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REPORT OF THE WORKING GROUP ON REDFISH IN REGION 1

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At the 1977 Statutory Meeting of ICES it was decided (C.Res.1977/2:25), that:

"the Working Group on Redfish in Region 1 should meet at Charlottenlund 21-28 February 1978 to:

(a) assess TACs for 1979 for redfish,

(b) calculate effective mesh sizes,

(c) identify and specify in detail shortcomings and gaps in data required for stock assessments,

(d) review and update data in the "Review of Fish Resources" given in Doc. C.M.1977/F:12".

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

2.1 Status of the Fisheries

The fishery for redfish in Sub-area I and Divisions IIa and IIb is based on *Sebastes mentella* and *Sebastes marinus*. A drastic reduction in total redfish catches was recorded for these areas (Table 1). The 1977 catches were 169 896 tons compared with 317 606 tons in 1976. This reduction was mainly caused by the introduction of a quota scheme for some part of the fishing area. According to the preliminary figures for 1977, the expected catches of 200 000 tons were not taken. The main change in the total catches was observed in Division IIb, where the landings dropped from 242 715 tons in 1976 to 40 867 tons in 1977 (Table 4). Some of this reduction was compensated by an increase in total landings in Division IIa from 58 796 tons in 1976 to 107 542 tons in 1977 (Table 3), and from 16 095 tons in 1976 to 21 487 tons in 1977 from Sub-area I (Table 2). Most of the increase for Division IIa comes from the northern part of this area, named Kopytov area.

The landings of the two species are not recorded separately. A splitting on an area basis has been established. All redfish landings from Division IIb together with German Democratic Republic, Polish and USSR catches from the northern part of Division IIa 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).

The total landings of Sebastes marinus increased from 48 584 tons in 1976 to 49 482 tons in 1977, which is the highest on record.

After a steady increase in the total landings of Sebastes mentella from 28 862 tons in 1972 to 269 022 tons in 1976, the landings dropped to 120 414 tons in 1977. The drastic reduction in the redfish landings from 1976 to 1977 is therefore related to a reduction in the landings of Sebastes mentella.

2.2 Catch per Unit Effort and Effort

The catches of Sebastes marinus in the North-East Arctic are to a great extent a by-catch in the fishery for cod and haddock. Catch per unit effort from this fishery might, therefore, give an unrealistic measure of the relative change in the stock size from year to year. However, a traditional fishery in the area might give some indication of changes in stock size. The fishing pattern of the British fleet fishing for cod and haddock in Division IIa might have been relatively unchanged in the period 1965-77. No trend is observed in its catch per unit effort. However, some years have a very low or a high catch per unit effort which might, to some extent, reflect changes in the fishing pattern for cod and haddock in the area.

The English catch per unit effort has been used to estimate total international effort in the fishery for Sebastes marinus. This gives high figures for total effort during the last 3 years.

A decrease is observed during the last 3 years for the Soviet fleet fishing for Sebastes mentella in the Kopytov area (Table 6). Its fishing effort was nearly reduced by 50% from 197t to 1977. The total international fishing effort estimated from the USSR catch per unit effort shows a decrease from 1976 to 1977 of 46%.

2.3 Recruitment

According to the international 0-group fish surveys in the Barents Sea and adjacent waters, which started in 1965, only the 1967 and 1968 year classes have been estimated to be very poor (Table 7). The 1966, 1969 and 1970 year classes were of average abundance, while the 1965, 1971 and 1972 year classes were somewhat below average. All the five most recent year classes were above average, and the 1973, 1974, 1976 and 1977 year classes were even rich. The 1977 year class has been the most abundant year class on record.

2.4 Age and Length Compositions

For 1976 and 1977 Federal Republic of Germany 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 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 Federal Republic of Germany.

No new age determinations were available, and the Working Group therefore decided to apply the Federal Republic of Germany age/length key for 1976 to the total length compositions for 1976 and 1977 as also used for the years prior to 1976. For fish smaller than 30 cm a Federal Republic of Germany age/length key from the Barents Sea in 1975 was used. The calculated age compositions for 1976 and 1977 consist of three year old fish and older. Fish younger than 12 years were missing in the age compositions prior to 1976.

Age composition data for Sebastes mentella were available from the USSR and German Democratic Republic fishery 1976 and 1977, covering almost the entire catch of this species. These data have been used to update the table on catch in numbers per age group from the previous report (see Table 14).

2.5 Assessments (Sebastes marinus)

2.5.1 Parameters used

A cohort analysis on the average length composition for Sebastes marinus for 1976 and 1977 was run for natural mortality M = 0.10, with a terminal fishing mortality rate = 0.20 on the highest length group (Table 9). The exploitation pattern by age groups was then estimated by splitting the F values estimated for the different length groups by applying the Federal Republic of Germany age/length key mentioned earlier. The exploitation pattern derived from this run had a bias for age groups 7-14, caused by an irregularity in the established age/length key. The exploitation pattern had therefore to be smoothed before the final pattern could be established (Table 10).

The fishing mortality rates estimated for length groups above 52 cm might be higher than F = 0.20 as used as terminal F in the cohort (length) analysis. A fishing mortality of F = 0.25, which corresponds to the average over the 53-60 cm groups,was therefore accepted as terminal F for age groups 24 and older in the VPA. The terminal Fs for the younger age groups were estimated by the established exploitation pattern. No recruitment data exist which would allow to check the terminal F on the younger age groups.

2.5.2 Stock size

Estimates of stock size for Sebastes marinus are given in numbers (Table 11). Total stock biomass, age group 12 and older, and the spawning stock biomass, age group 15 and older, were estimated by using the average weight at age given in Table 13. These assessments indicate that the stock biomass and the spawning stock biomass decreased from 1976 to 1977 by 2% and 8% respectively. Estimates prior to 1976 are influenced by the inadequate sampling on some of the catches. Even with this bias in mind, the assessments indicate a relatively stable stock biomass and spawning stock biomass over the whole period.

2.5.3 Fishing mortality (Table 12)

The addition of the USSR length compositions for Sebastes marinus in 1976 and 1977 creates difficulties in comparing the fishing mortality rates from the VPA run over the period 1967-77. This is caused by the fact that fish younger than 12 years are missing in the age compositions prior to 1976 because of inadequate sampling. The weighted fishing mortality rates for 1976 and 1977 over the age groups 16-24 is F = 0.19 and F = 0.17, respectively. No reliable effort data were at hand to confirm that the fishing mortality rates were at the same level in these years.

2.5.4 Yield per recruit

A yield per recruit curve for Sebastes marinus has been calculated for fishing mortality rates on the age groups subject to maximum exploitation, using natural mortality M = 0.10 and the exploitation pattern applied for 1977 in the VPA analysis on age groups (Figure 1). This curve has a maximum for F = 0.23, and the fishing mortality assumed for 1977 (F = 0.25) is just beyond that.

2.5.5 Catch prediction

TACs were calculated for 1979. Data used in the calculations are given in Table 13.

Total catch in 1978 of Sebastes marinus and Sebastes mentella was assumed to be 20 000 tons and 130 000 tons, respectively, giving a total expected redfish catch of 150 000 tons from the North-East Arctic (Sub-area I and Divisions IIa and IIb).

An expected catch of Sebastes marinus in 1978 of 20 000 tons would be achieved by assuming the 1977 exploitation pattern and a fishing mortality rate on the age groups subject to maximum exploitation of F = 0.10. This fishing mortality rate is close to the $F_{0.1}$.

Continuing this level of F into 1979 (Option 1 in the text table below) would increase the spawning stock biomass at the beginning of 1980 by about 13% compared to 1977. This management objective could be achieved by introducing a TAC of 22 000 tons for 1979.

Another option (Option 2) could be to increase the fishing mortality from the expected 1978 level to F = 0.23, which corresponds to that generating maximum yield per recruit. Fishing under this option would leave a spawning stock at the beginning of 1980 by about 2% greater than in 1977 and would allow a TAC of 50 000 tons in 1979.

The TAC calculations are summarised in the text table below.

	Option	1977	1978	1979	1980
Spawning stock biomass (age 15+) at beginning of year (1 000 tons)	1	206	201	205	232
	2	206	201	205	210
Fishing mortality on age groups subject to maximum exploitation	1	.25	.10	.10	
	2	.25	.10	.23	
Calculated catch (1 000 tons)	1	49	20	22	
	2	49	20	50	

Realistic recruitment figures are not available for 1978 and 1979. However, 3, 4 and 5 year old fish make up only a small fraction of the catches by weight and therefore, the corresponding bias in the calculated TACs is negligible.

