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PRELIMINARY REPORT FROM A STUDY OF SPECIES COMPOSITION, SIZE COMPOSITION AND DISTRIBUTION OF THE FISH IN A FJORD OF WESTERN NORWAY BASED ON REGULARLY CONDUCTED EXPERIMENTAL FISHING AND CATCH STATISTICS DURING ONE YEAR.

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ABSTRACT

This paper is a contribution to the research program investigating the possibility of building up the local cod population in Masfjorden, a fjord in the westen Norway, by releasing large numbers of artificially produced young cod. Both the local cod stock as well as other fish species will be studied over a 2-3 year period before a large number of artificially produced cod is released into the fjord.

Cod over a wide length range are found to be present during the whole year. However, in the period January-April there seems to be an arrival of migrating maturing cod. To establish a migration pattern of the cod, one should in a further investigation include a tag-recapture experiment at the spawning grounds. The results also indicate a time lag between the spawning at separate areas, and that the spawning areas also change to a certain degree between spawning seasons.

Among other mature Gadidae caught in the region are pollack, saithe, haddock, ling, blue ling, and tusk, and among others the spurdog is caught in large quantities during the period May - October.

During our experimental fishery, which mainly is conducted at depths less than 25 m, pollack and saithe are found to be the most important Gadidae. They are present during the whole year, and have sizes in the range 15-60 cm. Wrasses are also found in large numbers, and are caught in highest quantities in the summer period.

The growth of cod and pollack is indicated by estimates of gutted-weight/ length relations. Separate relations for mature and immature fish, aswell as for each sex, are given.

1. INTRODUCTION

In recent years public interest in aquaculture-related research has had an exceptional increase, and a recently published report on scientific research in Norway has listed fish ranching as one of the preferred research fields for the coming years.

Norwegian scientists finally succeeded in 1983 in developing methods for mass rearing of cod (Øiestad, Kvenseth and Folkvord. 1984, Øiestad, Kvenseth and Pedersen. 1985). On this basis, a small scale experiment involving the release of artificially reared 0-group cod, in a semienclosed basin has been conducted. Preliminary results from the experiment indicate that the released cod may be of great importance in building up local cod populations (Svåsand, 1985). In the light of these results it has been decided to do the experiment on a large scale, and the Institute of Marine Research in Bergen has taken the initiative for a research program to investigate whether it is possible to build up the local cod population in Masfjorden, which is topographically typical for western Norway. This demands investigations of the local cod stock and its environment prior and after cod are released into the fjord in large numbers. The investigations are carried out in cooperation with the University of Bergen.

Masfjorden is a 15 km long fjord separated from Fensfjorden by a sill of 75 m depth. The experimental fishing is conducted at three sub areas of the region, namely areas 1, 2 and 4a (fig. 1). Areas 1 and 2 have an extension of 6 km^2. Area 1 has depths mainly between 75 and 200 m, while area 2 has depths between 200 and 475 m. Area 4a is located outside the sill which separates Masfjorden from Fensfjorden, has an extension of about 20 km^2 with depths mainly between 50 and 200 m.

The Masfjorden/ Fensfjorden region has earlier been the subject of investigations describing physical and biological features before the freshwater outflow was altered by hydroelectric power production (Sætre, 1974), and also of investigations describing mesopelagic fish species (Cruz, 1981a and 1981b) and planktonic species (Anon 1978).

The present paper is a preliminary report from the part of the research program which concentrates on the study of the population dynamics and distribution of the local cod population as well as the abundance of other species assosiated with the cod population. After 2-3 years' investigation, artificially reared young cod will be released in Masfjorden, and the studies will then be focused on the possible changes in the population parameters of cod as well as changes in the parameters of other species.

Also 3600 tagged artificially produced young cod were released in Masfjorden November 1985. In addition there is a plan of releasing 7-8000 cod this year. The aim of these experiments is to get an idea of the size of the local cod population. A later report will give an analyse of these experiments.

2. MATERIAL AND METHODS

The experimental fishing started in June 1985, and since then it has been conducted monthly with four nights' fishing. Initially a pilot examination in order to get field investigations under way. From September experimental fishing has been conducted more systematically. The data material is supplemented with information gathered from daily catch statistics in a close collaboration with local fishermen and the local delivery place for fish in Masfjorden. It is also supplemented with beach seining in autumn catching Gadoid species of small sizes, and other species as small gobies, sticklebacks and small wrasses, all probably potential food items of Gadoid fishes in the fjords of western Norway.

In choosing sampling strategy and sampling gear, due regard had to be given to the topography of the region and the availability of proper gears to ensure that as many species and size groups as possible would be collected by means of the available effort. The topography of the region allows trawling, but only with a small ship, and not close to the shore where the local fishermen usually fish with nets. As Svåsand and Kristiansen (1985) found that trammelnets only were selective for small sizes, we decided to use such nets.

We have used trammelnets with two different mesh sizes for the inner net, namely 45 mm and 70 mm. The inner nets are loosely hanging between two nets having 261 mm mesh sizes, all made of nylon. The first net is 21 m long and the second one is 28 m. Both are 2 m deep. In addition to those two nets, single nets 25 m long, 1.5 m deep, with 39 mm mesh made of 0.2 mm monofilament have been used.

The experimental fishery is conducted one night at each of the three areas with the addition of one extra fishing night at one of them, changing from month to month. The nets are mainly placed between 1 and 25 m depth after recommendations by local fishermen. Geographical positions as well as depth, type of net and time of fishing are recorded for each set. Tide and weather conditions are also recorded. The catch from each net is kept separate and covered with ice to keep the digestion rate as low as possible before the examination is carried out at land. Every individual is measured for total length in cm, rounded downwards, and is weighed to the nearest 5 g. In examining <u>Gadoid</u> fishes, the sex and maturity stage are recorded and the fish are weighed gutted. Also the degree of stomach fullness is recorded and the stomachs containing food are conserved in 6 % formaldehyde for dietary analysis. Otoliths are taken for agedetermination. A small piece of muscle and a droplet of blood are collected for genetic analysis . In immature cod, the liver and gonads also are weighed for condition studies . In addition a maximum of five individuals of each species of <u>Labridae</u> are conserved each day by freezing for a subsequent dietary analysis.

The Margalef(1958) index for species diversity $\left(\frac{S - 1}{\ln N}\right)$ where S = number of species and N = number of specimens, has been calculated to observe seasonal variations. Separate calculations have been done for fish caught at depths less or equal to 25 m, and for fish caught deeper than 25 m.

3. COMMERCIAL FISHERY

During the period May 1985 - April 1986 nearly 31.5 tonnes of fish were landed at the local delivery place in Masfjorden, including 20 tonnes gutted and head cutted fish and 11.5 tonnes spurdog weighed round. Table 1 gives the landings by species. Approximately 33% are cod and nearly 36% are spurdog. Among others ling, haddock and tusk were also well represented in the landings.

Fig. 2 shows the landings of several fish species by area and month. The largest landings of cod occure during the spawning season in February- March, and the largest quantities are caught in area 4a and b. Also haddock, ling, blue ling, tusk and pollack are caught in higher quantities this period than during the rest of the year. The marked higher landings during the spawning season is probably due to a spawning migration into the area. Also the spurdog fishery is seasonal, with the highest quantities taken in the period May-November.

Unfortunately, fig. 2 does not include the main catches from area 3 caught by fishermen who send their catch directly to the fish exporter in Bergen. However, all the local fishermen have agreed to prepare daily catch statistics in a diary, including length measurements of the cod. Fig. 3 is based on this statistics, and shows length distributions of cod caught at different areas in differing months during the 1986 spawning season. Fig. 3 shows a peak in the distribution at nearly 70 cm in area 1+2 for January and February, while the peaks from area 3 lay at 60 cm in January and 70 cm in February. For area 4a+b the peak in the distribution lies at nearly 75 cm. The distributions of cod caught in March are skewed to the right in all areas. There is a tendency of increasing proportion of larger cod in the catches as spawning progresses. This is also supported by fig. 4 showing the monthly length distributions of head cutted cod landed at the local delivery place in Masfjorden. So far we have only made age determinations of cod caught during the period June 85 - April 86. However, the preliminary results show an increase in mean ages in the catches as the spawning progresses January-March, and a decrease to April as the main spawning is over (tab. 2). This is also what Godø (1984,and Godø, pers. comm.) found for cod at the spawning grounds off Møre and Hordaland. He concluded according to the otolith pattern that North-east arctic cod dominated over coastal cod at the spawning grounds off Møre during the most intense spawning, and that the spawning population off Hordaland was mixed up with cod from Møre, the banks of the North Sea, and Skagerrak. Therefore an extended analysis of cod in the Masfjord/ Fensfjord region should include an experiment by tagging cod at the spawning grounds.

4. EXPERIMENTAL FISHERY

4.1. Species composition of the catches.

48 species of fish were recorded. The most numerous among the Gadidae were in order of importance, saithe (Pollachius virens),poor cod (Trisopterus minutus), pollack (Pollachius pollachius), cod (Gadus morhua), whiting (Merlangius merlangus), and ling (Molva molva). Among the Labridae, the most numerous were in order of importance ,cockoo wrasse (Labrus bimaculatus), small mouthed wrasse (Centrolabrus exoletus), ballan wrasse (Labrus berggylta), cold sinny (Ctenolabrus rupestris), and corkwing (Symphodus melops). Among the flatfishes only the lemon sole (Microstomus kitt) was caught regularly, while the grey gurnard (Eutrigela gurnardes), the redfishes Sebastes marinus and Sebastes viviparus, and the bullrout (Myxocephalus scorpius) were only found in small quantities in the catches.

