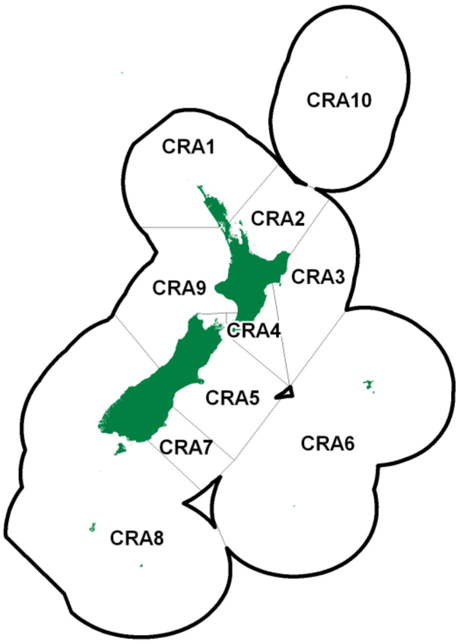
# INTRODUCTION –RED ROCK LOBSTER (CRA)

(*Jasus edwardsii*)
Crayfish, Kōura papatea




## 1. FISHERY SUMMARY

Two species of rock lobsters are taken in New Zealand coastal waters. The red rock lobster (*Jasus edwardsii*) supports nearly all the landings and is caught all around the North Island and South Island, Stewart Island, and the Chatham Islands. The packhorse rock lobster (*Sagmariasus verreauxi*) is taken by a targeted fishery centred in the Northland region and also in the bycatch of the red rock lobster fishery around Northland and the Bay of Plenty (Roberts & Webber 2021). Packhorse rock lobsters (PHC) grow to a much larger size than red rock lobsters (CRA) and have different shell colouration and shape. A 2020 stock assessment for this species, along with its catch history and other introductory content, is presented in a separate chapter.

### 1.1 Commercial fisheries

The rock lobster fisheries were brought into the Quota Management System (QMS) on 1 April 1990, when Total Allowable Commercial Catches (TACCs) were set for each Quota Management Area (QMA) shown in the figure above. Before this, rock lobster fishing was managed by input controls, including limited entry, minimum legal size (MLS) regulations, a prohibition on the taking of berried females and soft-shelled lobsters, and some local area closures. Most of these input controls have been retained, but the limited entry provisions were removed and allocation of individual transferable quota (ITQ) was made to the previous licence holders based on catch history.

Historically, three rock lobster stocks were recognised for stock assessment purposes:

- NSI – the North Island and South Island (including Stewart Island) red rock lobster stock
- CHI – the Chatham Islands red rock lobster stock
- PHC –the New Zealand packhorse rock lobster stock

In 1994, the Rock Lobster Working Group (RLWG) agreed to divide the NSI stock into three sub-stocks based on groupings of the existing QMAs (without assigning CRA 9):

- NSN –the northern stocks CRA 1 and 2
- NSC –the central stocks CRA 3, 4, and 5
- NSS –the southern stocks CRA 7 and 8

Since 2001, stock assessments have been carried out at the QMA level. Beginning in 2016, stock assessments have looked for differences in fishery data trends and biology among statistical areas within a QMA, with the intent of representing finer scale spatial variability in the stock assessment population model when appropriate. The fishing year runs from 1 April to 31 March.

TACs (Total Allowable Catches which include TACCs plus all non-commercial allowances) were set for the first time in 1997–98 for three CRA QMAs (CRA 2, CRA 3, CRA 6). Setting a TAC is a requirement under the Fisheries Act 1996 and TACs have been reset whenever adjustments have been made to the TACCs or non-commercial allowances. Table 1 presents, for each lobster QMA, the TAC, showing the TACC and the allowances for customary fishing, recreational fishing, and all other mortality caused by fishing while Table 2 summarises management actions for stocks since 1990. Figure 1 shows the historical commercial landings and TACC values for all CRA stocks. More details of the management history of each stock are provided in their respective chapters.

Management procedures (MPs) were used to adaptively manage TACCs for some rock lobster QMAs between 1996 and 2019 (Table 2). These rules were evaluated through computer simulations and were found to meet the requirements of the Fisheries Act. Use of these CPUE based procedures was discontinued following the introduction of an Electronic Reporting System (ERS) in 2019, however, because of concerns that these data were not reported in a manner consistent with the CELR data that previously evaluated procedures were based on (see section 1.1.1 below). In 2024, MPs were reintroduced for CRA 7 and CRA 8 following the evaluation of new CPUE series (based on ERS data for CRA 7 and Logbook (LB) data for CRA 8).

Commercial landings in 2019–20 were affected by the worldwide COVID-19 pandemic, resulting in a failure to catch the full TACC in many QMAs. This was caused by a combination of market factors, particularly a sudden slump in demand for rock lobsters during the 2020 Chinese New Year. The Minister of Fisheries authorised a carry-over (up to 10%) of uncaught ACE (Annual Catch Entitlement) in each QMA (except for CRA 1, which had its TACC reduced for 2020–21). As a result of this authorisation, the 2020–21 TACCs were exceeded in CRA 2 (by 4.9%), CRA 4 (10%), CRA 5 (3.9%), CRA 6 (8.6%), CRA 7 (1.5%), CRA 8 (9.2%), and CRA 9 (3.8%).

**Table 1: April 2025 TAC, TACC, and non-commercial allowances (all in tonnes) for customary fishing, recreational fishing, and all other mortality caused by fishing for the red rock lobster QMAs.**

| Fishstock | Recreational allowance | Customary non-commercial allowance | Other mortality | TACC | TAC |
|---|---|---|---|---|---|
| CRA 1 | 22 | 20 | 41 | 89 | 172 |
| CRA 2 | 34 | 16.5 | 42.5 | 80 | 173 |
| CRA 3 | 8 | 20 | 60 | 156 | 244 |
| CRA 4 | 40 | 35 | 33 | 280 | 388 |
| CRA 5 | 87 | 40 | 37 | 350 | 514 |
| CRA 6 | 6 | 4 | 0 | 360 | 370 |
| CRA 7 | 5 | 10 | 11 | 111.5 | 137.5 |
| CRA 8 | 39 | 30 | 140 | 1 392 | 1 601 |
| CRA 9 | 30 | 20 | 5 | 60.8 | 115.8 |
| PHC 1 | 15 | 10 | 5 | 49.3 | 79.3 |

The MLS in the commercial fishery for red rock lobster is based on tail width (TW), except for CRA 7, where the MLS for commercial fishing is a tail length (TL) of 127 mm for both sexes. The female MLS in all other rock lobster QMAs (except CRA 8) has been 60 mm TW since mid-1992. For CRA 8, the female MLS has been 57 mm TW since 1990. The male MLS has been 54 mm TW for all QMAs since 1988, except in CRA 7 (see above) and CRA 3, where, since 1993, it has been 52 mm TW for the June-

August period. A closed season applies in CRA 6 from 1 March to 30 April in each year. For recreational fishers, the red rock lobster MLS has been 54 mm TW for males since 1990 and 60 mm TW for females since 1992, in all areas. There is also a general prohibition for all commercial and recreational fisheries in all QMAs against the taking of females carrying eggs (berried) and post-moulting (soft-shelled) individuals.

**Table 2: Summary of management actions by QMA since 1990 up to 1 April 2025 for red rock lobster stocks:**

| QMA | Frequency of review | First and last year MP calculated | Year of TACC/TAC changes since 1990 |
|---|---|---|---|
| CRA 1 (Northland) | 5 years | 2015, 2018 | 1991, 1992, 1993, 1996, 1999, 2015,2020, 2022, 2023 |
| CRA 2 (Bay of Plenty)[1] | 5 years | 2014, 2016 | 1991, 1992, 1993, 1997, 2014, 2018 |
| CRA 3 (Gisborne)[2] | 5 years | 2005, 2018 | 1991, 1992, 1993, 1996, 1997, 1998, 2005, 2009, 2012, 2013, 2014, 2017, 2019, 2021, 2024 |
| CRA 4 (Wellington/Hawke Bay)[3] | 5 years | 2007, 2019 | 1991, 1992, 1993, 1999, 2009, 2010, 2011, 2013, 2014, 2016, 2017, 2018, 2021 |
| CRA 5 (Canterbury/Marlborough) | 5 years | 2009, 2019 | 1991, 1992, 1993, 1996, 1999, 2016 |
| CRA 6 (Chatham Islands) | 5 years | Not applicable | 1991, 1993, 1997, 1998 |
| CRA 7 (Otago) | 5 years | 1996, 2019 | 1991, 1992, 1993, 1996, 1999, 2001, 2004, 2006, 2008, 2009, 2010, 2011, 2012, 2013, 2014, 2015, 2017, 2018, 2020, 2022, 2025 |
| CRA 8 (Southern) | 5 years | 1996, 2024 | 1991, 1992, 1993, 1999, 2001, 2004, 2006, 2008, 2009, 2011, 2018, 2019, 2020, 2022, 2024 |
| CRA 9 (Westland/Taranaki) | Suspended in 2016 | 2014 | 1991, 1992, 1993, 2014 |
| CRA 10 (Kermadec Island) | Unspecified | Not applicable | – |

Voluntary TACC reductions through shelving of ACE:
[1] CRA 2: reduced to 175 t in 2015–16, 150 t in 2016–17 and 2017–18,
[2]CRA 3: reduced to 195 t in 2004–05, 139 t in 2024–25 and 2025-26,
[3]CRA 4: reduced to 340 t in 2007–08 and 250 t in 2008–09.

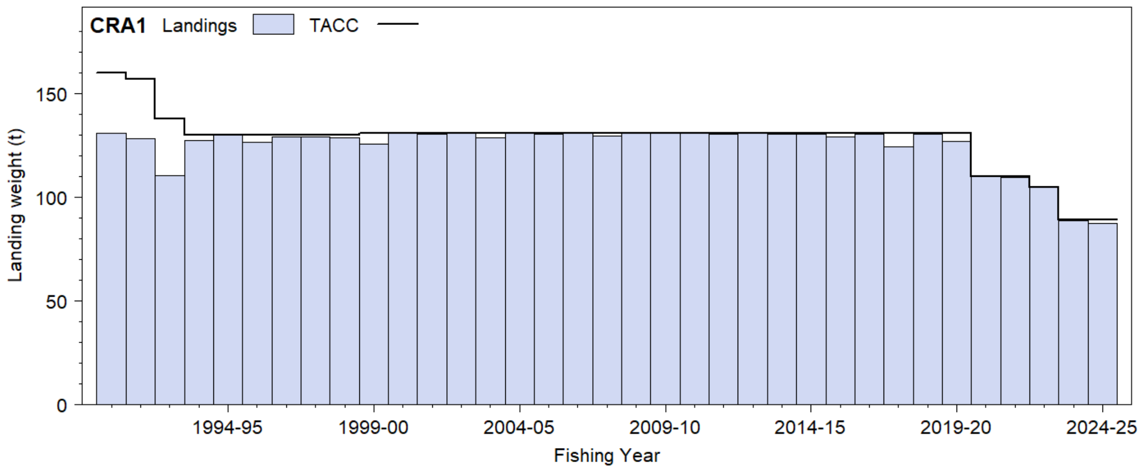



**Figure 1: Historical landings and TACC for the nine main CRA stocks. Dashed lines denote voluntary shelving limits when applied [Continued on next 3 pages]**

