**Figure 1: Historical landings and TACCs for the five main SPO stocks. From top to bottom: SPO 1 (Auckland East) and SPO 2 (Central East), SPO 3 (South East Coast), SPO 7 (Challenger). [Continued on next page.]**

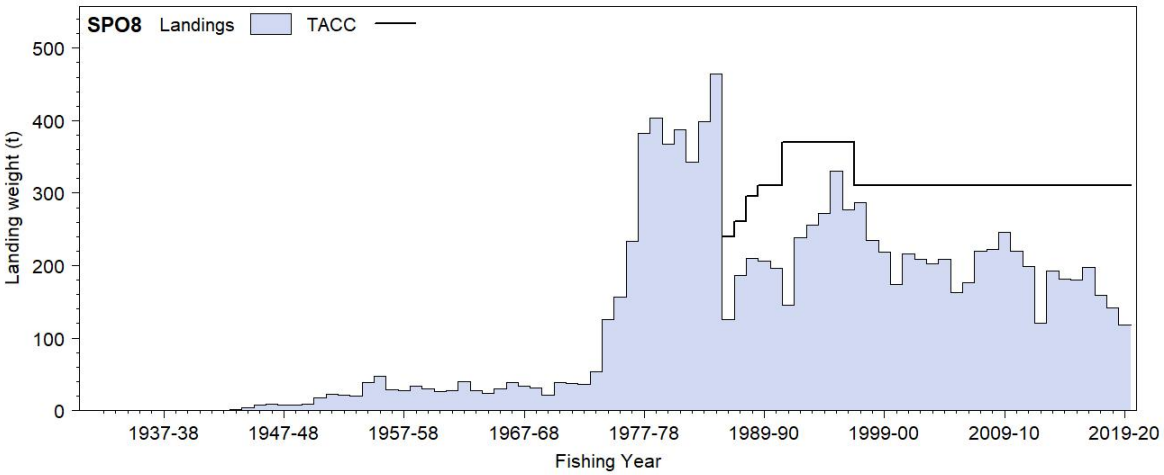



**Figure 1 [Continued]: Historical landings and TACCs for the five main SPO stocks. SPO 8 (Central Egmont).**

## 1.2 Recreational fisheries

Rig are the most commonly recreationally caught shark in New Zealand (Wynne-Jones et al 2014). Rig are caught by recreational fishers throughout New Zealand. They are predominantly taken on rod and reel (75.2%) with some taken on longline (16.6%) and less in set net (7.2%). The rod and reel catch is taken predominantly from land (57.5%) and trailer boat (29.6%), highlighting the importance of this species to land-based fishers.

### 1.2.1 Management Controls

The main method used to manage recreational harvests of rig is daily bag limits. Spatial and method restrictions also apply. Fishers can take up to 20 rig as part of their combined daily bag limit in the Auckland and Kermadec, Central, and Challenger Fishery Management Areas. Fishers can take up to 5 rig as part of their combined daily bag limit in the Fiordland and South-East Fishery Management Areas. Fishers can take up to 3 rig as part of their combined daily bag limit in the Kaikoura Fishery Management Area. Spatial closures for set netting and minimum mesh sizes for rig are also in place in all areas. There is currently no bag limit in place for the Southland Fishery Management Area.

### 1.2.2 Estimates of recreational harvest

There are two broad approaches to estimating recreational fisheries harvest: the use of onsite or access point methods where fishers are surveyed or counted at the point of fishing or access to their fishing activity; and, offsite methods where some form of post-event interview and/or diary are used to collect data from fishers.

The first estimates of recreational harvest for rig were calculated using an offsite approach, the offsite regional telephone and diary survey approach. Estimates for 1996 came from a national telephone and diary survey (Bradford 1998). Another national telephone and diary survey was carried out in 2000 (Boyd & Reilly 2002). The harvest estimates provided by these telephone diary surveys (Table 5) are no longer considered reliable.

In response to the cost and scale challenges associated with onsite methods, in particular the difficulties in sampling other than trailer boat fisheries, offsite approaches to estimating recreational fisheries harvest have been revisited. This led to the development and implementation of a national panel survey for the 2011–12 fishing year (Wynne-Jones et al 2014). The panel survey used face-to-face interviews of a random sample of New Zealand households to recruit a panel of fishers and non-fishers for a full year. The panel members were contacted regularly about their fishing activities and catch information collected in standardised phone interviews. Estimated catches in numbers of fish were converted to weights using mean weights estimated from boat ramp surveys (Hartill & Davey 2015). The national panel survey was repeated during the 2017–18 fishing year using very similar methods to produce directly comparable results (Wynne-Jones et al 2019, Davey et al 2019). Recreational catch estimates from the two national panel surveys are given in Table 5. Note that national panel survey estimates do not include recreational harvest taken under s111 general approvals.

**Table 5: Recreational harvest estimates for rig stocks. Early surveys were carried out in different years in the regions: South in 1991–92, Central in 1992–93, and North in 1993–94. Early survey harvests are presented as a range to reflect the considerable uncertainty in the estimates. The telephone/diary surveys ran from December to November but are denoted by the January calendar year. National panel surveys ran throughout the October to September fishing year but are denoted by the January calendar year.**

| Stock | Year | Method | Number of fish | Total weight (t) | CV |
|---|---|---|---|---|---|
| SPO 1 | 1994 | Telephone/diary | 11 000 | 5–25 | – |
| | 1996 | Telephone/diary | 28 000 | 35 | 0.31 |
| | 2000 | Telephone/diary | 13 000 | 17 | 0.30 |
| | 2012 | Panel survey | 7 780 | 8.5 | 0.25 |
| | 2018 | Panel survey | 3 830 | 6.1 | 0.34 |
| SPO 2 | 1993 | Telephone/diary | 5 000 | 5–15 | – |
| | 1996 | Telephone/diary | 4 000 | – | – |
| | 2000 | Telephone/diary | 16 000 | 21 | 0.58 |
| | 2012 | Panel survey | 7 172 | 7.8 | 0.26 |
| | 2018 | Panel survey | 3 044 | 4.8 | 0.32 |
| SPO 3 | 1992 | Telephone/diary | 12 000 | 15–30 | 0.22 |
| | 1996 | Telephone/diary | 12 000 | 15 | 0.20 |
| | 2000 | Telephone/diary | 43 000 | 57 | 0.32 |
| | 2012 | Panel survey | 8 142 | 8.9 | 0.24 |
| | 2018 | Panel survey | 9 372 | 14.9 | 0.26 |
| SPO 7 | 1993 | Telephone/diary | 8 000 | 10–25 | 0.39 |
| | 1996 | Telephone/diary | 19 000 | 24 | 0.20 |
| | 2000 | Telephone/diary | 33 000 | 33 | 0.38 |
| | 2012 | Panel survey | 19 126 | 20.9 | 0.25 |
| | 2018 | Panel survey | 11 688 | 18.6 | 0.27 |
| SPO 8 | 1993 | Telephone/diary | 18 000 | 20–60 | 0.43 |
| | 1994 | Telephone/diary | 1 000 | 0–5 | – |
| | 1996 | Telephone/diary | 7 000 | – | – |
| | 2000 | Telephone/diary | 7 000 | 9 | 0.48 |
| | 2012 | Panel survey | 5 499 | 6.0 | 0.45 |
| | 2018 | Panel survey | 7 435 | 11.8 | 0.41 |

### 1.3 Customary non-commercial fisheries

Maori fishers traditionally caught large numbers of "dogfish" during the last century and early this century. Rig was probably an important species, although spiny dogfish and school shark were also taken. The historical practice of having regular annual fishing expeditions, during which thousands of dogfish were sun-dried on wooden frames, is no longer prevalent. However, rig are still caught in small quantities by customary non-commercial fishers in parts of the North Island, especially the harbours of the Auckland region. Quantitative information on the current level of customary non-commercial take is not available.

### 1.4 Illegal Catch

Quantitative information on the level of illegal catch is not available.

### 1.5 Other sources of mortality

Unknown quantities of juvenile rig are caught by set nets placed in harbours and shallow bays. Quantitative information on the level of other sources of mortality is not available.

## 2. BIOLOGY

Rig are born at a total length (TL) of 25–30 cm. Off the South Island male and female rig attain maturity at 5–6 y (about 85 cm) and 7–8 y (about 100 cm), respectively (Francis & Ó Maolagáin 2000). Rig in the Hauraki Gulf mature earlier – 4 y for males and 5 y for females – and at smaller sizes (Francis & Francis 1992 a & b). Longevity is not known because few large fish have been aged. However, a male

rig that was mature at tagging was recaptured after nearly 14 years of liberty, suggesting a longevity of 20 years or longer. Females reach an average maximum length of 151 cm and males 126 cm TL.

Rig give birth to young during spring and summer, following a 10–11 month gestation. Most females begin a new pregnancy immediately after parturition, and therefore breed annually. The number of young produced increases exponentially with the length of the mother, and ranges from 2 to 37 (mean about 11). Young are generally born in shallow coastal waters, especially in harbours and estuaries, around the North Island and South Island. They grow rapidly during their first summer and then disappear as water temperatures drop in autumn when they presumably move into deeper water.

Rig make extensive coastal migrations, with one tagged female moving at least 1160 km. Over half of the tagged rig that were recaptured had moved over 50 km, and over half of the females had moved more than 200 km. Females travel further than males, and mature females travel further than immature females. Biological parameters relevant to stock assessment are shown in Table 6.

**Table 6: Estimates of biological parameters for rig.**

| Fishstock | Estimate | | | | Source |
|---|---|---|---|---|---|
| 1. Natural mortality (*M*) | | | | | |
| All | 0.2–0.3 | | | | Francis & Francis (1992a) |
| 2. Weight = a(length)$^b$ (Weight in g, length in cm total length). | | | | | |
| | Females | | Males | | |
| | a | b | a | b | |
| SPO 3 | $3.67 \times 10^{-7}$ | 3.54 | $1.46 \times 10^{-6}$ | 3.22 | Francis (1979) |
| SPO 7&8 | $9.86 \times 10^{-7}$ | 3.32 | $3.85 \times 10^{-}$ | 3.01 | Blackwell (unpubl. data) |
| 3. von Bertalanffy growth parameters | | | | | |
| | Both Sexes | | | | |
| | L | k | $t_o$ | | |
| SPO 3 &7 | 147.2 | 0.119 | -2.35 | | Francis & Ó Maolagáin (2000) |

## 3. STOCKS AND AREAS

Information relevant to determining rig stock structure in New Zealand was reviewed in 2009 (Smith 2009, Blackwell & Francis 2010, Francis 2010). These reviews concluded that the existing QMAs are a suitable size for rig management, although the boundaries between biological stocks are poorly defined, especially in the Cook Strait region. Insufficient tagging had occurred in SPO 1 to determine whether division of that stock into separate 1E and 1W stocks is warranted. Genetic, biological, fishery, and tagging data were all considered, but the evidence available for the existence and geographical distribution of biological stocks is poor. Some differences were found in CPUE trends at a small spatial scale but stock separation at the indicated spatial scales seems unlikely, and the CPUE differences may have resulted from processes acting below the stock level, such as localised exploitation of different sexes or different size classes of sharks. Genetic and morphological evidence indicate that a separate undescribed species of *Mustelus* occurs at the Kermadec Islands, but it is not known if rig occur there.

The most useful source of information was a tagging programme undertaken mainly in 1982–84 (Francis 1988a). However, most tag releases were made around the South Island, so little information was available for North Island rig. Male rig rarely moved outside the release QMA, even after more than five years at liberty. Female rig were more mobile than male rig, with about 30% of recaptures reported beyond the release QMA boundaries within 2–5 years of release. The proportion reported beyond the release QMA increased steadily with time. However, few females moved more than one QMA away from the release point. Because males move shorter distances than females, a conservative management approach is to set rig QMAs at a size appropriate for male stock ranges.

# 4. STOCK ASSESSMENT

**Estimates of fishery parameters and abundance**

New Zealand rig stock status has been assessed based on standardised CPUE analyses of the set net and bottom trawl fisheries in SPO 3 and SPO 7 since the early 2000s. A comprehensive CPUE analysis of the SPO 1 set net and bottom trawl fisheries was done in 2011 by Kendrick & Bentley (2012). Starr & Kendrick (2015) did an EEZ-wide CPUE analysis of all five rig QMAs in 2013. This extensive analysis was repeated in 2016 (Starr & Kendrick 2017) and again in 2019 (Starr & Kendrick in 2020).

All CPUE analyses presented here are based on commercial catch and effort data reported by fishers using compulsory statutory forms. These forms have changed over the period covered by these analyses, most notably in 2006–07 for set net and 2007–08 for trawl, when the form changed from a daily report to an "event" report, where an event is defined as a net set or a tow made. To derive continuous series of relative abundance, the catch and effort data collected with the new event-based forms needed to be converted into the equivalent daily form to create a series that spanned the change in form type. However, in the old system a fisher only needed to report the estimated catch of the top 5 species (by weight) in a day, whereas the equivalent reporting on the event-based forms is the top 8 species for the event.

It is furthermore necessary to base the rig CPUE analysis on landed rather than estimated weight, because this species is processed at sea and many fishers report the estimated catch as processed weight instead of green [whole] weight. This is achieved by allocating the trip landings proportionately to each fishing day, based on the reported estimated catch, so the explanatory information associated with each day can be incorporated into the CPUE analysis. For trips when rig are landed and sold at the end of a trip, but there is no estimated rig catch information for the trip, the procedure defaults to using the effort to make the allocation. When this happens, it means that the CPUE for the trip is directly proportional to the effort expended, not where rig are caught. This is not usually a problem when only a small proportion (less than 10%) of the trips fall into this category, but can introduce bias when 50–80% of trips have no estimated catches, as occurs for rig caught in bottom trawl fisheries. Because of this problem, the 2016 Plenary agreed to use data amalgamated to the level of a complete trip for all rig bottom trawl CPUE analyses. The auxiliary information on location of capture and intended target species was retained by assigning each trip with the value of the most frequent statistical area occupied and the most common target species.

The set net CPUE data were prepared by amalgamating the effort data and other associated information (month, year, target species, vessel, statistical area) to represent a day of fishing. The procedure assigns the most frequent statistical area and target species for that day of fishing to the trip/date record. All estimated catches for the day were summed and the five species with the greatest catch were assigned to the date. Landings were then assigned to each daily record in one of two ways: 1) by allocating the landings for the trip proportionately to the estimated catch for each day of fishing; or 2) calculating a "vessel correction factor" (*vcf*) for each vessel in a year (Kendrick & Bentley 2012). This factor is then applied to all estimated catches for that vessel in that year. Only *vcf* values in a specified range (0.75 to 2.0) were used, dropping all remaining vessels. This latter procedure is required in SPO 1 because fishers in that QMA tend to hold back their catch rather than deliver it to a Licensed Fish Receiver, thus breaking the link between the top part of the form which holds the effort, location of catch, and the catch estimate and the bottom part of the form which holds the actual catch information.

