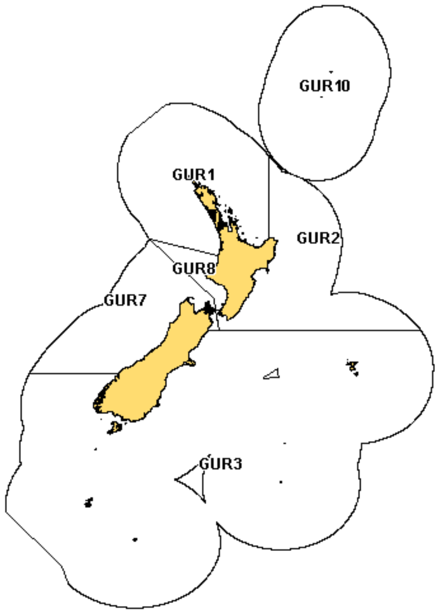
# RED GURNARD (GUR)

(*Chelidonichthys kumu*)
Kumukumu




## 1. FISHERY SUMMARY

### 1.1 Commercial fisheries

Red gurnard are a major bycatch of inshore trawl fisheries in most areas of New Zealand, including fisheries for red cod in the southern regions, and flatfish on the west coast of the South Island (WCSI) and in Tasman Bay. They are also directly targeted in some areas. Some minor target fisheries for red gurnard are known in Pegasus Bay, off Mahia and off the west coast South Island. Red gurnard is also a minor bycatch in the jack mackerel trawl fishery in the South Taranaki Bight. Up to 15% of the total red gurnard catch is taken by bottom longline and setnet.

The 1986 TACCs were based on 1984 landings for Southland and 1983 landings for other regions. TACCs for GUR 3 and 7 were increased by 76 t (14%) and 137 t (20%) respectively for the 1991–92 fishing year under the Adaptive Management Programme (AMP), to 600 t in GUR 3 and to 815 t in GUR 7. The TACC for GUR 7 was returned to 815 t in 1997–98 fishing year. The TACC for GUR 3 was again increased, by 300 t (50%), for the 1996–97 fishing year under the AMP.

Recent reported landings and actual TACCs by Fishstock are shown in Table 1.

Annual landings of GUR 1 have been relatively stable since 1986–87, generally ranging between 900 and 1300 t; substantially lower than the 2287 t TACC. About 60% of the GUR 1 total is taken from FMA 1, as a bycatch of a number of fisheries including inshore trawl fisheries for snapper, John dory and tarakihi. The remaining 40% is taken from FMA 9, mainly as a bycatch of the snapper and trevally inshore trawl fisheries.

GUR 2 landings have fluctuated within the range of 400–700 t since 1991–92, typically well below the TACC. In addition to the target fishery off Mahia, red gurnard are taken as a bycatch of the tarakihi, trevally and snapper inshore trawl fisheries.

**Table 1: Reported landings (t) of red gurnard by Fishstock from 1983–84 to 2006–07 and actual TACCs (t) from 1986–87 to 2006–07. * FSU and †QMS data.**

| Fishstock | GUR 1 | | GUR 2 | | GUR 3 | | GUR 7 | |
|---|---|---|---|---|---|---|---|---|
| QMA (s) | 1 & 9 | | 2 | | 3, 4, 5 & 6 | | 7 | |
| | Landings | TACC | Landings | TACC | Landings | TACC | Landings | TACC |
| 1983–84* | 2 099 | – | 782 | – | 366 | – | 468 | – |
| 1984–85* | 1 531 | – | 665 | – | 272 | – | 332 | – |
| 1985–86* | 1 760 | – | 495 | – | 272 | – | 239 | – |
| 1986–87† | 1 021 | 2 010 | 592 | 610 | 210 | 480 | 421 | 610 |
| 1987–88† | 1 139 | 2 081 | 596 | 657 | 386 | 486 | 806 | 629 |
| 1988–89† | 1 039 | 2 198 | 536 | 698 | 528 | 489 | 479 | 669 |
| 1989–90† | 916 | 2 283 | 451 | 720 | 694 | 501 | 511 | 678 |
| 1990–91† | 1 123 | 2 284 | 490 | 723 | 661 | 524 | 442 | 678 |
| 1991–92† | 1 294 | 2 284 | 663 | 723 | 539 | 600 | 704 | 815 |
| 1992–93† | 1 629 | 2 284 | 618 | 725 | 484 | 601 | 761 | 815 |
| 1993–94† | 1 153 | 2 284 | 635 | 725 | 711 | 601 | 469 | 815 |
| 1994–95† | 1 054 | 2 287 | 559 | 725 | 685 | 601 | 455 | 815 |
| 1995–96† | 1 163 | 2 287 | 567 | 725 | 633 | 601 | 382 | 815 |
| 1996–97† | 1 055 | 2 287 | 503 | 725 | 641 | 900 | 378 | 815 |
| 1997–98† | 1 015 | 2 287 | 482 | 725 | 477 | 900 | 309 | 678 |
| 1998–99† | 927 | 2 287 | 469 | 725 | 395 | 900 | 323 | 678 |
| 1999–00† | 944 | 2 287 | 521 | 725 | 411 | 900 | 331 | 678 |
| 2000–01† | 1 294 | 2 287 | 623 | 725 | 569 | 900 | 571 | 678 |
| 2001–02† | 1 109 | 2 287 | 619 | 725 | 717 | 900 | 686 | 681 |
| 2002–03† | 1 256 | 2 287 | 552 | 725 | 888 | 800 | 793 | 681 |
| 2003–04† | 1 225 | 2 287 | 512 | 725 | 725 | 800 | 717 | 681 |
| 2004–05† | 1 354 | 2 287 | 708 | 725 | 854 | 800 | 688 | 681 |
| 2005–06† | 1 113 | 2 287 | 542 | 725 | 957 | 800 | 604 | 681 |
| 2006–07† | 1 180 | 2 287 | 575 | 725 | 1 002 | 800 | 710 | 681 |

| Fishstock | GUR 8 | | GUR 10 | | | |
|---|---|---|---|---|---|---|
| QMA (s) | 8 | | 10 | | Total | |
| | Landings | TACC | Landings | TACC | Landings | TACC |
| 1983–84* | 251 | – | 0 | – | 3 966 | – |
| 1984–85* | 247 | – | 0 | – | 3 047 | – |
| 1985–86* | 163 | – | 0 | – | 2 929 | – |
| 1986–87† | 159 | 510 | 0 | 10 | 2 403 | 4 230 |
| 1987–88† | 194 | 518 | 0 | 10 | 3 121 | 4 381 |
| 1988–89† | 167 | 532 | 0 | 10 | 2 749 | 4 596 |
| 1989–90† | 173 | 538 | 0 | 10 | 2 745 | 4 730 |
| 1990–91† | 150 | 543 | 0 | 10 | 2 866 | 4 762 |
| 1991–92† | 189 | 543 | 0 | 10 | 3 390 | 4 975 |
| 1992–93† | 208 | 543 | 0 | 10 | 3 700 | 4 978 |
| 1993–94† | 174 | 543 | 0 | 10 | 3 142 | 4 978 |
| 1994–95† | 217 | 543 | 0 | 10 | 2 969 | 4 982 |
| 1995–96† | 182 | 543 | 0 | 10 | 2 927 | 4 982 |
| 1996–97† | 219 | 543 | 0 | 10 | 2 796 | 5 281 |
| 1997–98† | 249 | 543 | 0 | 10 | 2 532 | 5 143 |
| 1998–99† | 170 | 543 | 0 | 10 | 2 284 | 5 143 |
| 1999–00† | 222 | 543 | 0 | 10 | 2 429 | 5 143 |
| 2000–01† | 291 | 543 | 0 | 10 | 3 348 | 5 143 |
| 2001–02† | 302 | 543 | 0 | 10 | 3 429 | 5 143 |
| 2002–03† | 342 | 543 | 0 | 10 | 3 831 | 4 993 |
| 2003–04† | 329 | 543 | 0 | 10 | 3 508 | 4 993 |
| 2004–05† | 370 | 543 | 0 | 10 | 3 974 | 4 993 |
| 2005–06† | 373 | 543 | 0 | 10 | 3 589 | 4 993 |
| 2006–07† | 349 | 543 | 0 | 10 | 3 817 | 4 993 |

*FSU data.
†QMS data.

GUR 3 landings regularly exceeded the TACC between 1988–89 and 1995–96. Ageing of fish collected during the east coast South Island trawl (ECSI) surveys suggests there were 1 or 2 relatively strong year classes moving through the fishery, which may help explain the overcatches. However, once the TACC in GUR 3 was increased to 900 t in the 1996–97 fishing year, landings declined to well below this quantum. In 2002–03, the TACC for GUR 3 was reduced by 100 t, to 800 t. GUR 3 has been consistently overcaught since 2004.

GUR 7 landings declined steadily from 761 t in 1992–93, to 309 t in 1997–98, but have since increased to the point that they have ranged between 604 t and 793 t since 2001–02, exceeding the

TACC. Landings in GUR 8 have remained well below the levels of the TACC since 1986–87, with a maximum catch of 373 t reported for the 2005–06 fishing year.

