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REPORT OF THE WORKING GROUP ON REDFISH IN REGION 1

Charlottenlund, 21-26 May 1979

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REPORT OF THE WORKING GROUP ON REDFISH IN REGION 1

1. PARTICIPANTS AND TERMS OF REFERENCE

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At the 66th Statutory Meeting of ICES it was decided (C.Res.1978/2:40) that:

"the Working Group on Redfish in Region 1 (Chairman: Professor A. Schumacher) should meet at ICES headquarters from 21-26 May 1979 to:

a) assess TACs for 1980 for redfish,

b) calculate effective mesh size,

c) estimate the by-catch of cod in the redfish fishery in Sub-Area XIV."

2. REDFISH IN THE NORTH-EAST ARCTIC REGION (Sub-Area I and Divisions IIa and IIb)

2.1. Status of the Fisheries

A further reduction in total redfish catches in the North-East Arctic region was recorded in 1978 (Table 1). The preliminary catch figures in 1978 were 119 581 tonnes compared to 185 874 tonnes in 1977. This was 30 419 tonnes lower than the recommended total TAC of 150 000 tonnes.

The total catch in Sub-Area I decreased from 17 012 tonnes in 1977 to 5 150 tonnes in 1978 (Table 2).

The main change was observed in Division IIa, where the catches dropped from 123 987 tonnes in 1977 to a level of 66 804 tonnes in 1978 (Table 3).

In Division IIb, the total catch in 1978 was 47 627 tonnes, which gives an increase of 2 753 tonnes compared with 1977 (Table 4). Redfish catches were split into Sebastes mentella and S. marinus on the same area basis as used in last year's report. All redfish landings from Division IIb, together with the German Democratic Republic, Polish and USSR catches from the northern part of Division IIa (Kopytov area), are recorded as Sebastes mentella. The total landings in Sub-Area I, together with the rest of the German Democratic Republic, Polish and USSR catches from Division IIa and all catches by other countries from this area, are assumed to be Sebastes marinus (Table 5).

Compared with 1977, the total landings in 1978 of Sebastes mentella decreased from 146 365 tonnes to 92 740 tonnes.

The preliminary catch of Sebastes marinus for 1978 of 29 019 tonnes represents a drop of 10 490 tonnes from the amount taken in 1977.

2.2. Catch per Unit Effort and Effort (Table 6)

Catch figures per hour trawling were available from the USSR for the Sebastes mentella fishery for the period 1965-78. A steady decrease is observed in the USSR catch per unit effort data since 1976, when the highest value was recorded for the period 1965-78.

Using these catch per unit effort values in the USSR fishery as a standard, the effort for the total fishery was calculated showing a considerable decrease over the last 3 years. From 1977 to 1978 total effort figures declined by 23%.

Data on effort and catch per unit effort for the fishery of S. marinus are not available since catches of that species in the North-East Arctic are to a great extent by-catches in the fishery for cod and haddock.

2.3. Recruitment (Table 7)

In the International 0-Group Survey which began in 1965, only two year classes have been estimated as very poor, namely the 1967 and 1968 year classes. The 1965, 1971 and 1972 year classes were somewhat below average, while the 1966, 1969 and 1970 year classes were of average abundance. All the six most recent year classes were above average, and the 1973, 1974, 1976, 1977 and 1978 year classes were even rich. The 1978 year class was almost as numerous as the 1977 year class which is the most abundant year class on record.

2.4. Age and Length Compositions

For 1976, 1977 and 1978, the Federal Republic of Germany age/length Compositions were available for Sebastes marinus in Division IIa. In addition, Soviet length compositions were available for the same years in Sub-area I and Division IIa. Total length compositions were calculated by applying the Federal Republic of Germany length compositions for Division IIa to the total catch of all countries except USSR (Table 8). Length compositions prior to 1976 were only available from the Federal Republic of Germany.

For Sebastes marinus, three Federal Republic of Germany age/length keys were available. One from 1978, one from 1976, which also included samples from 1974, and one from 1975 which covered fish between 20 and 30 cm. For 1977, the Working Group decided to use a standard age/length key which included the 1976, 1974 and 1978 data. For the 1978 material, the age/length key from 1978 was used. For both 1977 and 1978, the age/length key from 1975 was used for fish between 30 and 20 cm. For fish smaller than 20 cm, the age compositions had to be estimated from the growth curve. For 1978, the standard age/length key was used for fish larger than 45 cm. For the years prior to 1977, the age/length key from 1976 was used as in the previous assessment. Input age composition data are given in Table 9.

The age composition for Sebastes mentella in 1977 was adjusted according to changes in the catch statistics.

For 1978, age composition data were available from the German Democratic Republic and the USSR Sebastes mentella fishery, covering 96% of the total catch of this species.

The age compositions were raised to the total landings in 1978 (Table 14).

2.5. Assessments (Sebastes marinus)

2.5.1. Parameters used (Table 10)

A preliminary VPA run using the same F-at-age array as in the previous assessment indicates that fishing mortality seemed to be underestimated for 1977.

For the present assessment, terminal Fs for 1978 on age groups up to age 20 were left unchanged in view of reduced catches and the reduced fishing effort in the fishery for cod and haddock in 1978 compared to 1977. It was also considered that younger fish of age 3 to 12 did not appear in the reported size compositions as numerous as in 1976 and 1977, indicating that no change in F for these ages was required in 1978. Since the number of fish older than 20 years was reduced by 64% in 1978 compared to previous years, whereas the total catch in numbers was reduced by about 40%, F on these age groups was reduced slightly from 0.25 to 0.20 in order to account for this change.

Natural mortality of 0.1 was used as in the previous assessments.

2.5.2. Stock size

Estimates of stock size in numbers for Sebastes marinus are given in Table 11. Total stock biomass (age group 6 and older) and the spawning stock biomass (age group 15 and older) (Table 12) were estimated by using the average weight at age data given in Table 13. These assessments show that both the total stock and the spawning stock have had a steady decrease since 1974, whereas in the preceding period the stock biomass seems to have been relatively stable.

2.5.3. Fishing mortality

Average fishing mortality age 13 to 24 in the 1965 to 1973 period fluctuated around the average value of 0.056 following the trend in catches. Since 1974, when catches increased considerably over the previous level, mean F increased to 0.132 for the 1974-77 period.

2.5.4. Yield per recruit

A yield per recruit curve for Sebastes marinus has been calculated for the fishing mortality rates on age groups subject to maximum exploitation, using natural mortality $M = 0.10$ and the exploitation pattern applied for 1978 in the VPA and used in the catch prediction (Figure 1). This curve has a maximum for $F = 0.21$ and $F_{0.1} = 0.08$.

2.5.5. Catch predictions

Catches for 1980 and both total stock biomass and spawning stock biomass for 1981 have been calculated for the options suggested by ACFM. These calculations are based on the assumption that the 1979 TAC for *S. marinus* of 22 000 tonnes will be taken. This catch level is generating a fishing mortality of 0.17 in 1979.

Parameters used for the catch predictions are given in Table 13. Recruitment at age 6 was taken as average over the years 1965-74 for the years 1977, 1978, 1979 and 1980. The number of 7-year-old fish in 1978 and 1979 were derived by applying the respective F on average recruitment in 1977 and 1978. The results of the calculations and the different options considered are given in the following text-table.

1979					1980				1981	
Stock bio-mass *)	Spawn-ing stock bio-mass *)	F	Catch*)	Management Option for 1980	Stock bio-mass *)	Spawn-ing stock bio-mass *)	F	Catch*)	Stock bio-mass *)	Spawn-ing stock bio-mass *)
236	153	.17	22	1) $F_{1980} = F_{1978} \simeq F_{(max)}$	232	148	.20	25	226	135
				2) $F_{1980} = F_{1979}$			.17	22	230	139
				3) $F_{1980} = F_{0.1}$			.08	11	241	149

Stock biomass = fish at age 6 to 28
Spawning stock biomass = fish at age 15 to 28
*) in thousand tonnes

Under Option 1, total biomass at the beinning of 1981 will be maintained at the 1978 level, whereas spawning biomass is expected to decline from the 1978 level by about 8%. Under the second option, total biomass increases slightly by the beginning of 1981 over the 1978 level and spawning stock biomass will decline by about 5%; this option is associated with the maintenance into 1980 of the catch level recommended for 1979 of 22 000 tonnes.

Fishing at $F_{0.1}$ (Option 3) would reduce the 1980 catch by 50% from the recommended 1979 level but would prevent a further reduction in spawning stock biomass; total biomass is expected to increase by 6% compared to 1978. The drastic cut-back in catch required under Option 3, however, is expected to create serious enforcement problems considering that this species is taken mainly as by-catch in the fishery for cod in Sub-area I and Division IIa.

2.6. Assessments (*Sebastes mentella*)

2.6.1. Parameters used

In a preliminary run of the VPA, a terminal fishing mortality of F = 0.20 was chosen for age groups 10 and older. Assuming that the bias on the calculated F values introduced by incorrect estimates of Fs in 1978 will be reduced to a minimum for 1974 and earlier years, the weighted mean F values for the age groups 13 to 21 were plotted against the total trawl effort for the period 1965 to 1974 (Figure 2). This range of age groups was chosen because the fishery in the period 1965-74 was mainly concentrated on these age groups.

The estimated $\bar{F}_{(13-21)}$ corresponding to the total effort in 1978 is 0.21 and therefore the terminal Fs for age groups 10 to 24 were left unchanged. (Results from the preliminary VPA run indicate that under the present exploitation pattern, the age groups 10 and older are fully recruited.) The fishing mortalities for the age groups 7, 8 and 9 were set at 0.06, 0.15 and 0.15 respectively (Table 15). The estimates are mainly based on the assumption that the exploitation of these age groups has increased in 1978 as indicated by the age distribution of the catches (Table 14).

Furthermore, the relationship between the estimated year class strength from VPA at age 6 and the corresponding 0-group survey abundance indices (Figure 3) indicatesthat the chosen F-array for age groups 7 to 9 could be appropriate.

Natural mortality of 0.1 was used as in the previous assessments.

2.6.2. Stock size

Estimates of stock size in numbers from VPA are given in Table 16. In addition, the total stock biomass (age 6 and older) and the spawning stock biomass (age 15 and older) were calculated using the mean weights at age given in Table 18. The results summarised in Table 17 show that both the total stock biomass and the spawning stock biomass increased considerably during the period from 1965 to 1975. In 1975, when both reached their highest level, the spawning stock size was about 3.5 times larger than in 1965.

Since 1975, the total stock size and the spawning stock size have declined. The assessment indicates that both the stock biomass and the spawning stock biomass decreased further from 1977 to 1978 by 2% and 18%, respectively.

2.6.3. Fishing mortality and exploitation pattern

Estimates of fishing mortalities from VPA are given in Table 15.

The results indicate that during the period 1965-73 both the total fishing mortality and the exploitation pattern were relatively stable. The fishery was concentrated on the age groups 13-24.

Since 1974, the exploitation shifted towards younger ages, mainly as a result of abundant incoming year classes. In addition, the total level of fishing mortality increased considerably in the period 1975-77, following the trend in the total effort (Table 6).

The age distribution of catches indicates that the exploitation of the younger age groups increased further in 1978.

2.6.4. Yield and spawning stock per recruit

In Figure 4, yield per recruit and spawning stock biomass per recruit curves are plotted against the F values on age groups subject to maximum exploitation.

The curves were calculated for the 1978 exploitation pattern and the average weights at age as given in Table 18. For the present exploitation pattern, the $F_{0.1}$ and F_{max} values are 0.10 and 0.20 respectively. The 1978 fishing mortality corresponds to the F_{max} level.

For $F_{0.1}$ and F_{max}, the corresponding sustainable yield and equilibrium spawning stock biomass were calculated assuming two different levels of average recruitment at age 6:

$$R_{1965-74} = 380 \times 10^6$$

$$R_{1970-74} = 539 \times 10^6$$

The results are given in the text-table below.

R_6	F	Y/R	Sustainable yield (tonnes $\times 10^{-3}$)	S/R	Spawning stock biomass (tonnes $\times 10^{-3}$)
380×10^6	.10	.217	82	1.075	408
	.20	.236	90	.357	136
539×10^6	.10	.217	117	1.075	576
	.20	.236	127	.357	192

2.6.5. Catch predictions

Catch predictions were made for the period 1979-81 using the exploitation pattern and mean weights at age given in Table 18. The stock size at the beginning of 1979 is estimated from the stock size and fishing mortalities in 1978.

Furthermore, it was assumed that the TAC of 135 000 tonnes will be taken in 1979. This catch level in 1979 would be achieved by a fishing mortality on age groups subject to maximum exploitation of F = 0.27 which is somewhat higher than F = 0.20 estimated in last year's report (C.M.1978/G:11) for this catch level.

Recruitment of 6-year-old redfish for 1979-81 is calculated on the basis of 0-group survey abundance indices and amounted to 656×10^6 in 1979, 671×10^6 in 1980 and 639×10^6 in 1981.

Catch predictions for 1980 were made for three options of fishing mortality. The options are as follows:

Option 1: Fishing at the level of F in 1980 equal to the level of F required to take the TAC of 135 000 tonnes in 1979;

Option 2: Fishing at F_{max} in 1980 which is equal to the F level in 1978;

Option 3: Fishing at $F_{0.1}$ in 1980.

The results of the calculations are summarised in the text-table below:

1979				Management Option for 1980	1980				1981	
Stock bio-mass ⁎)	Spawn-ing stock bio-mass ⁎)	F	Catch ⁎)		Stock bio-mass ⁎)	Spawn-ing stock bio-mass ⁎)	F	Catch ⁎)	Stock bio-mass ⁎)	Spawn-ing stock bio-mass ⁎)
827	87	.27	135	1) $F_{1980} = F_{1979}$	847	84	.27	139	860	88
				2) $F_{1980} = F_{1978} = F_{max}$			.20	106	896	94
				3) $F_{1980} = F_{0.1}$			.10	55	953	104

Stock biomass = fish at age 6 to 24
Spawning stock biomass = fish at age 15 to 24
⁎) in thousand tonnes

Under option 1 which projects a catch of 139 000 tonnes in 1979, the total stock biomass increases slightly by 1981 and the spawning stock biomass will be kept at the 1980 level.

Option 2 provides a possible catch of 106 000 tonnes in 1979. Under this option, both the stock biomass and the spawning stock biomass increase from 1980 to 1981 by 6% and 12% respectively.

Option 3 would require a drastic reduction of the catch in 1980 followed by an increase in both the total stock biomass and the spawning stock biomass over recent levels.

3. REDFISH IN SUB-AREAS V AND XIV

3.1. Latest Developments in the Fishery (Tables 19-22)

The total catch from the Irminger Sea redfish stock complex decreased from 83 360 tonnes in 1977 to about 64 000 tonnes in 1978, which is the lowest total catch on record since 1965 (see Table 22).

In Iceland (Division Va), the main change in the fishery was the absence of trawlers from the Federal Republic of Germany in 1978; in 1977 their catch amounted to 31 632 tonnes. The Icelandic fleet increased their effort from 1977 to 1978 and the catch increased at the same time from 28 119 tonnes to about 33 300 tonnes, i.e. approximately the same level as in 1976.

In Division Vb, the catches increased from 7 402 tonnes in 1977 to about 9 800 tonnes in 1978, due to an increase in the catches of the Federal Republic of Germany and the Faroe Islands from 1977 to 1978.

In Sub-Area XIV, the catch increased from 14 433 tonnes in 1977 to about 19 000 tonnes in 1978, which corresponds to the increase in catches of the Federal Republic of Germany from 1977 to 1978.

Up to 1977, the fishing pattern in Division Va was changing: the effort being increasingly directed towards greater depths where S. mentella is concentrated, especially when the fleet of the Federal Republic of Germany was fishing in that area. The Icelandic trawler fleet also showed the same change in their fishing pattern. Because of the absence of the Federal Republic of Germany fleet from the fishery in 1978, the total effort at greater depths decreased. Thus, S. mentella was by far less subject to fishing in Division Va than in previous years.

3.2. Recruitment of Redfish in the Irminger Sea Area

Although most of the 0-group surveys in the past years have not covered the total area of distribution of the redfish fry, they indicate a great variation in the number of fry found.

In 1978, the distribution of 0-group redfish showed the same density pattern as in the previous years. The abundance was, however, considerably lower than in most previous years, and only in 1976 was it so low since this series of observations started in 1970.

The year-to-year fluctuations in the abundance of 0-group redfish are presented in the following text-table as index figure of individuals per nautical square mile.

