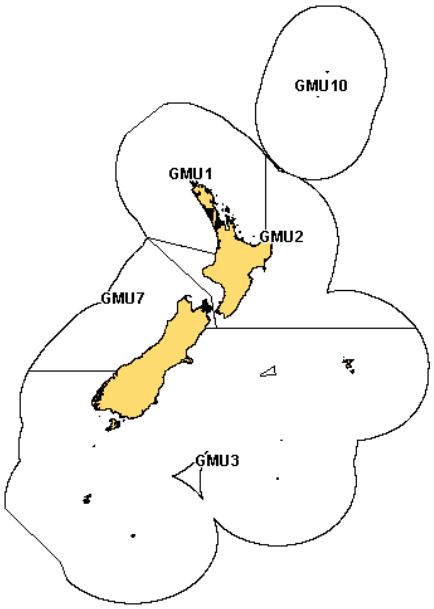
GREY MULLET (GMU)

(*Mugil cephalus*)



1. FISHERY SUMMARY

(a) Commercial fisheries

Commercial fishing for grey mullet occurs predominantly in the GMU 1, where annual landings increased from approximately 420 t in 1974 to a maximum of 1142 t in 1983–84. Marked changes in fishing effort occurred during this period through the development of more efficient fishing techniques and an increase in the market demand for this species. Before the introduction of the QMS, total domestic catches declined from the maximum (1160 t) in 1983–84 to 901 t in 1985–86. The TACC was consistently under caught after GMU 1 was introduced into the QMS. The Minister of Fisheries therefore reduced the TACC for GMU 1 to 925 t, beginning in 1998–99. The reduction in TACC had little effect on the annual catches, and it has only ever been reached in GMU 1 in 204/05 (Table 1). Although catches declined slightly in 2005/2006 from the previous year, they were still above the average catch for the last 15 years.

Table 1: Reported landings (t) of grey mullet by Fishstock from 1983–84 to 2005–06 and actual TACs (t) for 1986–87 to 2005–06.

Fishstock	GMU 1		GMU 2		GMU 3		GMU 7		GMU 10			
QMA (s)	1 & 9		2 & 8		3, 4, 5 & 6		7		10		Total	
	Landings	TAC	Landings	TAC	Landings	TAC	Landings	TAC	Landings	TAC	Landings	TAC
1983–84*	1142	–	6	–	5	–	7	–	0	–	1160	–
1984–85*	1 69	–	5	–	0	–	15	–	0	–	1089	–
1985–86*	881	–	10	–	0	–	10	–	0	–	901	–
1986–87†	595	910	3	20	<1	30	0	20	0	10	598	990
1987–88†	751	941	3	20	0	30	0	20	0	10	754	1021
1988–89†	792	963	3	20	0	30	0	20	0	10	795	1043
1989–90†	907	990	2	20	0	30	4	20	0	10	913	1070
1990–91†	875	994	2	20	1	30	<1	20	0	10	879	1073
1991–92†	848	1006	1	20	2	30	1	20	0	10	852	1086
1992–93†	711	1006	<1	20	<1	30	0	20	0	10	712	1086
1993–94†	743	1006	<1	20	<1	30	0	20	0	10	706	1086
1994–95†	776	1006	0	20	<1	30	10	20	0	10	787	1086
1995–96†	866	1006	0	20	<1	30	<1	20	0	10	866	1086
1996–97†	870	1006	<1	20	1	30	<1	20	0	10	872	1086
1997–98†	730	1006	<1	20	<1	30	<1	20	0	10	730	1086
1998–99†	750	925	<1	20	<1	30	<1	20	0	10	750	1005
1999–00†	749	925	<1	20	0	30	<1	20	0	10	750	1005
2000–01†	797	925	1	20	0	30	<1	20	0	10	798	1005
2001–02†	782	925	2	20	<1	30	<1	20	0	10	784	1005
2002–03†	797	925	1	20	<1	30	0	20	0	10	798	1005
2003–04†	886	925	<1	20	0	30	<1	20	0	10	796	1005

(*Table 1 continued*)

Fishstock	GMU 1		GMU 2		GMU 3		GMU 7		GMU 10			
QMA (s)	1 & 9		2 & 8		3, 4, 5 & 6		7		10		Total	
	Landings	TAC	Landings	TAC	Landings	TAC	Landings	TAC	Landings	TAC	Landings	TAC
2004–05†	941	925	<1	20	0	30	0	20	0	10	941	1005
2005–06†	878	925	<1	20	<1	30	0	20	0	10	878	1005

* FSU data., † QMS data.