## 1.2 Recreational fisheries

Red gurnard is, by virtue of its wide distribution in shallow coastal waters, an important recreational species. Vulnerable to recreational fishing methods, it is often taken by snapper and tarakihi anglers, particularly in the Northern Region.

Recreational harvest estimates were obtained from national telephone diary surveys undertaken in 1996 and 2001. Regional diary surveys were undertaken from 1991 to 1994. A key component of the estimating recreational harvest from diary surveys is determining the proportion of the population that fish. The Recreational Working Group has concluded that the methodological framework used for telephone interviews produced incorrect eligibility figures for the 1996 and previous surveys. Consequently the harvest estimates derived from these surveys are considered to be underestimated. However, relative comparisons can be made between stocks within these surveys. The Recreational Working Group considered that the 2000 survey using face-to-face interviews better estimated eligibility and that the derived recreational harvest estimates are believed to be more accurate. FMA2 catches are nevertheless considered to be an over-estimate, probably because of an unrepresentative diarist sample. The 1999–00 Harvest estimates for each Fishstock should be evaluated with reference to the coefficient of variation. Recreational catch estimates are given in Tables 2-4.

**Table 2: Estimated number and weight of red gurnard harvested by recreational fishers by Fishstock and survey. Surveys were carried out in different years in the Ministry of Fisheries regions: South in 1991–92, Central in 1992–93 and North in 1993–94 (Teirney *et al*. 1997). The estimated Fishstock harvest is indicative and was made by combining estimates from the different years.**

| | | Total | | |
|---|---|---|---|---|
| Fishstock | Survey | Number | CV(%) | Survey harvest (t) |
| GUR 1 | North | 349 000 | 14 | 155–245 |
| GUR 2 | North | 2 000 | – | – |
| GUR 2 | Central | 156 000 | 31 | 50–125 |
| GUR 7 | Central | 21 000 | 23 | 5–20 |
| GUR 8 | Central | 157 000 | 37 | 50–110 |

**Table 3: Results of a national diary survey of recreational fishers in 1996. Estimated number of red gurnard harvested by recreational fishers by Fishstock and the corresponding harvest tonnage. The mean weights used to convert numbers to catch weight are considered the best available estimates. Estimated harvest is presented as a range to reflect the uncertainty in the estimates (from Bradford 1998).**

| Fishstock | Number caught | CV (%) | Harvest Range (t) | Harvest Point Estimate (t) |
|---|---|---|---|---|
| GUR 1 | 262 000 | 7 | 100–120 | 108 |
| GUR 2 | 38 000 | 18 | 10–20 | 16 |
| GUR 3 | 1 000 | – | – | – |
| GUR 7 | 26 000 | 15 | 10–15 | 12 |
| GUR 8 | 67 000 | 15 | 25–35 | 28 |

**Table 4: Results of the 1999–00 national diary survey of recreational fishers (Dec 1999 – Nov 2000). Estimated number of red gurnard harvested by recreational fishers by Fishstock and the corresponding harvest tonnage. Estimated harvest is presented as a range to reflect the uncertainty in the estimates (Boyd & Reilly 2002).**

| **Fishstock** | Number caught | CV (%) | Harvest Range(t) | Harvest Point estimate(t) |
|---|---|---|---|---|
| GUR 1 | 465 000 | 16 | 188-256 | 223 |
| GUR 2 | 209 000 | 37 | 80-173 | 127 |
| GUR 3 | 11 000 | 70 | 2-9 | 5 |
| GUR 7 | 36 000 | 23 | 9-14 | 11 |
| GUR 8 | 99 000 | 36 | 26-55 | 40 |

## 1.3 Customary non-commercial fisheries

Red gurnard is an important species for customary non-commercial fishing interests, by virtue of its wide distribution in shallow coastal waters. However, no quantitative estimates of customary non-commercial catch are currently available.

## 1.4 Illegal catch

No quantitative information is available.

## 1.5 Other sources of mortality

No quantitative information is available.

# 2. BIOLOGY

Red gurnard reach sexual maturity at an age of 2–3 years and a fork length (FL) of about 23 cm, after which the growth rate slows. Growth rate varies with location, and females grow faster and are usually larger at age than males. Maximum age ($A_{MAX}$) is about 16 years and maximum size is 55+ cm.

*M* was estimated using the equation $M = \log_e 100/\text{maximum age}$, where maximum age is the age to which 1% of the population survives in an unexploited stock. Samples from the ECSI suggested an $A_{MAX}$ of about 16 years for males and 13 years for females, giving estimates for *M* of 0.29 and 0.35 respectively. Samples from the WCSI indicate an $A_{MAX}$ of about 15 years for both sexes, giving an estimate of 0.31 for *M*. These samples were not from virgin populations, so *M* may be slightly overestimated.

Red gurnard have a long spawning period which extends through spring and summer with a peak in early summer. In the Hauraki Gulf, ripe adults can be found throughout the year. Spawning grounds appear to be widespread, although perhaps localised over the inner and central shelf. Egg and larval development takes place in surface waters, and there is a period of at least eight days before feeding starts. Small juveniles (< 15 cm FL) are often caught in shallow harbours, but rarely in commercial trawls.

Biological parameters relevant to the stock assessment are shown in Table 5.

**Table 5: Estimates of biological parameters for red gurnard.**

| Fishstock | | | | | | Estimate | Source |
|---|---|---|---|---|---|---|---|
| 1. Natural mortality (*M*) | | | | | | | |
| | | | Female | | | Males | |
| GUR 1W & 1E | | | 0.30 | | | 0.35 | Stevenson (2000) |
| GUR 3 | | | 0.29 | | | 0.35 | Sutton (1997) |
| GUR 7 | | | 0.31 | | | 0.31 | Sutton (1997) |
| 2. Weight = a(length)$^b$ (Weight in g, length in cm fork length). | | | | | | | |
| | | | Both Sexes | | | | |
| | | a | b | | | | |
| GUR 1 | | 0.00998 | 2.99 | | | | Elder (1976) |
| GUR 1W & 1 E | | 0.026 | 2.775 | | | | Stevenson (2000) |
| GUR 2 | | 0.0053 | 3.19 | | | | Stevenson (2000) |
| 3. von Bertalanffy growth parameters | | | | | | | |
| | | Females | | | Males | | |
| | $L_\infty$ | k | $t_0$ | $L_\infty$ | k | $t_0$ | |
| GUR 1 | 36.4 | 0.641 | 0.189 | 28.8 | 0.569 | -0.552 | Elder (1976) |
| GUR 1W | 45.3 | 0.25 | -0.88 | 36.5 | 0.45 | -0.30 | Stevenson (2000) |
| GUR1E | 44.5 | 0.28 | -0.76 | 35.2 | 0.49 | -0.24 | Stevenson (2000) |
| GUR 3 | 48.2 | 0.44 | 0.1 | 42.2 | 0.49 | -0.26 | Sutton (1997) |
| GUR 7 | 45.7 | 0.40 | -0.36 | 40.3 | 0.37 | -0.96 | Sutton (1997) |

## 3. STOCKS AND AREAS

There are no new data that would alter the stock boundaries given in previous assessment documents. No information is available on stock separation of red gurnard.

## 4. STOCK ASSESSMENT

In 1998 stock reduction analyses were undertaken for GUR 1W, GUR 1E and GUR 2 using MIAEL estimation (Cordue 1998). The MIAEL model used a two-stage process. All input data are used in the first stage to obtain least squares estimates of year class strengths and trawl survey selectivities. The second stage of the model produces the least squares and MIAEL estimates of biomass. The MIAEL procedure produces a performance index for each estimate which, if it is low, indicates that the parameter is not well estimated within its bounds. Estimates of MCY and CAY are presented for all three stocks, based on the MIAEL method.

There are no new data which would alter the yield estimates given for the other GUR stocks in the 1997 Plenary Report. Those yield estimates were based on commercial landings data only and have not changed since the 1992 Plenary Report.

### 4.1 Estimates of fishery parameters and abundance

### GUR 1

Catch histories for GUR 1W and GUR 1E were collated for the period 1931 to 1997–98 (Table 6). The catch history for GUR 1 was divided into east and west of North Cape. The catches were split on the basis of port of landing up until 1984 and since then at a 60:40 ratio based on logbook data. Other model input parameters are given in Tables 6 and 7.