2.5.6 Discussion and advice on management

The catch of Sebastes marinus in the North-East Arctic region is to a large extent taken as by-catch in the fishery for cod. Therefore, there are some uncertainties about the size of the 1978 catch of this species on which the calculation of TAC for 1979 is based. This assumption was made according to the recommended catch level for 1978 in the previous Working Group report, i.e., 20 000 tons. If this assumption is a realistic one, then the calculated catch for 1979 could be taken from the text table above, depending on the management objective to be applied.

The data available do not justify a calculation of the spawning stock biomass prior to 1977, which could be compared to the actual situation.

Therefore the management objective at present should be to avoid a reduction in spawning stock biomass until a proper assessment of the size of the spawning stock could be made.

This objective could be met even by increasing fishing mortality on the age groups subject to maximum exploitation from the assumed F in 1978 ($F = 0.1$) to the level which would give the maximum yield per recruit ($F = 0.23$, Option 2 in the text table). The corresponding catch of about 50 000 tons in 1979, which is at the same level as that of 1977, would probably not generate any problems in the fishery for cod due to restrictions in the by-catch of redfish. Under this option, the spawning stock biomass at the beginning of 1980 would not increase, but remain at about the same level as in the three preceding years.

If, however, the fishery for Sebastes marinus in 1978 cannot be managed in a way that the catch assumed in the calculation, i.e. 20 000 tons, will not be exceeded, then the spawning stock biomass at the beginning of 1979 will possibly be reduced below the 1977-78 level. In this situation, fishing in 1979 under Option 2, i.e., a TAC of 50 000 tons, would reduce the spawning stock considerably by 1980 compared to the previous years. This reduction in spawning stock has to be avoided, and it is, therefore, advisable to adopt Option 1, i.e., to limit the catch of Sebastes marinus in 1979 to a level corresponding to $F_{(0.1)} = 0.1$. This would result in a TAC of 22 000 tons. In this case, the probability of maintaining the present size of the spawning stock could be increased depending on the actual catch in 1978.

The Working Group therefore recommends a TAC of 22 000 tons of Sebastes marinus in 1979.

2.6 Assessments (Sebastes mentella)

2.6.1 Parameters used

In a preliminary run of the VPA a terminal fishing mortality of $F = 0.25$ was chosen for age groups 10 and older. The bias on the calculated F values introduced by incorrect assumptions of Fs in 1977 will be reduced to a minimum for 1972 and earlier years.

Therefore, the weighted mean F values were calculated for age groups 13 to 21 (F_{13-21}) in the years 1965 to 1972 and plotted against the total trawl effort. This range of age groups was chosen, because the fishery in the period 1965-74 was mainly concentrated on these age groups.

The linear regression (Figure 2) shows that the F_{13-21} corresponding to the effort in 1977 would be 0.205 and therefore the terminal Fs for age groups 10 to 24 were changed to 0.20. (It was assumed that under the present exploitation pattern, the age groups 10 and older are subjected to the same fishing mortality.) The fishing mortalities for the age groups 7, 8 and 9 were set at 0.003, 0.03 and 0.12, respectively. The relationship between the estimated year class strength from VPA at age 6 and the corresponding 0-group survey abundance indices (Figure 3) indicates that these F values for age groups 7 to 9 could be appropriate.

2.6.2 Stock size

Estimates of stock size from VPA are given in Table 15. 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 given in Table 18. The results are summarised in Table 17.

Both the stock size and the spawning stock size increased considerably from 1965 to 1975. In 1975, where both reached their highest level, the spawning stock size was about 5 times larger than in 1965. From 1975 to 1977 the calculations show a reduction in total stock biomass (-16%) and spawning stock biomass (-23%).

2.6.3 Fishing mortality and exploitation pattern

Estimates of fishing mortalities from cohort analysis are given in Table 16. Compared with the 1977 assessment (WG, 1977), there is a decrease of the fishing mortality for 1976. This decrease results mainly from the updated age composition for 1976, which shows a reduction in catch by number for the age groups 10 and older. The estimates of fishing mortality indicate that during the period 1965-73 the exploitation pattern was relatively stable. The fishery was mainly concentrated on the age groups 13 to 24. Since 1974 there has been an increase of the fishing mortality for the younger age groups. For 1977 it was assumed that the age groups 10 and older are subjected to the same fishing mortality.

2.6.4 Yield per recruit

In Figure 4 curves of yield per recruit and spawning stock biomass per recruit for Sebastes mentella are plotted against the F values of age groups subject to maximum exploitation. The curves were calculated for the present exploitation pattern as used in the cohort analysis, and the average weights per age group as given in Table 18. The present situation (F = 0.20) and the position of F_{max} = 0.26 are marked with arrows.

For these fishing mortalities the corresponding sustainable yield and equilibrium spawning stock biomass assuming two different levels of average recruitment at age 6

$$R_{1965-74} = 467 \times 10^6$$
$$R_{1970-74} = 668 \times 10^6$$

were calculated. The results are given in the text table below:

R_6	F	Y/R	Sustainable yield (tons x 10^{-3})	S/R	Spawning stock biomass (tons x 10^{-3})
467×10^6	.20	.248	116	.442	206
	.26	.250	117	.261	122
668×10^6	.20	.248	166	.442	295
	.26	.250	167	.261	174

If fishing mortality is increased to 0.26 the equilibrium sustainable yield for both recruitment levels will only increase by 1%. However, fishing at F = 0.2 would produce an equilibrium spawning stock size at a level about 70% higher than fishing at F = 0.26.

2.6.5 Catch prediction

Catch predictions were made for the period 1978-80. Data used in the calculations are given in Table 18. The stock size 1978 is estimated from the stock and fishing mortalities in 1977. Fishing mortality in 1978 for age group 10 and older corresponds to the catch quota of 130 000 tons agreed for that year. Recruitment of 6 year old redfish for 1977 to 1980 is calculated on the basis of 0-group survey abundance indices and amounted to 700×10^{-6} in 1977 and 1978 and to 800×10^{-6} recruits in 1979 and 1980 (see Figure 3).

On the basis of a fishing mortality of 0.2 corresponding to the present F and 0.26 corresponding to F_{max}, two options of catches for 1979 are given in the text table below:

	Option	1977	1978	1979	1980
Spawning stock biomass (age 15+) at beginning of year (1 000 tons)	1 2	180 180	192 192	217 217	249 234
Fishing mortality on age groups subject to maximum exploitation	1 2	.20 .20	.20 .20	.20 .26	
Calculated catch (1 000 tons)	1 2	120 120	129 129	135 171	

2.6.6 Discussion and advice on management

The results of the catch prediction for Sebastes mentella are given in the text table above for two management options.

In both options, an increase of the spawning stock biomass to a maximum level ever recorded in the updated period will be reached. The remaining spawning stock biomass at the beginning of 1980 under the second option is 6% lower than at the first option, the gain in catch in the second option amounts to 27% compared to the first option.

Although the abundance indices of 0-group redfish indicate that the year classes entering the fishery in the 1980s are at least of average size,some uncertainty still exists about their survival up to the age of 6 years, when they recruit to the fishery. Furthermore, considering the long-term aspects of the management of Sebastes mentella (see Section 2.6.4) only a small increase in yield per recruit is to be expected by increasing the fishing mortality from the present F to the level of $F_{(max)}$, whereas a reduction in spawning stock biomass per recruit of about 40% is indicated by the shape of the relevant curve in Figure 4.

The Working Group therefore recommends that the present level of fishing should be maintained and a TAC of 135 000 tons for Sebastes mentella in the North-East Arctic region should be introduced for 1979.

2.7 Enforcement of Redfish TACs in the North-East Arctic

In view of the fact that the two species of redfish cannot be separated in the statistics, enforcement of TACs for both species separately is impossible at present. This could generate a situation in which one species might be overfished while the other species remained only lightly exploited. This danger exists particularly in the North-East Arctic, where Sebastes mentella is caught mainly in a directed fishery, whereas Sebastes marinus is caught mainly as by-catch in the fishery for cod.

The Working Group therefore recommends to apply the TAC for Sebastes mentella as TACs for total redfish to the area where the directed fishery takes place, which is Division IIb and that part of Division IIa situated north of 71°15'N and west of 20°00'E.

The TAC for Sebastes marinus should then be applied as TAC for total redfish to the remaining area of Division IIa and to Sub-area I.

If, however, the fishery for Sebastes marinus cannot be managed as a single species' fishery, then every effort should be made to limit the by-catches of Sebastes marinus in fisheries for other species as close as possible to the recommended catch level. This necessity implies that any directed fishery on this species has to be prohibited.