Number of 0-group redfish x 10^6 per nautical square mile

Year class	No. of fish
1970	8.6
1971	12.6
1972	38.1
1973	74.0
1974	23.6
1975	12.6
1976	5.8
1977	13.0
1978	6.5

According to the reports on the 0-group surveys, a substantial part of the 0-group redfish drifts over to the East Greenland shelf and along this coast to West Greenland. During the 1978 survey, the main concentrations were found off East Greenland and lesser ones in the center of the Irminger Sea.

There has not yet been any separation of the 0-group redfish into species and thus it is not possible to allocate them to the appropriate parts of the exploited redfish stocks.

3.3. Splitting of Catches into S. marinus and S. mentella Components

The splitting of the redfish catches into S. marinus and S. mentella was revised. For the 1978 catches in Division Vb and Sub-Area XIV, the Federal Republic of Germany observations on landed catches were used for the splitting.

In accordance with these observations, 20% of the 1978 catch were allocated to S. marinus in Division Vb, and 74% in Sub-Area XIV.

In Division Va, the catches were split on the area and depth basis according to the results of Icelandic research vessel catches and commercial trawlers records (Doc. C.M.1978/G:37). Of the 1978 total catch in Division Va, 13.7% was allocated to S. mentella accordingly.

3.4. Length and Age Compositions: Sebastes marinus and S. mentella

Sub-Area XIV - Data on length composition of the 1978 catches from the Federal Republic of Germany fishery were available for both species. These figures were applied to the total catch of each species in the Sub-Area.

Division Va - Length data from the Icelandic catches in 1978 were available for both species. These figures were used to calculate the length distribution of the total catch of each species in the Division.

Division Vb - For Division Vb, data were available on the length composition of the 1978 catch for both species from the Federal Republic of Germany fishery.

Age-length keys for both S. marinus and S. mentella in Sub-Area XIV and Division Vb from the Federal Republic of Germany fishery have been made available to the Working Group. Age-length keys for the 1978 fishery in Division Va were not available. It was decided to use the combined age-length keys from Sub-area XIV and Division Vb for each species for the 1978 fishery in Division Va. For Sub-Area XIV and Division Vb, the respective 1978 age-length keys were used for both species. The resulting age compositions of total catches in Sub-Areas V and XIV are given in Table 23, for S. marinus, and Table 28, for S. mentella.

3.5. Assessments

No data were available on effort, catch per unit effort, and survey results, on the basis of which the fishing mortality for 1978 could be estimated. It was therefore necessary to evaluate qualitative information on changes in fishing effort and the areal distribution of the fishery during 1978 in order to find indications for changes in F for 1978 compared to the 1977 situation.

3.5.1. Sebastes marinus

The removal of the Federal Republic of Germany fleet from Division Va resulted, to some extent, in an increase in its effort in Division Vb and Sub-Area XIV. At the same time, the Icelandic fleet increased its effort in Division Va, but this increase was supposed to be still smaller than the reduction in effort due to the elimination of the Federal Republic of Germany fishing activity in that Division. The total effort directed towards S. marinus seems to be reduced somewhat in relation to 1977. This small decrease in effort was associated with a decrease in catch weight by about 11%, whereas the decrease in catch numbers was only 4%. The Group, therefore, felt that there is no sufficient justification to change the terminal F values in 1978 from the 1977 level in last year's report.

The input data for the VPA are given in Table 23 and the results are given in Tables 24, 25 and 26. Trends in fishing mortality and stock size did not change markedly from the results of the previous assessment, although the absolute figures in the present assessment are slightly lower but still within the range of normal fluctuations.

3.5.1.1. Catch predictions

The basic data used in the catch predictions are given in Table 27. Previous catch predictions were made assuming an age of recruitment of 12 years. Age and length distribution of catches show that since the mid-1970's the exploitation pattern has changed to include ages 9 to 11, and consequently these age groups have now been included in the catch predictions accounting for about 3% of the calculated catches.

The recruitment used in the catch predictions is the average of the number of 9-year-old fish over the years 1967 to 1974 from the VPA. The relative fishing mortality corresponds to the 1978 situation, expecting no considerable change in the exploitation pattern for 1979 and 1980. The sums of products (number at age x weight at age) check for 1978 was only about 4% higher than the reported catch and therefore no adjustments were made to the mean weight at age data. Since no estimates could be made about the likely 1979 catches of S. marinus from the Irminger Sea stock complex, the Working Group developed some graphs (Figures 5-8) from which catches in 1980 and the biomass in 1981 can be taken for all likely options at the time when information on expected catches in 1979 will become available. In addition, three assumptions about catches in 1979 have been made to illustrate how the catch in 1979 might affect calculated catches for 1980 and the biomass in 1981 under the management options suggested by ACFM.

These assumptions are:

1) The recommended TAC would be taken, the corresponding $F = 0.145$.

2) The catch in 1979 is equal to that of 1978, i.e. 47 000 tonnes, the corresponding $F = 0.12$.

3) A relatively high level of 80 000 tonnes was taken arbitrarily, the corresponding $F = 0.21$.

The options and the results of the catch predictions are given in the text-table on page 11.

Under all assumptions about the 1979 catch levels and all options, the spawning stock biomass is expected to increase at the beginning of 1981 to the 1967-69 level, whereas the total biomass will not increase substantially above the estimated level for 1980 which is only slightly below the long-term average. For all assumptions as to the catch level in 1979, fishing in 1980 at $F = 0.16$, i.e. the fishing mortality at which the yield per recruit curve approaches the maximum level (Figure 9), would not have adverse effects on both the spawning stock biomass and the total recruited biomass in 1981 compared to previous years (Table 26). Under this option, the present satisfactory state of the stock will be maintained or even improved during 1980.

Options and results of the catch predictions.

1979				Management option for 1980	1980				1981	
Stock biomass*)	Spawning stock biomass*)	F	Catch*)		Stock biomass*)	Spawning stock biomass*)	F	Catch*)	Stock biomass*)	Spawning stock biomass*)
748	363	.145	57	$F_{1980} = F_{1978}$	762	401	.13	53	780	435
	Rec. TAC for 1979			$F_{1980} = F_{1979}$			.145	59	774	430
				$F_{1980} = F_{\text{Top level on Y/R curve}}$			.16	64	768	426
				$F_{1980} = F_{0.1}$			.075	31	804	454
748	363	.12	47	$F_{1980} = F_{1978}$	772	410	.13	54	790	442
	Catch 1979 = Catch 1978			$F_{1980} = F_{1979}$			.12	50	793	446
				$F_{1980} = F_{\text{Top level on Y/R curve}}$			.16	66	777	432
				$F_{1980} = F_{0.1}$			.075	32	813	462
748	363	.21	80	$F_{1980} = F_{1978}$	738	384	.13	51	758	417
				$F_{1980} = F_{1979}$			.21	80	728	393
				$F_{1980} = F_{\text{Top level on Y/R curve}}$			.16	62	747	408
				$F_{1980} = F_{0.1}$			.075	30	780	434

Stock biomass = fish age 9 to 30
Spawning stock biomass = fish at age 16 to 30
*) in thousand tonnes

3.5.2. Sebastes mentella

3.5.2.1. Parameters used

Developments in the fisheries are outlined in Section 3.5.1. In Sub-Area XIV, a part of the Federal Republic of Germany effort in 1978 was directed towards S. mentella in contrast to previous years in which the catches only consisted of S. marinus.

The Federal Republic of Germany effort in Division Vb increased by about 10%. In general, for Sub-Areas XIV and V, the effort on S. mentella might have decreased to some extent from 1977 to 1978; whereas the catches decreased by about 40%. A preliminary VPA run with a reduced level of F for 1978 resulted in the stock size for 1977 lower than that of the previous assessment, indicating that the considerable reduction in catch for 1978 could not fully be attributed to a reduction in effort, but rather to the reduced stock size. Therefore, terminal F for 1978 was not lowered from the 1977 level as used in last year's report. A natural mortality of 0.1 was used as in the previous assessments.

3.5.2.2. Stock size (Tables 30 and 31)

Both the spawning stock biomass and the total biomass decreased continuously during the period 1967-78 by about 2/3 to the very low level of 91 000 tonnes and 150 000 tonnes respectively. Due to the complex stock situation in Sub-Areas V and XIV, this decline cannot be attributed to a particular fishery in that region.

3.5.2.3. Fishing mortality (Table 29)

The fishing mortality on ages 12 to 24 fluctuated without trend around an average of 0.085 during the period 1967-71 followed by an increase to about 0.115 in the 1972-75 period. In 1976, F increased by a factor of 3.2 from the previous years as a result of the very high catch in that year.

3.5.2.4. Catch predictions

The basic data used in the catch predictions are given in Table 32. Since the exploitation of redfish aged 9 to 11 increased in recent years, these age groups have been included in the calculations accounting for about 6% of the calculated catches.

Relative fishing mortality was left unchanged for ages 12 to 28 and for age groups 9 to 11. Relative F was taken equal to that of 12-year-old fish.

Average recruitment at age 9 over the years 1967-74 of 57.5 million fish was applied for the years 1979 to 1981. Average weight at age was left unchanged, since the sums of products check for 1978 was only 35% below the reported catch.

As in the case of S. marinus, no information about the likely catches in 1979 are available. The Working Group therefore followed a similar approach as outlined in Section 3.5.1.1. and provided the corresponding set of figures (Figures 10-13). In addition, two assumptions about likely catches in 1979 were made:

1. Catch in 1979 = 12 000 tonnes, the recommended TAC for 1979.

2. Catch in 1979 = 17 000 tonnes, corresponding to the 1978 catch.

On this basis, catches for 1980 and stock sizes for 1981 have been calculated for the options suggested by ACFM. The options and the results of the calculations are given in the following text-table.

1979				Management option for 1980	1980				1981	
Stock biomass ⋇)	Spawning stock biomass ⋇)	F	Catch ⋇)		Stock biomass ⋇)	Spawning stock biomass ⋇)	F	Catch ⋇)	Stock biomass ⋇)	Spawning stock biomass ⋇)
149	90	.275	12	$F_{1980} \rightarrow$ Sp. stock 1981 = 1979	153	89	.15	7	163	90
	Catch 1979 = rec. TAC			$F_{1980} = F_{1978}$			.40	17	152	81
				$F_{1980} = F_{1979}$			.275	12	157	85
				$F_{1980} = 0.8\ F_{1979}$			.22	10	159	87
				$F_{1980} = F_{0.1}$			.35	15	154	83
149	90	.40	17	$F_{1980} \rightarrow$ Sp. stock 1981 = 1980 level	148	85	.17	7	157	85
	Catch 1979 = Catch 1978			$F_{1980} \rightarrow$ Sp. stock 1981 = 1979 level			.05	2	162	90
				$F_{1980} = F_{1978} = F_{1979}$			.40	16	148	77
				$F_{1980} = 0.8\ F_{1979}$			.32	13	151	80
				$F_{1980} = F_{0.1}$			.35	14	150	79

Stock biomass = fish age 9 to 28
Spawning stock biomass = fish age 16 to 28
⋇) in thousand tonnes

Under all assumptions as to the 1979 catch, the options which are expected to halt the decline in the spawning stock biomass are associated with very low catch figures for 1980, whereas the total biomass (age 9+) is expected to at least maintain its 1979 level.

3.6. Since the data base of the Working Group could not be improved substantially during 1978, the statement in Section 3.8 of the previous reports on the accuracy of the redfish assessments is still valid.

4. MESH ASSESSMENTS

The calculations of effective mesh size in the redfish fishery in Region I could not be carried out at present. However, arrangements have been made to assess effective mesh size in use in the course of the current year.

5. BY-CATCHES OF COD IN SUB-AREA XIV

No data on by-catches of cod in the fishery for redfish in Sub-Area XIV were available to the Group and therefore this question could not be considered.

6. STANDARD AGE/LENGTH KEYS

In the previous assessments of the stocks of S. marinus in Sub-Area I and II, Sub-Area V and XIV and S. mentella in Sub-Area V and XIV, standard age/length keys were used to convert catch in numbers per cm-group into the relevant numbers per age group. The construction of standard age/length keys based on a limited number of age/length keys from the Federal Republic of Germany fisheries for different years and fishing areas, became necessary, since for these stocks a continuing series of age determinations was not available.

However, the Working Group considered this situation to be quite unsatisfactory, since the age distribution of the catches over the years turned out to be very similar, so it is hardly possible to follow a good year class throughout a series of years. Therefore, the Working Group attempted to evaluate the effect on the results of the VPA based on standard age/length keys (Run 1) against that based on a series of age composition data derived from age/length keys for individual years (Run 2). This was done for S. mentella in Sub-Area V and Sub-Area XIV, the only stock for which age/length keys were available for the years 1975-78.

The results show that the estimated total stock size in Run 2 was different from Run 1 within a range from -7% to +2%, the corresponding range for the spawning stock biomass was -3% to +3%, and -5% to +9% for the average F (weighted by stock in numbers).

In all cases, the general trend over the years was not changed. However, the differences in estimated recruitment at age 12 are remarkably high, ranging from +38% to -30%, whereas the difference in average recruitment over the years 1970-76 was only -1%.

In the light of these results, the Group concluded that for 1977 and earlier years, catch in numbers per age group derived from standard age/length keys should be used. For the year 1978, for which age/length keys are available from the Federal Republic of Germany fishery, these age/length keys were to be applied to the relevant length distribution of the catches in order to estimate on a more realistic basis the stock size for 1980, i.e. the year for which catch predictions are to be made. This approach should also serve as a starting point for improving the data base for further assessments.

National laboratories of countries having substantial redfish fisheries, which do not provide age data at present, are urged to initiate age determination programmes.

Table 1. Nominal catch of Redfish (in tonnes) by countries (Sub-area I, Divisions IIa and IIb combined)

Country	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978*
Belgium							30	28	2	2	-
Faroe Isl.			60		9	32	6	67	137	8	10
France							1 116		-	660	289
German Dem.Rep.	852	1 069	7 149	14 786	9 972	11 756	28 275	28 020	22 636	17 614	16 165
Germany, Fed.Rep.	3 258	5 573	2 416	3 076	1 697	3 479	6 597	5 182	7 894	7 231	11 461
Netherlands		20							127	-	-
Norway	4 024	3 904	3 832	4 644	6 776	7 714	7 055	4 966	7 305	7 381	7 765
Poland		5 973	4 631	2 532	1 112	215	1 269	4 711	4 137	175	2 957
Portugal								331	3 463	1 480	419
Spain								1 194	3 398	-	151
U.K.	5 058	5 224	4 554	4 002	4 379	4 791	3 509	2 746	4 961	6 330	2 272
USSR	5 477	9 144	13 091	29 839	22 647	31 829	48 787	230 950	263 546	144 993	78 092
Total	18 669	30 907	35 733	58 879	46 592	59 816	96 644	278 195	317 606	185 874	119 581**

* Provisional data

** The total figure used by the Working Group for assessments (including catches by non-members)

Table 2 Nominal catch of Redfish (in tonnes) by countries in Sub-area I.

Country	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978*
Belgium							30		2	1	-
Faroe Islands						6	6				-
France							26				-
German Dem. Rep.	25	23	4 912	78	36		358	201	90	-	-
Germany Fed.Rep.			133	148	7	76	1 086	483	635	786	-
Netherlands											
Norway	464	365	141	316	1 000	1 917	194	482	739	1 181	1 868
Poland		5 973	6	1	22			93	47	-	
Portugal								331	478	55	
Spain								820	301	-	
U.K.	1 163	1 385	1 384	1 406	1 363	1 894	1 320	1 048	1 392	1 686	707
USSR	1 076	3 647	2 281	3 743	4 403	4 885	9 318	30 750	12 411	13 154	2 575
Total	2 728	11 393	8 857	5 692	6 831	8 778	12 338	34 208	16 095	17 012	5 150

* Provisional data

Table 3 Nominal catch of Redfish (in tonnes) by countries in Division IIa

Country	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978*
Faroe Isl.			60		9	22		67	137	8	10**
France							980			478	282**
German Dem.Rep.		812	2 212	12 339	8 963	11 474	27 153	22 778	16 921	12 688	12 933
Germany, Fed.Rep.	3 258	5 573	2 165	1 188	1 466	2 207	4 167	4 263	6 722	4 764	11 460
Netherlands		20							127	-	-
Norway	3 518	3 510	3 679	4 277	5 720	5 564	6 837	4 444	6 515	6 050	5 853
Poland			269	1 605	784	156	869	920	217	47	2 477
Portugal									2 849	1 249	394**
Spain								153	2 082	-	88**
U.K.	3 820	3 578	2 741	2 463	2 680	2 125	1 991	1 621	2 919	4 064	1 524
USSR	3 779	14	142	209	291	131	14	39 138	20 307	94 639	31 783
Total	14 375	13 507	11 268	22 081	19 913	21 679	42 011	73 384	58 796	123 987	66 804

* Provisional data

** As reported to Norwegian authorities

Table 4 Nominal catch of Redfish (in tonnes) by countries in Division IIb

Country	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978*
Belgium								28		-	
Faroe Isl.						4				-	
France							110			33	7**
German Dem.Rep.	827	234	25	2 369	973	282	764	5 041	5 625	4 926	3 232
Germany, Fed.Rep.			118	1 740	224	1 196	1 344	436	537	1 681	1
Norway	42	29	12	51	56	233	24	40	51	150	44
Poland			4 356	926	306	59	400	3 698	3 873	128	480
Portugal									136	176	25**
Spain								221	1 015	-	63**
U.K.	75	261	429	133	336	772	198	77	650	580	41
USSR	622	5 483	10 668	25 887	17 953	26 813	39 455	161 062	230 828	37 200	43 734
Total	1 566	6 007	15 608	31 106	19 848	29 359	42 295	170 603	242 715	44 874	47 627
Non-members											296

* Provisional data

** As reported to Norwegian authorities

Table 5 Nominal catch of Sebastes marinus and Sebastes mentella in Sub-area I and Divisions IIa and IIb combined (in tonnes)

Year	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978*
S. marinus	17 703	13 256	24 071	12 817	13 816	17 730	21 436	27 272	39 125	48 584	39 509	29 019
S. mentella	6 239	5 413	6 836	22 916	45 063	28 862	38 380	69 372	239 070	269 022	146 365	92 740
Total	23 942	18 669	30 907	35 733	58 879	46 592	59 816	96 644	278 195	317 606	185 874	121 759

* Provisional data

Table 6   Sebastes mentella in Divisions IIa and IIb

Effort and catch per unit of effort 1965 - 1978.

