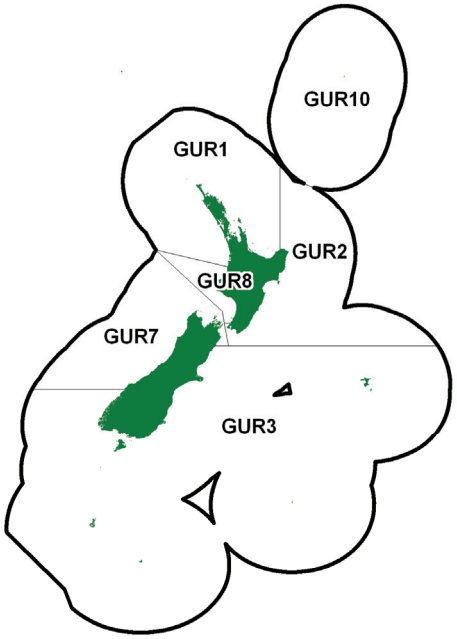
RED GURNARD (GUR)

(*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 GUR 7 TACC was reduced to 678t, in 1997–98. For the 2009-10 fishing season, the TACC in GUR 7 has been increased from 680.86 t to 715 t. The TACC for GUR 3 was again increased, by 300 t (50%) to 900t, for the 1996–97 fishing year under the AMP, the TACC was dropped to 800t in 2002–03. For the 2009-10 fishing season, the TACC for GUR 3 has been increased from 800 t to 900 t.

Recent reported landings and actual TACCs by Fishstock are shown in Table 1, while Figure 1 depicts the historical landings and TACC values for the main GUR stocks.

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 2008–09 and actual TACCs (t) from 1986–87 to 2008–09. QMS data from 1986–present.

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	1 004	800	714	681
2007–08	1 198	2 287	517	725	842	800	563	681
2008–09	1 060	2 287	621	725	939	800	595	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	3 822	4 993
2007–08	223	543	0	10	3 344	4 993
2008–09	274	543	0	10	3 489	4 993

*FSU 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. 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 then increased to a peak of 793 t in 2002–03. The TACC has not been caught in the last two years. Landings in GUR 8 have remained well below the levels of the TACC since 1986–87.

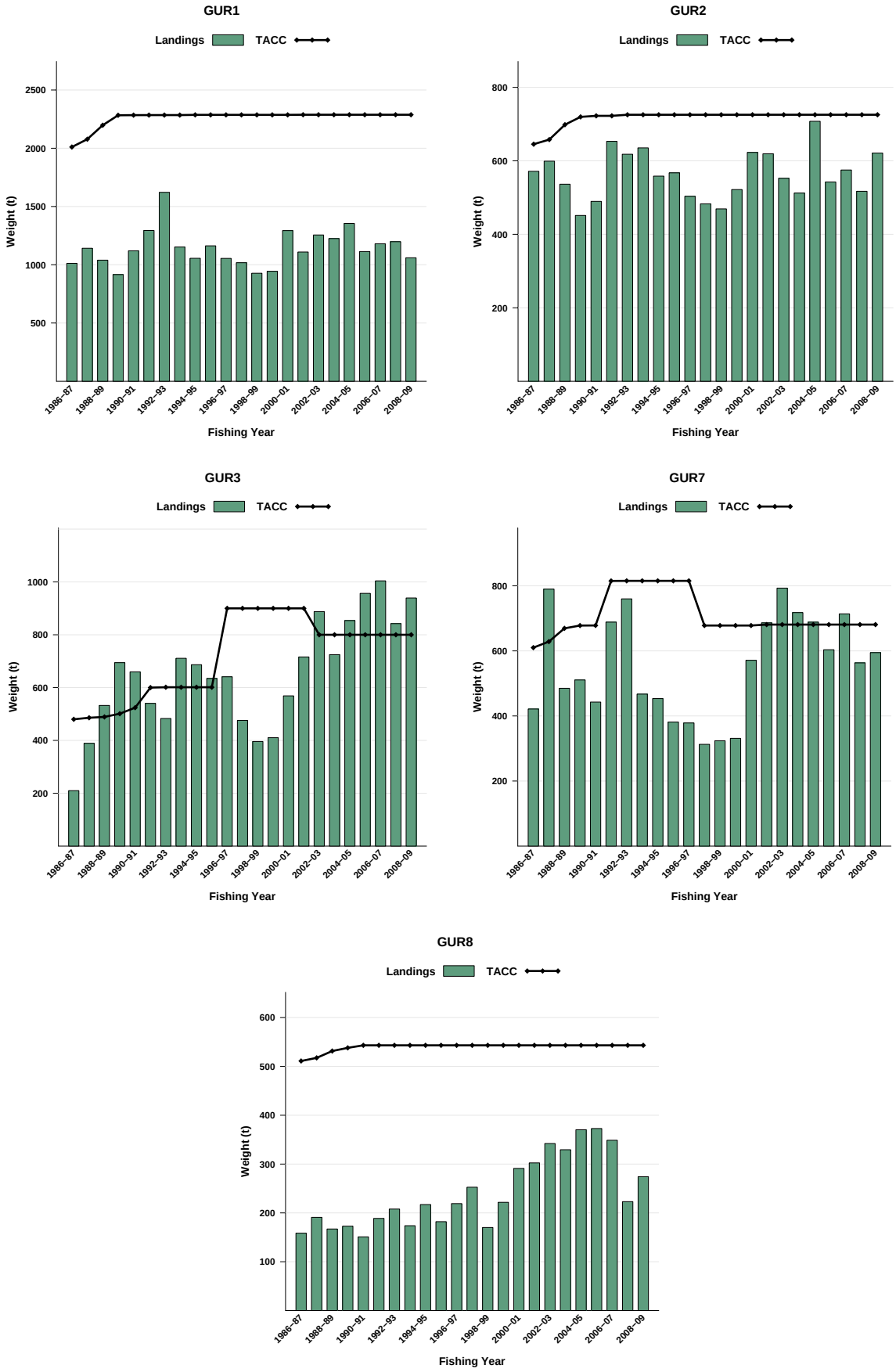


Figure 1: Historical landings and TACC for the five main GUR stocks. From top left: GUR1 (Auckland East), GUR2 (Central East), GUR3 (South East Coast), GUR7 (Challenger), and GUR8 (Central Egmont). Note that these figures do not show data prior to entry into the QMS.

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. The Recreational Technical Working Group concluded that the harvest estimates from the diary surveys should be used only with the following qualifications: a) they may be very inaccurate; b) the 1996 and earlier surveys contain a methodological error; and, c) the 2000 and 2001 estimates are implausibly high for many important fisheries. The 1999–2000 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
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
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

Owing to the limitations of diary surveys a combined aerial overflight / boat ramp survey was undertaken in FMA 1 during 2005 (1 December 2004 to 30 November 2005), primarily targeting snapper (Hartill *et al*. (2007). The GUR 1 recreational harvest was estimated by this survey to be 127t (c.v. 14%).

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 $M = \log_e 100$/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 = $a(\text{length})^b$ (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_∞	k	t_0	L_∞	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

There are no new data which would alter the yield estimates given for the 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.

In 2010, Kendrick & Bentley (in prep.) updated CPUE analyses for GUR 1W, GUR 1E, and GUR 1BP (Figures 2 & 3). In each substock positive catches from single bottom trawl targeted at gurnard, snapper, trevally, tarakihi or John dory were standardised using lognormal models. Separate analyses were done for each of the two main form types (CELR and TCEPR/TCE) and the data were analysed in their original resolution (daily and tow-by-tow respectively) This was done because of concern that the systematic shift in this fishery from reporting on daily CELR forms to reporting tow-by-tow on TCEPRs may potentially confound the year effects and yield overly-optimistic trajectories.

For each substock, there appears to have been an increase in abundance from a low in the mid-1990s to a peak in the early to mid-2000s followed by a subsequent decline. GUR 1W has returned to around the level observed in 1997–98, while GUR 1E and GUR 1 BP are currently above the mean for the series.