Table 3 shows species composition in number (N) and in "catch per net per night" (CPNN) divided into type of entangling nets and into two time periods: April-September (summer) and October-March (winter). Cod and saithe showed an increase in CPNN from summer to winter. This agrees with Pethon (1985) who reported that pollack prefers warmer water than cod and saithe which leads to a migration to deeper and warmer water masses in the winter period. The Labridae also showed a marked decrease in the catches from summer to winter. Agreeing with the findings at Austevoll (Svåsand and Kristiansen, 1985). According to Pethon (1985), also this reflects a migration to deeper and warmer waters in the winter.

The Margalef diversity index of the fish fauna in Masfjorden is shown in fig. 5. Separate calculations on the basis of fish caught at two depth intervals are made, namely 0-25 m (upper layer) and deeper than

25 m. The index for the deepest layer showed a marked minimum in both the summer 1985 and 1986 reflecting the absence of species which is found to be abundant in the upper depth interval. The divesity index for the upper layer, did not vary to the same extent.

4.2. Size distributions.

The length distributions of cod, pollack and saithe, are shown in the figures 6, 7 and 8 respectively for each month.

Cod over a wide length range were found to be present the whole year. Sizes less than 60 cm were predominant outside the spawning season. However, during the spawning season cod of sizes 60 - 120 cm appeared in the catches. Supporting the previously mentioned suggestion about arrival of mature cod. Distributions representing various age groups seem to overlap. However, at least two peaks are present the whole year, supplemented with two more in the spawning season.

Pollack were also found to be mainly of size less than 60 cm during most of the year. The same tendency of arrival of larger individuals during the spawning season is not present for pollack to the same extent as for cod. The distributions reflecting the various age groups seem to be less overlapping for pollack than for cod, and at least 3 peaks can be identified.

Saithe were mainly caught in the length range 17-50 cm. The distributions of the various age groups are not overlapping, and two or three groups seems to be present during the year. A slight peake around 50 cm appeared in Januar-February 86, probably reflecting a migration of mature saithe as these lengths seems to be nearly absent the rest of the year. We did notice a small number of maturing and mature saithe in the catches during the spawning season.

An analysis of growth will be presented in a later report as age determinations so far only has been made for a limited number of individuals.

4.3. Length and weight relation

The relationship between length and gutted weight is shown in the figures 9, 10, 11 and 12 for respectively cod, pollack, saithe and poor cod. Separate figures are made for immature and mature females, and immature and mature males.

The parameters of the function. $W=a\ L^b$ (W= gutted weight and L = total length) were estimated by numerical methods according to Baker and Nelder (1978). The estimated parameters are given in Table 4.

4.4. Length at age relation.

As a first and preliminary presentation of the growth of cod in the Masfjorden area, the length at age relationship is shown in fig. 13. Separate relationships are shown for mature and immature females and males. Reliable estimates of growth rates requires that the population is sampled representative. The high variance in length at age in fig. 13 may partly be an effect of the different gears used for sampling the fish. An extended analysis will take into more detailed consideration the gears used instead of just lumping all available data together as has been done here.

5. ACKNOWLEDGEMENTS

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Table 1. Fish landed at the local delivery place in Masfjorden during the period May 1985 - April 1986.

Species	Weight (kg)	Percent
Cod	10 295.5	32.7
Saithe	370.0	1.2
Pollack	892.5	2.9
Haddock	2 594.5	8.3
Tusk	1 496.5	4.8
Ling	3 378.5	10.7
Blue ling	548.0	1.7
* Flatfish	168.5	0.5
Spurdog	11 492.5	36.5
** Others	210.0	0.7
Total	31 446.5	100.0

* Flatfish includes lemon sole, European place, halibut, sole and turbot

** Others includes rockfishes, skates, rays, monk, hake and flying squid.

Table 2. Variations in the mean age ($\overline{x}$) in the catches of cod during the period June-1985 to April-1986.

Year	1985							1986			
Month	6	7	8	9	10	11	12	1	2	3	4
N	35	3	40	113	125	91	103	101	183	58	60
$\overline{x}$	3.57	2.33	1.30	1.58	2.02	1.06	1.18	2.50	4.55	4.86	2.23
sd.	1.65	0.58	0.69	0.90	1.11	0.50	0.98	1.31	1.80	2.05	1.27

Table 3. Species composition of the catches in the experimental fishing conducted in Masfjorden. The nets having 70 and 45 mm mesh length are trammel nets, while the 39 mm nets are "ordinary" nets. CPNN (catch per night per net), are given for each species. Values of CPNN less than 0.1 are marked with "+", and species not present are marked with a "-".

Entangling nets	70 mm mesh size				45 mm mesh size				39 mm size			
	Apr - Sept		Oct - March		Apr - Sept		Oct - March		Apr - Sept		Oct - March	
Species	85 nets		92 nets		137 nets		100 nets		100 nets		105 nets	
	N	CPNN	N	CPNN	N	CPNN	N	CPNN	N	CPNN	N	CPNN
GADIDAE												
Gadus morhua	134	1.6	198	2.2	81	0.6	121	1.2	20	0.2	56	0.5
Pollachius virens	192	2.3	240	2.6	253	1.8	444	4.4	256	2.6	364	3.5
Pollachius pollachius	80	0.9	88	1.0	131	1.0	71	0.7	454	4.5	220	2.1
Melanogrammus aeglefinus	12	0.2	4	+	16	0.1	6	0.1	1	+	3	+
Trisopterus minutus	49	0.6	76	0.8	281	2.1	180	1.8	433	4.3	237	2.3
Merlangius merlangus	1	+	2	+	12	0.1	6	0.1	6	0.1	5	+
Molva molva	2	+	5	0.1	7	0.1	4	+	1	+	1	+
Brosme brosme	-		-		1	+	-		-		-	
Ciliata mustela	-		-		-		1	+				
Raniceps raninus	2	+	-		2	+	1	+	1	+	1	+
LABRIDAE												
Labrus berggylta	113	1.3	130	1.4	308	2.2	56	0.6	146	1.5	65	[illegible]
Centrolabrus exoletus	1	+	-		37	0.3	10	0.1	973	9.7	56	0.5
Labrus bimaculatus	21	0.2	20	0.2	401	2.9	79	0.8	1005	10.1	163	1.6
Symphodus melops	1	+	1	+	59	0.4	18	0.2	78	0.8	29	0.3
Ctenolabrus rupestris	3	+	1	+	1	+	1	+	437	4.4	144	1.4
FLATFISH												
Microstomus kitt	112	1.3	20	0.2	72	0.5	10	0.1	10	0.1	1	+
Platichthys flesus	13	0.2	4	+	3	+	5	0.1	2	+	5	+
Pleuronectes platessa	8	0.1	6	0.1	5	+	2	+	4	+	3	+
Lepidorhombus whiffiagonis	3	+	5	0.1	4	+	4	+	1	+	-	
Phrynorhombus norvegicus	-		-		-		1	+	-		1	+
Zeugopterus punctatus	2	+	-		-		1	+	1	+	1	+
Hippoglossoides platessoides	2	+	1		-		2	+	1	+	-	
Limanda limanda	1	+	1		-		1	+	-		-	
Psetta maxima	-		1		-		-		-		-	
OTHERS												
Merluccius merluccius	-		3	+	-		3	+	2	+	-	
Salmo salar	-		-		-		1	+				
Salmo trutta	-		2	+	-		3	+	4	+	3	+
Clupea harengus	-		-		-		-		-		1	
Argentina sphyraena	-		-		1	+	-		-		-	
Scomber scombrus	-		3	+	-		4	+				
Trachurus trachurus	-		2	+	-		3	+	-		-	
Squalus acantias	3	+	3	+	1	+	1	+	5	0.1	-	
Scyliorhinus caniculus	-		7	0.1	2	+	1	+	-		-	
Sebastes marinus	-		-		35	0.3	-		-		-	
Sebastes viviparus	2	+	2	+	41	0.3	1	+	-		1	+
Anarchias lupus	1	+	1	+	2	+	1	+	-		1	+
Lophius piscatori	-		-		-		1	+	-		-	
Eutrigela gurnardus	2	+	-		8	0.1	1	+	25	0.3	-	
Myxocephalus scorpius	-		1	+	6	+	12	0.1	7	0.1	13	0.1
Taurulus bubalis	-		-		2	+	4	+	2	+	10	0.1
Taurulus liljeborgi	-		-		-		-		1	+	-	
Triglops pingeli	-		-		-		-		1	+	-	
Callonimus lyra	1	+	-		3	+	-		-		-	
Callonimus maculata	-		-		-		1	+	-		1	+
Cyclopterus lumpus	2	+	1	+	2	+	1	+	-		1	+
Raja clavata	1	+	-		-		-		-		-	
Raja radiata	-		1	+	-		-		-		-	
Gobius niger	-		-		-		-		2	+	1	+
Phoca vitulina	-		1	+	-		-		-		-	
TOTAL	764	9.0	830		1777	13.0	1062	10.6	3879	38.8	1387	13.2

Table 4. Estimated parameters $\hat{a}$ and $\hat{b}$ of the function $W = a\,L^{b}$ for cod, pollack, saithe and poor cod. W = gutted weight, L = total length. Separate estimates for immature and mature females, and immature and mature males.