**Table 6: Catch histories (t) for GUR 1W and GUR 1E for the period 1931 to 1997–98 used in the modelling.**

| Year | GUR 1 West | GUR 1 East | Year | GUR 1 West | GUR 1 East |
|---|---|---|---|---|---|
| 1931 | – | 66 | 1966 | 561 | 557 |
| 1932 | – | 41 | 1967 | 549 | 455 |
| 1933 | – | 66 | 1968 | 651 | 443 |
| 1934 | – | 50 | 1969 | 794 | 502 |
| 1935 | – | 74 | 1970 | 832 | 581 |
| 1936 | – | 113 | 1971 | 670 | 468 |
| 1937 | – | 203 | 1972 | 340 | 401 |
| 1938 | – | 107 | 1973 | 677 | 577 |
| 1939 | – | 118 | 1974 | 512 | 355 |
| 1940 | – | 122 | 1975 | 386 | 294 |
| 1941 | – | 105 | 1976 | 610 | 427 |
| 1942 | – | 121 | 1977 | 690 | 569 |
| 1943 | – | 125 | 1978 | 833 | 696 |
| 1944 | – | 232 | 1979 | 1 119 | 767 |
| 1945 | – | 353 | 1980 | 1 153 | 664 |
| 1946 | – | 418 | 1981 | 1 499 | 810 |
| 1947 | – | 368 | 1982 | 1 021 | 987 |
| 1948 | – | 222 | 1983 | 629 | 1 139 |
| 1949 | – | 362 | 1984 | 624 | 1 029 |
| 1950 | – | 298 | 1984–85 | 612 | 919 |
| 1951 | – | 211 | 1985–86 | 704 | 1 056 |
| 1952 | 8 | 376 | 1986–87 | 408 | 613 |
| 1953 | 83 | 392 | 1987–88 | 456 | 683 |
| 1954 | 106 | 371 | 1988–89 | 416 | 623 |
| 1955 | 126 | 354 | 1989–90 | 366 | 550 |
| 1956 | 178 | 244 | 1990–91 | 449 | 674 |
| 1957 | 182 | 294 | 1991–92 | 518 | 776 |
| 1958 | 117 | 301 | 1992–93 | 652 | 977 |
| 1959 | 109 | 335 | 1993–94 | 461 | 692 |
| 1960 | 203 | 267 | 1994–95 | 422 | 632 |
| 1961 | 261 | 278 | 1995–96 | 465 | 698 |
| 1962 | 207 | 279 | 1996–97 | 422 | 633 |

**Table 6 (*Continued*):**

| Year | GUR 1 West | GUR 1 East | Year | GUR 1 West | GUR 1 East |
|---|---|---|---|---|---|
| 1963 | 238 | 303 | 1997–98 | 406 | 609 |
| 1964 | 320 | 627 | | | |
| 1965 | 508 | 750 | | | |

**Table 7: Input parameters used for the MIAEL modelling for the base case and sensitivity analysis for all stocks unless specified.**

| Parameter | Estimate | Sensitivity |
|---|---|---|
| Steepness | 0.9 | – |
| Recruitment variability | 0.6 | – |
| Natural mortality males | 0.35 | ± 0.05 |
| Natural mortality females | 0.3 | ± 0.05 |
| Maximum exploitation ($r_{MAX}$) pre-spawning, spawning | 0.5 | 0.3 |
| Minimum exploitation rate when largest catch ($r_{MMX}$) | 0.01 | – |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Maturity ogive | Age | 1 | 2 | 3 | 4 | 5 | ≥ 6 |
| GUR 1W & 1E | Male | 0.00 | 0.75 | 1.00 | 1.00 | 1.00 | 1.00 |
| | Female | 0.00 | 0.25 | 1.00 | 1.00 | 1.00 | 1.00 |
| Trawl survey selectivity | | | | | | | |
| GUR 1W | Male | 0.25 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| | Female | 0.10 | 0.40 | 1.00 | 1.00 | 1.00 | 1.00 |
| GUR 1E | Male | 0.10 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |
| | Female | 0.10 | 0.30 | 1.00 | 1.00 | 1.00 | 1.00 |
| Fishing selectivity | Age | 1 | 2 | 3 | 4 | 5 | ≥ 6 |
| GUR 1W | Male | 0.10 | 0.35 | 0.60 | 0.80 | 0.90 | 1.00 |
| | Female | 0.10 | 0.35 | 0.65 | 0.85 | 1.00 | 1.00 |
| Fishing selectivity | | | | | | | |
| GUR 1E | Male | 0.10 | 0.35 | 0.60 | 0.80 | 0.90 | 1.00 |
| | Female | 0.10 | 0.35 | 0.70 | 1.00 | 1.00 | 1.00 |

Standardised CPUE indices for GUR 1W, GUR 1E are shown in Table 7. The indices are based on an analysis of gurnard CPUE from inshore trawl fisheries where gurnard was either the target species or one of the important bycatch species (Stevenson 2000). Log-linear and combined models showed similar trends and only the log-linear results are presented here.

**Table 8: Relative year effects from the linear model of log (catch per day) for GUR 1W, GUR 1E and GUR 2.**

| Year | GUR 1W | GUR 1E |
|---|---|---|
| 1989–90 | 1.00 | 1.00 |
| 1990–91 | 0.90 | 0.90 |
| 1991–92 | 0.97 | 0.85 |
| 1992–93 | 1.35 | 0.81 |
| 1993–94 | 1.20 | 0.64 |
| 1994–95 | 1.46 | 0.62 |
| 1995–96 | 1.20 | 0.50 |
| 1996–97 | 1.04 | 0.43 |

The input data sets and the CV's used for those series in the modelling are listed in Table 9. For the base case all trawl survey indices and proportion at age data were fitted in the model. Sensitivity runs were carried out without fitting the age data or 1+ indices, and fitting the CPUE indices instead. Estimated year class strengths from base case model runs are given in Table 10.

**Table 9: Coefficients of variation (CV) applied in the model to the series of relative abundance indices*.**

| Fishstock | Data series | Base case CV (%) | Sensitivity CV (%) |
|---|---|---|---|
| GUR 1W | Trawl survey adults (*Kaharoa*, Oct/Nov) | 25 | |
| | Trawl survey 1+ (*Kaharoa*, Oct/Nov) | 25 | NF |
| | Trawl survey proportion-at-age (1994, 1996) | 25 | NF |
| | CPUE | NF | 35 |
| GUR 1E | Trawl survey adults BOP (*Kaharoa*, Feb) (excl. 1985 & 1987) | 25 | |
| | Trawl survey adults HG (*Kaharoa*, Nov–Dec) (excl. 1985) | 25 | |
| | Trawl survey 1+ BOP (*Kaharoa*, Feb) (excl. 1985 & 1987) | 25 | NF |
| | Trawl survey 1+ HG (*Kaharoa*, Nov–Dec) (excl. 1985) | 25 | NF |
| | Trawl survey proportion-at-age HG (1992, 1994) | 25 | NF |
| | CPUE | NF | 35 |

*BoP- Bay of Plenty. HG- Hauraki Gulf. NF- not fitted.

**Table 10: Estimates of year class strengths from model runs incorporating age data. (– not estimated).**

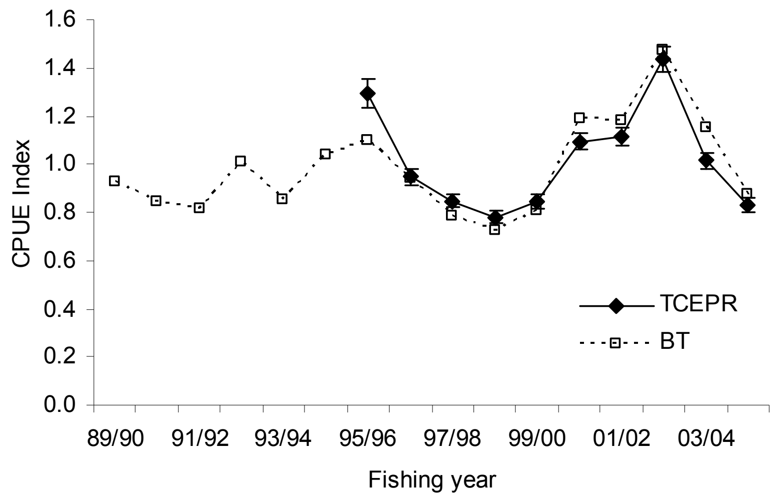
| Year class | GUR 1W | GUR 1E |
|---|---|---|
| 1984 | – | 0.01 |
| 1985 | 0.95 | 0.42 |
| 1986 | 0.85 | 0.37 |
| 1987 | 0.01 | 0.82 |
| 1988 | 0.22 | 0.61 |
| 1989 | 0.72 | 1.04 |
| 1990 | 0.29 | 0.13 |
| 1991 | 2.56 | 1.44 |
| 1992 | 3.13 | 0.13 |
| 1993 | 0.92 | 2.45 |
| 1994 | 2.11 | 0.29 |
| 1995 | 1.59 | 0.01 |
| 1996 | – | 2.45 |
| 1997 | – | 0.13 |

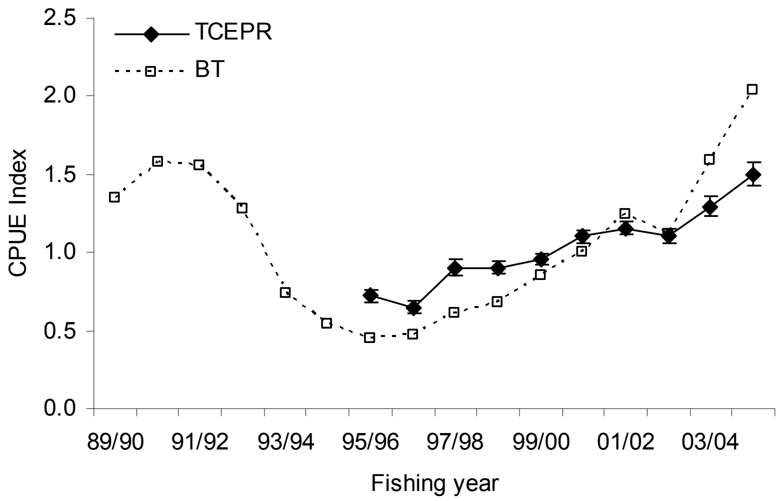
In 2006, Kendrick (in prep) updated CPUE analyses for GUR 1W, GUR 1E, GUR 1BoP (Figure 1). In each substock positive catches from single bottom trawl targeted at snapper, trevally or John dory were standardised using a lognormal model (BT). The analysis was done on landed greenweight and the data were amalgamated to a trip-stratum resolution to allow CELR and TCEPR format data to be combined.