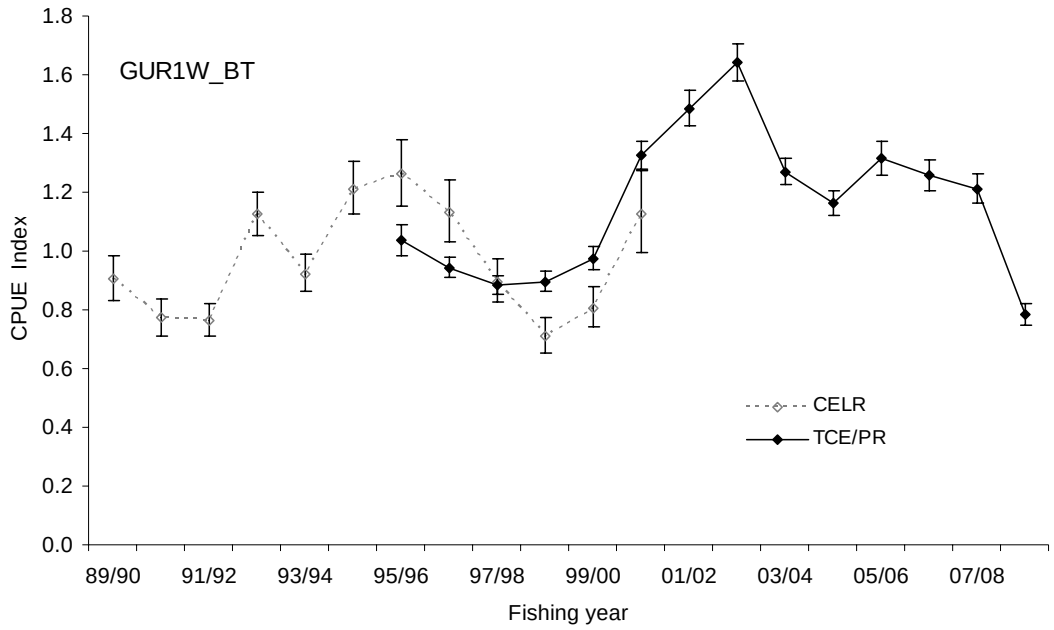


Figure 2: Comparison of indices for GUR 1W. Lognormal indices for bottom trawl based on CELR format data, and the lognormal series based on TCEPR/ TCE format data (Kendrick & Bentley, 2010 in prep).

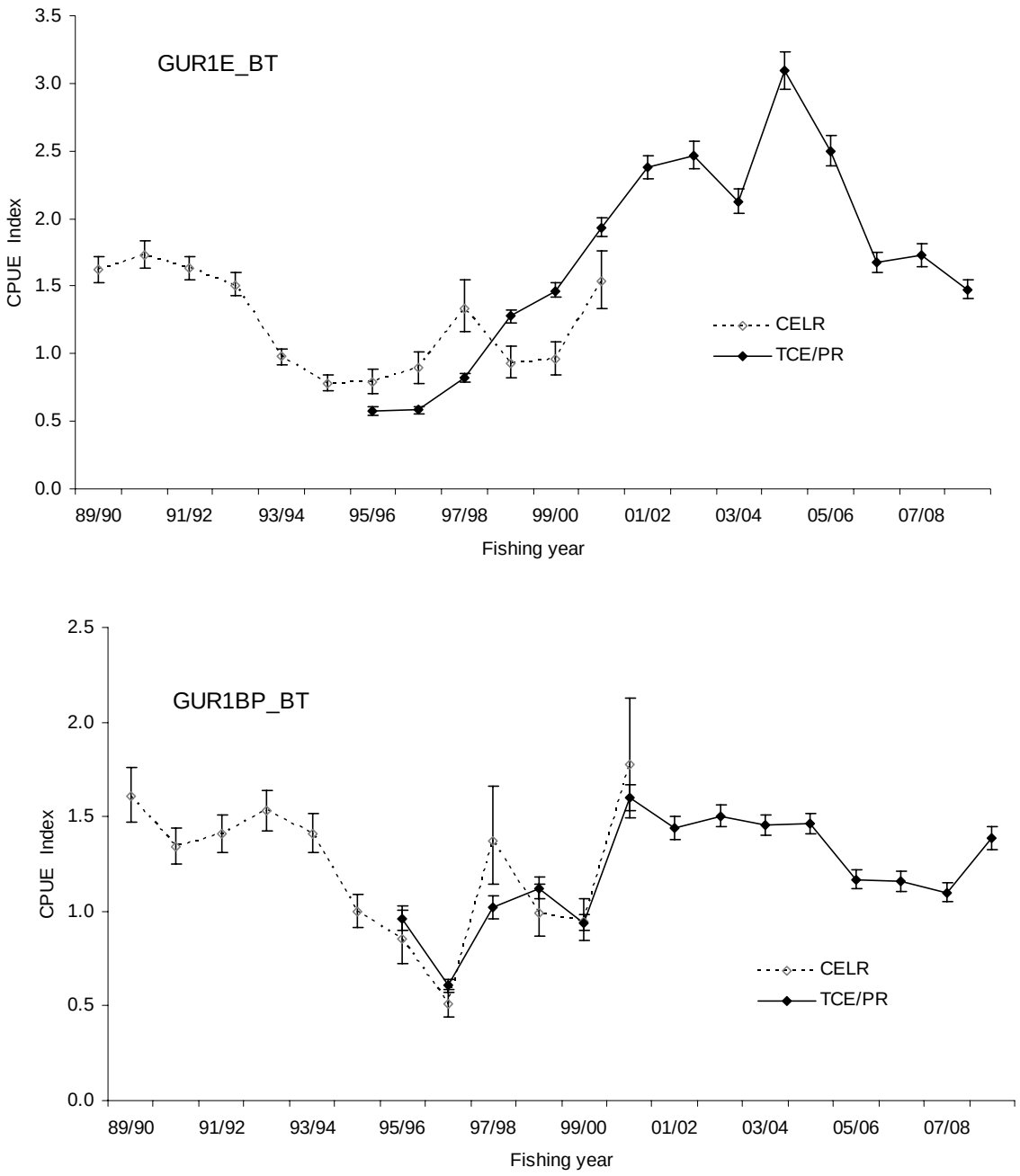


Figure 3: Comparison of indices for GUR 1E (middle) and GUR 1BP (bottom). Lognormal indices for bottom trawl based on CELR format data, and the lognormal series based on TCEPR/ TCE format data (Kendrick & Bentley, 2010 in prep.).

GUR 2

In 2006, Kendrick (2009b) updated CPUE analyses for GUR 2 (Figure 4). 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.

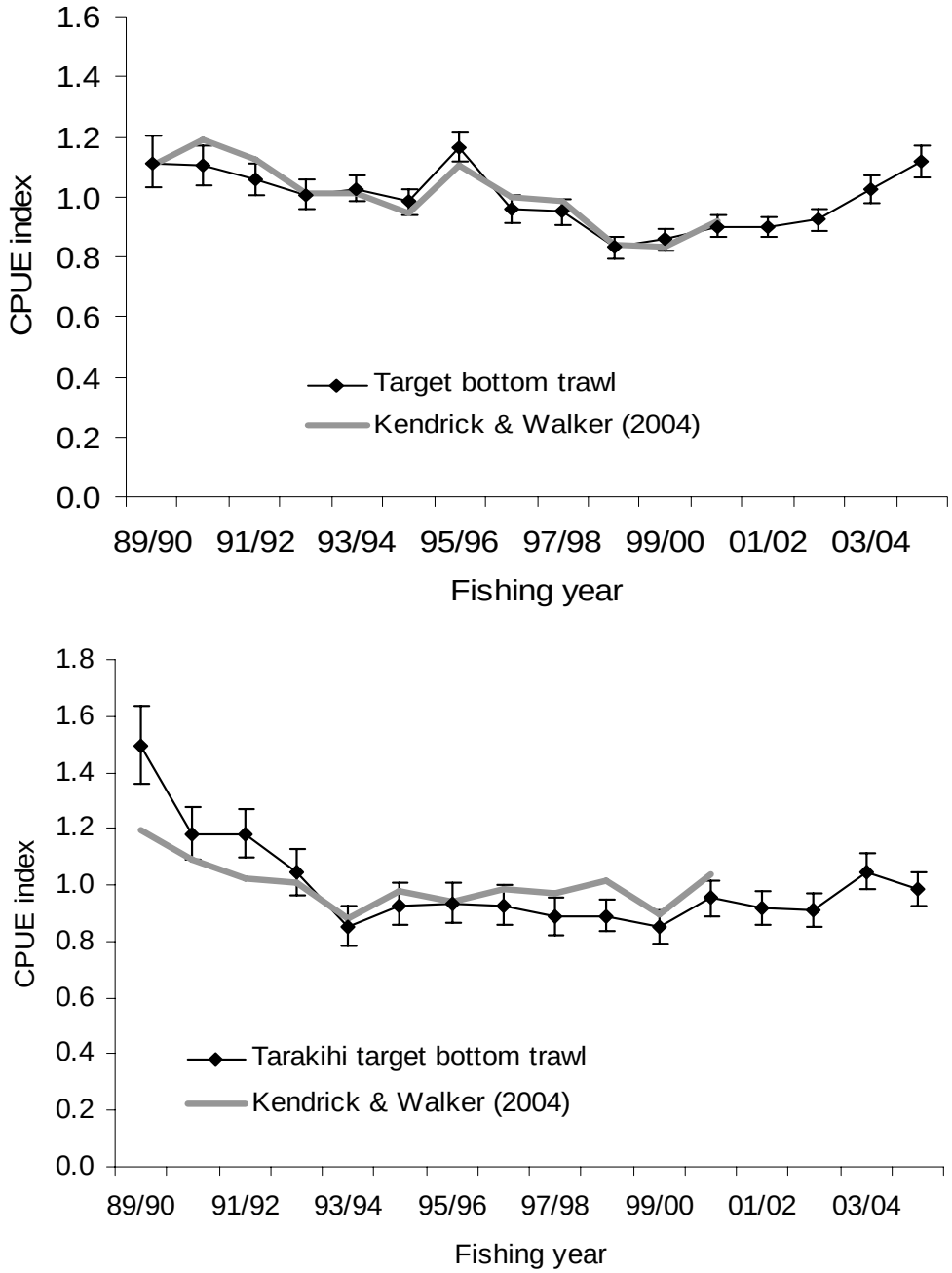


Figure 4: Comparison of lognormal models of successful catches of red gurnard in the target GUR 2 fishery (top) and bycatch from the TAR target fishery (bottom); this study and previous series from Kendrick & Walker (2004). Both series rescaled relative to the geometric mean of the years in common (1989–90 to 2000–01) (Kendrick, 2009b).