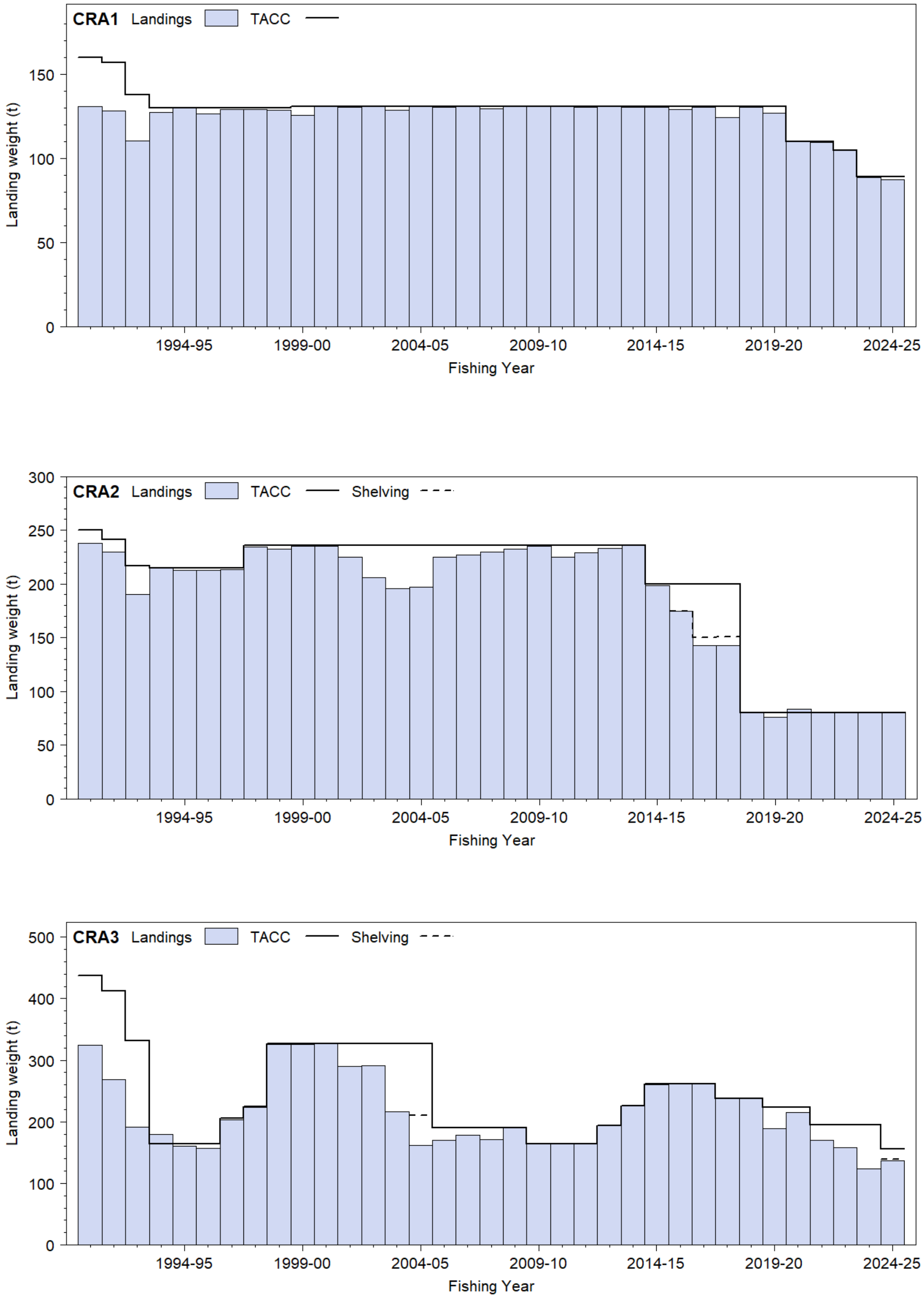
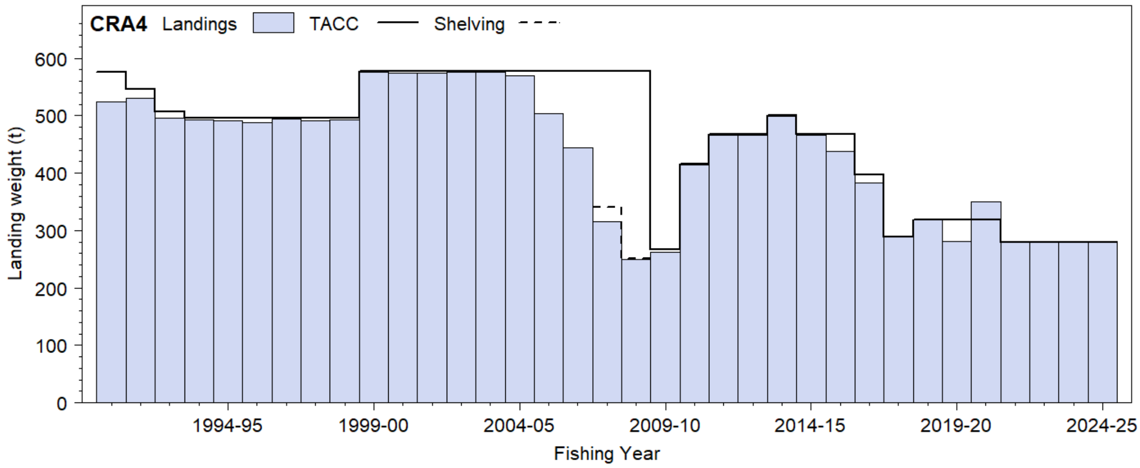
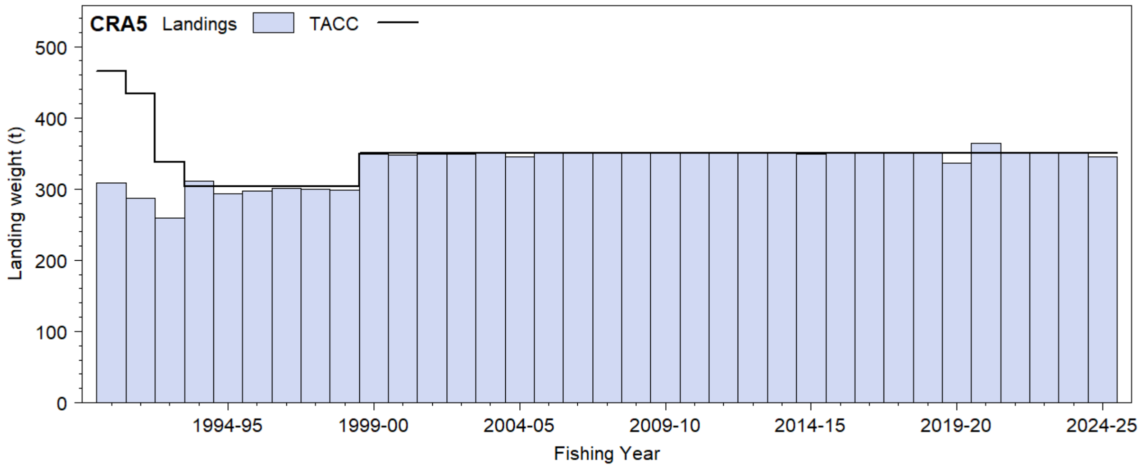
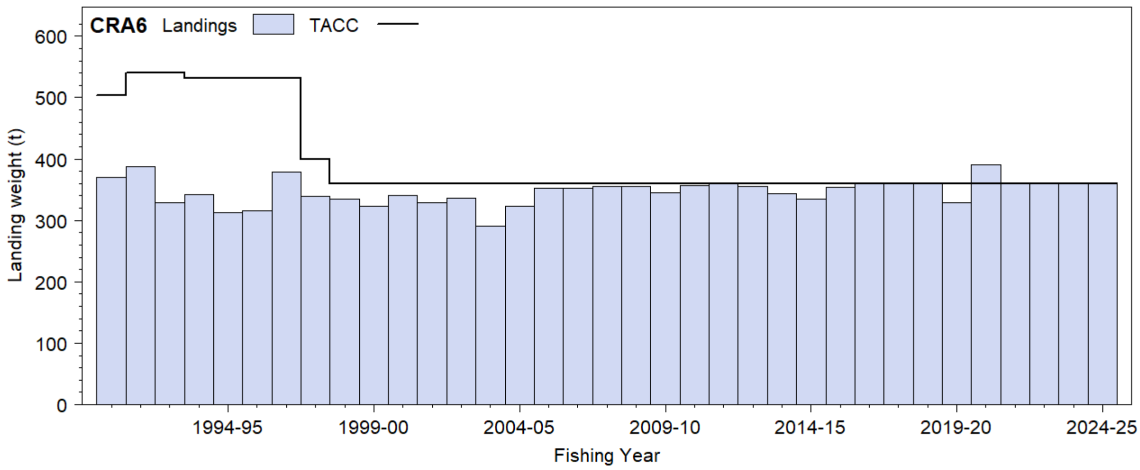



**Figure 1: [Continued]**

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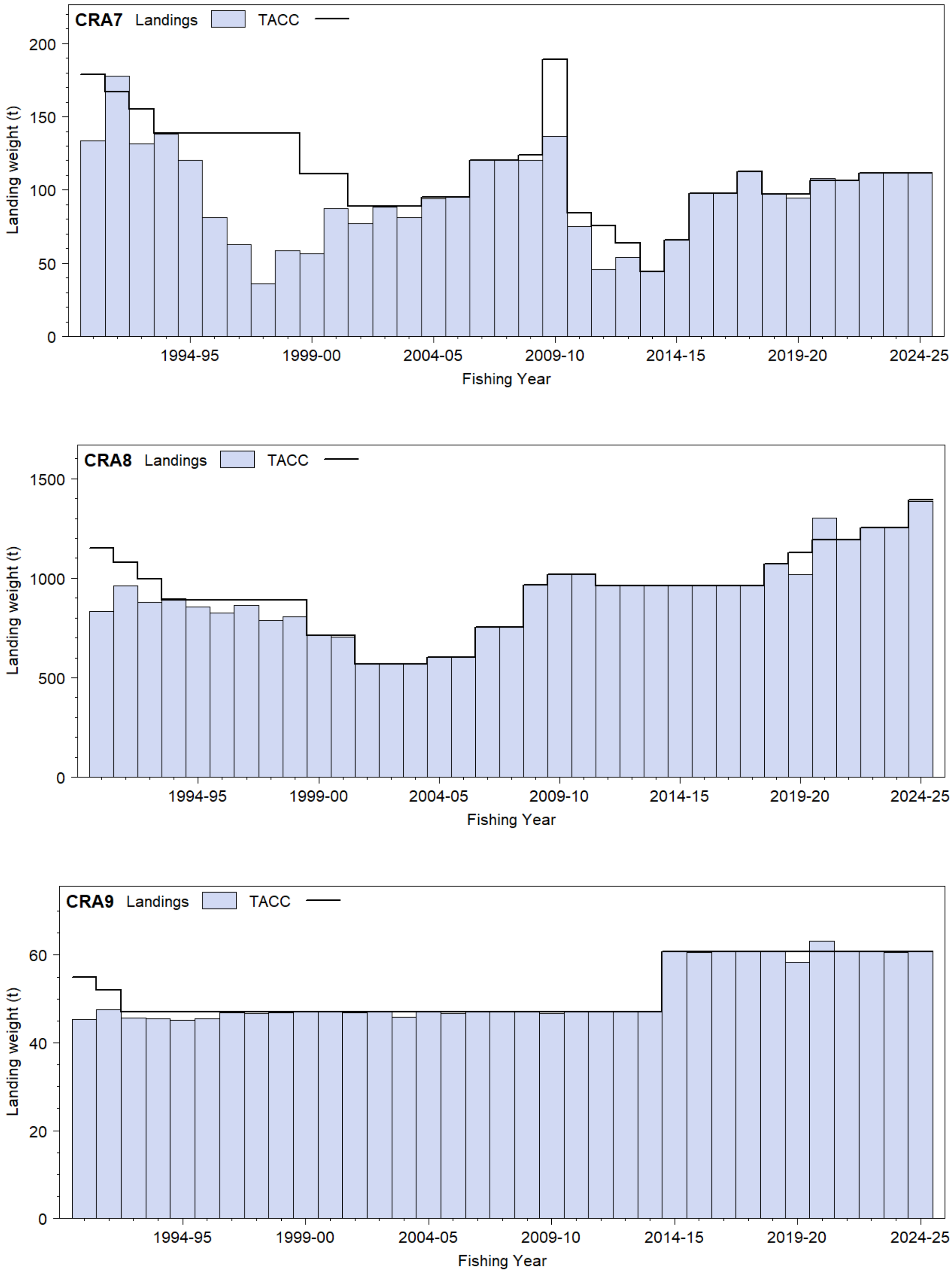


**Figure 1: [Continued]**

Table 3 provides a summary by fishing year of the reported commercial catches, TACCs, and TACs by Fishstock (CRA). The Quota Management Reports (QMRs) and their replacement Monthly Harvest Returns (MHRs, since 1 October 2001) provide the most accurate information on landings. Other sources of annual catch estimates include the Licensed Fish Receiver Returns (LFRRs), the Catch Effort and Landing Returns (CELRs), and the replacement Electronic Reporting System (ERS).

**Table 3: Reported commercial catch (t) from QMRs or MHRs (after 1 October 2001), TACC (t), and TAC (t) (where this quantity has been set) for *Jasus edwardsii* by rock lobster QMA for each fishing year since the species was included in the QMS on 1 April 1990. '–': TAC not set for QMA or catch not available (current fishing year). [Continued on next page]**

| | CRA 1 | | | CRA 2 | | | CRA 3 | | | CRA 4 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fishing year | Catch | TACC | TAC | Catch | TACC | TAC | Catch | TACC | TAC | Catch | TACC | TAC |
| 1990–91 | 131.1 | 160.1 | – | 237.6 | 249.5 | – | 324.1 | 437.1 | – | 523.2 | 576.3 | – |
| 1991–92 | 128.3 | 157.0 | – | 229.7 | 241.3 | – | 268.8 | 411.9 | – | 530.5 | 545.7 | – |
| 1992–93 | 110.5 | 138.0 | – | 190.3 | 216.6 | – | 191.5 | 330.9 | – | 495.7 | 506.7 | – |
| 1993–94 | 127.4 | 130.5 | – | 214.9 | 214.6 | – | 179.5 | 163.9 | – | 492.0 | 495.7 | – |
| 1994–95 | 130.0 | 130.5 | – | 212.8 | 214.6 | – | 160.7 | 163.9 | – | 490.4 | 495.7 | – |
| 1995–96 | 126.7 | 130.5 | – | 212.5 | 214.6 | – | 156.9 | 163.9 | – | 487.2 | 495.7 | – |
| 1996–97 | 129.4 | 130.5 | – | 213.2 | 214.6 | – | 203.5 | 204.9 | – | 493.6 | 495.7 | – |
| 1997–98 | 129.3 | 130.5 | – | 234.4 | 236.1 | 452.6 | 223.4 | 224.9 | 379.4 | 490.4 | 495.7 | – |
| 1998–99 | 128.7 | 130.5 | – | 232.3 | 236.1 | 452.6 | 325.7 | 327.0 | 453.0 | 493.3 | 495.7 | – |
| 1999–00 | 125.7 | 131.1 | – | 235.1 | 236.1 | 452.6 | 326.1 | 327.0 | 453.0 | 576.5 | 577.0 | 771.0 |
| 2000–01 | 130.9 | 131.1 | – | 235.4 | 236.1 | 452.6 | 328.1 | 327.0 | 453.0 | 573.8 | 577.0 | 771.0 |
| 2001–02 | 130.6 | 131.1 | – | 225.0 | 236.1 | 452.6 | 289.9 | 327.0 | 453.0 | 574.1 | 577.0 | 771.0 |
| 2002–03 | 130.8 | 131.1 | – | 205.7 | 236.1 | 452.6 | 291.3 | 327.0 | 453.0 | 575.7 | 577.0 | 771.0 |
| 2003–04 | 128.7 | 131.1 | – | 196.0 | 236.1 | 452.6 | 215.9 | 327.0 | 453.0 | 575.7 | 577.0 | 771.0 |
| 2004–05 | 130.8 | 131.1 | – | 197.3 | 236.1 | 452.6 | 162.0 | 327.0 | 453.0 | 569.9 | 577.0 | 771.0 |
| 2005–06 | 130.5 | 131.1 | – | 225.2 | 236.1 | 452.6 | 170.1 | 190.0 | 319.0 | 504.1 | 577.0 | 771.0 |
| 2006–07 | 130.8 | 131.1 | – | 226.5 | 236.1 | 452.6 | 178.7 | 190.0 | 319.0 | 444.6 | 577.0 | 771.0 |
| 2007–08 | 129.8 | 131.1 | – | 229.7 | 236.1 | 452.6 | 172.4 | 190.0 | 319.0 | 315.2 | 577.0 | 771.0 |
| 2008–09 | 131.0 | 131.1 | – | 232.3 | 236.1 | 452.6 | 189.8 | 190.0 | 319.0 | 249.4 | 577.0 | 771.0 |
| 2009–10 | 130.9 | 131.1 | – | 235.2 | 236.1 | 452.6 | 164.0 | 164.0 | 293.0 | 262.2 | 266.0 | 461.0 |
| 2010–11 | 130.8 | 131.1 | – | 224.8 | 236.1 | 452.6 | 163.7 | 164.0 | 293.0 | 414.8 | 415.6 | 610.6 |
| 2011–12 | 130.4 | 131.1 | – | 229.0 | 236.1 | 452.6 | 163.9 | 164.0 | 293.0 | 466.2 | 466.9 | 661.9 |
| 2012–13 | 130.9 | 131.1 | – | 234.3 | 236.1 | 452.6 | 193.3 | 193.3 | 322.3 | 466.3 | 466.9 | 661.9 |
| 2013–14 | 130.3 | 131.1 | – | 235.7 | 236.1 | 452.6 | 225.5 | 225.5 | 354.5 | 499.4 | 499.7 | 694.7 |
| 2014–15 | 130.2 | 131.1 | – | 198.6 | 200.0 | 416.5 | 260.4 | 261.0 | 390.0 | 465.5 | 467.0 | 662.0 |
| 2015–16 | 129.4 | 131.1 | 273.1 | 174.7 | 200.0 | 416.5 | 260.8 | 261.0 | 390.0 | 438.1 | 467.0 | 662.0 |
| 2016–17 | 130.6 | 131.1 | 273.1 | 142.5 | 200.0 | 416.5 | 260.9 | 261.0 | 390.0 | 382.9 | 397.0 | 592.0 |
| 2017–18 | 124.3 | 131.1 | 273.1 | 142.8 | 200.0 | 416.5 | 237.7 | 237.9 | 366.9 | 289.0 | 289.0 | 484.0 |
| 2018–19 | 130.6 | 131.1 | 273.1 | 80.0 | 80.0 | 173.0 | 238.1 | 237.9 | 366.9 | 318.4 | 318.8 | 513.8 |
| 2019–20 | 126.9 | 131.1 | 273.1 | 76.0 | 80.0 | 173.0 | 189.0 | 222.9 | 351.9 | 280.3 | 318.8 | 513.8 |
| 2020–21 | 110.0 | 110.0 | 203.0 | 83.9 | 80.0 | 173.0 | 215.4 | 222.9 | 351.9 | 350.5 | 318.8 | 513.8 |
| 2021–22 | 109.7 | 110.0 | 203.0 | 80.0 | 80.0 | 173.0 | 170.0 | 195.0 | 302.0 | 279.7 | 280.0 | 388.0 |
| 2022–23 | 104.9 | 105.0 | 193.0 | 80.0 | 80.0 | 173.0 | 157.7 | 195.0 | 302.0 | 279.2 | 280.0 | 388.0 |
| 2023–24 | 88.7 | 89.0 | 172.0 | 80.0 | 80.0 | 173.0 | 123.7 | 195.0 | 302.0 | 280.0 | 280.0 | 388.0 |
| 2024–25 | 87.7 | 89.0 | 172.0 | 80.0 | 80.0 | 173.0 | 137.0 | 156.0 | 244.0 | 279.8 | 280.0 | 388.0 |