There was concern that the systematic shift in this fishery from reporting on daily CELR forms to reporting tow-by-tow on TCEPRs may potentially confounded the year effects and have contributed to overly-optimistic trajectories, so shorter time series based on lognormal models of positive estimated catches, regardless of target species, reported in TCEPR format and standardised for depth, are also presented.

For each substock the TCEPR series was less optimistic, and was preferred by the Inshore Stock Assessment Working Group.

If compared to the time of the previous assessment, there appears to have been an increase in abundance in GUR 1W followed by a decline to around the level observed in 1997–98. For GUR 1E there appears to have been a strong increase in abundance while in the GUR 1BoP CPUE appears to have been stable.



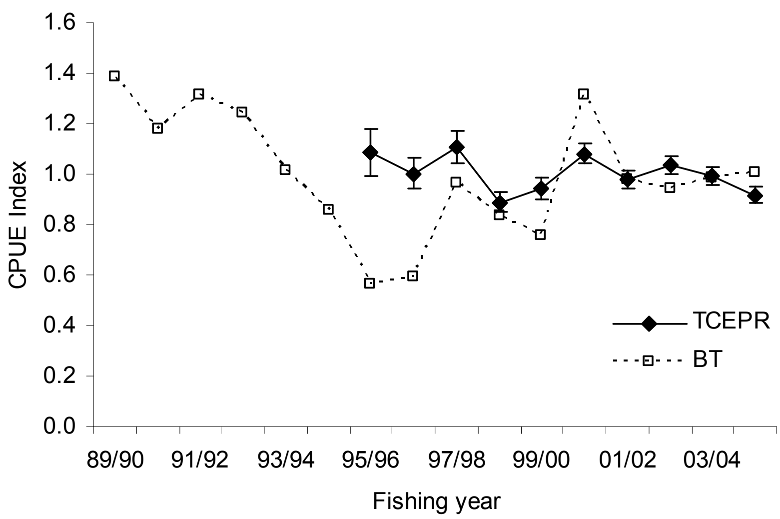




**Figure 1: Comparison of indices for the GUR 1W (top), GUR 1E (middle), and GUR1BoP (bottom). Lognormal indices for the series based on bottom trawl including both formtypes (BT), and the lognormal series based on TCEPR format data (Kendrick, in prep).**

## GUR 2

In 2006, Kendrick (in prep) updated CPUE analyses for GUR 2 (Figure 2). Presently GUR 2 is monitored using the bottom trawl target fishery and standardised CPUE is based on a lognormal model of positive estimated catches from statistical areas 011–014.

For contrast or corroboration the bycatch of red gurnard from tows targeted at tarakihi in the same areas is also monitored. Whilst the lognormal model of positive estimated catches shows no trend up or down, analyses that include unsuccessful effort were markedly more optimistic.

Aside from a decline in the early part of the bycatch CPUE series and an increase in the later part of the target series, there have been no drastic changes in CPUE with current levels similar to that from the early 1990s.

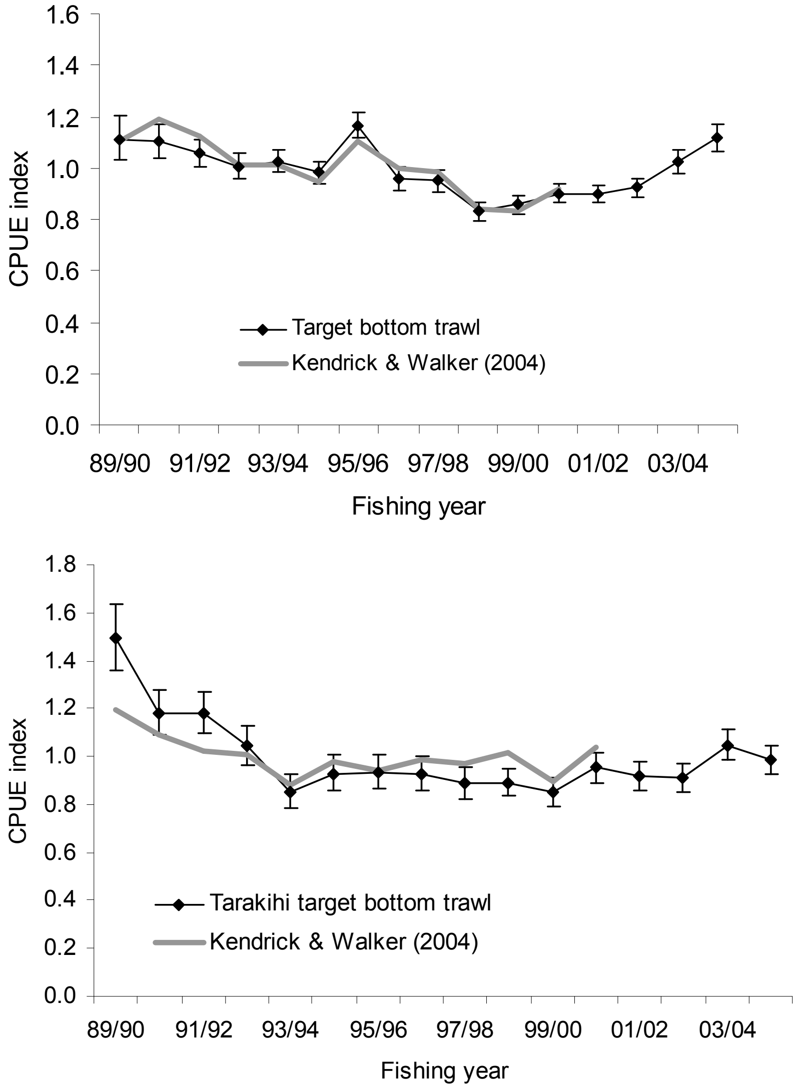



**Figure 2: Comparison of lognormal models of successful catches of red gurnard in the target GUR 2 fishery (top) and bycatch from the TAR target fishery (bottom); this study and previous series from Kendrick & Walker (2004). Both series rescaled relative to the geometric mean of the years in common (1989–90 to 2000–01) (Kendrick, in prep).**

## GUR 3

Further CPUE analyses have been carried out by Seafood Industry Council (SeaFIC) (2002, 2005, and 2007) as part of the monitoring programme for adaptive management stocks. In 2002, the Plenary agreed that the CPUE indices resulting from the FLA fishery appeared to be more stable than those for the RCO bycatch. Therefore, the FLA bycatch regression analysis is now being used to monitor abundance in GUR 3 (Figure 3).

Winter trawl surveys were conducted annually off the east cast of the South Island (GUR 3) between 1991 and 1996 (Table 10); however, the biomass estimates are highly variable between surveys and are unlikely to monitor the abundance of red gurnard (the trawl surveys were optimised to sample red cod and, consequently, neither the survey depth range or areal stratification are appropriate to survey the red gurnard population). Five summer surveys, which were optimised for red gurnard, were carried out annually between 1996–97 and 2000–01. There has been a downward trend in the indices since 1996–97, but this may have been due to changing catchability for this species. In 2001, the Inshore FAWG recommended that the summer east coast South Island trawl survey be discontinued due to the extreme variability in the catchability of the target species. The east coast South Island trawl survey was reinstated in 2007.