Year	USSR catch/hour (tonnes)	USSR effort (hours trawling)	Total effort (hours trawling)
1965	0.38	37 895	41 216
1966	0.39	22 308	26 008
1967	0.37	15 135	16 862
1968	0.45	9 778	12 029
1969	0.48	11 458	14 242
1970	0.46	23 261	49 817
1971	0.38	68 158	118 587
1972	0.38	47 368	79 953
1973	0.45	59 556	85 289
1974	0.69	60 000	100 539
1975	0.95	217 789	251 653
1976	0.99	244 379	271 739
1977	0.77	132 866	190 084
1978	0.63	118 356	147 206

Table 7. Year class strength of Redfish in Sub-area I and Divisions IIa and IIb.

Year class	DRAGESUND 1971	SURKOVA, 1960		BARANENKOVA, 1968		0-group surveys Abundance indices
		S.marinus	S.mentella	S.marinus	S.mentella	
1956	strong		strong	strong		
1957	average	average	strong	average	average	
1958	poor	poor	poor	below average	poor	
1959	average		average	strong	strong	
1960	poor			poor	poor	
1961	poor					
1962	very poor					
1963	poor					
1964	strong					
1965	strong					159
1966	strong					236
1967	average					44
1968	average					21
1969	very strong					295
1970	strong					247
1971	average					172
1972	average					177
1973	strong					385
1974						468
1975						315
1976						447
1977						472
1978						460

Table 8. *Sebastes marinus*, Sub-area I and Div. IIa. Length compositions 1976, 1977 and 1978 in numbers ($x\ 10^{-3}$).

Length cm	1976 All countries except USSR	1976 USSR Sub-area I	1976 Div. II a	1976 Total	1977 All countries except USSR	1977 USSR Sub-area I	1977 USSR Div. IIa	1977 Total	1978 All countries except USSR	1978 USSR Sub-area I	1978 USSR Div. IIa	1978 Total
11-12						237		237				
13-14						475		475				
15-16		966	60	1 026		1 425		1 425	15			15
17-18		4 539	164	4 703		2 232	10	2 242		6		6
19-20		4 250	193	4 443		2 802	40	2 842		19		19
21-22		5 602	550	6 152		3 514	110	3 624	15	65	1	81
23-24		5 119	714	5 833		3 324	229	3 553		162	2	164
25-26		7 389	1 086	8 475		4 891	439	5 330	15	446	3	464
27-28		8 016	1 517	9 533	15	5 698	608	6 321	11	588	9	608
29-30	39	4 877	1 027	5 943	15	5 176	957	6 148	122	1 183	13	1 318
31-32	211	3 718	1 398	5 327	527	4 131	1 117	5 775	781	1 028	29	1 838
33-34	1 249	1 739	908	3 896	1 631	3 799	1 047	6 477	3 357	705	28	4 090
35-36	3 036	1 304	1 413	5 753	3 140	3 894	1 356	8 390	5 903	821	44	6 768
37-38	4 175	483	1 562	6 220	3 933	2 659	987	7 579	6 841	530	70	7 441
39-40	4 224	193	1 309	5 726	3 817	1 662	897	6 376	5 767	323	113	6 203
41-42	3 442	48	1 205	4 695	3 539	712	688	4 939	3 013	181	135	3 329
43-44	2 371	-	506	2 877	2 538	142	369	3 049	1 531	78	112	1 721
45-46	1 489	-	476	1 965	1 564	142	409	2 115	732	71	94	897
47-48	1 189	-	268	1 457	1 174	142	259	1 575	239	39	78	356
49-50	1 006	-	134	1 140	850	95	179	1 124	118	19	54	191
51-52	657	-	119	776	572	95	110	777	101	26	37	164
53-54	684	-	60	744	661	47	30	738	64	19	18	101
55-56	383	-	104	487	450	47	50	547	55	45	10	110
57-58	303	48	60	411	245	47	30	322	4	32	4	40
59-60	132		30	162	92	-	20	112		39	2	41
61-62	25		15	40	42	95	20	157		26	1	27
63-64	8			8			10	10		13	1	14
65-79											7	7
Total	24 623	48 291	14 878	87 792	24 805	47 483	9 971	82 259	28 684	6 464	865	36 013

Table 9 Sebastes marinus in Sub-area I and Division IIIa. Age composition of the total catch in numbers ($x10^3$), 1967-1978

AGE	1967	1968	1969	1970	1971	1972
3	0	0	0	0	0	0
4	0	0	0	0	0	0
5	0	0	0	0	0	0
6	0	0	0	0	0	0
7	0	0	0	0	0	0
8	0	0	0	0	0	0
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	44	43	51	62	46	261
13	94	32	35	122	41	332
14	199	74	97	229	107	633
15	406	165	209	444	239	1137
16	1363	550	666	1232	886	2563
17	919	364	556	723	594	1261
18	1536	611	954	1138	935	2014
19	1695	684	1223	997	990	2046
20	310	131	223	185	185	385
21	1459	753	1456	1003	858	1732
22	951	555	1084	750	595	1112
23	1167	898	1518	921	779	1251
24	1241	1266	2259	966	1123	1121
25	896	993	1845	716	776	746
26	723	887	1667	623	636	585
27	504	644	1362	526	426	429
28	432	614	1038	347	431	377
TOTAL	13939	9264	16243	10984	9647	17985

AGE	1973	1974	1975	1976	1977	1978
3	0	0	0	0	86	0
4	0	0	0	0	428	0
5	0	0	0	530	1839	18
6	0	0	0	2884	1831	12
7	0	0	0	5719	1621	28
8	0	0	0	12162	4179	300
9	0	0	0	10250	4620	586
10	0	0	0	9515	4501	851
11	0	0	0	5963	2359	563
12	590	387	693	5008	3306	1832
13	570	455	868	1686	2557	2589
14	913	1049	1638	2670	4242	4985
15	1527	2079	2984	2991	5334	5855
16	3266	5479	7397	6775	6072	5376
17	1441	2757	3563	2707	2372	2349
18	2157	4164	5117	3938	3462	3354
19	1892	3528	4402	3417	3115	2486
20	342	638	775	614	964	1406
21	1420	2359	2829	2475	2408	1569
22	849	1373	1721	1529	1170	349
23	1123	1527	1813	1814	1464	449
24	1248	1103	1432	1672	1318	376
25	884	702	930	1106	923	220
26	729	530	817	918	772	160
27	568	369	701	822	666	141
28	508	332	589	624	677	129
TOTAL	20027	28831	38269	87789	62286	35983

Table 10 Sebastes marinus in Sub-area I and Division IIa. Fishing mortalities estimated by VPA (M = 0.10)

AGE	1965	1966	1967	1968	1969	1970	1971	1972	1973
3	.000	.000	.000	.000	.000	.000	.000	.000	.000
4	.000	.000	.000	.000	.000	.000	.000	.000	.000
5	.000	.000	.000	.000	.000	.000	.000	.000	.000
6	.000	.000	.000	.000	.000	.000	.000	.000	.000
7	.000	.000	.000	.000	.000	.000	.000	.000	.000
8	.000	.000	.000	.000	.000	.000	.000	.000	.000
9	.000	.000	.000	.000	.000	.000	.000	.000	.000
10	.000	.000	.000	.000	.000	.000	.000	.000	.000
11	.000	.000	.000	.000	.000	.000	.000	.000	.000
12	.007	.001	.001	.001	.001	.001	.001	.004	.014
13	.011	.004	.003	.001	.001	.003	.001	.007	.011
14	.028	.014	.007	.003	.004	.008	.003	.016	.020
15	.056	.034	.017	.007	.008	.018	.009	.031	.045
16	.104	.132	.063	.026	.030	.055	.041	.115	.105
17	.053	.062	.050	.019	.030	.037	.031	.068	.079
18	.098	.116	.065	.038	.058	.072	.056	.125	.143
19	.136	.144	.087	.033	.090	.072	.074	.150	.149
20	.025	.037	.020	.008	.012	.016	.015	.034	.030
21	.150	.165	.129	.055	.101	.064	.085	.175	.150
22	.118	.146	.080	.060	.094	.062	.044	.137	.109
23	.168	.204	.128	.090	.205	.097	.077	.110	.178
24	.143	.250	.155	.179	.305	.174	.148	.136	.138
25	.151	.098	.158	.161	.378	.134	.185	.124	.136
26	.174	.123	.090	.208	.390	.188	.151	.186	.154
27	.171	.143	.126	.097	.496	.182	.170	.130	.247
28	.200	.200	.200	.200	.200	.200	.200	.200	.200

AGE	1974	1975	1976	1977	1978
3	.000	.000	.000	.010	.000
4	.000	.000	.000	.194	.000
5	.000	.000	.155	1.313	.010
6	.000	.000	.185	1.006	.020
7	.000	.000	.223	.135	.030
8	.000	.000	.378	.225	.030
9	.000	.000	.476	.215	.040
10	.000	.000	.236	.351	.050
11	.000	.000	.125	.076	.060
12	.005	.009	.072	.085	.070
13	.012	.013	.025	.043	.080
14	.022	.048	.044	.072	.100
15	.052	.073	.104	.104	.120
16	.202	.237	.211	.282	.130
17	.109	.175	.115	.095	.150
18	.304	.268	.266	.189	.170
19	.326	.535	.257	.310	.180
20	.062	.098	.116	.096	.200
21	.267	.372	.452	.754	.200
22	.189	.284	.314	.355	.200
23	.261	.362	.481	.493	.200
24	.238	.369	.585	.682	.200
25	.096	.288	.478	.664	.200
26	.101	.139	.452	.639	.200
27	.098	.169	.182	.612	.200
28	.200	.200	.200	.200	.200

MEAN F FOR AGES >= 13 AND <= 24 (WEIGHTED BY STOCK IN NUMBERS)

	1974	1975	1976	1977	1978
	.116	.145	.129	.137	.129

Table 11 Sebastes marinus in Sub-area I and Division IIa. Stock size in numbers ($x 10^3$) estimated by VPA.

AGE	1967	1968	1969	1970	1971	1972
3	185470	118595	95607	51644	66744	44782
4	181380	167820	107309	86508	46729	60393
5	164038	164119	151850	97097	78276	42282
6	84120	148428	148501	137399	87857	70827
7	102619	76115	134303	134370	124324	79497
8	88491	92854	68872	121522	121583	112493
9	67543	80070	84017	62318	109958	110012
10	65236	61115	72451	76022	56387	99494
11	41515	59028	55299	65556	68788	51021
12	35303	37565	53411	50037	59318	62242
13	32823	31902	33949	48280	45216	53629
14	29175	29610	28835	30685	43569	40875
15	25158	26210	26722	25999	27547	39322
16	23457	22378	23559	23981	23103	24699
17	19920	19930	19726	20684	20528	20062
18	25765	17151	17687	17320	18028	18010
19	21354	21853	14938	15097	14590	15424
20	16706	17711	19124	12354	12713	12261
21	12670	14821	15901	17092	11003	11328
22	13043	10079	12695	13005	14512	9141
23	10200	10898	8592	10457	11054	12565
24	9053	8121	9008	6334	8587	9262
25	6420	7013	6146	6008	4814	6703
26	8844	4959	5403	3813	4756	3619
27	4456	7315	3645	3309	2858	3700
28	2500	3553	6007	2008	2494	2182

AGE	1973	1974	1975	1976	1977	1978
3	24205	4740	3195	2818	9082	0
4	40520	21902	4289	2891	2550	0
5	54646	36664	19817	3881	2616	1901
6	38259	49445	33175	17932	3008	637
7	64087	34618	44740	30018	13487	995
8	71931	57988	31324	40482	21734	10664
9	101788	65086	52470	28343	25102	15699
10	99543	92102	58892	47477	15938	18328
11	90026	90071	83337	53288	33929	10154
12	46166	81459	81499	75406	42553	28459
13	56070	41212	73339	73085	63472	35362
14	48210	50193	36857	65535	64527	55001
15	36383	42754	44419	31793	56761	54355
16	34499	31469	36710	37356	25926	46292
17	19914	28113	23274	26197	27371	17699
18	16955	16649	22819	17676	21132	22513
19	14383	13293	11116	15793	12258	15835
20	12013	11217	8682	5891	11048	8137
21	10728	10545	9543	7120	4747	9080
22	8605	8359	7303	5954	4098	2020
23	7215	6980	6260	4976	3937	2599
24	10181	5462	4867	3946	2784	2176
25	7316	8027	3895	3046	1988	1273
26	5357	5780	6596	2642	1709	926
27	2719	4155	4727	5193	1521	816
28	2940	1921	3409	3611	3918	747

Table 12 Sebastes marinus, Sub-area I and Division IIa.

Biomass of the total stock (age 6 years and older) and the spawning stock (age 15 and older).

Year	Total stock (1 000 tonnes)	Spawning stock (1 000 tonnes)
1965	361	230
1966	357	219
1967	350	205
1968	359	200
1969	370	196
1970	366	176
1971	377	176
1972	386	184
1973	385	184
1974	379	185
1975	362	182
1976	329	159
1977	274	152
1978	227	147

Table 13 Sebastes marinus, Sub-area I and Division IIa

Parameters used in catch prediction.

AGE	Stock size at beginning of 1979	Proportional fishing mortality	Mean weight per age group (kg)
6	98 633	0.10	0.086
7	87 480	0.15	0.147
8	76 839	0.15	0.194
9	9 364	0.20	0.254
10	13 648	0.25	0.334
11	15.775	0.30	0.421
12	8 653	0.35	0.477
13	24 010	0.40	0.512
14	29 537	0.50	0.577
15	45 031	0.60	0.611
16	43 621	0.65	0.710
17	36 781	0.75	0.761
18	13 784	0.85	0.826
19	17 186	0.90	0.895
20	11 968	1.00	0.947
21	6 028	1.00	1.093
22	6 727	1.00	1.145
23	1 496	1.00	1.293
24	1 925	1.00	1.580
25	1 612	1.00	1.793
26	943	1.00	1.885
27	686	1.00	2.393
28+	1 158	1.00	2.454

Table 14 Sebastes mentella in Divisions IIa and IIb. Age composition of the total catch in numbers ($x10^3$), 1967-1978.