| | CRA 5 | | | CRA 6 | | | CRA 7 | | | CRA 8 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Fishing year | Catch | TACC | TAC | Catch | TACC | TAC | Catch | TACC | TAC | Catch | TACC | TAC |
| 1990–91 | 308.6 | 465.2 | – | 369.7 | 503.0 | – | 133.4 | 179.4 | – | 834.5 | 1 152.4 | – |
| 1991–92 | 287.4 | 433.7 | – | 388.3 | 539.6 | – | 177.7 | 166.8 | – | 962.7 | 1 077.0 | – |
| 1992–93 | 258.8 | 337.7 | – | 329.4 | 539.6 | – | 131.6 | 154.5 | – | 876.5 | 993.7 | – |
| 1993–94 | 311.0 | 303.7 | – | 341.8 | 530.6 | – | 138.1 | 138.9 | – | 896.1 | 888.1 | – |
| 1994–95 | 293.9 | 303.7 | – | 312.5 | 530.6 | – | 120.3 | 138.9 | – | 855.6 | 888.1 | – |
| 1995–96 | 297.6 | 303.7 | – | 315.3 | 530.6 | – | 81.3 | 138.9 | – | 825.6 | 888.1 | – |
| 1996–97 | 300.3 | 303.2 | – | 378.3 | 530.6 | – | 62.9 | 138.7 | – | 862.4 | 888.1 | – |
| 1997–98 | 299.6 | 303.2 | – | 338.7 | 400.0 | 480.0 | 36.0 | 138.7 | – | 785.6 | 888.1 | – |
| 1998–99 | 298.2 | 303.2 | – | 334.2 | 360.0 | 370.0 | 58.6 | 138.7 | – | 808.1 | 888.1 | – |
| 1999–00 | 349.5 | 350.0 | 467.0 | 322.4 | 360.0 | 370.0 | 56.5 | 111.0 | 131.0 | 709.8 | 711.0 | 798.0 |
| 2000–01 | 347.4 | 350.0 | 467.0 | 342.7 | 360.0 | 370.0 | 87.2 | 111.0 | 131.0 | 703.4 | 711.0 | 798.0 |
| 2001–02 | 349.1 | 350.0 | 467.0 | 328.7 | 360.0 | 370.0 | 76.9 | 89.0 | 109.0 | 572.1 | 568.0 | 655.0 |
| 2002–03 | 348.7 | 350.0 | 467.0 | 336.3 | 360.0 | 370.0 | 88.6 | 89.0 | 109.0 | 567.1 | 568.0 | 655.0 |
| 2003–04 | 349.9 | 350.0 | 467.0 | 290.4 | 360.0 | 370.0 | 81.4 | 89.0 | 109.0 | 567.6 | 568.0 | 655.0 |
| 2004–05 | 345.1 | 350.0 | 467.0 | 323.0 | 360.0 | 370.0 | 94.2 | 94.9 | 114.9 | 603.0 | 603.4 | 690.4 |
| 2005–06 | 349.5 | 350.0 | 467.0 | 351.7 | 360.0 | 370.0 | 95.0 | 94.9 | 114.9 | 603.2 | 603.4 | 690.4 |
| 2006–07 | 349.8 | 350.0 | 467.0 | 352.1 | 360.0 | 370.0 | 120.2 | 120.2 | 140.2 | 754.9 | 755.2 | 842.2 |
| 2007–08 | 349.8 | 350.0 | 467.0 | 356.0 | 360.0 | 370.0 | 120.1 | 120.2 | 140.2 | 752.4 | 755.2 | 842.2 |
| 2008–09 | 349.7 | 350.0 | 467.0 | 355.3 | 360.0 | 370.0 | 120.3 | 123.9 | 143.9 | 966.0 | 966.0 | 1 053.0 |
| 2009–10 | 349.9 | 350.0 | 467.0 | 345.2 | 360.0 | 370.0 | 136.5 | 189.0 | 209.0 | 1 018.3 | 1 019.0 | 1 110.0 |
| 2010–11 | 350.0 | 350.0 | 467.0 | 357.4 | 360.0 | 370.0 | 74.8 | 84.5 | 104.5 | 1 018.3 | 1 019.0 | 1 110.0 |
| 2011–12 | 350.0 | 350.0 | 467.0 | 359.7 | 360.0 | 370.0 | 45.7 | 75.7 | 95.7 | 961.2 | 962.0 | 1 053.0 |
| 2012–13 | 350.0 | 350.0 | 467.0 | 355.9 | 360.0 | 370.0 | 53.8 | 63.9 | 83.9 | 960.8 | 962.0 | 1 053.0 |
| 2013–14 | 350.0 | 350.0 | 467.0 | 343.6 | 360.0 | 370.0 | 44.0 | 44.0 | 64.0 | 964.6 | 962.0 | 1 053.0 |

**Table 3:[Continued]**

| Fishing | CRA 5 | | | CRA 6 | | | CRA 7 | | | CRA 8 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| year | Catch | TACC | TAC | Catch | TACC | TAC | Catch | TACC | TAC | Catch | TACC | TAC |
| 2014–15 | 349.2 | 350.0 | 467.0 | 334.5 | 360.0 | 370.0 | 66.0 | 66.0 | 86.0 | 962.0 | 962.0 | 1 053.0 |
| 2015–16 | 350.1 | 350.0 | 467.0 | 353.3 | 360.0 | 370.0 | 97.6 | 97.7 | 117.7 | 961.8 | 962.0 | 1 053.0 |
| 2016–17 | 350.0 | 350.0 | 514.0 | 359.5 | 360.0 | 370.0 | 97.6 | 97.7 | 117.7 | 962.0 | 962.0 | 1 053.0 |
| 2017–18 | 350.0 | 350.0 | 514.0 | 359.1 | 360.0 | 370.0 | 112.7 | 112.5 | 132.5 | 961.9 | 962.0 | 1 053.0 |
| 2018–19 | 349.9 | 350.0 | 514.0 | 359.9 | 360.0 | 370.0 | 97.0 | 97.0 | 117.0 | 1 070.6 | 1 070.7 | 1 161.7 |
| 2019–20 | 336.2 | 350.0 | 514.0 | 328.7 | 360.0 | 370.0 | 94.5 | 97.0 | 117.0 | 1 017.5 | 1 129.6 | 1 220.6 |
| 2020–21 | 363.7 | 350.0 | 514.0 | 390.9 | 360.0 | 370.0 | 107.8 | 106.2 | 126.2 | 1 301.8 | 1 191.7 | 1 282.7 |
| 2021–22 | 350.0 | 350.0 | 514.0 | 359.9 | 360.0 | 370.0 | 106.3 | 106.2 | 126.2 | 1 191.1 | 1 191.7 | 1 282.7 |
| 2022–23 | 350.0 | 350.0 | 514.0 | 359.1 | 360.0 | 370.0 | 111.7 | 111.5 | 134.5 | 1 251.6 | 1 251.0 | 1 453.0 |
| 2023–24 | 350.0 | 350.0 | 514.0 | 359.8 | 360.0 | 370.0 | 111.7 | 111.5 | 134.5 | 1 251.2 | 1 251.0 | 1 453.0 |
| 2024–25 | 344.6 | 350.0 | 514.0 | 360.3 | 360.0 | 370.0 | 111.5 | 111.5 | 134.5 | 1 386.9 | 1 392.0 | 1 601.0 |

**Table 3: [Continued]**

| Fishing | CRA 9 | | | Total | | |
|---|---|---|---|---|---|---|
| year | Catch | TACC | TAC | Catch[1] | TACC[1] | TAC[1] |
| 1990–91 | 45.3 | 54.7 | – | 2 907.4 | 3 777.8 | – |
| 1991–92 | 47.5 | 51.5 | – | 3 020.9 | 3 624.5 | – |
| 1992–93 | 45.7 | 47.1 | – | 2 629.9 | 3 264.9 | – |
| 1993–94 | 45.5 | 47.0 | – | 2 746.2 | 2 913.0 | – |
| 1994–95 | 45.2 | 47.0 | – | 2 621.5 | 2 913.0 | – |
| 1995–96 | 45.4 | 47.0 | – | 2 548.6 | 2 913.0 | – |
| 1996–97 | 46.9 | 47.0 | – | 2 690.5 | 2 953.3 | – |
| 1997–98 | 46.7 | 47.0 | – | 2 584.2 | 2 864.1 | 1 312.0 |
| 1998–99 | 46.9 | 47.0 | – | 2 726.0 | 2 926.2 | 1 275.6 |
| 1999–00 | 47.0 | 47.0 | – | 2 748.5 | 2 850.2 | 3 442.6 |
| 2000–01 | 47.0 | 47.0 | – | 2 795.9 | 2 850.2 | 3 442.6 |
| 2001–02 | 46.8 | 47.0 | – | 2 593.0 | 2 685.2 | 3 277.6 |
| 2002□03 | 47.0 | 47.0 | – | 2 591.1 | 2 685.2 | 3 277.6 |
| 2003–04 | 45.9 | 47.0 | – | 2 451.5 | 2 685.2 | 3 277.6 |
| 2004–05 | 47.0 | 47.0 | – | 2 472.3 | 2 726.4 | 3 318.8 |
| 2005–06 | 46.6 | 47.0 | – | 2 475.8 | 2 589.4 | 3 184.8 |
| 2006–07 | 47.0 | 47.0 | – | 2 604.6 | 2 766.6 | 3 362.0 |
| 2007–08 | 47.0 | 47.0 | – | 2 472.5 | 2 766.6 | 3 362.0 |
| 2008–09 | 47.0 | 47.0 | – | 2 640.7 | 2 981.0 | 3 576.5 |
| 2009–10 | 46.6 | 47.0 | – | 2 688.8 | 2 762.2 | 3 362.6 |
| 2010–11 | 47.0 | 47.0 | – | 2 781.7 | 2 807.3 | 3 407.7 |
| 2011–12 | 47.0 | 47.0 | – | 2 753.0 | 2 792.8 | 3 393.2 |
| 2012–13 | 47.0 | 47.0 | – | 2 792.2 | 2 810.3 | 3 410.7 |
| 2013–14 | 47.1 | 47.0 | – | 2 840.1 | 2 855.4 | 3 455.8 |
| 2014–15 | 60.8 | 60.8 | 115.8 | 2 827.2 | 2 857.8 | 3 560.3 |
| 2015–16 | 60.6 | 60.8 | 115.8 | 2 826.5 | 2 889.5 | 3 865.0 |
| 2016–17 | 60.8 | 60.8 | 115.8 | 2 746.7 | 2 819.5 | 3 842.0 |
| 2017–18 | 60.7 | 60.8 | 115.8 | 2 638.1 | 2 703.2 | 3 725.7 |
| 2018–19 | 60.8 | 60.8 | 115.8 | 2 705.2 | 2 706.2 | 3 605.2 |
| 2019–20 | 58.4 | 60.8 | 115.8 | 2 507.4 | 2 750.2 | 3 649.2 |
| 2020–21 | 63.1 | 60.8 | 115.8 | 2 987.2 | 2 800.4 | 3 650.4 |
| 2021–22 | 60.8 | 60.8 | 115.8 | 2 707.9 | 2 733.7 | 3 474.7 |
| 2022–23 | 60.8 | 60.8 | 115.8 | 2 754.9 | 2 793.3 | 3 643.3 |
| 2023–24 | 60.6 | 60.8 | 115.8 | 2 705.5 | 2 777.3 | 3 622.3 |
| 2024–25 | 60.7 | 60.8 | 115.8 | 2 848.5 | 2 879.3 | 3 712.3 |

[1] does not include CRA 10.

### 1.1.1 Rock lobster commercial catch and effort data

All catch and effort data reported by commercial rock lobster fishers between 1989–90 and 2018–19 was recorded on paper CELR forms. There were two types of data recorded on a CELR form: the top part of each form contained the fishing effort and an estimated catch associated with that effort. The bottom part of the form contained the landed catch and other destination codes, which could span several records of effort. Estimated catches from the top part of the CELR form often showed large differences from the catch totals on the bottom part of the form, particularly in CRA 5 and CRA 8 (Vignaux & Kendrick 1998, Bentley et al. 2005b). Substantial discrepancies were identified in 1997 between the estimated and weighed catches in CRA 5 (Vignaux & Kendrick 1998), which were attributed to fishers including all rock lobster catch in the estimated total and included those returned to the sea by regulation. This led to an overestimate of CPUE, but this problem appeared to be confined to CRA 5 and was remedied by providing additional instruction to fishers on how to properly complete the forms.

After 1998, all CELR catch data used in stock assessments were modified to reflect the landed catch (bottom of form) rather than the estimated catch (top of form). This resulted in changes to the CPUE values compared with those reported before 1998.

Methods have been iteratively developed to deal with discrepancies between estimated and landed trip catch totals, including delayed landings of some catches from previous trips, which were temporarily placed in holding pots. The method that is currently used to scale estimated trip catch data to landed catch weights is the ‘F2’ procedure, which was adopted by the RLWG in 2012. This procedure is thought to better represent the estimation/landing/holding pot process and should be more robust to data errors and other uncertainties. The ‘F2’ method uses annual estimates, by vessel, of the ratio of landed catch divided by estimated catch to correct every estimated catch record in a QMA for the vessel for that year. Vessel-year combinations are removed entirely from the analysis when a Vessel Conversion Factor (*vcf*) ratio was less than 0.8 (overestimates of landed catch) or greater than 1.2 (underestimates of landed catch). Testing of the ‘F2’ method was undertaken to establish that CPUE series based on the new procedure did not differ substantially from previous series that were produced when using the previous ‘B4’ method (Bentley et al. 2005b). In general, the differences tended to be minor for most QMAs, with the exception of CRA 1 and CRA 9, where there were greater differences (Starr 2018). Use of *vcf* (Table 4) for likelihood weighting in CPUE standardisation has been developed and is now used in most recent CPUE standardisations of the mandatory catch/effort reporting.

The data used to calculate the standardised CPUE estimates for vessels with acceptable *vcf* ratios is subjected to error screening (Bentley et al. 2005b), with estimated catches being scaled using the ‘F2’ algorithm to the combined landings made to Licensed Fish Receivers (destination code ‘L’), section 111 landings for personal use (destination code ‘F’), and legal discards (destination code ‘X’). The RLWG accepted the use of these additional destination codes because of the increasing practice of discarding legal lobsters with the overall increase in abundance. The estimates of CPUE would be biased if discarded legal fish were not included in the analysis. The reporting of releases using destination code ‘X’ became mandatory on 1 April 2009, so this correction was not available before that date.