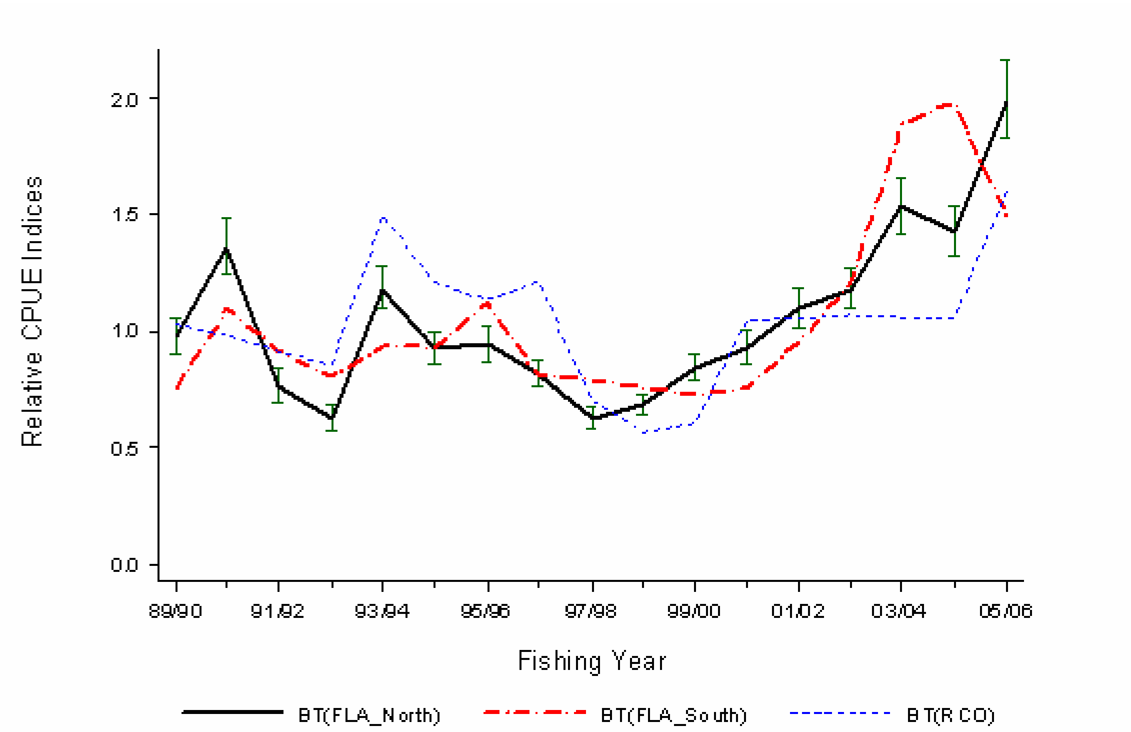



**Figure 3. Comparison of the lognormal indices from three independent CPUE series for GUR 3: target FLA bottom trawl, statistical areas 020. 022, and 024: [BT(FLA_North)]; target FLA bottom trawl, statistical areas 026. 025, and 030: [BT(FLA_South)] and target RCO bottom trawl, statistical areas 020. 022, and 024: [BT(RCO)]. (Starr *et al.* 2007)**

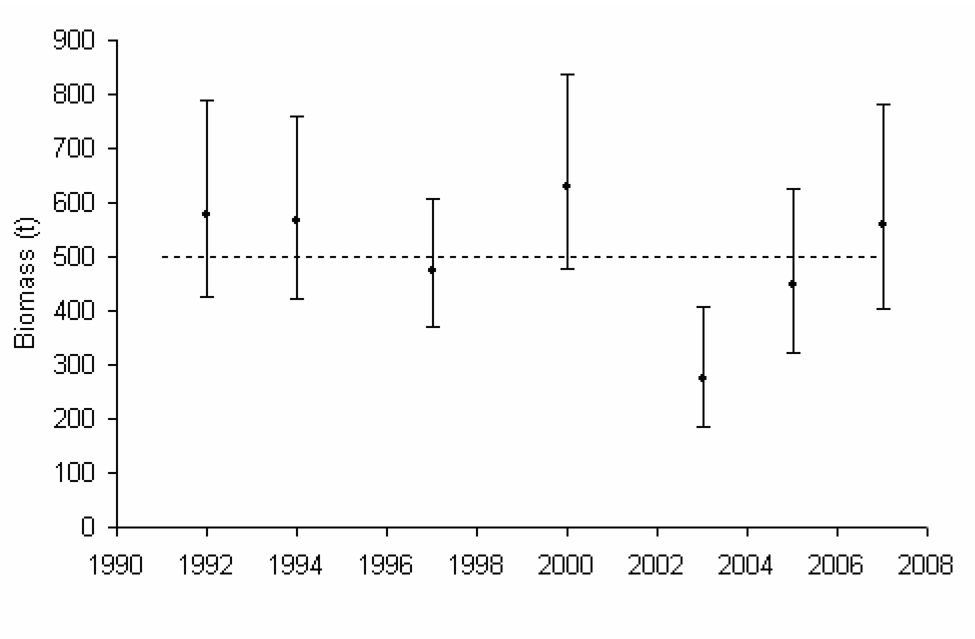
## GUR 7

Biomass indices derived from the raw CPUE (kg of gurnard/trawl) of vessels bottom trawling for barracouta, gurnard and flatfish in FMA 7 were developed in support of a proposal to introduce GUR 7 into the Adaptive Management Programme (Challenger Finfish Management Company 2003). The annual indices declined from 1991–92 to 1994–95, were relatively stable until 1989–99 and then increased sharply in 2002–03. Trawl surveys, on the other hand, indicate that the relative biomass of red gurnard declined gradually from 1992 to 2003 on the west coast of the South Island, and the relative biomass declined sharply in 2003 in Tasman and Golden Bays. On account of the low CVs and low inter-annual variability, WCSI trawl surveys have been thought to reflect biomass trends of the gurnard and other target species.

Relative abundance indices have been obtained from trawl surveys of the Bay of Plenty, west coast North Island and Hauraki Gulf within the GUR 1 Fishstock and the South Island west coast and Tasman/Golden Bays (GUR 7) (Table 11). The biomass trends from the west and east coast South Island trawl surveys are shown in Figure 4.

**Table 11: Estimates of red gurnard biomass (t) from *Kaharoa* trawl surveys.**

| Year and location | Trip Code | Biomass | CV (%) |
|---|---|---|---|
| Bay of Plenty | | | |
| 1983 | KAH8303 | 380 | 23 |
| 1985 | KAH8506 | 57 | 17 |
| 1987 | KAH8711 | 410 | 28 |
| 1990 | KAH9004 | 432 | 12 |
| 1992 | KAH9202 | 290 | 9 |
| 1996 | KAH9601 | 332 | 14 |
| 1999 | KAH9902 | 364 | 14 |
| North Island west coast (QMA 9) | | | |
| 1986 | KAH8612 | 1 763 | 16 |
| 1987 | KAH8715 | 2 022 | 24 |
| 1989 | KAH8918 | 1 013 | 12 |
| 1991 | KAH9111 | 1 846 | 23 |
| 1994 | KAH9410 | 2 498 | 30 |
| 1996 | KAH9615 | 1 820 | 14 |
| North Island west coast (QMA 8) | | | |
| 1989 | KAH8918 | 628 | 15 |
| 1991 | KAH9111 | 817 | 9 |
| 1994 | KAH9410 | 685 | 22 |
| 1996 | KAH9615 | 370 | 37 |
| 1999 | KAH9915 | (QMAs 8 & 9 combined) 2099 | 13 |
| Hauraki Gulf | | | |
| 1984 | KAH8421 | 595 | 15 |
| 1985 | KAH8517 | 49 | 44 |
| 1986 | KAH8613 | 426 | 36 |
| 1987 | KAH8716 | 255 | 15 |
| 1988 | KAH8810 | 749 | 19 |
| 1989 | KAH8917 | 105 | 29 |
| 1990 | KAH9016 | 141 | 16 |
| 1992 | KAH9212 | 330 | 9 |
| 1993 | KAH9311 | 177 | 17 |
| 1994 | KAH9411 | 247 | 19 |
| 1997 | KAH9720 | 242 | 14 |
| 2000 | KAH0012 | 24 | 46 |
| South Island west coast and Tasman/Golden Bays | | | |
| 1992 | KAH9204 | 572 | 15 |
| 1994 | KAH9404 | 559 | 15 |
| 1995 | KAH9504 | 584 | 19 |
| 1997 | KAH9704 | 471 | 13 |
| 2000 | KAH0004 | 301 | 23 |
| 2003 | KAH0304 | 270 | 20 |
| 2005 | KAH0503 | 442 | 17 |
| 2007 | KAH 0704 | 553 | 17 |
| North Island east coast | | | |
| 1993 | KAH9304 | 439 | 44 |
| 1994 | KAH9402 | 871 | 16 |
| 1995 | KAH9502 | 178 | 26 |
| 1996 | KAH9605 | 708 | 29 |
| South Island east coast (winter) | | | |
| 1991 | KAH9105 | 763 | 40 |
| 1992 | KAH9205 | 142 | 30 |
| 1993 | KAH9306 | 576 | 31 |
| 1994 | KAH9406 | 112 | 34 |
| 1996 | KAH9606 | 505 | 27 |
| 2007 | KAH0705 | 1 453 | 35 |
| South Island east coast (summer) | | | |
| 1996/97 | KAH9618 | 765 | 13 |
| 1997/98 | KAH9704 | 317 | 16 |
| 1998/99 | KAH9809 | 493 | 13 |
| 1999/00 | KAH9917 | 202 | 20 |
| 2000/01 | KAH0014 | 146 | 34 |



