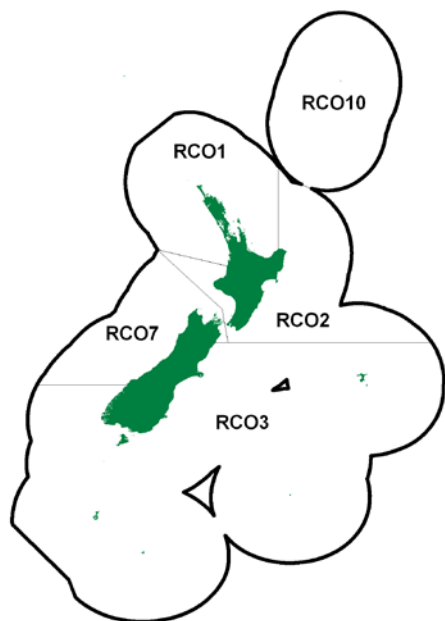


RED COD (RCO)

(Pseudophycis bachus)

Hoka



1. FISHERY SUMMARY

1.1 Commercial fisheries

Red cod are targeted primarily by domestic trawlers in the depth range between 30 and 200 m and are also a bycatch of deepwater fisheries off the southeast and southwest coasts of the South Island. The domestic red cod fishery is seasonal, usually beginning in November and continuing to May or June, with peak catches around January and May. During spring and summer, red cod are caught inshore before the fishery moves into deeper water during winter. RCO entered the QMS in 1986

, Foreign vessel catches declined and were negligible by 1987-88. Reported annual catches by nation from 1970 to 1986-87 are given in Table 1.

Table 1: Reported annual catch (t) of red cod by nation from 1970 to 1986-87.

| Fishing year | New Zealand | | Japan | Korea | USSR | Foreign licensed | Combined Total |
|--------------|-------------|-----------|-------|-------|--------|------------------|----------------|
| | Domestic | Chartered | | | | Total | |
| 1970* | 760 | - | 995 | - | - | 995 | 1 755 |
| 1971* | 393 | - | 2 140 | - | - | 2 140 | 2 533 |
| 1972* | 301 | - | 2 082 | - | < 100 | 2 182 | 2 483 |
| 1973* | 736 | - | 2 747 | - | < 100 | 2 847 | 3 583 |
| 1974* | 1 876 | - | 2 950 | - | < 100 | 3 050 | 4 926 |
| 1975* | 721 | - | 2 131 | - | < 100 | 2 231 | 2 952 |
| 1976* | 948 | - | 4 001 | - | 600 | 4 601 | 5 549 |
| 1977* | 2 690 | - | 8 001 | 1 358 | §2 200 | 11 559 | 14 249 |
| 1978-79* | 5 343 | 124 | 2 560 | 151 | 51 | 2 762 | 8 229 |
| 1979-80* | 5 638 | 883 | 537 | 259 | 116 | 912 | 7 433 |
| 1981-82* | 3 210 | 387 | 474 | 70 | 102 | 646 | 4 243 |
| 1982-83* | 4 342 | 406 | 764 | 675 | 52 | 1 493 | 6 241 |
| 1983-83† | 3 751 | 390 | 149 | 401 | 3 | 553 | 4 694 |
| 1983-84† | 10 189 | 1 764 | 1 364 | 480 | 49 | 1 893 | 13 846 |
| 1984-85† | 14 097 | 2 381 | 978 | 829 | 7 | 1 814 | 18 292 |
| 1985-86‡ | 9 035 | 1 014 | 739 | 147 | 5 | 891 | 10 940 |
| 1986-87‡ | 2 620 | 1 089 | 197 | 4 | 59 | 261 | 3 969 |

1970-1977 = calendar years; 1978-79 to 1982-83 = 1 April-31 March; 1980-1981=no fishing returns processed this year; 1983-1983 - 1 April-30 September; 1983-84 to 1986-87 - 1 October-30 September; * MAF data; † FSU data; ‡ QMS data § mainly ribaldo and red cod.

Recent reported landings and TACCs of red cod by Fishstock are shown in Table 2, while Figure 1 depicts historical landings and TACC values for the three main RCO stocks.

Table 2: Reported landings (t) of red cod by Fishstock from 1983–84 to 2012–13, and actual TACCs (t) for 1986–87 to 2012–13. The QMS data is from 1986–present.