The set net and bottom trawl CPUE analyses were conducted in a similar manner and included: a) identification of core vessels which participated consistently in the fishery for a reasonably long period so that the analysis could be confined to these vessels; b) a stepwise selection of explanatory variables, with each step selecting the variable with the greatest remaining explanatory power, after forcing fishing year (the abundance variable) as the first variable. The available explanatory variables included fishing year (forced), month, vessel, statistical area, target species, duration of fishing, and length of net set (for the set net analysis) or number of tows (for the bottom trawl analysis). The landing information had been corrected for changes in conversion factors that have occurred over the history of the dataset as well as to eliminate trips with unreasonably large landings (Starr & Kendrick 2016). Three standardised analyses were conducted for all bottom trawl fisheries: a) a lognormal non-zero catch

model; b) a binomial presence/absence catch model; and c) a delta-lognormal model that combines the two series, using the method of Vignaux (1994). Both Inshore Working Groups have agreed to use combined models which integrate the signal from the tows with positive catch with the signal from presence/absence models based on the same data. These methods are preferred for use as the basis for monitoring species that are taken by bottom trawl, especially those for species taken predominantly as bycatch. Simulation work has shown that the use of the combined series accounts for reporting trends as well as trends in the incidence of capture (Langley 2015). Only standardised models based on positive catch records were used for the set net catch/effort data. This is because zero catch records are relatively rare (less than 5% in most instances and only rarely >10%). Experience has shown that models which combine positive and zero catch information are nearly indistinguishable from the positive catch model when the zero catch records are less than 10% of the total records.

**SPO 1**

Standardised CPUE indices were calculated for five SPO 1 setnet fisheries by modelling (GLM) non-zero catches by core vessels targeting rig and other shark species when this species was reviewed in 2016. Two coastal bottom trawl fisheries targeting a range of species were analysed by combining a non-zero catch series with a binomial presence/absence series. The SPO 1 set net analyses were complicated by the fact that up to 50% of the set net landings were accumulated ashore using intermediate destination codes for subsequent landing to a Licensed Fish Receiver, thus breaking the link between effort and landing within a trip. Estimated catches are unreliable in rig fisheries because many fishers report the processed weight rather than the equivalent green weight. This problem was solved by applying a "vessel correction factor" (*vcf*), calculated for each vessel and year, to correct the estimated catch observations (see above).

**SPO 1E**

In 2016, three CPUE analyses for SPO 1E were presented to the Working Group: a) a target shark (NSD, SPO, SHK, SPD) set net fishery operating in the Firth of Thames (Area 007) [SN(007)]; b) a target shark set net fishery operating in the remaining SPO 1E Statistical Areas (002 to 006 and 008 to 010) [SN(coast)]; and c) a mixed target species (SNA, TRE, GUR, JDO, BAR, TAR) bottom trawl fishery operating in all SPO 1E Statistical Areas (002 to 010) [BT(coast)].

The Southern Inshore Working Group (SINSWG) and Plenary gave the SN(007) series a research rating of '2' because, although this fishery targets mature female rig and the diagnostics were considered credible, it provides an index of abundance for only a portion of the total area. The Plenary gave the BT(coast) and SN(coast) series research ratings of '3' because annual catches were unacceptably low and, in the case of the set net index, the fishing locations were widely dispersed and occupied sporadically. The latter two series were not updated in 2019 (Starr & Kendrick 2019) because of their low research rating. The SN(007) analysis was updated, showing a relatively strong upturn since the 2016 analysis (Figure 2).

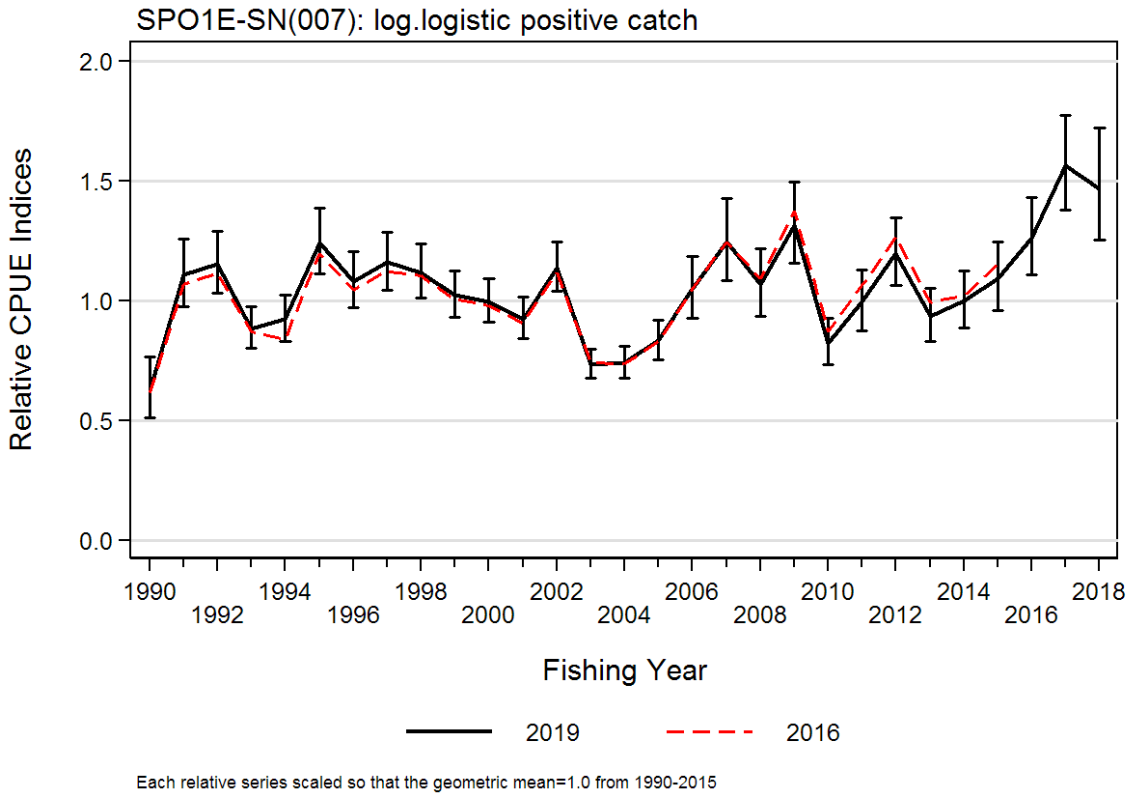



**Figure 2: Standardised CPUE for SPO 1E in the target shark set net in the Firth of Thames (Statistical Area 007) [SN(007)]. Error bars show 95% confidence interval on the prediction.**

## SPO 1W

In 2016, four CPUE analyses for SPO 1W were presented to the Working Group: a) a target shark (NSD, SPO, SHK, SPD) set net fishery operating in Manukau Harbour (Statistical Area 043) [SN(043)]; b) a target shark set net fishery operating in Kaipara Harbour (Statistical Area 044) [SN(044)]; c) a target shark set net fishery operating in all the remaining SPO 1W Statistical Areas (042, 045–048) plus the most northerly SPO 8 Statistical Area (041) [SN(41–47)]; and d) a mixed target species (SNA, TRE, GUR, JDO, BAR, TAR) bottom trawl fishery operating in all SPO 1W Statistical Areas (042, 045–048) [BT(coast)] outside the harbours plus the most northerly SPO 8 Statistical Area (041).

The 2016 Plenary assigned the BT index a quality ranking of '1', but noted that although the analysis was credible the method of capture does not representatively sample large female rig. The two harbour-based set net indices were given a ranking of '2' (medium or mixed quality) because they are probably indexing localised abundance. The Plenary rejected the coastal set net index as an index of abundance on account of the considerable impact the dolphin closures have had on this fishery.

The coastal set net index series was not updated in 2019 (Starr & Kendrick 2019) because of its rejection in 2016. The other three series were updated in 2019. The coastal BT series has shown a slow increasing trend since the mid-2000s, although the 2016–17 and 2017–18 indices appear to have dropped relative to 2015–16. The SN(043 Manukau Harbour) series shows a strong decline in the early portion of the series whereas the SN(044 Kaipara Harbour) series shows no trend throughout the 1990s. Both set net indices show a slowly declining trend since the late 1990s, although there is a suggestion that the Kaipara Harbour series may be showing an increase from 2013–14 (Figure 3).

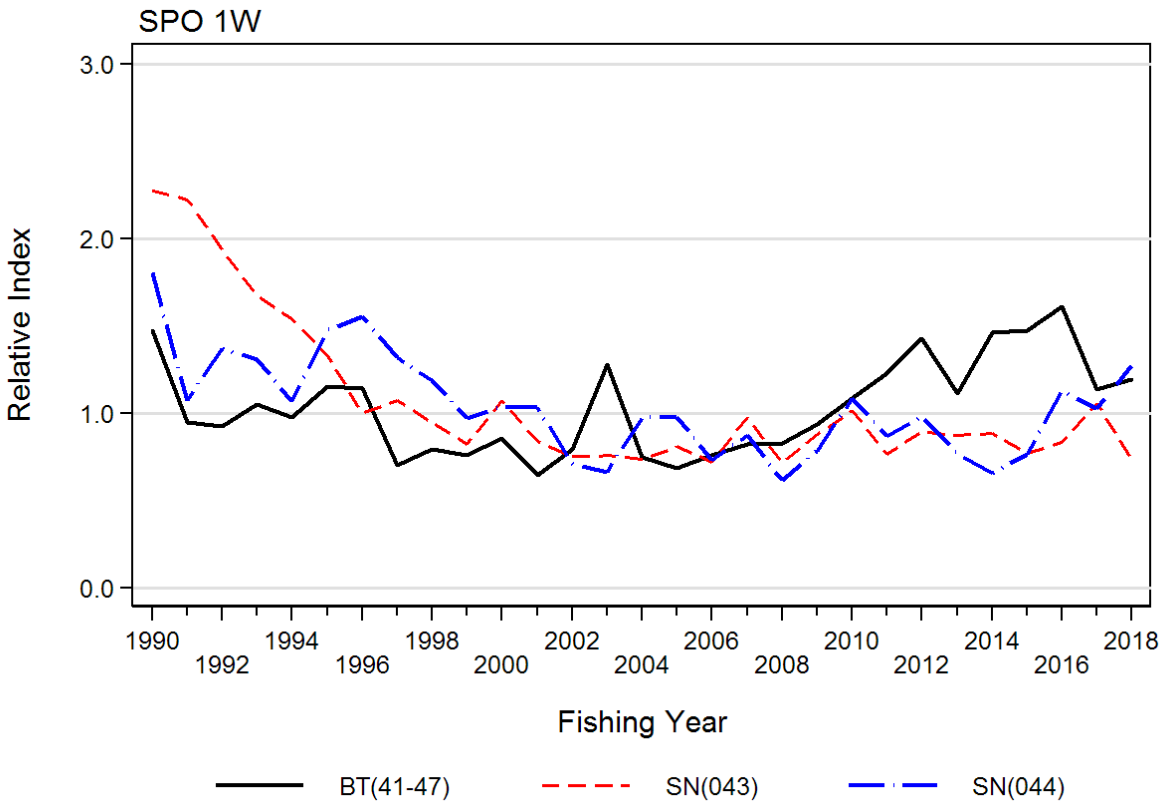



**Figure 3: Comparison of standardised CPUE for SPO 1W in three fisheries: a) target shark set net in Manukau Harbour (Area 043) [SN(043)]; b) target shark set net in Kaipara Harbour (Area 044) [SN(044)]; c) coastal bottom trawl north of Cape Egmont [BT(41-47)].**

## SPO 2

As done for the 2016 review, a trip-based bottom trawl series was used to index SPO 2 relative abundance from 1989–90 to 2017–18 (Starr & Kendrick 2019). As before, the corresponding set net analysis was not repeated due to the small amount of available data. The SPO 2 landing data, regardless of the method of capture, did not exhibit the behaviour observed in SPO 1 of landing to temporary holding receptacles. Only one SPO 2 (BT) analysis was conducted in 2019; this analysis defined the data set by selecting trips which fished exclusively in the Statistical Areas 011–015 and targeted flatfish, gurnard, or tarakihi.

The trip-based combined SPO 2 series constructed from bottom trawl data shows a gradually increasing trend from 1989–90 to 2002–03, after which the series drops to a nadir in 2009–10 (Figure 4). This is followed by an increasing trend, culminating in 2016–17, the highest level in the series and more than double the 2009–10 index. The 2017–18 index dropped 16% relative to the 2016–17 index but is still more than 50% greater than the series geometric mean. The Plenary gave the BT(trip) series an overall assessment quality rank of '1' but noted that, though the analysis was credible, the method of capture does not representatively sample large female rig.

Establishing $B_{MSY}$ compatible reference points

The Plenary agreed to use a Proxy for $B_{MSY}$ based on the average CPUE during 2005–2015, a period of relatively stable CPUE and catches.