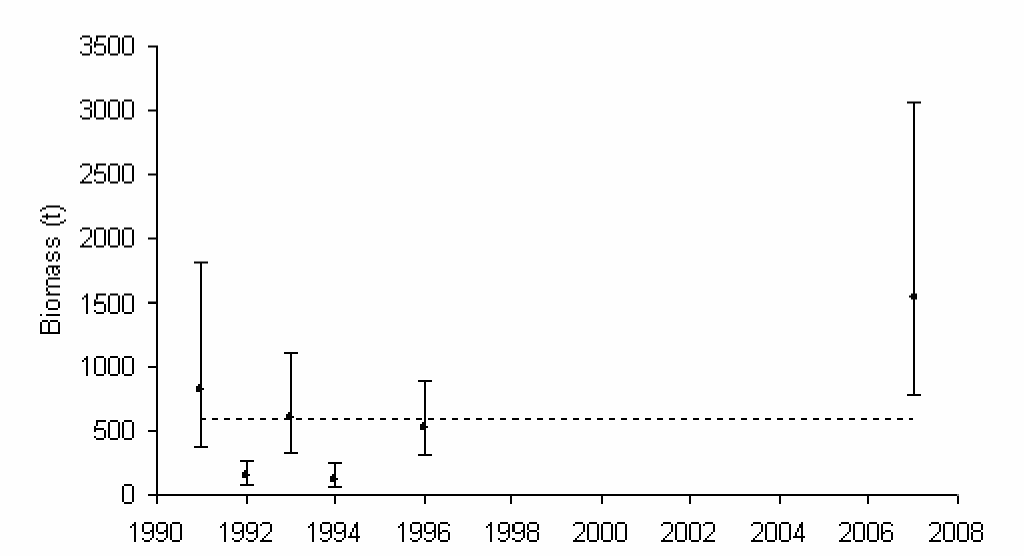




**Figure 4: Biomass trends ± 95% CI (estimated from survey CV's assuming a lognormal distribution) and the time series mean (dotted line) from the West (top) and East (bottom) Coast South Island trawl surveys.**

## 4.2 Biomass estimates

Bounded estimates of mid-spawning season virgin ($B_0$, assumed to exist in 1931) and mid-spawning season current ($B_{MID}$) biomass, and estimates of next season's beginning of year total biomass ($B_{BEG}$) were obtained using the least squares and MIAEL estimation techniques of Cordue (1998) (Table 11 and Figure 2). The model was run using the parameters from Tables 4 and 6, catch histories from Table 5, and biomass indices from Tables 7 and 10.

### West Coast North Island GUR 1W (QMA 9)

The MIAEL estimate of $B_0$ for GUR 1W is about 27000 t (range 5090 to 101930), with a low performance index of 10% (Table 11). This estimate is substantially higher than the sensitivity runs without age data, although the bounds and performance indices are virtually unchanged. The MIAEL estimate of $B_{MID99}$ is about 80% of $B_0$ (range 40–147%) (Figure 2), but has a low performance index of only 3%. This estimate is slightly higher than the sensitivity runs without age data. However, the bounds were generally narrower and the performance indices higher for the sensitivity runs. The assessment for GUR 1W suggests that the stock has been only lightly exploited. Even if the stock were at $B_{MIN}$, the current biomass would still be greater than $B_{MSY}$, and the current level of catches would be sustainable, as indicated by the increasing stock trajectory (Figure 5).

## North-east coast North Island GUR 1E (QMA 1)

The MIAEL estimate of $B_0$ for GUR 1E is about 31100 t (range 6290 to 94490), with a low performance index of 14% (Table 12). This estimate is substantially higher than the sensitivity runs without age data. The MIAEL estimate of $B_{MID99}$ is about 59% of $B_0$ (range 9–83%), and has a high performance index of 58%. This estimate is considerably higher than the sensitivity runs without age data. The assessment for GUR 1E suggests that the stock has been low to moderately exploited. Current biomass appears to be greater than $B_{MSY}$, and the current level of catches appear to be sustainable.

**Table 12: Estimates of $B_{MIN}$ and $B_{MAX}$, least squares (LS) estimates of biomass, and MIAEL estimates of *p*, biomass (MIAEL), and performance indices (Perf.), for the base case assessment and sensitivity runs for GUR 1W and GUR 1E. $r_{MAX}$, maximum exploitation rate; cpue, inclusion of cpue index; age data, inclusion of catch-at-age data. Biomass estimates are: mid-spawning season virgin biomass ($B_0$) in tonnes, and mid-spawning season mature biomass for 1998–99 ($B_{MID99}$) as a percentage of virgin biomass. All sensitivities tests should be compared to the no age data run.**

| Estimate | Run | $B_{MIN}$–$B_{MAX}$ | LS | *p* | MIAEL | Perf. % |
|---|---|---|---|---|---|---|
| GUR 1W | | | | | | |
| $B_0$ | Base case | 5 090–101 930 | 101 930 | 0.128 | 27 050 | 9.5 |
| | No age data | 5 020–101 980 | 15 680 | 0.131 | 15 860 | 10.7 |
| | *M* +0.05 | 4 540–93 800 | 18 310 | 0.122 | 14 920 | 9.8 |
| | *M* –0.05 | 5 880–110 420 | 14 930 | 0.133 | 17 790 | 10.5 |
| | $r_{MAX}$ = 0.3 | 6 160–101 900 | 15 680 | 0.078 | 18 190 | 4.3 |
| | CPUE | 5 000–101 950 | 13 060 | 0.136 | 15 480 | 11.3 |
| $B_{MID99}$ (%$B_0$) | Base case | 40.0–147.2 | 1 47.2 | 0.111 | 79.9 | 2.6 |
| | No age data | 36.7–98.0 | 76.3 | 0.645 | 69.7 | 58.6 |
| | *M* +0.05 | 52.7–98.1 | 80 | 0.473 | 75.1 | 36.3 |
| | *M* –0.05 | 38.1–97.8 | 72.9 | 0.585 | 67.1 | 49.5 |
| | $r_{MAX}$ = 0.3 | 65.5–98.0 | 79.7 | 0.237 | 79.6 | 11.5 |
| | cpue | 34.6–98.0 | 74.8 | 0.681 | 68.7 | 64.3 |
| GUR 1E | | | | | | |
| $B_0$ | Base case | 6 290–94 490 | 94 490 | 0.169 | 31 140 | 13.5 |
| | No age data | 5 000–76 920 | 76 920 | –0.030 | 12 770 | 1 |
| | *M* +0.05 | 4 310–70 680 | 70 680 | –0.034 | 10 860 | 1.5 |
| | *M* –0.05 | 5 930–83 630 | 83 630 | –0.006 | 16 460 | 0 |
| | $r_{max}$ = 0.3 | 5 460–76 920 | 76 920 | 0.026 | 17 180 | 0.6 |
| | CPUE | 5 000–76 920 | 76 920 | –0.019 | 13 460 | 0.4 |
| $B_{MID99}$ (%$B_0$) | Base case | 8.7–82.6 | 82.6 | 0.619 | 59.4 | 58.4 |
| | No age data | 11.2–96.1 | 96.1 | –0.011 | 26.5 | 0 |
| | *M* +0.05 | 10.8–96.4 | 96.4 | –0.037 | 24 | 1.1 |
| | *M* –0.05 | 13.6–95.7 | 95.7 | 0.031 | 32.9 | 0.5 |
| | $r_{max}$ = 0.3 | 31.0–96.1 | 96.1 | 0.124 | 57.3 | 4.1 |
| | CPUE | 11.2–96.1 | 96.1 | 0.003 | 27.5 | 0 |

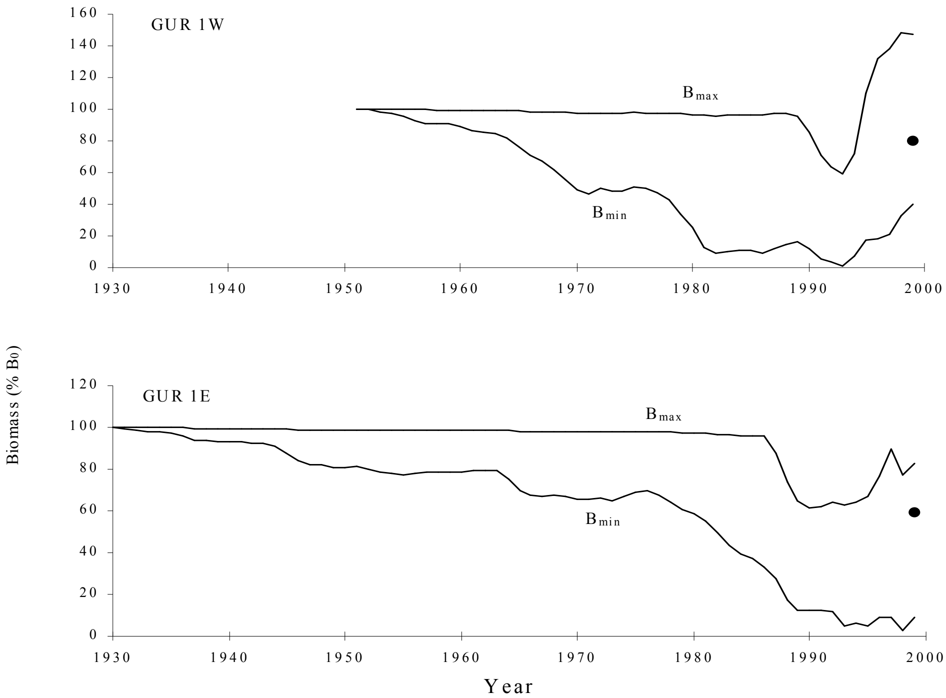



**Figure 5: Trajectories for minimum ($B_{MIN}$) and maximum ($B_{MAX}$) estimates of biomass from the base case model runs for GUR 1W and GUR 1E. The closed circles indicate the MIAEL estimates of mid spawning season biomass at the end of the 1998–99 fishing year.**

## East Coast North Island GUR 2

An assessment of GUR 2 was attempted by fitting the trawl and CPUE indices using the MIAEL method. However, the performance indices were very low (< 1%), and the assessment was rejected by the Working Group due to the paucity of data and the assumption of deterministic recruitment.