**Table 4: Percentage of vessels by fishing year and QMA which have annual vessel correction factors (*vcf*) between 0.8 and 1.2. The *vcf* is the ratio of the landings to estimated catches for a vessel in a fishing year and QMA. The 2019–20 fishing year was a transition year between CELR and electronic reporting, with the changeover complete by the end of September 2019. Vessels landing less than 1000 kg of CRA in a QMA for the year have been excluded from this analysis.**

| Fishing year | CRA 1 | CRA 2 | CRA 3 | CRA 4 | CRA 5 | CRA 6 | CRA 7 | CRA 8 | CRA 9 |
|---|---|---|---|---|---|---|---|---|---|
| **CELR (paper) data** | | | | | | | | | |
| 2009–10 | 85.7 | 91.4 | 88.5 | 89.1 | 85.2 | 86.5 | 78.9 | 78.5 | 85.7 |
| 2010–11 | 85.7 | 91.9 | 92.6 | 90.2 | 88.9 | 83.3 | 76.5 | 80.3 | 85.7 |
| 2011–12 | 92.3 | 94.3 | 96.0 | 90.4 | 92.9 | 94.3 | 75.0 | 84.1 | 66.7 |
| 2012–13 | 92.9 | 88.1 | 87.0 | 92.0 | 85.2 | 92.1 | 83.3 | 84.8 | 60.0 |
| 2013–14 | 78.6 | 91.9 | 80.8 | 85.4 | 77.8 | 97.1 | 77.8 | 79.7 | 60.0 |
| 2014–15 | 92.9 | 85.3 | 96.0 | 89.8 | 85.7 | 91.7 | 54.5 | 74.6 | 60.0 |
| 2015–16 | 92.3 | 87.5 | 100.0 | 89.8 | 82.8 | 89.2 | 58.3 | 80.0 | 62.5 |
| 2016–17 | 78.6 | 96.3 | 96.0 | 91.7 | 74.2 | 97.2 | 81.8 | 70.6 | 66.7 |
| 2017–18 | 69.2 | 96.4 | 84.0 | 95.1 | 82.8 | 92.7 | 72.7 | 60.6 | 66.7 |
| 2018–19 | 71.4 | 90.0 | 80.0 | 95.6 | 77.4 | 94.9 | 72.7 | 65.2 | 57.1 |
| 2019–20 | 76.9 | 100.0 | 82.6 | 82.1 | 75.0 | 87.5 | 80.0 | 57.4 | 50.0 |
| **Electronic reporting data** | | | | | | | | | |
| 2019–20 | 50.0 | 66.7 | 62.5 | 57.1 | 41.2 | 54.3 | 100.0 | 57.1 | 50.0 |
| 2020–21 | 46.2 | 66.7 | 60.0 | 66.7 | 68.0 | 69.7 | 90.0 | 64.5 | 83.3 |
| 2021–22 | 61.5 | 62.5 | 81.0 | 61.1 | 80.8 | 79.5 | 100.0 | 61.5 | 57.1 |
| 2022–23 | 58.3 | 73.3 | 69.6 | 66.7 | 75.0 | 68.4 | 80.0 | 69.6 | 80.0 |
| 2023–24 | 54.5 | 80.0 | 81.8 | 68.8 | 54.2 | 69.4 | 81.8 | 73.1 | 80.0 |
| 2024–25 | 45.5 | 52.9 | 84.0 | 72.4 | 81.8 | 66.7 | 72.7 | 75.4 | 85.7 |

The RLWG reviewed data from 2019–20, the first year of reporting using the new electronic reporting system (ERS), by comparing the reporting of estimated catches under the two reporting systems. This was a transition year, with fishers having the new system introduced in a phased fashion from April–

September 2019. Thus, this review of the electronic reporting was for only a partial year, during which fishers were becoming accustomed to the new system. The review found a shift in the way that rock lobster estimated catch data were being reported under the new electronic reporting scheme, suggesting that data from the new system were not comparable with data from the previous system. The RLWG concluded that CPUE estimated under the new electronic reporting system was likely to differ from CPUE calculated under the previous paper form system for two reasons. Firstly, fewer vessels than previously would contribute to the CPUE calculation, because fewer vessels fell within the preferred 0.8 to 1.2 *vcf* range for data acceptability (see Table 4 caption for the definition of this *vcf* quantity and the associated estimates). Secondly, some vessels appeared to have changed the way they reported catches under the new regime when the progression of *vcf* ratios over time for an individual vessel was tracked. The RLWG has revisited this issue three times, after each complete year of ERS returns (successively covering the period 1 April 2020 to 31 March 2021, followed by 1 April 2021 to 31 March 2022 and then 1 April 2022 to 31 March 2023). Unfortunately, these reviews suggested that there had been no apparent change to the ERS reporting of estimated catches and that the previous conclusions were still valid (see Table 4).

### 1.1.2 Description of fisheries

**CRA 1**

CRA 1 extends from Kaipara Harbour on the west coast to Te Arai Point, south of Whangarei (Figure 2). This QMA includes the Three Kings Islands, designated as a separate area—statistical area 901. Commercial fishing has occurred on both sides of the Northland Peninsula, as well as at the Three Kings Islands. From 1 April 2025, the CRA 1 industry has voluntarily chosen to cease fishing on the east coast of CRA 1 in statistical areas 903, 904, and 905 for 5 years.

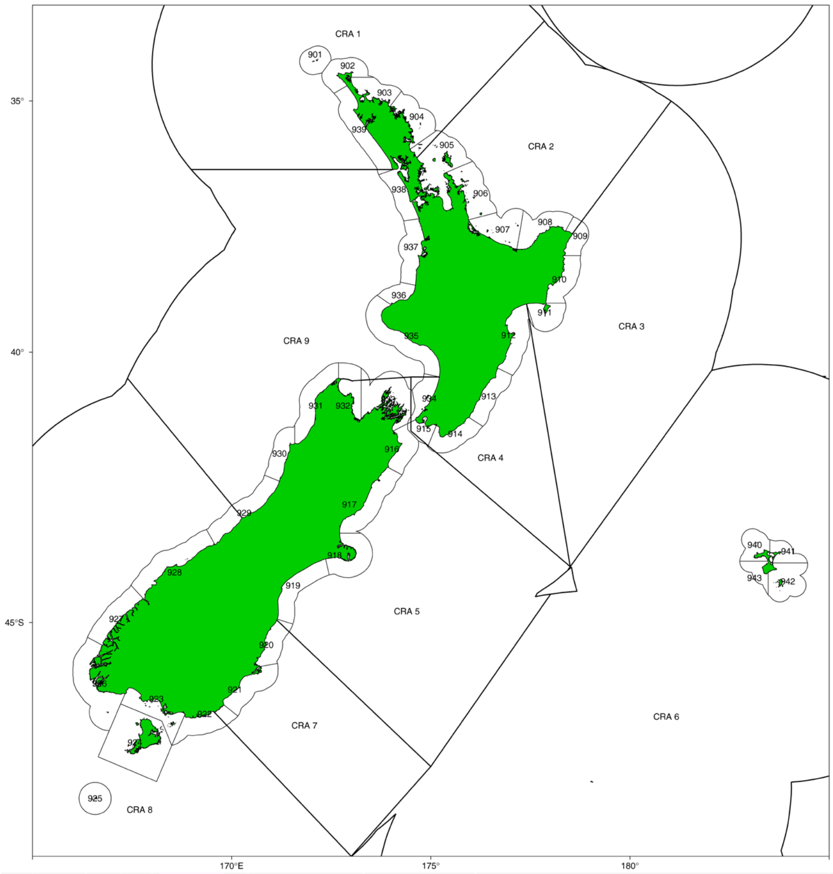


**Figure 2: Rock lobster statistical areas by QMA.**

A TAC was set for CRA 1 for the first time in 2015, even though the CRA 1 stakeholders elected to maintain the TACC at its original level (Table 3). Commercial landings remained at or near the 131 t TACC from the early 1990s up to 2019–20 (Table 3). The CRA 1 TACC was then reduced by 16% (21 t) for the 2020–21 fishing year to retain current levels of vulnerable biomass. The allowance for the recreational fishery was also reduced for the same year from 50 t to 32 t and the allowance for all other mortality caused by fishing was reduced from 72 t to 41 t, resulting in a 2020–21 CRA 1 TAC of 203 t. The TAC was reduced to 193 t for the 2022–23 fishing year by reducing the TACC by 5 t to 105 t and the recreational allowance from 32 t to 27 t. A further reduction in the CRA 1 TACC to 89 t and the recreational allowance to 22 t was made for the 2023–24 fishing, resulting in a 172 t TAC (Table 1). In the 2024–25 fishing year, there were 10 vessels operating in CRA 1, a drop from the 13–15 vessels that operated in this fishery from the mid-2000s (Starr & Roberts in prep.).

**CRA 2**

CRA 2 extends from Te Arai Point, south of Whangarei, to East Cape at the easternmost end of the Bay of Plenty. This QMA includes the Hauraki Gulf, both sides of the Coromandel Peninsula, and the Bay of Plenty. Commercial fishing is mainly confined to the Bay of Plenty, extending from the eastern side of the Coromandel Peninsula to East Cape. Lobster potting also occurs around Little Barrier Island and Great Barrier Island. From 1 April 2025, the Minister of Fisheries closed the inner Hauraki Gulf to commercial and recreational rock lobster fishing to address concerns of localised depletion. The closure is to be reviewed after 3 years. This fishery supports processing and export operations primarily in Tauranga, Whitianga, and Auckland. In response to apparent low biomass levels, the CRA 2 industry voluntarily shelved 25 t of the 200 t TACC in 2015–16, even though the operation of the MP did not require a TACC reduction. The amount of shelving was increased to 49 t for 2016–17 and 2017–18. After the 2017 stock assessment, the TAC was reduced for 2018–19 from 416.5 t to 173.1 t. This reduced TAC comprised an 80 t TACC, 34 t for recreational catch, 16.5 t for customary harvest, and 42.5 t for the allowance for all other mortality caused by fishing (Table 1). The TAC was reviewed for 2025–26 and the settings were retained. The number of vessels operating in CRA 2 dropped to below 20 after this drop in TACC, with 15 vessels operating in 2024–25 compared with 29 to 40 vessels operating in the previous three decades (Starr & Roberts in prep.).

**CRA 3**

CRA 3 extends from East Cape, around the Māhia Peninsula, to the Wairoa River (Figure 2). Commercial fishing occurs throughout this QMA. TACs and TACCs have been set for this QMA nine times since 2000–01, with the most recent change in the 2024–25 fishing year (Tables 1 and 2). The CRA 3 TACC was lowered to 238 t from 261 t for the 2017–18 fishing year and again to 223 t for the 2019–20 fishing year through the operation of the CRA 3 MP (Table 3). The CRA 3 TAC was lowered to 302 t for the 2021–22 fishing year through the Minister's decision-making process, with the TACC dropping to 195 t, the recreational allowance to 12 t, and the allowance for all other mortality caused by fishing to 75 t (Table 1). The CRA 3 TAC was reduced for the 2024–25 fishing year to 244 t, with at TACC of 156 t, a recreational fishery allowance of 8 t and the allowance for all other mortality caused by fishing dropping to 60 t. The customary fishery allowance has remained at 20 t since the CRA 3 TAC was introduced in the 2005–06 fishing year. The number of commercial vessels operating in CRA 3 has been below 30 since 2005–06, with 23 vessels operating in 2024–25 (Starr & Roberts in prep.).

Beginning with the 1993–94 fishing year, the CRA 3 fishery was closed, by regulation, to all users from September to the end of November. The commercial fishery was additionally shut for all of December up to 15 January. The month of May was also closed to commercial fishing. These regulatory closures ended after 2001–02, except for the May closure, which was retained until the end of the 2013–14 fishing year. After the regulatory closures were dropped in 2001–02, the fishing industry instituted a voluntary closure from 15 December to 15 January, beginning with the 2002–03 fishing year. From the 2008–09 fishing year, the voluntary closure was extended to start in September, but only in statistical areas 909 and 910. Industry in statistical area 911 (Māhia Peninsula) opted at that time to remain open in the spring-summer (SS) season but chose to impose a 54-mm MLS on all male lobster taken during the June to August winter fishery concession period (when the legal male MLS is 52 mm).

**CRA 4**

The CRA 4 fishery extends from the Wairoa River in northern Hawke's Bay, southwards through Hawke Bay, the Wairarapa and the Wellington coasts, then north to the Manawatu River on the Kapiti Coast (Figure 2). The CRA 4 TACC was reduced from 397 t to 289 t for the 2017–18 fishing year through the operation of a new CRA 4 MP resulting from the 2016 stock assessment. The operation of the same MP in 2017 resulted in an increase to the TACC to 319 t for the 2018–19 fishing year. However, the MP-recommended increases from 319 t to 380 t for 2019–20 and to 378 t in 2020–21 were both rejected by the Minister and the TACC remained at 319 t (Table 3). The CRA 4 TACC for the 2021–22 fishing year was lowered to 280 t through the Minister's decision-making process, with the recreational allowance lowered from 85 t to 40 t, the allowance for all other mortality caused by fishing lowered from 75 t to 33 t and the customary allowance left at 35 t, for a total TAC of 388 t (Table 1). Only 27 vessels operated in this fishery in 2024–25, a large drop from the 35 vessels operating in this fishery in 2020–21 and 2021–22 and an even larger drop from over 40 to 60 vessels which operated in this fishery in the two decades following 2000–01 (Starr & Roberts in prep.).

**CRA 5**

The CRA 5 fishery extends from the Golden Bay to the Marlborough Sounds across to Cape Jackson and then southwards to the Waitaki River (Figure 2). There are three distinct regions of commercial fishing—Picton/Port Underwood, Ward-Kaikōura-Motunau, and Banks Peninsula, although a small number of commercial vessels work the area from Nelson to D'Urville Island. The bulk of the commercial catch is taken from the area bounded by Tory Channel in the north and Motunau in the south, although there has been a recent increase in fishing activity around Banks Peninsula. The CRA 5 fishery was affected by the November 2016 earthquake, which restricted fisher access to the productive Cape Campbell region and may have reduced catch rates in the Kaikōura region.

The CRA 5 TAC was set in 2016–17 at 514 t, with a TACC of 350 t and allowances of 40 t for customary catch, 87 t for recreational, and 37 t for all other mortality caused by fishing (Table 1). The CRA 5 TACC has been unchanged at 350 t/year since 1999–2000 (Table 3), with the latest TACC review in 2021. Twenty-one vessels operated in this fishery in 2024–25 compared with 25 to 34 vessels which operated in this fishery in the two decades following 2000–01 (Starr & Roberts in prep.).

**CRA 6**

CRA 6 comprises all of the Chatham Islands, including the two main islands (Chatham and Pitt) and most of the marine environment shallower than the 200 m depth contour (Figure 2). There are four rock lobster statistical areas (940, 941, 942, and 943) which roughly divide the Chatham Islands rock lobster habitat into four quadrants. The TAC (at 370 t) and the TACC (at 360 t) have remained unchanged since 1998–99 (Table 3). Mean annual CPUE in the Chatham Islands fishery was higher than in the other New Zealand QMAs in the 1980s. The number of vessels operating in this fishery has ranged from 31 (in 2023–24) to 40 (in 2017–18) since 1999–2000, with 35 vessels operating in 2024–25 (Starr & Roberts in prep.).

**CRA 7 and CRA 8**

The CRA 7 and CRA 8 fisheries are currently assessed using a combined stock regional model, because puerulus settling in CRA 7 are thought to be sourced down current from CRA 8 and subsequent migrate back against this prevailing easterly current towards and into CRA 8 soon after they reach reproductive maturity.