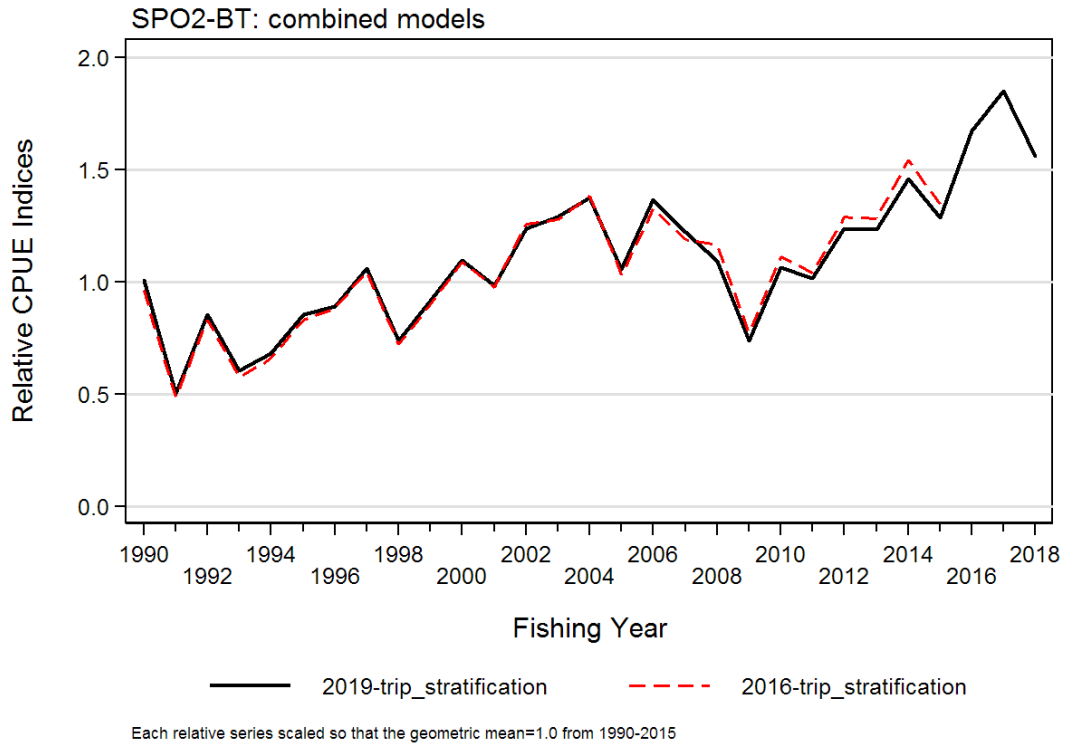



**Figure 4: Standardised combined delta-lognormal CPUE series for SPO 2 bottom trawl based on trips which landed rig from Statistical Areas 011 to 015 and targeted flatfish, red gurnard, or tarakihi up to 2017–18. Also plotted is the equivalent series from the 2016 SPO 2 review.**

## SPO 3

Rig in SPO 3 are mostly landed in the shark set net and bottom trawl fisheries directed at a range of species, with additional small amounts landed by Danish seine vessels. Two CPUE standardisations were accepted by the Working Group in 2016, one based on a shark target set net fishery (SN[SHK]) and the other based on a mixed target species (flatfish, barracouta, red cod, tarakihi, stargazer, elephant fish, and red gurnard) bottom trawl fishery (BT[All]). Two bottom trawl series had previously been constructed from the bottom trawl data, separating the target flatfish data from the target species that are taken at deeper depths. However, the switch to a trip-based analysis showed that the two SPO 3 bottom trawl fisheries (FLA and MIX) had very similar CPUE trends for rig. The SINSWG agreed that it would be advisable to perform a single analysis on the full suite of bottom trawl target species, amalgamated at the level of a trip. The final two fisheries (set net and trawl) will have different selectivities, harvesting a different size range of rig, with the set net fishery taking larger fish and the trawl fishery taking juveniles and sub-adults.

The SPO 3 landing data, regardless of the method of capture, did not exhibit the behaviour observed in SPO 1 of landing to temporary holding receptacles.

The 2019 review (Starr & Kendrick 2019) repeated the BT(All) and SN(SHK) analyses. The trawl series shows an increasing trend (1989–90 to 2017–18), whereas the SN(SHK) series fluctuates without trend (Figure 5). The point estimates for rig from the East Coast South Island (ECSI) winter trawl survey core strata largely follow the pattern of the BT(All) series, except for the 1991, 2008, and 2018 observations which show large deviations from the BT(All) series. The 2016 Plenary assigned all three indices of abundance (SN(SHK), BT(ALL), and ECSI Trawl Survey) a quality ranking of '1', but noted that the method of capture used for the BT(All) analysis and the ECSI trawl survey does not representatively sample mature rig. The 2019 review undertook an event based (tow-by-tow) standardised analysis to test whether amalgamating the data to the level of a complete trip was introducing bias. Figure 5 shows that the two series agree well in the overlapping years.

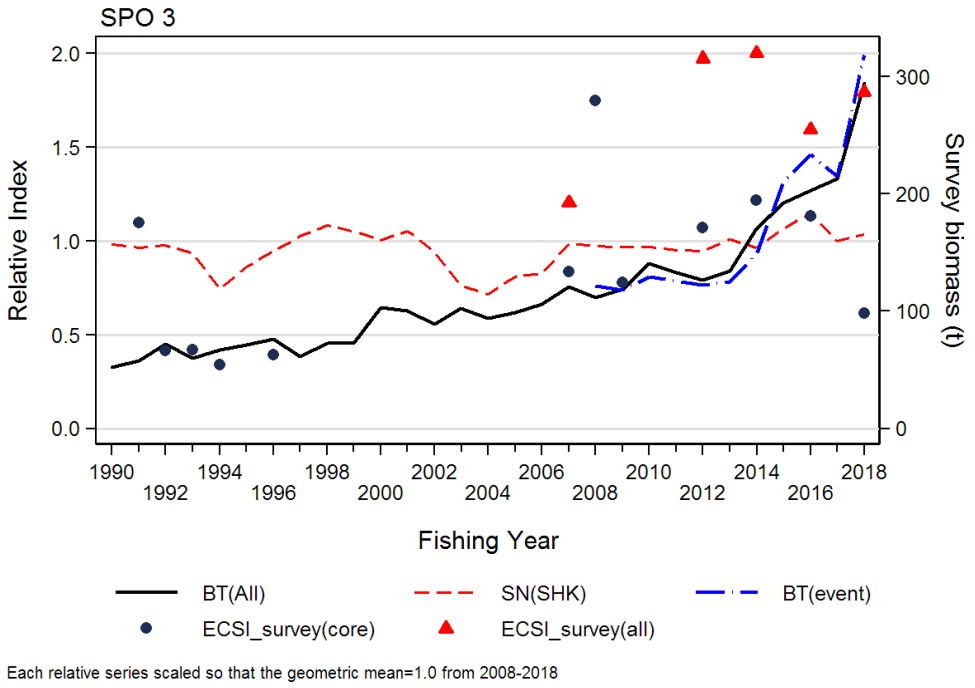



**Figure 5: Comparison of the standardised indices from the three CPUE series for SPO 3: a) BT(All): trip-based mixed target species (including flatfish) bottom trawl fishery; b) SN(SHK): target shark species setnet fishery; c) BT(event): tow-by-tow mixed target species bottom trawl data; also shown are 12 index values collected for rig from the East Coast South Island winter trawl survey core strata and combined core and shallow strata ('all').**

Biomass estimates: ECSI

Rig biomass estimates in the East Coast South Island winter trawl survey core strata (30–400 m) are generally higher in recent years compared with the 1990s (Figure 6, Table 7). The additional biomass captured in the 10–30 m depth range accounts for 30%, 46%, 39%, 29%, and 66% of the biomass in the core plus shallow strata (10–400 m) for 2007, 2012, 2014, 2016, and 2018 respectively, indicating that it is necessary to monitor the shallower strata as well as the core area for this species. This observation is particularly important for 2018: the 2018 SPO estimate in the core strata dropped nearly 50% relative to the 2016 estimate (Figure 5), whereas the total 2018 estimate, which includes the shallow strata, was greater than the equivalent 2016 estimate (Figure 6, Table 7). The core strata (30–400 m) of the ECSI winter trawl survey are not fully representative of the rig population because there is a large and variable proportion of the rig biomass inside the 30 m depth contour.

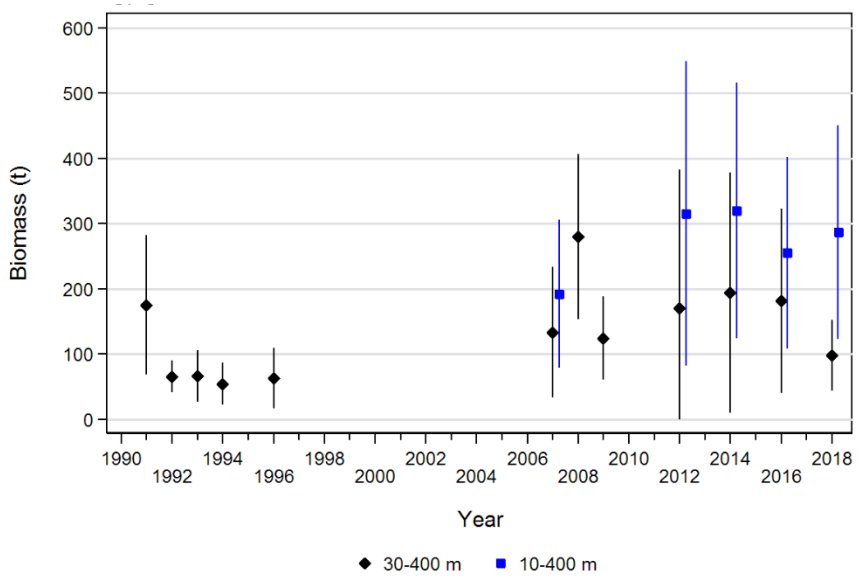



**Figure 6: Rig total biomass and 95% confidence intervals for all ECSI winter surveys in core strata (30–400 m), and core plus shallow strata (10–400 m) in 2007, 2012, 2014, 2016, and 2018.**

**Table 7: Relative biomass indices (t) and coefficients of variation (CV) for rig for the East Coast South Island (ECSI) winter survey area*. Biomass estimates for ECSI in 1991 have been adjusted to allow for non-sampled strata (7 & 9 equivalent to current strata 13, 16, and 17). – , not measured; NA, not applicable.**

| Region ECSI (winter) | Fishstock SPO 3 | Year | Trip number | Total biomass estimate | CV (%) 30–400m | Total biomass estimate | CV (%) 10–400m |
|---|---|---|---|---|---|---|---|
| | | 1991 | KAH9105 | 175 | 30 | – | – |
| | | 1992 | KAH9205 | 66 | 18 | – | – |
| | | 1993 | KAH9306 | 67 | 30 | – | – |
| | | 1994 | KAH9406 | 54 | 29 | – | – |
| | | 1996 | KAH9608 | 63 | 37 | – | – |
| | | 2007 | KAH0705 | 134 | 37 | 192 | 30 |
| | | 2008 | KAH0806 | 280 | 23 | – | – |
| | | 2009 | KAH0905 | 125 | 26 | – | – |
| | | 2012 | KAH1207 | 171 | 62 | 315 | 37 |
| | | 2014 | KAH1402 | 194 | 48 | 320 | 21 |
| | | 2016 | KAH1605 | 181 | 39 | 255 | 29 |
| | | 2018 | KAH1803 | 98 | 28 | 287 | 29 |

Length frequency distributions: ECSI

The length frequency distributions for the East Coast South Island winter trawl survey often have modes centred round 40 cm and 60 cm, most pronounced in the shallow 10–30 m depth range. These two modes correspond to pre-recruit rig of ages 1+ and 2+. Rig tend to be larger overall in the 30–100 m depth range. The survey appears to be monitoring pre-recruited cohorts (1+ and 2+) reasonably well, but probably not the full extent of the recruited size distribution, because the proportion of rig over 1 m long in the survey catch is low. Plots of time series length frequency distributions are spiky because of the low numbers caught, but the size range is reasonably consistent among surveys. The addition of the 10–30 m depth range has changed the shape of the length frequency distribution, by increasing the proportion of fish under 70 cm in the survey catch. Figure 7 demonstrates that catches from the shallow (10–30 m) strata included a higher proportion of smaller rig than those in the core (30–400 m) strata. High numbers of rig under 70 cm in both core and inshore strata in the 2012, 2014, and 2016 surveys are indicative of strong recruitment in recent years (Starr & Kendrick in 2020).

By combining length distributions across years to overcome small sample sizes, Figure 8 shows there are substantial differences in the mean length distributions between the ECSI trawl survey, the SPO 3 BT fishery, and the SPO 3 SN fishery.

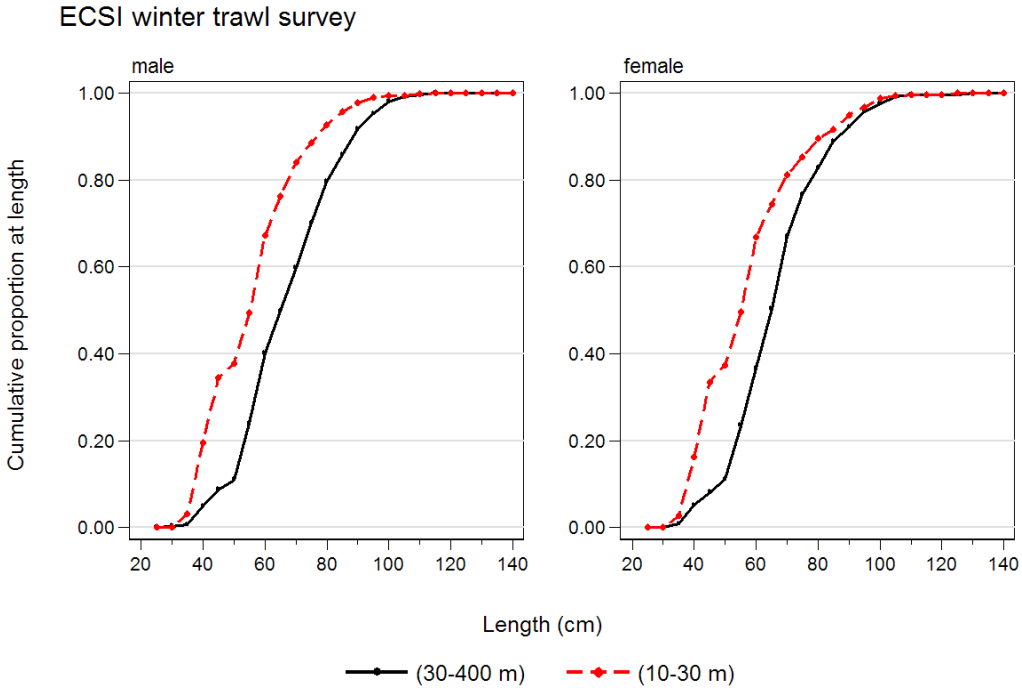



**Figure 7: Empirical cumulative frequency plots for male and female rig comparing the combined length frequencies for the core (30–400 m) and shallow (10–30 m) strata across the five years (2007, 2012–2018) with valid surveys in the shallow (10–30 m) strata.**

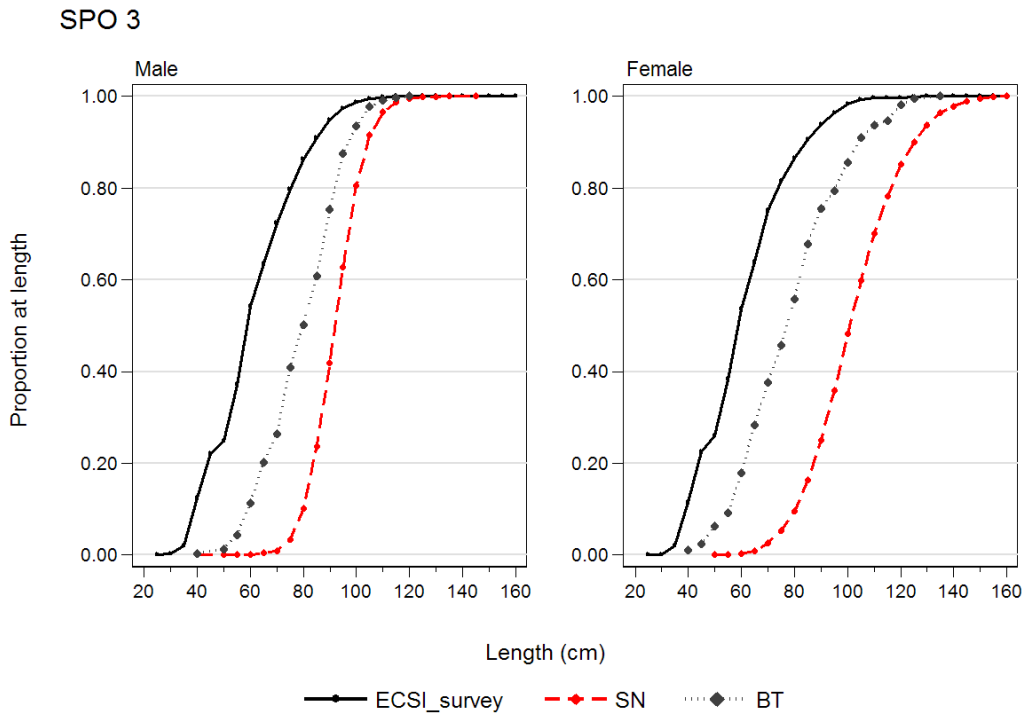



**Figure 8: Empirical cumulative frequency plots for male and female rig comparing the combined length frequencies for the total (10–400 m) ECSI trawl survey, the SPO 3 SN observer data and the SPO 3 BT observer data. The ECSI trawl survey data include 2007, 2012–2018; the SPO 3 SN observer data include 2008, 2010, 2014–2018; the SPO 3 BT observer data include 2010, 2012–2014.**

Establishing $B_{MSY}$ compatible reference points

The above conclusion that core strata (30–400 m) of the ECSI winter trawl survey are not fully representative of the rig population renders the previously selected $B_{MSY}$ proxy target reference point invalid because it was based on the core strata. The SINSWG agreed to revise the definition of the *Bmsy* proxy target reference point to be the average of the five survey years which adequately covered the 10–30 m strata (2007, 2012, 2014, 2016, and 2018). The rationale for choosing this period was that abundance was stable and catches were relatively high, indicating high surplus production. The Soft Limit will be one-half of the *Bmsy* proxy and the Hard Limit will be one-quarter of the *Bmsy* proxy.