3. REDFISH IN SUB-AREA V AND SUB-AREA XIV

3.1 Latest Development in the Fishery (Tables 19-22)

During 1977 a great change took place in the exploitation of redfish in the area. The total catch from the Irminger Sea redfish stocks complex decreased from about 189 000 tons in 1976 to about 80 000 tons in 1977, which is the lowest total catch on record since 1965 (see Table 22).

The catch in Division Vb remained at the same level as in 1976, while the catch in Division Va declined from about 70 000 tons in 1976 to about 62 000 tons in 1977.

At Iceland, Federal Republic of Germany catches declined only slightly from 33 000 tons to 32 000 tons, but Iceland reduced the effort in 1977, and the Icelandic catch decreased from 34 000 tons in 1976 to 28 000 tons in 1977.

The main change occurred in Sub-area XIV, where the USSR reported only a catch of 251 tons in 1977 compared to 101 000 tons in 1976; the Federal Republic of Germany almost trebled the catch, while there was no Icelandic catch in that area in 1977. Thus, the Federal Republic of Germany catches were the highest in all three areas.

In recent years the fishing pattern for redfish, particularly in Division Va, has been changing, the effort being increasingly directed towards greater depths. Thus, Sebastes mentella has become a subject to a heavier fishery in recent years than before.

3.2 Recruitment of Redfish in the Irminger Sea Area

Earlier surveys and present 0-group surveys of redfish larvae in the Irminger Sea indicate a great variation in the number of larvae found. None of the surveys have covered the total area of the distribution of the larvae.

It is not possible neither to separate the larvae into species nor to allocate them to the part of the redfish stocks which are exploited.

In order to indicate the year-to-year fluctuations in the abundance of young redfish, the results of the 0-group surveys are presented as index figure of individuals per nautical square mile. The results are shown in the following text table:

Number of O-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

According to the reports of the O-group surveys, a substantial part of the O-group redfish drifts over the East Greenland shelf and along this coast to West Greenland.

Important nursery grounds for both species of redfish have been located on the East Greenland shelf.

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

The 1977 catches were splitted into *S. marinus* and *S. mentella* following the same general principles as described in the 1977 report of the Working Group. According to observations in Division Vb, 10% of the 1977 catch in that division were allocated to *S. marinus.* The total catch in Sub-area XIV was allocated to *S. marinus*.

3.4 Length and Age Compositions

Sebastes marinus

Sub-area XIV - Figures for the length composition of the catches from the fishery of the Federal Republic of Germany were used to split the total catch in 1977 into length groups, since no other information was available.

Division Va - In Division Va length data from the Icelandic and Federal Republic of Germany catches were available. The Icelandic figures for the length composition were used to split the catches of other nations.

Division Vb - In Division Vb, figures were available on the length composition of the 1977 catch from the fishery of the Federal Republic of Germany.

Sebastes mentella

In Divisions Va and Vb, the Federal Republic of Germany figures on the length composition in the 1977 catches were used for the total catch in the area.

Age/length keys for both species from the German (F.R.) fishery have been made available to the Working Group. These age/length keys, however, did not cover all years and all fishing areas, and it was, therefore, decided to construct overall age/length keys for the two species. On this basis the number of fish in each cm-group was allocated to the different ages (Tables 23 and 24).

3.5 Mean Weight at Age

Sebastes marinus

The mean weight at age given in the 1977 report ranges from ages 7 to 28; but in the assessments in the present report, the range of ages reaches from 9 to 38. Therefore, the regression for the natural logarithm on weight at age against age was calculated (Figure 5) and from that regression the mean weight at age was calculated (Table 25).

Sebastes mentella

In the report from 1977, the mean weight in cm-groups is given. An average weight per age group is found by using the ranges for each age group in the age/length key (see Section 3.4), and the weight per cm-group weighted by numbers per cm-group taken from the cohort on length (1975-77). A regression of the natural logarithm of these weights at age against age has been calculated and from that regression the average weight at age to be used in the assessments was calculated (Table 25 and Figure 6).

3.6 Assessments

The assessments have been carried out by the cohort analysis using length data and by the cohort analysis based on age composition data of the catches.

3.6.1 Cohort analysis on length composition data

The comments on the limitations of this method made in the 1977 report are still valid and, therefore, the method was only used to describe the average situation in the periods 1967-74 and 1975-77, and to obtain from the latter some indications about the terminal Fs to be used in the cohort analysis on age data.

The basic data and the parameters used are given in Table 26, and the results are summarised in Table 27.

For both species an increase in fishing mortality from 1967-74 to the more recent period is indicated to be associated with a reduction in both adult and spawning stock biomass in the order of about one third.

3.6.2 Cohort analysis on age composition data

In the absence of any other indications from the fishery, the terminal F values for 1977 have been taken from the results of the cohort (length) analysis for the period 1975-77 by averaging for the different age groups the F values over the respective range of cm-groups in the age/length keys.

Natural mortality was taken as 0.1 as in the 1977 report.

Sebastes marinus

The catch in numbers for the years 1967-77 is given in Table 28. Average fishing mortality (Table 29) for the spawning stock (age 16 and older) fluctuated without trend around F = 0.17 during the years 1967 to 1971. In the period 1972-74 F decreased to a level of 0.9 but increased again in the following years up to a level of 0.17 in 1976.

Total biomass (Table 31) of the Sebastes marinus stock decreased continuously from the high level of 932 000 tons in 1967 to about 846 000 tons in 1971, followed by an increase up to the previous level in 1974. Since 1975 the total biomass decreased again to the lowest level of about 777 000 tons in 1977. The figures for the spawning stock biomass show a similar trend with a delay of about two years.

Sebastes mentella

The catch in numbers for the years 1967-77 is given in Table 32. Fishing mortality (Table 33) in the spawning stock fluctuated without any recognisable trend around a value of 0.15 up to 1972, followed by an increase to a level of 0.20. In 1976 F dropped again to 0.15 in the spawning component of the stock, whereas in the juvenile part of the stock F was remarkably high compared to all other years as a result of the high fishing effort of the USSR fleet in the East Greenland area.

The biomass (Table 35) of the exploited part of the stock (age 12 and older) as well as the spawning stock biomass decreased continuously throughout the entire period by about 50%.

3.7 Calculation of TACs

3.7.1 Sebastes marinus

The parameters on which the calculations of catches in 1979 are based are given in Table 36. The proportion of F on younger ages is taken from the terminal fishing mortality for 1977 in the cohort analysis. The size of the recruiting year classes (age 12) in 1978 and 1979 is taken as 117.4 million of redfish, the average over the years 1967-74.

Since no catch limitations on the Irminger Sea stock complex are imposed at present, assumptions have to be made about the fishing mortality and the corresponding catch in 1978. These assumptions and the results of the calculations are given in the text table below.

Catch prediction, Sebastes marinus

Assumption	Year	Spawning biomass at beginning of the year (1 000 t)	F	Catch (1 000 t)	Spawning biomass at beginning of the following year (1 000 t)
	1977	400	.13	54	410
A	1978	410	.13	56	452
	1979	452	.13	57	471
B	1978	410	.16	68	442
	1979	442	.13	56	461
C	1978	410	.145	62	447
	1979	447	.13	57	466
C	1978	410	.145	62	447
	1979	447	.075	33	488

The assumptions are:

A - F in 1978 remains at the 1977 level, i.e. 0.13 on age groups subject to maximum exploitation.

B - F in 1978 increases to 0.16, the level at which the yield per recruit curve (Figure 7) starts to flatten off.

C - F in 1978 increases to an intermediate value of 0.145.

3.7.1.1 Discussion of management objective and advice on TAC for 1979

The resulting catches for 1978 under these assumptions range from 56 000 tons to 68 000 tons. The remaining spawning biomass at the beginning of 1979 ranges from 442 000 tons to 452 000 tons. This level is higher than that estimated for the beginning of 1977 and 1978 and exceeds the long-term average for the 1967-74 period of 424 000 tons.

For all assumptions the catch for 1979 was calculated applying the 1977 level of F. The estimated catch ranges from 56 000 tons to 57 000 tons and the range of the spawning stock biomass at the beginning of 1980 is 461 000 tons to 471 000 tons, a level which corresponds to that of 1967.

On the basis of $F_{0.1} = 0.075$ and Assumption C, the estimated catch for 1979 would be 33 000 tons, leaving a spawning biomass of 488 000 tons in 1980. Fishing at $F_{0.1}$ in 1979 would, however, impose unnecessary hardship on the fishery in a situation when the spawning stock is expected to increase considerably at the present level of fishing.

