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**Grey mullet**

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This series documents the scientific basis for stock assessments and fisheries management advice in New Zealand. It addresses the issues of the day in the current legislative context and in the time frames required. The documents it contains are not intended as definitive statements on the subjects addressed but rather as progress reports on ongoing investigations.

## GREY MULLET (*Mugil cephalus*)

### INTRODUCTION

The biology and fishery of grey mullet was reviewed by Hore (1985, 1986, 1988). This document provides a summary of these earlier reviews and presents an update of more recent catches. Catch information previously provided by calendar year is now presented by fishing year. New information on the biology and distribution of grey mullet in the lower Waikato River and Manukau Harbour is presented.

Grey mullet are widespread throughout tropical and sub tropical seas. In New Zealand they are most common around the North Island but are also found around the northern areas of the South Island. The commercial fishery for this species takes place predominantly in the harbours and estuaries of the Auckland Fisheries Management Area (FMA) particularly those on the West Coast. The major West Coast fishery areas of the Kaipara and Manukau Harbours and the Lower Waikato River in recent years accounted for around 70% of the Auckland FMA commercial catch. Seasonal peaks in catch occur in Kaipara Harbour from June-November, in Manukau Harbour from August-January and in the lower Waikato area from October-February (Hore 1988). The total allowable catch and recent catches for this species by FMA are shown in Table 1.

Grey mullet are most commonly taken commercially by ring netting, drift netting or set netting. The operation of these three methods is quite distinct yet historically ring netting and set netting have been combined under the method gill net/set net for the purposes of catch recording. The most common method of fishing is that of ring setting from small high powered dories. Schools of grey mullet are actively sought with jumping fish identifying schools visually during daylight hours or by sound during the hours of darkness. Once identified schools are surrounded by sinking nets and the dories are circled within the ring to sound fish into the nets. Current fisheries regulations prohibit the joining of the two ends of a ring net which must be separated by a distance of 60 metres and also limit the length of any one net to 1000 metre. The active seeking of fish schools separates this method from the passive methods of drift netting, commonly used in areas such as the Waikato River, and the static set net method. Catch per unit effort analysis using grouped set net catches is therefore of doubtful value in evaluating the grey mullet fishery in some areas. This is particularly the case where ring netting is the predominant method used and in the absence of any measure of searching effort.

The information available on grey mullet around New Zealand is limited however this species has been widely studied overseas because of its importance as a fishery throughout Asia and the Middle-East and its potential as an aquaculture species (Thomson 1963). Grey mullet in the lower Waikato basin were studied by Wells (1976) who reported on aspects of the biology of grey mullet taken in this area. He estimated that mullet become mature in their third year when approximately 33cm in length and suggested that mullet were most likely to spawn in the sea.

Thomson (1963) reports the spawning period for this species as extending over the late summer, autumn and early winter months although generally earlier in higher latitudes. Lengths and age at maturity for grey mullet vary throughout its distribution however in general grey mullet appear to mature younger and at a smaller size in warmer waters within its range. Age and lengths of maturity reported for grey mullet in Australia are 3 years and 30-35cm respectively. Tagging and catch per unit effort analysis have been used to estimate population size of grey mullet in Australia and North America and tagging has been used to estimate mortality rates (Thomson 1963).

## REVIEW OF THE FISHERY

### Commercial

Reported catches by fishing return area for the fishing years 1983-84, 1984-85 and 1985-86 are shown in Figure 1. Catches grouped by FMA are shown in Table 1. Catches for which no area of capture information has been provided are apportioned to FMAs by port of landing. Prior to the introduction of the Quota Management System (QMS) total domestic catches declined from 1160 tonnes in 1983-84 to 901 tonnes in 1985-86. Annual landings of grey mullet in the Auckland FMA by fishery zone are shown in Figure 2 for the period 1974-1984. Landings increased throughout this time to reach a maximum in 1984. The reported catch for the 1986-87 fishing year, shown in Table 2, was 612 tonnes. The TAC for the Auckland FMA was 33% uncaught and in other FMAs only minor quantities of grey mullet were taken relative to the TAC. Domestic catch by method is shown in Table 3 from which it is clear that the majority of the catch of grey mullet is taken by set net.

### Recreational and Maori Fisheries

Grey mullet are a popular species for amateur fishermen particularly in the Auckland FMA. Some information is available on the relative levels of commercial and amateur catch of this species in the Manukau Harbour and lower Waikato River from a small scale tagging programme undertaken in these areas. To date 41% (14) of tag recoveries from the programme have been by amateur fishermen suggesting that non-commercial use of the resource is relatively high. No other information is available with which to assess the recreational and Maori fishery for grey mullet.