The CRA 7 fishery extends from the Waitaki River south along the Otago coastline to Long Point (Figure 2). The TACC was informed by the operation of a MP from the mid-1990s to 2020–21 (Webber & Starr 2020). For that final year, the CRA 7 TACC was raised from 97 to 106 t, with unchanged allowances of 10 t for customary catch, 5 t for recreational catch, 5 t for all other mortality caused by fishing, for a new TAC of 126 t. The TACC was again raised by 5% for the 2022–23 fishing year to 111.5 t, along with the allowance for all other mortality caused by fishing to 8 t and leaving the customary and recreational allowances unchanged, for a TAC of 134.5 t (Table 1). A MP was reinstated in 2024–25 to inform TAC settings. For 2025–26, the Minister increased the TAC to 137.5 t and increased the allowance for all other mortality caused by fishing to 11 t but rejected the TACC increase recommended by the MP. The CRA 7 commercial fishery operates with an MLS of 127 mm tail length for both males and females (equivalent to 47 mm TW for males and 48 mm TW for females). The fishery is open to recreational fishing with an MLS of 54 mm TW for males and 60 mm TW for females. The number of vessels operating in CRA 7 has varied between 9 and 12 since 2011–12, with 10 operating in 2024–25 (Starr & Roberts in prep.).

The CRA 8 fishery is the largest New Zealand rock lobster fishery by area and landings, extending from Long Point south to Stewart Island and the Snares Islands, the islands and coastline of Foveaux Strait, and then northwards along the Fiordland coastline to Okarito Lagoon (Bruce Bay) (Figure 2). From 1996 to 2019, the TACC was informed by MPs, ending with setting the TACC for 2020–21. That TACC was raised from 1130 t to 1251 t, with unchanged allowances of 30 t for customary, 33 t for recreational, and 28 t for all other mortality caused by fishing. The TACC was raised again for 2021–22 by 5% to 1251 t, along with the allowance for all other mortality caused by fishing from 28 t to 139 t, while leaving the customary and recreational allowances at 30 t and 33 t, respectively, for a TAC of 1453 t (Table 1). A MP was reinstated in 2024–25 which informed a TACC increase for 2024–25 to 1392 t, along with the recreational allowance to 39 t and the allowance for all other mortality caused by fishing to 140 t, while retaining the customary allowance at 33 t, for a TAC of 1601 t. The number of operating vessels in CRA 8 has varied between 61 and 71 since 2002–03, with 71 operating in 2024–25 (Starr & Roberts in prep.).

**CRA 9**

The CRA 9 area is large (Figure 2), but CRA 9 has the smallest TACC of any fished region. The fishery extends from north of Bruce Bay to the Kaipara Harbour, excluding the area south of a line between Farewell spit and the Manawatu river. Commercial lobster fishing occurs mostly on the north-west coast of the South Island and the area between Pātea and Kawhia on the Taranaki coastline. The TACC was raised from 47 t to 60.8 t in 2014–15, where it has since remained (Table 3). Allowances were made of 20 t for customary catch, 30 t for recreational catch, 5 t for all other mortality caused by fishing which, with the addition of the 60.8 t TACC, result in a TAC of 115.8 t (Table 1). Less than 10 vessels have operated in this fishery since 2003–04, with 6 vessels operating in 2024–25 (Starr & Roberts in prep.).

## 1.2 Recreational fisheries

Recreational fisheries harvest can be estimated using either offsite methods such as a National Panel Survey (NPS) where post-event interviews or diaries are used to collect data, or some form of onsite creel survey, where participants are surveyed on the water or at boat ramps when returning from a fishing.

The first recreational rock lobster harvest estimates were provided by offsite telephone-diary surveys conducted between 1991 and 2001 (Bradford 1997, 1998, Teirney et al. 1997, Boyd at al 2004). These estimates are no longer considered to be reliable by the Marine Amateur Fishing Working Group (MAFWG), because the method was prone to 'soft refusal' bias during recruitment of potential participants and overstated catches during reporting (Wright et al. 2004). The recreational harvest estimates provided by the 2000 and 2001 telephone-diary surveys were also thought to be implausibly high for many species by the MAFWG.

Concerns about the reliability of these telephone diary surveys and the limited spatial extent at which on-site survey methods can be cost effectively applied over large scales led to the development of a rigorously designed National Panel Survey (NPS) for the 2011–12 (1 October–30 September) fishing year (Wynne-Jones et al. 2014). This NPS survey used face-to-face interviews of a random sample of 30,390 households to recruit a panel of 7,013 fishers and non-fishers for a full year. Recruited panel members were contacted regularly about their fishing activity and catch information was collected in standardised computer-assisted telephone interviews. NPS surveys have subsequently been repeated in

2017–18 and 2022–23 (1 October–30 September) following the same design as used in 2011–12, with face-to-face interview surveys of 34 431 and 36 197 households being used to recruit 6 975 and 5 625 panellists in each year respectively (Wynne-Jones et al. 2019, Heinemann & Gray 2024) (Table 5).

The precision of many of the rock lobster harvest estimates provided by these NPS surveys has been low, and onsite surveys have sometimes been commissioned to provide additional recreational harvest estimates for specific QMAs in some years. In most instances these creel surveys have only been conducted for a single fishing year. Onsite surveys of recreational rock lobster fisheries were completed for the western Bay of Plenty (CRA 2) in 2010 and 2011 (Holdsworth 2016), for CRA 5 (Kaikōura-Motunau only) from January-April 2013 (2012–13, Kendrick & Hanley 2021) and the 2021–22 October fishing year (Maggs et al. 2023), and for CRA 1 in 2013–14, extending from Rangiputa to Mangawhai Heads and covering most of statistical areas 903 and 904 (Holdsworth 2014) (Table 5). This latter survey area was estimated to represent 70% of the total CRA 1 recreational catch, based on the 2011–12 NPS.

**Table 5: Available offsite survey recreational rock lobster harvest estimates (numbers and tonnes [t] by QMA) provided by National Panel Surveys conducted in 2011–12, 2017–18 and 2022–23 (Wynne-Jones et al. 2014, Heinemann et al. 2015, Heinemann & Gray 2024) and occasional QMA specific onsite surveys: Kaikōura/Motunau in 2012–13 and 2021–22 (Kendrick & Hanley 2021, Maggs et al. 2023); eastern Northland in 2013–14 (Holdsworth 2014); from the western Bay of Plenty in 2010 & 2011 (Holdsworth 2016); and from a CRA 2 monitoring programme initiated in 2019 (Maggs et al. 2024). '–': not available.**

| QMA | Number | CV (%) | Nominal point estimate (t) | Recreational allowance (t) |
|---|---|---|---|---|
| National Panel Survey Oct 2011–Sep 12 | | | | |
| CRA 1 | 29 720 | 0.30 | 23.98 | – |
| CRA 2 | 58 413 | 0.24 | 40.86 | 140 |
| CRA 3 | 13 912 | 0.33 | 8.07 | 20 |
| CRA 4 | 53 813 | 0.17 | 44.17 | 85 |
| CRA 5 | 47 493 | 0.23 | 43.47 | 40 |
| CRA 7 | 357 | 1.03 | 0.23 | 5 |
| CRA 8 | 5 149 | 0.60 | 6.93 | 33 |
| CRA 9 | 15 530 | 0.30 | 17.96 | 30 |
| Kaikōura & Motunau 2012–13: | | | | |
| CRA 5 | 96 800 | 0.10 | 54.56 | 40 |
| Northland: 1 Apr 2013–31 Mar 2014 | | | | |
| CRA 1 | 50 400 | 0.17 | 37.3 | – |
| CRA 2: Western Bay of Plenty | | | | |
| Nov 2010–Sep 2011 | 55 260 | 0.47 | 40.9 | 140 |
| Oct 2011–Sep 2012 | 31 602 | 0.47 | 22.1 | 140 |
| National Panel Survey: Oct 2017–Sep 2018 | | | | |
| CRA 1 | 19 350 | 0.47 | 15.91 | 50 |
| CRA 2 | 19 123 | 0.36 | 14.21 | 34[1] |
| CRA 3 | 22 515 | 0.26 | 12.21 | 20 |
| CRA 4 | 52 145 | 0.23 | 41.38 | 85 |
| CRA 5 | 51 464 | 0.21 | 40.96 | 87 |
| CRA 7 | 82 | 1.00 | 0.09 | 5 |
| CRA 8 | 24 732 | 0.36 | 16.17 | 33 |
| CRA 9 | 20 034 | 0.34 | 17.07 | 30 |
| CRA 2: Barrier Islands, Coromandel, Bay of Plenty since 2019–20 | | | | |
| Apr 2019–Mar 2020 | – | 0.40 | 26.9 | 34 |
| Apr 2020–Mar 2021 | – | 0.44 | 26.4 | 34 |
| Apr 2021–Mar 2022 | – | 0.42 | 26.1 | 34 |
| Apr 2022–Mar 2023 | 11 593 | 0.31 | 14.0 | 34 |
| Apr 2023–Mar 2024 | – | 0.44 | 8.8 | 34 |
| Apr 2024–Mar 2025 | – | 0.47 | 7.1 | 34 |
| Kaikōura & Motunau 2021–22: | | | | |
| CRA 5 | 46 711 | 0.11 | 26.50 | 87 |
| National Panel Survey: Oct 2022–Sep 2023 | | | | |
| CRA 1 | 9 873 | 0.49 | 8.00 | 22[2] |
| CRA 2 | 11 593 | 0.31 | 9.99 | 34 |
| CRA 3 | 9 257 | 0.51 | 5.74 | 12 |
| CRA 4 | 46 483 | 0.39 | 32.58 | 40 |
| CRA 5 | 47 483 | 0.26 | 38.48 | 87 |
| CRA 7 | 1 992 | 0.54 | 1.41 | 5 |
| CRA 8 | 17 300 | 0.33 | 12.50 | 33 |
| CRA 9 | 5 767 | 0.42 | 4.66 | 30 |

1 – CRA 2 recreational allowance reduced from 140 t to 34 t on 01/04/2018
2 – CRA 1 recreational allowance reduced from 27 t to 22 t on 01/04/2023

A longer-term creel survey programme has since been commissioned by Fisheries New Zealand to monitor trends in recreational harvesting from CRA 2, as part of a rebuilding plan implemented in 2018–19 to address the poor stock status in this fishery. Boat ramp interviewing has been conducted at 11 sites across CRA 2 between 2019–20 and 2023–24 (Maggs et al. 2024) and is ongoing across a reduced set of key ramps. Relative trends in recreational landing rates (lobster per hour of interviewing) during the peak effort period between October to February each year have been scaled up by NPS and other onsite survey estimates when available, to estimate the annual tonnage landed by all recreational fishers in CRA 2 (Table 5).

The recreational harvest estimates provided in Table 5 have been used to inform recreational catch histories for each QMA, with trends in unsurveyed years being mostly inferred from long- term trends in commercial CPUE. Stock specific descriptions of the reconstruction methods used and decisions about the validity of these estimates and their use in stock assessments are detailed in the individual CRA chapters.

### 1.2.1 Section 111 commercial landings

Commercial fishermen are allowed to take home lobsters for personal use under section 111 of the Fisheries Act. These lobsters must be declared on landing forms using the destination code 'F'. The maximum in recent fishing years for these landings by QMA has ranged from about 1.68 t (CRA 6) to nearly 19.36 t (CRA 8) (Table 6). The annual reported catches where available (or maximum of catches) declared under section 111 should be added to the recreational harvest estimates reported in Table 6, along with annual amateur charter boats estimates, which have been reported via the Amateur Charter Vessel- Amateur Catch Reporting since 2009–10 to provide total recreational harvest.

**Table 6: Section 111 commercial landings (in t, summed from landing destination code 'F') by fishing year and QMA. '–': no data. Note: the accuracy of these statistics from 2019 onwards is uncertain because of concerns about the reliability of estimated catch reporting following the introduction of electronic reporting.**

| Fishing year | CRA 1 | CRA 2 | CRA 3 | CRA 4 | CRA 5 | CRA 6 | CRA 7 | CRA 8 | CRA 9 |
|---|---|---|---|---|---|---|---|---|---|
| 2001 | 0.11 | 0.23 | 0.14 | 0.65 | 0.46 | – | 0.08 | 0.25 | 0.01 |
| 2002 | 0.49 | 0.61 | 0.50 | 2.66 | 1.96 | – | 0.15 | 1.95 | 0.91 |
| 2003 | 2.22 | 1.02 | 0.37 | 3.40 | 2.91 | 0.06 | 0.09 | 1.68 | 0.97 |
| 2004 | 3.55 | 0.73 | 0.31 | 3.71 | 3.19 | 0.09 | 0.10 | 3.51 | 1.64 |
| 2005 | 3.08 | 0.78 | 0.99 | 3.68 | 4.39 | 0.00 | 0.15 | 4.57 | 2.13 |
| 2006 | 5.02 | 1.28 | 0.98 | 3.11 | 5.10 | 0.02 | 0.29 | 5.81 | 1.22 |
| 2007 | 3.83 | 1.03 | 1.17 | 2.71 | 5.41 | 0.41 | 0.93 | 7.79 | 1.46 |
| 2008 | 3.63 | 1.18 | 1.37 | 2.19 | 6.11 | 0.54 | 1.50 | 9.57 | 1.60 |
| 2009 | 4.01 | 1.37 | 2.25 | 3.22 | 6.24 | 0.30 | 1.69 | 10.72 | 2.26 |
| 2010 | 3.67 | 1.19 | 2.18 | 4.70 | 6.58 | 0.28 | 0.43 | 13.54 | 1.85 |
| 2011 | 4.16 | 1.17 | 2.21 | 4.73 | 4.83 | 0.47 | 0.08 | 14.91 | 1.90 |
| 2012 | 4.21 | 1.19 | 2.58 | 5.83 | 7.22 | 1.03 | 0.10 | 15.82 | 1.85 |
| 2013 | 3.94 | 1.66 | 2.94 | 4.81 | 6.63 | 1.01 | 0.14 | 13.23 | 1.70 |
| 2014 | 3.58 | 2.04 | 3.03 | 5.18 | 6.12 | 0.63 | 0.13 | 13.93 | 3.76 |
| 2015 | 3.34 | 1.38 | 2.83 | 5.11 | 6.10 | 0.62 | 0.33 | 13.74 | 2.96 |
| 2016 | 3.01 | 1.17 | 3.05 | 4.20 | 5.70 | 0.85 | 0.44 | 12.83 | 1.88 |
| 2017 | 2.85 | 1.28 | 2.37 | 3.04 | 6.19 | 0.81 | 0.53 | 12.40 | 2.38 |
| 2018 | 2.05 | 1.15 | 2.92 | 4.40 | 5.04 | 1.68 | 0.49 | 16.45 | 2.50 |
| 2019 | 2.10 | 1.51 | 3.14 | 4.17 | 6.29 | 0.93 | 0.35 | 16.00 | 2.18 |
| 2020 | 1.09 | 1.62 | 3.51 | 5.43 | 6.01 | 1.29 | 0.89 | 16.62 | 1.84 |
| 2021 | 1.74 | 1.35 | 3.13 | 3.92 | 9.08 | 1.35 | 1.78 | 13.62 | 1.93 |
| 2022 | 2.02 | 1.20 | 2.27 | 4.04 | 5.79 | 1.24 | 2.24 | 15.10 | 1.14 |
| 2023 | 0.97 | 1.13 | 2.04 | 4.30 | 4.83 | 1.24 | 2.42 | 14.08 | 1.20 |
| 2024 | 0.94 | 1.28 | 1.93 | 5.32 | 3.72 | 0.69 | 1.71 | 19.36 | 1.14 |
| Maximum | 5.02 | 2.04 | 3.51 | 5.83 | 9.08 | 1.68 | 2.42 | 19.36 | 3.76 |
| Last 5 year mean | 1.35 | 1.32 | 2.58 | 4.60 | 5.89 | 1.16 | 1.81 | 15.76 | 1.45 |

## 1.3 Customary non-commercial fisheries

Customary catches used in each stock assessment are summarised in the respective CRA 1, CRA 2, CRA 3, CRA 4, CRA 5, CRA 6, and CRA 7&8 chapters.