GUR 3

CPUE analyses have been updated as part of the monitoring programme for adaptive management stocks (see below for details).

GUR 7

The relative biomass index declined from 1995 to 2000 and has increased steadily from 2003 to the highest level in the series in 2009, the 2009 estimate is preliminary.

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 5.

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	625	15
2003	KAH0304	270	20
2005	KAH0503	442	17
2007	KAH0704	553	17
2009	KAH0904	651	18
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
2008	KAH0806	1 309	35
2009	KAH0905	1 725	30
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

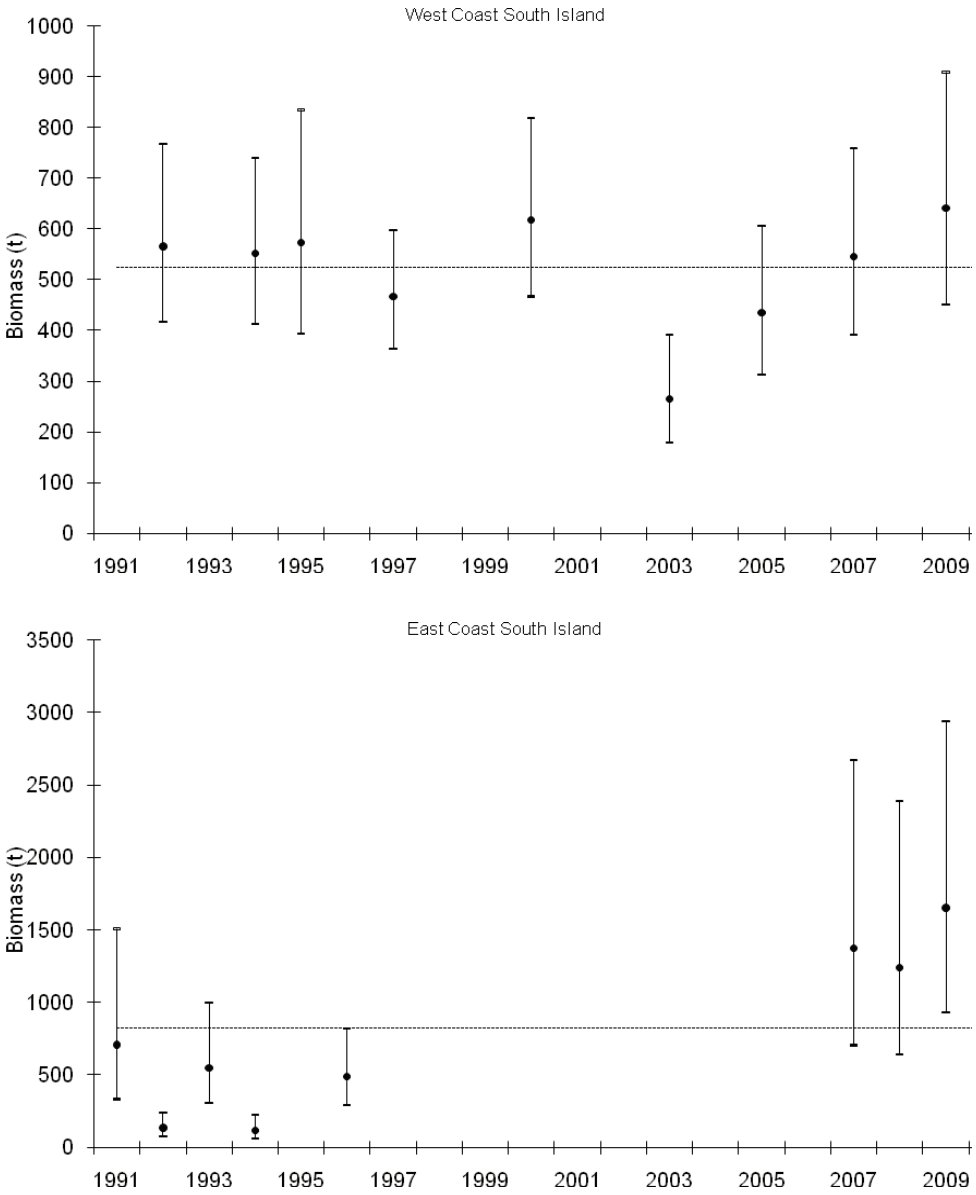


Figure 5: Biomass trends ± 95% CI (estimated from survey CV's assuming a lognormal distribution) and the time series mean (dotted line) from the West (top) and East (bottom) Coast South Island trawl surveys.

Length frequency trends for the West Coast South Island red gurnard catch are presented in Figure 6. These data show that there were substantial numbers of 20-25cm fish in 1997 and 2000. These size fish did not appear in large numbers in 2003 or 2005 but high numbers were landed again in 2007.

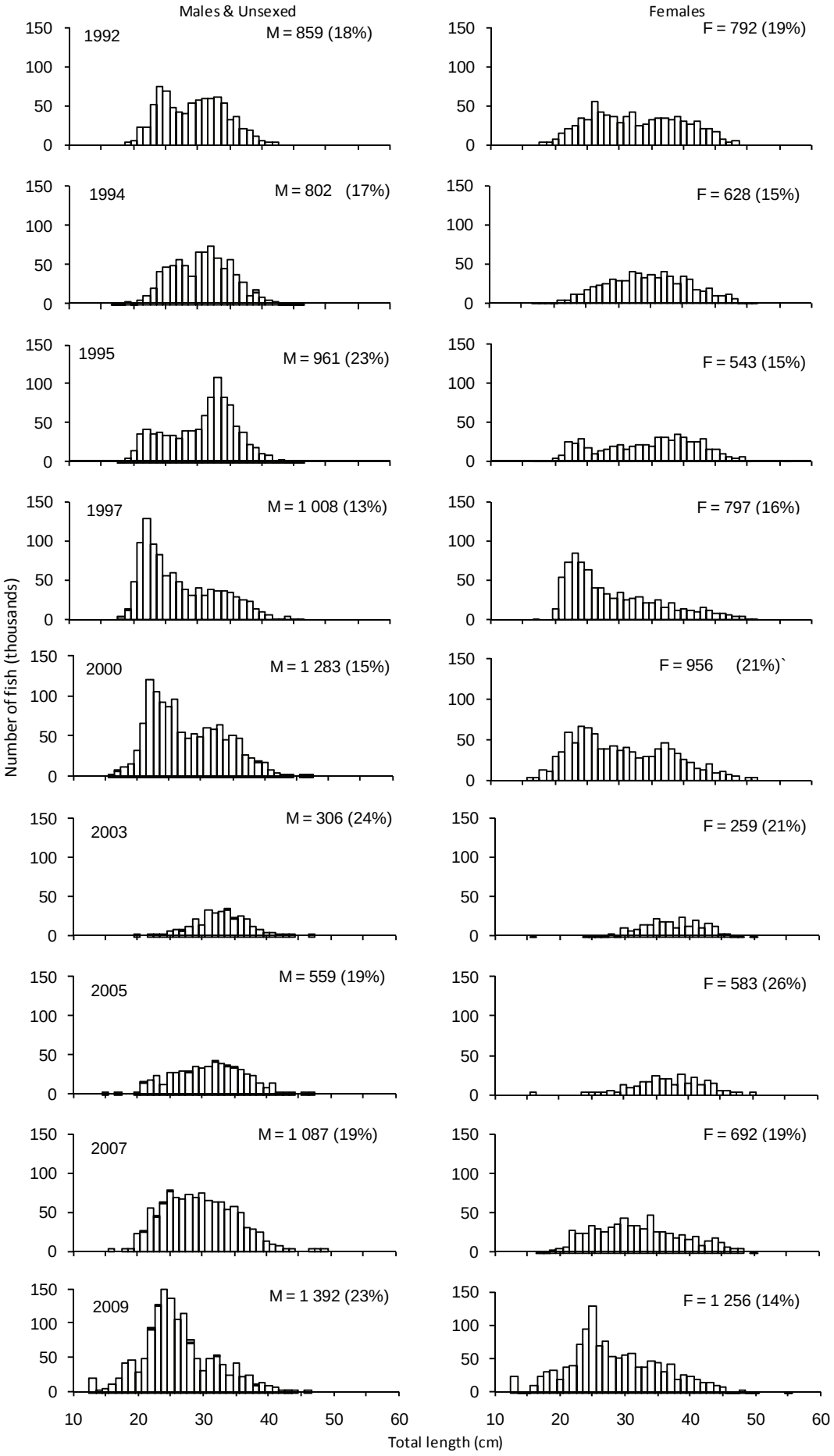


Figure 6: Scaled length frequency distributions for red gurnard in 30–400 m, for all WCSI surveys. M, males; F, females; (CV%). (Stevenson In press).