In view of the uncertainties about the catch level in 1978 and also in view of the weakness of the data base available, the Working Group felt that an increase in fishing mortality in 1979 is not advisable.

The Working Group, therefore, recommends that the 1977 level of fishing mortality should not be exceeded and that a TAC of about 57 000 tons of Sebastes marinus for 1979 should be introduced in Sub-areas V and XIV.

3.7.2 Sebastes mentella

The parameters for the calculation of the 1979 catch are given in Table 37. As in the case of Sebastes marinus, the proportion of F for the younger age groups is taken from the terminal fishing mortality for 1977 in the cohort analysis. The size of the recruiting year classes at age 12 in 1978 and 1979 is taken as 65.4 million fish, the average over the years 1967-74.

Calculations of catches for 1979 have been made based on the assumption that the fishing mortality in 1978 would remain at the 1977 level of 0.4. This would result in a catch of about 32 000 tons and the spawning biomass at the beginning of 1979 would be 170 000 tons.

3.7.2.1 Discussion of management objective and advice on TAC for 1979

In view of the continuous decline in spawning stock biomass the Working Group adopted as management objective for 1979 to stop this decline and, if possible, to initiate an increase in spawning biomass. For the recommendation of a TAC in 1979 three options have been examined by the Working Group (see text table below):

Catch prediction, Sebastes mentella

Option	Year	Spawning biomass at beginning of year (1 000 tons)	F	Catch (1 000 t)	Spawning biomass at beginning of following year (1 000 t)
	1977	196	.40	30	183
	1978	183	.40	32	170
1	1979	170	.35	27	166
2	1979	170	.20	16	176
3	1979	170	.15	12	180

Option 1 - fishing at $F_{0.1}$ = 0.35. This option would reduce further the already very low spawning biomass, and it was, therefore, rejected by the Working Group.

Option 2 - fishing at F = 0.20, i.e., half the fishing mortality in 1977. Although this level of fishing would result in an increase in spawning biomass of about 6 000 tons over the 1979 level at the beginning of 1980, the Working Group felt that this increase is not sufficient, having in mind the relatively weak data base and the uncertainties about the 1978 fishery. Therefore, the Group adopted:

Option 3 - fishing at F = 0.15. This level of fishing mortality would result in a catch of 12 000 tons in 1979, but about 60% less than in 1977. Spawning biomass, however, is expected to increase by about 10 000 tons over the 1979 level.

Furthermore, the Working Group investigated the effect on spawning biomass of adopting Option 3 for levels of fishing mortality in 1978 higher than that in 1977. It was found that even at F = 0.6 with a catch of 46 000 tons in 1978, the management objective could still be met.

The Working Group therefore recommends to reduce fishing mortality in 1979 to a level of 0.15 and to set a TAC of 12 000 tons for Sebastes mentella in Sub-areas V and XIV.

3.8 Note on Enforcement of TACs in Sub-areas V and XIV

Since both species of redfish are often caught together and could not be recorded separately in the statistics, the calculated TACs have to be combined as a TAC for total redfish of 70 000 tons of which not more than 12 000 tons should consist of *Sebastes mentella*.

The Working Group cannot at present provide precise advice as to how to allocate TACs for the two species to different fishing areas. It should be noted, however, that at the present pattern of fishing *Sebastes mentella* is mainly caught in Division Vb and off the south and southeast coasts of Iceland, whereas *Sebastes marinus* is mainly fished at East Greenland and off the west coast of Iceland.

In view of the fact that the assessments presented in this section of the report are worked out on a limited data base and on the basis of restricted information as to species' composition of catches in different areas, it has to be pointed out that the estimated TACs are less accurate than comparable figures for other species.

4. MESH ASSESSMENTS

A method to assess the present mesh size in use and the effect of changes in mesh size has been developed by Mr K P Andersen of the Danish Institute of Fisheries and Marine Research. The time and expertise to use this method has not beeen available to the Working Group during the meetings, and, therefore, it is not possible to report on the effective mesh size in use or on the effect of changes in mesh size. Mainly length compositions of the landings were available to the Working Group. These do not always correspond to the length composition of catches. Due to the lack of length compositions of discarded fish which are mainly small, mesh assessments on the length composition available might therefore be biased. Furthermore, it is known that the selection of redfish can be reduced considerably due to meshing of redfish and big catches. The benefit by increasing mesh size might therefore be less than estimated by assuming that selection follows the selection ogive calculated from selectivity experiments with moderate catches.

An example of the effect of increased mesh size in addition to an already existing minimum landing size is reported from Iceland, where the minimum weight of redfish allowed to be landed is 500 g corresponding to a minimum length of about 33 cm. Since May 1976 a minimum mesh size of 135 mm has been in force. Measurements on landed redfish prior to and after this increase in the mesh size have not shown any decrease in the relative number of the smallest size groups in the landings. Thus, the proportion of these size groups in the landings are dependent on the discarding practice, after like before the introduction of the 135 mm mesh.

5. SHORTCOMINGS AND GAPS IN DATA REQUIRED FOR STOCK ASSESSMENT ON REDFISH IN REGION 1

5.1 Species Composition of Catches

Since the two species of redfish are not separated in the landings and in the corresponding statistics, it is very difficult to estimate the proportion of the different species in the reported redfish landings from different fishing grounds. The species' separation done by the Working Group was considered to be not very accurate and it was thought that more detailed information on the distribution of the species both in respect of areas and depth zones is urgently needed.

5.2 Age/Length Keys for Sexes separated

One of the major difficulties in the redfish assessment work is the scarcity of reliable age readings and the lack of proper age/length keys. Another problem in this connection is that the growth rate of males and females is different. The length at first maturity is also different for the sexes by each species. Migration pattern for mature redfish differs also for males and females, sometimes resulting in catches of almost one sex only. It is, therefore, of greatest importance for the future assessment work to provide age/length keys for each sex by both species.

5.3 Information on Discards

No information on amount and size composition of discarded redfish or redfish reduced on board of factory vessels to fishmeal is available at present. It is well known that young redfish are caught in large quantities in the directed fishery for redfish as well as in fisheries for other species like cod, haddock and deep sea prawns. Redfish are recruiting to the directed fishery at an age of 6 to 9 years, which means that young redfish are exposed to some unknown fishing mortality over a number of years. Therefore, information on the quantity, size (length and age), and species composition of discards from all fisheries would be helpful in future assessments, in particular to estimate the size of year classes recruiting to the directed fishery.

6. TIMING OF WORKING GROUP MEETINGS

The current practice to hold the meetings of Assessment Working Groups in spring of the year in order to advise on management action for the following year creates serious problems, which are affecting the actuality of the assessments.

These problems are connected with the necessity to work with incomplete and provisional catch and age composition data or even with assumptions for the two years preceding the year for which advice has to be given.

As a consequence, on several occasions the Working Groups had to change the management advice for the current year in the light of more recent information and sometimes even additional meetings in autumn have been necessary. This situation resulted in considerable difficulties of administrative, legal and economic nature for the user of the advice given by ICES.

Moving the meeting of the Redfish Working Group into the second half of the year would enable the Group to work on more up-to-date information on catches and on age composition data. Thereby, the accuracy of the assessments could be improved and the necessity for changing the management advice could be reduced.

The Working Group therefore asks ICES to examine this problem considering the scientific requirements for assessments as well as other contingencies which are outside the scope of the Working Group.

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

Country	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977*
Belgium								30	28	2	1
Faroe Isl.				60		9	32	6	67	137	-
France								1 116		-	-
German Dem.Rep.	311	852	1 069	7 149	14 786	9 972	11 756	28 275	28 020	22 636	20 680
Germany, Fed.Rep.	5 550	3 258	5 573	2 416	3 076	1 697	3 479	6 597	5 182	7 894	7 142
Netherlands			20							127	-
Norway	5 205	4 024	3 904	3 832	4 644	6 776	7 714	7 055	4 966	7 305	8 269
Poland			5 973	4 631	2 532	1 112	215	1 269	4 711	4 137	175
Portugal									331	3 463	
Spain									1 194	3 398	
U.K.	5 607	5 058	5 224	4 554	4 002	4 379	4 791	3 509	2 746	4 961	6 322[a)]
USSR	7 269	5 477	9 144	13 091	29 839	22 647	31 829	48 787	230 950	263 546	127 307
Total	23 942	18 669	30 907	35 733	58 879	46 592	59 816	96 644	278 195	317 606	169 896

* Provisional data.

a) U.K. (England and Wales) only.