### Research

Some new information is available for the grey mullet fishery in the Manukau Harbour. In general the length distribution of grey mullet catches is determined by the mesh size of the set net used which limits both the minimum and maximum size of fish caught. The current minimum mesh size for the capture of grey mullet is 85mm. A length frequency distribution for grey mullet sampled from commercial catches taken in the Manukau harbour is shown in Figure 3. This distribution has been weighted by the size of the catch sampled. Unweighted age frequency distributions of grey mullet sampled from commercial catches are shown in Figure 4. Ages assume the formation of only one annulus per year and a birthdate of 1 January. Grey mullet taken from commercial catches ranged in size from 30-45 cm and in age from 2-13 years. A growth curve of mean length at age is shown in Figure 5 for both

males and females. The early growth of this species is relatively rapid slowing for both sexes in their third and fourth year.

Grey mullet mature at approximately 32cm for males and 35cm for females (Figure 6) at which lengths they are already recruited to the commercial fishery. Seasonal peaks in female gonadosomatic index occur in December and January and juveniles of between 20-35mm in length have been taken by beach seine in the Manukau harbour during February. Newly hatched larvae of grey mullet vary in length between 2.2 and 3.5mm (Nash and Shehadeh 1981) and when they first appear in small schools they measure 18-28 mm in length at which stage they are between 30-45 days old. This would indicate that spawning of grey mullet on the west Auckland coast takes place during January.

### Tagging

In order to study the movements of grey mullet within the Manukau Harbour and lower Waikato river and the dispersal of fish from these areas, a small scale tagging programme was undertaken in October and November 1987. A total of 257 grey mullet were tagged 132 in the lower Waikato river and 125 in the Manukau harbour. As at 28.3.88 34 (13.2%) of these tagged fish had been recovered. The proportions recovered by release site and commercial/amateur status are shown in the table below.

<u>Release Area</u>	N	<u>Recoveries</u>				<u>TOTAL</u>	
		<u>Commercial</u>		<u>Non Commercial</u>		N	%
		N	%	N	%		
Manukau	125	5	4.0	5	4.0	10	8.0
Waikato	132	15	11.4	9	6.8	24	18.2
TOTAL	257	20	7.8	14	5.4	34	13.2

Details of the number released by tagging site are shown in Figure 7 . Movements of grey mullet in relation to release site are shown in Figure 8. Grey mullet moved between the lower Waikato river and the Manukau harbour in both directions and were also recovered along the coastal beaches by both commercial and amateur beach seine. The longest distance moved between release and recovery to date has been for a grey mullet tagged in the Manukau harbour and recovered by commercial beach seine at Dargaville beach. Within the first four months since tagged grey mullet were released 34 tags (13.2%) were recovered. The fishery for grey mullet in the tagging area is known to be seasonal however the current return rate suggests that this species is subject to a relatively high level of exploitation.

### Stock Assessment

#### (i) Estimation of Maximum Constant Yield (MCY)

Previous estimates of yield were based on average catch for the period 1981-83 for the Auckland FMA and 1983 catches for all other areas. Annual landings of grey mullet in the Auckland FMA for the period 1974-84 (Figure 2) show an increasing trend to a maximum in 1984 with some fluctuations throughout this period. A general increase in fishing effort is likely to have occurred this time. In order to calculate MCY's catches during the period 1983-86 were

used as representative of a period of relatively constant fishing effort to derive an average annual catch  $Y$ . A constant ( $c$ ) of 0.8 was chosen to reflect the relatively short life span of this species. Current estimates of ages of grey mullet taken in commercial catches are between 3-13 years. Estimates of MCY by FMA are shown in the table below.

<b>FMA</b>	<b>TAC (t)</b>	<b>c</b>	<b>Y (t)</b>	<b>MCY (t)</b>
Auckland	910	0.8	1030	824
Central	20	0.8	7	6
Challenger	20	0.8	11	9
Southern, Southeast	30	0.8	2	2

(ii) Estimation of Current Annual Yield (CAY)

No information is available to allow the estimation of Current Annual Yield.

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TABLE 1. Catch (t) by fishing year of grey mullet by Fishery Management Area, 1983-1986.

FMA	TAC 1986-87	reported catch		
		1983-84	1984-85	1985-86
Auckland	910	1142	1069	881
Central	20	6	5	10
Challenger	20	7	15	10
South-east	30	5	*	*
<b>Total</b>		<b>1160</b>	<b>1089</b>	<b>901</b>

TABLE 2.

FMA	TAC, tonnes 1986-87	reported catch, Kg 1986-87	% TAC Uncaught
Auckland	910	609	33.1
Central	20	2	86.9
Challenger	20	*	98.5
South-east	30	*	100.0
Kermadec	10	0	100.0

TABLE 3. Domestic catch (t) of grey mullet by fishing method, 1983 - 1986.