### 1.4 Illegal catch

Illegal catches used in each recent stock assessment are presented in the respective CRA 1, CRA 2, CRA 3, CRA 4, CRA 5, CRA 6, and CRA 7&8 chapters.

In 2019, the RLWG rejected previously used estimates from MPI Compliance Services because members felt that the estimates could not be validated and were not adequately documented. In the most recent stock assessments, the RLWG has opted to take a fixed percentage (usually 10% to 20%) of the commercial catch before 1990 when rock lobsters were brought into the QMS, dropping to 2% to 15% of the post-1990 commercial catch in recognition of the impact of the introduction to the QMS, including greater control over the sale and receipt of lobsters once they became a tradeable asset.

### 1.5 All other sources of mortality caused by fishing

Other sources of mortality relating to the pot fishery include handling mortality caused by the return of under-sized lobsters and berried female lobsters, and high-grading; as well as predation by octopus and other predators within pots. Data on the presence of octopus in pots are available from observer catch sampling as well as from the voluntary logbooks. Octopus presence in pots was included as a covariate in the 2022 CRA 2 standardised CPUE analysis based on the voluntary logbook data where it was associated with a reduction in catch rates (Webber & Starr 2022). Stock assessments beginning in 2017 have assumed that handling mortality was 10% of returned lobsters until 1990 and then 5%, based on a literature review and the reasoning that greater care would be taken for the product with the development of the live export market.

The allowance for all other sources of mortality caused by fishing also accounts for illegal catch (see above).

## 2. BIOLOGY

Although red rock lobsters have not been aged, they are thought to be relatively long-lived. *Jasus edwardsii* occurs both in New Zealand and southern Australia, where this species (known there as southern rock lobster) is considered to live at least 20 years (Linnane et al. 2021).

Sexual maturity in females is reached from 34 to 77 mm TW (about 60–120 mm carapace length), depending on locality within New Zealand (Annala et al. 1980). For instance, in CRA 3 and CRA 4, 50% maturity appears to be about 40 mm TW, compared with about 60 mm TW in CRA 7&8, noting that mature females are absent from catches in CRA 7 and the Southland/Stewart Island statistical areas of CRA 8, and that some of these are likely to move to the CRA 8 Fiordland statistical areas prior to maturity, based on historical tagging data (McKoy 1983).

Mating takes place after moulting in autumn, and the eggs hatch in spring into naupliosoma larvae. Most of the phyllosoma larval development takes place in oceanic waters tens to hundreds of kilometres offshore over at least 12 months. Near the edge of the continental shelf, the final-stage phyllosoma metamorphoses into the settling stage, the puerulus, which swims to shore. Puerulus settlement takes place mainly at depths less than 20 m, but not uniformly over time or between regions. Settlement indices measured on collectors can fluctuate widely from year to year. The time lag from puerulus settlement to recruitment in the stock assessment models (at 32–34 mm TW) was estimated to be approximately 2–3 years, depending on locality, based on an analysis of juvenile growth information from Gisborne Wharf and Stewart Island (Roberts & Webber 2022).

After the larval phase, puerulus settle on coastal rocky reef and less frequently on complex seaweeds and bryozoans. Rocky reef in shallow water less than 20 metres deep is critical settlement habitat for rock lobsters and provides the conditions and substrates key for kelp habitat in New Zealand (Booth et al. 1991). Pueruli of rock lobsters use chemical cues associated with coastal waters to help locate settlement habitats (Hinojosa et al. 2018). Evidence from Australia suggests that kelp habitat is important for spiny rock lobster settlement, and that declines in kelp habitat could negatively affect spiny rock lobster productivity (Hinojosa et al. (2015), Hinojosa et al. (2018), Shelamoff et al. (2022)). For example, in Tasmania juvenile spiny rock lobster showed increased recruitment and survival in kelp compared to long-spined urchin barren habitat (Hinojosa et al. 2015) and larger reefs with kelp appear critical to the recruitment of spiny rock lobsters (Shelamoff et al. 2022).

In New Zealand, pueruli have been observed to detect and respond to both underwater sounds (acoustic cues) and substrate or chemical cues from different habitats, with seaweed and rock substrates increasing settlement and speeding up moulting (Stanley et al. 2015). Underwater sounds can provide orientation cues for pelagic crustacean larvae, expedite settlement and initiate settlement behaviour (Stanley et al. 2012). Juvenile rock lobster are more vulnerable to predation in kina barrens compared to kelp habitats during the day and potentially during dusk/dawn, but not during the night when they are typically active (Hesse et al. 2016). Kelp habitats also provide more of the preferred invertebrate prey for juvenile lobsters (Taylor 1998), potentially increasing nutrition and growth, though further research is required to confirm this relationship.

Red rock lobsters are mainly found on reef habitat and sometimes on sandy seafloor down to 200 m depth, although their bathymetric distribution around New Zealand is not well understood. The fishery data should be useful in this regard, although fishing patterns in each QMA are likely to be optimised for targeting the most valuable size grade of lobsters (i.e., just above the MLS), rather than the largest lobsters. Fishery-independent surveys for the Australian stocks indicate that the catch rate typically increases with depth up to the deepest depth stratum (> 90 m), with similar temporal patterns in catch rate comparing shallower depth strata (where most fishing occurs) and the deeper strata (Linnane et al. 2020). The 2022 standardisation of fishery catch rate data based on the CRA 2 voluntary logbook found that CPUE was greatest at depths greater than 40 m (Webber & Starr 2022), but these depths are deeper than where most commercial fishing occurs. However, there is likely to be considerable mixing of deep and shallow-distributed lobsters due to annual migrations up and down reefs during their annual moulting and breeding cycles (MacDiarmid 1991).

Values used for some biological parameters in stock assessments are shown in Table 7. For natural mortality (*M*), the mean of the prior used by stock assessments is shown. Model estimates of *M* vary widely by stock, e.g., from around 0.09 in CRA 7&8 to around 0.24 in CRA 3. However, the estimation of *M* is typically confounded with other model parameters, such as the assumed shape of the selectivity function.

**Table 7: Values used for some biological parameters and priors.**

| Stock | M (assumed prior)[1] | Fecundity[2] $a\mathrm{TW}^b$ (TW[3] in mm) | | Weight $a\mathrm{TW}^b$ (weight in kg, TW[3] in mm) Females | | Males | |
|---|---|---|---|---|---|---|---|
| | | a | b | a | b | a | b |
| CRA 1 | 0.12 | | | 1.30 E-05 | 2.5452 | 4.16 E-06 | 2.9354 |
| CRA 2 | 0.12 | | | 1.30 E-05 | 2.5452 | 4.16 E-06 | 2.9354 |
| CRA 3 | 0.12 | 0.21 | 2.95 | 1.30 E-05 | 2.5452 | 4.16 E-06 | 2.9354 |
| CRA 4 | 0.12 | 0.86 | 2.91 | 1.30 E-05 | 2.5452 | 4.16 E-06 | 2.9354 |
| CRA 5 | 0.12 | 0.86 | 2.91 | 1.30 E-05 | 2.5452 | 4.16 E-06 | 2.9354 |
| CRA 6 | 0.12 | | | 1.05 E-05 | 2.6205 | 6.63 E-07 | 3.3629 |
| CRA 7 | 0.12 | | | 1.04 E-05 | 2.6323 | 3.39 E-06 | 2.9665 |
| CRA 8 | 0.12 | 0.06 | 3.18 | 1.04 E-05 | 2.6323 | 3.39 E-06 | 2.9665 |

1. This assumed value has been used as the mean of an informative prior; *M* was estimated as a parameter of the model and is usually substantially updated.
2. Fecundity has not been used in stock assessments since 1999.
3. Tail width-carapace length relationships: See Tables D.6 and D.7 of Webber et al. 2024 for predicted carapace lengths by tail widths for males and females by QMA.

Long-distance migrations of rock lobsters have been observed between Otago (CRA 7) and Stewart Island and Fiordland (CRA 8) (Kendrick & Bentley 2003), although there is little evidence from the tagging data that red rock lobsters are migratory in other parts of New Zealand. The tagging data provide some limited evidence of movement between Otago and Stewart Island and from the more southerly fiords to the central fiords (from statistical area 926 to statistical area 927). During spring and early summer, variable proportions of usually small males and immature females move various distances against the current from the east and south coasts of the South Island towards Fiordland and south Westland (Annala 1983).

## 2.1 Growth modelling

The primary sources of information for growth of lobsters recruited to the stock assessment model are tag-recapture data and, to a lesser extent, size composition data. Lobsters have been caught, measured, tagged, and released, then recaptured and remeasured later (and in some instances re-released and re-recaptured later). Since 1998, statistical length-based models have been used to estimate the expected increment-at-size, which is represented stochastically by growth transition matrices for each sex. Growth increments-at-size are assumed to be normally distributed with means and variances determined from the growth model. The transition matrices contain the probabilities that a lobster will move into specific size bins given its initial size.

Since 2006, the growth model applied to the tag-recapture data has been a continuous model—giving a predicted growth increment for any time at liberty—whereas the older version assumed specific moulting periods between which growth did not occur. For assessment models used from 2006 to 2014, records from lobsters at liberty for fewer than 30 days were excluded. In that period, the robust normal distribution precluded the need for extensive grooming of outliers. In 2015, the grooming was relaxed so that only records from lobsters at liberty for less than 1 day were excluded. Lobsters at liberty for short periods provide the growth models with information on observation error. However, since 2023 all lobsters at liberty less that six months have been excluded after discovering that shorter times at liberty could result in biased estimates of growth rates if the timing of tagging/recapture coincided with moulting (e.g., growth can be biased high if a lobster is tagged and then moults and grows shortly after tagging and is then recaptured shortly after that). Growth parameters are estimated simultaneously with other parameters of the assessment model in an integrated way, so growth estimates might be affected by the size frequency and CPUE data as well as the tag-recapture data.

Juvenile (pre-recruitment) growth at 30 mm TW was estimated to be about 9 mm/year in the Halfmoon Bay area of Stewart Island and about 12 mm/year at Gisborne Wharf, based on the cohort progression in successive juvenile dive surveys (Roberts & Webber 2022). These growth estimates are less than the equivalent growth increment estimated by some previous stock assessment models. This is unsurprising given the lack of fishery tagging data at less than 40 mm TW. For CRA 1 and CRA 3 in 2019 and a sensitivity run of CRA 4 in 2020, the fixed value used for the *Galpha* parameter was dropped from 50 mm TW to 30 mm TW (the size at which lobsters enter the model) and the *Galpha* prior was narrowed.

## 2.2 Predicting annual recruitment

For some other rock lobster species/stocks, e.g., the Western rock lobster (*Panulirus cygnus*) fishery of Australia, annual recruitment strength appears to be predictable to some extent from annual indices of puerulus settlement density across location-specific monitoring sites (summarised by Kolbusz et al. 2021). Within New Zealand, annual levels of puerulus settlement were monitored at sites in Gisborne, Napier, Castlepoint, Kaikōura, Moeraki, Chalky Inlet, Halfmoon Bay, and Jackson Bay between 1979 and 2024, and monthly catches of the puerulus from each collector were used as the basis for producing a standardised index of settlement (Forman et al. 2022).

However, the puerulus settlement indices have proven to be a poor predictor of recruitment patterns experienced across QMAs and have not been used to inform any stock assessments since they were last fitted within the 2015 CRA 5 base case model run, and as a sensitivity for the 2020 CRA 4 assessment.

A comprehensive review of the puerulus collector programme was undertaken in early 2024, and it was concluded that while the data it provided appeared to be representative of regional puerulus settlement patterns, the resulting standardised settlement indices were poorly correlated with model-based estimates of annual year class strength. Puerulus settle on reefs at around 6 mm TW and this poor correspondence was attributed to subsequent density dependent and environmental processes that impact on survival during the 18 to 24-month period between settlement and recruitment into the model at 30 mm (Roberts and Webber 2024). The puerulus monitoring programme was discontinued given these conclusions.

Further analyses were undertaken by Roberts and Webber (2024), that explored the predictive power of non-linear relationships fitted between sea surface temperature (SST) data and recruitment deviate estimates predicted by stock assessment models (i.e., assessed outside of the stock assessment models). When assuming plausible time lags between settlement and recruitment, there was some agreement between puerulus series and recruitment deviates for CRA 5 and to a lesser extent CRA 4. However, these relationships disappeared when uncertainty was included both in the settlement series and the recruitment deviates. For the other stocks, there was no discernible relationship. Stronger relationships were generally obtained when assuming no time lag between settlement and recruitment to the model, which could only be plausible if stock assessment growth estimates are consistently negatively biased for smaller individuals. Also based on this analysis, there was evidence for an optimal temperature range for red rock lobster recruitment, where relatively warm years were associated with poorer recruitment in northern QMAs and better recruitment in southern QMAs.

A review was undertaken in 2022 to explore whether there is any evidence of a stock-recruitment relationship for any of New Zealand's rock lobster stocks, based on estimates provided by the most recent length-based assessment for each stock (Pons et al. 2022). These analyses suggested that there was little, if any, evidence of a relationship between annual SSB (Spawning Stock Biomass) estimates and subsequently recruitment deviate estimates, for a range of lagged periods, for any stock or combinations of stocks. The lack of any apparent stock recruitment relationship for any stock was attributed to the variability in both levels of natural mortality and inter-stock mixing that may occur during the 18 to 24-month pelagic life phase of this species, and varying survival between the time at which the ~6 mm tail width puerulus settle onto reefs and when their abundance is first estimated by the assessment model, at 30 mm+ tail width. For these reasons a stock-recruitment relationship is not currently included within CRA stock assessments. However, it is possible that such a relationship may exist for some stocks (at some undetected scale or unobserved stock level) and the exploration of including a relationship in the assessment model has been recommended (de Lestrang et al. 2024) and identified as a future research consideration.

## 3. STOCKS AND AREAS

There is no published evidence for genetic subdivision of lobster stocks within New Zealand based on biochemical genetic and mitochondrial DNA studies. The observed long-distance migrations in some areas and the long larval life probably result in genetic homogeneity among areas. Gene flow at some level probably occurs to New Zealand from populations in Australia (Chiswell et al. 2003), although significant genetic separation was evident when comparing samples collected from Tasmania and the Otago Coast of New Zealand (Morgan et al. 2013).

Subdivision of stocks on other than genetic grounds has been considered (Booth & Breen 1992, Bentley & Starr 2001). There are geographic discontinuities in the prevalence of antennal banding, size at onset of maturity in females, migratory behaviour, fishery catch and effort patterns, phyllosoma abundance patterns, and puerulus settlement levels. These observations led to division of the historical NSI stock into three sub-stocks (NSN, NSC, and NSS) for assessments in the 1990s. Cluster analysis based on similarities in CPUE trends between rock lobster statistical areas provided support for these stock definitions (Bentley & Starr 2001).

Since 2001, these historical stock definitions have not been used, and rock lobsters in each of the CRA QMA areas have been assumed to constitute separate stocks for the purposes of stock assessment and management.

# 4. ENVIRONMENTAL AND ECOSYSTEM CONSIDERATIONS

This section was last updated in 2024. This summary focusses on the environmental and ecosystem considerations specific to rock lobster fisheries; a more detailed summary from an issue-by issue perspective across all fisheries is available in the Aquatic Environment and Biodiversity Annual Review Chapter 13 (2024).