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.

GUR 3 - Three yearly review (AMP WG/09/07)

Management questions

It was noted that inshore fisheries managers had posed a number of specific questions regarding GUR 3 stock structure, appropriate indicators or proxies and stock status of GUR 3, to be addressed by the AMP working group (in background document List of Fishstocks to be Potentially Reviewed During 2009. Industry participants clarified that the suggested possible 10% TACC increase in that document had not been an industry proposal, and that Industry were of the opinion that the stock can sustain a larger increase in catch.

Fishery characterization

- Gurnard have been managed under an AMP since 1991/92, when the TACC was increased from 542t to 601t. The TACC was again increased to 900t in Oct 1997 and reduced to 800t in 2002 after the full-term review of the 2nd five-year AMP period.
- Catches fluctuated around the TACC levels from 1988-89 to 1995-96 but dropped sharply to below 400t in 1998-99, the lowest levels since 1986-87, immediately after the 1997-98 TACC increase. Catches remained below the 900t TACC until 2001-02, but exceeded the 800t TACC in 2002-03, and again from 2004-05 onwards. The 2007-08 catches reached 1,004t, the highest level since 1986-87, before dropping back to 842 tons in 2007-08.
- Industry participants suggested that there had been substantial discarding and under-reporting prior to 1986 as a result of size constraints. They also noted that the decline in catch in 2007-08 may have been a response to high deemed values paid in the previous season, and the increase in deemed values in 2007-08.

- The QMA3 gurnard fishery remains primarily (96% of catch over the past 19 years) a bottom trawl fishery, but a Danish seine (DS) fishery, which first appeared in 2002/03, has expanded considerably in 2006–07 and 2007–08, accounting for 12% and 16% of the total landings in those two years. Industry participants explained that this resulted from reduced operating costs in DS fishing, more selective fishing on specific habitats to target chosen species and better quality of product
- The GUR 3 trawl catch is mainly taken in Statistical Areas 020 or 022, with some trawl catches taken in Foveaux Strait in Southland. A new fishery using the Danish seine method has developed in Areas 020 and 022 over the last six years, exceeding 100 t of GUR in 2006-07 and 2007-08. This fishery began in Area 020 in 2002–03 but has been evenly split between Areas 020 and 022 since 2006.
- There is an even monthly distribution of bottom trawl catch from GUR 3, declining in towards the end of the fishing year. The Danish seine fishery appears to be more concentrated in late spring and summer, tapering off more in the autumn and winter than the bottom trawl fishery.
- The red cod and flatfish BT target fisheries account for about 70% of the GUR 3 catch, with some catch also made in the gurnard, stargazer and tarakihi targeted trawl fisheries. The Danish seine fishery is mainly targeted at red cod and flatfish. BT target about one third RCO and one third FLA.
- Gurnard are generally caught fairly shallow, between 50 - 10m, mainly by the flatfish and red cod target fisheries, with some caught deeper to about 150m in the TAR, STA and SQU targeted fisheries.

CPUE analysis

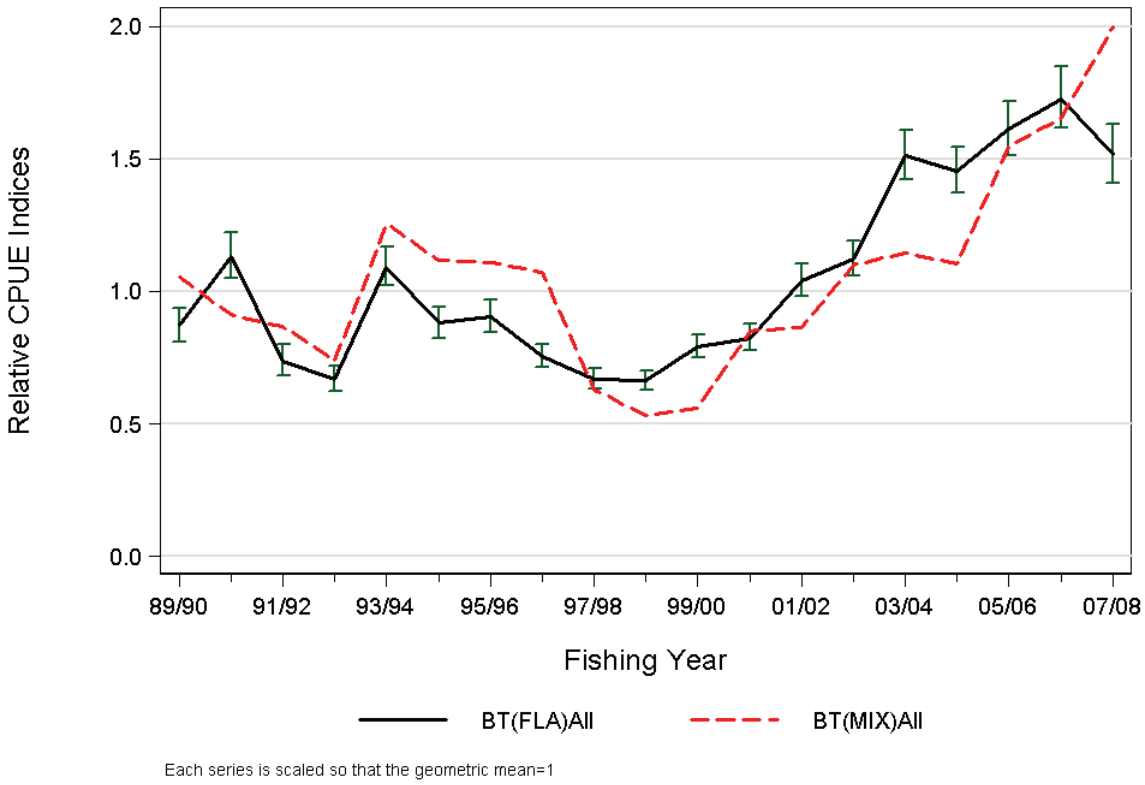


Figure 7: Comparison of the lognormal indices from two independent CPUE series for GUR 3 calculated for all valid statistical areas (018, 020, 022, 024, 026,025 and 030); a) [BT(FLA)All]: bottom trawl, flatfish target; b) [BT(MIX)All]: bottom trawl, target RCO, STA, BAR, TAR, GUR.

- In the previous review in 2007, three fisheries were used to develop CPUE indices for GUR3: 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).
- Following recommendations made in 2007, CPUE indices were initially developed for four fisheries in 2009. The primary indices were based on the flatfish trawl fisheries in the Canterbury Bight (Areas 22 and 24) and Southland (Areas 25, 26 and 30); with alternative indices developed

for red cod trawl fisheries north (Areas 18 and 20) and south (Areas 22 and 24) of Banks Peninsula.

- There is a strong observable effect (seen as a reduction in the number of tows per trip-stratum) resulting from the move in 2007–08 to the new TCER forms on the CPUE data in the BT(RCO) indices, a moderate effect on the BT(FLA)CB index and no apparent effect on the BT(FLA)PB index.
- Trends in the BT(RCO) indices north and south of Banks Peninsula were virtually identical, with no indication of separate stocks in these areas. The Canterbury Bight and Southland BT(FLA) indices were also similar and the WG recommended that analyses be combined to provide two independent indices: targeted RCO, STA, BAR, TAR, GUR and targeted FLA indices, each applicable to all GUR 3 areas.
- The increase in the proportion of positive trip-strata (with GUR catches) in these index fisheries may indicate some increase in targeting GUR over the past 5 - 10 years but may also be a function of increased abundance. Standardisation showed a strong vessel effect, with an overall increase in the efficiency of the fleet as the less effective vessels left the fishery.
- The resulting indices (Figure 7) show close correspondence between the two independent series, with both showing a period of steady and continual increase from 1998-99 onwards, following a period of slowly declining CPUE from 1989-90 to 1997-98. Recent levels are about 1.7 times the long-term average and over twice the 1998-99 levels. There is some indication in these indices of a lag in the RCO series, with peaks and troughs which are one or two years behind the FLA index, and with opposing trends in 2007-08: declining in the FLA index, but still increasing in the RCO index.
- The WG again questioned whether the shift to TCER forms in the recent year may have had some effect on the indices in the final year. It was observed that the BT(RCO) index, in which the trip stratum roll-up is strongly affected by the new forms, is increasing whereas the BT(FLA) index, which is not strongly affected, is decreasing. However, this difference may also be explained by the possible lag between the two sets of CPUE indices.