Cod	Immature female	$W= -4.9838\ L^{3.0607}$	$sd(\hat{a})=0.0141$	$sd(\hat{b})=0.0033$
	Mature female	$W= -4.5561\ L^{2.9544}$	$sd(\hat{a})=0.0345$	$sd(\hat{b})=0.0078$
	Immature male	$W= -4.8636\ L^{3.0327}$	$sd(\hat{a})=0.0167$	$sd(\hat{b})=0.0039$
	Mature male	$W= -4.3062\ L^{2.8919}$	$sd(\hat{a})=0.0289$	$sd(\hat{b})=0.0067$
Pollack	Immature female	$W= -5.0769\ L^{3.0721}$	$sd(\hat{a})=0.0376$	$sd(\hat{b})=0.0105$
	Mature female	$W= -4.8739\ L^{3.0127}$	$sd(\hat{a})=0.0573$	$sd(\hat{b})=0.0147$
	Immature male	$W= -4.6892\ L^{2.9673}$	$sd(\hat{a})=0.0383$	$sd(\hat{b})=0.0106$
	Mature male	$W= -5.0594\ L^{3.058}$	$sd(\hat{a})=0.0800$	$sd(\hat{b})=0.0209$
Saithe	Immature female	$W= -4.1723\ L^{2.8142}$	$sd(\hat{a})=0.0430$	$sd(\hat{b})=0.0119$
	Mature female	$W= -2.5346\ L^{2.3932}$	$sd(\hat{a})=0.2975$	$sd(\hat{b})=0.0776$
	Immature male	$W= -4.0796\ L^{2.7941}$	$sd(\hat{a})=0.0405$	$sd(\hat{b})=0.0132$
	Mature male	$W= -5.3532\ L^{3.1375}$	$sd(\hat{a})=0.0304$	$sd(\hat{b})=0.0789$
Poor cod	Immature female	$W= -3.8617\ L^{2.7194}$	$sd(\hat{a})=0.1660$	$sd(\hat{b})=0.0549$
	Mature female	$W= -4.787\ L^{3.0003}$	$sd(\hat{a})=0.1375$	$sd(\hat{b})=0.0448$
	Immature male	$W= -4.9208\ L^{3.1824}$	$sd(\hat{a})=0.3182$	$sd(\hat{b})=0.1088$
	Mature male	$W= -3.7524\ L^{2.6519}$	$sd(\hat{a})=0.2995$	$sd(\hat{b})=0.1023$

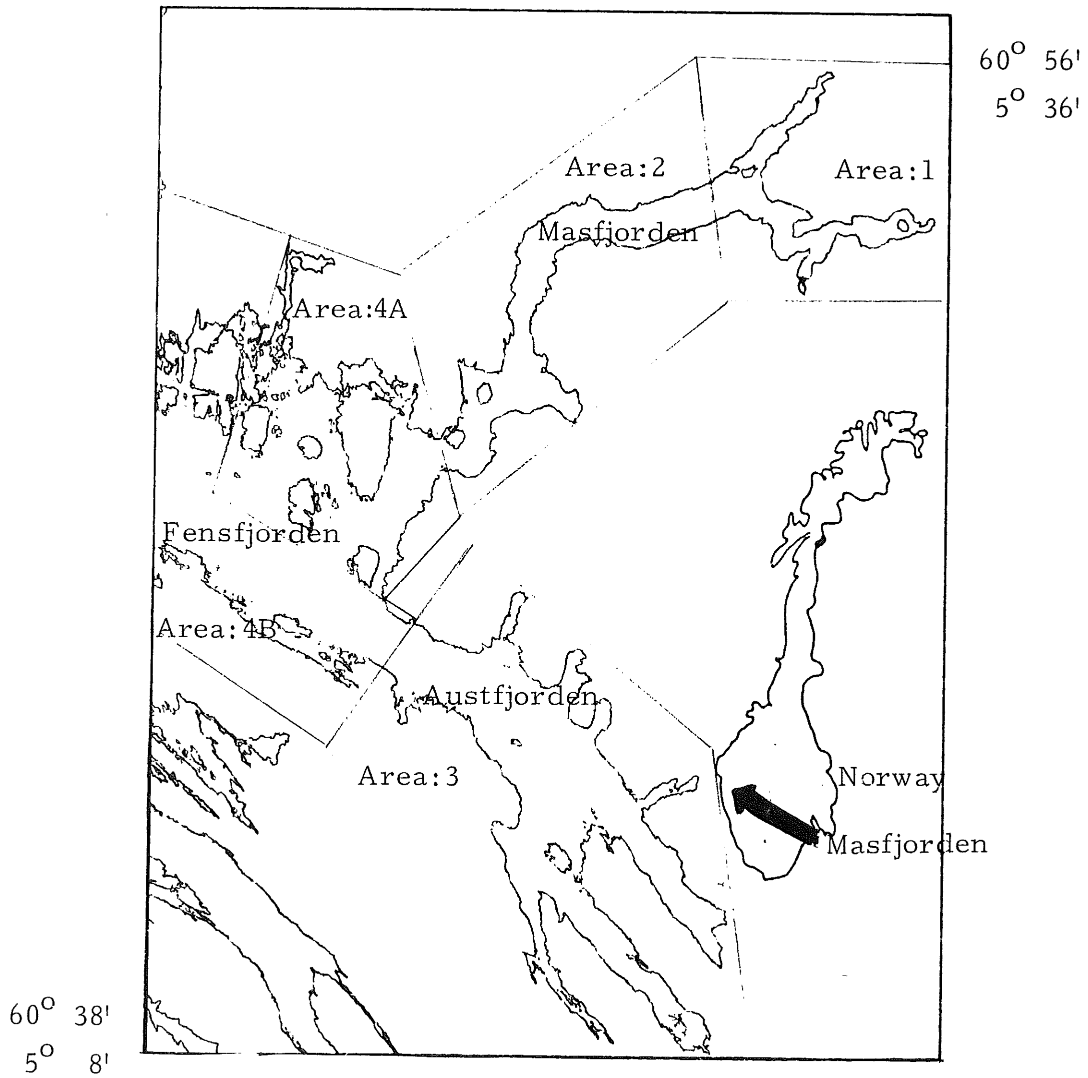

Fig.1. Map of the area of investigation.

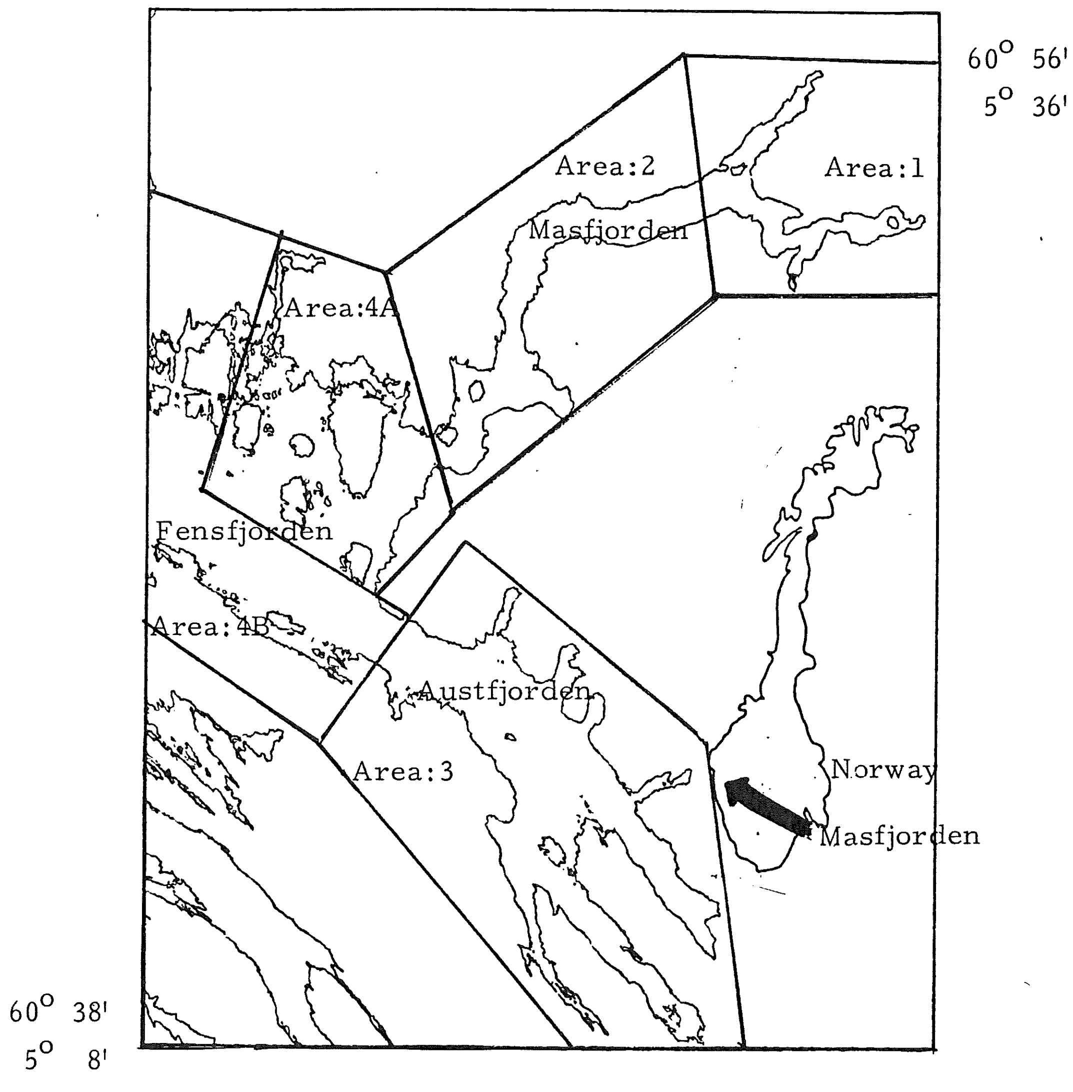

Fig.1. Map of the area of investigation.