AGE	1967	1968	1969	1970	1971	1972
6	0	7	31	0	0	466
7	0	0	94	0	0	792
8	7	15	409	33	114	5728
9	15	89	524	131	284	3586
10	182	192	838	620	681	2049
11	285	355	933	2122	1590	1770
12	343	436	954	3428	4429	3865
13	394	554	849	3983	4884	4564
14	489	864	618	3526	5451	4704
15	496	768	482	2808	4940	4098
16	628	931	807	3983	7496	4704
17	613	694	451	2743	4486	3632
18	540	665	849	3559	7382	3167
19	949	702	786	2318	4770	1816
20	649	369	555	1567	3918	885
21	693	347	440	784	2385	373
22	598	251	514	653	1874	279
23	248	89	199	327	1590	47
24	117	44	42	65	397	47
TOTAL	7246	7372	10375	32650	56671	46572

AGE	1973	1974	1975	1976	1977	1978
6	172	606	5834	18891	0	2909
7	1660	4847	19417	29815	2418	30200
8	4865	15451	42425	59395	17175	65253
9	9729	28781	82480	78241	33454	53465
10	4636	30144	108462	110712	52102	33316
11	2633	19843	119075	112524	49617	19936
12	3148	10603	57231	93144	53938	17266
13	5208	8634	29651	49550	33287	9283
14	5666	8634	20894	26134	19095	7420
15	4578	6514	16499	13881	12605	5464
16	5380	5908	13465	9839	5796	4139
17	3777	3332	13668	6300	4874	2137
18	2747	2878	12207	7233	5499	1547
19	1316	1666	6757	3486	3155	667
20	973	2121	7112	3168	3941	1062
21	630	757	5113	1818	2955	423
22	114	454	2242	1715	2531	308
23	10	151	735	1041	1002	301
24	10	151	407	211	322	159
TOTAL	57252	151475	563674	627098	303766	255255

Table 15 Sebastes mentella in Division IIa and Division IIb. Fishing mortalities estimated by VPA (M = 0.10)

AGE	1967	1968	1969	1970	1971	1972	1973
6	.000	.000	.000	.000	.000	.001	.000
7	.000	.000	.000	.000	.000	.001	.003
8	.000	.000	.003	.000	.000	.012	.010
9	.000	.001	.005	.001	.002	.013	.023
10	.002	.002	.009	.006	.006	.013	.019
11	.004	.004	.010	.026	.018	.019	.019
12	.005	.007	.013	.041	.063	.049	.038
13	.008	.010	.015	.062	.069	.077	.078
14	.015	.021	.012	.072	.101	.079	.115
15	.025	.026	.013	.064	.123	.092	.093
16	.042	.053	.032	.128	.216	.148	.151
17	.063	.054	.030	.129	.186	.138	.153
18	.090	.081	.078	.303	.522	.174	.132
19	.174	.146	.116	.280	.740	.207	.091
20	.160	.085	.148	.316	.917	.256	.146
21	.524	.108	.125	.285	.971	.173	.260
22	.940	.323	.207	.246	1.961	.240	.066
23	.653	.298	.406	.177	1.357	.188	.011
24	.300	.200	.200	.200	.300	.100	.050

MEAN F FOR AGES >= 13 AND <= 21 (WEIGHTED BY STOCK IN NUMBERS)

	1967	1968	1969	1970	1971	1972	1973
	.041	.034	.028	.109	.200	.111	.113

AGE	1974	1975	1976	1977	1978
6	.001	.010	.032	.000	.005
7	.013	.053	.059	.005	.060
8	.035	.133	.205	.040	.150
9	.069	.235	.342	.153	.150
10	.083	.350	.498	.356	.200
11	.097	.469	.652	.386	.200
12	.088	.393	.728	.668	.200
13	.124	.333	.617	.550	.200
14	.161	.435	.485	.452	.200
15	.169	.458	.510	.405	.200
16	.149	.544	.483	.368	.200
17	.119	.525	.468	.416	.200
18	.150	.709	.518	.852	.200
19	.100	.542	.395	.396	.200
20	.186	.677	.466	.924	.200
21	.146	.782	.320	.942	.200
22	.270	.714	.580	.864	.200
23	.105	.805	.765	.708	.200
24	.200	.400	.500	.500	.200

MEAN F FOR AGES >= 13 AND <= 21 (WEIGHTED BY STOCK IN NUMBERS)

	1974	1975	1976	1977	1978
	.144	.470	.529	.506	.200

Table 16 Sebastes mentella in Divisions IIa and IIb. Stock size in numbers (x10^{30}) estimated by VPA.

AGE	1967	1968	1969	1970	1971	1972
6	167196	249652	382697	616842	622306	579619
7	143506	151286	225887	346249	558142	563085
8	118405	129849	136889	204302	313299	505027
9	121227	107130	117478	123473	184829	283376
10	96329	109676	96851	105801	111599	166970
11	73695	86989	99057	86838	95143	100331
12	66208	66411	78373	88743	76557	84577
13	49082	59581	59676	70008	77040	65062
14	34666	44036	53385	53190	59561	65067
15	21429	30902	39024	47717	44778	48714
16	15991	18918	27231	34852	40508	35824
17	10611	13872	16233	23873	27753	29538
18	6569	9019	11893	14259	18996	20853
19	6233	5431	7529	9954	9527	10199
20	4601	4739	4247	6066	6808	4112
21	1778	3547	3937	3316	4002	2463
22	1024	953	2879	3145	2257	1372
23	541	362	624	2118	2226	287
24	473	255	243	376	1606	519
TOTAL	939562	1092607	1364134	1841121	2256932	2566997

AGE	1973	1974	1975	1976	1977	1978
6	442533	434319	606555	623170	605 192	612 879
7	524018	400257	392412	543287	545910	544 673
8	508748	472573	357559	336615	463251	491661
9	451522	455709	412915	283239	248203	402842
10	253000	399305	384992	295349	182102	192814
11	149133	224516	332664	245525	162408	115378
12	89101	132438	184299	188226	115743	99926
13	72855	77629	109760	112521	82279	53725
14	54534	60973	62041	71200	54939	42943
15	54405	43962	46972	36342	39675	31623
16	40185	44879	33594	26874	19741	23954
17	27948	31252	34997	17651	14999	12368
18	23278	21702	25113	18727	10004	8953
19	15861	18454	16903	11184	10097	3860
20	7505	13102	15115	8899	6816	6146
21	2881	5867	9841	6952	5051	2448
22	1874	2009	4590	4074	4566	1783
23	976	1588	1387	2034	2064	1742
24	215	874	1293	561	856	920
TOTAL	2720573	2841406	3033001	2832429	2424581	2289194

Table 17. *Sebastes mentella*, Divisions IIa and IIb. Biomasses of the recruited stock B (N_{6+}), the spawning stock B (N_{15+}) and the year class strength (estimates from VPA).

Year	B (N_{6+}) (tonnes x 10^{-3})	B (N_{15+}) (tonnes x 10^{-3})	Year class	Year class strength at age 6 (millions)
1965	275	48	1965	622
1966	302	52	1966	580
1967	336	59	1967	443
1968	388	74	1968	434
1969	464	96	1969	607
1970	581	124	1970	(623)
1971	689	135	1971	(605)
1972	778	129	1972	(613)
1973	873	148		
1974	966	158		
1975	1 046	166		
1976	(921)	(116)		
1977	(779)	(98)		
1978	(766)	(80)		

Table 18. Sebastes mentella, Divisions IIa and IIb. Parameters used in catch predictions.

Age	Stock size at the beginning of 1979	Proportional fishing mortality (1978-79)	Mean weight at age (kg)
6	656 000*)	0.025	0.168
7	551 790	0.30	0.183
8	464 140	0.75	0.255
9	382 906	0.75	0.311
10	313 734	1.00	0.367
11	142 840	1.00	0.432
12	85 474	1.00	0.508
13	74 027	1.00	0.611
14	39 430	1.00	0.679
15	31 813	1.00	0.753
16	23 427	1.00	0.821
17	17 746	1.00	0.872
18	9 162	1.00	0.910
19	6 633	1.00	0.923
20	2 857	1.00	0.985
21	4 553	1.00	1.056
22	1 814	1.00	1.124
23	1 321	1.00	1.193
24	1 972	1.00	1.215

*) for estimates of recruitment, see Section 2.6.5.

Table 19. Nominal catches of Redfish (in tonnes) by countries in Division Va (Iceland).

Country	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978*)
Belgium	4 117	3 360	2 204	2 798	2 484	1 622	2 114	1 945	1 522	1 395	1 549
Faroe Isl.	2	8		35	9	243	254	82	211	292	202
German Dem. Rep.	419	656	827	238	135		11		-	-	-
Germany, F.R.	62 521	55 831	48 907	46 580	43 963	38 358	36 398	33 602	32 948	31 632	-
Iceland	24 716	24 321	23 807	29 118	26 973	26 470	27 799	32 659	34 028	28 119	33 318
Netherlands		2							-	-	
Norway	20			1	1	4	15	22	31	87	82
Poland			259	17	35		18		-	-	
UK	3 871	2 302	2 948	3 552	3 697	2 951	2 519	2 424	1 124	+	-
USSR	809	1 256	10	31	28	2			-	-	-
Total	96 475	87 736	78 962	82 370	77 325	69 650	69 129	70 734	69 864	61 525	35 151

Table 20. Nominal catches of Redfish (in tonnes) by countries in Division Vb (Faroe Islands).

Country	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978*)
Faroe Isl.	1	5				121	28	9	33	54	1 525
France							300	800	-	1 368	332
German Dem.Rep	45						1	1	-		
Germany, F.R.	6 358	1 293	1 914	2 328	4 034	9 490	7 328	7 628	5 255	5 854	7 769
Netherlands								105	-	-	-
Norway							10	7	17	10	9
UK	53	28	33	24	53	85	98	41	59	116	161
Total	6 637	1 326	1 947	2 352	4 087	9 696	7 765	8 591	5 364	7 402	9 796

*)provisional data.

Table 21. Nominal catch of Redfish (in tonnes) by countries in Sub-area XIV (East Greeland). Total nominal catch in ICNAF Sub-area I (West Greenland).

Country	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978*)
Canada									420	-	-
Greenland									129	1	3
Faroe Isl.						13	43	1	3	19	-
German Dem.Rep.		154	409	611	703	841	1 275	4 490	-		
Germany, F.R.	17 552	26 289	16 316	17 062	7 287	4 491	2 632	4 979	4 403	13 347	19 086
Iceland	5 527	3 906	1 001	2 380	5 490	2 144	9 777	5 632	7 410	81	151
Norway								63	5	112	3
Poland			436	312	464	281	6	276	-	-	-
UK			+	+	5	65	127	56	286	622	13
USSR		18		71	21	64	118	9 830	101 000	251	-
Total SA XIV	23 079	30 367	18 162	20 436	13 970	7 899	13 978	25 329	113 656	14 433	19 256
Total ICNAF SA I	9 606	4 252	4 101	2 756	2 988	3 319	3 324	8 629	13 698	31 808	10 000**)

Table 22. Nominal catch (in tonnes) of Redfish in Sub-area XIV, Divisions Va and Vb, and by species for Sub-area XIV and Sub-area V combined.

Year	Div. Va	Div. Vb	Sub-area XIV	Total	*S. marinus*	*S. mentella*
1965	114 100	5 862	36 513	156 475	97 006	59 469
1966	107 068	3 297	23 290	133 655	80 347	53 308
1967	95 083	5 013	33 198	133 294	85 249	48 045
1968	96 475	6 637	23 074	126 191	68 712	57 479
1969	87 736	1 326	30 367	119 429	79 467	39 962
1970	78 962	1 947	18 162	99 071	62 020	37 051
1971	82 370	2 352	20 436	105 158	68 374	36 784
1972	77 325	4 087	13 970	95 382	50 961	44 421
1973	69 650	9 696	7 899	87 245	41 818	45 347
1974	69 129	7 765	13 978	90 872	49 845	41 027
1975	70 734	8 591	25 329	104 654	60 980	43 674
1976	69 864	5 364	113 656	188 884	93 605	95 279
1977	61 525	7 402	14 433	83 360	52 752	30 608
1978*)	35 151	9 796	19 256	64 203	46 860	17 343

*) provisional data. **) estimate.

Table 23. S. marinus in Sub-areas V and XIV. Input catch data for VPA.

AGE	1967	1968	1969	1970	1971	1972
9	0	0	0	8	4	59
10	0	0	0	15	5	65
11	154	138	137	183	102	503
12	1166	1101	1108	1148	803	3066
13	2075	1996	2141	1826	1565	4539
14	4546	3971	4891	3599	3713	5998
15	4159	3519	4354	3133	3323	4044
16	6810	5373	6617	4706	5081	4469
17	3563	2718	3200	2352	2424	1928
18	9205	6618	7746	5814	5798	4269
19	7317	5272	6047	4824	4712	3003
20	2682	1964	2245	1908	1841	1020
21	8153	6025	6567	5844	6152	3217
22	5533	4252	4608	4592	4939	2304
23	7410	5892	6240	6596	7342	3269
24	6970	5619	6204	6856	7233	3066
25	2966	2502	2868	3076	3189	1268
26	1882	1630	1894	1956	2205	726
27	829	774	910	916	981	303
28	650	527	717	683	762	211
29	382	210	324	275	259	59
30	143	117	284	184	121	29
TOTAL	76595	60218	69102	60494	62554	47415

AGE	1973	1974	1975	1976	1977	1978
9	21	48	273	2023	50	87
10	28	68	374	2715	71	167
11	402	533	878	6229	556	1019
12	2624	3292	3009	19819	3539	5841
13	4017	4987	3320	19604	5398	5567
14	5652	7437	4282	15776	7820	7867
15	4106	5261	3620	8889	5327	6325
16	4873	6152	5536	9193	5898	5591
17	2074	2518	2704	3780	2392	2145
18	4287	5159	6545	8440	5108	3111
19	2883	3322	4744	5596	3512	2901
20	934	1028	1570	1844	1213	3124
21	2786	3096	4799	5552	3753	3335
22	1798	1956	2973	3389	2484	1482
23	2349	2537	3724	4348	3323	1712
24	2536	2549	3763	3817	2832	1445
25	1239	1229	1740	1751	1170	811
26	783	845	1160	1283	798	599
27	360	407	558	587	364	371
28	255	306	425	429	271	153
29	84	118	197	173	112	97
30	11	12	110	73	69	36
TOTAL	44102	52860	56304	125310	56060	53776

Table 24. S. marinus in Sub-areas V and XIV. Fishing mortalities from VPA (M = 0.10).

AGE	1967	1968	1969	1970	1971	1972	1973	1974	1975
9	.000	.000	.000	.000	.000	.000	.000	.000	.001
10	.000	.000	.000	.000	.000	.000	.000	.000	.002
11	.002	.001	.001	.002	.001	.006	.003	.003	.004
12	.011	.012	.009	.010	.008	.032	.036	.023	.019
13	.021	.022	.027	.016	.015	.052	.048	.079	.027
14	.054	.046	.061	.052	.037	.065	.076	.105	.081
15	.057	.049	.059	.045	.056	.046	.053	.085	.061
16	.109	.087	.110	.075	.087	.089	.065	.094	.109
17	.067	.052	.062	.047	.045	.039	.049	.039	.049
18	.192	.153	.184	.137	.139	.095	.102	.149	.121
19	.172	.144	.183	.149	.141	.089	.077	.096	.178
20	.068	.057	.076	.073	.070	.037	.033	.032	.054
21	.244	.193	.245	.256	.313	.152	.121	.130	.184
22	.215	.174	.199	.242	.319	.165	.107	.105	.159
23	.417	.331	.367	.426	.656	.321	.226	.193	.265
24	.653	.567	.609	.771	1.024	.560	.392	.361	.429
25	.525	.455	.564	.614	.907	.427	.408	.297	.398
26	.578	.544	.657	.842	1.107	.467	.451	.478	.447
27	.466	.440	.590	.686	1.308	.370	.395	.397	.592
28	.584	.539	.830	1.092	2.261	1.029	.538	.605	.821
29	1.008	.334	.663	.795	1.746	1.348	1.551	.454	.892
30	.130	.130	.130	.130	.130	.130	.130	.130	.130

MEAN F FOR AGES >= 16 AND <= 30 (WEIGHTED BY STOCK IN NUMBERS)

	1967	1968	1969	1970	1971	1972	1973	1974	1975
	.196	.160	.194	.190	.225	.116	.098	.106	.143

AGE	1976	1977	1978
9	.032	.005	.020
10	.011	.001	.020
11	.035	.003	.020
12	.110	.022	.030
13	.148	.036	.040
14	.154	.073	.060
15	.215	.054	.070
16	.195	.194	.080
17	.091	.064	.090
18	.189	.153	.100
19	.130	.101	.110
20	.088	.034	.110
21	.246	.230	.110
22	.171	.148	.120
23	.326	.226	.130
24	.420	.325	.130
25	.322	.195	.130
26	.507	.213	.130
27	.379	.233	.130
28	1.150	.268	.130
29	.849	.978	.130
30	.130	.130	.130

MEAN F FOR AGES >= 16 AND <= 30 (WEIGHTED BY STOCK IN NUMBERS)

	1976	1977	1978
	.189	.141	.103

Table 25. S. marinus in Sub-areas V and XIV. Stock size in numbers from VPA.