## SPO 7

CPUE analyses standardising set net and bottom trawl catches for core vessels were undertaken in 2016 to assess relative abundance of rig in SPO 7. Two of these analyses were updates of analyses previously accepted by the Working Group: 1) set net fishery in Statistical Area 038 targeting rig, spiny dogfish, and school shark [SN(038)]; and 2) bottom trawl fishery in Statistical Areas 016–018, 032–037, 038, 039, and 040 targeting flatfish, red cod, rig, barracouta, tarakihi, red gurnard, snapper, blue warehou, and trevally [BT(ALL)]. An analysis of the set net fishery in Statistical Areas 032–037 was rejected by the SINSWG in 2015 (after being accepted in the 2006–2013 analyses) because of lack of sufficient data to create a reliable index. This lack is attributed to the movement of ACE to other SPO 7 fisheries and the management regulations imposed to protect Hector's dolphins. Examination of the distribution of set net effort off the west coast of the South Island showed that there had been a substantial decline in the number of vessels operating in these statistical areas since 2005–06, with less than 2% of the set net fishery catches originating from statistical areas other than 038 during 2015–16 to 2017–18. In 2016, an alternate set net fishery analysis was trialed (SN[STB]), covering the statistical areas of the South Taranaki Bight (037, 039, and 040). This was done after examining the fine scale spatial distribution of catches in these three statistical areas, showing that most of the catch came from the coastal section of South Taranaki Bight. This analysis also showed there was catch in Statistical Area 037 on the line separating Statistical Areas 037 and 038 (between D'Urville Island and Farewell Spit) which may belong more logically to the Statistcal Areas 038 analysis. However, spatial data at this level of detail are not available before October 2007 from the earlier daily forms. The SN(STB) series was

rejected by the 2016 Plenary (quality ranking of '3') on account of the impact the dolphin closures have had on this fishery.

The SPO 7 landing data, regardless of the method of capture, did not exhibit the behaviour of landing to temporary holding receptacles observed in SPO 1.

The 2019 review (Starr & Kendrick 2019) repeated the BT(All) and SN(038) analyses. The SN(038) index, which was assigned a quality ranking of '1', showed a continuous declining trend from the beginning of the series to a low in the mid-2000s, approximately coincident with the lowering of the SPO 7 TACC. This low point was followed by an increasing trend to a peak in 2010–11, after which the series has varied about the series mean, with the 2016–17 index 14% above the mean and the 2017–18 index 9% below the mean (Figure 8).

The BT(ALL) series (also with a quality ranking of '1') shows an increasing trend since the mid-2000s, with low points observed in both 2004–05 and 2006–07, but has since more than doubled to reach the highest point in the series in 2016–17, followed by a 10% drop in 2017–18. The Plenary noted that the BT(All) index does not adequately sample large female rig. The 2019 review also implemented an event-based (tow-by-tow) standardised analysis to test whether amalgamating the data to the level of a complete trip was introducing bias. Figure 9 shows that two series agree well in the overlapping years.

Although large rig are not effectively targeted with bottom trawl gear, the WCSI trawl survey is believed to provide reliable indices of the relative biomass of males and younger females in SPO 7. Relative biomass declined by more than 50% between 1995 and 2005, and subsequently increased to a stable level from 2007 to 2013. It then increased sharply in 2015, with total biomass remaining high in the 2017 survey, but dropped relative to the 2015 index (Figure 10, Table 8).

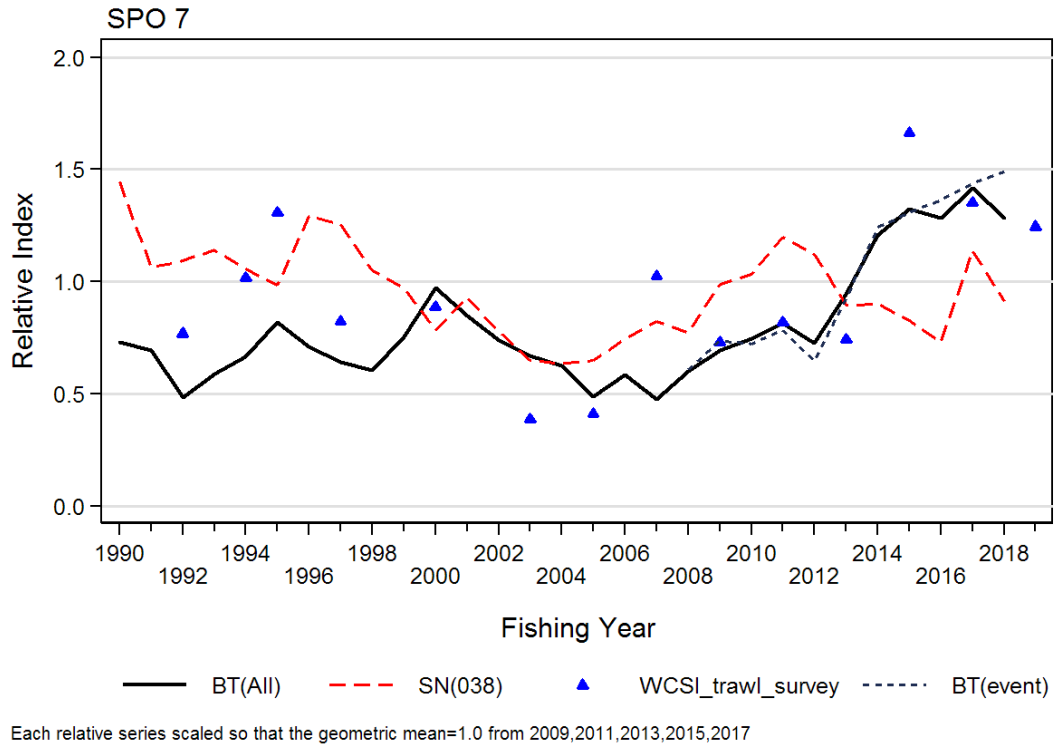



**Figure 9: Comparison of three SPO 7 standardised CPUE series: a) bottom trawl fishery (mix of targets in all SPO 7) [BT(ALL)]; b) shark target set net fishery in Tasman Bay/Golden Bay [SN(038)]; c) BT(event): tow-by-tow mixed target species bottom trawl data. Also shown are rig index values from the West Coast South Island (WCSI) trawl survey: 1992–2019. The 2019 survey index is preliminary.**

**Table 8: Relative biomass indices (t) and coefficients of variation (CV) for rig for the west coast South Island (WCSI) trawl survey.**

| Survey | Fishstock | Year | Trip number | Total biomass (t) | CV (%) |
|---|---|---|---|---|---|
| WCSI | SPO 7 | | | | |
| | | 1992 | KAH9204 | 288 | 14 |
| | | 1994 | KAH9404 | 380 | 10 |
| | | 1995 | KAH9504 | 490 | 11 |
| | | 1997 | KAH9701 | 308 | 18 |
| | | 2000 | KAH0004 | 333 | 18 |
| | | 2003 | KAH0304 | 144 | 22 |
| | | 2005 | KAH0503 | 153 | 19 |
| | | 2007 | KAH0704 | 383 | 33 |
| | | 2009 | KAH0904 | 274 | 26 |
| | | 2011 | KAH1104 | 307 | 18 |
| | | 2013 | KAH1305 | 278 | 20 |
| | | 2015 | KAH1503 | 622 | 27 |
| | | 2017 | KAH1703 | 506 | 33 |
| | | 2019 | KAH1902 | 467 | 14 |

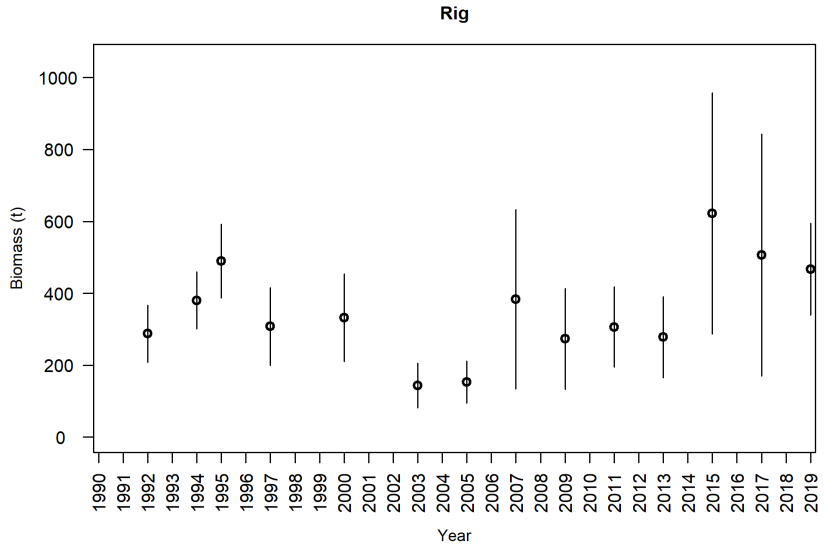



**Figure 10: Plots of biomass estimates (t) for rig from the West Coast South Island trawl survey by year. Error bars are ± two standard deviations.**

West Coast South Island inshore trawl survey

Although not optimised for rig, the West Coast South Island inshore trawl survey still provides useful abundance indices (Table 8, Figure 10). Stevenson & Hanchet (2000) reported that the survey is likely to provide a reasonable index of abundance for juveniles and pre-recruits less than 90 cm (Stevenson 2007). The depth range of the core survey (20–400 m) is suitable for rig but the lack of larger female rig in the length frequency distribution from the trawl survey suggests they may not be well sampled as noted by Stevenson & Hanchet (2000), but that pre-recruit and adult males are well sampled.

Total biomass has been relatively steady over time but has increased in recent years with the last three surveys having three of the four highest estimates in the time series.

Length frequency distributions of rig show that distinct modes can be present in some years particularly for 0+ fish under 40 cm (e.g. 2007, 2011, 2013, and 2019) (Figure 11). Several distinct year classes are visible in some years (e.g., 2011). The distributions show that 0+ fish are relatively common in Tasman Bay and Golden Bay (e.g., 2007, 2009, 2017) but these fish are in some years present in strong numbers off the west coast as well (e.g., 2011, 2019).

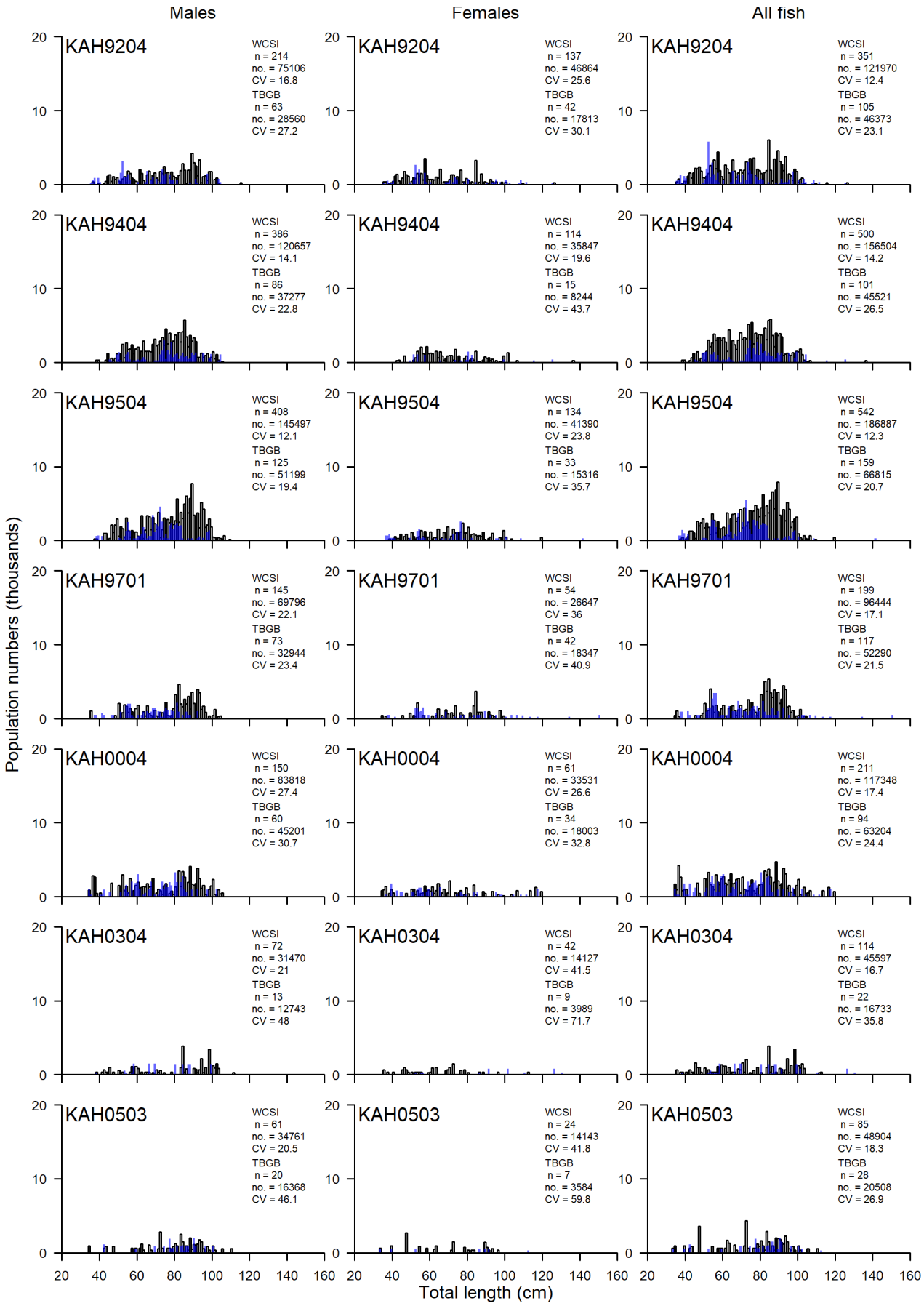



**Figure 11: Scaled population length frequencies for rig from the West Coast South Island inshore trawl survey time series core strata (20–400 m). Blue bars represent strata from Tasman Bay and Golden Bay, black bars represent the west coast of the South Island strata.**