METHOD	REPORTED CATCH		
	1983-84	1984-85	1985-86
single trawl	*	-	*
pair trawl	-	3	-
beach seine	96	157	95
set net	1063	929	806
fyke net	*	-	-
bottom longline	-	-	*



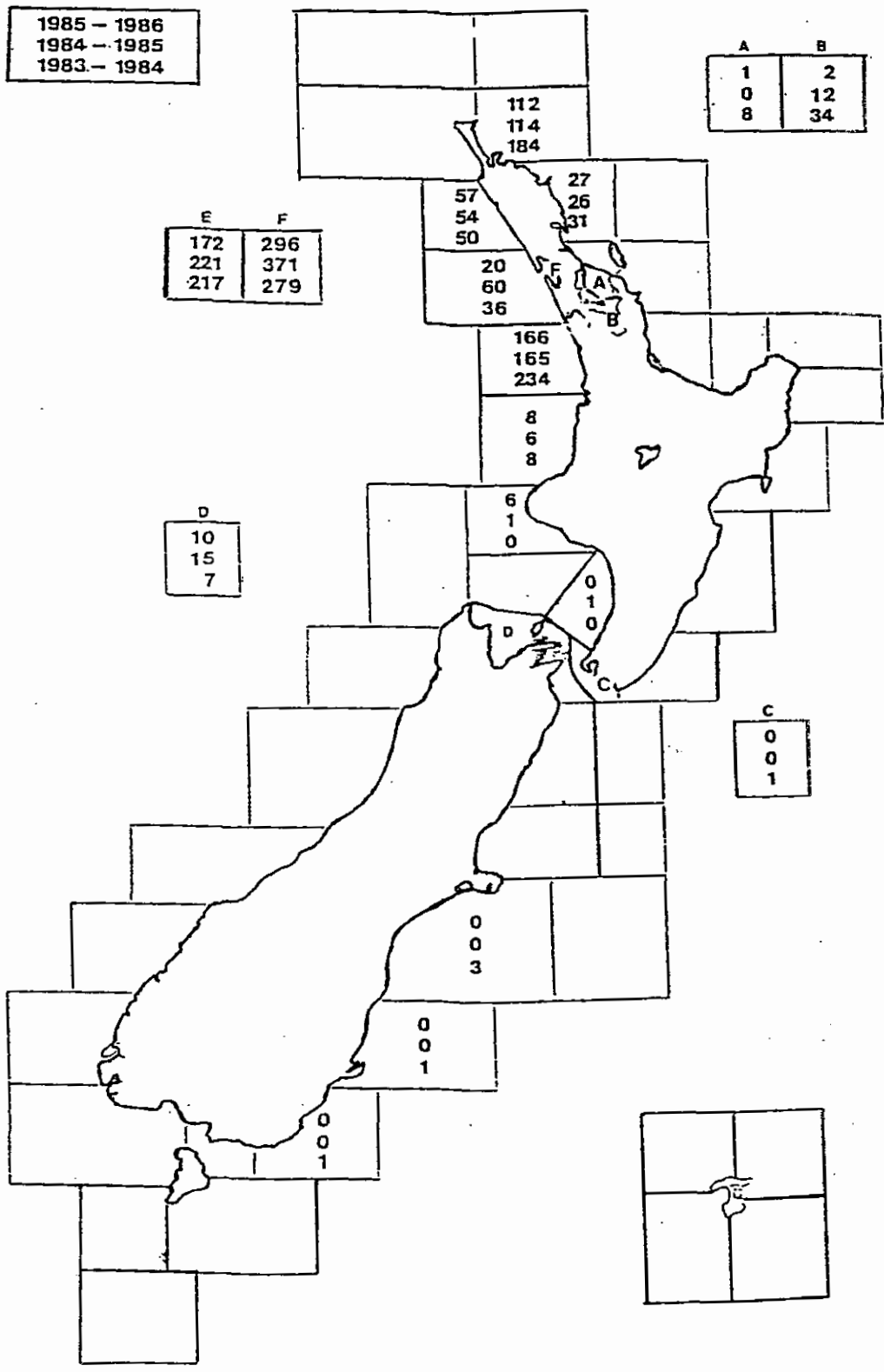
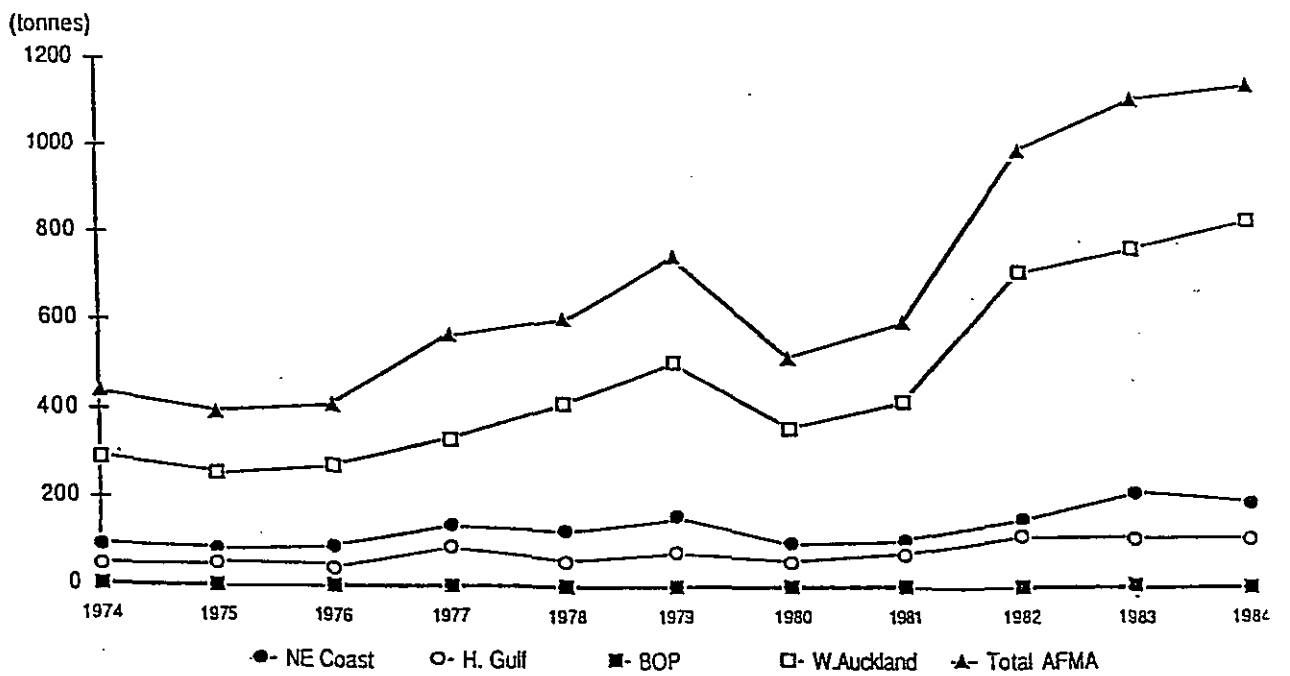