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

Country	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977*
Belgium								30		2	-
Faroe Isl.							6	6			
France								26			
German Dem. Rep.	81	25	23	4 912	78	36		358	201	90	937
Germany, Fed.Rep.	354			133	148	7	76	1 086	483	635	796
Netherlands											
Norway	242	464	365	141	316	1 000	1 917	194	482	739	...a)
Poland			5 973	6	1	22			93	47	-
Portugal									331	478	
Spain									820	301	
U.K.	1 419	1 163	1 385	1 384	1 406	1 363	1 894	1 320	1 048	1 392	1 567b)
USSR	1 640	1 076	3 647	2 281	3 743	4 403	4 885	9 318	30 750	12 411	18 187
Total	3 736	2 728	11 393	8 857	5 692	6 831	8 778	12 338	34 208	16 095	21 487

* Provisional data.

a) Included in Division IIa.

b) U.K. (England and Wales) only.

Table 3. Nominal catch of Redfish (in metric tons) by countries in Division IIa.

Country	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977*
Belgium											1
Faroe Isl.				60		9	22		67	137	
France								980			
German Dem. Rep.	26		812	2 212	12 339	8 963	11 474	27 153	22 778	16 921	13 760
Germany, Fed.Rep.	5 196	3 258	5 573	2 165	1 188	1 466	2 207	4 167	4 263	6 722	4 679
Netherlands			20							127	-
Norway	4 961	3 518	3 510	3 679	4 277	5 720	5 564	6 837	4 444	6 515	8 269a)
Poland				269	1 605	784	156	869	920	217	47
Portugal										2 849	
Spain									153	2 082	
U.K.	3 781	3 820	3 578	2 741	2 463	2 680	2 125	1 991	1 621	2 919	4 117b)
USSR	4 715	3 779	14	142	209	291	131	14	39 138	20 307	76 669
Total	18 679	14 375	13 507	11 268	22 081	19 913	21 679	42 011	73 384	58 796	107 542

* Provisional data.

a) Includes Sub-area I and Division IIb.

b) U.K. (England and Wales) only.

Table 4. Nominal catch of Redfish (in metric tons) by countries in Division IIb.

Country	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977*
Belgium									28		-
Faroe Isl.							4				
France								110			
German Dem. Rep.	204	827	234	25	2 369	973	282	764	5 041	5 625	5 983
Germany, Fed.Rep.				118	1 740	224	1 196	1 344	436	537	1 667
Netherlands											
Norway	2	42	29	12	51	56	233	24	40	51	...a)
Poland				4 356	926	306	59	400	3 698	3 873	128
Portugal										136	
Spain									221	1 015	
U.K.	407	75	261	429	133	336	772	198	77	650	638b)
USSR	914	622	5 483	10 668	25 887	17 953	26 813	39 455	161 062	230 828	32 451
Total	1 527	1 566	6 007	15 608	31 106	19 848	29 359	42 295	170 603	242 715	40 867

* Provisional data.

a) Included in Division IIa.

b) U.K. (England and Wales) only.

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

YEAR	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977*
S. marinus	17 703	13 256	24 071	12 817	13 816	17 730	21 436	27 272	39 125	48 584	49 482
S. mentella	6 239	5 413	6 836	22 916	45 063	28 862	38 380	69 372	239 070	269 022	120 414
Total	23 942	18 669	30 907	35 733	58 879	46 592	59 816	96 644	278 195	317 606	169 896

* Provisional data.

Table 6. *Sebastes mentella* in Divisions IIa and IIb.
Effort and catch per unit of effort 1965-77.

Year	USSR catch/hour (tons)	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	0.90	268 817	298 913
1977	0.75	136 409	160 552

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

Year class	DRAGESUND 1971	SURKOVA, 1960 S.marinus	S.mentella	BARANENKOVA, 1968 S.marinus	S.mentella	0-group surveys Abundance indices
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

Table 8. *Sebastes marinus.* Sub-area I and Division IIa.
Length compositions 1976, 1977 and average 1976-77 in numbers (x 10^{-3}).

Length cm	1976				1977				Mean 1976-77
	All countries except USSR	USSR Sub-area I	USSR Div.IIa	Total 1976	All countries except USSR	USSR Sub-area I	USSR Div.IIa	Total 1977	
11-12						237		237	119
13-14						475		475	238
15-16		966	60	1 026		1 425		1 425	1 226
17-18		4 539	164	4 703		2 232	10	2 242	3 473
19-20		4 250	193	4 443		2 802	40	2 842	3 643
21-22		5 602	550	6 152		3 514	110	3 624	4 888
23-24		5 119	714	5 833		3 324	229	3 553	4 693
25-26		7 389	1 086	8 475		4 891	439	5 330	6 903
27-28		8 016	1 517	9 533	15	5 698	608	6 321	7 927
29-30	39	4 877	1 027	5 943	15	5 176	957	6 148	6 046
31-32	211	3 718	1 398	5 327	527	4 131	1 117	5 775	5 551
33-34	1 249	1 739	908	3 896	1 631	3 799	1 047	6 477	5 187
35-36	3 036	1 304	1 413	5 753	3 140	3 894	1 356	8 390	7 072
37-38	4 175	483	1 562	6 220	3 933	2 659	987	7 579	6 900
39-40	4 224	193	1 309	5 726	3 817	1 662	897	6 376	6 051
41-42	3 442	48	1 205	4 695	3 539	712	688	4 939	4 817
43-44	2 371	-	506	2 877	2 538	142	369	3 049	2 963
45-46	1 489	-	476	1 965	1 564	142	409	2 115	2 040
47-48	1 189	-	268	1 457	1 174	142	259	1 575	1 516
49-50	1 006	-	134	1 140	850	95	179	1 124	1 132
51-52	657	-	119	776	572	95	110	777	777
53-54	684	-	60	744	661	47	30	738	741
55-56	383	-	104	487	450	47	50	547	517
57-58	303	48	60	411	245	47	30	322	367
59-60	132		30	162	92	-	20	112	137
61-62	25		15	40	42	95	20	157	99
63-64	8			8			10	10	9
Total	24 623	48 291	14 878	87 792	24 805	47 483	9 971	82 259	85 032

Table 9. Sebastes marinus. Sub-area I and Division IIa.
Cohort (length) analysis 1976 and 1977.
M = 0.1, L_∞ = 86.45, K = 0.032.

Length (cm)	Catch numbers x 10^{-3}	F Δ t	F (year)	Stock numbers x 10^{-6}
11-12	119	.00041	.00049	250.6
13-14	238	.00089	.00105	236.9
15-16	1 226	.005	.006	223.4
17-18	3 473	.016	.017	209.6
19-20	3 643	.018	.020	194.1
21-22	4 888	.028	.029	179.0
23-24	4 693	.030	.031	163.3
25-26	6 903	.051	.050	148.2
27-28	7 927	.069	.066	131.5
29-30	6 046	.063	.058	114.3
31-32	5 551	.069	.061	99.5
33-34	5 187	.077	.066	86.3
35-36	7 072	.132	.108	73.8
37-38	6 900	.169	.133	59.6
39-40	6 051	.203	.153	46.2
41-42	4 817	.229	.166	34.5
43-44	2 963	.202	.140	25.0
45-46	2 040	.197	.130	18.5
47-48	1 516	.209	.131	13.8
49-50	1 132	.228	.136	10.0
51-52	777	.235	.132	7.1
53-54	741	.360	.190	5.0
55-56	517	.457	.225	3.1
57-58	367	.705	.317	1.7
59-60	137	.656	.276	.7
61-62	99	1.933	.593	.3
63-64	9		$\boxed{.2}$	<.1

Table 10. *Sebastes marinus*. Age composition of the total catch in numbers ($\times 10^{-3}$) 1967-77. Sub-area I and Division IIa.