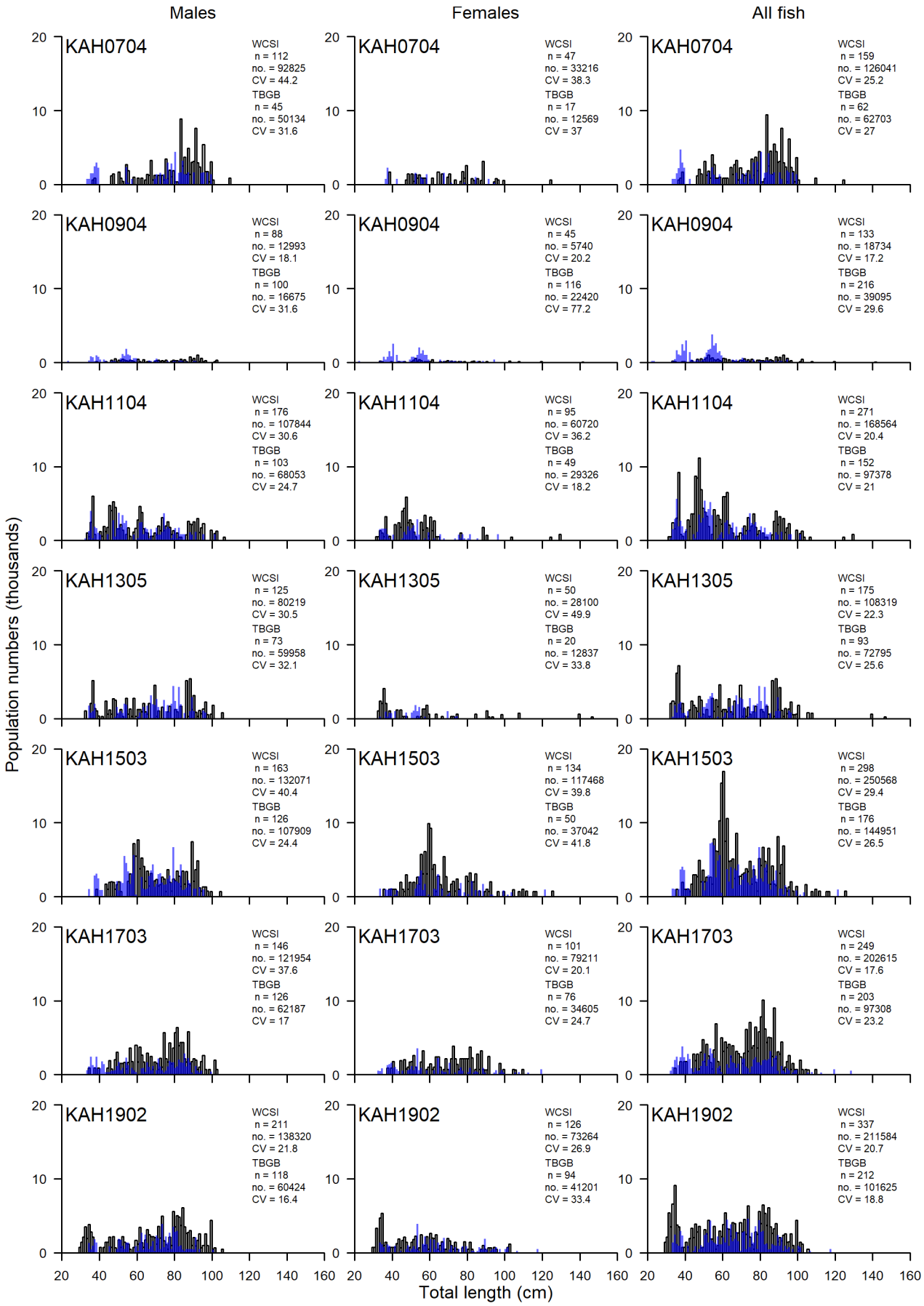



**Figure 11 [Continued]**

By combining length distributions across years to overcome small sample sizes, Figure 12 shows there are differences in the mean length distributions between the WCSI trawl survey and the SPO 7&8 BT fishery, with the latter being larger than the former. Unfortunately, SN was only sampled in one year in SPO 7&8 by observers and the resulting length distribution seems small compared with unpublished length frequency data available from the SPO 7 Adaptive Management Programme for the same fishery (Starr et al. 2010).

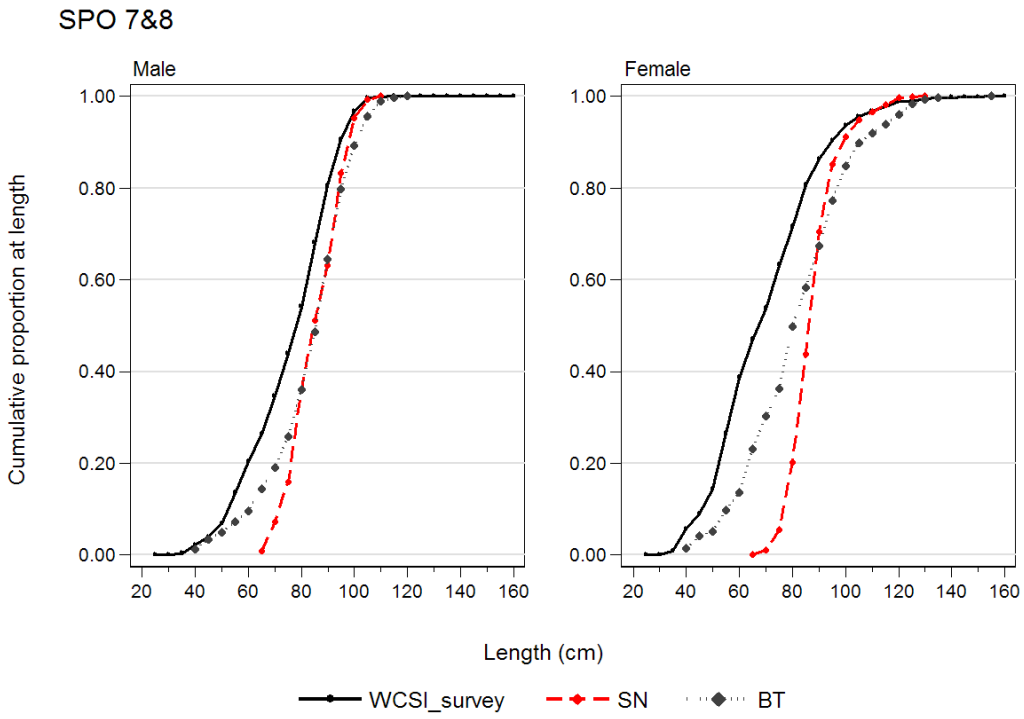



**Figure 12: Empirical cumulative frequency plots for male and female rig comparing the combined length frequencies for the WCSI trawl survey, the SPO 7&8 SN observer data and the SPO 7&8 BT observer data. The WCSI trawl survey data include 2007, 2009, 2011, 2013, 2015, and 2017; the SPO 7&8 SN observer data only include a single year of sampling in 2008 from Area 038; the SPO 7&8 BT observer data include 2010, 2011 and 2012.**

Establishing $B_{MSY}$ compatible reference points

The Working Group agreed to use the two lowest survey biomass values (2003 and 2005: see Table 8) as a proxy for the SPO 7 Soft Limit. This definition establishes the $B_{MSY}$ proxy target reference point as twice the average 2003–2005 biomass level and the Hard Limit as one-half the average 2003–2005 biomass level. These are based on the definitions from the default Harvest Strategy Standard where the Soft and Hard Limits are one-half and one-quarter the target, respectively.

## SPO 8

SPO 8 landings are primarily from a set net fishery that operates along the coast from Kapiti to beyond New Plymouth. The SPO 8 bottom trawl fishery operates further offshore in the North and South Taranaki bights and takes rig as a bycatch in fisheries targeted at tarakihi, snapper, and red gurnard. Recent average set net landings in SPO 8 have been between 150 and 200 t per year, whereas bottom trawl landings average between 10 and 30 t per year. The SPO 8 landing data, regardless of the method of capture, did not exhibit the behaviour of landing to temporary holding receptacles.

The CPUE analyses previously completed for SPO 8 have been discontinued by agreement of the SINSWG. The SPO 8 BT analysis consisted of four Statistical Areas (037, 039, 040, and 041), three of which were also used in the SPO 7_BT(All) analysis. Examination of the spatial distributions of the Statistical Area 041 set net and bottom trawl catches indicated that rig catches in this area merge seamlessly with the equivalent catches in Statistical Area 042, immediately to the north of Statistical Area 041. As a result, it was decided that Statistical Area 041 should be amalgamated with the SPO 1W

coastal bottom fishery, adding much needed data to these analyses. A new fishery to monitor the South Taranaki Bight was constructed from the remaining statistical areas that were included in the discontinued SPO 8_SN fishery, but this analysis was not accepted by the 2016 Plenary because of the disappearance of the set net fishery in all statistical areas other than Statistical Area 038 (Tasman Bay/Golden Bay).

### 4.2 Other factors

Stock mixing occurs in the South Taranaki Bight to the Cook Strait and South Westland regions, and probably elsewhere. Some regional fisheries therefore exploit more than one stock. This means that biological stock boundaries do not necessarily coincide with QMA boundaries. Consequently, management by quota within Fishstocks may be sub-optimal for individual stocks.

The use of small mesh commercials set nets (125 mm) in the Auckland FMA probably results in a large proportion of the rig catch being immature fish. Elsewhere, the minimum size is 150 mm.

There have been several changes to the rig conversion factors over the period that SPO has been managed within the QMS. The trend has been towards lower conversion factors. Although researchers correct catches for these changes when undertaking CPUE analyses, this has not been done for total landings reported in this Working Group Report. These changes reduce the relative effect of catches in recent years compared with early years, e.g., if actual catch had been constant it would appear to be declining.

## 5. STATUS OF THE STOCKS

A review of stock structure in 2009 concluded that the existing QMAs were suitable for rig management, although the boundaries between biological stocks were poorly defined, especially in the Cook Strait region (Francis 2010).