(b) Recreational fisheries

Grey mullet are a popular recreational species particularly in the Auckland FMA. Information is available on the relative levels of commercial and amateur catch of this species in the Manukau Harbour and the lower Waikato River based on limited tagging work undertaken in 1987. Of the number of tags returned 38% were from amateur fishers, suggesting that recreational use of the resource was relatively high.

The 1993–94 North Region Recreational Fishing Survey (Teirney et al., 1997) estimated the annual recreational catch from GMU 1 at 150 t (Table 2). This represents 17% of the total landings from GMU 1 in 1993–94. The 1996 National Recreational Fishing Survey (Bradford, 1998) estimated the annual recreational catch from GMU 1 in the 1996 fishing year at 106 t (Table 2). The 2000 National Recreational Fishing Survey (Boyd et al., 2000) fishing survey provided an estimate of 102 t (Table 2). Results from the three recreational surveys are relatively consistent; it is likely the annual level of recreational extraction from GMU 1 is in the order of 100–150 t. The Minister of Fisheries provided an allowance for customary harvest of 100 t beginning in 1998–99.

Table 2: Estimated number of grey mullet harvested by recreational fishers by Fishstock and survey year, the corresponding estimated survey harvest, and the estimated Fishstock harvest.

		Total			
Fishstock	Survey year	Number	*CV*	Estimated harvest range (t)	Point estimate (t)
GMU 1	1993–94	170 000	19%	90–210	150
GMU 1	1996	110 000	25%	80–130	106
GMU 1	2000	110 000	33%	68–136	102

A nationwide recreational survey was also undertaken in 2001. The results from this survey are still under review and are not available for inclusion in the stock assessment process.

(c) Maori customary fisheries

No quantitative information is available on the current level of Maori customary take. The Minister of Fisheries provided an allowance for customary harvest of 100 t per annum beginning in 1998–99.

(d) Illegal catch

Estimates of illegal catch are unknown but anecdotal evidence suggests 10–20% under-reporting is plausible. In the latest stock assessment, an annual under-reporting of 20% was assumed for the period before 1986 and 10% thereafter.

(e) Other sources of mortality

No quantitative estimates are available regarding the impact of other sources of mortality on grey mullet stocks. Grey mullet principally occur in sheltered harbours and estuarine ecosystems. Some of these habitats are known to have suffered environmental degradation.

2. BIOLOGY

Grey mullet has a world wide distribution, occurring commonly along coasts, in estuaries, and in lower river systems between latitudes of 42° N and 42° S. Overseas and New Zealand tagging studies indicate that movement patterns of adult grey mullet are complex. Some schools remain in one locality, while others appear to be on the move almost continuously. Recorded movements of tagged grey mullet of 160 km within a few weeks of release are not uncommon.

Females grow faster than males and attain a larger size. Both sexes mature at 3 years of age at an average size of 33 cm fork length (FL) for males and 35 cm FL for females. Maximum ages appear to be 12 to 14 years, with the commercial fishery based primarily on 5 to 9 year old fish.

M was estimated from 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. Using 15 years for the maximum age results in an estimate of M = 0.33. (Note: the maximum age of 15 years was obtained from an exploited population, so M is likely to be less than 0.33).

Grey mullet commonly occur in schools, which generally become larger and more prevalent in the spawning season. Spawning in northern New Zealand occurs during November through February. Females are highly fecund and may release up to 1 million eggs at a spawning. It is likely that grey mullet spawn at sea, because running-ripe females have only been caught off coastal beaches or in offshore waters, and eggs and larvae are a component of the offshore coastal plankton at certain times of the year. Small post-larval grey mullet occur seasonally in estuaries, which serve as nursery grounds for juveniles.

Adult grey mullet typically feed on diatom algae and small invertebrates which are gulped along with surface scum or with detrital ooze and sifted by fine teeth and gill-rakers.