Table 4. Maximum Likelihood Estimates of a and b in $W = a\ L^b$ for cod, pollack, saithe and poor cod. W = gutted weight, L = total length. Separate estimates for immature and mature females, and immature and mature males. Also the asymptotic approximations of the standard errors are given. Statistical methods used are described in Baker and Nelder(1978).

			S.E.(ln(a))	S.E.(b)
COD	Immature female	$W= 0.0068\ L^{3.0607}$	0.0141	0.0033
	Mature female	$W= 0.0105\ L^{2.9544}$	0.0345	0.0078
	Immature male	$W= 0.0077\ L^{3.0327}$	0.0167	0.0039
	Mature male	$W= 0.0135\ L^{2.8919}$	0.0289	0.0067
POLLACK	Immature female	$W= 0.0062\ L^{3.0721}$	0.0376	0.0105
	Mature female	$W= 0.0076\ L^{3.0127}$	0.0573	0.0147
	Immature male	$W= 0.0092\ L^{2.9673}$	0.0383	0.0106
	Mature male	$W= 0.0063\ L^{3.058}$	0.0800	0.0209
SAITHE	Immature female	$W= 0.0154\ L^{2.8142}$	0.0430	0.0119
	Mature female	$W= 0.0793\ L^{2.3932}$	0.2975	0.0776
	Immature male	$W= 0.0169\ L^{2.7941}$	0.0405	0.0132
	Mature male	$W= 0.0047\ L^{3.1375}$	0.0304	0.0789
POOR COD	Immature female	$W= 0.0210\ L^{2.7194}$	0.1660	0.0549
	Mature female	$W= 0.0083\ L^{3.0003}$	0.1375	0.0448
	Immature male	$W= 0.0073\ L^{3.1824}$	0.3182	0.1088
	Mature male	$W= 0.0235\ L^{2.6519}$	0.2995	0.1023

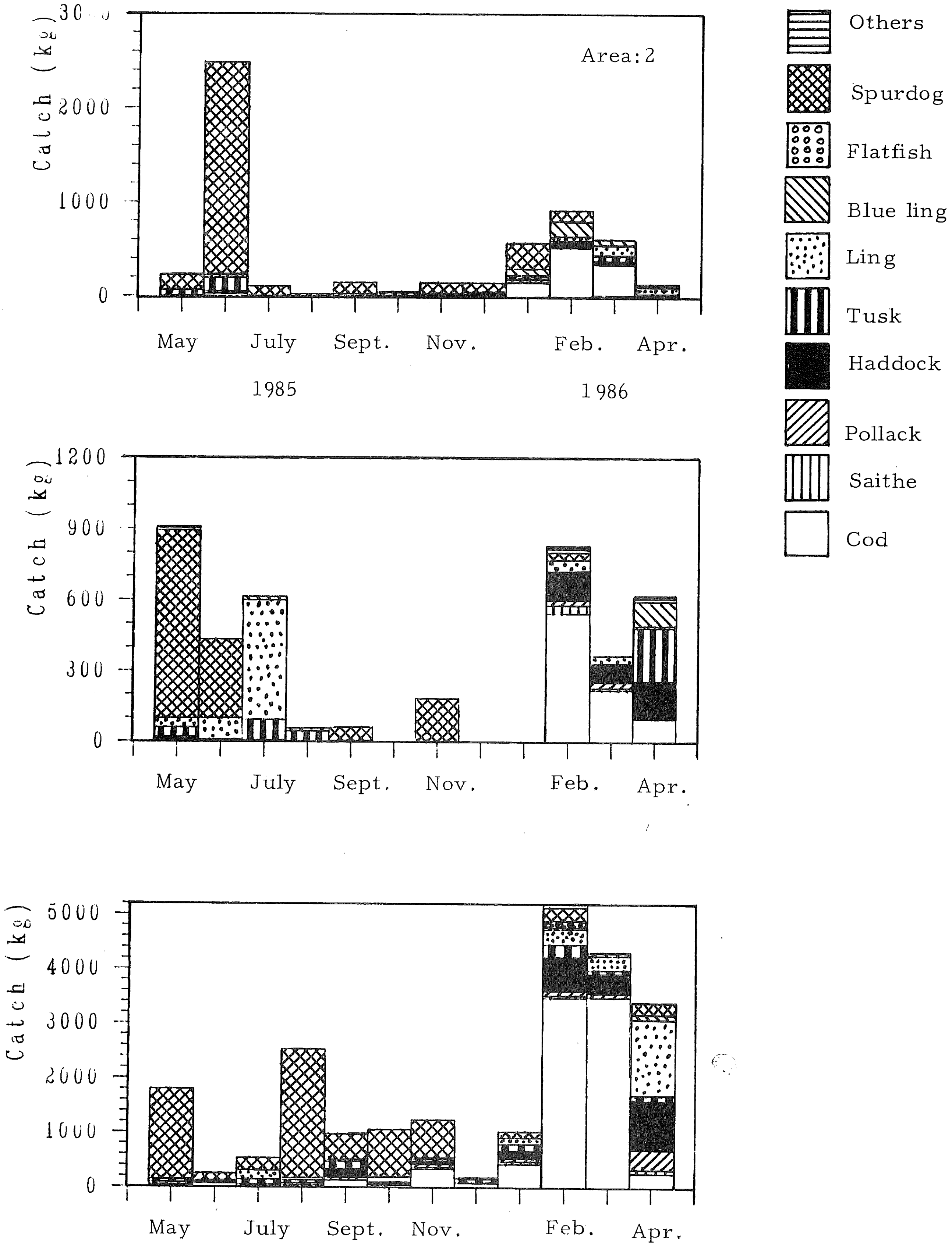

Fig.2. Catch statistics during one year based on landings at the local delivery place in Masfjorden. The fish weight are gutted and without heads for all species except for spurdog which is weighed round.

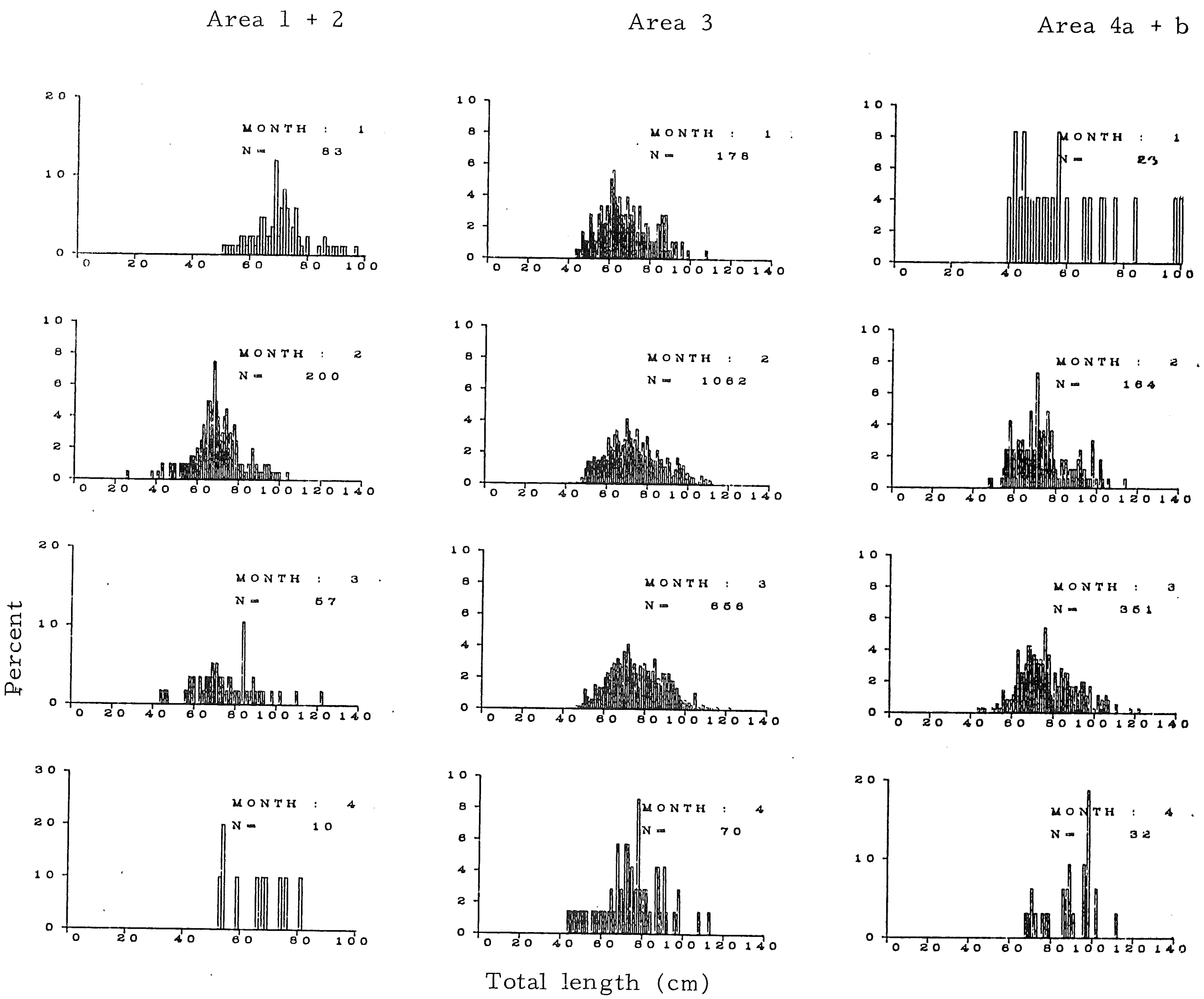

Fig.3. Length distributions of cod caught at different areas in differing months during the spawning season 1986. Length measurements have been taken by the local fishermen. The fishermen used the same type of nets the whole spawning season.