AGE	1967	1968	1969	1970	1971	1972
9	168225	141541	140030	107298	201742	228313
10	165829	152216	128071	126705	97080	182540
11	104980	150048	137731	115884	114633	87837
12	110148	94844	135638	124494	104682	103627
13	104734	98557	84771	121677	111555	93957
14	90488	92795	87281	74669	108362	99451
15	78909	77557	80190	74327	64143	94520
16	69472	67447	66831	68421	64276	54881
17	57698	56391	55923	54186	57438	53331
18	55226	48822	48442	47561	46794	49668
19	48656	41232	37891	36478	37513	36834
20	42579	37078	32302	28544	28425	29468
21	39451	35979	31683	27095	24015	23971
22	30009	27960	26835	22437	18971	15895
23	22760	21901	21262	19907	15944	12482
24	15200	13573	14230	13324	11763	7484
25	7595	7162	6963	7007	5578	3824
26	4485	4065	4110	3586	3430	2038
27	2330	2277	2135	1928	1398	1026
28	1537	1323	1327	1071	879	342
29	627	775	698	524	325	83
30	253	207	502	326	214	51
TOTAL						
	1221190	1173749	1144849	1077446	1119159	1181623

AGE	1973	1974	1975	1976	1977	1978
9	271705	235594	284424	68247	9845	4616
10	206530	245828	213129	257098	59829	8861
11	165107	186850	222370	192491	230050	54068
12	79000	149013	168562	200374	168252	207630
13	90851	68988	131703	149660	162479	148877
14	80702	78388	57684	116014	116801	141886
15	84287	67651	63863	48126	89992	98255
16	81682	72364	56215	54345	35109	76366
17	45412	69278	59633	45606	40447	26169
18	46424	39119	60292	51388	37675	34325
19	40886	37933	30497	48337	38485	29239
20	30476	34255	31167	23091	38422	31486
21	25694	26688	30018	26709	19141	33613
22	18635	20603	21207	22606	18399	13758
23	12195	15153	16784	16366	17237	14742
24	8194	8805	11303	11653	10686	12443
25	3870	5011	5551	6662	6928	6983
26	2258	2327	3369	3374	4368	5158
27	1156	1302	1306	1949	1838	3195
28	641	705	792	653	1207	1317
29	111	339	343	315	187	835
30	19	21	195	129	122	64
TOTAL						
	1295834	1366215	1470410	1345194	1108000	953885

Table 26. Sebastes marinus in Sub-areas V and XIV. Total stock biomass (age 9+) and spawning stock biomass (age 16+) (in '000 tonnes).

Year	Total stock biomass	Spawning stock biomass
1967	882	454
1968	839	417
1969	816	400
1970	769	373
1971	767	349
1972	772	314
1973	828	339
1974	874	360
1975	932	364
1976	(892)	(352)
1977	(784)	(315)
1978	(726)	(331)

Table 27. Sebastes marinus in Sub-areas V and XIV. Paramaters used in catch predictions.

Age	Stock size beginning of 1979 x 10^{-3}	Relative fishing mortality	Mean weight at age (kg.)	
9	187 000	0.15	0.399	
10	4 096	0.15	0.440	
11	7 863	0.15	0.486	
12	47 978	0.23	0.536	
13	182 337	0.31	0.591	Recruitment: average over 1967-1974) 187 000 x 10^{-3}
14	129 389	0.46	0.652	
15	120 931	0.54	0.720	M = 0.1
16	82 877	0.62	0.794	
17	63 748	0.69	0.876	
18	21 647	0.77	0.966	
19	28 100	0.85	1.066	
20	23 688	0.85	1.176	
21	25 509	0.85	1.297	
22	27 232	0.92	1.431	
23	11 045	1.00	1.579	
24	11 713	1.00	1.742	
25	9 886	1.00	1.922	
26	5 548	1.00	2.120	
27	4 098	1.00	2.339	
28	2 539	1.00	2.580	
29	1 046	1.00	2.846	
30+	714	1.00	3.905	

Table 28. S. mentella in Sub-areas V and XIV. Input catch data for VPA.

AGE	1967	1968	1969	1970	1971	1972
9	0	0	0	0	0	0
10	0	0	0	0	0	0
11	0	0	0	0	0	0
12	32	12	46	75	19	15
13	84	40	137	218	66	46
14	437	250	649	975	372	320
15	479	292	606	891	385	414
16	1452	1024	1576	2142	1066	1567
17	1519	1221	1492	1871	1059	1685
18	2515	2260	2362	2649	1691	2743
19	3349	3433	3000	2923	2284	3500
20	1060	1136	844	820	699	993
21	8121	9195	6578	5822	5609	6885
22	3203	3945	2610	2043	2528	2483
23	10430	12819	9126	6632	8854	8162
24	5339	6473	5960	3673	4758	4703
25	2490	2908	2390	1792	2186	2285
26	1851	2149	2079	1441	1647	1844
27	785	914	717	704	666	824
28	369	441	899	516	385	492
TOTAL	43515	48512	41071	35187	34274	38361

AGE	1973	1974	1975	1976	1977	1978
9	0	0	0	3202	2	308
10	1	0	0	2948	2	629
11	2	0	1	6533	3	870
12	122	71	87	22608	142	1458
13	269	196	262	21121	362	636
14	549	802	1331	14107	1438	782
15	408	677	1161	5547	1334	1156
16	1068	1591	2384	4431	3411	1511
17	1107	1445	1797	2619	2897	845
18	1874	2242	2285	2841	3722	1515
19	2586	2790	2202	2229	3454	1314
20	779	795	605	541	802	1044
21	5741	5467	4474	3625	4884	1618
22	2379	2029	1785	1192	1314	1211
23	9044	7398	6357	4050	3958	1984
24	5862	4602	4093	2403	2172	1330
25	3063	2306	2147	1232	1089	789
26	2551	1935	1862	1061	928	485
27	1158	900	913	544	480	100
28	565	489	581	331	377	0
TOTAL	39128	35735	34327	103165	32771	19585

Table 29. S. mentella in Sub-areas V and XIV. Fishing mortalities from VPA (M = 0.10).

AGE	1967	1968	1969	1970	1971	1972	1973	1974	1975
9	.000	.000	.000	.000	.000	.000	.000	.000	.000
10	.000	.000	.000	.000	.000	.000	.000	.000	.000
11	.000	.000	.000	.000	.000	.000	.000	.000	.000
12	.001	.000	.001	.002	.001	.000	.004	.001	.002
13	.002	.001	.003	.006	.002	.001	.008	.007	.006
14	.008	.005	.014	.027	.012	.012	.018	.026	.052
15	.009	.006	.014	.022	.012	.014	.016	.025	.043
16	.026	.021	.038	.058	.029	.056	.042	.074	.103
17	.026	.025	.035	.052	.033	.053	.046	.067	.101
18	.047	.045	.055	.073	.054	.102	.070	.110	.128
19	.071	.076	.070	.081	.075	.137	.119	.126	.136
20	.026	.028	.022	.022	.022	.038	.037	.044	.033
21	.240	.284	.201	.183	.185	.283	.287	.342	.327
22	.106	.157	.109	.080	.101	.105	.134	.139	.159
23	.558	.673	.569	.389	.503	.477	.587	.672	.724
24	.544	.716	.680	.417	.472	.484	.663	.597	.879
25	.477	.572	.558	.392	.417	.387	.594	.527	.546
26	.586	.870	.936	.688	.667	.656	.868	.832	.961
27	.852	.571	.718	.868	.705	.743	1.025	.775	1.125
28	.400	.400	.400	.400	.400	.400	.400	.400	.400

MEAN F FOR AGES >= 12 AND <= 24 (WEIGHTED BY STOCK IN NUMBERS)

	1967	1968	1969	1970	1971	1972	1973	1974	1975
	.076	.096	.086	.079	.086	.107	.119	.116	.115

AGE	1976	1977	1978
9	.112	.000	.040
10	.063	.000	.040
11	.283	.000	.040
12	.646	.008	.040
13	.524	.016	.040
14	.398	.053	.040
15	.279	.053	.050
16	.204	.247	.070
17	.141	.179	.080
18	.206	.272	.120
19	.160	.366	.130
20	.040	.071	.160
21	.249	.524	.180
22	.121	.120	.210
23	.565	.634	.240
24	.588	.599	.400
25	.634	.512	.400
26	.506	1.321	.400
27	.738	.400	.400
28	.400	.400	.000

MEAN F FOR AGES >= 12 AND <= 24 (WEIGHTED BY STOCK IN NUMBERS)

	1976	1977	1978
	.369	.175	.092

Table 30. S. mentella in Sub-areas V and XIV. Stock size in numbers from VPA.

AGE	1967	1968	1969	1970	1971	1972
9	48536	53859	54773	46271	74695	80948
10	51111	43918	48734	49561	41868	67587
11	52328	46247	39738	44096	44845	37884
12	60058	47349	41846	35957	39900	40577
13	54682	54313	42831	37820	32464	36085
14	55499	49399	49106	38625	34014	29312
15	56601	49802	44460	43816	34023	30423
16	59479	50759	44785	39653	38799	30419
17	61106	52439	44955	39025	33844	34094
18	57020	53847	46288	39259	33533	29616
19	51135	49204	46575	39638	33006	28735
20	44225	43086	41259	39292	33089	27694
21	39965	39009	37906	36530	34773	29275
22	33582	28455	26575	28055	27527	26139
23	25521	27343	22001	21566	23444	22506
24	13304	13221	12620	11271	13228	12829
25	6870	6984	5844	5784	6718	7463
26	4365	3858	3568	3026	3535	4007
27	1428	2198	1462	1266	1375	1641
28	461	551	1124	645	481	615
TOTAL	777277	715839	656450	601157	585160	577849

AGE	1973	1974	1975	1976	1977	1978
9	67008	33986	56153	31832	18626	8252
10	73245	60632	30752	50809	25761	16851
11	61155	66274	54862	27825	43172	23308
12	34279	55334	59967	49640	18980	39061
13	36701	30901	50000	54177	23534	17039
14	32607	32953	27774	44993	29026	20950
15	26218	28982	29055	23866	27342	24897
16	27135	23335	25581	25186	16333	23472
17	26035	23537	19603	20881	18584	11542
18	29248	22505	19924	16030	16407	14065
19	24192	24684	18234	15858	11808	11315
20	22676	19434	19685	14407	12232	7410
21	24115	19778	16829	17236	12522	10306
22	19958	16374	12712	10985	12156	6707
23	21293	15800	12889	9808	8807	3751
24	12634	10709	7301	5654	5041	4225
25	7154	5888	5336	2742	2842	2507
26	4587	3576	3145	2796	1316	1541
27	1882	1742	1408	1089	1525	318
28	706	611	726	414	471	0
TOTAL	552829	497033	471933	426229	306487	253516

Table 31 Sebastes mentella Sub-divisions V and XIV

Total stock biomass (age 9+) and spawning stock biomass (age 16+) in 1 000 tonnes

Year	Total Stock biomass	Spawning stock biomass
1967	495	351
1968	462	332
1969	421	301
1970	387	277
1971	371	263
1972	353	241
1973	327	212
1974	290	178
1975	264	152
1976	(235)	(129)
1977	(181)	(110)
1978	(150)	(91)

Table 32 Sebastes mentella Sub-divisions V and XIV
Parameters used in catch predictions

Age	Stock size in numbers beginning of 1979($\times 10^{-3}$)	Relative fishing mortality	Mean Weight at age (kg)	
9	57 500	0.10	0.260	
10	7 174	0.10	0.292	
11	14 650	0.10	0.327	
12	20 263	0.10	0.367	Recruitment:
13	33 958	0.10	0.410	(average over 1967 - 78)
14	14 813	0.10	0.461	57 500 x 10^3
15	18 213	0.13	0.516	M = 0.1
16	21 386	0.18	0.578	
17	19 763	0.20	0.648	
18	9 641	0.30	0.726	
19	11 287	0.33	0.813	
20	8 972	0.40	0.912	
21	5 713	0.45	1.022	
22	7 789	0.53	1.145	
23	4 909	0.60	1.284	
24	6 940	1.00	1.438	
25	2 563	1.00	1.614	
26	1 521	1.00	1.809	
27	1 128	1.00	2.028	

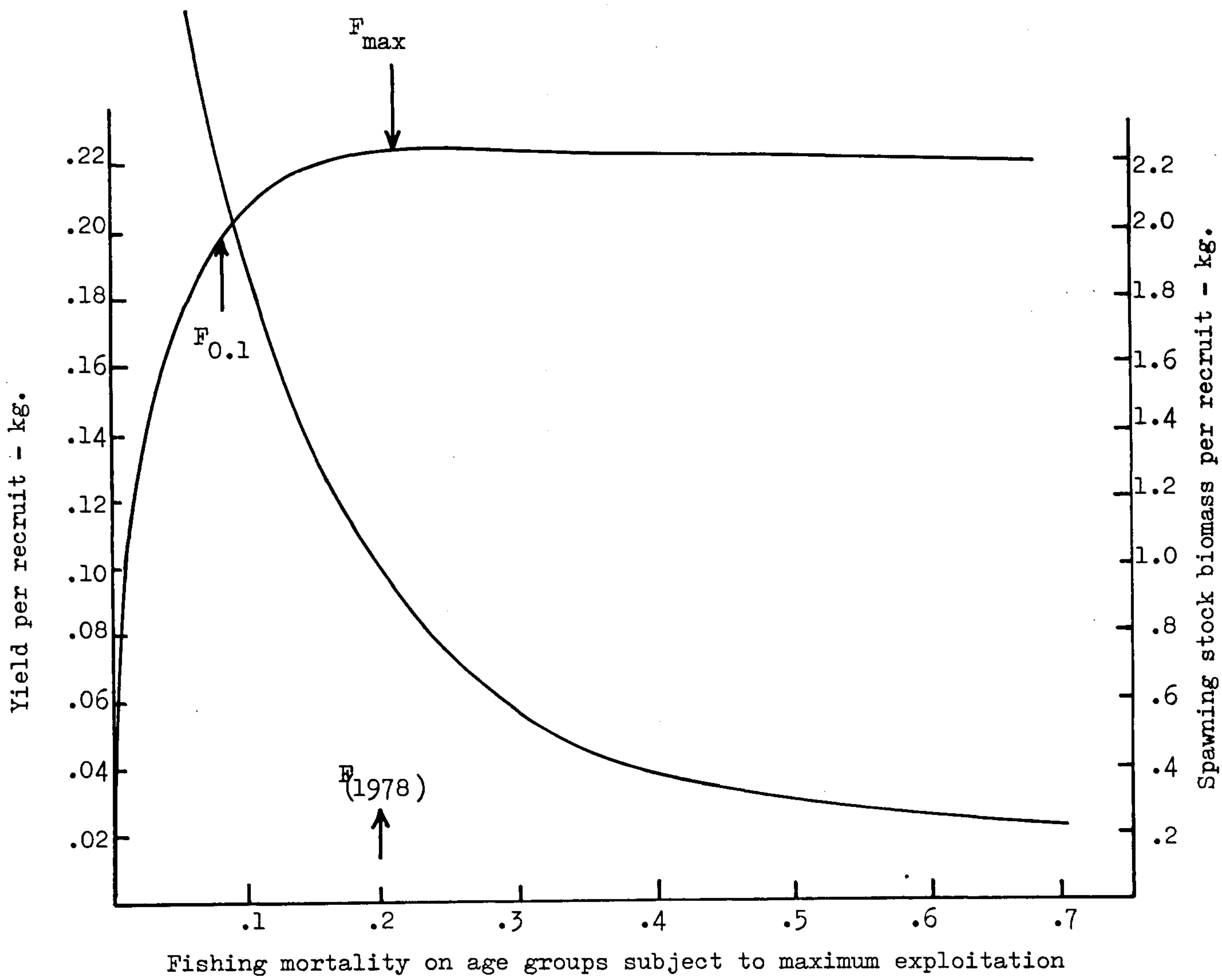


Figure 1. Sebastes marinus in Sub-area I and Division IIa.
Yield per recruit and spawning stock per recruit curves for the present exploitation pattern (M = 0.10).