## 4.3 Estimation of Maximum Constant Yield (MCY)

Two methods were used to estimate MCY.

(i) MCY = $cY_{AV}$, where c = 0.7 is based on $M$ = 0.31 and $Y_{AV}$ is the mean catch for the years 1983–84 to 1986–87. Data for 1987–88 were excluded, as significant over-runs occurred in GUR 7 and catch may have been limited by the TAC. MCY estimates are shown in Table 12.

(ii) MCY = p.$B_0$ where p is determined for each stock using the simulation method of Francis (1992) such that the spawning biomass does not go below 20% $B_0$ more than 10% of the time. $B_0$ and its range are as determined by the MIAEL method (from Table 11), and MCY estimates, ranges and related parameters are listed in Table 12.

## GUR 1E and GUR 1W

The estimate of MCY for GUR 1E and GUR 1W from the MIAEL method had wide ranges, low performance indices, and were sensitive to the inclusion of age data (Table 14). The combined MCY of 5970 t is considerably higher than the 1120 t estimated using the average catch method (Table 13).

**Table 13: Estimates of MCY (t) (rounded to the nearest 10 t) .**

| Fishstock | QMA | | Average Catch 1983–84 to 1986–87 | MCY |
|---|---|---|---|---|
| GUR 1 | Auckland (East) (West) | 1 & 9 | 1 603 | 1120 |
| GUR 2 | Central (East) | 2 | 635 | 450 |
| GUR 3 | South-East (Coast) (Chatham), Southland and Sub-Antarctic | 3, 4, 5, & 6 | 280 | 200 |
| GUR 7 | Challenger | 7 | 365 | 260 |
| GUR 8 | Central (West) | 8 | 205 | 140 |
| GUR 10 | Kermadec | 10 | – | – |
| Total | | | 3 088 | 2 170 |

**Table 14: Estimates of $B_{MCY}$ (as % of $B_0$), MCY (as %$B_0$), MCY range (t) (from $B_{MIN}$ and $B_{MAX}$), and MCY (t) (from MIAEL) and its performance index (Perf.), for the base case assessment and sensitivity runs for GUR 1W and GUR 1E. $B_{MAY}$ (% of $B_0$) was 29.8% for GUR 1W and 29.9% for GUR 1E for the base case runs. All sensitivities tests should be compared to the no age data run.**

| Fishstock | Model run | $B_{MCY}$ (% of $B_0$) | MCY (% of $B_0$) | MCY Range | MCY (t) | Perf. (%) |
|---|---|---|---|---|---|---|
| GUR 1W | Base case | 48.1 | 10.2 | 520–10 400 | 2 760 | 9.5 |
| | No age data | 48 | 9.4 | 470–9 570 | 1 490 | 10.7 |
| | $M$ +0.05 | 49.5 | 10.7 | 480–10 070 | 1 600 | 9.8 |
| | $M$ –0.05 | 46.7 | 8.1 | 470–8 910 | 1 430 | 10.5 |
| | $r_{MAX}$ = 0.3 | 47 | 10.3 | 630–1 040 | 1 860 | 4.3 |
| | CPUE | 48 | 9.4 | 470–9 580 | 1 450 | 11.3 |
| GUR 1E | Base case | 48.9 | 10.3 | 650–9 730 | 3 210 | 13.5 |
| | No age data | 48.3 | 9.6 | 470–7 360 | 1 220 | 1 |
| | $M$ +0.05 | 49.5 | 10.9 | 470–7 710 | 1 180 | 1.5 |
| | $M$ –0.05 | 46.7 | 8.2 | 480–6 880 | 1 350 | 0 |
| | $r_{MAX}$ = 0.3 | 47.1 | 10.5 | 570–8 050 | 1 790 | 0.6 |
| | CPUE | 48.3 | 9.6 | 470–7 360 | 1 280 | 0.4 |

The level of risk to the stock by harvesting the population at the estimated MCY value cannot be determined.

### 4.4 Estimation of Current Annual Yield (CAY)

No estimate of CAY is available for red gurnard.

### 4.5 Other yield estimates and stock assessment results

Other yield estimates and stock assessment results are not available.

### 4.6 Other factors

Red gurnard is a major bycatch of target fisheries for several different species, such as snapper and flatfish. The target species may differ between areas and seasons. The recorded landings are influenced directly by changes in the fishing patterns of fisheries for these target species and indirectly by the abundance of these target species. Some target fishing for gurnard also occurs. Therefore, MCY estimates based on catch data are subject to a great deal of uncertainty.

## 5. ANALYSIS OF ADAPTIVE MANAGEMENT PROGRAMMES (AMP)

The Ministry of Fisheries revised the AMP framework in December 2000. The AMP framework is intended to apply to all proposals for a TAC or TACC increase, with the exception of fisheries for which there is a robust stock assessment. In March 2002, the first meeting of the new Adaptive Management Programme Working Group was held. Two changes to the AMP were adopted:

- a new checklist was implemented with more attention being made to the environmental impacts of any new proposal;

- the annual review process was replaced with an annual review of the monitoring requirements only. Full analysis of information is required a minimum of twice during the 5 year AMP.

## GUR 3

GUR 3 is managed within the AMP that will be reviewed every two years . The first GUR 3 TACC increase (from 524 t to 600 t) took effect in the 1991–92 fishing year under the AMP. A subsequent increase to 900 t was granted in 1996 for the 1996–97 fishing year. On 1 October 2002 the TACC was reduced to 800 t.

### Review of GUR 3 AMP in 2007

In 2007 the AMP FAWG reviewed the performance of the AMP (Starr *et al*. 2007).

### Fishery Characterisation

- Red gurnard have been managed under an AMP since 1991–92, when the TACC was increased from 542 t to 601 t. The TACC was again increased to 900 t in Oct 1997, and then reduced again to 800 t after full-term review of the 2nd five-year AMP period in 2002.
- Catches exceeded TACC levels for 6 of the 9 years from 1988–89 to 1996–97, but dropped sharply to the lowest levels since 1986–87 after the 1997–98 TACC increase. Catches remained below the 900 t TACC until 2001–02, but exceeded the reduced 800 t TACC in 2002–03.
- After a slight decline in 2003–04, catches again increased to exceed the current TACC. Catches in the fishery have remained above 700t since 2001–02, with the 2005–06 catches being the highest since the series began in 1986–87.
- The GUR 3 fishery is almost entirely (98%) a bottom trawl fishery, with a small catch being taken using Danish seine since 2002–03.
- Trawling is concentrated in Pegasus Bay, the Canterbury Bight and with some catch from the Foveaux Strait. Catches are made throughout the year, with a slight decline over June–September. Catches in Southland are more concentrated from September - February.
- Gurnard are mainly caught as a bycatch in the red cod (areas 18–22) and flatfish (SE South Island) targeted fisheries, with some bycatch in the barracouta and stargazer fisheries. There is a small target gurnard fishery. Gurnard are generally caught fairly shallow, between 50–150 m, in the typical depth range of the flatfish and red cod target fisheries.

### CPUE Analysis

- In 2002, the AMP Working Group (AMPWG) concluded that gurnard CPUE trends in the flatfish fishery were more stable, and provided a better index, than in the red cod fishery. Noting differences between flatfish fisheries in the northern and southern areas of QMA3, three fisheries were used in this year's gurnard CPUE review: a northern flatfish fishery (areas 20, 22 and 24), a southern flatfish fishery (areas 25, 26 and 30) and the red cod fishery (areas 20, 22 and 24).
- CPUE for these fishery definitions were standardised using a lognormal model based on non-zero catches. In addition, a binomial model was used to investigate the effect of changing the proportion of non-zero catches.
- The AMPWG noted that, for many of these fisheries, the increasing proportion of non-zero catches driving observed trends in the binomial component of the models may result, to some extent, from the rolling up of CELR data into trip strata, particularly where changes have occurred in fishing behaviour over time (i.e., move to increased number of shorter tows to improve targeting or fish quality). The WG concluded that the binomial models should not be given much weight, and that attention should focus on the lognormal model results.
- Trends in the three standardised series are similar, showing a steady increase from lowest levels in ~1997–98 to the present, after a dip in 1992–93 and a decline from 1993–94 to 1997–98. Current CPUE estimates are the highest in the 20 years of the series and are about

double the rate at the start of the series, even in the southern flatfish index, which is the only one to show a downturn in the most recent year.

- Additional analyses were presented at the 24 April 2007 AMP WG meeting where the GUR 3 CPUE analysis from the target red cod fishery were split into separate areas above and below Banks Peninsula. This analysis did not materially change the conclusions from the initial analyses presented to the AMP WG. The AMP WG noted that the increase since then was more modest for the analysis north of Banks Peninsula, with the strong increase being confined to the area south of Banks Peninsula. The Working Group also noted that the series for the red cod target fishery south of Banks Peninsula corresponded closely to the target flatfish analysis presented previously, which is also a fishery which takes place primarily south of Banks Peninsula.