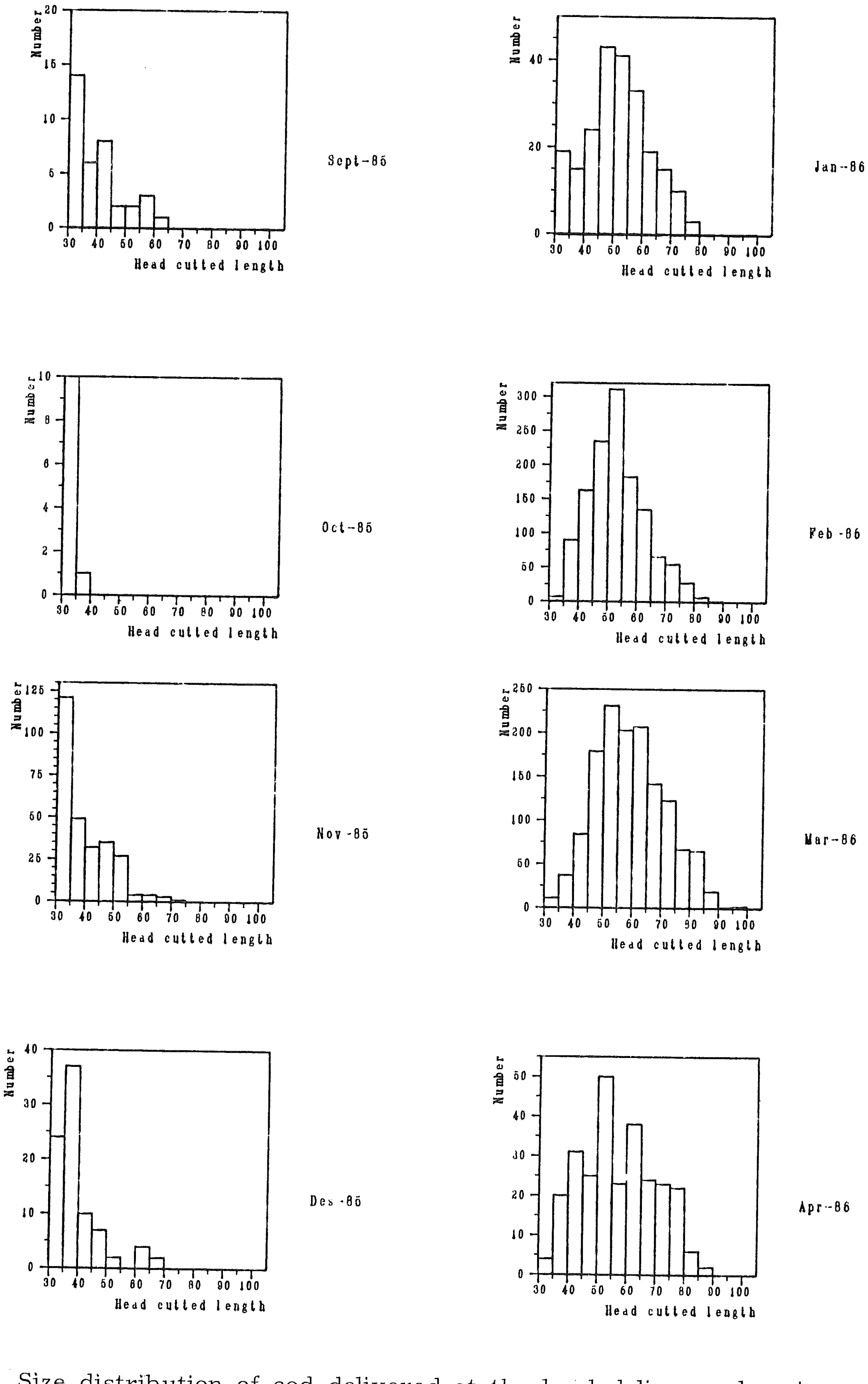

Fig.4. Size distribution of cod delivered at the local delivery place in Masfjorden during the period Sept. 85 - April 86.

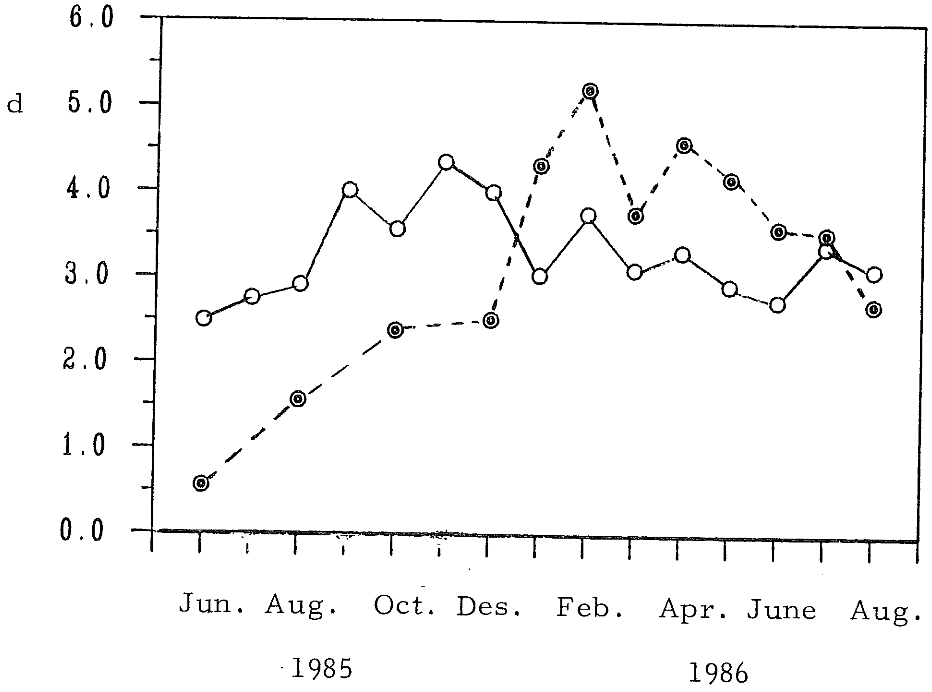

Fig.5. Margalef's diversity index (d) for fish fauna in the Masfjorden. The index is based on fish caught with gill nets at depths less than 25 m (0-0) and deeper than 25 m (0---0).

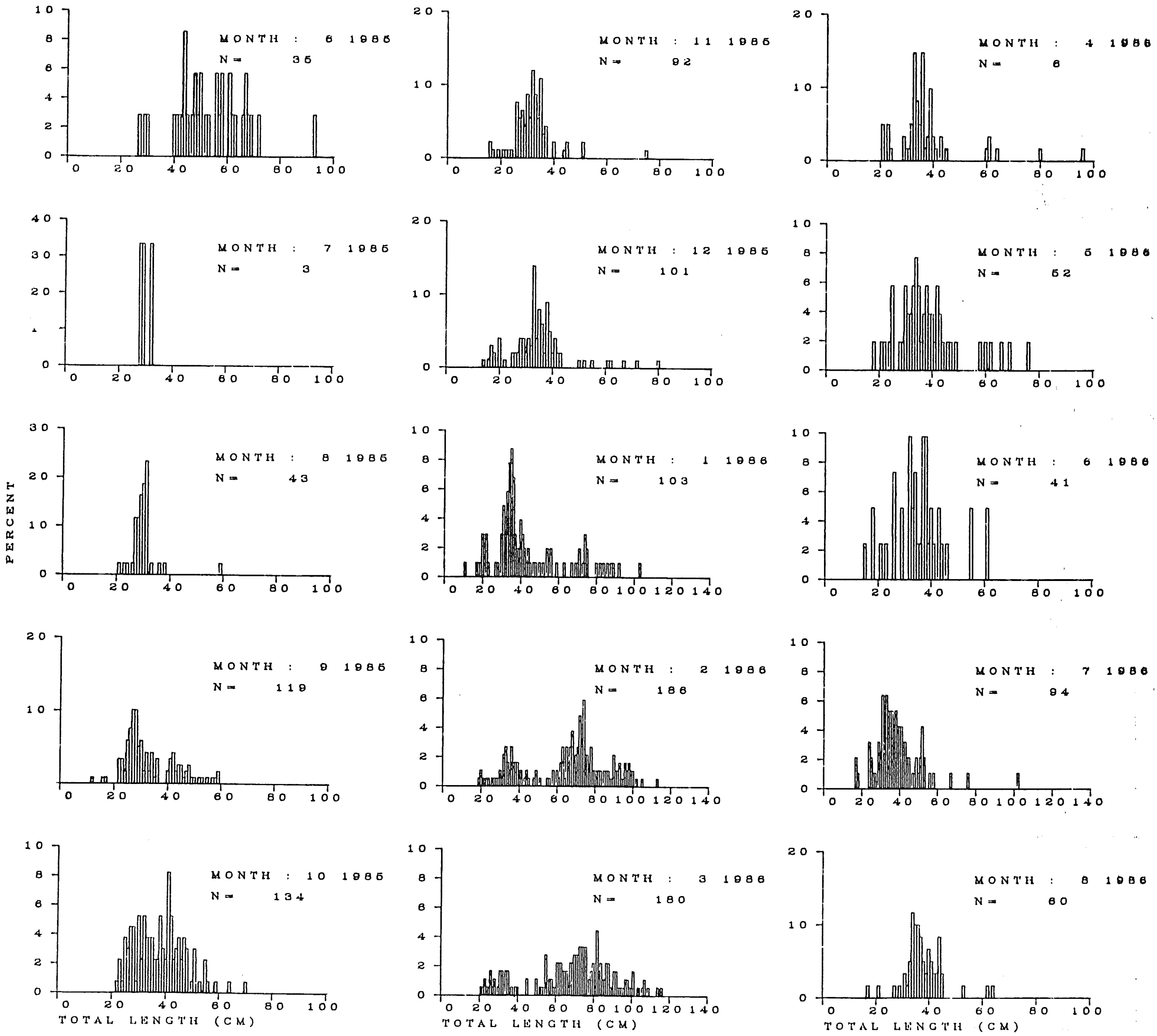

Fig.6. Size distribution of cod caught in the experimental fishery in Masfjorden during the period June 1985 - August 1986.