FIGURE 1 Domestic landings (t) of grey mullet by fishing return area (Area unknown 1983-84 : 65t, 1984-85 : 41t, 1985-86 : 24t)



**Figure 2** Grey mullet landings (tonnes) by fishery zone and total for the Auckland FMA (all methods combined), 1974-1984.

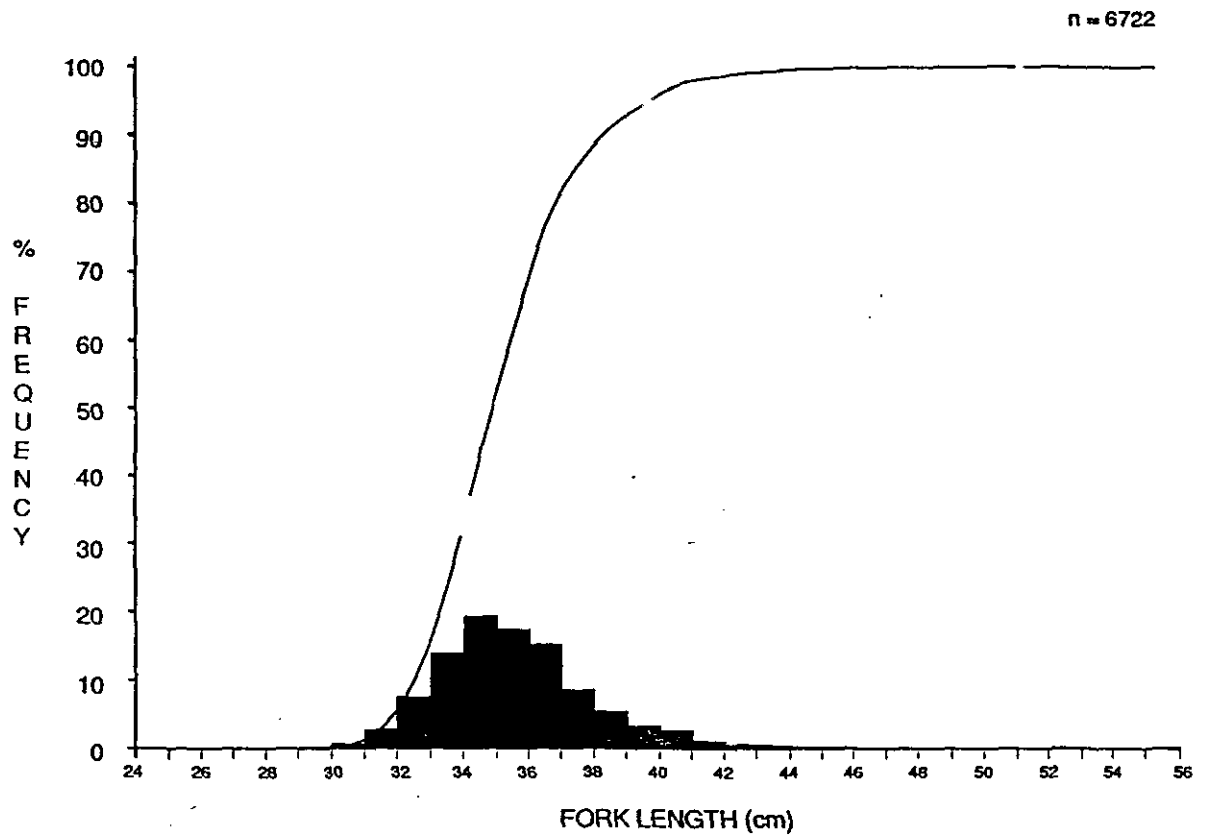


Figure 3 Grey mullet length-frequency distribution of the commercial catch from the Manukau Harbour;