Trawl surveys

- The results of the 2007 and 2008 ECSI winter trawl surveys are consistent with the recent increasing CPUE trends, indicating abundance at twice the long term average level.
- The two most recent ECSI Winter trawl surveys indicate increased abundance of small fish, similar to the abundance of small fish found by the 1992 survey. 1992 - 1994 age-frequency distributions showed the progression of a strong 1991 year class which probably contributed to the high CPUE in 1994.
- In contrast, the 1994 and 1996 surveys found the largest fish, which is consistent with the decline in the fishery after the 1996–97 fishing year. The increased abundance of small fish in recent surveys indicate that good recruitment may be available in the next year or two.

Status of the stock

Analysis recommendations

The following analyses were conducted or recommended during the 2009 review:

- Separate CPUE analyses north and south of the Banks Peninsula (as recommended in 2008) showed virtually identical trends. For this review, analyses were therefore redone for all valid statistical areas combined.
- The BT(FLA) and BT(MIX) targeted indices across all valid statistical areas should be the main CPUE indices calculated for this stock in future. Statistical area should be as an explanatory variable in the standardised models, and effects of (Area * Year) interaction checked to make sure that the indices are not diverging.
- The WG again recognised the substantial amount of data available for this fishery, and noted that a stock assessment should be feasible. Close correspondence between indices in all areas indicate that such an assessment should be for a single GUR3 stock including all areas north and south of the Banks Peninsula and in Foveaux Strait.
- It would be useful in future reviews (for all stocks) to have a brief section on regulatory history and key operational changes that may have altered targeting, reporting, catch rates, efficiency and selectivity.

Abundance indices

Standardised CPUE in the BT(RCO) and BT(FLA) bottom trawl fisheries does appear to provide representative abundance indices for GUR 3. Close correspondence between CPUE indices for different fishery definitions, and in different areas, has resulted in increased confidence that abundance is adequately monitored by these indices. Trends in these indices are also consistent with indices derived from the ECSI winter trawl surveys. Consistent lags between the two CPUE indices suggest that they may be tracking separate components of the stock, with the BT(FLA) fishery in 10m - 25m catching smaller fish, than the BT(RCO) fishery in 50m - 70m. The BT(FLA) index may contain a recruitment component.

Sustainability of current catches

There has been a consistent and steady increase in GUR 3 CPUE from 1998-99 to 2007-08, over which period CPUE more than doubled from the nadir in 1998–99 to about 70% above long-term average levels. This increase followed an apparent slow decline in CPUE from near long-term average levels in 1989-90 to a historical minimum of about 50% - 70% of long-term average levels by 1998-99. In the most recent year (2007-08) the two indices show conflicting trends, with the BT(FLA) index starting to level off or decline, and the BT(MIX) continuing to increase. The BT(MIX) index has lagged fairly consistently behind the BT(FLA) index by about two years, suggesting that the BT(MIX) index might also level off or decline over the next year or two.

The steady CPUE increase observed from 1998-99 to 2006-07 occurred over a period when annual catches averaged 724t. Catches at this level appear to be sustainable. Catches over the past five fishing years have averaged 876t and, at current abundance levels, the current TACC is likely to be sustainable. Higher TACCs might be sustainable over the short term. However, for this short-lived species, management should be prepared to respond to declines in abundance which may result from increased catches or reduced recruitment.

Stock status

In the absence of a stock assessment, the state of the stock in relation to BMSY is unknown. However, the chosen abundance indices for GUR 3 indicate that current abundance is as high as it has ever been over the 19 year period reviewed.

6. STATUS OF THE STOCKS

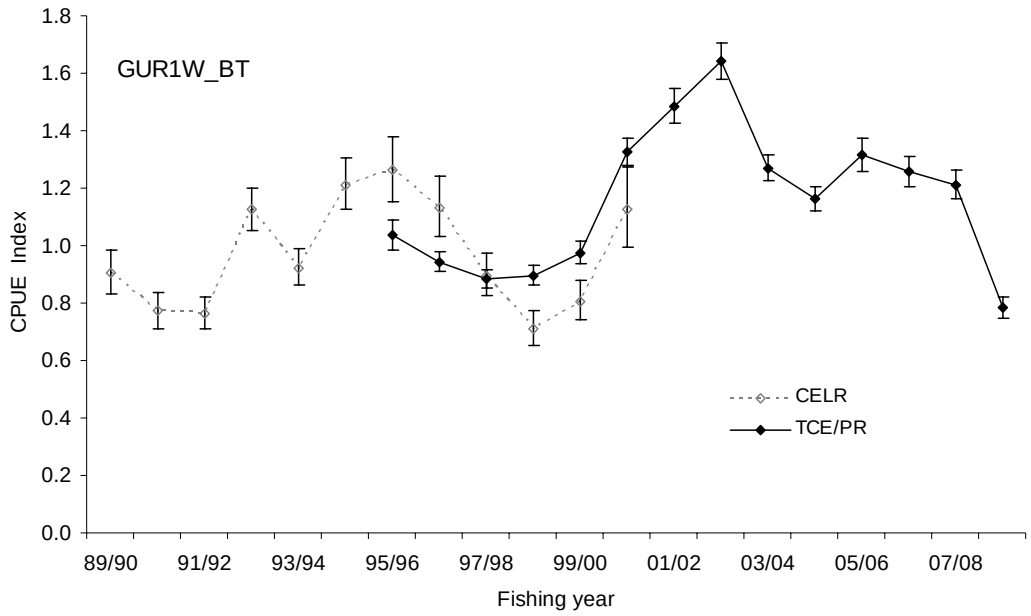
Stock Structure Assumptions

For the purpose of this summary GUR1 is considered to be a single stock with three sub-stocks.

GUR 1W

Stock Status	
Year of Most Recent Assessment	2010
Assessment Runs Presented	
Reference Points	Target(s): Not established Soft Limit: 20%B_0 Hard Limit: 10%B_0
Status in relation to Target	Unknown
Status in relation to Limits	Soft Limit: Unknown Hard Limit: Unknown

Historical Stock Status Trajectory and Current Status



Standardised CPUE indices for red gurnard in GUR 1W from lognormal models of catch rate in successful bottom trawl trips done separately by the two main data formats (Kendrick & Bentley in prep).

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	The lognormal CPUE indices depict a trend that cycles over a 4-8 year period that is consistent with what one would expect from a short lived species with variable recruitment. Indices of abundance suggest that stock size has fluctuated around the long-term average since 1989-90. An increase that was sustained over five consecutive years peaked in 2002–03 and then declined, suggesting that the stock is now in a downward part of the cycle.
Recent Trend in Fishing Mortality or Proxy	None
Other Abundance Indices	None
Trends in Other Relevant Indicators or Variables	None

Projections and Prognosis	
Stock Projections or Prognosis	Without corroborating information on recruitment from a trawl survey, it is not possible to predict how the stock is going to respond in the next few years.
Probability of Current Catch or TACC causing decline below Limits	Soft Limit: Unknown Hard Limit: Unknown

Assessment Methodology		
Assessment Type	Level 2 – Partial quantitative stock assessment	
Assessment Method	Standardized CPUE based on lognormal error distribution and positive catches.	
Main data inputs	Catch and effort data	
Period of Assessment	Latest assessment: 2010	Next assessment: 2014
Changes to Model Structure and Assumptions	Improvements in the analysis of the daily CELR data have made the two CPUE series more comparable.	

Major Sources of Uncertainty	Uncertainty in the stock structure Relationship between CPUE and biomass.