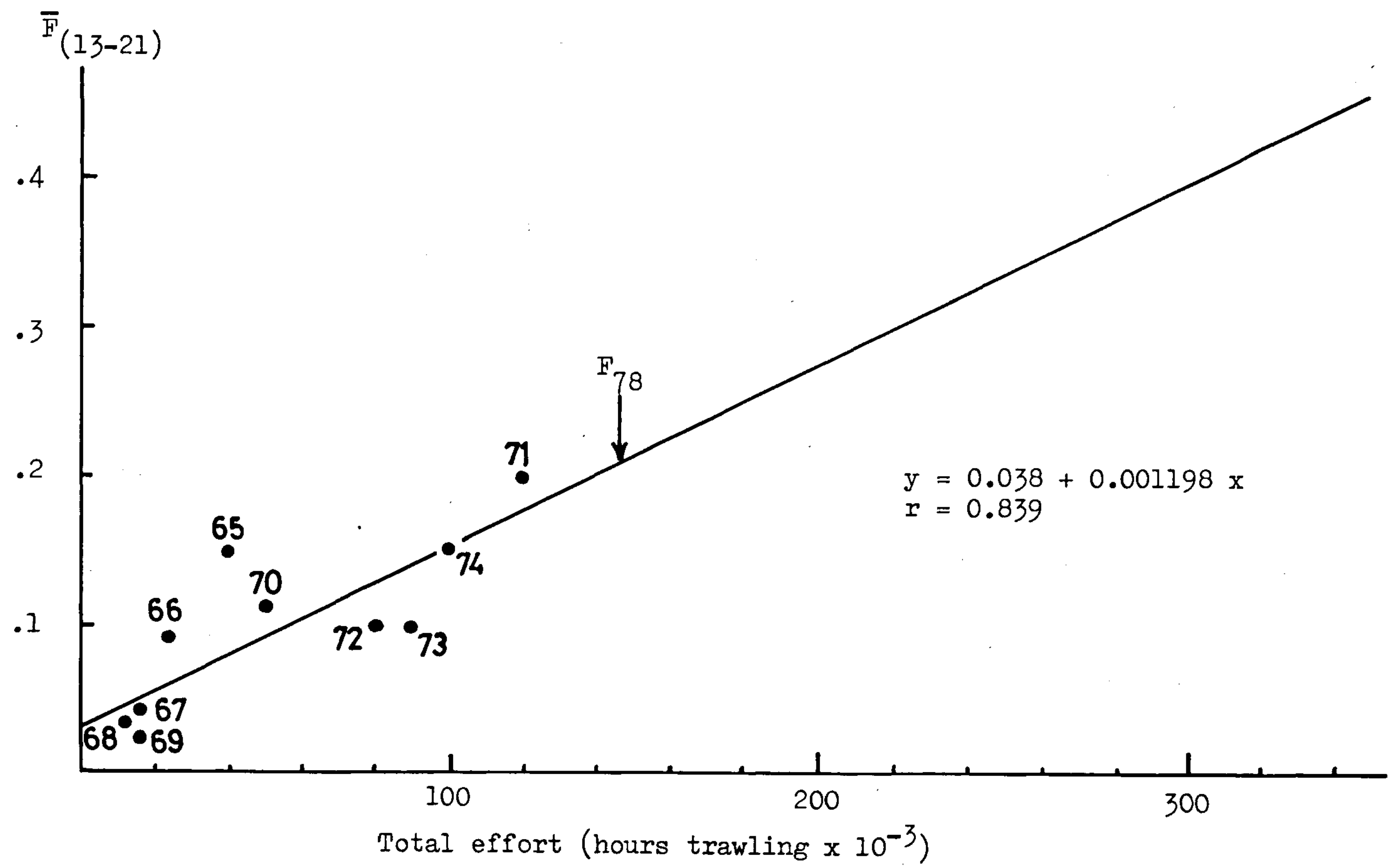


Figure 2. *Sebastes mentella* in Divisions IIa and IIb. Relation of weighted mean fishing mortality (ages 13-21) to total effort.

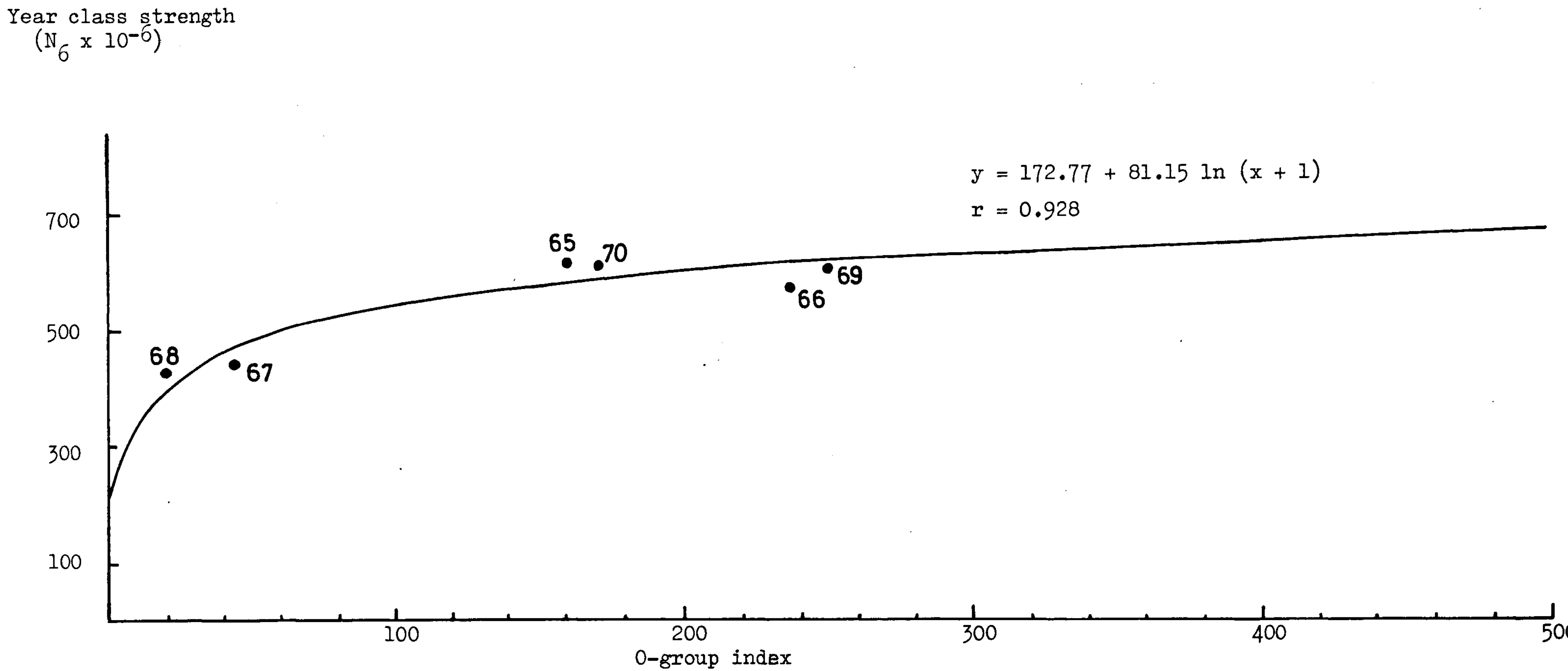


Figure 3. *Sebastes mentella* in Division IIa and IIb. Relation of year class strength at age 6 (from VPA) to corresponding 0-group survey abundance indices.

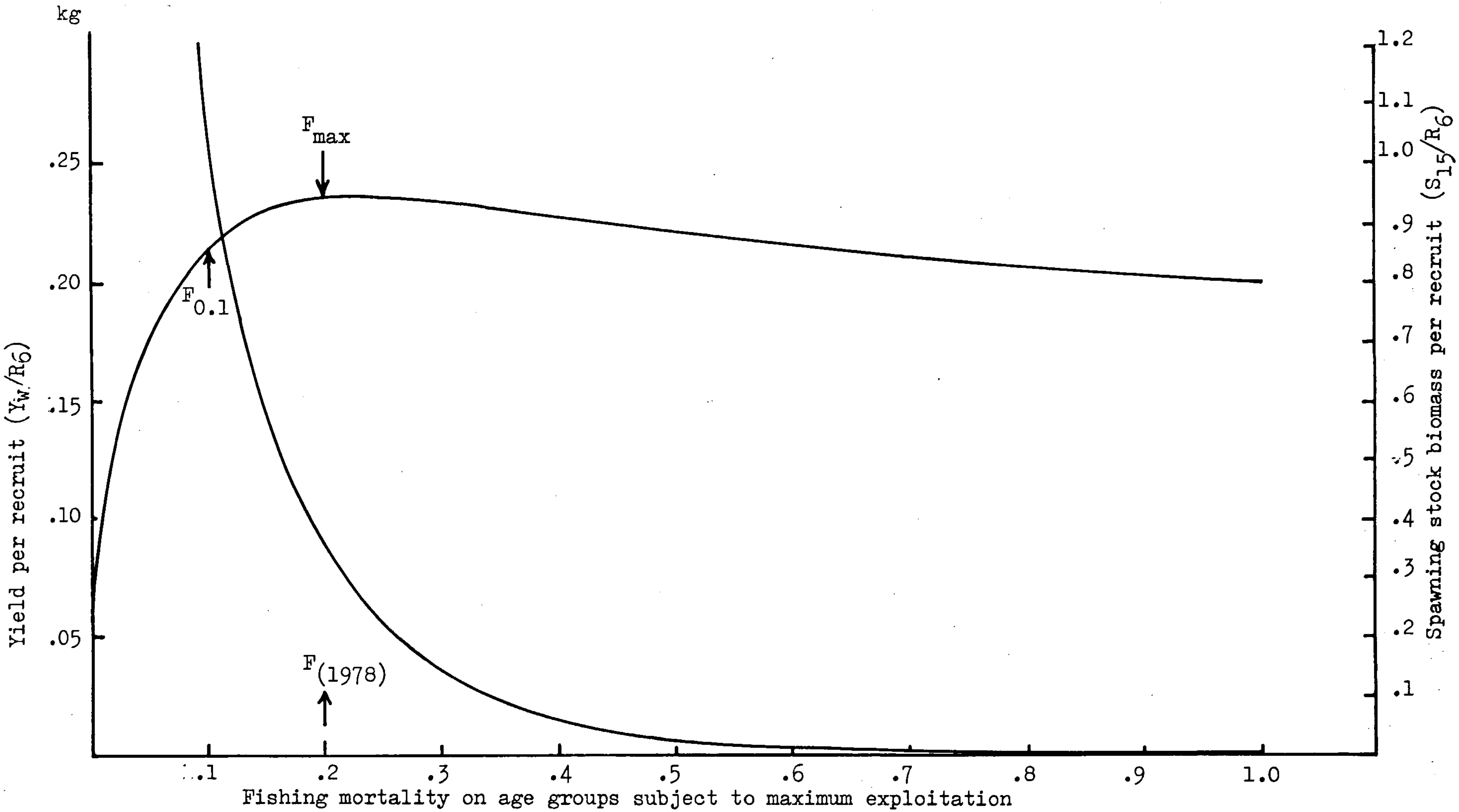
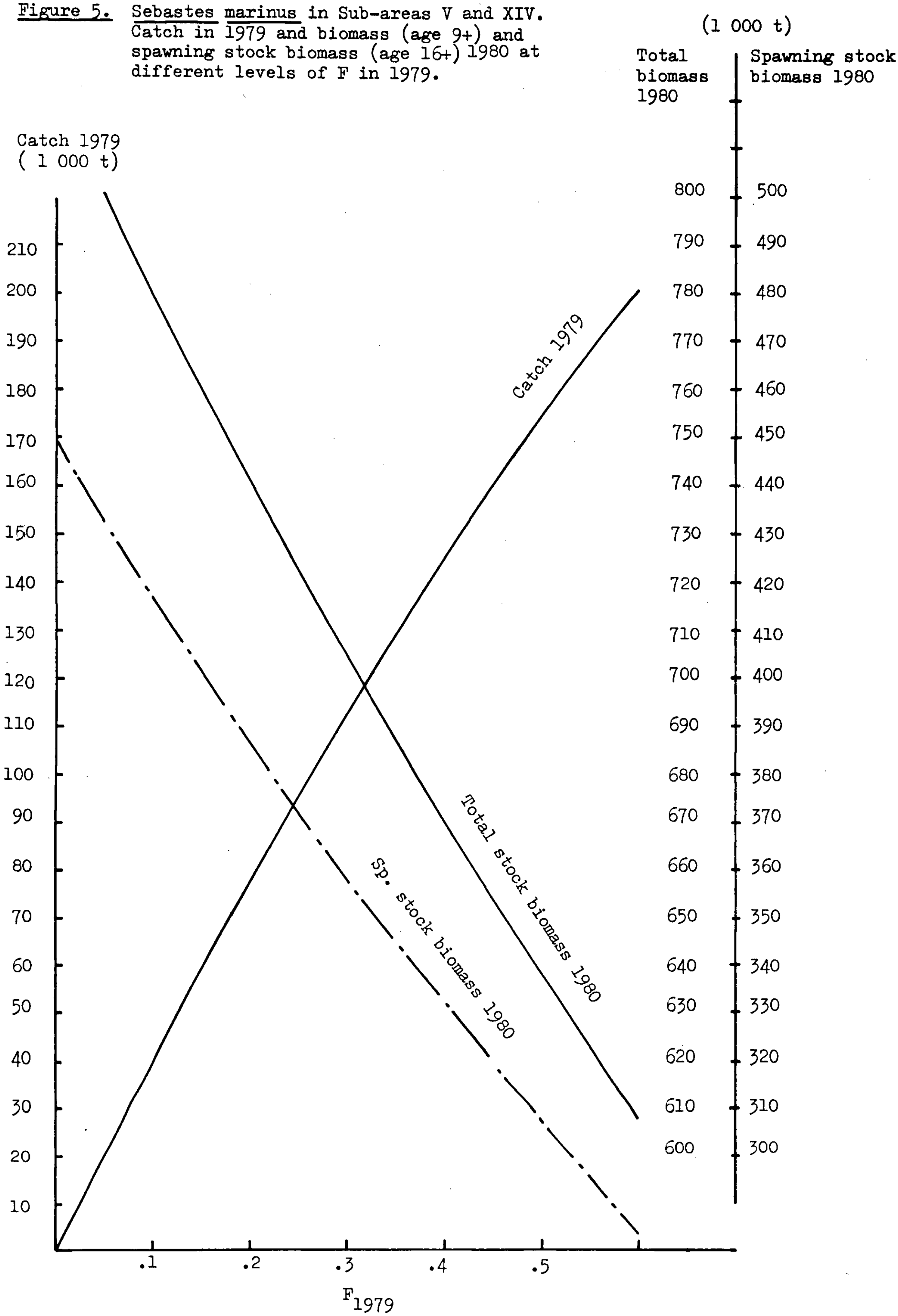


Figure 4. *Sebastes mentella* in Divisions IIa and IIb. Yield per recruit and spawning stock per recruit curves for present exploitation pattern (M = 0.1)

Figure 5. Sebastes marinus in Sub-areas V and XIV. Catch in 1979 and biomass (age 9+) and spawning stock biomass (age 16+) 1980 at different levels of F in 1979.



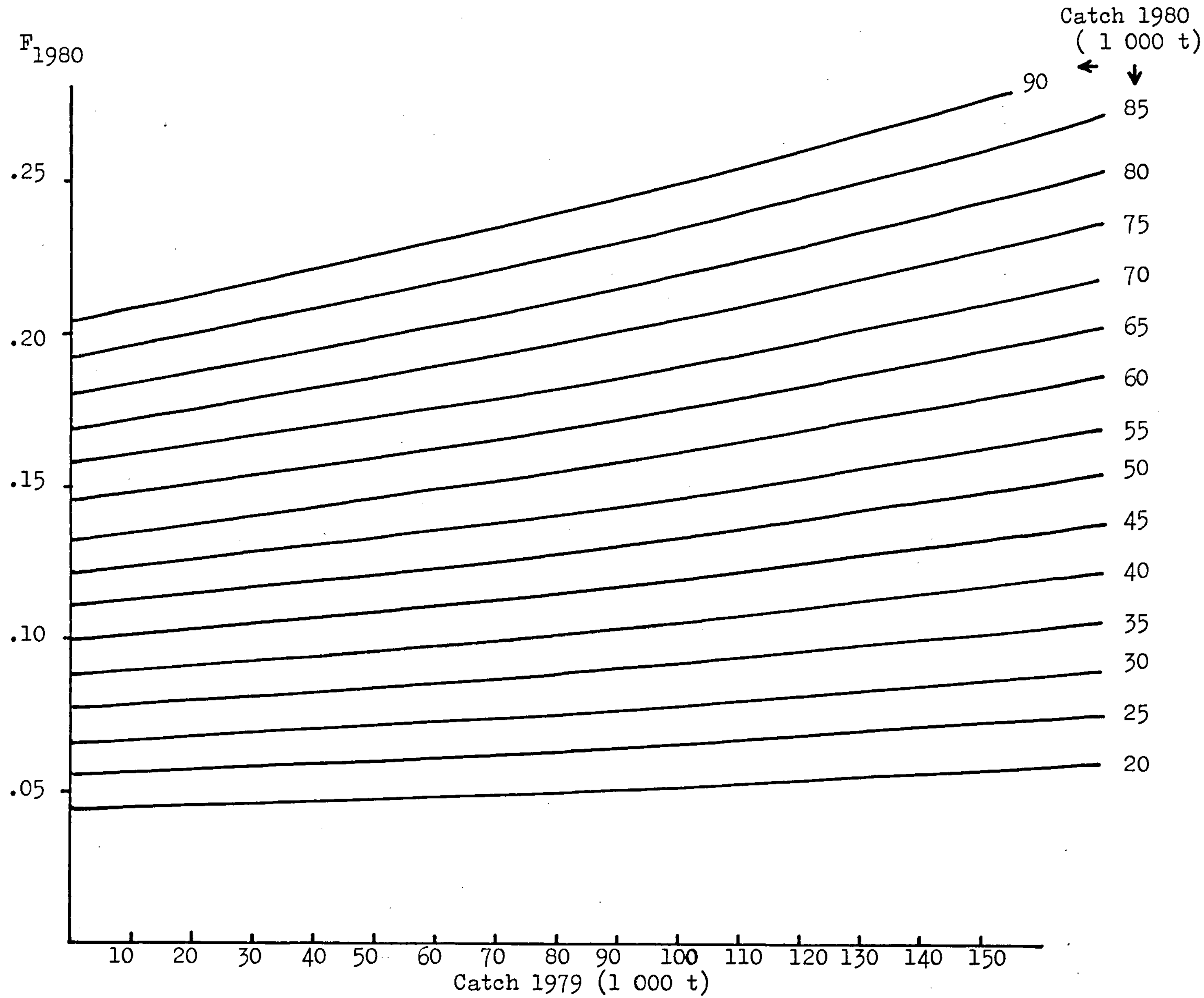


Figure 6. *Sebastes marinus* in Sub-areas V and XIV. Catch in 1980 at different levels of F in 1980 and different catch levels in 1979.