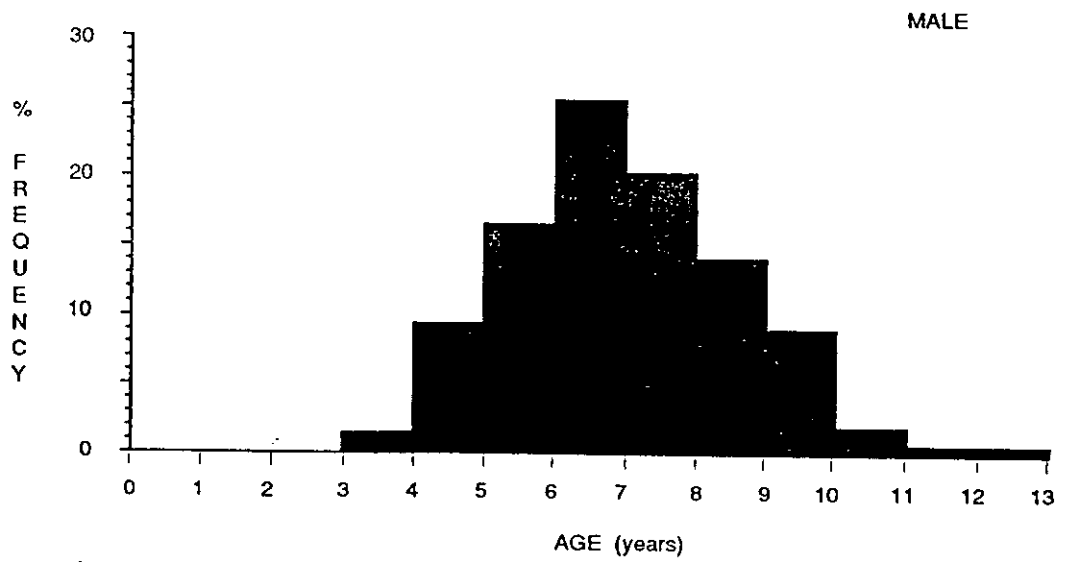
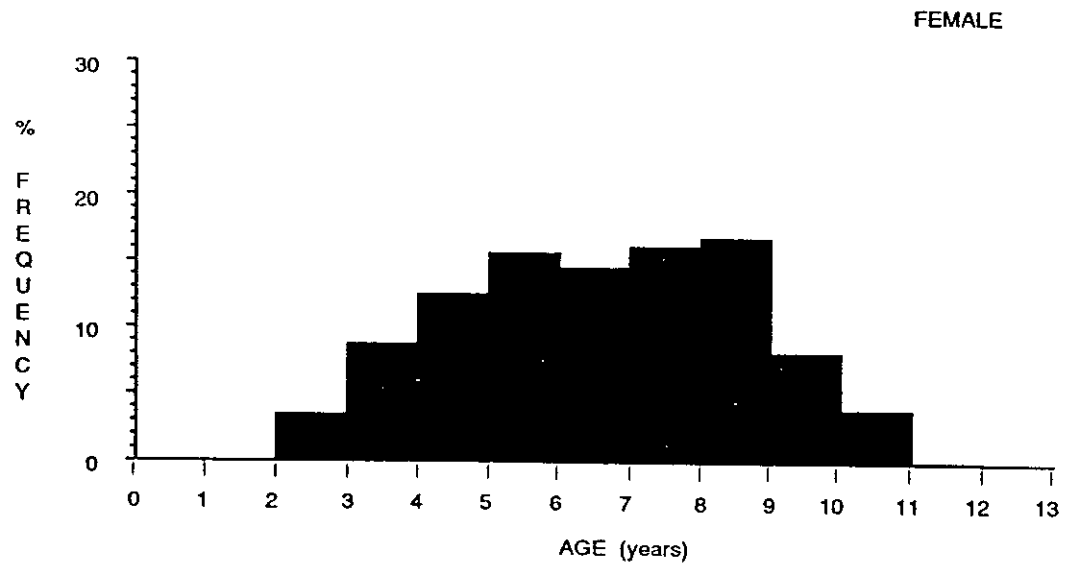


Figure 4 Age-frequency distribution by sex of grey mullet sampled from the commercial catch in the Manukau Harbour.