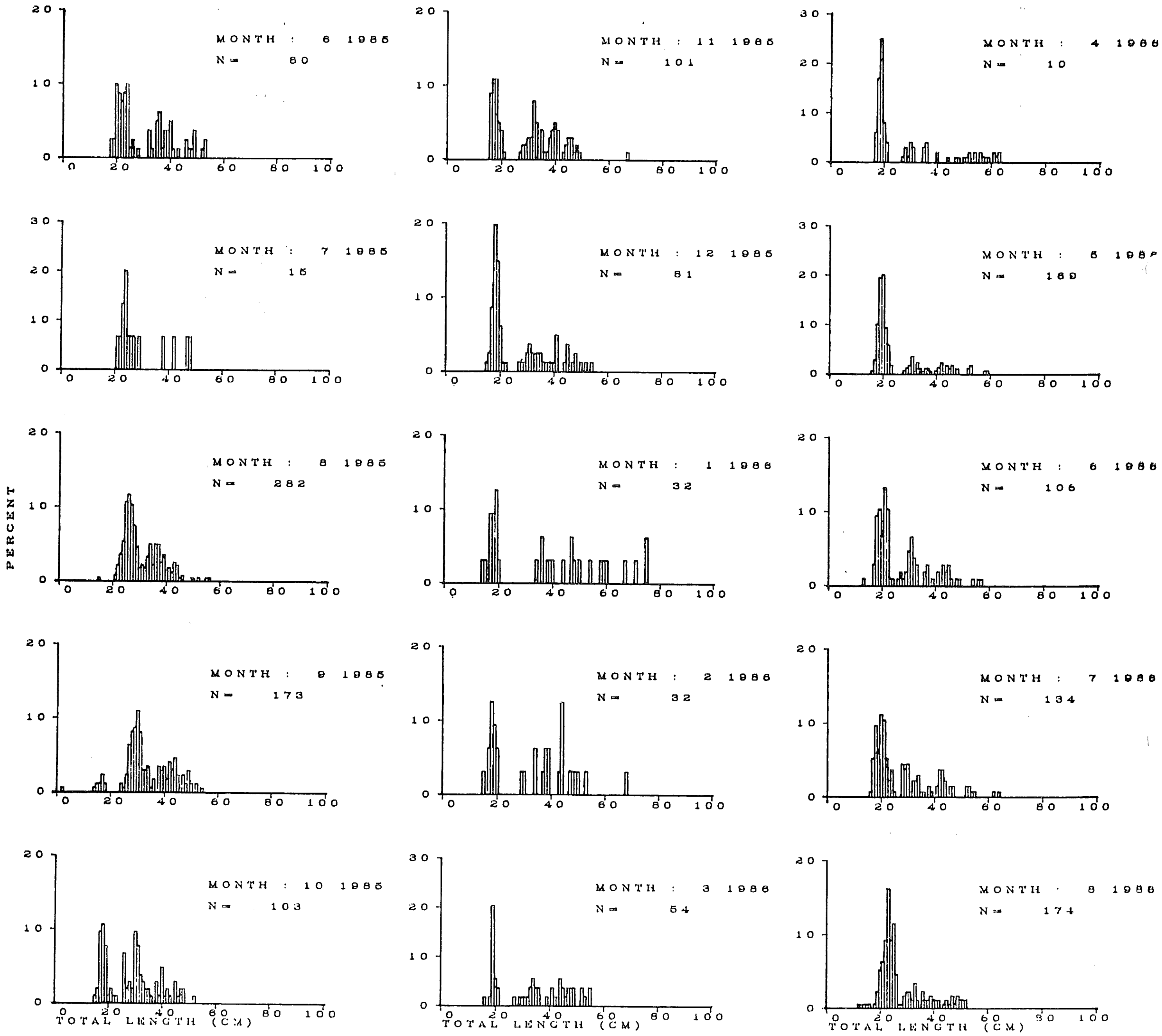

Fig. 7. Size distribution of pollack caught in the experimental fishery in Masfjorden during the period June 1985 - August 1986.

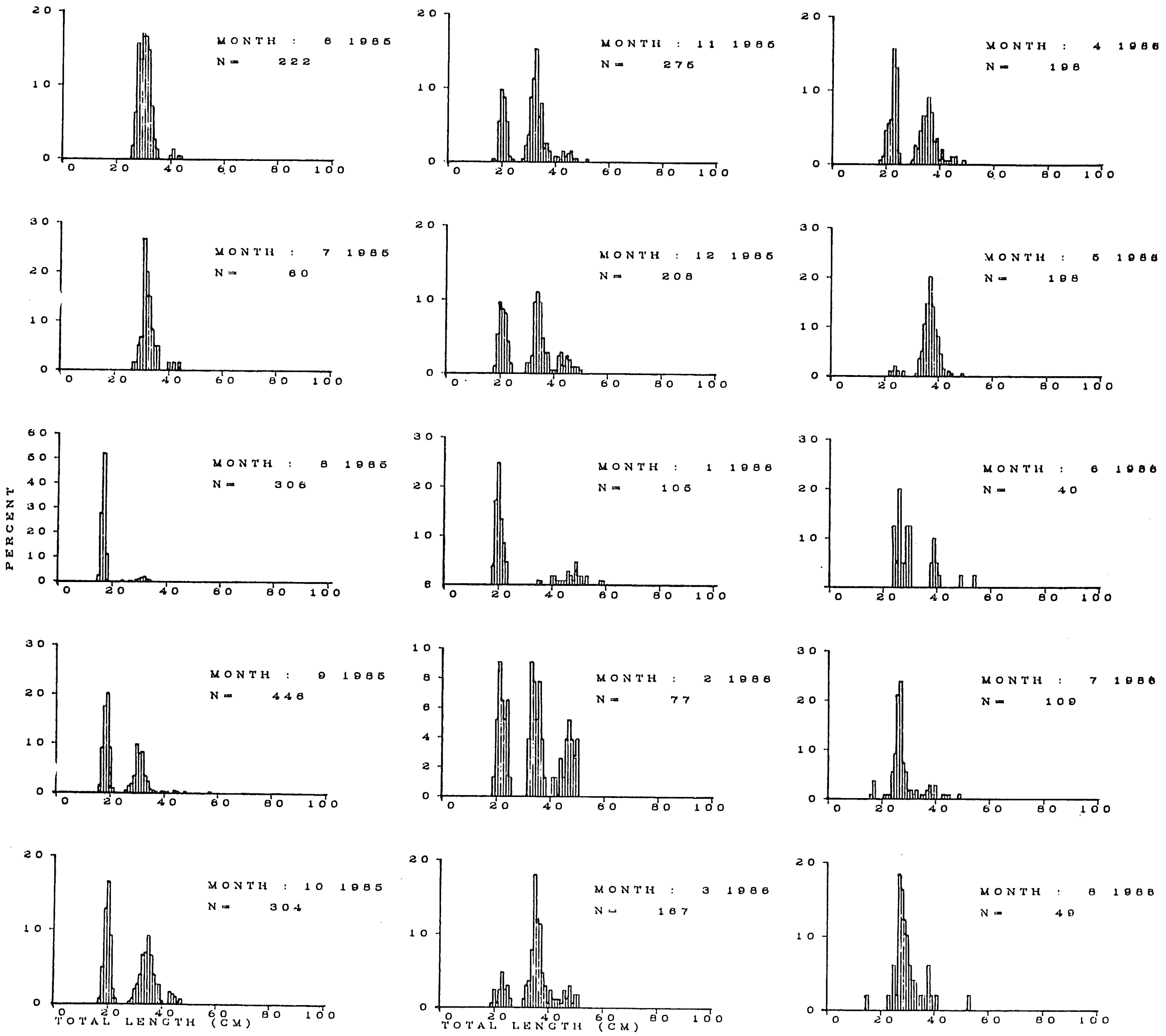

Fig. 8. Size distribution of saithe caught in the experimental fishery in Masfjorden during the period June 1985 - August 1986.