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
3											30
4											305
5										530	809
6										2 884	1 919
7										5 719	3 476
8										12 162	7 575
9										10 250	6 768
10										9 515	7 290
11										5 963	6 029
12	44	43	51	62	46	261	590	387	693	5 008	7 075
13	94	32	35	122	41	332	570	455	868	1 686	2 800
14	199	74	97	229	107	633	913	1 049	1 638	2 670	5 565
15	406	165	209	444	239	1 137	1 527	2 079	2 984	2 991	3 509
16	1 363	550	666	1 232	886	2 563	3 266	5 479	7 397	6 775	7 542
17	919	364	556	723	594	1 261	1 441	2 757	3 563	2 707	2 755
18	1 536	611	954	1 138	935	2 014	2 157	4 164	5 117	3 938	3 724
19	1 695	684	1 223	997	990	2 046	1 892	3 528	4 402	3 417	3 043
20	310	131	223	185	185	385	342	638	775	614	558
21	1 459	753	1 456	1 003	858	1 732	1 420	2 359	2 829	2 475	2 832
22	951	555	1 084	750	595	1 112	849	1 373	1 721	1 529	2 078
23	1 167	898	1 518	921	779	1 251	1 123	1 527	1 813	1 814	1 760
24	1 241	1 266	2 259	966	1 123	1 121	1 248	1 103	1 432	1 672	1 661
25	896	993	1 845	716	776	746	884	702	930	1 106	1 035
26	723	887	1 667	623	636	585	729	530	817	918	843
27	504	644	1 362	526	426	429	568	369	701	822	666
28	432	614	1 038	347	431	377	508	332	589	624	612
Total	13 939	9 264	16 243	10 984	9 647	17 985	20 027	28 831	38 269	87 790	82 259

Table 11. Sebastes marinus. Stock size in numbers ($x\ 10^{-6}$) Sub-area I and Division IIa, 1967-77, estimated by VPA ($M = 0.1$).

Age (years)	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
3	116.9	284.3	262.1	335.8	351.5	452.9	188.4	138.1	104.4	177.3	157.6
4	172.9	105.8	257.2	237.2	303.8	318.0	409.8	170.5	125.0	94.4	160.4
5	98.3	156.4	95.7	232.7	214.6	274.9	287.7	370.8	154.3	113.1	85.4
6	190.2	88.9	141.5	86.6	210.6	194.2	248.8	260.4	335.5	139.6	101.8
7	84.6	172.1	80.5	128.1	78.4	190.6	175.7	225.1	235.6	303.6	123.6
8	99.0	76.6	155.7	72.8	115.9	70.9	172.4	159.0	203.7	213.2	269.3
9	86.9	89.6	69.3	140.9	65.9	104.9	64.2	156.0	143.9	184.3	181.3
10	43.9	78.7	81.1	62.7	127.5	59.6	94.9	58.1	141.2	130.2	157.0
11	69.5	39.7	72.2	73.3	56.7	115.4	54.0	85.9	52.5	127.7	108.7
12	53.0	62.9	36.0	64.4	66.4	51.3	104.4	48.8	77.7	47.5	109.9
13	45.7	47.9	56.9	32.5	58.2	60.0	46.2	93.9	43.8	69.6	38.2
14	43.0	41.2	43.3	51.5	29.3	52.6	54.0	41.3	84.5	38.8	61.4
15	33.1	38.8	37.2	39.1	46.3	26.4	47.0	48.0	36.3	74.9	32.6
16	29.7	29.6	34.9	33.5	35.0	41.7	22.8	41.1	41.4	30.0	64.9
17	24.4	25.6	26.2	31.0	29.1	30.8	35.3	17.5	32.0	30.5	20.8
18	23.0	21.2	22.8	23.2	27.3	25.8	26.7	30.6	13.2	25.6	25.0
19	19.7	19.4	18.6	19.7	19.9	23.8	21.4	22.1	23.7	7.1	19.4
20	19.0	16.3	16.9	15.7	16.9	17.1	19.6	17.6	16.6	17.3	3.2
21	13.8	16.9	14.6	15.0	14.0	15.1	15.1	17.4	15.3	14.3	15.0
22	14.7	11.1	14.6	11.8	12.7	11.8	12.0	12.3	13.5	11.2	10.6
23	11.3	12.4	9.6	12.2	10.0	10.9	9.7	10.1	9.8	10.6	8.7
24	10.2	9.1	10.3	7.2	10.1	8.3	8.7	7.7	7.7	7.2	7.9
25	7.2	8.0	7.0	7.2	5.6	8.1	6.4	6.7	5.9	5.6	4.9
26	11.1	5.7	6.3	4.6	5.8	4.3	6.6	5.0	5.4	4.5	4.0
27	5.6	9.3	4.3	4.1	3.6	4.7	3.4	5.3	4.0	4.1	3.2
28	3.3	4.6	7.8	2.6	3.3	2.8	3.8	2.5	4.4	3.0	2.9

Table 12. *Sebastes marinus.* Fishing mortality in Sub-area I and Division IIa 1967-77 estimated by VPA (M = 0.1).

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
3	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.00
4	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.00
5	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.00	.01
6	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.02	.02
7	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.02	.03
8	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.06	.03
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.06	.04
10	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.08	.05
11	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	.05	.06
12	.00	.00	.00	.00	.00	.01	.01	.01	.01	.12	.07
13	.00	.00	.00	.00	.00	.01	.01	.01	.02	.03	.08
14	.00	.00	.00	.00	.00	.01	.02	.03	.02	.07	.10
15	.01	.00	.01	.01	.01	.05	.03	.05	.09	.04	.12
16	.05	.02	.02	.04	.03	.07	.16	.15	.21	.27	.13
17	.04	.02	.02	.02	.02	.04	.04	.18	.12	.10	.15
18	.07	.03	.04	.05	.04	.09	.09	.15	.52	.18	.17
19	.09	.04	.07	.05	.05	.09	.10	.18	.22	.69	.18
20	.02	.01	.01	.01	.01	.02	.02	.04	.05	.04	.20
21	.12	.05	.11	.07	.07	.13	.10	.15	.22	.20	.22
22	.07	.05	.08	.07	.05	.10	.08	.12	.14	.16	.23
23	.11	.08	.18	.08	.09	.13	.13	.17	.21	.20	.24
24	.14	.16	.26	.15	.12	.15	.16	.16	.22	.28	.25
25	.14	.14	.32	.11	.16	.10	.16	.12	.18	.23	.25
26	.07	.18	.32	.15	.12	.15	.12	.12	.17	.24	.25
27	.10	.08	.40	.14	.13	.10	.20	.08	.20	.24	.25
28	.15	.15	.15	.15	.15	.15	.15	.15	.15	.25	.25

Table 13. Parameters used in TAC calculations.
Sebastes marinus in Sub-area I and Division IIa.

Age	Stock size at beginning of 1979	Proportional fishing mortality (1977-79)	Mean weight at age (kg)
3	165 000	.0006	.022
4	149 289	.006	.034
5	128 967	.04	.059
6	130 611	.07	.086
7	68 765	.10	.147
8	81 103	.13	.194
9	97 391	.16	.245
10	210 020	.20	.334
11	139 807	.24	.421
12	119 378	.29	.477
13	81 444	.33	.512
14	80 973	.39	.577
15	27 729	.46	.611
16	43 550	.53	.710
17	22 546	.59	.761
18	43 903	.66	.826
19	13 727	.73	.895
20	16 130	.79	.947
21	12 217	.86	1.093
22	1 991	.91	1.145
23	9 068	.96	1.293
24	6 284	1.00	1.580
25	5 040	1.00	1.793
26	4 542	1.00	1.885
27	2 830	1.00	2.393
28	5 800	1.00	2.454

Table 14. *Sebastes mentella*. Age composition of the total catch in numbers (x 10^{-3}) 1967-77, Sub-area I and Division IIa.

Age	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
6	0	7	31	0	0	466	172	606	5 834	18 891	-
7	0	0	94	0	0	782	1 660	4 847	19 417	29 815	1 989
8	7	15	403	33	114	5 728	4 865	15 451	42 425	59 395	14 130
9	15	89	524	131	284	3 586	9 729	28 781	82 480	78 241	27 523
10	182	192	838	620	681	2 049	4 636	30 144	108 462	110 712	42 867
11	285	355	933	2 122	1 590	1 770	2 633	19 843	119 075	112 524	40 820
12	343	436	954	3 428	4 429	3 865	3 148	10 603	57 231	93 144	44 375
13	394	554	849	3 983	4 884	4 564	5 208	8 634	29 651	49 550	27 385
14	489	864	618	3 526	5 451	4 704	5 666	8 634	20 894	26 134	15 709
15	496	768	482	2 808	4 940	4 098	4 578	6 514	16 499	13 881	10 370
16	628	931	807	3 983	7 496	4 704	5 380	5 908	13 465	9 839	4 768
17	613	694	451	2 743	4 486	3 632	3 777	3 332	13 668	6 300	4 010
18	540	665	849	3 559	7 382	3 167	2 747	2 878	12 207	7 233	4 524
19	349	702	786	2 318	4 770	1 816	1 316	1 666	6 757	3 486	2 596
20	649	369	555	1 567	3 918	885	973	2 121	7 112	3 168	3 242
21	693	347	440	784	2 385	373	630	757	5 113	1 818	2 431
22	598	251	514	653	1 874	279	114	454	2 242	1 715	2 082
23	248	89	199	327	1 590	47	10	151	735	1 041	824
24	117	44	42	65	397	47	10	151	407	211	265
Total	6 646	7 372	10 375	32 650	56 671	46 572	57 252	151 475	563 674	627 092	249 910

Table 15. *Sebastes mentella.* Stock size in numbers (x 10^{-6}).
Divisions IIa and IIb. 1967-77 estimated by VPA (M = 0.1).