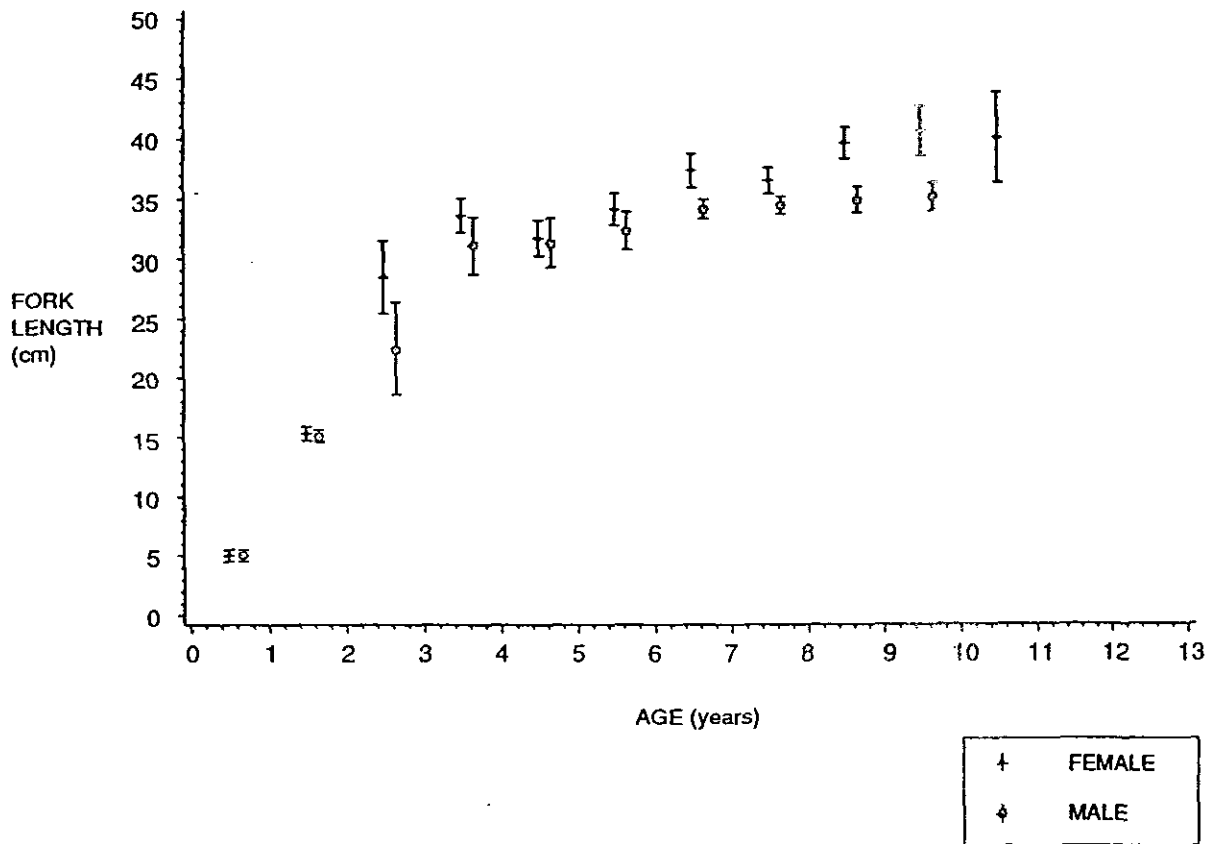


Figure 5 Mean length at age for grey mullet from the Manukau Harbour. The values for each year are represented by the average  $\pm$  2 standards errors.