| Fishstock FMA (s) | RCO 1 1 & 9 | | RCO 2 2 & 8 | | RCO 3 3, 4, 5 & 6 | | RCO 7 7 | | RCO 10 10 | |
|----------------------|----------------|--------|----------------|------|----------------------|--------|------------|-------|--------------|------|
| | Landings | TACC | Landings | TACC | Landings | TACC | Landings | TACC | Landings | TACC |
| 1983–84* | 12 | - | 197 | - | 9 357 | - | 3051 | - | 0 | - |
| 1984–85* | 9 | - | 126 | - | 14 751 | - | 1 442 | - | 0 | - |
| 1985–86* | 6 | - | 48 | - | 9 346 | - | 408 | - | 0 | - |
| 1986–87 | 5 | 30 | 46 | 350 | 3 300 | 11 960 | 619 | 2 940 | 0 | 10 |
| 1987–88 | 8 | 40 | 81 | 357 | 2 878 | 12 182 | 1 605 | 2 982 | 0 | 10 |
| 1988–89 | 9 | 40 | 85 | 359 | 7 732 | 12 362 | 1 345 | 3 057 | 0 | 10 |
| 1989–90 | 8 | 42 | 105 | 362 | 6 589 | 13 018 | 800 | 3 105 | 0 | 10 |
| 1990–91 | 12 | 42 | 68 | 364 | 4 630 | 12 299 | 839 | 3 125 | 0 | 10 |
| 1991–92 | 26 | 42 | 358 | 364 | 6 500 | 12 299 | 2 220 | 3 125 | 0 | 10 |
| 1992–93 | 46 | 42 | 441 | 364 | 9 633 | 12 389 | 4 083 | 3 125 | 0 | 10 |
| 1993–94 | 44 | 42 | 477 | 364 | 7 977 | 12 389 | 2 992 | 3 125 | 0 | 10 |
| 1994–95 | 63 | 42 | 762 | 364 | 12 603 | 12 389 | 3 569 | 3 125 | 0 | 10 |
| 1995–96 | 28 | 42 | 584 | 500 | 11 038 | 12 389 | 3 728 | 3 125 | 0 | 10 |
| 1996–97 | 42 | 42 | 396 | 500 | 10 056 | 12 389 | 3 710 | 3 125 | 0 | 10 |
| 1997–98 | 22 | 42 | 192 | 500 | 9 972 | 12 389 | 2 700 | 3 125 | 0 | 10 |
| 1998–99 | 10 | 42 | 282 | 500 | 13 926 | 12 389 | 2 055 | 3 125 | 0 | 10 |
| 1999–00 | 3 | 42 | 130 | 500 | 4 824 | 12 389 | 633 | 3 125 | 0 | 10 |
| 2000–01 | 5 | 42 | 112 | 500 | 2 776 | 12 389 | 1 538 | 3 125 | 0 | 10 |
| 2001–02 | 6 | 42 | 150 | 500 | 2 862 | 12 389 | 1 409 | 3 126 | 0 | 10 |
| 2002–03 | 8 | 42 | 144 | 500 | 5 107 | 12 389 | 1 657 | 3 126 | 0 | 10 |
| 2003–04 | 11 | 42 | 225 | 500 | 7 724 | 12 389 | 2 358 | 3 126 | 0 | 10 |
| 2004–05 | 21 | 42 | 423 | 500 | 4 212 | 12 389 | 3 052 | 3 126 | 0 | 10 |
| 2005–06 | 24 | 42 | 372 | 500 | 3 222 | 12 389 | 3 061 | 3 126 | 0 | 10 |
| 2006–07 | 25 | 42 | 256 | 500 | 1 877 | 12 389 | 3 409 | 3 126 | 0 | 10 |
| 2007–08 | 12 | 42 | 225 | 500 | 3 236 | 4 600 | 2 984 | 3 126 | 0 | 10 |
| 2008–09 | 12 | 42 | 212 | 500 | 2 542 | 4 600 | 2 131 | 3 126 | 0 | 10 |
| 2009–10 | 14 | 42 | 364 | 500 | 2 994 | 4 600 | 1 864 | 3 126 | 0 | 10 |
| 2010–11 | 19 | 42 | 501 | 500 | 4 567 | 4 600 | 1 603 | 3 126 | 0 | 10 |
| 2011–12 | 8 | 42 | 549 | 500 | 5 389 | 4 600 | 1 608 | 3 126 | 0 | 10 |
| 2012–13 | 6 | 42 | 300 | 500 | 5 292 | 4 600 | 1 282 | 3 126 | 0 | 10 |
| Fishstock FMA (s) | Total | | | | | | | | | |
| | Landings§ | TACC | | | | | | | | |
| 1983–84* | 13 848 | - | | | | | | | | |
| 1984–85* | 18 292 | - | | | | | | | | |
| 1985–86* | 10 940 | - | | | | | | | | |
| 1986–87 | 3 970 | 15 290 | | | | | | | | |
| 1987–88 | 4 506 | 15 571 | | | | | | | | |
| 1988–89 | 9 171 | 15 828 | | | | | | | | |
| 1989–90 | 7 502 | 16 537 | | | | | | | | |
| 1990–91 | 5 549 | 15 840 | | | | | | | | |
| 1991–92 | 9 104 | 15 840 | | | | | | | | |
| 1992–93 | 14 203 | 15 930 | | | | | | | | |
| 1993–94 | 11 491 | 15 930 | | | | | | | | |
| 1994–95 | 16 997 | 15 930 | | | | | | | | |
| 1995–96 | 15 350 | 16 066 | | | | | | | | |
| 1996–97 | 14 204 | 16 066 | | | | | | | | |
| 1997–98 | 12 886 | 16 066 | | | | | | | | |
| 1998–99 | 16 273 | 16 066 | | | | | | | | |
| 1999–00 | 5 590 | 16 066 | | | | | | | | |
| 2000–01 | 4 432 | 16 066 | | | | | | | | |
| 2001–02 | 4 427 | 16 067 | | | | | | | | |
| 2002–03 | 6 916 | 16 067 | | | | | | | | |
| 2003–04 | 10 318 | 16 067 | | | | | | | | |
| 2004–05 | 7 708 | 16 067 | | | | | | | | |
| 2005–06 | 6 679 | 16 067 | | | | | | | | |
| 2006–07 | 5 567 | 16 067 | | | | | | | | |
| 2007–08 | 6 457 | 8 278 | | | | | | | | |
| 2008–09 | 4 897 | 8 278 | | | | | | | | |
| 2009–10 | 5 236 | 8 278 | | | | | | | | |
| 2010–11 | 6 691 | 8 278 | | | | | | | | |
| 2011–12 | 7 627 | 8 278 | | | | | | | | |
| 2012–13 | 6 881 | 8 278 | | | | | | | | |

*FSU data.

§ Includes landings from unknown areas before 1986–87.

RED COD (RCO)

The bulk of reported landings are taken from RCO 3, in particular the Canterbury Bight and Banks Peninsula areas. The red cod fishery is characterised by large variations in catches between years. Research indicates that this interannual variation in catch is due to varied recruitment causing biomass fluctuations rather than a change in catchability. The RCO 3 TACC was reduced by 63% from the 1 October 2007 to 4600 t, with the TAC being set at 4930 t (customary, recreational and other sources of mortality were allocated 5, 95 and 230 t respectively). All RCO stocks fisheries have been put on to Schedule 2 of the Fisheries Act 1996. Schedule 2 allows that for certain “highly variable” stocks, the Total Annual Catch (TAC) can be increased within a fishing season. The base TAC is not changed by this process and the “in-season” TAC reverts to the original level at the end of each season. No RCO stocks have yet had an in-season increase.