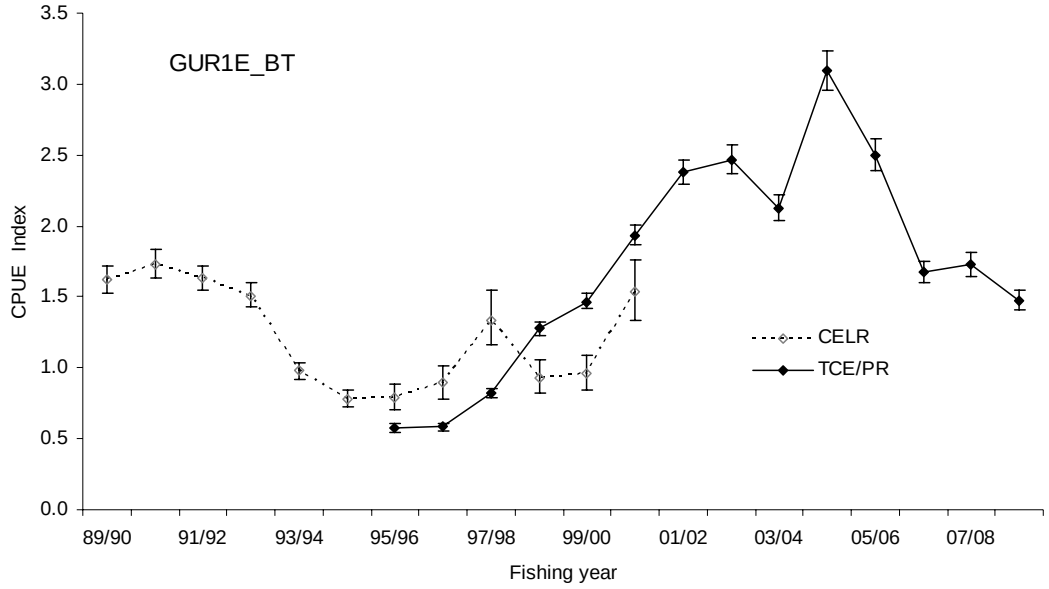
Qualifying Comments
As the red gurnard fishery in FMAs 1 and 9 has a long history, it is not possible to infer stock status from abundance trends from only the last 20 years. The abundance of all three sub-stocks appears to be cyclical, probably in response to recruitment variation, and in at least two sub-stocks trends are currently downward. This makes it difficult to predict future trends without recruitment information. Given that the catch levels observed over the last 23 years have been relatively consistent (averaging 1100t for all of GUR 1) and that red gurnard are mainly taken as bycatch, current catch is unlikely to affect the long-term viability of this stock. As the TACC is substantially higher than the current catch, it is not possible to evaluate catches at the level of the TACC.

Fishery Interactions
Red gurnard is taken on the west coast by bottom trawl targeted at snapper and trevally.

GUR 1E

Stock Status	
Year of Most Recent Assessment	2010
Assessment Runs Presented	
Reference Points	Target(s): Not established Soft Limit: 20%B_0 Hard Limit: 10%B_0
Status in relation to Target	Unknown
Status in relation to Limits	Soft Limit: Unknown Hard Limit: Unknown

Historical Stock Status Trajectory and Current Status



Standardised CPUE indices for red gurnard in GUR 1E from lognormal models of catch rate in successful bottom trawl trips done separately by the two main data formats (Kendrick & Bentley in prep).

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	An increase in CPUE was sustained over six consecutive years, peaked in 2004–05 and has since declined. The most recent years are currently near the mean for the TCE/PR series. The lognormal CPUE indices depict a trend that cycles over a period that is consistent with what one would expect from a short lived species with variable recruitment.
Recent Trend in Fishing Mortality or Proxy	
Other Abundance Indices	
Trends in Other Relevant Indicators or Variables	

Projections and Prognosis	
Stock Projections or Prognosis	Without corroborating information on recruitment from a trawl survey, it is not possible to predict how the stock is going to respond in the next few years.
Probability of Current Catch or TACC causing decline below Limits	Soft Limit: Unknown Hard Limit: Unknown

Assessment Methodology		
Assessment Type	Level 2 – Partial quantitative stock assessment	
Assessment Method	Standardized CPUE based on lognormal error distribution and positive catches.	
Main data inputs	Catch and effort data	
Period of Assessment	Latest assessment: 2010	Next assessment: 2014
Changes to Model Structure and Assumptions	Improvements in the analysis of the daily CELR data have made the two CPUE series more comparable.	
Major Sources of Uncertainty	Uncertainty in the stock structure Relationship between CPUE and biomass.	

Qualifying Comments
As the red gurnard fishery in FMAs 1 and 9 has a long history, it is not possible to infer stock status from abundance trends from only the last 20 years. The abundance of all three sub-stocks appears to be cyclical, probably in response to recruitment variation, and in at least two sub-stocks trends are currently downward. This makes it difficult to predict future trends without recruitment information. Given that the catch levels observed over the last 23 years have been relatively consistent (averaging 1100t for all of GUR 1) and that red gurnard are mainly taken as bycatch, current catch is unlikely to affect the long-term viability of this stock. As the TACC is substantially higher than the current catch, it is not possible to evaluate catches at the level of the TACC.

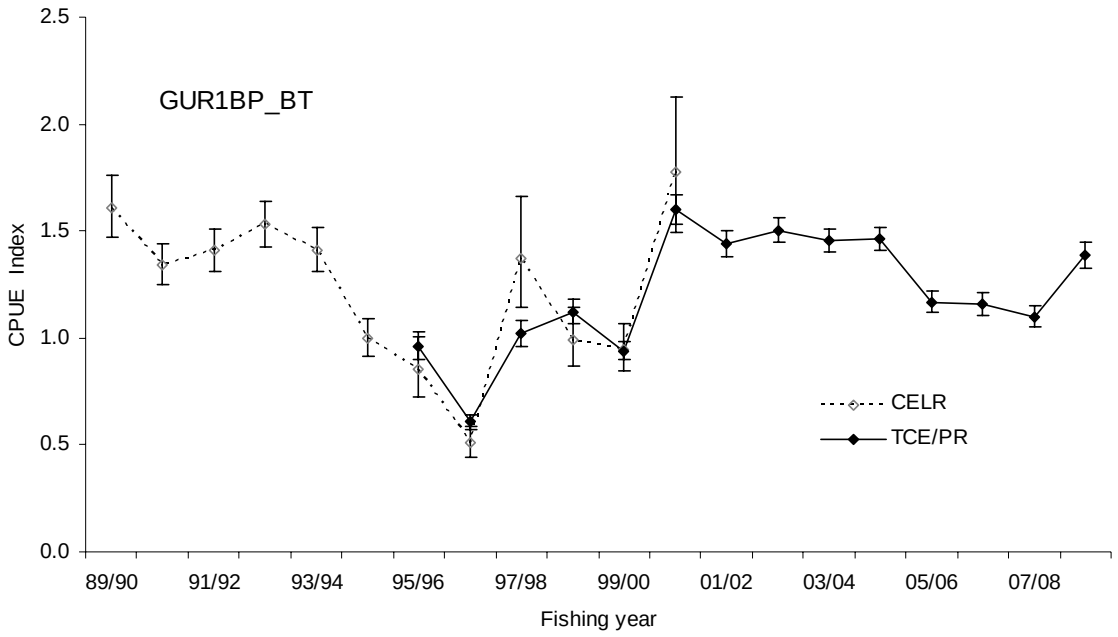
Fishery Interactions
Red gurnard is taken as a bycatch on the east coast mainly by bottom longline targeted at snapper, with the balance taken almost equally by bottom trawl and Danish seine targeting snapper and John dory.

GUR 1 - BoP

Stock Status	
Year of Most Recent Assessment	2010
Assessment Runs Presented	

Reference Points	Target(s): Not established Soft Limit: 20%B_0 Hard Limit: 10%B_0
Status in relation to Target	Unknown
Status in relation to Limits	Soft Limit: Unknown Hard Limit: Unknown

Historical Stock Status Trajectory and Current Status



Standardised CPUE indices for red gurnard in GUR 1BP from lognormal models of catch rate in successful bottom trawl trips done separately by the two main data formats (Kendrick & Bentley in prep).

Fishery and Stock Trends	
Recent Trend in Biomass or Proxy	Biomass increased from a low in 1996–97 to a peak in 2000–01 and has been relatively stable at the new level.
Recent Trend in Fishing Mortality or Proxy	None
Other Abundance Indices	None
Trends in Other Relevant Indicators or Variables	None

Projections and Prognosis	
Stock Projections or Prognosis	Without corroborating information on recruitment from a trawl survey, it is not possible to predict how the stock is going to respond in the next few years.
Probability of Current Catch or TACC causing decline below Limits	Soft Limit: Unknown Hard Limit: Unlikely (<40%) (current catch only)

Assessment Methodology		
Assessment Type	Level 2 – Partial quantitative stock assessment	
Assessment Method	Standardized CPUE based on lognormal error distribution and positive catches.	
Main data inputs	Catch and effort data	
Period of Assessment	Latest assessment: 2010	Next assessment: 2014
Changes to Model Structure and Assumptions	Improvements in the analysis of the daily CELR data have made the two CPUE series more comparable.	

Major Sources of Uncertainty	Uncertainty in the stock structure Relationship between CPUE and biomass.

Qualifying Comments
As the red gurnard fishery in FMAs 1 and 9 has a long history, it is not possible to infer stock status from abundance trends from only the last 20 years. The abundance of all three sub-stocks appears to be cyclical, probably in response to recruitment variation, and in at least two sub-stocks trends are currently downward. This makes it difficult to predict future trends without recruitment information. Given that the catch levels observed over the last 23 years have been relatively consistent (averaging 1100t for all of GUR 1) and that red gurnard are mainly taken as bycatch, current catch is unlikely to affect the long-term viability of this stock. As the TACC is substantially higher than the current catch, it is not possible to evaluate catches at the level of the TACC.