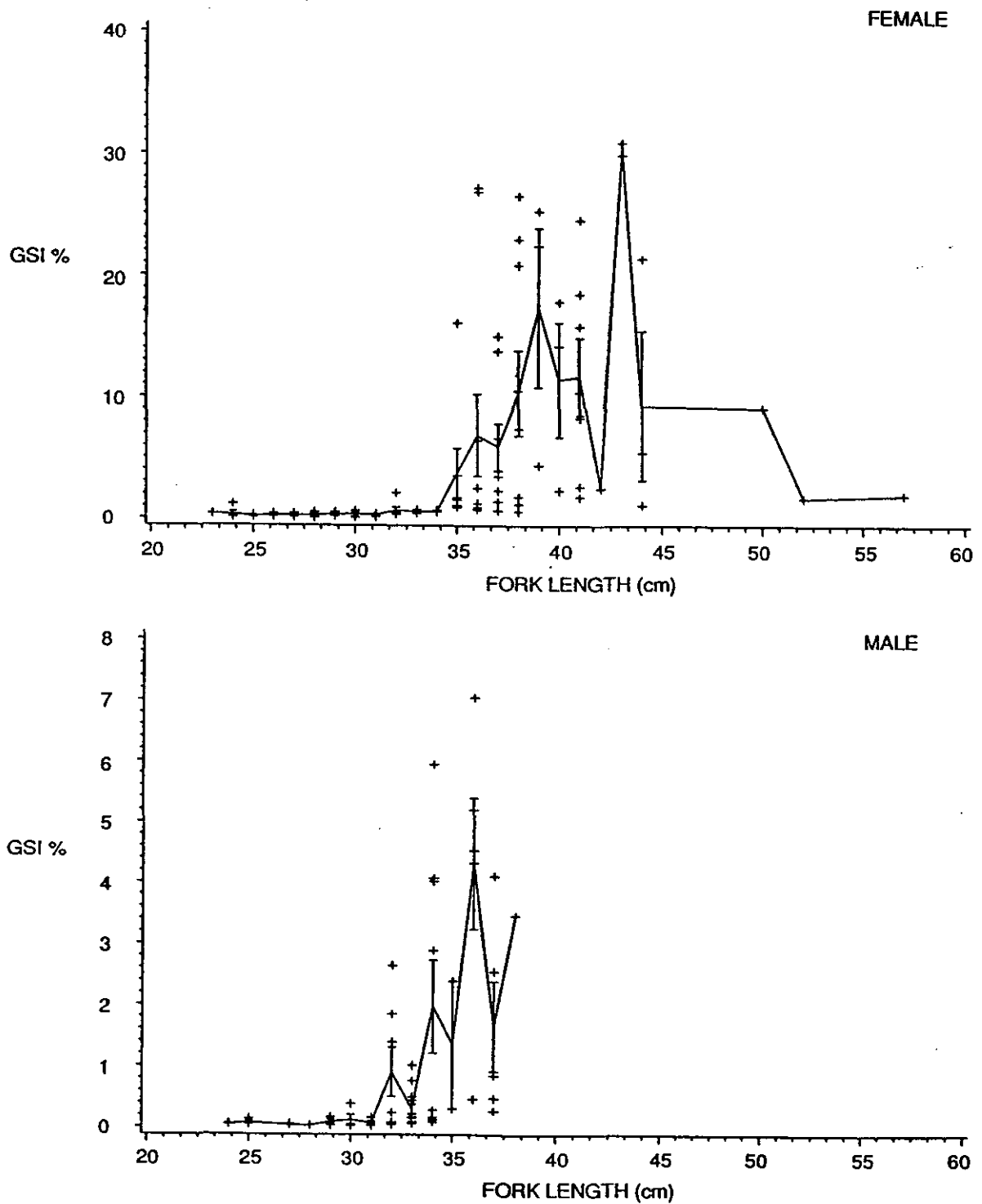


Figure 6

Grey mullet Gonado-Somatic Index (GSI) by length from the Manukau Harbour for males and females. Fish were collected in November, December and January. The values for each length are represented by the average  $\pm$  1 standard error.