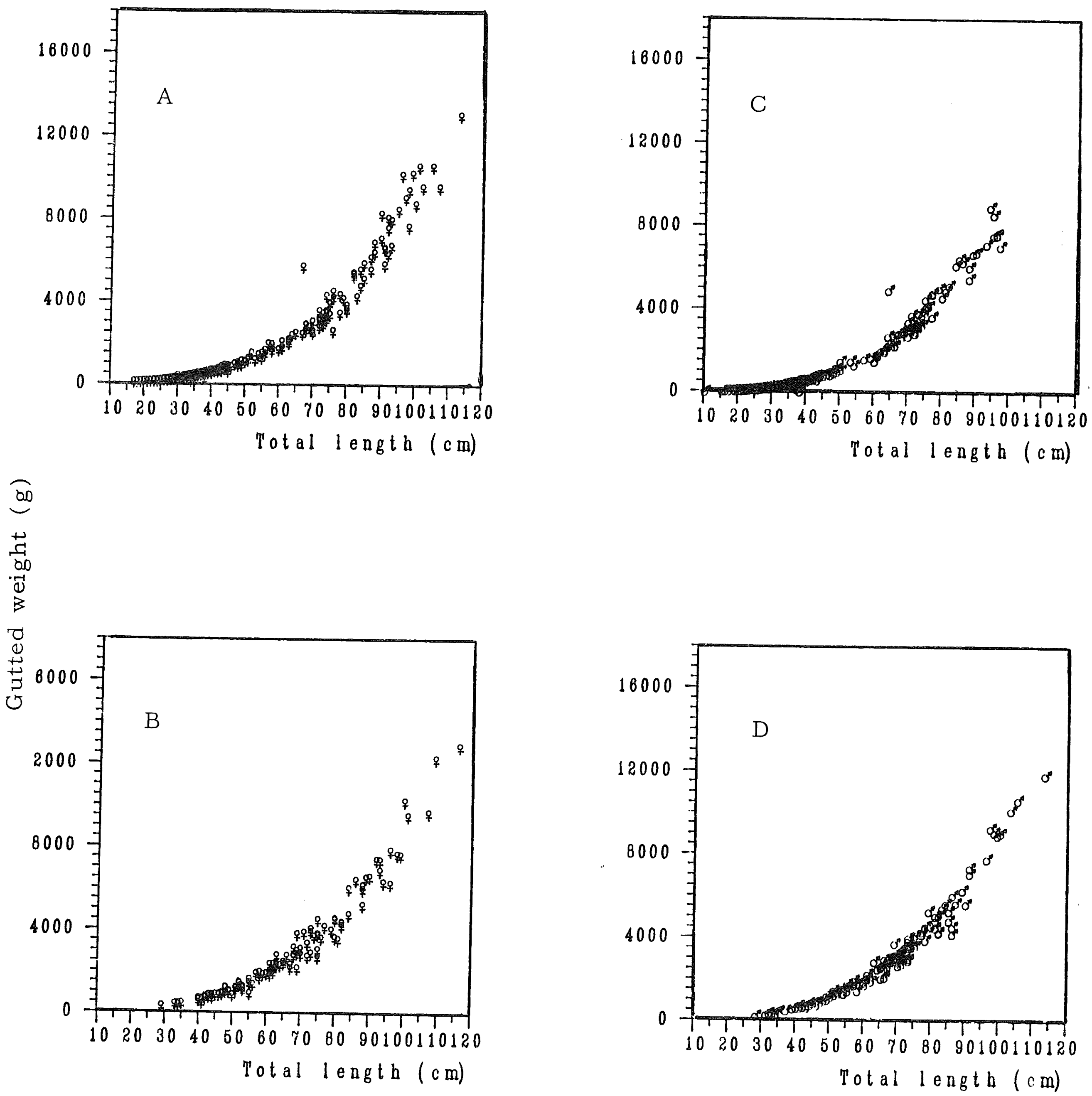

Fig.9. The relationship between gutted weight and total length for cod caught in Masfjorden. A; immature females, B; mature females, C; immature males and D; mature males.

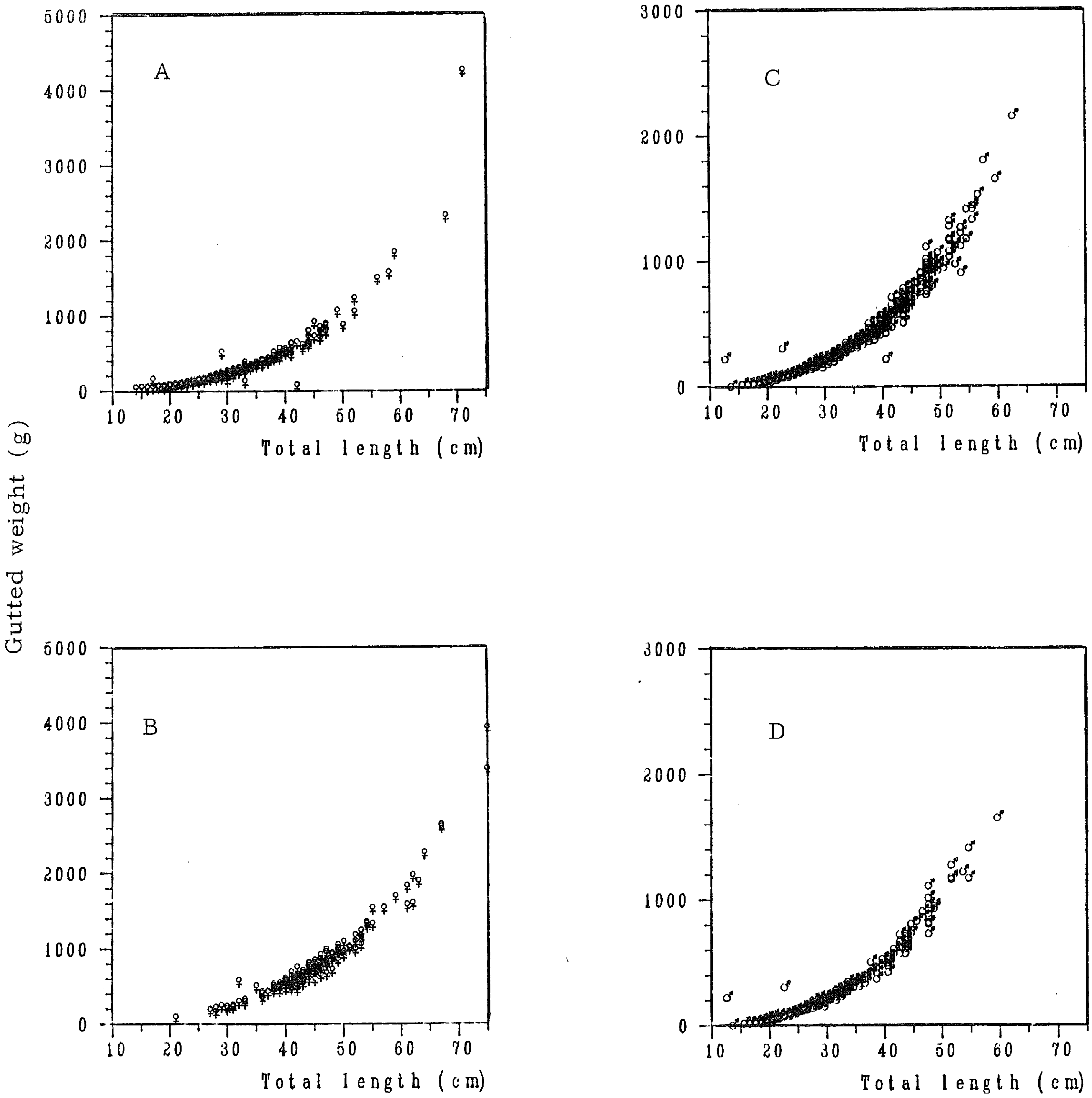

Fig.10. The relationship between gutted weight and total length of pollack caught in Masfjorden. A; immature females, B; mature females, C; immature males and D; mature males.