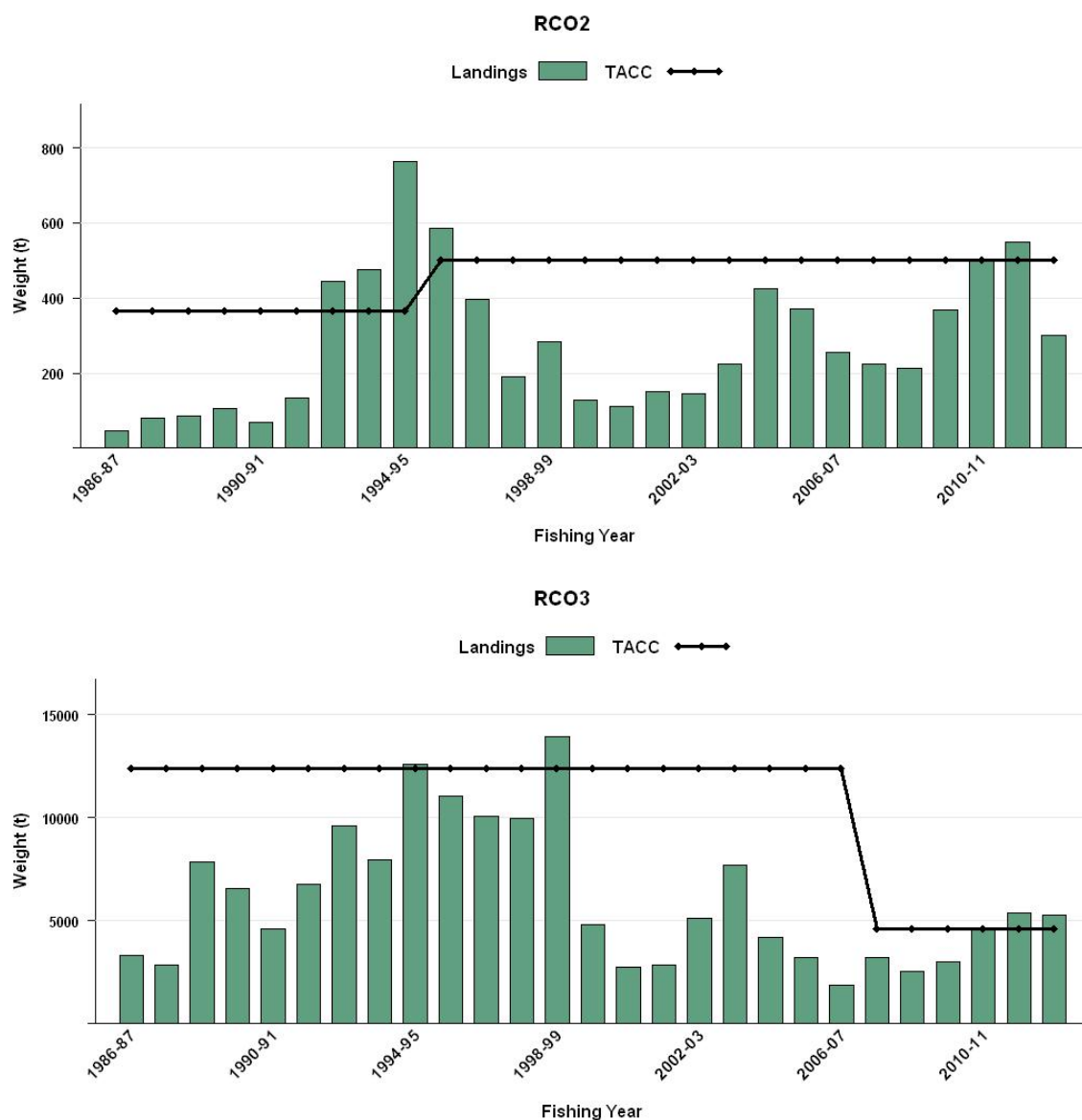


Figure 1: Historical landings and TACC for the three main RCO stocks. From top to bottom: RCO2 (Central East) and RCO3 (South East Coast). [Figure continued on next page].

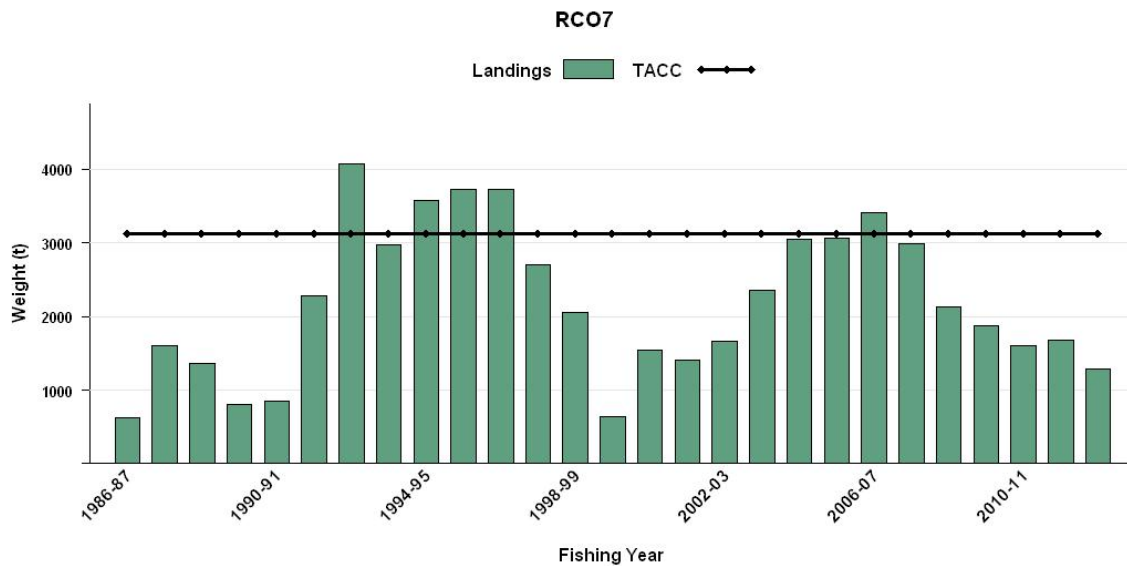


Figure 1 [Continued]: Historical landings and TACC for the three main RCO stocks. Above: RCO7 (Challenger).

1.2 Recreational fisheries

Recreational fishers take red cod, particularly on the east coast of the South Island. Results of five separate recreational fishing surveys are shown in Table 3.

Table 3: Estimated number and weight of red cod harvested by recreational fishers, by Fishstock and survey. Surveys were carried out in different years in the MAF Fisheries regions: South in 1991–92, Central in 1992–93, North in 1993–94 (Teirney *et al.* 1997) and nationally in 1996 (Bradford 1998) and 1999–00 (Boyd & Reilly 2002). Survey harvest is presented as a range to reflect the uncertainty in the estimates.

| Fishstock | Survey | Number | CV % | Estimated harvest range (t) | Estimated point estimate (t) |
|-----------|----------|---------|------|-----------------------------|------------------------------|
| 1991–92 | | | | | |
| RCO 3 | South | 104 000 | 16 | 90–120 | - |
| RCO 7 | South | 1 000 | - | 0–5 | - |
| 1992–93 | | | | | |
| RCO 2 | Central | 151 000 | 19 | 105–155 | - |
| RCO 7 | Central | 1 100 | 34 | 5–15 | - |
| 1993–94 | | | | | |
| RCO 1 | North | 9000 | 34 | 5–15 | - |
| 1996 | | | | | |
| RCO 1 | National | 11 000 | 18 | 515 | 11 |
| RCO 2 | National | 88 000 | 11 | 80–105 | 92 |
| RCO 3 | National | 99 000 | 10 | 90–115 | 103 |
| RCO 7 | National | 38 000 | 15 | 30–50 | 40 |
| 1999–00 | | | | | |
| RCO 1 | National | 21 000 | 36 | 5–11 | 8 |
| RCO 2 | National | 39 000 | 25 | 8–14 | 11 |
| RCO 3 | National | 207 000 | 25 | 210–349 | 280 |
| RCO 7 | National | 23 000 | 50 | 5–14 | 9 |

A key component of the process of estimating recreational harvest from diary surveys is determining the proportion of the population that fish. The Recreational Technical Working Group concluded that the harvest estimates from the diary surveys should be used only with the following qualifications: a) they may be very inaccurate; b) the 1996 and earlier surveys contain a methodological error; and c) the 2000 and 2001 estimates are implausibly high for many important fisheries. The 1999–00 harvest estimates for each Fishstock should be evaluated with reference to the coefficient of variation.

RED COD (RCO)

1.3 Customary non-commercial fisheries

Quantitative estimates of the current level of customary non-commercial catch are not available.

1.4 Illegal catch

Quantitative estimates of the level of illegal catch are not available.

1.5 Other sources of mortality

Processing limits on red cod are sometimes imposed to discourage fishers from landing red cod when the species cannot be processed or when markets are poor. This practice has encouraged dumping. Processing limits are currently less of a problem than in earlier years.