Age (years)	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
6	188.6	299.8	463.0	770.9	880.0	701.6	541.1	444.2	654.2	252.0	-
7	165.9	170.7	271.3	418.9	697.6	796.3	634.4	489.4	401.3	586.4	697.7
8	162.5	150.1	154.4	245.4	379.1	631.2	719.8	572.4	438.2	344.7	502.3
9	134.7	147.0	135.8	139.3	222.0	342.9	565.7	646.6	503.3	356.2	255.5
10	128.9	121.8	133.0	122.4	126.0	200.6	306.8	502.6	557.7	377.1	248.1
11	98.3	116.5	110.1	119.5	110.2	113.3	179.5	273.2	426.1	401.7	236.2
12	86.6	88.7	105.1	98.7	106.1	98.2	100.9	160.0	228.4	272.7	256.8
13	56.5	78.0	79.8	94.1	86.1	91.8	85.1	88.3	134.7	152.4	158.5
14	36.5	50.7	70.1	71.4	81.4	73.2	78.7	72.1	71.7	93.7	90.9
15	22.2	32.6	45.1	62.8	61.3	68.5	61.8	65.9	57.0	45.0	60.0
16	17.4	19.6	28.8	40.3	54.2	50.7	58.1	51.6	53.4	36.0	27.6
17	10.6	15.1	16.8	25.3	32.8	41.9	41.4	47.4	41.0	35.6	23.2
18	6.6	9.0	13.1	14.8	20.2	25.3	34.5	33.9	39.8	24.2	26.2
19	6.2	5.4	7.5	11.0	10.0	11.3	19.9	28.6	27.9	24.4	15.0
20	4.6	4.7	4.3	6.1	7.8	4.6	8.5	16.8	24.3	18.9	18.8
21	1.8	3.6	3.9	3.3	4.0	3.3	3.3	6.8	13.2	15.2	14.1
22	1.0	1.0	2.9	3.1	2.3	1.4	2.7	2.4	5.4	7.1	12.1
23	0.5	0.4	0.6	2.1	2.2	0.3	0.9	2.3	1.7	2.8	4.8
24	0.5	0.3	0.2	0.4	1.6	0.5	0.2	0.9	1.9	0.9	1.5

Table 16. *Sebastes mentella*. Divisions IIa and IIb.
Fishing mortality by year and by age, 1965-77.

Age	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
6	.00	0.00	0.00	.00	.00	0.00	0.00	.00	.00	.00	.01	.08	.00
7	.00	0.00	0.00	0.00	.00	0.00	0.00	.00	.00	.01	.05	.05	.01
8	.01	.00	.00	.00	.00	.00	.00	.01	.01	.03	.11	.20	.03
9	.02	.00	.00	.00	.00	.00	.00	.01	.02	.05	.19	.26	.12
10	.01	.01	.00	.00	.01	.01	.01	.01	.02	.07	.23	.37	.20
11	.02	.01	.00	.00	.01	.02	.02	.02	.02	.08	.35	.35	.20
12	.04	.01	.00	.01	.01	.04	.04	.04	.03	.07	.30	.44	.20
13	.08	.03	.01	.01	.01	.05	.06	.05	.07	.11	.26	.42	.20
14	.12	.08	.01	.02	.01	.05	.07	.07	.08	.13	.36	.35	.20
15	.13	.10	.02	.03	.01	.05	.09	.06	.08	.11	.36	.39	.20
16	.20	.14	.04	.05	.03	.11	.16	.10	.10	.13	.31	.34	.20
17	.18	.19	.06	.05	.03	.12	.16	.10	.10	.08	.43	.21	.20
18	.21	.13	.09	.08	.07	.29	.48	.14	.09	.09	.39	.38	.20
19	.34	.16	.17	.15	.12	.25	.69	.18	.07	.06	.29	.16	.20
20	.36	.25	.16	.09	.15	.32	.75	.23	.13	.14	.37	.19	.20
21	.39	.28	.52	.11	.12	.28	.97	.13	.23	.12	.52	.13	.20
22	.35	.28	.94	.32	.21	.25	1.96	.24	.05	.22	.57	.29	.20
23	.64	.12	.65	.30	.41	.18	1.36	.19	.01	.07	.60	.50	.20
24	.20	.20	.30	.20	.20	.20	.30	.10	.05	.20	.25	.30	.20

Table 17. Sebastes mentella, Divisions IIa and IIb.
The biomass 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+}) Tons x 10^{-3}	B (N_{15+}) Tons x 10^{-3}	Year class	Year class strength at age 6 (millions)
1965	324	48	1965	880
1966	356	53	1966	702
1967	399	61	1967	541
1968	465	77	1968	444
1969	559	104	1969	654
1970	707	142	1970	(750)
1971	863	166	1971	(700)
1972	983	174		
1973	1 110	196		
1974	1 219	221		
1975	1 320	233		
1976	(1 225)	(186)		
1977	(1 108)	(180)		
1978	(1 154)	(192)		
1979	(1 214)	(217)		

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

Age	Stock size at beginning of 1979	Proportional fishing mortality (1977-79)	Mean weight per age (kg)
6	800 000	.00	.168
7	633 386	.015	.183
8	571 395	.15	.255
9	521 633	.60	.311
10	353 949	1.00	.367
11	151 907	1.00	.432
12	136 155	1.00	.508
13	129 653	1.00	.611
14	140 945	1.00	.679
15	86 981	1.00	.753
16	49 895	1.00	.821
17	32 937	1.00	.872
18	15 144	1.00	.910
19	12 737	1.00	.923
20	14 369	1.00	.985
21	8 245	1.00	1.056
22	10 297	1.00	1.124
23	7 721	1.00	1.193
24	10 072	1.00	1.215

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

Country	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977*
Belgium	3 788	4 117	3 360	2 204	2 798	2 484	1 622	2 114	1 945	1 522	1 345
Faroe Isl.	3	2	8		35	9	243	254	82	211	224
GDR	341	419	656	827	238	135		11		-	
Germany,F.R.	66 638	62 521	55 831	48 907	46 580	43 963	38 358	36 398	33 602	32 948	32 058
Iceland	17 857	24 716	24 321	23 807	29 118	26 973	26 470	27 799	32 659	34 028	28 204
Netherlands			2							-	
Norway		20			1	1	4	15	22	31	91
Poland				259	17	35		18		-	-
UK(England and Wales)	5 742	3 727	2 174	2 810	3 436	3 608	2 923	2 482	2 368	1 104	-
UK(Scotland)	279	144	128	138	116	89	28	37	56	20	
USSR	435	809	1 256	10	31	28	2			-	-
Total	95 083	96 475	87 736	78 962	82 370	77 325	69 650	69 129	70 734	69 864	61 922

* Provisional data.

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

Country	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977*
Faroe Isl.		1	5				121	28	9	33	54
France								300	800	-	
GDR	18	45						1	1	-	
Germany.F.R.	4 949	6 538	1 293	1 914	2 328	4 034	9 490	7 328	7 628	5 255	5 378
Netherlands									105	-	-
Norway								10	7	17	10
U.K.	46	53	28	33	24	53	85	98	41	59	12a)
Total	5 013	6 637	1 326	1 947	2 352	4 087	9 696	7 765	8 591	5 364	5 454

* Provisional data.

a) UK (England and Wales) only.

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

Country	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977*
Canada										420	
Denmark										129	
Faroe Isl.							13	43	1	3	19
GDR	28		154	409	611	703	841	1 275	4 490	-	
Germany, F.R.	23 225	17 552	26 289	16 316	17 062	7 287	4 491	2 632	4 979	4 403	12 011
Iceland	9 935	5 527	3 906	1 001	2 380	5 490	2 144	9 777	5 632	7 410	
Norway									63	5	62
Poland				436	312	464	281	6	276	-	-
UK(Engl.&Wales)	10			+	+	5	65	127	56	286	622
USSR			18		71	21	64	118	9 830	101 000	251
Total SA XIV	33 198	23 079	30 367	18 162	20 436	13 970	7 899	13 978	25 329	113 656	12 956
Total ICNAF SA I	13 210	9 606	4 252	4 101	2 756	2 988	3 319	3 324	8 629	13 698	

* Provisional data.