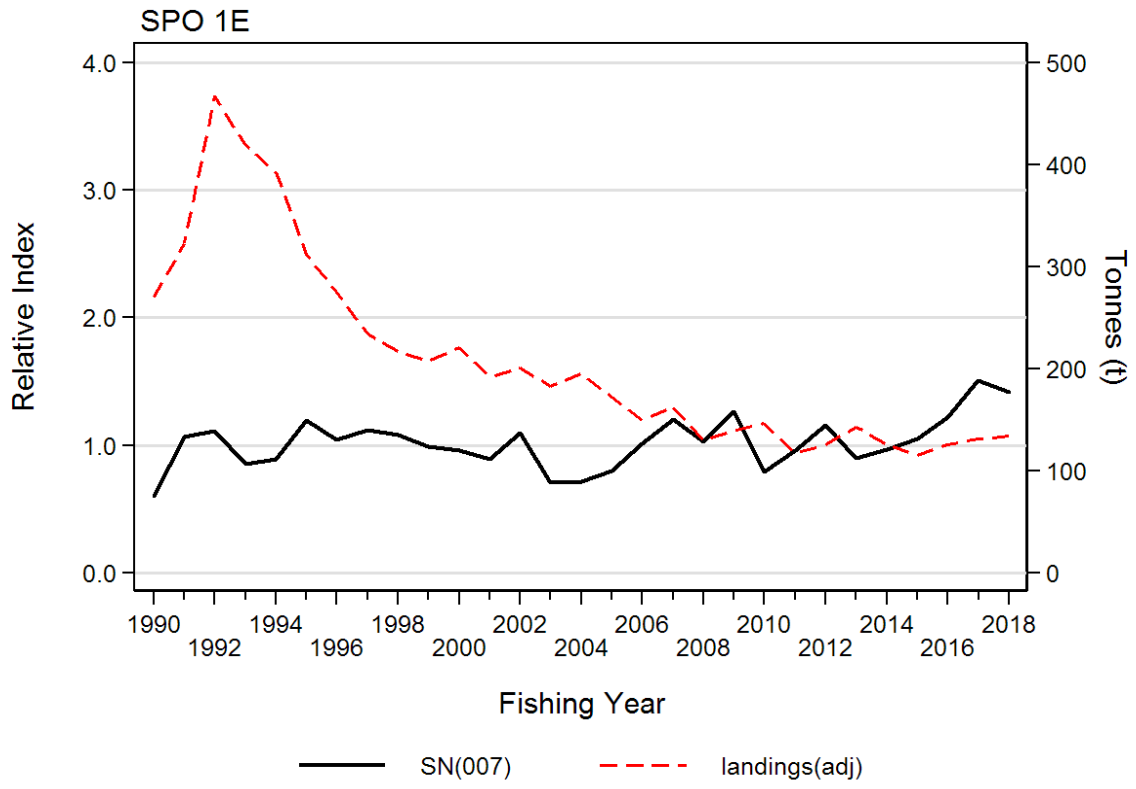
- **SPO 1**

**Stock Structure Assumption**

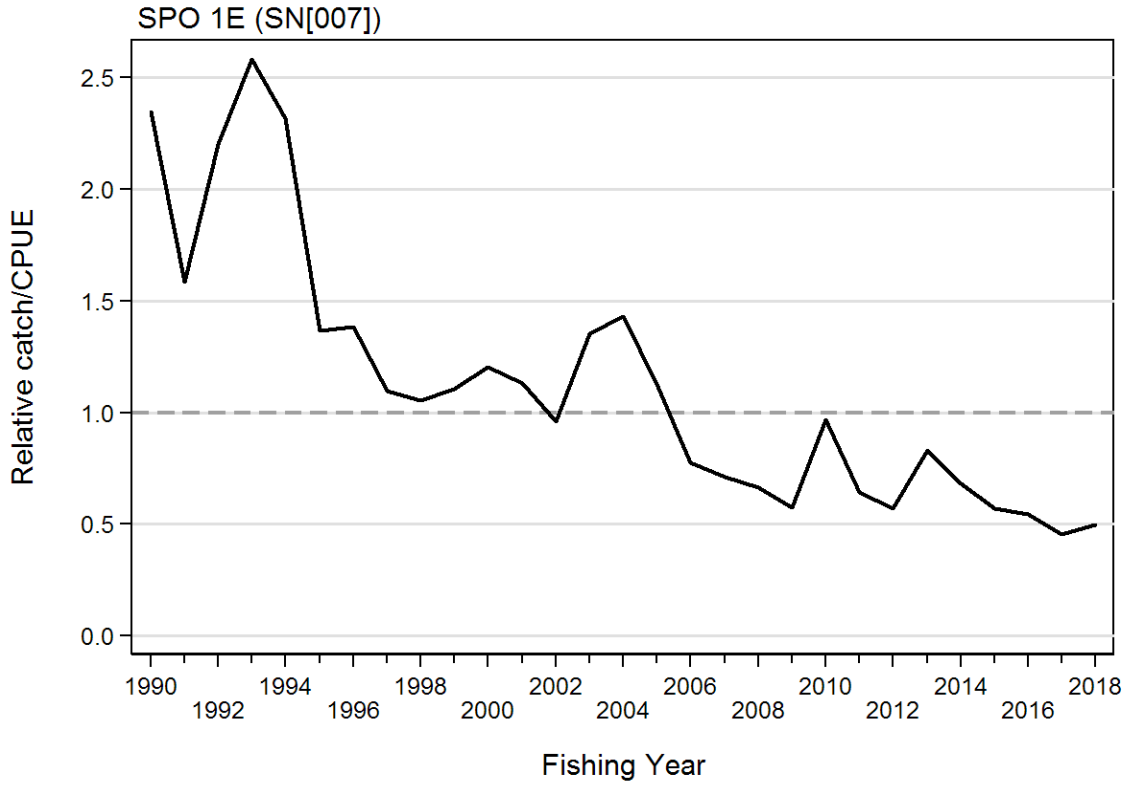
For the purposes of this summary SPO 1E is defined as the sum of Statistical Areas 002 to 010 and is treated as a discrete stock. SPO 1W is defined as the sum of Statistical Areas 041 to 048 and is treated as a discrete stock. It is not known if the rig stocks on the west and east coasts of the North Island are separate.

| **Stock Status** | |
|---|---|
| Year of Most Recent Assessment | 2019 |
| Assessment Runs Presented | Standardised CPUE index:<br>SPO 1E: SN(007)<br>SPO 1W: BT(41-47), SN(043), SN(044) |
| Reference Points | Target (1E and W): 40% $B_0$<br>Soft Limit: 20% $B_0$<br>Hard Limit: 10% $B_0$<br>Overfishing threshold: $F_{MSY}$ |
| Status in relation to Target | 1E and 1W: Unknown |
| Status in relation to Limits | 1E and 1W<br>Soft Limit: Unknown<br>Hard Limit: Unknown |
| Status in relation to Overfishing | 1E and 1W: Unknown |

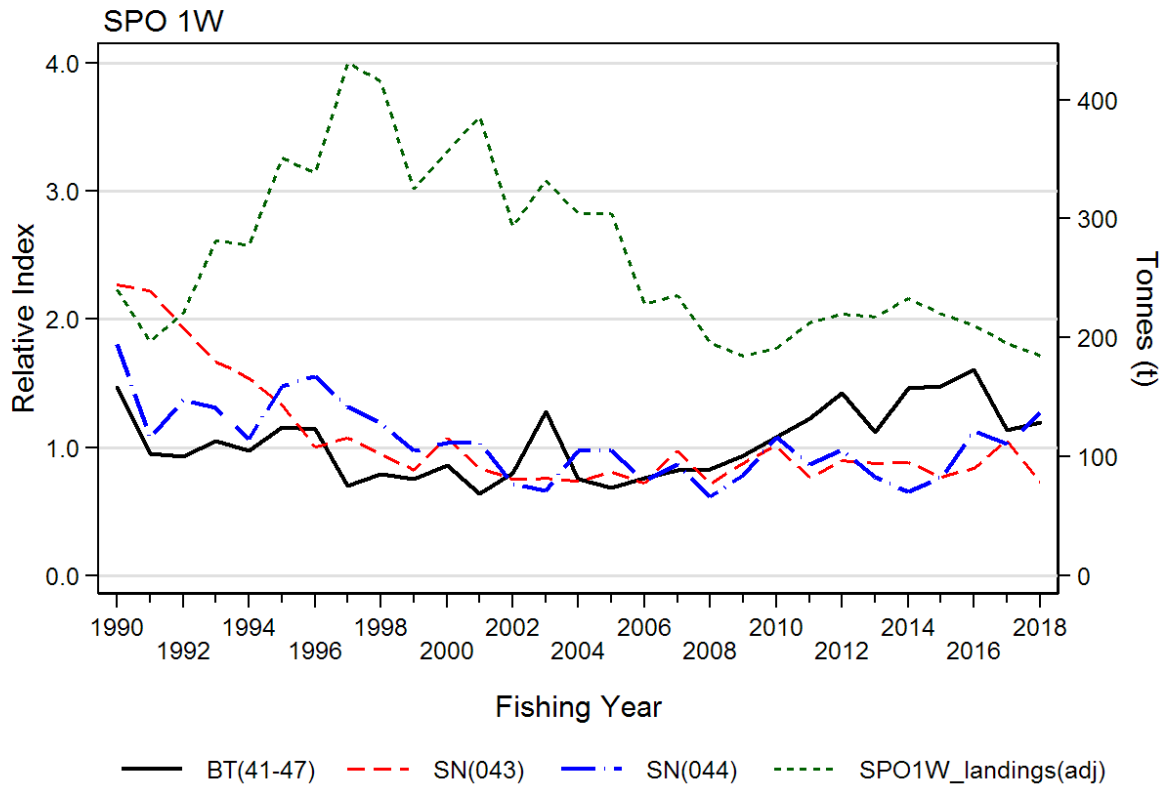
**Historical Stock Status Trajectory and Current Status**



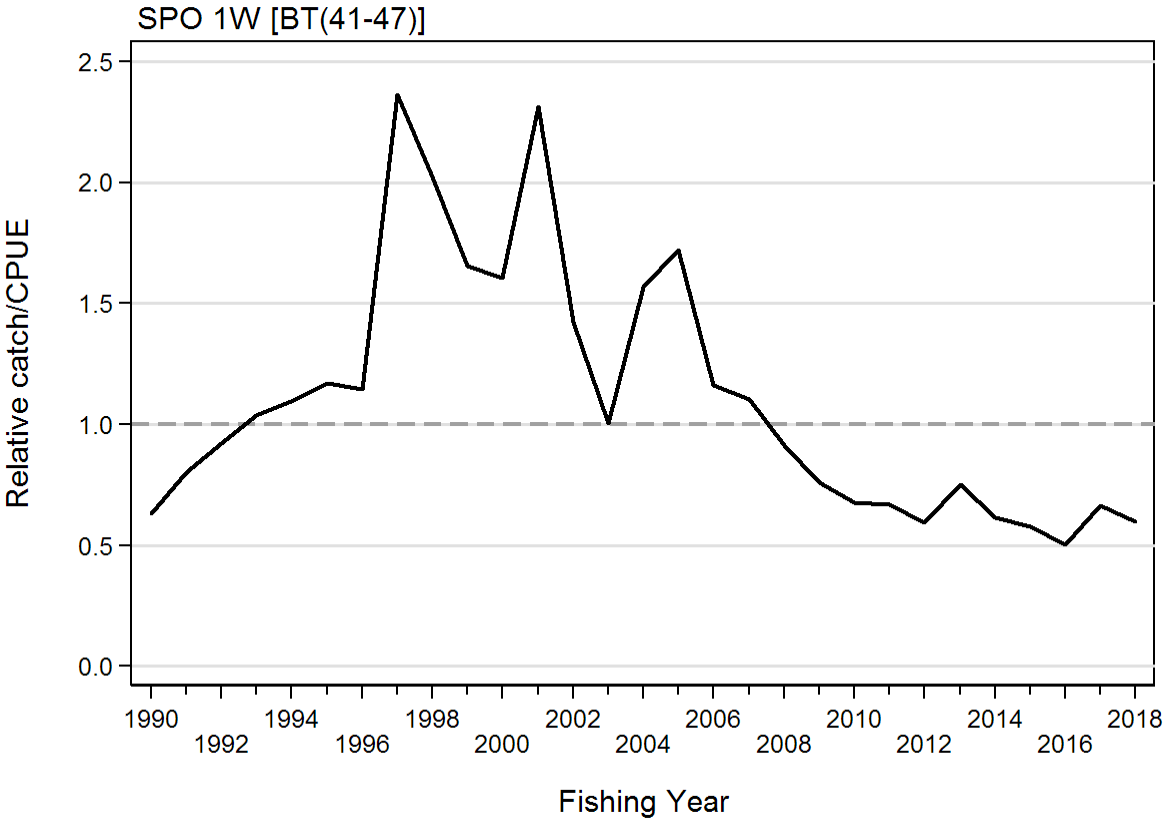

**Accepted CPUE indices for SN(007) with the adjusted QMR/MHR landings for SPO 1E. Adjustments were made to ensure that all values in every year are based on a common conversion factor.**




**Relative fishing pressure for SPO 1E based on the ratio of QMR/MHR (adj) landings relative to the SN(007) CPUE series. Each series has been normalised so that its geometric mean=1.0 for all common years.**




**Comparison of three accepted CPUE indices [SN(043), SN(044), BT(41-47)] with the adjusted QMR/MHR landings for SPO 1W. Adjustments were made to ensure that all values in every year are based on a common conversion factor.**




**Relative fishing pressure for SPO 1W based on the ratio of QMR/MHR (adj) landings relative to the BT(41-47) CPUE series.**

| Fishery and Stock Trends | |
|---|---|
| Recent Trend in Biomass or Proxy | 1E: Adult biomass (as indexed by the set net fishery in Statistical Area 007) has fluctuated without trend since 1990.<br>1W: The coastal BT series is relatively flat from 1990 to the late 2000s, but showed a strong upturn around 2008, which peaked in 2015 and has since dropped; the SN(043 Manukau harbour) series shows a strong decline in the early portion of the series while the SN(044 Kaipara harbour) series showed a modest decline through the 1990s. Both set net indices have been relatively stable, fluctuating below the series mean since the early 2000s. |
| Recent Trend in Fishing Intensity or Proxy | 1E: Fishing intensity (as indexed by the set net fishery in area 007) appears to have been declining since the mid-1990s.<br>1W: The coastal BT series indicates that fishing intensity increased to relatively high levels from the late 1990s to the early 2000s and has been declining to relatively low levels since |
| Other Abundance Indices | - |
| Trends in Other Relevant Indicators or Variables | - |

| Projections and Prognosis | |
|---|---|
| Stock Projections or Prognosis | Unknown |
| Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits | Soft Limit: Unknown (Catch)<br>Hard Limit: Unknown (Catch)<br>Since current catches are well below the TACC, it is Unknown if the TACC will cause the stock to decline. |
| Probability of Current Catch or TACC causing Overfishing to continue or to commence | Unknown |

| Assessment Methodology and Evaluation | | |
|---|---|---|
| Assessment Type | Level 2 - Partial Quantitative Stock Assessment | |
| Assessment Method | Fishery characterisation and standardised CPUE analysis | |
| Assessment Dates | Latest assessment: 2019 | Next assessment: 2022 |
| Overall assessment quality rank | 1E: 2 – Medium or mixed quality: decline in catch should have resulted in an increase in CPUE<br>1W: 1 – High Quality | |
| Main data inputs (rank) | 1E:<br>Set net CPUE series: target shark in Area 007 (Firth of Thames) | 2 – Medium or mixed quality: series only indexes a small proportion of area 1E |
| | 1W:<br>Bottom trawl CPUE series: mixed target species (Areas 042, 045–048) | 1 – High Quality |
| | Setnet CPUE series: target shark in Area 043 (Manukau Harbour) | 2 – Medium or Mixed Quality: series only indexes a small proportion of area 1W |
| | Setnet CPUE series: target shark in Area 044 (Kaipara Harbour) | 2 – Medium or Mixed Quality: series only indexes a small proportion of area 1W |

| | | |
|---|---|---|
| Data not used (rank) | 1E:<br>Bottom trawl CPUE series: mixed target species (Areas 002–010)<br>Setnet CPUE series: target shark (Areas 002–006 and 008–010)<br>1W:<br>Setnet CPUE series: shark target species (Areas 041–047) | <br><br>3 – Low Quality: few data<br><br>3 – Low Quality: few data<br><br>3 – Low Quality: regulatory changes appear to have had significant impact |
| Changes to Model Structure and Assumptions | - | |
| Major Sources of Uncertainty | - Contradictory trends in the bottom trawl and setnet CPUE indices<br>- Lack of historical information relating to stock abundance during the 1970s–1980s when the stock was believed to have been heavily fished means that the current relative stock status is difficult to determine<br>- BT CPUE series may not index large mature females | |

| **Qualifying Comments** |
|---|
| The accepted BT(coast) CPUE series (SPO 1E) and BT(41-47) (SPO 1W) do not sample large mature females in the rig population. |