2. BIOLOGY

Red cod are a fast-growing, short-lived species with few fish in the commercial fishery older than six years. Red cod grow to about 25 cm total length (TL) in the first year, followed by annual growth increments of around 15, 10 and 5 cm. Growth of sexes is similar for the first two years, after which females tend to grow faster than males and reach a larger overall length. Sexual maturity ranges from 45 to 55 cm TL with a mean value of 52 cm TL for both sexes at an age of 2–3 years. M has been estimated to equal 0.76 for both sexes. In 1995, ageing of red cod was validated using marginal zone analysis.

In the 1989–90 to 1992–93 fishing years, 80% of the landings in RCO 3 were 2+ and 3+ fish (50–57 cm TL). The sex ratio of the commercial catch during this period was skewed towards females during November (F:M ratio of 3.4:1) with the ratio tending to even out by May. Schools are generally comprised of single age cohorts rather than a mix of age classes.

Spawning in red cod varies with latitude, with spawning occurring later at higher latitudes. In the Canterbury Bight, spawning occurs from August to October. No definite spawning grounds have been identified on the southeast coast, but there is some evidence that red cod spawn in deeper water (300–750 m). Running ripe fish were caught on the Puysegur Bank in 600 m during the Southland trawl survey in February 1994. Juvenile red cod are found in offshore waters after the spawning period; however, no nursery grounds are known for this species.

Red cod are seasonally abundant, with schools appearing in the Canterbury Bight and Banks Peninsula area around November. These schools are feeding aggregations and are not found in these waters after about June. Catch data indicates that they move into deeper water after this time. Recruitment is highly variable resulting in large variations in catches between years.

Biological parameters relevant to the stock assessment are shown in Table 4.

Table 4: Estimates of biological parameters for red cod.

| Fishstock | Estimate | | | | Source | |
|---|----------------|-------|--------------|--------------|-----------------|-----------------|
| <u>1. Natural mortality (M)</u> | | | | | | |
| RCO 3 | 0.76 | | | | Beentjes (1992) | |
| <u>2. Weight = $a(\text{length})^b$ (Weight in g, length in cm fork length).</u> | | | | | | |
| | <u>Females</u> | | <u>Males</u> | | | |
| | a | b | a | b | | |
| RCO 3 | 0.0074 | 3.059 | 0.0145 | 2.892 | Beentjes (1992) | |
| RCO 3 combined sexes | 0.009249 | 3.001 | | | Beentjes (1992) | |
| <u>3. von Bertalanffy growth parameters</u> | | | | | | |
| | <u>Females</u> | | | <u>Males</u> | | |
| | L_∞ | k | t_0 | L_∞ | k | t_0 |
| RCO 3 | 76.5 | 0.41 | -0.03 | 68.5 | 0.47 | 0.06 |
| RCO 7 | 79.6 | 0.49 | 0.20 | 68.2 | 0.53 | 0.22 |
| | | | | | | Horn (1995) |
| | | | | | | Beentjes (2001) |

3. STOCKS AND AREAS

The number of red cod stocks is unknown. There is no information about stock structure, recruitment patterns, or other biological characteristics that would indicate stock boundaries.

4. STOCK ASSESSMENT

No recent stock assessments have been carried out on any red cod stocks. Previous assessments were undertaken, however, these are now outdated. Details appear in previous versions of the Plenary report.

Trawl survey biomass estimates are available from one *Tangaroa* and four *Kaharoa* time series (Table 5, Figures 2, 3 and 4). In 2001, the Inshore FAWG recommended that the summer east coast South Island trawl survey be discontinued due to the extreme variability in the catchability of the target species. The winter series was re-instated in 2007 and was run initially for three consecutive years. The East and West Coast South Island trawl surveys track both biomass and population length structure.

4.1 Biomass estimates

The biomass of red cod from core strata (30–400m) of the East Coast South Island trawl survey was largely unchanged between 2007 and 2009 and remained low relative to the period between 1991 and 1994. In contrast the biomass in 2012 was more than six-fold greater than in 2009 and was predominantly contributed by 1+ fish. The proportion of pre-recruited biomass has varied greatly among surveys ranging from 7 to 59% of the total biomass and in 2012 it was the highest ever at 59%, reflecting the strong 1+ cohort. The proportion of juvenile biomass (based on the length-at-50% maturity) has also varied greatly among surveys from 27 to 80% and in 2012 it was 70% (Figure 3).

The additional red cod biomass captured in the 10–30 m depth range accounted for only 4% and 2% of the biomass in the core plus shallow strata (10–400 m) for 2007 and 2012 respectively, indicating that in terms of biomass, it is informative but, probably not essential to monitor the shallow strata for red cod. Further, the addition of the 10–30 m depth range had little effect on the shape of the length frequency distributions (Figure 4).

The distribution of red cod hot spots varies, but overall this species is consistently well represented over the entire survey area, most commonly from 30 m to about 300 m, but is also found in waters shallower than 30 m.

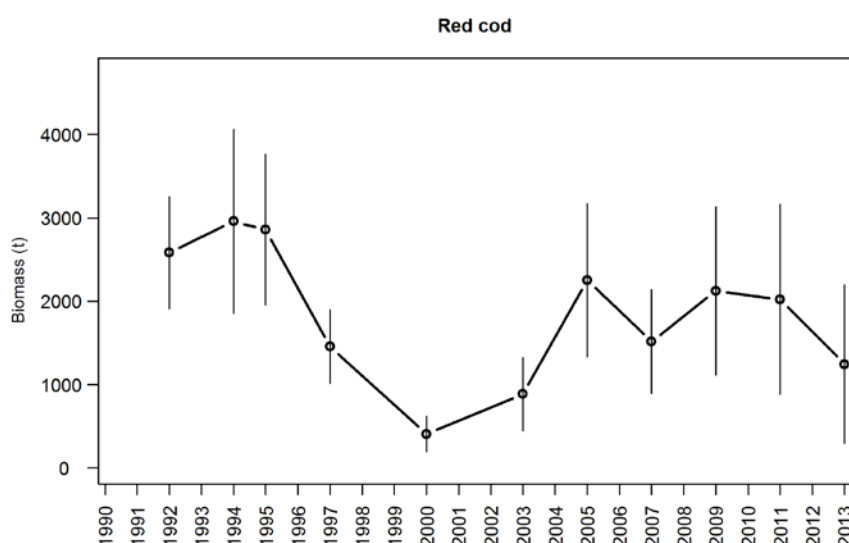


Figure 2: Biomass trends $\pm 95\%$ CI (estimated from survey CVs assuming a lognormal distribution) and the time series mean (dotted line) from the West Coast South Island trawl survey

RED COD (RCO)