Biological parameters relevant to stock assessment are shown in Table 3.

Table 3: Estimates of biological parameters of grey mullet.

Fishstock	Estimate						Source
1. Natural mortality (M)							
GMU 1	0.33 for both sexes						NIWA (unpubl. data)
2. Weight = a (length)^b (Weight in g, length in cm fork length)							
Both sexes combined							
GMU 1	a = 0.04236 b = 2.826						Breen & McKenzie (in press)
3. von Bertalanffy growth parameters							
	Females			**Males**			
	K	**t_0**	**L_∞**	**K**	**t_0**	**L_∞**	
GMU 1	0.587	1.3469	40.1	0.619	1.3257	37.0	Breen & McKenzie (in press)

3. STOCKS AND AREAS

There is little biological data to determine the level of sub stock separation within GMU 1. Results from a small scale tagging program in the Manukau Harbour and the Lower Waikato River indicated that there is fish movement between these two localities and also north along the west coast but the level of net movement cannot be ascertained. There is evidence in the CPUE data that GMU 1 may be comprised of 6 populations with low to moderate mixing between them (McKenzie, 1997).

GMU 1 has been divided into two substocks for the purposes of fisheries stock assessment: east cost substock; west coast substock. The boundary between the two sub-stocks is assumed to be due north from North Cape.

4. STOCK ASSESSMENT

(a) Estimates of fishery parameters and abundance

Catch per unit effort analysis shows that the key harbours and estuaries covered by the GMU 1 fishery exhibit different abundance trends (Watson et al., 2003). The overall trend for the west coast is generally downward and the east coast is relatively flat (Figures 1 & 2). The inshore FAWG concluded in 2005 that catches on the west coast of GMU 1 were probably unsustainable.

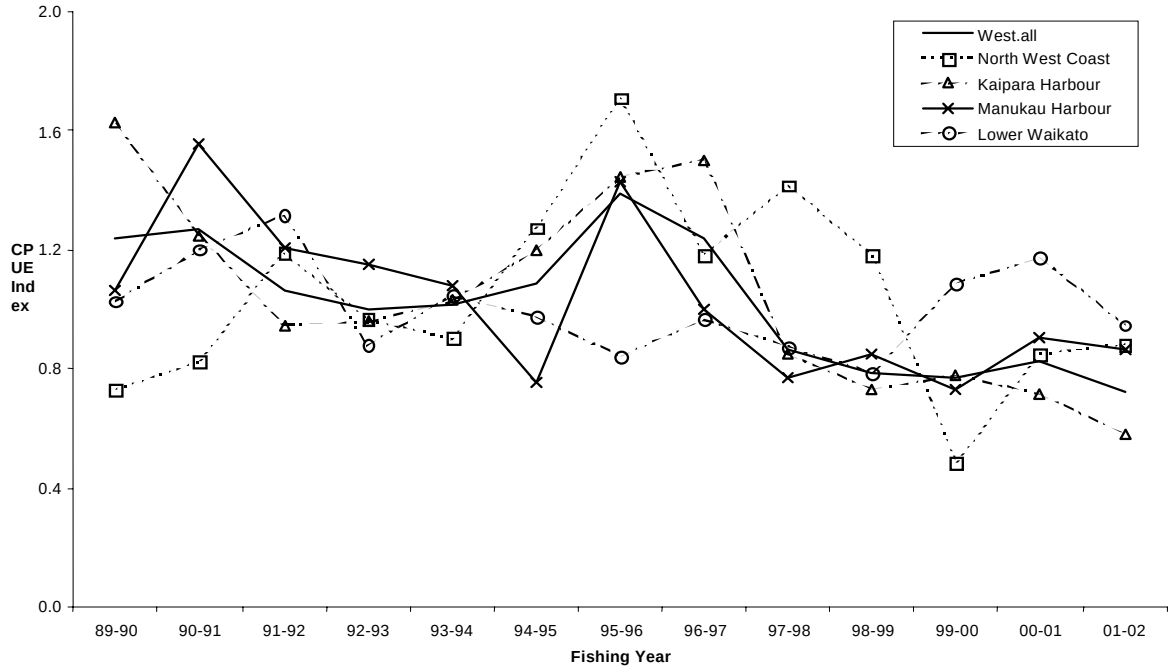


Figure 1: CPUE Index per year for West Coast stat areas.