Fishery Interactions
Red gurnard is taken as a bycatch on the east coast mainly by bottom longline targeted at snapper, with the balance taken almost equally by bottom trawl and Danish seine targeting snapper and John dory.

GUR 2

Stock Structure Assumptions

For the purpose of this summary GUR2 is considered to be a single stock with three sub-stocks.

A stock assessment of GUR2 was attempted in 1997–98, but rejected by the Inshore Working Group. CPUE analyses suggest that GUR2 abundance remained fairly stable between 1989/90 and 2004/05. Reported landings were also reasonably stable during this period, fluctuating between 450t and 708t. These results suggest that catches in this time period and the TACC are probably sustainable, at least in the short-term.

GUR 3

Stock Structure Assumptions

No information is available on the stock separation of red gurnard. The Fishstock GUR 3 is treated in this summary as a unit stock.

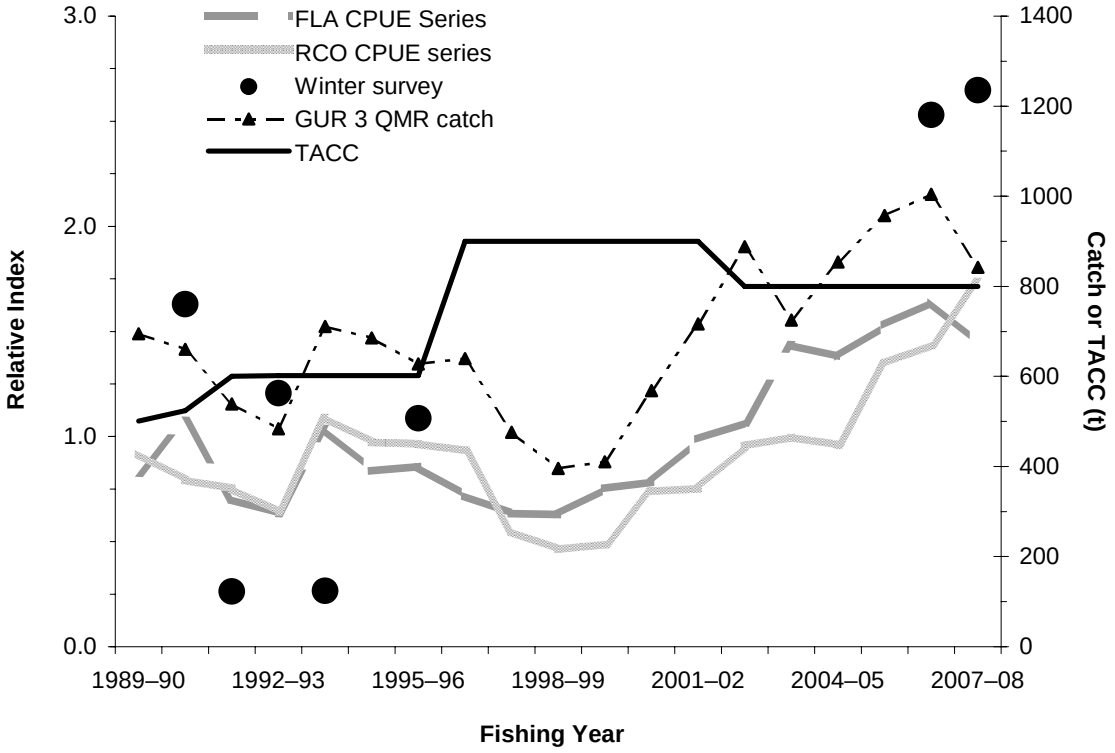
Stock Status	
Year of Most Recent Assessment	2009 (East Coast South Island trawl survey)
Reference Points	Target: Not established Soft Limit: 20% B_0 Hard Limit: 10%B_0
Status in relation to Target	Unknown
Status in relation to Limits	Soft Limit: Unknown Hard Limit: Unlikely (< 40%) to be below

Fishery and Stock Trends	
Trend in Biomass or Proxy	Two bottom trawl CPUE series (one targeted at flatfish and the other at red cod), which are considered to be an index of stock abundance, have been increasing steadily since the late 1990s. The resumed east coast South Island trawl survey has returned two biomass indices in 2007 and 2008 which are greater than equivalent estimates from the early 1990s.

Trend in Fishing Mortality or Proxy	Unknown. Catches are increasing but abundance is thought to be increasing as well.

Historical Stock Status Trajectory and Current Status

East coast South Island winter trawl survey, CPUE, Catch and TACC Trajectories



Comparison of three available biomass series (east coast South Island winter trawl survey and two bottom trawl CPUE series, one targeted at flatfish and the other at red cod) with the trajectories of catch and TACCs from 1989–90 to 2007–08. The three biomass series have been converted to a consistent mean (90–91 to 93–94, 95–96, 06–07, and 07–08).

Other Abundance Indices	
Trends in Other Relevant Indicator or Variables	

Projections and Prognosis	
Stock Projections or Prognosis	Quantitative stock projections are unavailable. . Stock size is Likely (> 60%) to remain near current levels or increase at levels of catch near the TACC.
Probability of Current Catch / TACC causing decline below Limits	Soft Limit: Unlikely (< 40%) Hard Limit: Unlikely (< 40%)

Assessment Methodology		
Assessment Type	Level 2: Standardised CPUE abundance index and a trawl survey,	
Assessment Method	Evaluation of agreed standardised CPUE indices which reflect changes in abundance as well as the trawl survey biomass indices.	
Main data inputs	Trawl survey biomass indices and associated length frequencies Catch and effort data derived from the Ministry of Fisheries compulsory logbooks. Length frequency data summarised from logbooks compiled under the industry Adaptive Management Programme.	
Period of Assessment	Latest assessment: 2009	Next assessment: 2011

Changes to Model Structure and Assumptions	The target flatfish and red cod CPUE series have been updated with data up to 2007–08 and have been expanded to cover all valid statistical areas for GUR 3. In particular, the flatfish series now combines flatfish catches from the east coast and south coasts of the South Island. The red cod series combines data from Pegasus Bay and Canterbury Bight.
Major Sources of Uncertainty	Red gurnard is not thought to be well monitored by the East Coast South Island trawl survey.

Qualifying Comments
Red gurnard are relatively short-lived and reasonably productive. They exhibit strong interannual fluctuations and were at apparent low levels in the mid-1990s. Stock size appears to have increased substantially since then and commercial fishers indicate that they find it difficult to stay within the TACC despite the low level of targeting on this species. Two independent CPUE series and the trawl survey corroborate that stock size for GUR 3 has increased since the late 1990's.

Fishery Interactions
Red gurnard in GUR 3 are taken almost entirely by bottom trawl in fisheries targeted at red cod, barracouta and flatfish. Some gurnard are also taken in the target tarakihi and stargazer bottom trawl fisheries. The level of targeting on this species is low, averaging less than 10% of the total landed catch since 1989–90.