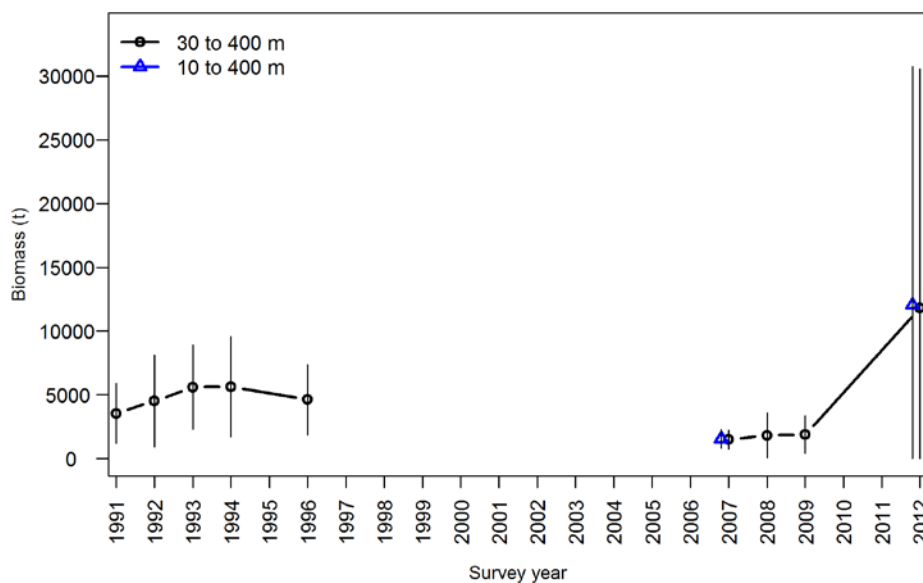


Figure 3: Red cod total biomass and 95% confidence intervals for the all ECSI winter surveys in core strata (30–400 m), and core plus shallow strata (10–400 m) for species found in less than 30 m in 2007 and 2012.

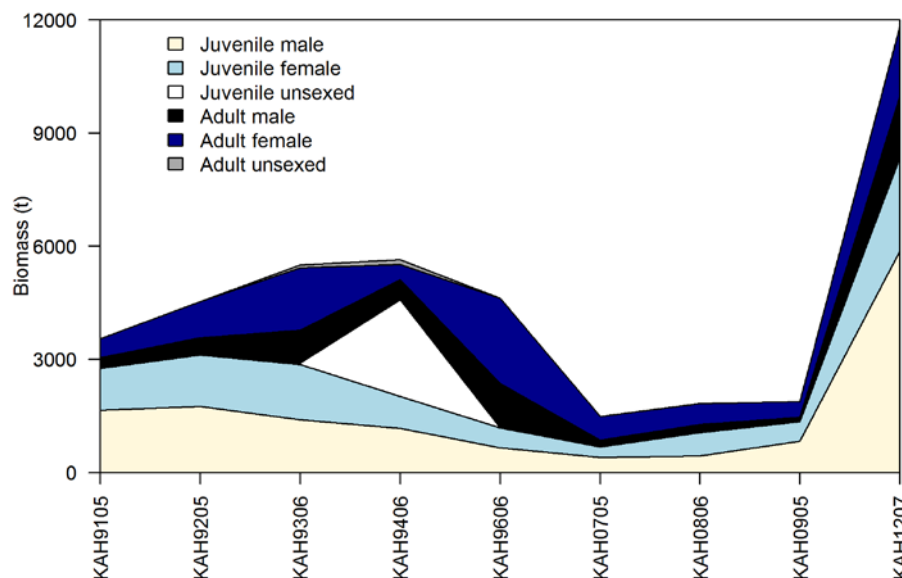


Figure 4: Red cod juvenile and adult biomass for ECSI winter surveys in core strata (30–400 m), where juvenile is below and adult is equal to or above length at which 50% of fish are mature.

4.2 Length frequency distributions

The size distributions of red cod in each of the nine core strata (30–400 m) of the East Coast South Island trawl survey surveys are similar and are generally characterised by a 0+ mode (10–20 cm), 1+ mode (30–40 cm), and a less defined right hand tail comprised predominantly of 2+ and 3+ fish. The 1996 to 2009 surveys show poor recruitment of 1+ fish compared to earlier surveys. The 2012 1+ cohort is the largest of all nine surveys. Red cod on the ECSI (Figure 5), sampled during these surveys, are generally smaller than those from Southland (Figure 6) suggesting that this area may be an important nursery ground for juvenile red cod.

4.3 Other factors

There have been large fluctuations in red cod abundance and landings, particularly on the east and the west coast of the South Island. This causes problems for the fishers who rely on red cod, and creates additional pressure on the ACE system. Changes in catch rates of red cod, combined with the recovery of other quota species since the introduction of the QMS, has resulted in a catch mix for which some fishers do not have the appropriate quota holdings. Bycatch species while targeting red cod are stargazer, red gurnard, elephant fish, rig, school shark, blue cod, groper and tarakihi. As a result, effort targeting red cod may be reduced to alleviate bycatch problems, despite the availability of red cod quota.

RED COD (RCO)

Table 5: Relative biomass indices (t) and coefficients of variation (CV) for red cod for east coast South Island (ECSI) - summer and winter, west coast South Island (WCSI), and Southland survey areas*. 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). The sum of pre-recruit and recruited biomass values do not always match the total biomass for the earlier surveys because at several stations length frequencies were not measured, affecting the biomass calculations for length intervals. – , not measured; NA, not applicable. Recruited is defined as the size-at-recruitment to the fishery (40 cm).