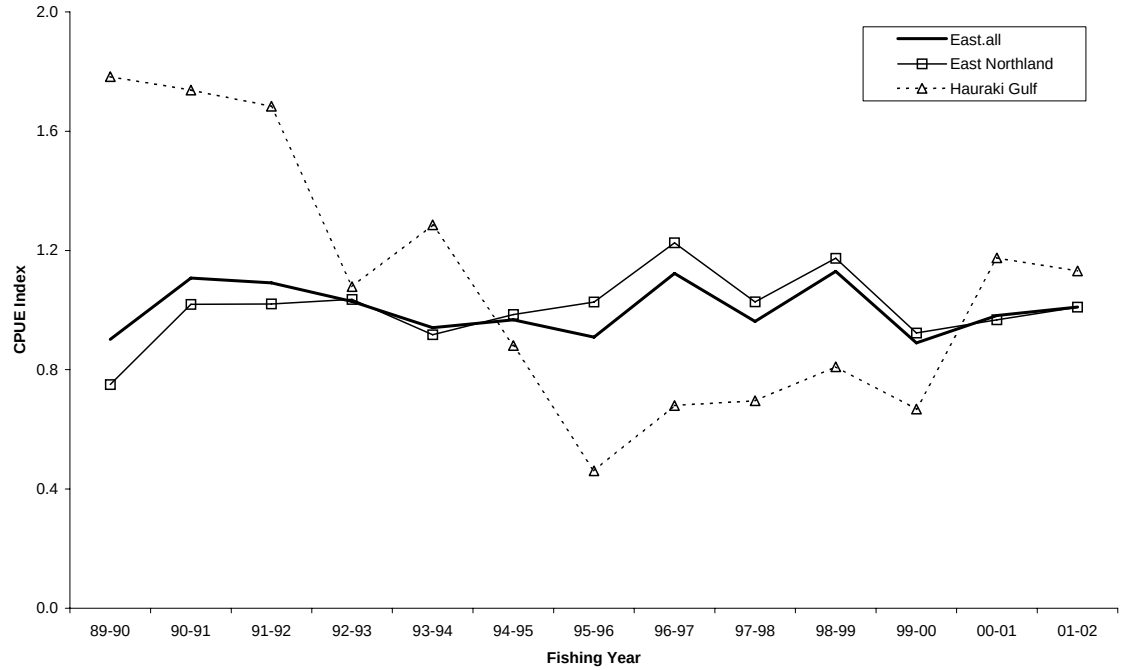


Figure 2: CPUE Index per year for East Coast stat areas.

The differences in abundance trends imply a degree of independence between the local area grey mullet populations that make up GMU 1. The strongest decline in CPUE is seen in the Kaipara Harbour. In the past the majority of the GMU 1 TACC was taken from this harbour. However the Kaipara harbour contribution to the GMU 1 TACC has declined markedly in recent years (Figure 3). The decline in Kaipara harbour catch has been offset by an increase in catches from East Northland and the Lower Waikato; the CPUE trends in both these areas being relatively stable (Figures 1 & 2).