The environmental effects of rock lobster fishing on non-target species and direct effects on habitats have been covered by Breen (2005) and indirect effects on habitats and ecosystems are discussed in AEBAR Chapter 13 (2024).

## 4.1 Ecosystem role

Rock lobsters (both the red rock lobster *Jasus edwardsii* and the packhorse crayfish *Sagmariasus verreauxi*) are primarily nocturnal in their foraging patterns (Williams & Dean 1989). They consume a broad range of prey, including molluscs, crustaceans, annelid worms, macroalgae, echinoderms, sponges, bryozoans, fish, foraminifera, and brachiopods (MacDiarmid et al. 2013). They prefer soft-sediment bivalves over rocky reef prey and make nocturnal foraging movements away from the reef (Flood 2021). Their feeding rates shift seasonally in relation to moulting and reproductive cycles and movements between the coast and deeper reefs (Kelly et al. 1999).

At high biomass, rock lobsters are ecologically important predators in New Zealand's rocky reef ecosystems, where they can exert top-down regulation of prey populations (Pinkerton et al. 2008, Pinkerton et al. 2015). For example, survey work and experimental work have shown that predation by rock lobsters in marine reserves can influence the demography of surf clams of the genus *Dosinia* (Langlois et al. 2005, Langlois et al. 2006).

Rock lobsters can consume sea urchins (*Evechinus chloroticus*) (Andrew & MacDiarmid 1991, Shears & Babcock 2002). Regime shifts from kelp forests to unproductive sea urchin dominated barren habitat have been observed throughout New Zealand, but are best documented along the northeastern coast of the North Island (Shears & Babcock 2003, Doheny et al. 2023). Although multiple factors can cause kelp decline (including sedimentation and marine heatwaves), evidence from marine reserves in northeastern New Zealand suggests fishing of apex reef predators, including rock lobsters, is a key factor behind the proliferation of the grazing sea urchin/kina (*Evechinus chloroticus*), extensive kelp loss and the expansion of sea urchin barrens in this region (Doheny et al. 2023). Please refer to AEBAR Chapter 13 Trophic and Ecosystem Effects (2024) and Doheny et al. (2023) for a full summary of the role of rock lobster in the development of urchin barrens in New Zealand.

Published scientific observations support predation upon small to medium rock lobsters by octopus (Brock et al. 2003), rig (King & Clark 1984), blue cod, groper, southern dogfish (Pike 1969), and seals (Yaldwyn 1958, cited by Kensler 1967).

## 4.2 Non-target catch of fish and invertebrates

The levels of incidental catch of species other than rock lobster landed from rock lobster potting were summarised for the period from 2019–20 to 2024–25. Non-rock lobster catch landed by QMA ranged from <1 to 11% of the estimated catches, with an average of about 5%. The most frequently reported incidental species caught were, in decreasing order of catch across all QMAs: conger eel, octopus, carpet shark, blue cod, wrasses, snapper, marblefish, red cod, ling, and blue moki (Table 8).

Following the implementation of Electronic Reporting/Geospatial Position Reporting, fishers are now required to report the top eight species, including all species discarded. Limited observer data on potlift bycatch are available.

**Table 8: Non-CRA/PHC catches by QMA as percent, from 2019–20 to 2024–25 for both reporting form types combined, shown in descending rank order. These are estimated catches with CRA/PHC species category excluded. Spp. column gives species codes that are defined in Table 9. TOT (t) is the total estimated catch of non-CRA/PHC species reported over the period 2019–20 to 2024–25 in tonnes.**

| | CRA 1 | | CRA 2 | | CRA 3 | | CRA 4 | | CRA 5 | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Rank** | **Spp.** | **Catch (%)** | **Spp.** | **Catch (%)** | **Spp.** | **Catch (%)** | **Spp.** | **Catch (%)** | **Spp.** | **Catch (%)** |
| 1 | SBR | 59.9 | OCT | 62.0 | OCT | 63.4 | CAR | 43.6 | CAR | 40.6 |
| 2 | CAR | 19.5 | RMO | 15.5 | CAR | 27.1 | OCT | 17.4 | CON | 30.7 |
| 3 | SNA | 4.2 | SNA | 9.0 | CON | 8.2 | CON | 13.4 | OCT | 16.4 |
| 4 | CON | 3.4 | MOR | 5.7 | BCO | 1.1 | GTR | 10.9 | BCO | 3.4 |
| 5 | PMA | 3.2 | CAR | 3.0 | HAG | 0.2 | HAG | 5.0 | GTR | 3.4 |
| 6 | BCO | 2.3 | KEL | 1.8 | SNA | 0.0 | BCO | 4.0 | BPF | 1.3 |
| 7 | RRC | 2.0 | CSH | 1.5 | – | – | WSE | 2.1 | SFI | 1.0 |
| 8 | BRC | 1.7 | GTR | 0.4 | – | – | RCO | 1.1 | HAG | 0.8 |
| 9 | POR | 1.2 | POR | 0.4 | – | – | SFI | 0.8 | RCO | 0.6 |
| 10 | OCT | 0.8 | KAH | 0.3 | – | – | RMO | 0.7 | BRC | 0.5 |
| 11 | TAR | 0.6 | BCO | 0.1 | – | – | KEL | 0.6 | WSE | 0.3 |
| 12 | MOR | 0.2 | KIN | 0.1 | – | – | MOK | 0.2 | RAG | 0.2 |
| 13 | SPD | 0.2 | CON | 0.1 | – | – | TAR | 0.1 | HPB | 0.2 |
| 14 | CRB | 0.2 | RCO | 0.0 | – | – | BUT | 0.0 | WHE | 0.2 |
| 15 | KIN | 0.2 | POT | 0.0 | – | – | SNA | 0.0 | MOK | 0.1 |
| | TOT (t) | 40.3 | TOT (t) | 11.3 | TOT (t) | 12.8 | TOT (t) | 107.7 | TOT (t) | 310.1 |

| | CRA 6 | | CRA 7 | | CRA 8 | | CRA 9 | | All | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Rank** | **Spp.** | **Catch (%)** | **Spp.** | **Catch (%)** | **Spp.** | **Catch (%)** | **Spp.** | **Catch (%)** | **Spp.** | **Catch (%)** |
| 1 | BCO | 94.8 | CAR | 44.2 | CON | 69.7 | CAR | 59.9 | CON | 36.5 |
| 2 | CAA | 4.7 | OCT | 30.8 | CAR | 10.0 | CON | 18.5 | CAR | 30.2 |
| 3 | HAP | 0.4 | CON | 16.0 | OCT | 7.2 | OCT | 18.1 | OCT | 16.1 |
| 4 | CFA | 0.1 | BCO | 3.5 | WSE | 7.0 | RCO | 2.5 | BCO | 4.5 |
| 5 | SCH | 0.1 | BPF | 1.8 | BCO | 3.1 | KIN | 0.3 | WSE | 2.6 |
| 6 | – | – | LIN | 1.1 | SPF | 1.0 | TAR | 0.2 | SBR | 2.5 |
| 7 | – | – | MOK | 0.5 | BPF | 1.0 | SNA | 0.2 | GTR | 2.3 |
| 8 | – | – | SPE | 0.5 | RCO | 0.3 | BRC | 0.2 | BPF | 1.0 |
| 9 | – | – | WSE | 0.3 | ASH | 0.2 | BCO | 0.2 | HAG | 0.8 |
| 10 | – | – | RCO | 0.3 | CAC | 0.2 | LIN | 0.0 | RCO | 0.5 |
| 11 | – | – | TRU | 0.2 | CBU | 0.1 | SCH | 0.0 | SFI | 0.4 |
| 12 | – | – | SBR | 0.1 | AER | 0.1 | SPD | 0.0 | SPF | 0.4 |
| 13 | – | – | SFI | 0.1 | GTR | 0.1 | JDO | 0.0 | SNA | 0.3 |
| 14 | – | – | LEA | 0.1 | MOK | 0.0 | MOK | 0.0 | RMO | 0.3 |
| 15 | – | – | SPF | 0.1 | LIN | 0.0 | – | – | BRC | 0.2 |
| | TOT (t) | 14.5 | TOT (t) | 151.5 | TOT (t) | 316.6 | TOT (t) | 28.7 | TOT (t) | 993.6 |

**Table 9: Common names for species codes used in Table 8.**

| Spp. | Common name | Spp. | Common name | Spp. | Common name | Spp. | Common name |
|---|---|---|---|---|---|---|---|
| AER | Whelk (*Aeneator recens*) | CON | Conger eel | LEA | Leatherjacket | RRC | Red scorpion fish |
| ASH | Circular saw shell | CRB | Crab (Unspecified) | LIN | Ling | SBR | Southern bastard cod |
| BCO | Blue cod | CSH | Cat shark | MOK | Blue moki | SCH | School shark |
| BPF | Banded wrasse | GTR | Marblefish | MOR | Moray eel | SFI | Starfish |
| BRC | Northern bastard cod | HAG | Hagfish | OCT | Octopus | SNA | Snapper |
| BUT | Butterfish | HAP | Hapuku | PMA | Pink maomao | SPD | Spiny dogfish |
| CAA | Bignose shark | HPB | Hapuku & Bass | POR | Porae | SPE | Sea perch |
| CAC | Cancer crab | JDO | John dory | POT | Parrotfish | SPF | Scarlet wrasse |
| CAR | Carpet shark | KAH | Kahawai | RAG | Ragfish | TAR | Tarakihi |
| CBU | Cran's bully | KEL | Kelpfish | RCO | Red cod | TRU | Trumpeter |
| CFA | Banded rattail | KIN | Kingfish | RMO | Red moki | WHE | Whelk (unknown) |
| | | | | | | WSE | Wrasses |

## 4.3 Incidental catch of seabirds and marine mammals

Recovery of shags from lobster pots has been documented in New Zealand. One black shag (*Phalacrocorax carbo*) of 41 recovered dead from a Wairarapa banding study was found drowned in a crayfish pot hauled up from 12 m depth (Sim & Powlesland 1995). A survey of rock lobster fishers on the Chatham Islands (Bell 2012) reported no shag bycatch in the five years from 2007–08 to 2011–12, 2 shag captures between 2001–02 and 2006–07, and 18 shags caught before the 2000–01 season. The fishers suggested the lack of more recent reported shag captures was attributable to changes in pot design and baiting methodologies.

In New Zealand waters, marine mammal entanglements with pot fishing gear have been documented since 1980. A 2022 study on cetacean interactions with pot fisheries (Pierre et al. 2022) found that from 1980 to the present, 1–2 entanglement events of cetaceans per year were reported on average. However, the same study found that more recently, from 2010 to 2020, an average of 4–5 entanglement events per year have been recorded. Most recorded entanglements over time have involved humpback whales (*Megaptera novaeangliae*, 62%), followed by orca (*Orcinus orca*, 16%). Over 90% of the pot fisheries studied targeted rock lobster, with the remaining <10% targeting packhorse lobster (*Sagmariasus verreauxi*), ling (*Genypterus blacodes*), blue cod (*Parapercis colias*), paddle crab (*Ovalipes catharus*), and hagfish (*Eptatretus cirrhatus*). Methods to reduce impacts on cetaceans from interactions and entanglements with pot and trap fishing gear include: gear modifications, spatial/temporal management, and disentanglement interventions. Disentanglement interventions are the main documented approach to addressing this issue in New Zealand to date.

### 4.4 Benthic effects

Potting is the main method of targeting rock lobster and is usually assumed to have very little direct effect on non-target species. No information exists regarding the benthic effects of potting in New Zealand.

A study on the effects of lobster pots was completed in a report on the South Australian rock lobster fisheries (Casement & Svane 1999). This fishery is likely to be the most comparable with New Zealand because the lobster species is the same and many of the same species are present, although pots and how they are fished may differ. The report concluded that the mass of algae removed by pots probably has no ecological significance.

Two other studies provide results from other parts of the world, but the comparability of these studies with New Zealand is questionable given differences in species and fishing techniques. The Western Australia Fishery Department calculated the proportion of corals (the most sensitive fauna) likely to be impacted by potting and concluded it was low, i.e., between 0.1 and 0.3% per annum (Department of Fisheries Western Australia 2007). Direct effects of potting on the benthos have been studied in Great Britain (Eno et al. 2001) and four weeks of intensive potting resulted in no significant effects on any of the rocky-reef fauna quantified. Observations in that paper indicated that sea pens were bent (but not damaged) and one species of coral was damaged by pots.

The only regulatory limitation on where lobster pots can be used is inside marine reserve boundaries, marine protection areas and some customary management areas; however, four areas within marine reserves in Fiordland have been designated for commercial pot storage due to the shortage of suitable space (Fiordland Marine Guardians 2022). Likewise, in the Taputeranga Marine Reserve (Wellington), an area is designated for vessel mooring and the storage of holding pots by commercial fishermen.

### 4.5 Climate change impacts

The ocean around New Zealand is, in some regions, warming at a rate well in excess of the global average (MfE & Stats NZ, 2025, Sutton & Bowen, 2019). While the extent to how this will impact the wider ecosystem is largely unknown, it can be expected that there will be an impact on rock lobster, including their spatial variability. Climate change will likely impact lobster species differently with warming potentially causing declines in rock lobster and range extensions of packhorse lobster (Twiname et al. 2022).

Organisms such as rock lobsters are particularly susceptible to ocean acidification because it lessens their ability to lay down calcified body structures during each moult (Bell et al., 2023, Hepburn et al., 2011). Changes to ocean circulation patterns also have the potential to affect the recruitment of the rock lobster, given the extended larval stage, and changes to ocean circulation are already being observed in New Zealand in relation to the subtropical front (MfE & Stats NZ 2025). Recent assessment indicates a potentially negative relationship between sea surface temperature and rock lobster recruitment in northern New Zealand (Roberts & Webber, 2024). This work is preliminary and requires further investigation, however this could be a significant development. Warmer ocean temperatures can increase the energetic costs of dispersal for spiny lobsters and could substantially impact post-larval recruitment under warming conditions (Garcia-Echauri et al. 2020).

Higher water temperatures may also affect predation risk for rock lobster by reducing their risk response (Briceño et al. 2020). Extended periods of extremely warm ocean temperatures known as marine heatwaves are increasing in intensity and frequency across the globe with trends predicted to accelerate under future climate change. New Zealand experienced several extended periods of marine heatwaves in recent years (Salinger et al., 2019 and Bell et al., 2023), causing a range of impacts including temporary southern migrations of warm-water fish and loss of ecologically important seaweeds (Thomsen et al., 2019, Salinger et al., 2020 and Thomsen et al., 2021). Marine heatwaves may have direct effects on rock lobster through temperature stress affecting their physiological condition (Oellermann et al., 2020) or indirect effects through impacts on associated habitats e.g., kelp forests. Negative effects have already been observed in rock lobster condition during marine heatwaves in southern New Zealand (Gnanalingam et al. 2025) and a summary of potential impacts of marine heatwaves to rock lobster can be found in Cook et al. 2025. Recent marine heatwave events have caused declines in macroalgal cover (Tait et al. 2021, Tait et al. 2025) which could have adverse effects on rock lobster given the multiple ecosystem services kelp provides to rock lobster (Mangan et al. 2025).