| Region | Fishstock | Year | Trip number | Total Biomass estimate | CV (%) | Total Biomass estimate | CV (%) | Pre-recruit | CV (%) | Pre-recruit | CV (%) | Recruited | CV (%) | Recruited | CV (%) |
|--------------|-----------|---------|-------------|------------------------|--------|------------------------|--------|-------------|--------|-------------|--------|-----------|--------|-----------|--------|
| ECSI(winter) | RCO 3 | | | 30–400m | | 10–400m | | 30–400m | | 10–400m | | 30–400m | | 10–400m | |
| | | 1991 | KAH 9105 | 3 760 | 40 | - | - | 1 823 | 45 | - | - | 2 054 | 37 | - | - |
| | | 1992 | KAH 9205 | 4 527 | 40 | - | - | 2 089 | 50 | - | - | 2 438 | 33 | - | - |
| | | 1993 | KAH 9306 | 5 601 | 30 | - | - | 1 025 | 51 | - | - | 4 469 | 27 | - | - |
| | | 1994 | KAH 9406 | 5 637 | 35 | - | - | 3 338 | 40 | - | - | 2 299 | 36 | - | - |
| | | 1996 | KAH 9606 | 4 619 | 30 | - | - | 590 | 31 | - | - | 4 029 | 34 | - | - |
| | | 2007 | KAH0705 | 1 486 | 25 | 1 552 | 24 | 190 | 33 | - | - | 1 295 | 25 | - | - |
| | | 2008 | KAH0806 | 1 824 | 49 | - | - | 129 | 36 | - | - | 1 695 | 50 | - | - |
| | | 2009 | KAH0905 | 1 871 | 40 | - | - | 833 | 50 | - | - | 1 038 | 41 | - | - |
| | | 2012 | KAH1207 | 11 821 | 79 | 12 032 | 78 | 7 015 | 97 | - | - | 4 806 | 55 | - | - |
| ECSI(summer) | RCO 3 | 1996-97 | KAH 9618 | 10 634 | 23 | - | - | 4 101 | 23 | - | - | - | - | - | - |
| | | 1997-98 | KAH 9704 | 7 536 | 23 | - | - | 4 426 | 24 | - | - | - | - | - | - |
| | | 1998-99 | KAH 9809 | 12 823 | 17 | - | - | 3 770 | 15 | - | - | - | - | - | - |
| | | 1999-00 | KAH 9917 | 6 690 | 30 | - | - | 2 728 | 41 | - | - | - | - | - | - |
| | | 2000-01 | KAH 0014 | 1 402 | 82 | - | - | 1 283 | 89 | - | - | - | - | - | - |
| ECNI | RCO 2 | 1993 | KAH 9304 | 913 | 52 | - | - | 197 | 31 | - | - | - | - | - | - |
| | | 1994 | KAH 9402 | 1 298 | 50 | - | - | 547 | 52 | - | - | - | - | - | - |
| | | 1995 | KAH 9502 | 469 | 36 | - | - | 47 | 34 | - | - | - | - | - | - |
| WCSI | RCO 7 | 1992 | KAH 9204 | 2 719 | 13 | - | - | 1 167 | 17 | - | - | - | - | - | - |
| | | 1994 | KAH 9404 | 3 169 | 18 | - | - | 888 | 25 | - | - | - | - | - | - |
| | | 1995 | KAH 9504 | 3 123 | 15 | - | - | 1 007 | 18 | - | - | - | - | - | - |
| | | 1997 | KAH 9701 | 2 546 | 23 | - | - | 1 353 | 28 | - | - | - | - | - | - |
| | | 2003 | KAH 0304 | 906 | 24 | - | - | 290 | 31 | - | - | - | - | - | - |
| | | 2005 | KAH0503 | 2610 | 18 | - | - | 501 | - | - | - | - | - | - | - |
| | | 2007 | KAH0704 | 1638 | 19 | - | - | 842 | - | - | - | - | - | - | - |
| | | 2009 | KAH0904 | 2 782 | 25 | - | - | 1 614 | 27 | - | - | - | - | - | - |
| | | 2013 | KAH1305 | 1 247 | 38 | - | - | - | - | - | - | - | - | - | - |
| Southland | RCO 3 | 1993 | TAN 9301 | 100 | 68 | - | - | - | - | - | - | - | - | - | - |
| | | 1994 | TAN 9402 | 707 | 68 | - | - | - | - | - | - | - | - | - | - |
| | | 1995 | TAN 9502 | 2 554 | 49 | - | - | 182 | 66 | - | - | - | - | - | - |
| | | 1996 | TAN 9604 | 33 390 | 94 | - | - | 736 | 99 | - | - | - | - | - | - |

*Assuming areal availability, vertical availability and vulnerability equal 1.0. Biomass is only estimated outside 10 m depth except for COM9901 and CMP0001. Note: because trawl survey biomass estimates are indices, comparisons between different seasons (e.g., summer and winter ECSI) are not valid

RED COD (RCO)

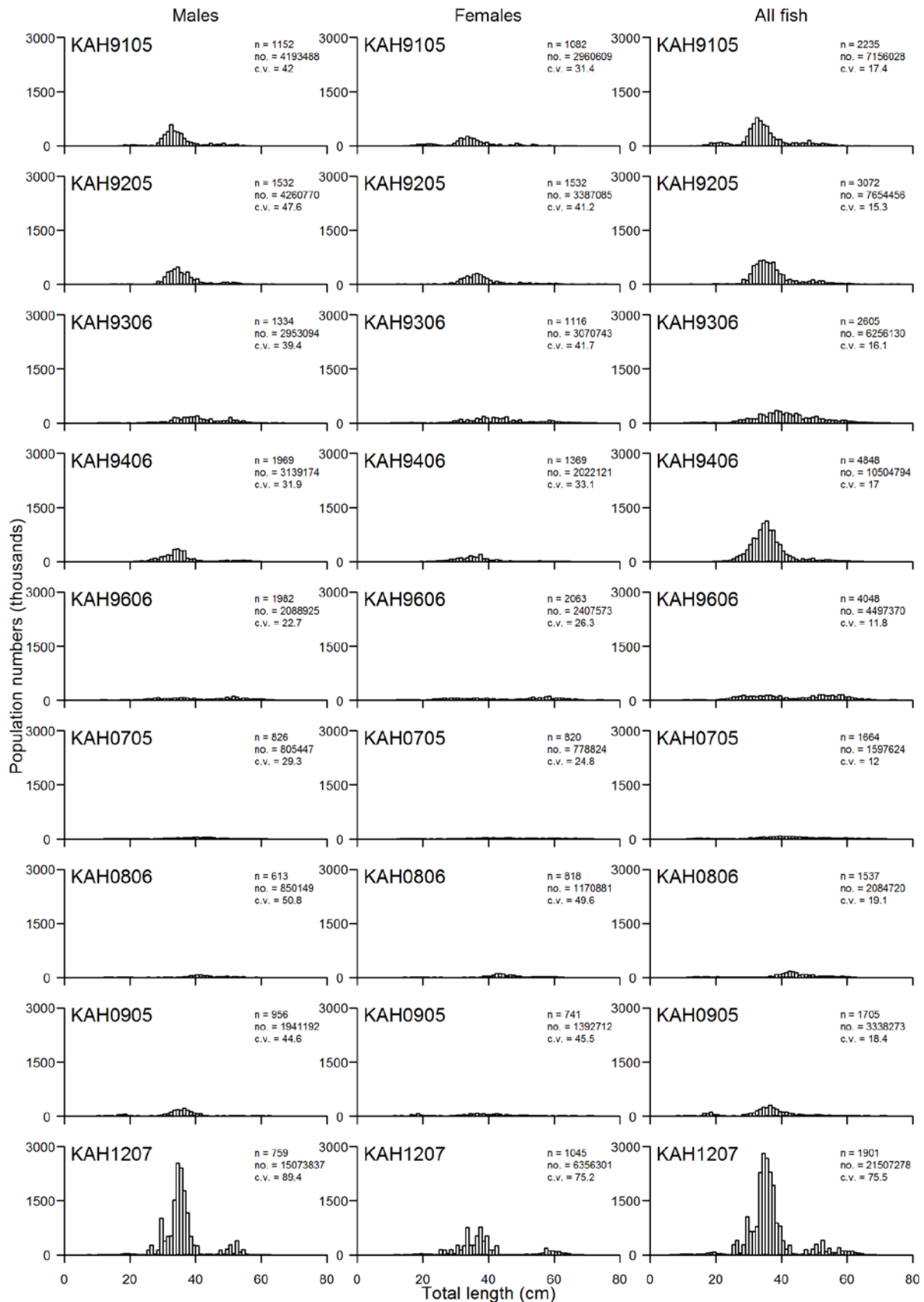


Figure 5: Scaled length frequency distributions for red cod in core strata (30–400 m) for all nine of the ECSI winter surveys. The length distribution is also shown in the 10–30 m depth strata for the 2007 and 2012 surveys overlaid (not stacked) in light grey. Population estimates are for the core strata only, in thousands of fish. Scales are the same for males, females and unsexed..