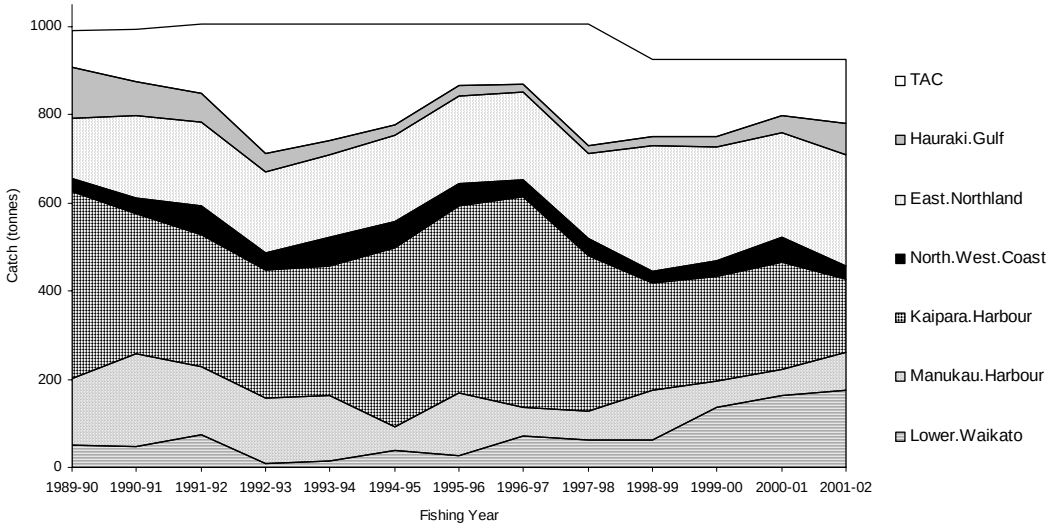


Figure 3: Recorded trip green weights in each zone (t) (groomed data scaled to annual catch).

(b) Biomass estimates

West coast GMU 1

A stock assessment was undertaken for the west GMU 1 substock using a stochastic dynamic age-structured observation-error time series model (Breen & McKenzie, 1998), but this did not prove to be robust and the results were rejected by the Working Group.

(c) Estimation of Maximum Constant Yield (MCY)

There is insufficient information with which to revise the yield estimates of either the West or East coast GMU 1 substocks. The MCY estimate derived in 1986 using the equation MCY = cY_{av} (Method 4) remains the accepted yield estimate for GMU 1.

Annual landings of grey mullet in the Auckland QMA for the period 1974–84 showed an increasing trend to a maximum in 1984. There were some fluctuations throughout this period. A general increase in fishing effort occurred during this time. Fishing effort between 1983–84 and 1985–86 appeared relatively constant, and catches during these years were averaged to estimate Y_{av}. The constant 'c' was set at 0.8. This is not consistent with the maximum observed age of 14 years, which equates with an estimate of M = 0.33 and c = 0.7. However, it is believed that they live to older ages in unexploited populations. Therefore, the accuracy of MCY derived for grey mullet is uncertain. The estimate of MCY for GMU 1 is shown in Table 4. MCY cannot be estimated for the other fish stocks.

Table 4: Estimate of MCY (t) rounded to the nearest 5 t.

Fishstock	QMA		Y_{av}	MCY
GMU 1	Auckland	1 & 9	1030	825

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

(d) Estimation of Current Annual Yield (CAY)

No estimates of current biomass, fishing mortality, or other information are available which would permit the estimation of CAY.

(e) Other Factors

The minimum legal mesh size for use in the grey mullet fishery is 89 mm. However, fishers typically use mesh larger than 89 mm when fishing for grey mullet (MFish data). There are no data available to compare the selectivity characteristics of different mesh sizes. It is possible that a significant fraction of the grey mullet stock comprising larger older fish is poorly selected by the fishery. If this is true then the von Bertalanffy parameter estimates, which are based on random samples from the 1997–98 setnet landings, are likely to be biased: $L\infty$ will be biased low, K biased high.

5. STATUS OF THE STOCKS

The CPUE data suggests that the GMU 1 fishery is composed of a number of spatially distinct substocks. The largest of these in terms of annual catch, the Kaipara harbour, shows evidence of declining abundance over the last 14 years. The Inshore FAWG concluded in 2005 that recent catches on the west coast of GMU 1 are unlikely to be sustainable. It is not known if the recent catches will allow the sub-stocks to move toward a size that will support the global MSY.

Yields, TACCs and reported landings are summarised in Table 5.

Table 5: Summary of yields (t), TACCs (t), and reported landings (t) of grey mullet for the most recent fishing year.

Fishstock	QMA		MCY	2005–06 Actual TACC	2005–06 Reported landings
GMU 1	Auckland (East) (West)	1 & 9	825	925	878
GMU 2	Central (East) (West)	2 & 8	–	20	<1
GMU 3	South–East (Coast) (Chatham), Southland and Sub–Antarctic	3, 4, 5 & 6	–	30	0
GMU 7	Challenger	7	–	20	0
GMU 10	Kermadec	10	–	10	0
Total			–	1005	878

6. FOR FURTHER INFORMATION

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