Figure 7. Sebastes marinus in Sub-areas V and XIV. Spawning stock biomass in 1981 at different levels of F in 1980 and different catch levels in 1979.

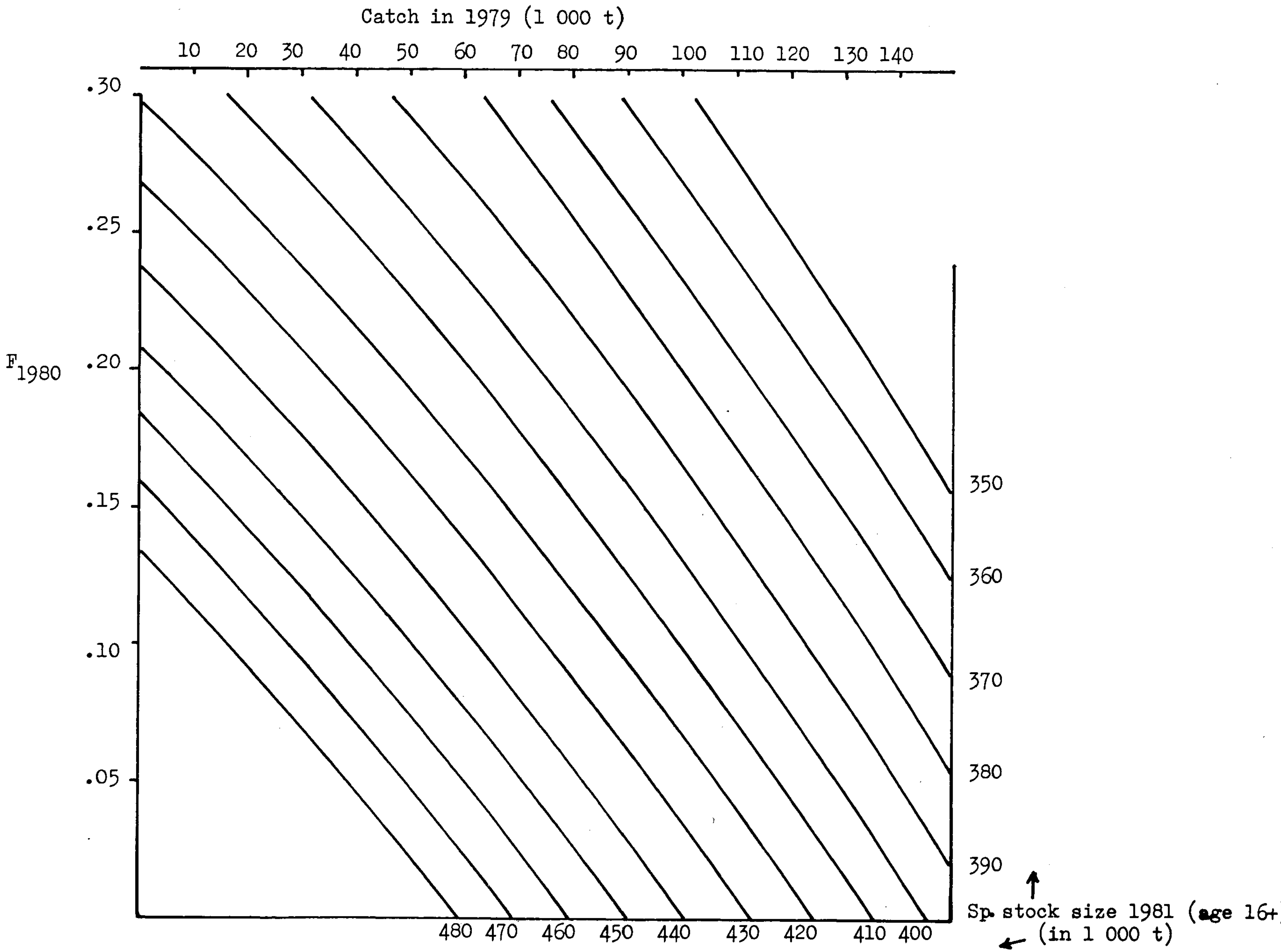
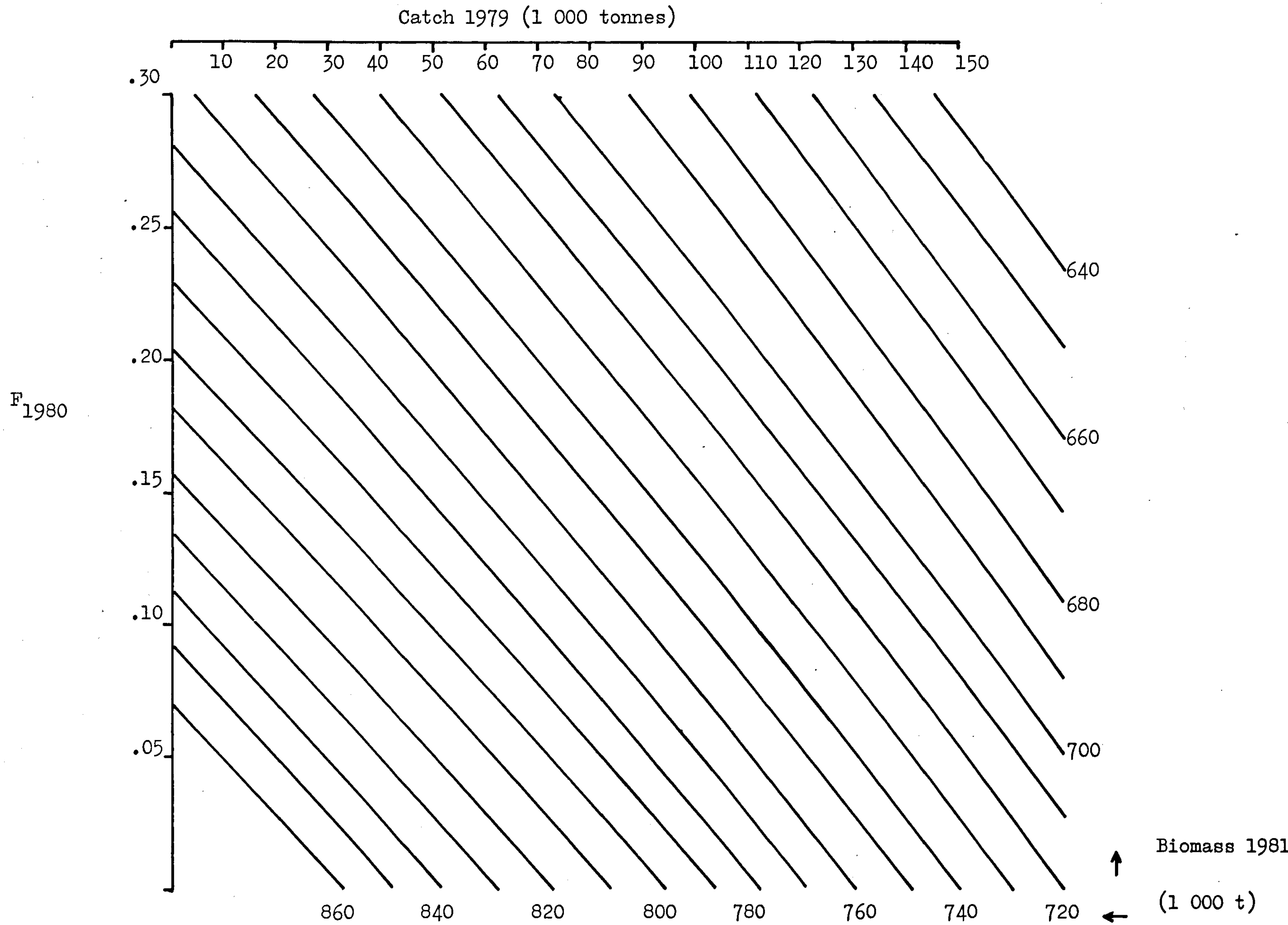
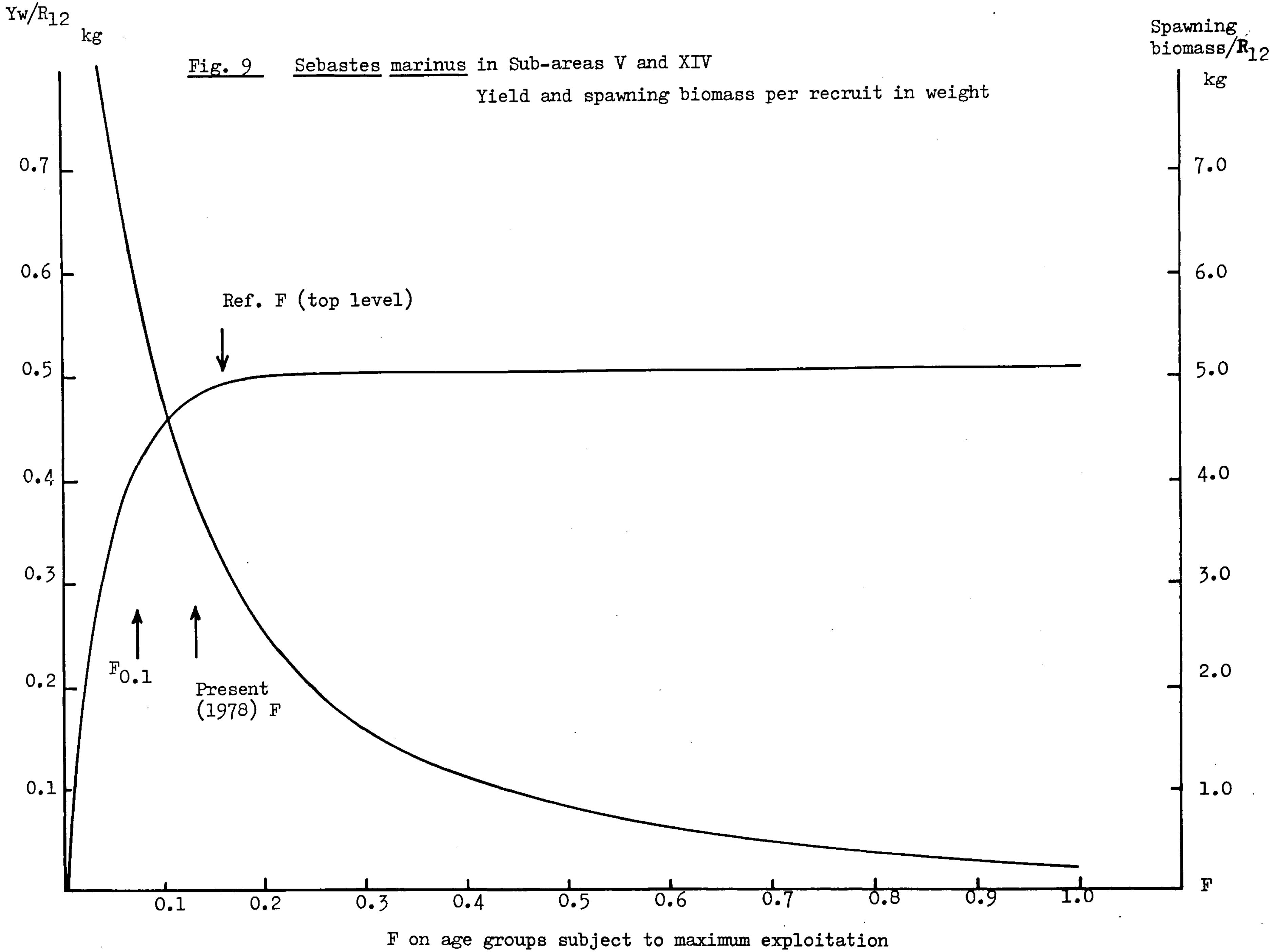


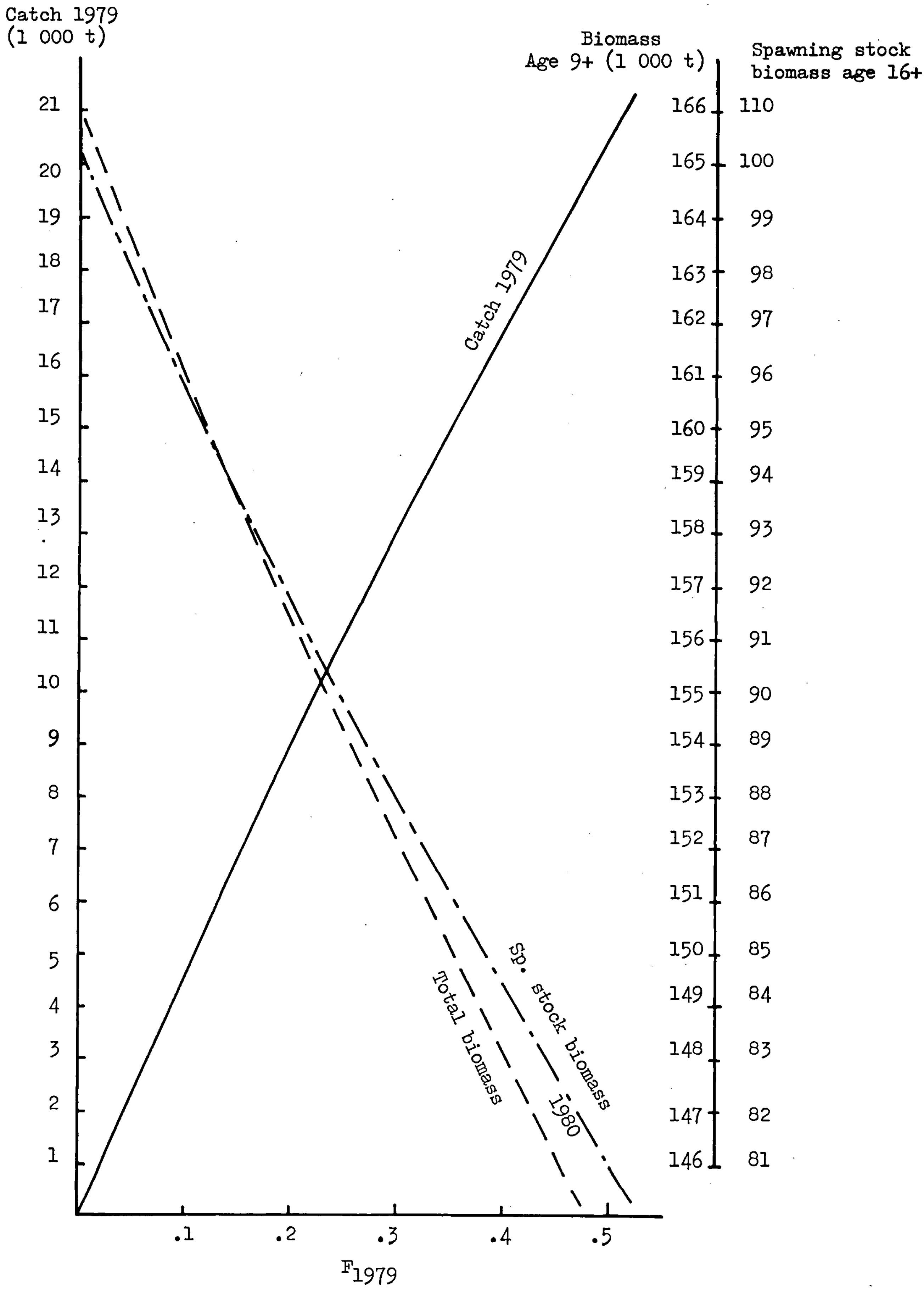
Fig. 8 Sebastes marinus Sub-areas V and XIV Biomass (age 9+) in 1981 at different level of F in 1980 and different catch levels in 1979