GUR 7

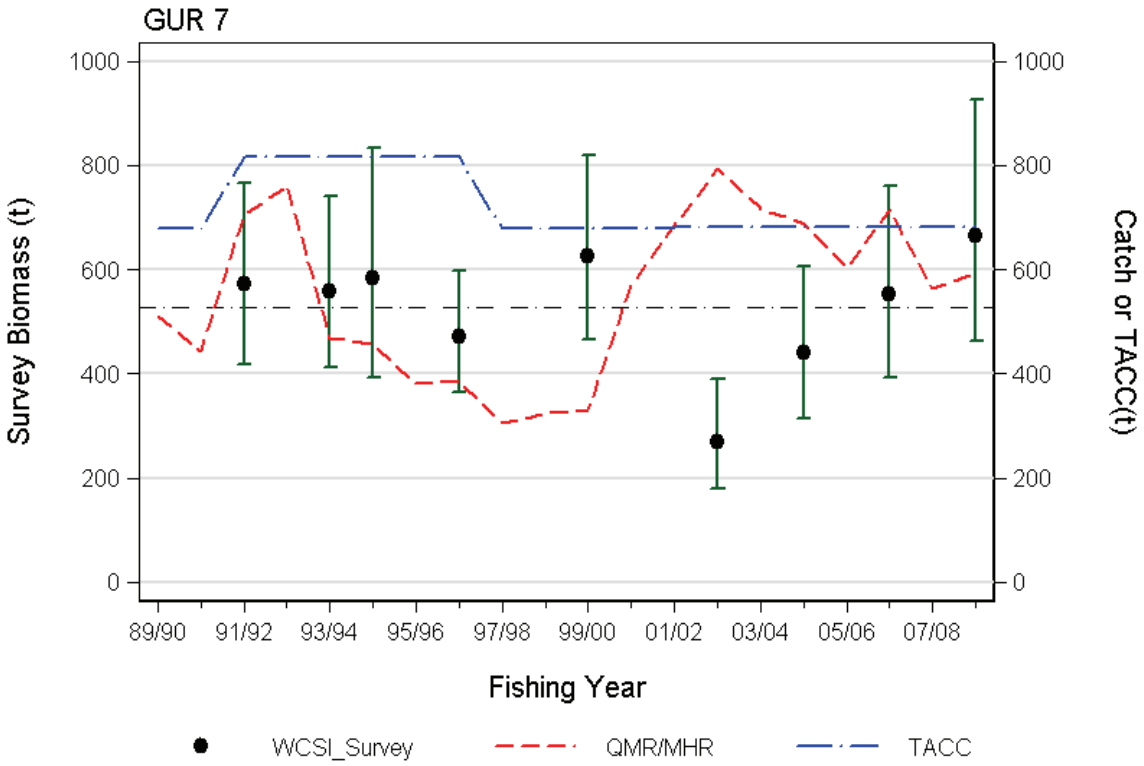
Stock Structure Assumptions

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

Stock Status	
Year of Most Recent Assessment	2009 (West Coast South Island trawl survey)
Reference Points	Target: Not established Soft Limit: Not established Hard Limit: Not established
Status in relation to Target	Unknown
Status in relation to Limits	Soft limit: Unknown Hard Limit: Unlikely

Fishery and Stock Trends	
Trend in Biomass or Proxy	The West Coast South Island trawl survey relative biomass index declined from 1995 to 2000 and has increased steadily from 2003 to the highest level in the series in 2009, the 2009 estimate is preliminary.
Trend in Fishing Mortality or Proxy	Unknown. Catches have increased since 2000–01 coincident with an apparent increase in the survey biomass indices, therefore trends in catch relative to biomass are unknown.

Historical survey biomass, Catch and TACC Trajectories



West Coast South Island survey biomass (points) commercial catch (red dashed line) and TACC (blue dashed line) for the period 1990 to 2007. Horizontal line dashed is the mean biomass index, 1992–2007.

Other Abundance Indices	-
Trends in Other Relevant Indicator or Variables	Levels of recent recruitment are unknown, but length frequency analysis from the West Coast South Island trawl survey showed substantial numbers of 20-25cm fish in 1997 and 2000. Gurnard in this size range did not appear in substantial numbers in 2003 or 2005 but were found in 2007 in reasonable quantities. The 2009 survey length frequency data are not available at this time.

Projections and Prognosis	
Stock Projections or Prognosis	Recent catches and the TACC are probably sustainable, at least in the short-term. Quantitative stock projections are unavailable.
Probability of Current Catch / TACC causing decline below Limits	Soft Limit: Unlikely (<40%) Hard Limit: Unlikely (<40%)

Assessment Methodology		
Assessment Type	Level 2: Agreed abundance index	
Assessment Method	West Coast South Island Trawl survey biomass – Survey length frequency.	
Main data inputs	Survey biomass and length frequencies.	
Period of Assessment	Latest assessment: 2009	Next assessment: 2011
Changes to Model Structure and Assumptions	N/A	
Major Sources of Uncertainty		

Qualifying Comments
Red gurnard are a survey target of the West Coast South Island trawl survey and the Southern Inshore Working Group regards the series as a reliable index of abundance.

Fishery Interactions
Red gurnard are primarily taken in conjunction with the following QMS species: barracouta, stargazer, red cod, tarakihi and other species in the West Coast South Island target bottom trawl fishery.

GUR 8

It is not known if recent catch levels or the current TACC are sustainable.

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)	2008–09 Actual TACC	2008–09 Reported landings
GUR 1	Auckland	1 & 9	1 120		2 287	1 060
	GUR 1W			520−10 400		
	GUR 1E			650−9730		
GUR 2	Central (east)	2	450		725	621
GUR 3	South–East, Southland and Sub–Antarctic	3, 4, 5, & 6		200	750	939
GUR 7	Challenger	7		260	678	594
GUR 8	Central (west)	8		140	543	274
GUR 10	Kermadec	10		–	10	0
Total				2 170	4 993	3 488

7. FOR FURTHER INFORMATION

Blackwell R. 1988. Red gurnard. New Zealand Fisheries Assessment Research Document 1988/23: 18p.

Boyd RO., Reilly JL. 2002. 1999–00 national marine recreational fishing survey: harvest estimates. Draft New Zealand Fisheries Assessment Report xxxx/xx: xxp..

Bradford E. 1998. Harvest estimates from the 1996 national recreational fishing surveys. New Zealand Fisheries Assessment Research Document 1998/16. 27p.

Cordue PL. 1998. Designing optimal estimators for fish stock assessment. Canadian Journal of Fisheries and Aquatic Science *55*: 376–386.

Challenger Finfisheries Management Company 2003. Report to the Adaptive Management Programme Fishery Assessment Working Group. GUR 7 Adaptive Management Proposal for the 2004–05 fishing year. Copies held by MFish.

Elder RD. 1976. Studies on age and growth, reproduction and population dynamics of red gurnard, *Chelidonichthys kumu* (Lesson and Garnot), in the Hauraki Gulf, New Zealand. Fisheries Research Bulletin No: 12. 62p.

Francis RICC. 1992. Recommendations concerning the calculation of maximum constant yield (MCY) and current annual yield (CAY). New Zealand Fisheries Assessment Research Document 1992/8. 26p.

Hartill B., Bian R., Armiger H., Vaughan M., Rush N. 2007. Recreational marine harvest estimates of snapper, kahawai, and kingfish in QMA 1 in 2004–05. New Zealand Fisheries Assessment Report 2007/26. 44p

Hartill, B.; Bian, R.; Davies, N.M. (2008). Review of methods used to estimate recreational harvests. Draft FAR

Kendrick, T.H.; Walker, N. (2004). Characterisation of the GUR 2 red gurnard (*Chelidonichthys kumu)* and associated inshore trawl fisheries, 1989-90 to 2000-01 New Zealand Fisheries Assessment Report 2004/21. 83p.

Kendrick, T.H (2009a). Fishery characterisation and catch-per-unit-effort indices for three sub-stocks of red gurnard in GUR 1; 1989-90 to 2004-05. New Zealand Fisheries Assessment Report 2009/10.

Kendrick, T.H (2009b). Updated Catch-per-Unit effort indices for red gurnard in GUR 2; 1989-90 to 2004-05 New Zealand Fisheries Assessment Report 2009/11.

Lydon GJ., Middleton DAJ., Starr PJ. 2006. Performance of the GUR 3 Logbook Programme. AMP-WG-06/22. (Unpublished manuscript available from the NZ Seafood Industry Council, Wellington).

Morrison MA., Francis MP., Parkinson DM. 2002. Trawl survey of the Hauraki Gulf, 2000 (KAH0012). New Zealand Fisheries Assessment Report 2002/46. 48p.

Starr PJ., Kendrick TH., Lydon GJ. and Bentley N. 2007. Report to the Adaptive Management Fishery Assessment Working Group: Full term review of the GUR 3 Adaptive Management Programme. AMP-WG-07/11v2. (Unpublished manuscript available from the NZ Seafood Industry Council, Wellington).

Stevenson ML. 2000. Assessment of red gurnard (*Chelidonichthys kumu*) stocks GUR 1 and GUR 2. New Zealand Fisheries Assessment Report 2000/40. 51p.

Stevenson ML. 2004. Trawl survey of the west coast of the South Island and Tasman and Golden Bays, March-April 2003 (KAH0304). New Zealand Fisheries Assessment Report 2004/4. 69p.

Stevenson ML. 2006. Trawl survey of the west coast of the South Island and Tasman and Golden Bays, March-April 2005 (KAH0503). New Zealand Fisheries Assessment Report 2006/4. 69p

Stevenson ML. 2007. Inshore trawl survey of the west coast of the South Island and Tasman and Golden Bays, March–April 2007 (KAH0704). New Zealand Fisheries Assessment Report 2007/41. 64p.

Stevenson ML. In press. Inshore trawl survey of the west coast of the South Island and Tasman and Golden Bays, March–April 2009. New Zealand Fisheries Assessment Report. 77p.

Sutton CP. 1997. Growth parameters, and estimates of mortality for red gurnard (*Chelidonichthys kumu*) from off the east and west coasts of the South Island, New Zealand. New Zealand Fisheries Assessment Research Document 1997/1: 15p.

Vignaux M. 1997. CPUE analyses for fishstocks in the adaptive management programme. New Zealand Fisheries Assessment Research Document 1997/24. 68p.

Teirney LD., Kilner AR., Millar RE., Bradford E., Bell JD. 1997. Estimation of recreational catch from 1991–92 to 1993–94 New Zealand Fisheries Assessment Research Document 1997/15. 43p.