### 4.6 Key information gaps

Breen (2005) identified, in a detailed risk assessment, that the most likely issues to cause concern for rock lobster fishing were: ghost fishing, everyday bycatch and its effect on bycatch species, effects on habitats and protected species, and indirect effects on marine communities caused by the removal of large predators. Additional information on the impacts of climate change on rock lobster ecology and life history and the environmental factors influencing settlement success are important areas of research going forward. Further investigation into the science required to incorporate information on the removal of predators and trophic cascades into management decisions for rock lobster and other relevant fisheries is a priority for Fisheries New Zealand and this topic was addressed by a literature review and workshop led by Fisheries New Zealand in March 2023 (Doheny et al. 2023). Literature identified in the review has been used to update AEBAR Chapter 13: Trophic and Ecosystem Level Effects (Fisheries New Zealand 2024).

## 5. RAPID UPDATES

Full stock assessments for each rock lobster stock are generally done once every four to five years. Full stock assessments require significant time and effort, including a review of the previous stock assessment and data inputs, updates to data processing code, the addition of new data, implementation of any structural changes to the model, review of prior specifications for model parameters, and many sensitivities to key model assumptions.

Rapid updates differ from a full stock assessment because they repeat the previous base case stock assessment model, with the same model settings and assumptions and only update inputs with new data (e.g., additional years of catch, length frequency, and tag-recapture data). This significantly speeds up the required process, with the result being that every stock can have a rapid update done each year. Rapid updates do not aim to replace full stock assessments but complement them by providing inference about stock status in the interim years between full assessments. However, retrospective analysis for CRA 2 and CRA 4 suggested that lacking three or more years of CPUE data could lead to a bias in model outputs (Pons et al. 2022).

The rapid assessment update process has been applied for four years for CRA 1 and CRA 3 (2020, 2021, 2022, and 2023), three years for CRA 4 and CRA 5 (2021, 2022, and 2023), two years for combined

CRA 7&8 (2022 and 2023), and two years for CRA 2 (2023 and 2024). Further information is available from Webber et al. (2021a), Rudd et al. (2022), and Pons et al. (2023, 2024, 2025).

The November 2022 Plenary rejected stock projections beyond the final year of the update (2023 for this year) from the rapid update assessments because of inconsistent patterns in estimates of recent recruitment and concerns that these may be an artefact of the model rather than supported by data. While these recruiting year classes do not influence the vulnerable or spawning biomass in the final year of the assessment, they are influential in the projections.

### 5.1 Future research considerations

An independent review of the CRA stock assessment modelling was undertaken in 2024 (de Lestrang et al. 2024). Future research considerations include:

Catch Data

- try to develop improved estimates of non-commercial catch;

Growth

- explore the potential to develop alternative growth models with fewer parameters, especially for cases when data are limited;
- explore the feasibility of DNA methylation to provide estimates of relative or absolute age by size, to independently validate tag based growth estimates;
- exploration of CL based growth;
- start to collect CL and TW data from the catch sampling programme;
- consider further analysis of the potential for a bias in the estimation of growth that could result from the timing of tagging with respect to the timing of moulting, and seasonal modelling for growth to inform minimum time at liberty to include in growth estimation;
- consideration of density effects or evidence of other changes over time on growth;
- explore the sensitivity of estimated growth parameters to priors;
- calculate the physical distance moved by tagged lobster (where possible) to inform movement patterns;

CPUE

- further explore spatio-temporal modelling approaches for the CPUE series;
- explore development of CPUE series by size category, including a below MLS index or ratio above:below MLS index as an ancillary data series;
- explore approaches for weighting all the CPUE series, both in terms of vessel weighting (e.g., alternative approaches to vcf weighting on CELR or ERS data) and spatial weighting of series from multiple statistical areas (e.g., habitat area, depth range, ERS mapping of fished area);
- make improvements to the Electronic Reporting System (ERS) so that the use of catch effort reporting CPUE indices can be resumed;
- consideration of the use of Marine Reserve data where available (CPUE, sex ratio, size composition…);

Maturity

- conduct a meta-analysis to estimate stock specific maturity ogives as inputs to assessment models;
- explore the effects of potential reproductive senescence of females around the North Island;
- compare estimates of maturity from the maturity curve with the proportion berried by season, fishing month and 5 mm tail width intervals;

Length frequency data

- explore the weighting of length data in relation to effective sample size (this issue goes beyond rock lobster assessments);
- have separate selectivities for the CPUE weighted length frequencies;

- develop simple summary diagnostics for the length frequency model (e.g., mean residual by year or area);

Assessment model

- explore alternative approaches to combining length frequency and sex ratio proportions, and consider alternative distributions (e.g. Beta distribution) within the assessment model;
- separate out the SS and AW CPUE indices in plots;
- reconsider period over which $R_0$ is estimated when an environmentally driven trend in recruitment is possible;
- explore use of environmental covariates such as SST when estimating recruitment;
- investigate the implications of not estimating recruitment deviations for the period with no relevant data or, alternatively, the implications of estimating recruitment deviations for all years;
- explore sensitivities to the assumptions about the size (and CV) of recruits;
- explore inclusion of a stock recruit relationship with appropriate steepness;
- revise error structures within the assessment model for the tag data and length frequency data;
- explore time varying selectivity, including underlying causes;
- explore separate selectivities for catch and CPUE;
- further develop methods for estimating (carapace) length and sex-based estimates of *M* within assessment models;
- consider fitting to carapace length data instead of tail width where available;
- consideration of sex varying recruitment and natural mortality;
- consider development of a stock status reference point incorporating both the mature male and mature female components of the population;

Model diagnostics

- construct performance criteria to identify changes in parameter estimates and model fits between the full assessment and the rapid update;
- develop better diagnostics to determine why the model generates particular outcomes (e.g., interpreting productivity changes), particularly when CPUE is unavailable;
- present other MCMC diagnostics and consistency of estimated parameters (and fits) with previous full assessment;

Rapid updates

- consider appropriate “break out rules” for rapid updates.

# 6. MANAGEMENT PROCEDURES

## Introduction

Management procedures (MPs) are simulation-tested decision rules (Butterworth and Punt 1999) or functions, often referred to as a harvest control rules (HCRs), that specify one or more inputs and return an output value. New Zealand rock lobster MPs use standardised catch per unit effort (CPUE) as the input and a catch limit (most commonly the TACC) as the output. Other controls, such as minimum or maximum change thresholds, may also be used to modify the output.

MPs are an important management tool globally (Edwards and Dankel 2016). They are used to manage rock lobsters in South Africa (Johnston and Butterworth 2005; Johnston et al. 2014), South Australia (Punt et al. 2012), and Victoria (Punt et al. 2013).

MPs were a major part of New Zealand’s rock lobster management regime (Bentley et al. 2003b; Breen et al. 2009a, 2016a, 2016b; Bentley and Stokes 2009), but were discontinued following the introduction of the ERS. CPUE based management procedures have since been reinstated in CRA 7 and CRA 8, but their operation will be reviewed when the next full assessment is done for these stocks in 2027. The first New Zealand MPs were used to rebuild the depleted CRA 8 stock and to concurrently manage the volatile CRA 7 stock (Starr et al. 1997; Bentley et al. 2003a; Breen et al. 2008; Haist et al. 2013). Much of the evolution of rock lobster MPs in New Zealand occurred as each stock was assessed and subsequent management procedure evaluations (MPEs) were done. The industry-inspired “plateau” rules, described below, can impart stability. However, because stable rules are less responsive to abundance changes, there are trade-offs between stability and safety. Past experiences (e.g., in CRA 2 and CRA 4) suggest a need for caution when locating the lower plateau edge.

**Harvest control rules**

Historically, MPs either had a “plateau step” harvest control rule or a “plateau slope” rule, illustrated in Figure 3 and Figure 4. With respect to output TACC vs. input CPUE, step and slope rules have:

- a straight-line segment from zero TACC at some value of CPUE (not necessarily zero CPUE) up to a plateau;
- a plateau over which TACC stays the same as CPUE changes (the plateau could be of zero width but all current rules have an actual plateau);
- and either:
    - a series of steps to the right of the plateau (step rules) or
    - an ascending function at CPUE values to the right of the plateau (slope rules)

Descriptions in this section assume that the MP informs the TACC. A TAC-determining MP was developed for CRA 5 in 2010, at the request of the Ministry of Fisheries (the name of the managing government agency in 2010, Haist et al. 2011). This had a TACC component plus components for non-commercial catch sectors. This approach was rejected by the Minister and a TACC-determining rule was developed and approved in the following year.

The rigor with which MPE testing of TAC-determining MPs is possible is also undermined by the uncertainty associated with the relationship between non-commercial sources of harvest and abundance. Recent monitoring of trends in recreational harvesting from CRA 2, for example, has shown that recreational catch is not necessarily proportional to abundance, and that catch can vary considerably from year to year (Maggs et al. 2024). TACC-determining MPs (rather than TAC-determining MPs) are therefore considered to be best practice, as the commercial catch limit is usually caught in most years, with a high degree of certainty.

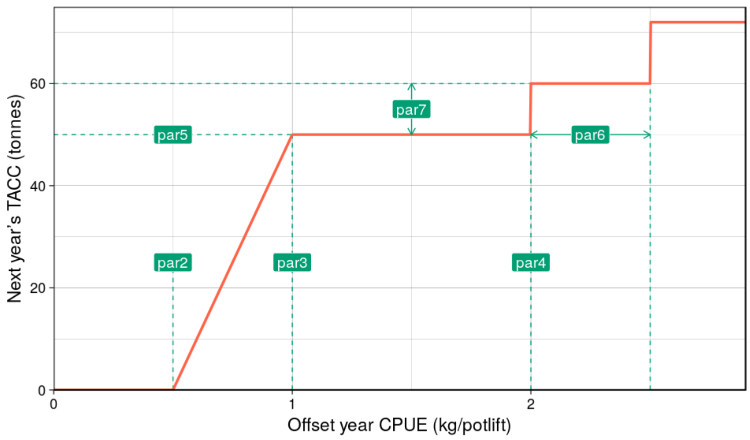


**Figure 3: An example of a generalised plateau step rule. See Table 10 for parameter definitions.**

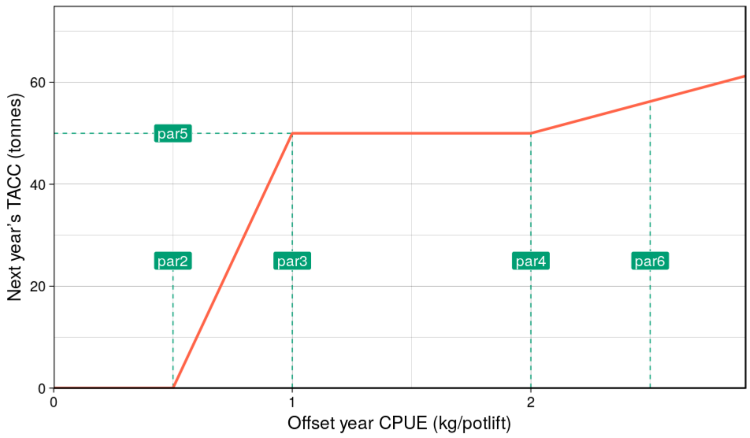


**Figure 4: An example of a generalised plateau slope rule.**

The generalised rule parameters are defined in Table 10.

**Table 10: Parameters for the generalised plateau rules and the CRA 3 rule.**

| Parameter | Applies to | Function |
|---|---|---|
| *par1* | all | rule type |
| *par2* | all except CRA 3 | CPUE at TACC = 0 |
| *par2* | CRA 3 rule | CPUE at first inflection |
| *par3* | all | CPUE at plateau left |
| *par4* | all | CPUE at plateau right |
| *par5* | all | plateau height |
| *par6* | step rules | step width |
| *par6* | slope rules | slope |
| *par6* | CRA 3 rule | slope (defined differently) |
| *par7* | step rules | step height |
| *par8* | all | minimum change |
| *par9* | all | maximum change |
| *par10* | all | latent year switch |

The rule type parameter (par1) is set to 3 for plateau slope rules and 4 for plateau step rules. The point at which TACC becomes zero (par2) can be zero or non-zero but must be less than the left edge of the plateau (par3). par3 must be less than or equal to the right edge (par4). In plateau slope rules (par6) must be greater than par4. Thus, for an acceptable rule:

$$par2 < par3 \leq par4,$$

$$par4 < par6 \quad \text{if} \quad par1 = 3.$$

Step height for step rules (par7) is defined as a proportion of the TACC on the previous step, thus 0.1 would indicate that TACC on the first step is 10% higher than TACC on the plateau and that each step increases by 10% of the previous step. The slope parameter for slope rules (par6) is defined as the CPUE at which TACC is 1.5 times the plateau height (par5).

The minimum change parameter (par8) defines the minimum proportional change in TACC. When CPUE changes only slightly and the rule specifies a new TACC differing from the existing TACC by an amount less than par8, there is no change to the TACC recommended. If the minimum change parameter and the step height are the same, then technically the TACC cannot be reduced from the second step to the first because the step downwards would be less than the minimum change threshold. Either it must be agreed that minimum change does not apply in the area of the steps, or the minimum change parameter must be set at less than $par7/(1 + par7)$.

The maximum change parameter (par9) specifies the maximum allowable proportional TACC change. When CPUE changes so much that the rule specifies a TACC change greater than par9, the TACC is recommended to be changed only by the par9 proportion. A value of zero for par9 indicates that there is no maximum change threshold and that any TACC change is allowed.

A latent year component to the rule means that TACC cannot be changed if it was changed in the previous year (par10 = 1). An "asymmetric latent year" means that TACC can be decreased but not increased when it was changed in the previous year (par10 = 2). If par10 = 0, then no latent year is used.

For both rule forms, and for CPUE less than or equal to the right edge of the plateau (par4), the provisional TACC (before operation of thresholds par8, par9, and par10) is given by:

$$TACC_{y+1} = \begin{cases} 0 & \text{if} \quad I_y \leq par2 \\ par5\left(\dfrac{I_y - par2}{par3 - par2}\right) & \text{if} \quad par2 < I_y \leq par3, \\ par5 & \text{if} \quad par3 < I_y \leq par4 \end{cases}$$

where $TACC_{y+1}$ is the provisional TACC and $I_y$ is the standardised offset-year CPUE in the preceding year. When CPUE is above the right edge of the plateau, the TACC for plateau step rules is given by:

$$TACC_{y+1} = par5\left((1 + par7)^{\lfloor (I_y - par4)/par6 \rfloor + 1}\right) \quad \text{if} \quad I_y > par4,$$

and for plateau slope rules by:

$$TACC_{y+1} = par5\left(1 + \frac{0.5(I_y - par4)}{par6 - par4}\right) \quad \text{if} \quad I_y > par4.$$

The provisional TACC that results from these equations may be modified by the operation of the minimum and maximum change thresholds, or by a latent year, to give the rule's recommended TACC. The change in TACC is defined as:

$$\Delta = \frac{TACC_{y+1} - TACC_y}{TACC_y}.$$

The minimum change threshold is applied as:

$$TACC'_{y+1} = \begin{cases} TACC_y & \text{if} \quad par8 > 0, |\Delta| < par8 \\ TACC_{y+1} & \text{if} \quad par8 > 0, |\Delta| \geq par8 \end{cases}$$

and the maximum change threshold is applied as:

$$TACC'_{y+1} = \begin{cases} (1 - par9)TACC_{y+1} & \text{if} \quad par9 > 0, |\Delta| > par9, \Delta < 0 \\ (1 + par9)TACC_{y+1} & \text{if} \quad par9 > 0, |\Delta| > par9, \Delta > 0 \end{cases}$$

The current MPs for CRA 7 and CRA 8 are described in the relevant Plenary report chapter.

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