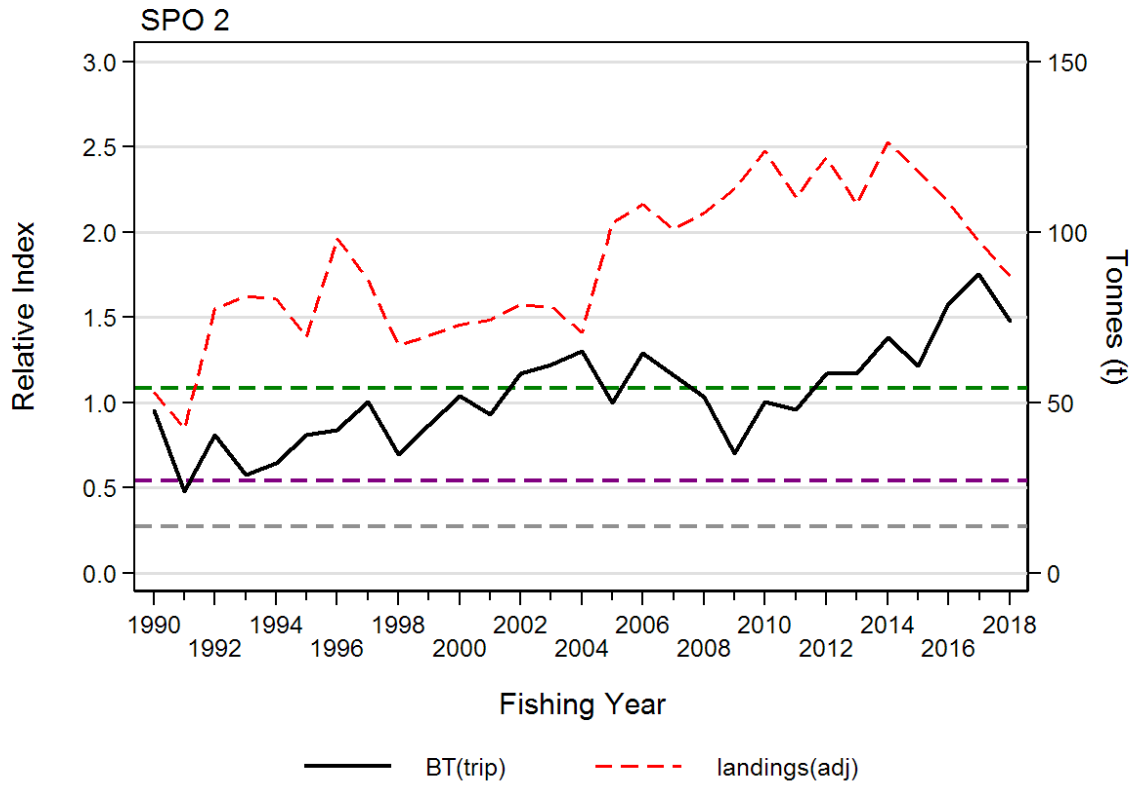
| **Fishery Interactions** |
|---|
| Rig are taken as a bycatch in bottom trawl fisheries targeted mainly at snapper, tarakihi, gurnard, John dory, barracouta, trevally (SPO 1E) while the setnet fisheries are almost exclusively targeted at rig in both SPO 1E and SPO 1W. Interactions with other species are currently being characterised. |

- **SPO 2**

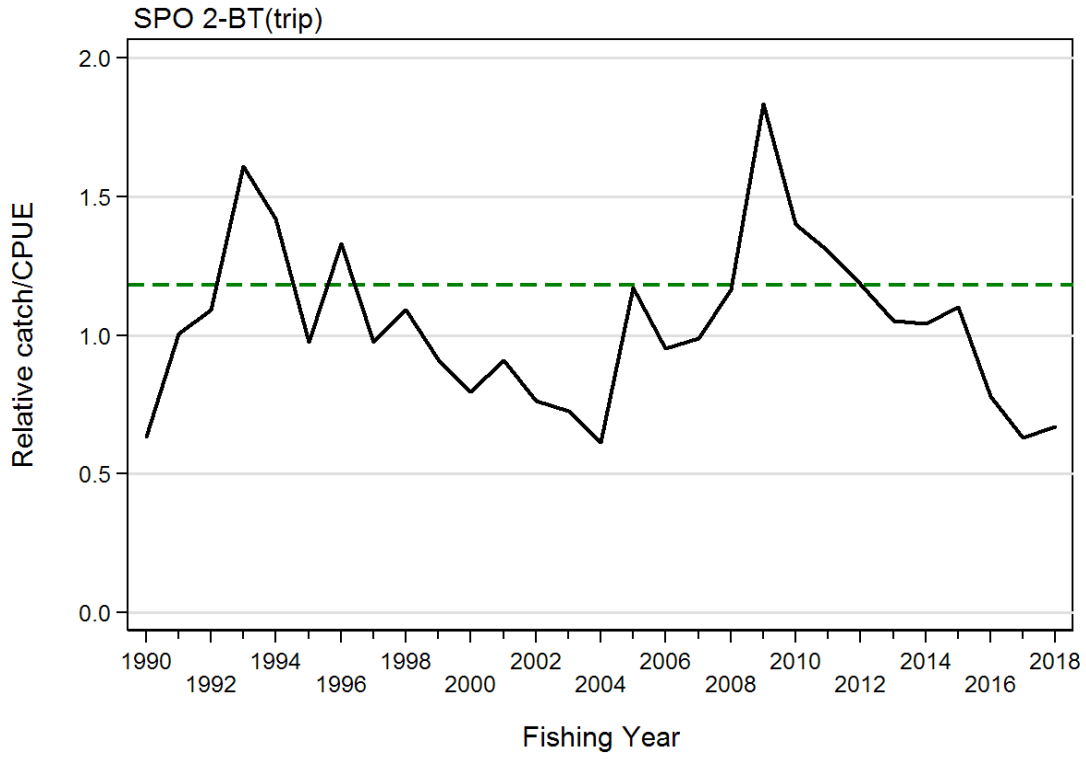
**Stock Structure Assumption**
For the purposes of this summary SPO 2 is defined as the sum of Statistical Areas 011 to 015 and is treated as a discrete stock.

| **Stock Status** | |
|---|---|
| Year of Most Recent Assessment | 2019 |
| Assessment Runs Presented | Standardised CPUE: BT(stat area) |
| Reference Points | Target: Proxy for $B_{MSY}$ based on the average CPUE during the period 2005–2015, a period of relatively stable CPUE and catches<br>Soft Limit: 50% of the target<br>Hard Limit: 50% of the soft limit<br>Overfishing threshold: $F_{MSY}$; assumed to be the average fishing intensity over the period 2005–2015 |
| Status in relation to Target | Likely (> 60%) to be at or above the target |
| Status in relation to Limits | Soft Limit: Unlikely (< 40%) to be below the soft limit<br>Hard Limit: Very Unlikely (< 10%) to be below the hard limit |
| Status in relation to Overfishing | Overfishing is Unlikely (< 40%) to be occurring |

**Historical Stock Status Trajectory and Current Status**




**Comparison of the accepted CPUE index [BT] with the adjusted QMR/MHR landings for SPO 2. Adjustments were made to ensure that all values in every year are based on a common conversion factor. The agreed $B_{MSY}$ proxy (average: 2005–2015) target is shown as a green line, the Soft Limit is shown as a purple line, and the Hard Limit is shown as a grey line.**




**Relative fishing pressure for SPO 2 based on the ratio of QMR/MHR (adj) landings relative to the [BT] CPUE series. This series has been normalised so that its geometric mean=1.0.**

| Fishery and Stock Trends | |
|---|---|
| Recent Trend in Biomass or Proxy | Biomass has increased strongly since 2009. |
| Recent Trend in Fishing Intensity or Proxy | Relative fishing intensity increased from 1990 to 1993, declined to 2004, increased to 2009 and has since declined to below the series average in 2017 and 2018. |
| Other Abundance Indices | - |
| Trends in Other Relevant Indicators or Variables | - |

| Projections and Prognosis | |
|---|---|
| Stock Projections or Prognosis | Current catches are Unlikely (< 40%) to cause the stock to decline |
| Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits | Current catches are Unlikely (< 40%) to cause the stock to decline below the soft or hard limits |
| Probability of Current Catch or TACC causing Overfishing to continue or to commence | Unlikely (<40%) |

| Assessment Methodology and Evaluation | | |
|---|---|---|
| Assessment Type | Level 2 - Partial Quantitative Stock Assessment | |
| Assessment Method | Fishery characterisation and standardised CPUE analysis | |
| Assessment Dates | Latest assessment: 2019 | Next assessment: 2022 |
| Overall assessment quality rank | 1 – High Quality | |
| Main data inputs (rank) | Bottom trawl CPUE series: trip-based analysis | 1 – High Quality |
| Data not used (rank) | The set net CPUE analysis up to 2009–10 | 3 – Low Quality: This series was not updated in 2016 (not ranked in 2011) as there were insufficient data to produce a reliable index of abundance |
| Changes to Model Structure and Assumptions | | |
| Major Sources of Uncertainty | - Lack of historical information relating to stock abundance during the 1970s–1980s when the stock was believed to have been heavily fished means that the current relative stock status is difficult to determine<br>- BT CPUE series may not index large mature fish | |

| Qualifying Comments |
|---|
| The accepted BT(statarea) CPUE series does not adequately sample large mature fish in the rig population; the Working Group agreed that the setnet series was not credible due to lack of data, poor vessel overlap, and the fact that the set net fishery targets a mixed group of species, including blue moki and blue warehou. |

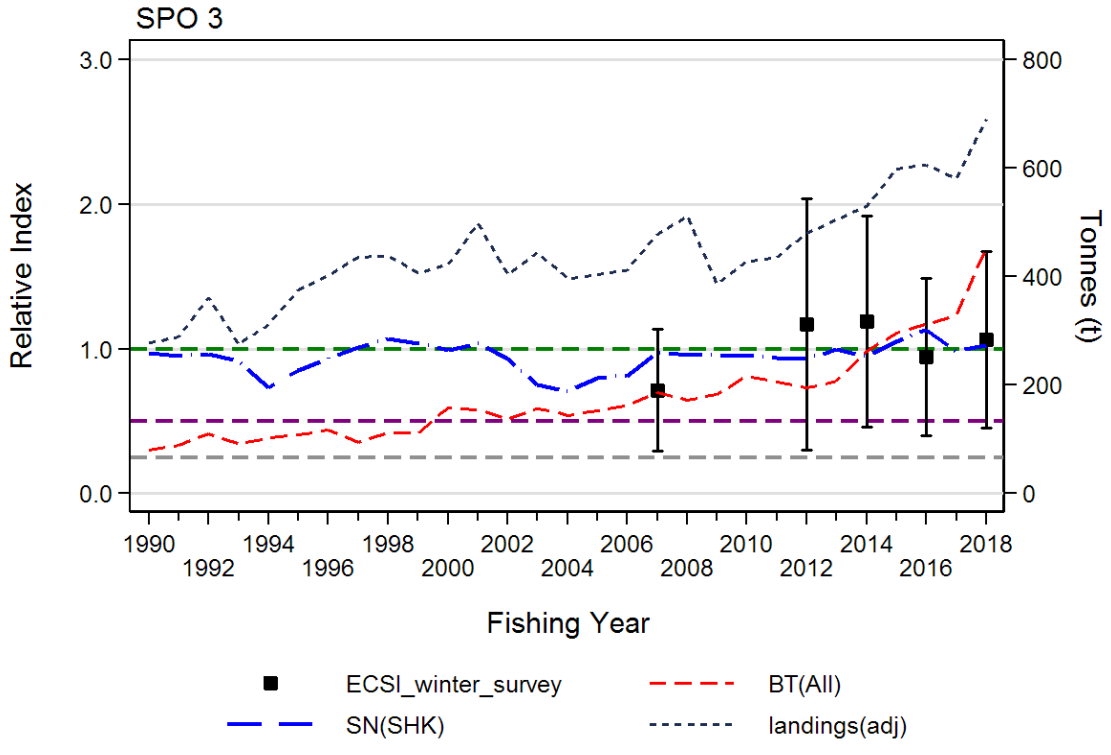
| Fishery Interactions |
|---|
| Rig are taken as a bycatch in bottom trawl fisheries targeted mainly at flatfish, tarakihi and gurnard while the setnet fisheries target rig, school shark, flatfish, blue warehou and blue moki. Interactions with other species are currently being characterised. |

- **SPO 3**

**Stock Structure Assumption**
For the purposes of this summary SPO 3 is defined as the sum of Statistical Areas 018 to 032 and areas 049 to 052 and is treated as a discrete stock.

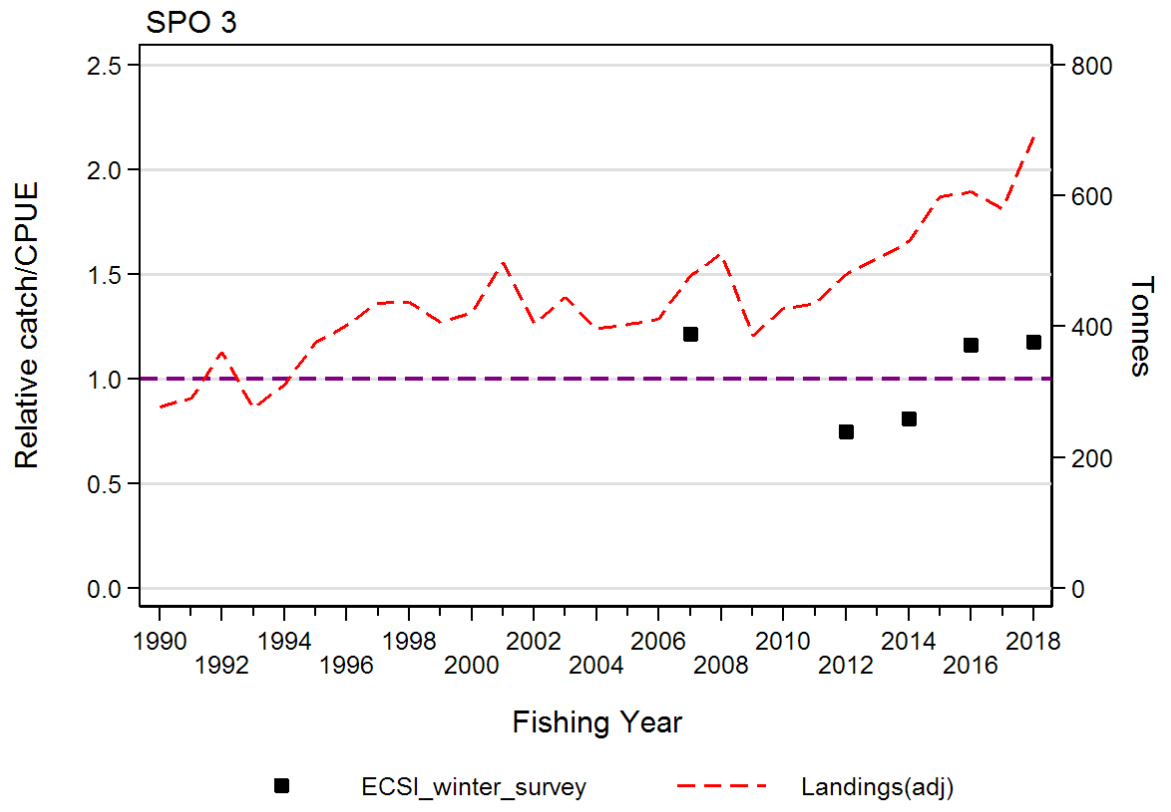
| **Stock Status** | |
|---|---|
| Year of Most Recent Assessment | 2019 |
| Assessment Runs Presented | ECSI trawl survey and two standardised CPUE indices: SN(SHK) and BT(All) |
| Reference Points | Target: Proxy for $B_{MSY}$ based on average ECSI trawl survey (all strata) indices for the period 2007 - 2018<br>Soft Limit: Half the Bmsy proxy<br>Hard Limit: 25% of the Bmsy proxy<br>Overfishing threshold: $F_{MSY}$, assumed to be the average fishing intensity for the 2007-2018 survey indices |
| Status in relation to Target | About as Likely as Not (40–60%) to be at or above the target |
| Status in relation to Limits | Soft Limit: Very Unlikely (< 10%) to be below the soft limit<br>Hard Limit:Very Unlikely (< 10%) to be below the hard limit |
| Status in relation to Overfishing | Overfishing is About as Likely as Not (40–60%) to be occurring |