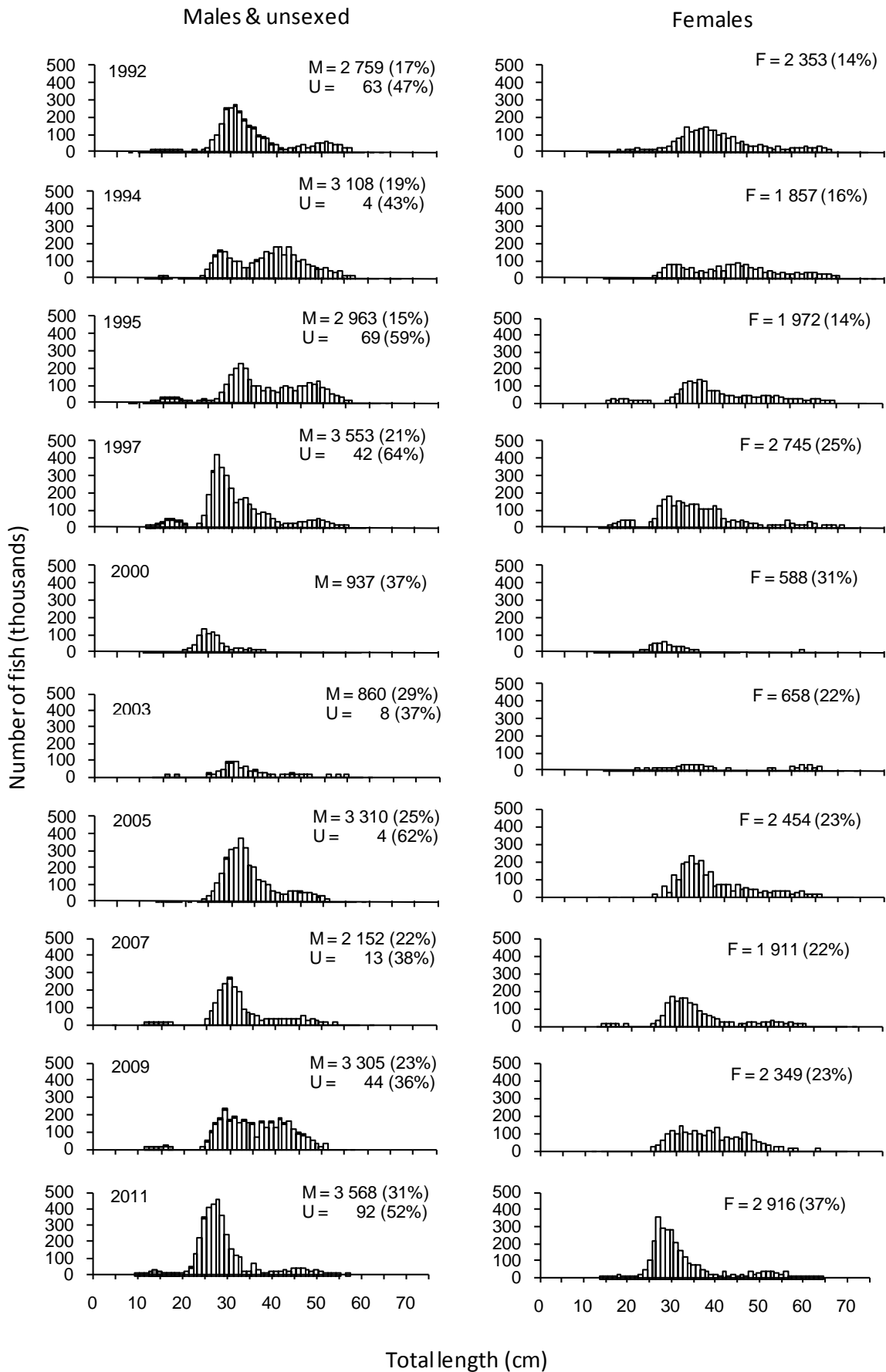


Figure 6: Scaled length frequency distributions for red cod in 30–400 m, for all WCSI surveys. M, males; F, females; U, unsexed (CV%) (Stevenson 2012).

5. STATUS OF THE STOCKS

Yearly fluctuations in red cod catch reflect changes in recruitment. Trawl surveys and catch sampling of red cod have shown that the fishery is based almost exclusively on two and three year old fish and is highly dependent on recruitment success.

The disparity between the TACC and reported landings indicates that the TACC is not generally attained. At the time of the introduction to the QMS, the rationale for introducing and retaining a TACC of this magnitude was to provide the fishing industry with the flexibility to capitalise on years when red cod are plentiful.

RCO 3

| | |
|---|---|
| Stock Status | |
| Year of Most Recent Assessment | 2009 |
| Assessment Runs Presented | - |
| Reference Points | Target: <i>MSY</i> -compatible proxy based on the East Coast South Island trawl survey (to be determined) Soft Limit: 50% of target Hard Limit: 25% of target |
| Status in relation to Target | Unknown |
| Status in relation to Limits | Soft limit: Unknown Hard Limit: Unknown |
| Historical Stock Status Trajectory and Current Status | |
| <p style="text-align: center;">● WCSI_Survey - - - QMR/MHR - · - TACC</p> | |
| <p>East Coast South Island survey biomass (points) commercial catch (red dashed line) and TACC (blue dashed line) for the period 1990 to 2009. Horizontal line dashed is the mean biomass index, 1992-2009.</p> | |
| Fishery and Stock Trends | |
| Recent Trend in Biomass or Proxy | Both catch and survey biomass have declined substantially since the mid 1990s. |
| Recent Trend in Fishing Mortality or Proxy | Unknown |

| | |
|--|--|
| Other Abundance Indices | - |
| Trends in Other Relevant Indicators or Variables | From 1991 to 1994 large recruitment pulses were seen in the survey catch. The most recent three surveys (2007, 2008 and 2009) have not detected any significant recruitment. |

| | |
|---|---|
| Projections and Prognosis | |
| Stock Projections or Prognosis | Biomass estimates from the recently re-instated winter East Coast South Island since 2007 confirm that biomass is low relative to the 1990s. |
| Probability of Current Catch or TACC causing decline below Limits | Soft Limit: Unknown Hard Limit: Unknown |
| Assessment Methodology and Evaluation | |
| Assessment Type | Level 2: Trawl survey |
| Assessment Method | Accepted biomass index |
| Assessment Dates | Latest assessment: 2011 Next assessment: Unknown |
| Overall assessment quality rank | 1 – High Quality. The Southern Inshore Working Group agreed that the East Coast South Island index was a credible measure of red cod biomass. |
| Main data inputs (rank) | Trawl survey biomass estimates and length frequency analysis 1 – High Quality |
| Data not used (rank) | - |
| Changes to Model Structure and Assumptions | - |
| Major Sources of Uncertainty | - |

| |
|----------------------------|
| Qualifying Comments |
| - |

| |
|---|
| Fishery Interactions |
| Red cod are landed as bycatch in barracouta, flatfish, squid and tarakihi bottom trawl fisheries and ling, school shark, spiny dogfish, rig, tarakihi and moki setnet fisheries. Incidental captures of seabirds occur. |