**Trawl Surveys**

- The time series of winter ECSI trawl surveys shows highly variable abundance GUR 3 estimates over 1991 to 1996, with high CVs and no apparent trend. These trawl indices showed little correspondence with FLA and RCO targeted GUR CPUE indices at the time.
- In 1997, the winter surveys were replaced by a summer trawl survey programme optimised for, among others, red gurnard, and considered to be suitable for monitoring gurnard.
- Summer trawl survey indices from 1997 to 2001 show a steady decline in estimates of gurnard abundance. However, there appeared to be correlated changes in estimates for a number of species, and there are concerns that differences in annual weather conditions affected catchabilities on these surveys.
- There is little similarity between abundance estimates from the summer surveys and the various CPUE series investigated. It was concluded in 2001 that the summer
- Surveys were not reliably monitoring the red gurnard population, and should therefore be discontinued.
- 1992 to 1994 age frequency distributions from the trawl surveys show the progression of a strong 1991 year class which probably contributed to the high CPUE in 1994.
- In contrast, substantial interannual variation in length frequencies in the trawl surveys confirm that these surveys probably did not capture red gurnard equivalently between years.
- There is little similarity between abundance estimates from the summer surveys and the various CPUE series investigated. It was concluded in 2001 that these surveys were not reliably monitoring the red gurnard population, and should therefore be discontinued.

**Logbook Programme**

- The SE Finfish Management Company introduced a logbook programme covering the east and south coast South Island bottom trawl fisheries in 2002, as part of the implementation of an AMP for ELE 3. This was extended to cover GUR 3 in 2004–05.
- Coverage of the gurnard fishery has been inadequate in both years of this programme to date, covering only 3.6% of catches in 2004–05 and 1.4% in 2005–06. Almost all of this has been in statistical area 22, with almost no sampling of significant catches in areas 20, 25 and 30. Seasonal coverage has also been poor, lagging well behind the fishery.
- Unsexed length frequency distributions of the sampled fish (3987 in 2004–05 and 1845 in 2005–06) differ, with the mode being slightly lower in 2005–06. This only represents fish from area 22 and appears to have resulted from a consistent decline in mean size across all quarters sampled.

**Effects of Fishing**

- Over 98% of red gurnard is taken by bottom trawling, mainly as a non-targeted bycatch in the red cod and flatfish fisheries. Increased TACCs under the AMP do not appear to have resulted in increased targeting for this species.

- One Hector's dolphin capture was reported in the red cod trawl fishery in 1997–98, but none have been reported since, and none have been observed on 187 observed trawls in 1999–00. Trawlers have been advised not to haul when dolphins are active in the vicinity, and to keep sonar on when hauling.
- Trawlers > 28 m length have been required since 12 January 2006 to deploy mitigation devices while trawling, to minimise warp-strikes by seabirds.
- Increased TACCs under the AMP have not resulted in any increases or significant changes in trawl fishing areas or effort. The ECSI inshore trawl areas have been trawled for decades, and benthic impacts of these trawlers has not thought to have increased as a result of the AMP.

**Conclusions**

- Red gurnard is a bycatch in the red cod and flatfish fisheries, and less than 6% of the total catch is actually targeted. It has been considered to be a low value species, with little economic incentive for targeting, although recent increases in value and rapid expansion of the domestic market have probably contributed to the recent increase in catches.
- CPUE trends closely mirror catch trends and it appears that CPUE trends in this largely non-targeted bycatch fishery do reflect actual changes in abundance of gurnard in the areas fished.
- However, the WG noted that decreases in red cod and hoki catches have probably resulted in increased targeting of red gurnard, or at least an increased proportion of gurnard in red cod and hoki 'targeted' trawls. Flatfish catches have also declined from Kaikoura to the Canterbury Bight.
- CPUE has been increasing steadily since the lowest point in 1997–98 and has reached the highest level in the series. This indicates that abundance of GUR 3 is at its highest level in 20 years. Current catches are probably sustainable in the short to medium term.

## 6. STATUS OF THE STOCKS

Estimates of current and reference absolute biomass are not available for any gurnard stock. . Estimates of current and reference biomass were available for GUR 1W and GUR 1E after the 1997–98 stock assessment, but can no longer be considered current and in 2008 the Northern Inshore Finfish Working Group (NINSWG) recommended that this assessment be revisited.

Red gurnard is a major bycatch species subject to wide variations in recorded catch. This is partly due to changes in target fisheries and stocks, and to natural variations in the red gurnard stocks. The MCY estimates derived from catch statistics are subject to a great deal of uncertainty and are probably conservative.

The current TACCs were based on a period of highest ever catches, and these levels have not been reached in recent years. In GUR 1, current catch levels are probably constrained by changes in the target fisheries.

**GUR 1W**

The available stock assessment was based on data up to the end of the 1997–98 fishing year. The model indicated that $B_{MID99}$ was about 80% of $B_0$ (range 40–147%, performance index 3%), suggesting that the stock has been only lightly exploited and is also benefiting from several recent years of strong recruitment. Recent CPUE analyses indicate that the stock status has not declined since the 1998–99 stock assessment,.

Current biomass at the time of the last assessment appeared to be greater than stock size that would support the $B_{MSY}$. Catch levels at that time appeared to be sustainable, and continued catches at that level were predicted to allow the stock to remain above $B_{MSY}$.

**GUR 1E**

The available stock assessment was based on data up to the end of the 1997–98 fishing year. The abundance indices all suggest that the biomass in GUR 1E declined in the early 1980s, but recovered slightly during the 1990s. The model indicated that biomass at the time of the assessment appeared to be above $B_{MSY}$ ($B_{MID99}$ was estimated at 59% of $B_0$; range 9–83%, performance index 58%) and catch levels at that time were probably sustainable. It was predicted that continued catches at those levels would allow the stock to remain above $B_{MSY}$.

Recent CPUE analyses (up to 2004–05) indicate that abundance has either been stable or likely increased since the 1998–99 stock assessment.

**GUR 2**

A stock assessment was attempted in 1997–98, but rejected by the Inshore Working Group. Recent CPUE analyses (up to 2004–05) indicate that there have been no drastic changes in CPUE with current levels similar to that from the early 1990s. Recent catches and the TACC are probably sustainable, at least in the short-term. It is not known if recent catches or the current TACC will allow the stock to move towards a size that will support the maximum sustainable yield.

**GUR 3**

GUR 3 is being managed within an AMP. The TACC for GUR 3 was decreased to 800 t for the 2002–03 fishing year, where it has remained since. CPUE has been increasing steadily since the lowest point in 1997–98 and reached the highest level at the end of the series in 2005/06. This observation is corroborated by the 2007 ECSI trawl survey result for GUR 3 which was also the highest on record (more than double the previous high), although the survey CV's are relatively high (range 27–40%). This indicates that the abundance of GUR 3 is probably at its highest level in 20 years. However, without a formal stock assessment it is not possible to determine the status of GUR 3 in relation to $B_{MSY}$. Given current productivity, current catches and the current TACC are probably sustainable in the short to medium-term.

**GUR 7**

The TACC for GUR 7 was increased from 678 t to 815 t in the 1991–92 fishing year under the AMP then reduced to 678 t in 1997–98 when the AMP finished and increased again to 681 t in 2001–02. Since 2001–02, landings have fluctuated around the 681 t TACC. Un-standardised commercial-trawl CPUE for GUR 7 declined from 1992–93 to 1996–97 and then increased from 1998–01 to 2002–03. Trawl surveys, on the other hand, indicate that the relative biomass of red gurnard declined gradually from 1992 to 2003 on the west coast of the South Island, and, the relative biomass index dropped sharply in 2003 but has since returned to historical levels.

Recent catches and the TACC are probably sustainable, at least in the short-term. It is not known if recent catches or the current TACC will allow the stock to move towards a size that will support the maximum sustainable yield.

**GUR 8**

It is not known if recent catch levels or the current TACC are sustainable or if they are at levels that will allow the stock to move towards a size that will support the maximum sustainable yield.

Yields estimates, TACCs, and reported landings for red gurnard for the most recent year are summarised in Table 15.

**Table 15: Summary of yield estimates (t), TACCs (t) and reported landings (t) of red gurnard for the most recent fishing year. MCY(1) from $cY_{AV}$ method, MCY(2) from MIAEL method (range only given).**

| Fishstock | QMA | | MCY(1) | MCY(2) | 2006–07 Actual TACC | 2006–07 Reported landings |
|---|---|---|---|---|---|---|
| GUR 1 | Auckland | 1 & 9 | 1 120 | | 2 287 | 1 180 |
| | GUR 1W | | | 520−10 400 | | |
| | GUR 1E | | | 650−9730 | | |
| GUR 2 | Central (east) | 2 | 450 | | 725 | 575 |
| GUR 3 | South–East, Southland and Sub–Antarctic | 3, 4, 5, & 6 | | 200 | 750 | 1 002 |
| GUR 7 | Challenger | 7 | | 260 | 678 | 710 |
| GUR 8 | Central (west) | 8 | | 140 | 543 | 349 |
| GUR 10 | Kermadec | 10 | | – | 10 | 0 |
| Total | | | | 2 170 | 4 993 | 3 817 |

## 7. FOR FURTHER INFORMATION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