**Historical Stock Status Trajectory and Current Status**




Each relative series scaled so that the geometric mean=1.0 from 2007,2012,2014,2016,2018

**Comparison of the East Coast South Island (ECSI) trawl survey (all strata) with two accepted CPUE indices [BT(All) and SN(SHK)] and with the adjusted QMR/MHR landings for SPO 3. Adjustments were made to ensure that all values in every year are based on a common conversion factor. The agreed $B_{MSY}$ proxy (average: 2007, 2012, 2014, 2016, 2018 ECSI survey biomass estimates) is shown as a green line, and the calculated Soft Limit (= 0.5 x $B_{MSY}$ proxy) is shown as a purple line and the calculated Hard Limit (=0.25 x $B_{MSY}$ proxy) is shown as a grey line.**




**Relative fishing pressure for SPO 3 based on the ratio of QMR/MHR (adj) landings relative to the ECSI trawl survey which has been normalised so that its geometric mean=1.0.**

| **Fishery and Stock Trends** | |
|---|---|
| Recent Trend in Biomass or Proxy | Core strata biomass estimates from survey years 2012 to 2016 of the ECSI winter trawl survey series suggest that biomass has increased relative to the 1990s. However, the low 2018 core strata biomass estimate contradicts this conclusion unless notice is taken of the considerable and variable biomass of rig in the shallow (10–30 m) strata. |
| Recent Trend in Fishing Intensity or Proxy | Fishing intensity has fluctuated around the overfishing threshold. |
| Other Abundance Indices | There has been a strong increasing trend in the bottom trawl CPUE series dating from the late 2000s, but the set net CPUE series has been relatively flat. |
| Trends in Other Relevant Indicators or Variables | - |

| **Projections and Prognosis** | |
|---|---|
| Stock Projections or Prognosis | Catches exceeded the TACC in 2018 for the first time in this QMA. It is Unknown if catches at this level or the TACC will cause the stock to decline. |
| Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits | Current catches and the TACC are Unlikely (< 40%) to cause the stock to decline below the soft or hard limits. |
| Probability of Current Catch or TACC causing Overfishing to continue or to commence | About as Likely as Not (40–60%) |

| Assessment Methodology and Evaluation | | |
|---|---|---|
| Assessment Type | Level 2 - Partial Quantitative Stock Assessment | |
| Assessment Method | Fishery characterisation, trawl survey biomass and standardised CPUE analysis | |
| Assessment Dates | Latest assessment: 2019 | Next assessment: 2022 |
| Overall assessment quality rank | 1 – High Quality | |
| Main data inputs (rank) | - East coast South Island winter trawl survey<br>- Bottom trawl CPUE series: mixed target species<br>- Setnet CPUE series: target shark | 1 – High quality<br>1 – High Quality<br>1 – High Quality |
| Data not used (rank) | N/A | |
| Changes to Model Structure and Assumptions | - | |
| Major Sources of Uncertainty | - The increasing trend in the trawl survey (core strata) and bottom trawl CPUE since 1990 is not corroborated by the setnet CPUE series, which has remained relatively flat.<br>- Lack of historical information relating to stock abundance during the 1970s–1980s when the stock was believed to have been heavily fished means that stock status relative to early levels of abundance is difficult to determine<br>- In some years the ECSI trawl survey indices have high CVs<br>- ECSI trawl survey and bottom trawl CPUE do not adequately sample large mature females | |

| Qualifying Comments |
|---|
| The accepted ECSI trawl survey and the BT(All) CPUE series do not representatively sample large mature female rig.<br>The core strata (30–400 m) of the ECSI winter trawl survey are not fully representative of the rig population because there is a large proportion of rig biomass inside the 30 m depth contour. |

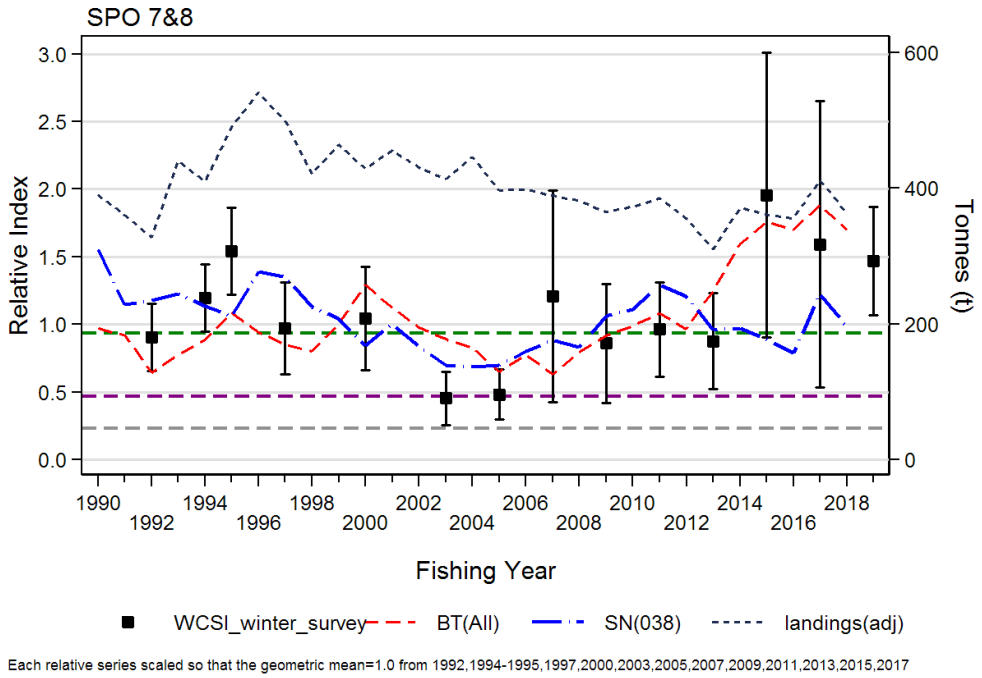
| Fishery Interactions |
|---|
| A 4 nautical mile setnet closure has been in place since October 2008 for the entire area to reduce the bycatch of Hector's dolphins. Rig are largely targeted by setnet but they are also caught as bycatch in target fisheries for school shark, flatfish, red cod, spiny dogfish and elephant fish in setnet, bottom trawl and bottom longline fisheries. Interactions with other species are currently being characterised. |

- **SPO 7**

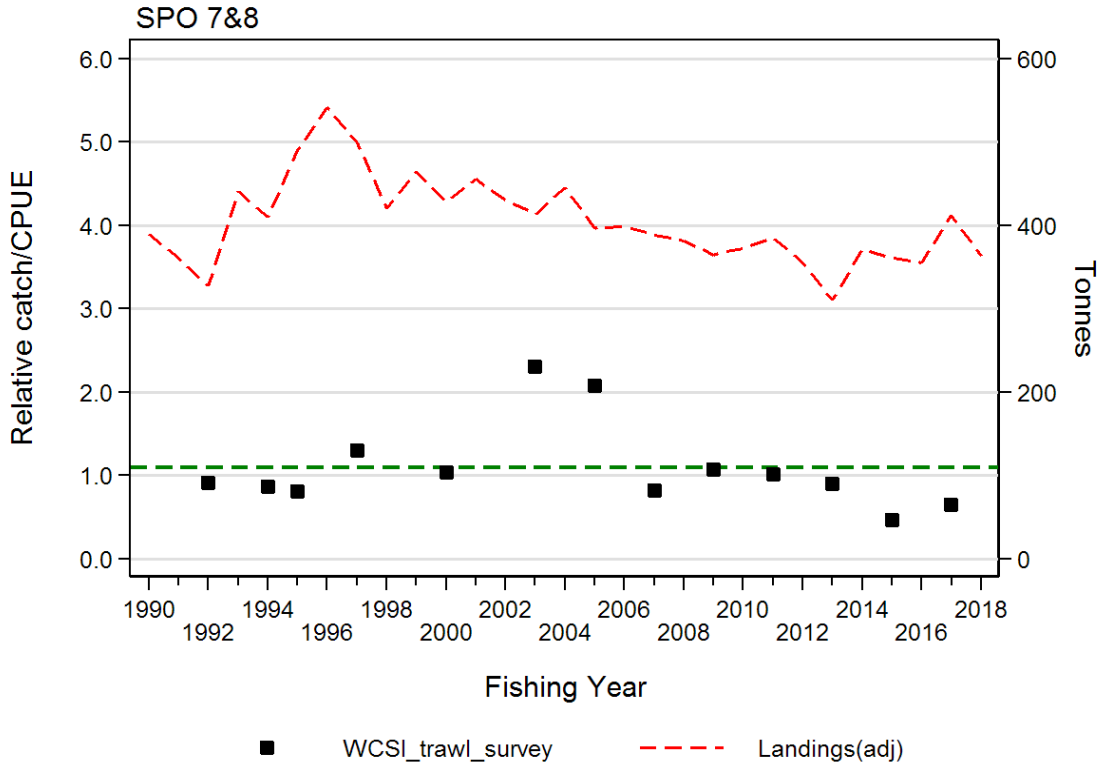
**Stock Structure Assumption**
For the purposes of this summary SPO 7 is defined as the sum of Statistical Areas 016, 017, 033 to 040 and is treated as a discrete stock.

| Stock Status | |
|---|---|
| Year of Most Recent Assessment | 2019 |
| Assessment Runs Presented | WCSI trawl survey series and two standardised CPUE series: BT (All) and SN (038) |
| Reference Points | Target: Proxy for $B_{MSY}$ based on twice the soft limit<br>Soft Limit: Mean WCSI trawl survey biomass estimates for 2003 and 2005 (148.6 t)<br>Hard Limit: 50% of soft limit<br>Overfishing threshold: $F_{MSY}$ |
| Status in relation to Target | Likely (> 40%) to be at or above the target |
| Status in relation to Limits | Soft Limit: Very Unlikely (< 10%) to be below the soft limit<br>Hard Limit: Very Unlikely (< 10%) to be below the hard limit |
| Status in relation to Overfishing | Overfishing is Unlikely (< 40%) to be occurring |

## Historical Stock Status Trajectory and Current Status




**Comparison of the West Coast South Island (WCSI) trawl survey and two accepted CPUE indices BT(All) and SN(038) with the adjusted QMR/MHR landings for SPO 7. Adjustments were made to ensure that all values in every year are based on a common conversion factor. The agreed Soft Limit (average: 2003 and 2005 WCSI survey biomass estimates=0.49) is shown as a purple line, and the calculated $B_{MSY}$ proxy (=2×Soft Limit) is shown as a green line and the calculated Hard Limit (=0.5×Soft Limit) is shown as a grey line. The 2019 survey index is preliminary.**




**Relative fishing pressure for SPO 7 based on the ratio of QMR/MHR (adj) landings relative to the WCSI trawl survey which has been normalised so that its geometric mean=1.0. Target fishing pressure (1.10) is one-half of the fishing pressure associated with the 2003 and 2005 trawl survey indices.**

| **Fishery and Stock Trends** | |
|---|---|
| Recent Trend in Biomass or Proxy | Relative biomass from the WCSI trawl survey was stable, at around the target level, from 2007 to 2013, but increased sharply in 2015 and has remained near that level in 2017. The SPO 7_BT(All) CPUE series shows an increasing trend in recent years from a low point in 2004–05. The SPO 7_SN(038) series has flattened out around the series mean after showing an increase from 2006–07. |
| Recent Trend in Fishing Intensity or Proxy | Relative fishing intensity has been declining since the early 2000s and is currently below the overfishing threshold. |
| Other Abundance Indices | - |
| Trends in Other Relevant Indicators or Variables | Size composition data from the WCSI trawl survey catches suggest strong recruitment in recent years. |

| **Projections and Prognosis** | |
|---|---|
| Stock Projections or Prognosis | Unlikely (< 40%) to decline at current catches or the TACC. |
| Probability of Current Catch or TACC causing Biomass to remain below or to decline below Limits | Soft Limit: Unlikely (< 40%)<br>Hard Limit: Very Unlikely (< 10%) |
| Probability of Current Catch or TACC causing Overfishing to continue or to commence | Very Unlikely (< 10%) |

| **Assessment Methodology and Evaluation** | | |
|---|---|---|
| Assessment Type | Level 2 - Partial Quantitative Stock Assessment | |
| Assessment Method | WCSI trawl survey series and two standardised CPUE abundance indices | |
| Assessment Dates | Latest assessment: 2019 | Next assessment: 2022 |
| Overall assessment quality rank | 1 – High Quality | |
| Main data inputs (rank) | 2016:<br>- West Coast South Island trawl survey index<br>- Setnet CPUE series: target shark in Area 038<br>- Bottom trawl CPUE series: mixed target species (all statistical areas) | <br><br>1 – High Quality<br><br>1 – High Quality<br><br>1 – High Quality |
| Data not used (rank) | - SN(STB) CPUE series | 3 – Low Quality: affected by dolphin management regulations |
| Changes to Model Structure and Assumptions | - | |
| Major Sources of Uncertainty | - The increasing trend in the bottom trawl CPUE and WCSI trawl survey series is not corroborated by set net CPUE series<br>- Lack of historical information relating to stock abundance during the 1970s–1980s when the stock was believed to have been heavily fished means that stock status relative to early levels of abundance is difficult to determine<br>- WCSI trawl survey and bottom trawl CPUE do not adequately sample large mature females | |

| Qualifying Comments |
| --- |
| The WCSI trawl survey and the accepted BT(All) CPUE series do not representatively sample large mature female rig, but they cover most of SPO 7; while the set net index (which does provide an index of mature rig abundance) provides an index of abundance for SPO 7 in Statistical Area 038. |

| Fishery Interactions |
| --- |
| SPO 7 is caught in a targeted set net fishery, which also targets school shark and spiny dogfish, and in a bottom trawl fishery targeting flatfish, barracouta, red cod and tarakihi. The set net fishery has historically been focused in Statistical Area 038 (Tasman and Golden Bays). Interactions with other species are currently being characterised. |

## 6. FOR FURTHER INFORMATION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