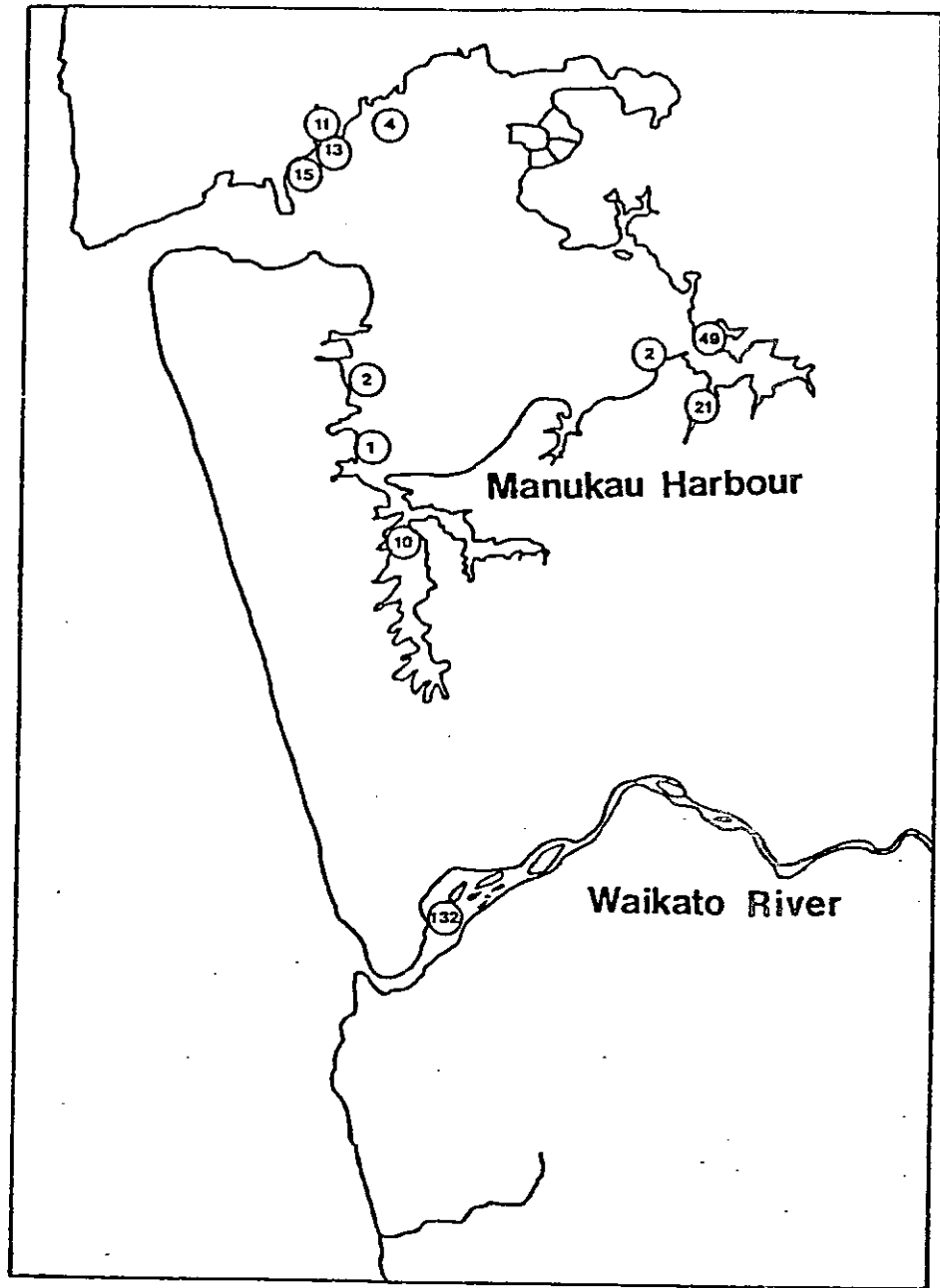


Figure 7

Release sites and numbers of tagged grey mullet released in the Manukau Harbour and lower Waikato River.

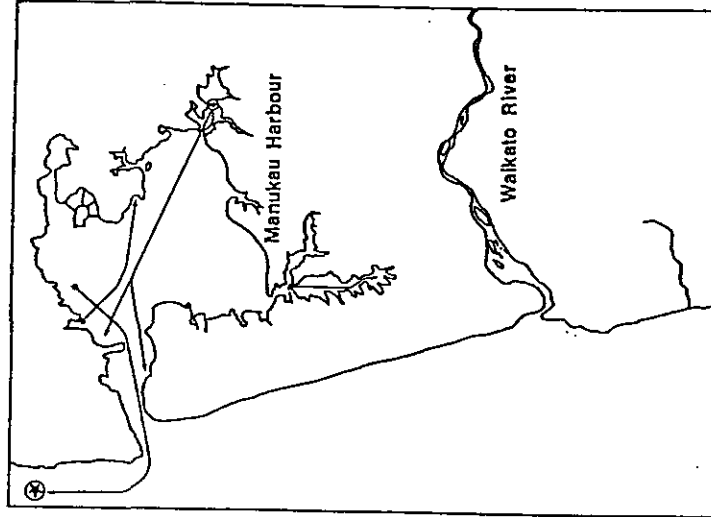
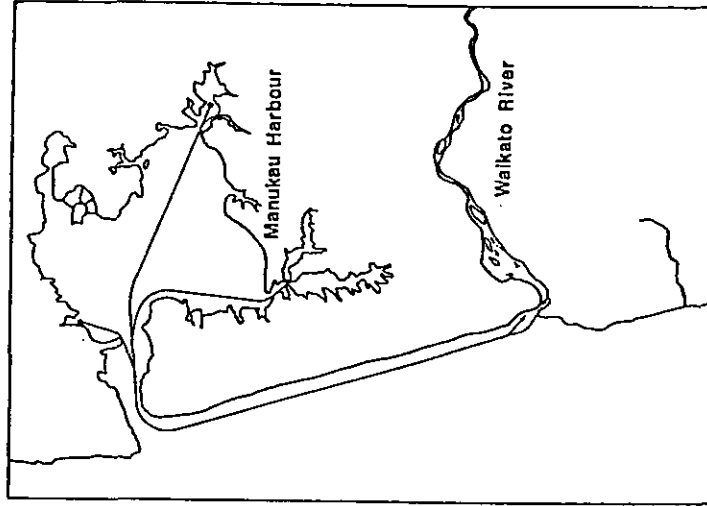
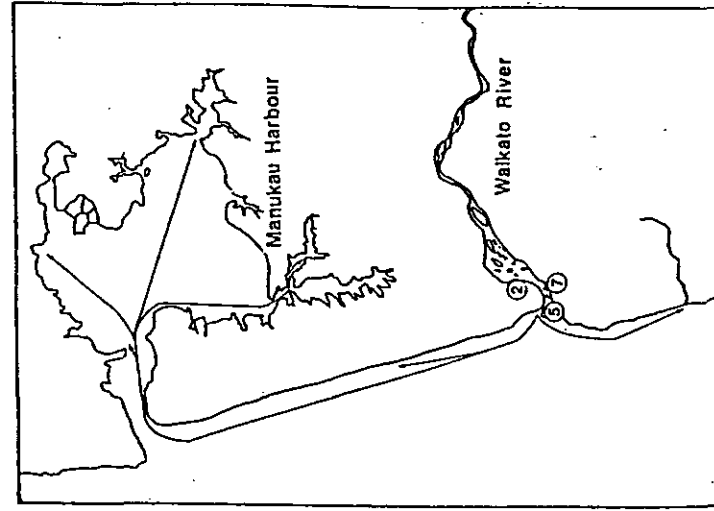


Figure 8 Grey mullet tagging programme showing release and recovery sites in the Manukau Harbour and lower Waikato River.