RCO 7

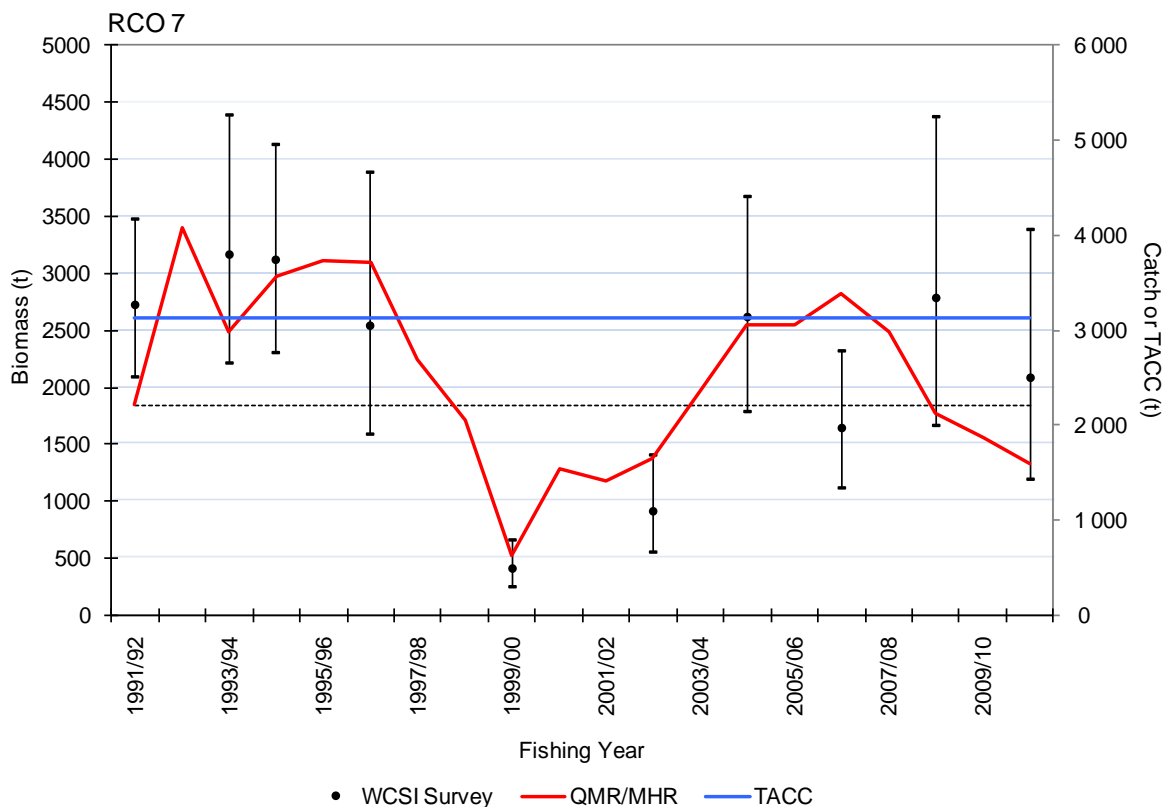
Stock Structure Assumptions

Stock boundaries are unknown, but for the purpose of this summary RCO 7 is considered to be a single management unit.

| | |
|-------------------------------------|---|
| Stock Status | |
| Year of Most Recent Assessment | 2009 West Coast South Island trawl survey |
| Reference Points | Target: <i>MSY</i> -compatible proxy based on the West Coast South Island trawl survey (to be determined) Soft Limit: 50% of target Hard Limit: 25% of target |
| Status in relation to Target | Unknown |
| Status in relation to Limits | Soft limit: Unknown Hard Limit: Unlikely (< 40%) to be below |
| Fishery and Stock Trends | |
| Trend in Biomass or Proxy | Biomass indices have been increasing from a series low in 2000, with the current 2009 index above the long-term mean. |
| Trend in Fishing Mortality or Proxy | Unknown |

RED COD (RCO)

Historical survey biomass, Catch and TACC Trajectories



West Coast South Island survey biomass (points) commercial catch (red line) and TACC (blue line) for the period 1990 to 2009. Horizontal line dashed represents the mean biomass index, 1992–2011.

| | |
|---|--|
| Other Abundance Indices | - |
| Trends in Other Relevant Indicator or Variables | Length frequency analysis from the West Coast South Island trawl survey in 2009 show a wide distribution of male fish in 2009. |

Projections and Prognosis

| | |
|--|---|
| Stock Projections or Prognosis | Based on the broad size composition in the survey, high biomass levels are expected to persist in the short-term. |
| Probability of Current Catch / TACC causing decline below Limits | Soft Limit: Unknown Hard Limit: Unknown |

Assessment Methodology

| | | |
|--|--|-----------------------|
| Assessment Type | Level 2: Partial Quantitative Stock Assessment | |
| Assessment Method | Evaluation of survey biomass trends and length frequencies. | |
| Assessment Date | Latest assessment: 2009 | Next assessment: 2013 |
| Overall assessment quality rank | 1 – High Quality. The Southern Inshore Working Group agreed that the West Coast South Island survey was a credible measure of biomass. | |
| Main data inputs (rank) | West Coast South Island survey biomass length frequency | 1 – High Quality |
| Data not used (rank) | - | |
| Changes to Model Structure and Assumptions | - | |
| Major Sources of Uncertainty | - | |

Qualifying Comments

| |
|---|
| - |
|---|

Fishery Interactions

Red cod are primarily taken in conjunction with the following QMS species: stargazer, red gurnard, tarakihi and various other species in the West Coast South Island target bottom trawl fishery. Smooth skates are caught as a bycatch in this fishery, and the biomass index for smooth skates in the west coast trawl survey has declined substantially since 1997. There may be similar concerns for rough skates but the evidence is less conclusive. Incidental captures of seabirds occur.

Yield estimates, TACCs and reported landings for the 2012–13 fishing year are summarised in Table 6.

Table 6: Summary of yield estimates (t), TACCs (t) and reported landings (t) of red cod for the most recent fishing year. *MCY(1)* from eY_{AV} method, *MCY(2)* from MIAEL method (range only given).

| Fishstock | FMA | | <i>MCY(1)</i> | <i>MCY(2)</i> | 2012–13 Actual TACC | 2012–13 Reported landings |
|-----------|---|--------------|---------------|---------------|------------------------|------------------------------|
| RCO 1 | Auckland (East) (West) | 1 & 9 | 60 | | 42 | 6 |
| RCO 2 | Central (East) (West) | 2 & 8 | | 500 | 500 | 300 |
| RCO 3 | South-East, Southland and Sub-Antarctic | 3, 4, 5, & 6 | 4 400 | 2 418–13 330 | 4 600 | 5 292 |
| RCO 7 | Challenger | 7 | 800 | 2 568–3 452 | 3 126 | 1 282 |
| RCO 10 | Kermadec | 10 | - | | 10 | 0 |
| Total | | | 5 260 | | 8 278 | 6 881 |

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