Yw/R12 kg
Spawning biomass/R12 kg
Fig. 9 Sebastes marinus in Sub-areas V and XIV
Yield and spawning biomass per recruit in weight
0.7
0.6
0.5
0.4
0.3
0.2
0.1
7.0
6.0
5.0
4.0
3.0
2.0
1.0
Ref. F (top level)
F0.1
Present (1978) F
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
0.9
1.0
F
F on age groups subject to maximum exploitation

Fig. 10 Sebastes mentella in Sub-areas V and XIV. Catch 1979 and stock size 1980 at different levels of F in 1979



<u>Fig. 11</u> <u>Sebastes mentella</u> Sub-areas V and XIV. Catch in 1980 at different levels of F in 1980 and different catch levels in 1979

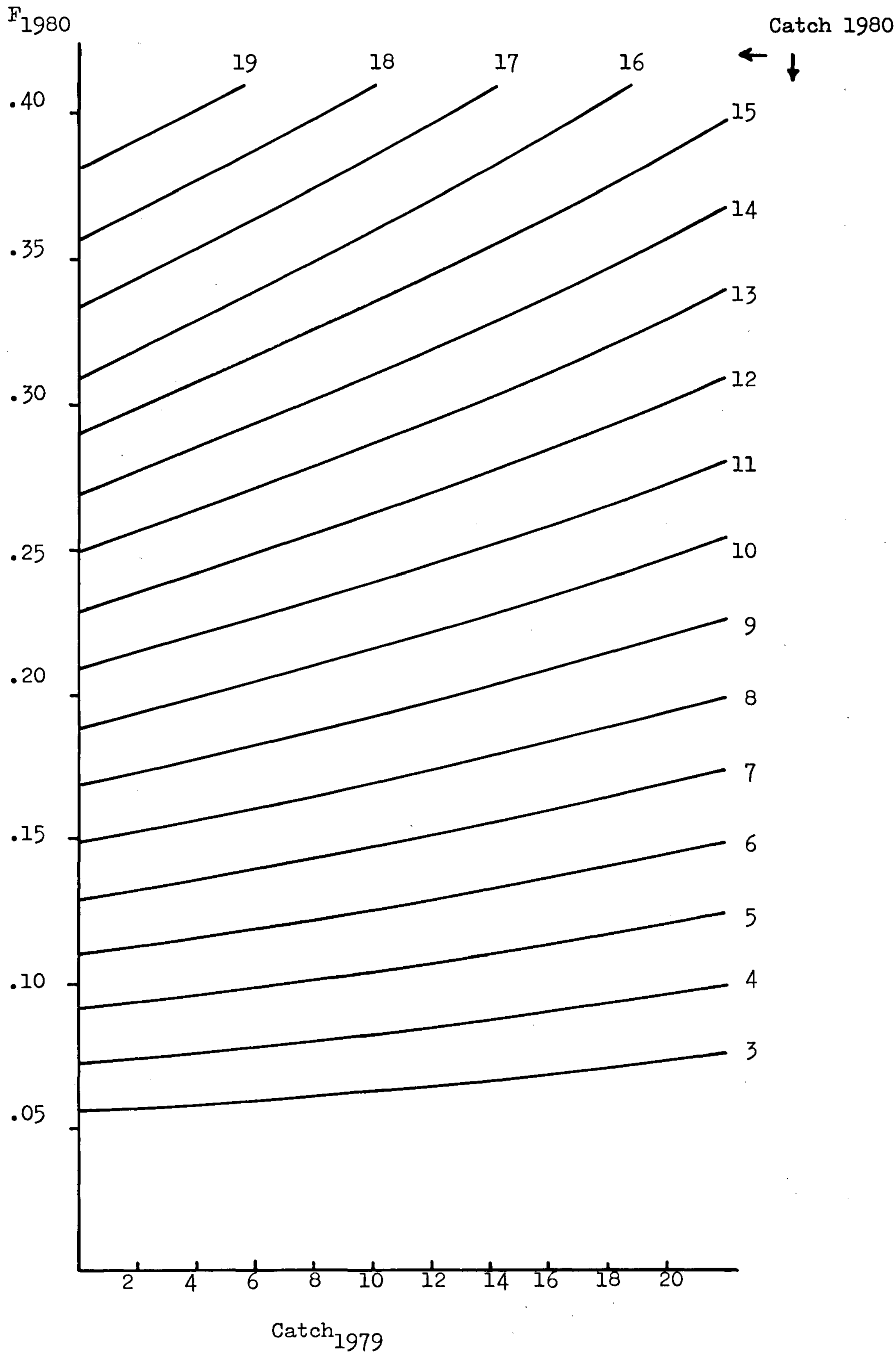


Fig. 12 Sebastes mentella Sub-areas V and XIV. Spawning stock biomass in 1981 at different levels of F in 1980 and different catch levels in 1979

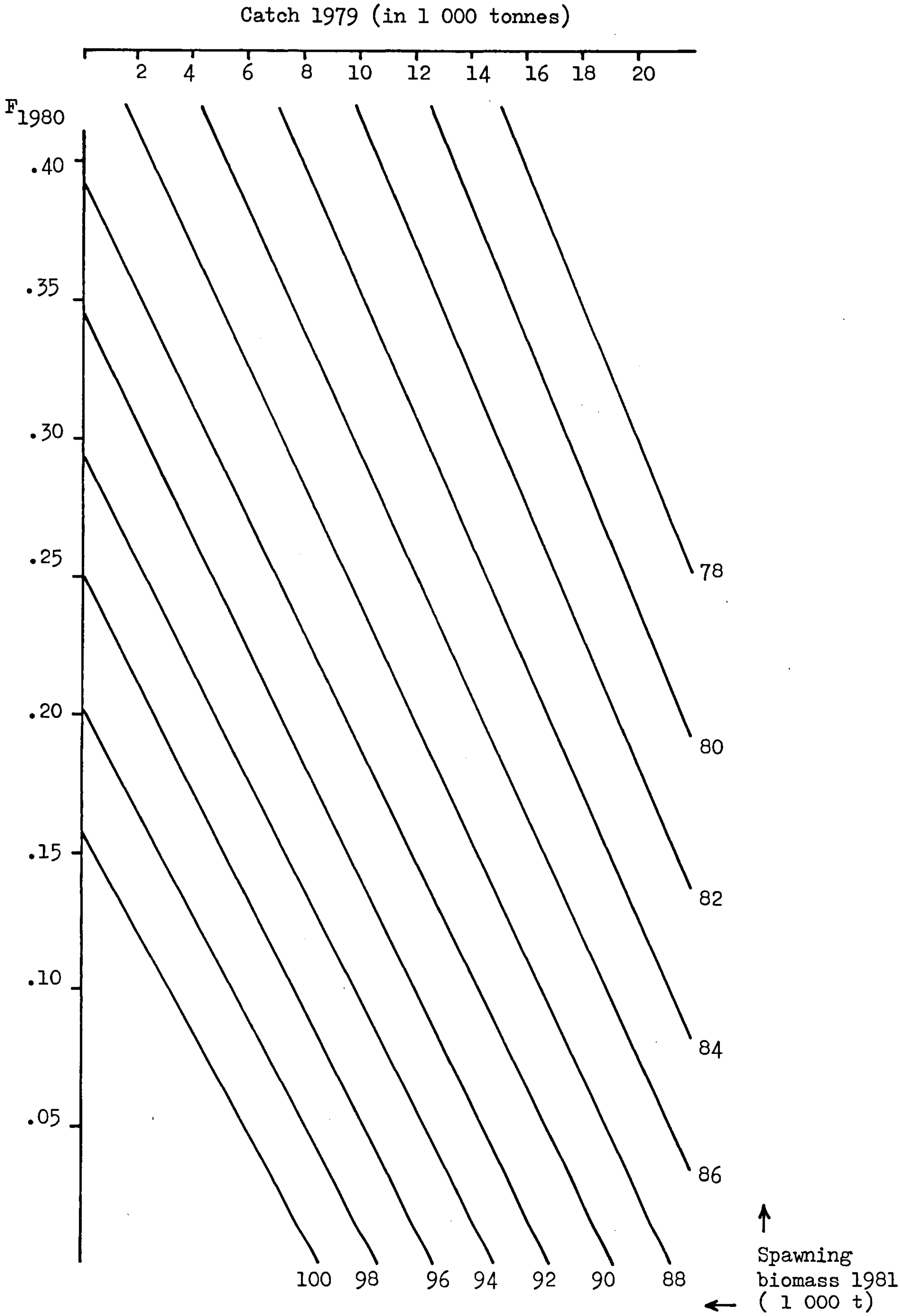
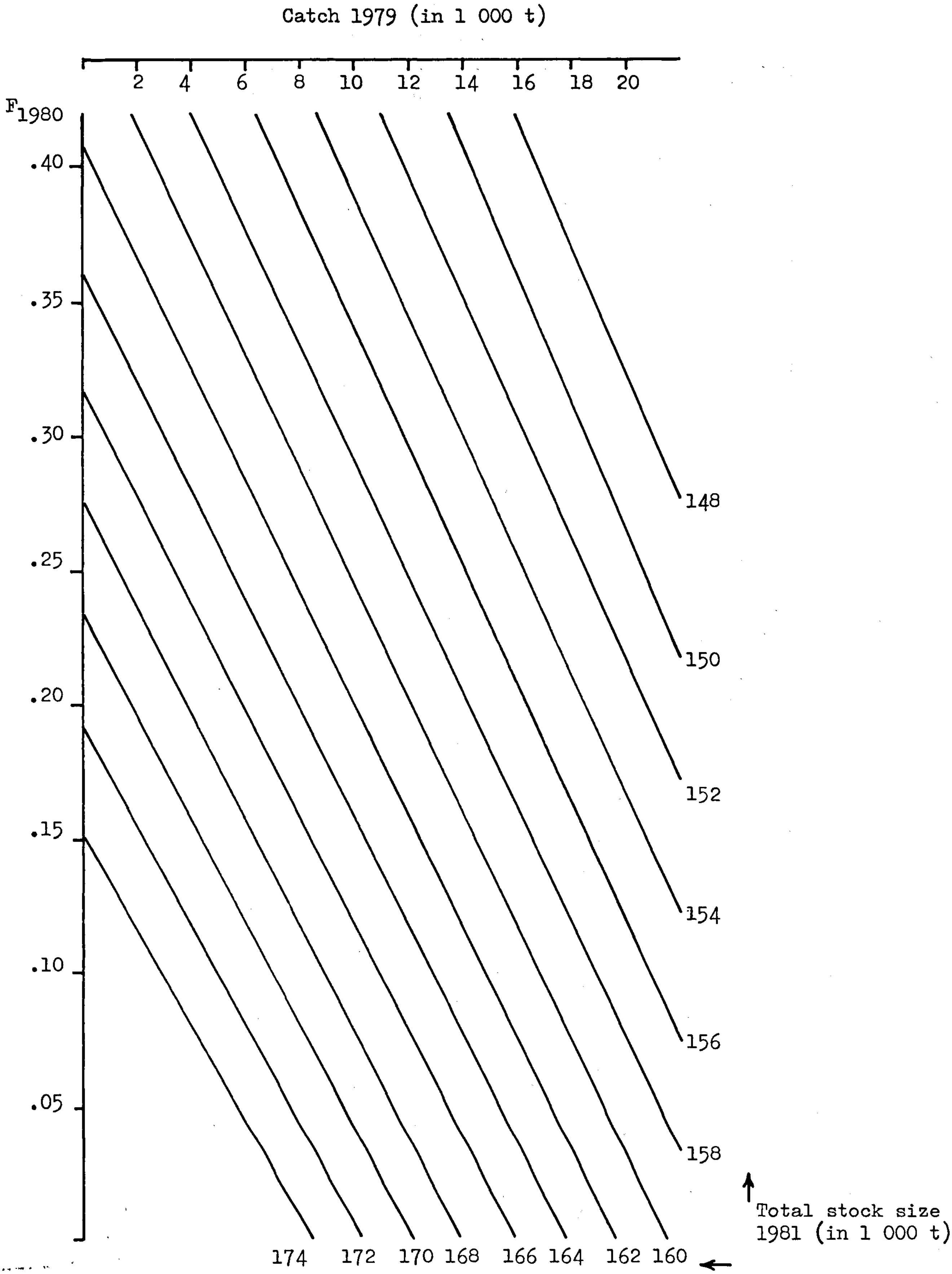


Fig. 13 Sebastes mentella Total stock biomass at different levels of F in 1980 and different catch levels in 1979



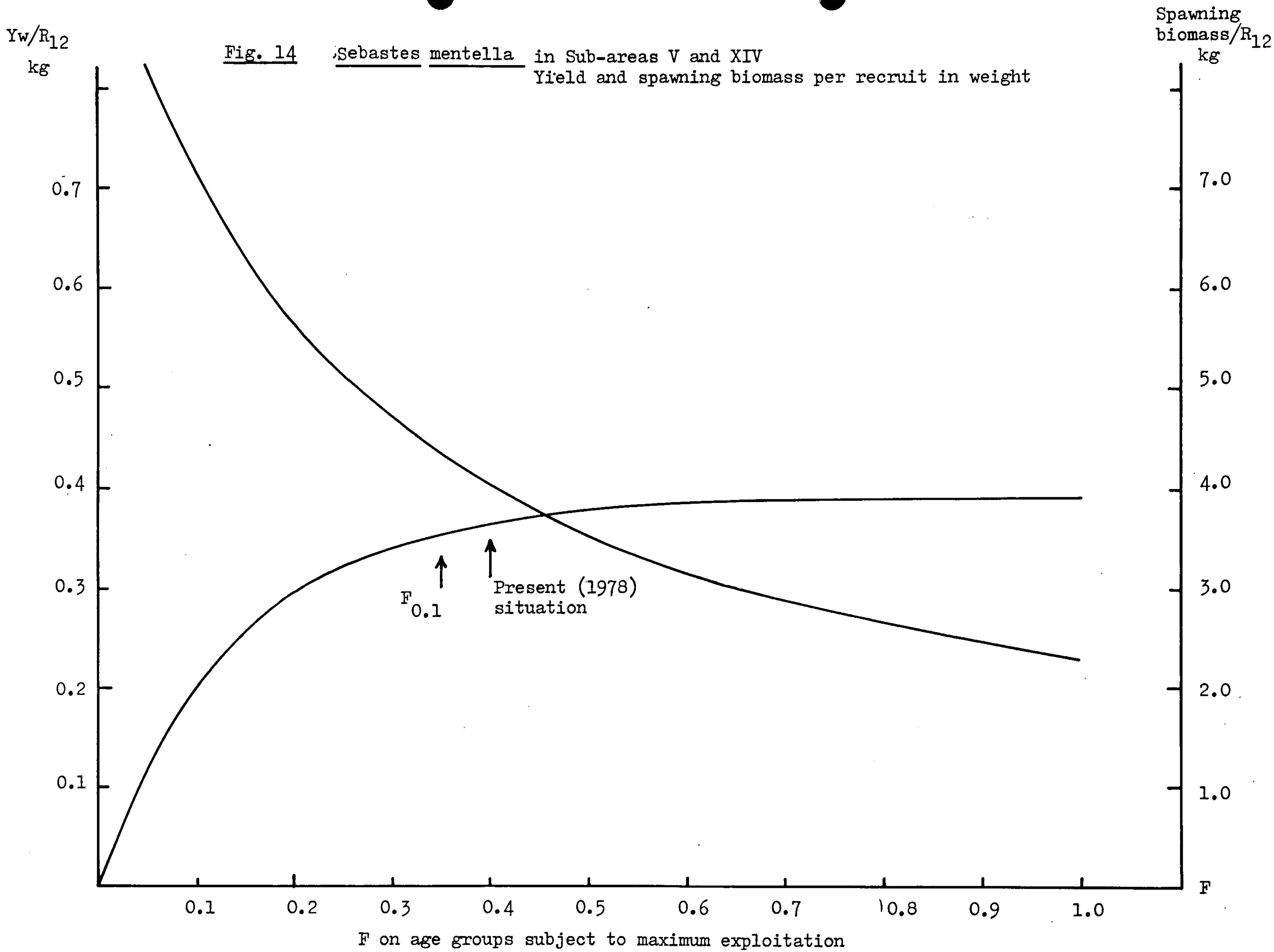


Fig. 14 *Sebastes mentella* in Sub-areas V and XIV
Yield and spawning biomass per recruit in weight