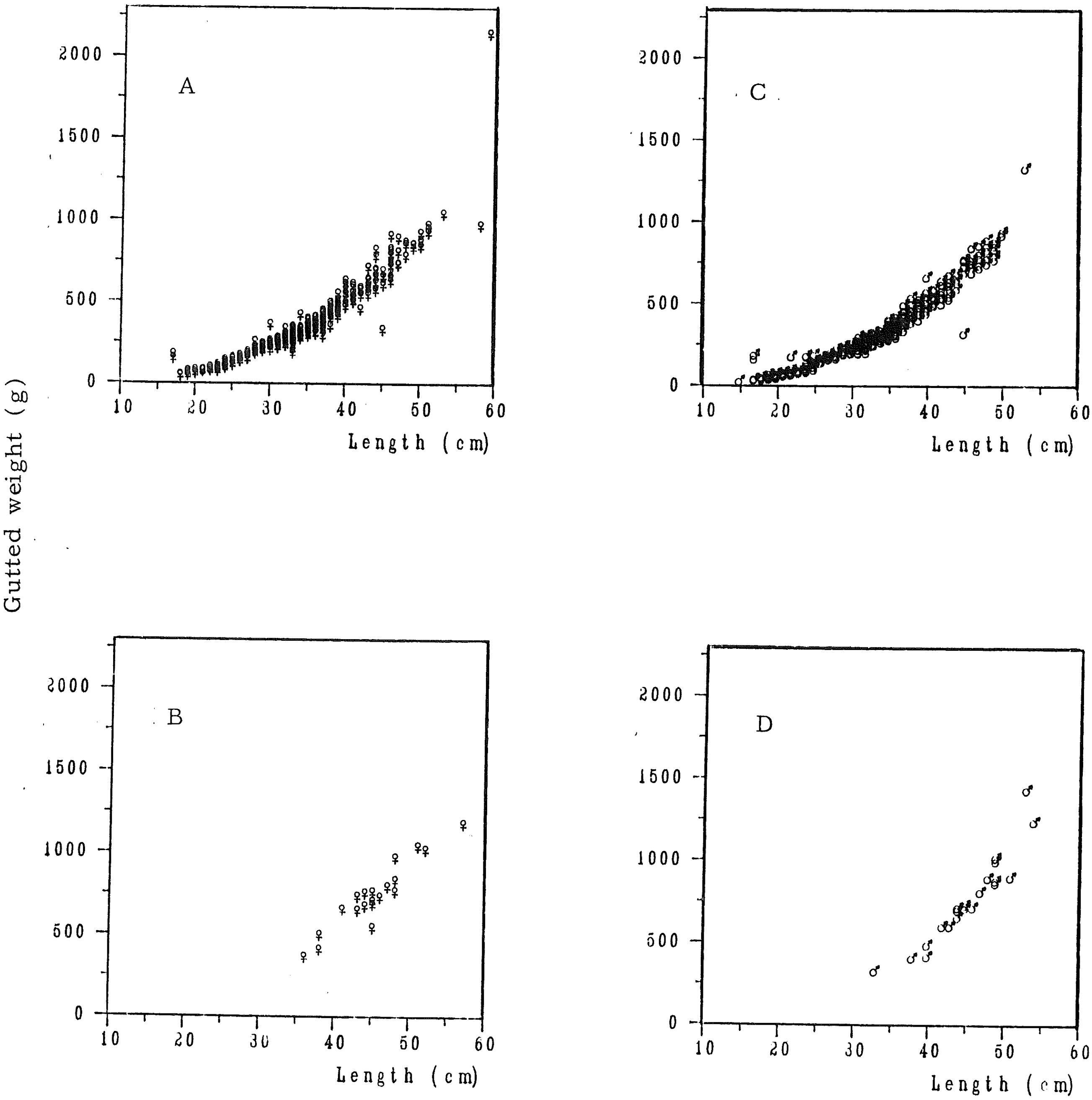

Fig.11. The relationship between gutted weight and total length of saithe caught in Masfjorden. A; immature females, B; mature females, C; immature males and D; mature males.

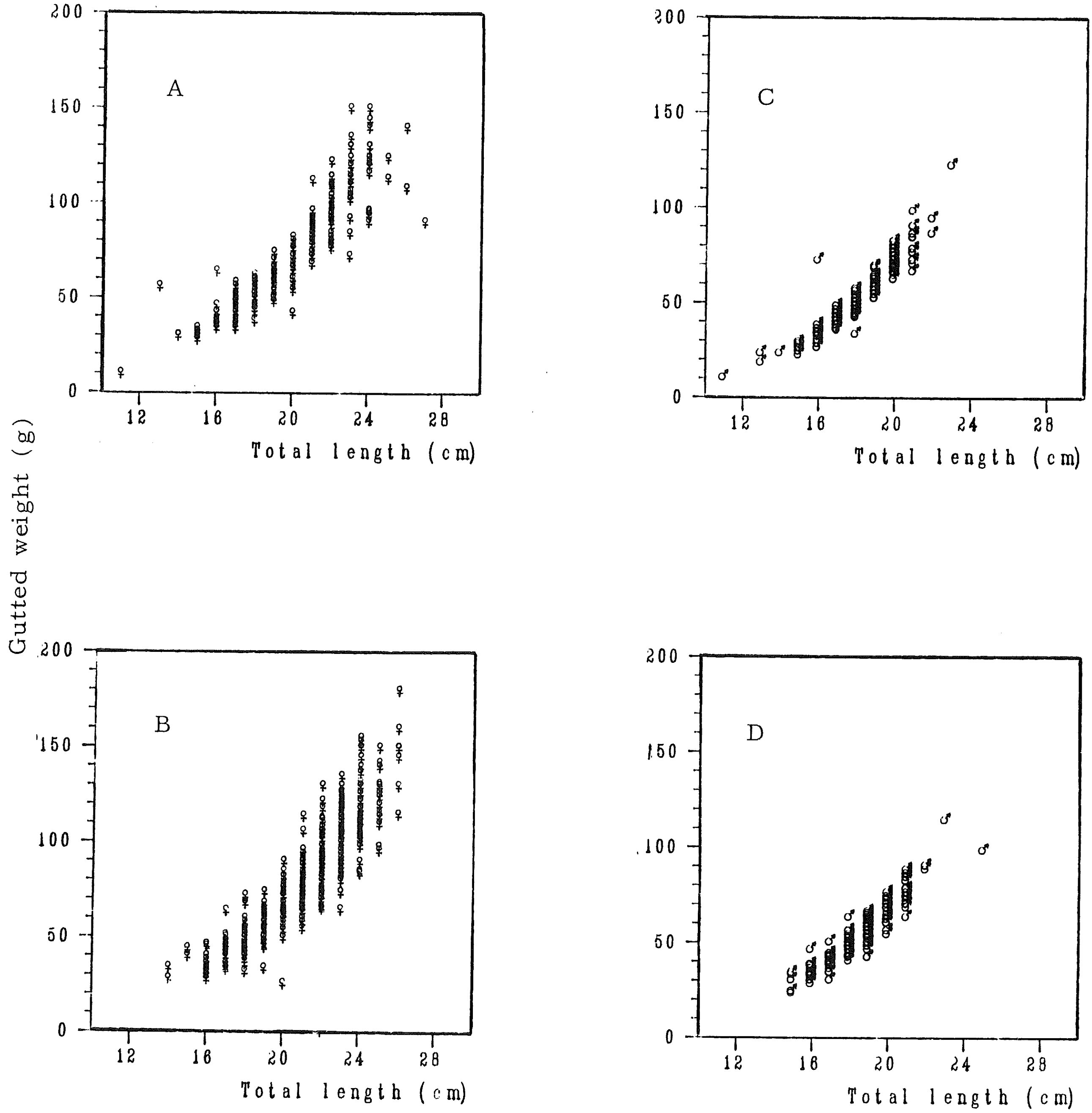

Fig.12. The relationship between gutted weight and total length for poor cod caught in Masfjorden, A; immature females, B; mature females, C; immature males and D; mature males.

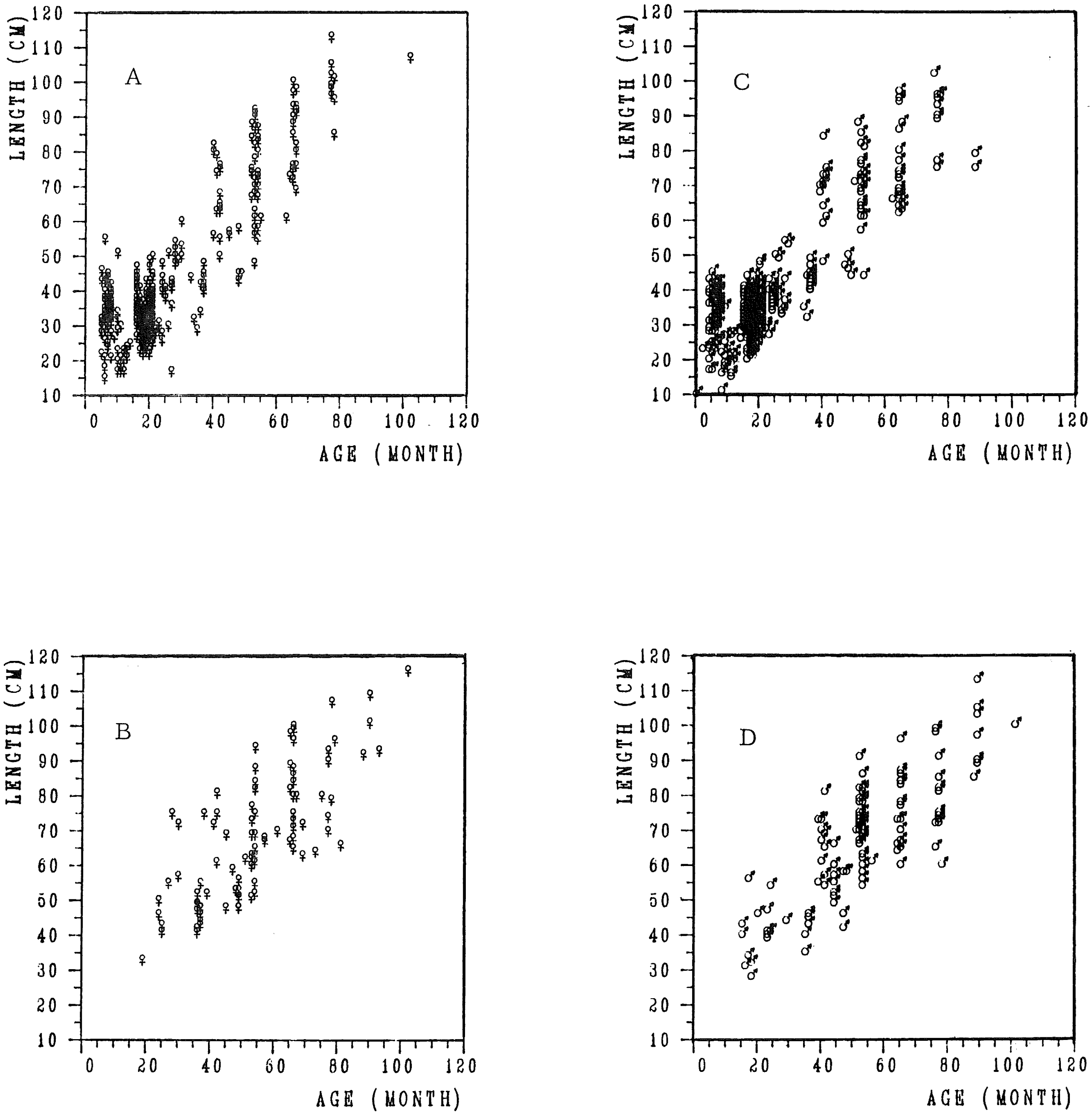

Fig.13. Length at age (months) of cod caught in Masfjorden. A; immature females, B; mature females, C; immature males and D; mature males.