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

Years	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*	61 922	5 454	12 965	80 341	51 421	28 920

* Provisional figures.

Table 23. *Sebastes marinus*. Sub-areas V and XIV combined.
Catch in numbers per cm-group (x 10^{-3}).

Length (cm)	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	Average 1967-74	Average 1975-77
20							8		13	107	12	1	44
21						28	-	8	13	107	-	4	40
22						-	-	8	57	212	25	1	98
23						28	-	-	71	321	-	4	131
24						57	8	15	176	1 393	19	10	529
25				22		28	-	8	272	2 142	34	7	816
26				-	5	28	33	8	285	2 382	19	9	895
27				17	12	57	28	153	520	4 163	116	33	1 600
28				57	16	57	86	217	513	3 673	129	54	1 438
29			15	139	8	230	306	267	703	5 330	159	121	2 064
30	345	176	111	254	128	797	509	640	678	5 144	604	370	2 142
31	310	291	263	371	184	939	713	977	1 072	6 639	1 114	506	2 942
32	629	644	611	501	397	1 792	1 581	1 778	1 513	9 328	2 161	992	4 334
33	946	1 135	1 200	986	811	2 620	2 503	2 968	1 400	8 608	3 003	1 646	4 337
34	1 773	1 645	1 840	1 444	1 328	3 533	2 979	4 141	1 689	8 541	4 182	2 335	4 804
35	2 726	2 512	2 808	2 005	2 305	3 968	3 533	4 129	2 079	8 322	4 969	2 998	5 123
36	3 490	2 732	3 960	2 820	2 899	3 236	3 412	5 184	3 029	7 491	4 694	3 467	5 071
37	3 961	3 551	4 422	3 171	3 372	3 619	3 935	4 785	3 720	6 648	4 561	3 852	4 976
38	5 410	4 065	5 208	3 604	3 970	2 967	3 342	4 325	4 313	6 431	3 920	4 111	4 888
39	5 596	4 388	4 668	3 451	3 755	2 715	3 139	3 467	4 275	5 142	3 135	3 897	4 184
40	6 817	4 510	5 259	3 850	3 864	2 787	2 598	3 253	4 872	5 199	2 904	4 117	4 325
41	6 301	4 397	5 076	3 740	3 499	2 027	2 245	2 498	4 356	4 821	9 584	3 723	3 920
42	5 664	4 077	5 118	4 248	3 400	2 376	1 988	2 345	3 029	3 908	2 413	3 652	3 117
43	5 655	4 087	4 153	3 779	3 950	1 952	1 656	1 563	3 041	3 071	2 413	3 349	2 842
44	4 110	3 234	3 627	3 493	3 981	1 494	1 380	1 488	2 349	2 951	2 054	2 851	2 451
45	3 955	3 217	2 906	3 364	4 235	2 102	1 276	1 461	1 977	2 511	1 889	2 815	2 126
46	3 657	2 897	3 055	3 357	3 818	1 615	956	1 290	1 446	2 058	1 620	2 581	1 708
47	3 188	2 787	2 839	3 043	3 251	1 377	1 030	940	1 548	1 679	1 326	2 307	1 518
48	2 647	2 010	2 613	3 020	3 293	1 358	991	922	1 647	1 292	1,016	2 107	1 318
49	2 547	1 884	2 032	2 603	2 575	1 052	949	1 048	1 344	1 048	915	1 836	1 102
50	1 976	1 754	2 098	1 917	2 279	868	831	693	991	1 612	699	1 552	1 101

continued.....

Table 23 (continued)

Length (cm)	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	Average 1967-74	Average 1975-77
51	1 548	1 322	1 405	1 711	1 387	576	673	602	1 029	645	536	1 153	737
52	1 015	833	1 125	1 115	1 044	563	588	608	715	697	448	861	620
53	655	869	895	751	884	176	318	345	478	578	290	612	449
54	247	372	507	509	474	163	141	241	273	233	197	332	234
55	390	212	225	311	873	84	181	169	190	363	177	306	243
56	209	144	123	151	105	4	81	149	191	232	77	121	167
57	411	85	94	61	116	5	36	54	77	63	38	108	59
58	11	48	76	89	12	2	2	29	35	6	44	34	28
59	12	39	42	33	8	3	3	8	41	50	14	19	35
60	13	33	55	31	12	32	17	–	12	50	19	24	27
61	22	22	48	50	13	4	4	14	13	16	13	22	14
62	20	24	47	34	18	4	16	–	19	9	13	20	14
63	31	20	46	44	15	34	3	14	17	–	–	26	6
64	32	22	51	27	18	7	4	10	17	6	6	21	10
65	37	24	47	34	26	7	4	16	19	44	13	24	25
66	31	21	44	39	26	6	3	–	24	–	19	21	14
67	33	16	51	34	26	5	3	2	23	–	6	21	10
68	31	16	47	32	32	6	2	14	22	–	6	23	9
69	28	15	46	35	24	5	2	3	17	–	–	20	6
70	27	15	47	33	20	5	1	3	30	–	–	19	10
71	18	13	42	26	19	2	1	–	27	–	13	15	13
72	18	12	39	25	16	3	1		19	–	–	14	6
73	15	17	29	20	13	2	1		9	44	6	12	20
74	11	7	28	12	13	1	1		8		6	9	5
75	11	6	16	12	9	1	1		8		–	7	3
76	9	5	16	8	8						6	6	2
77	7	13	29	13	8						18	9	6
Σ	76 595	60 218	69 102	60 496	62 554	47 407	44 102	52 860	56 304	125 310	54 654	59 167	78 756
W̄	1.113	1.141	1.150	1.025	1.093	1.075	0.950	0.943	1.083	0.747	0.941	1.070	0.872
Corresp. Catch in tons	85 249	68 712	79 467	62 020	68 374	50 961	41 898	49 845	60 980	93 605	51 421	63 316	68 669

Table 24. Sebastes mentella. Sub-areas XIV and V combined.
Catch in numbers per cm-group.

Length (cm)	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	Average 1967-74	Average 1975-77
9										110			37
10										110			37
11									85	-			28
12									289	330			206
13									580	441			340
14									1 413	2 093			1 169
15									4 295	8 922			4 406
16									8 028	13 989			7 339
17									8 001	16 633			8 211
18									9 356	24 343			11 233
19									10 490	28 089			9 645
20									10 679	28 639			13 106
21									3 939	24 674			9 534
22									599	23 242			7 947
23									858	16 854			5 904
24									375	29 521			9 965
25									-	13 108			4 369
26									-	15 972			5 324
27									-	19 056			6 352
28									-	21 590	2		7 197
29									-	21 700	16		7 239
30	16			6		6	88	4	22	13 693	52	15	4 589
31	16	15	34	67	4	9	156	30	72	7 638	132	41	2 614
32	53	30	70	114	29	19	222	132	142	4 612	214	84	1 656
33	94	35	211	307	68	62	255	323	292	3 363	375	169	1 343
34	236	105	359	564	297	134	309	475	772	2 327	757	310	1 285
35	354	296	589	894	336	323	276	770	1 398	2 383	1 260	480	1 680
36	834	402	985	1 398	591	629	441	877	1 927	2 242	1 879	770	2 016
37	1 209	844	1 105	1 625	732	1 229	761	1 035	1 652	2 721	2 499	1 068	2 291
38	1 689	1 203	1 628	2 142	1 256	2 148	1 261	1 620	1 792	2 790	3 447	1 618	2 676
39	1 843	1 783	1 967	2 057	1 403	2 590	1 614	1 929	1 728	1 634	3 477	1 898	2 280
40	3 365	3 255	3 143	3 043	2 106	3 852	2 863	3 308	1 994	2 200	3 196	3 117	2 463
41	4 503	4 942	3 829	3 333	2 882	3 711	2 937	2 733	2 365	1 923	2 361	3 608	2 216
42	5 922	6 673	4 070	3 688	3 672	4 318	3 758	3 351	2 832	1 928	2 315	4 432	2 358

continued....

Table 24 (continued)

Length (cm)	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	Average 1967-74	Average 1975-77
43	5 693	7 803	4 344	3 471	4 689	4 257	3 879	3 522	2 939	2 038	2 056	4 707	2 344
44	5 323	6 976	4 460	3 253	4 989	4 236	4 388	3 406	3 373	1 984	1 692	4 929	2 350
45	5 217	5 502	3 843	3 102	4 681	3 432	5 264	4 117	2 952	2 007	1 521	4 395	2 160
46	2 917	3 755	6 331	2 161	2 953	3 137	3 701	2 899	2 646	1 389	1 228	3 482	1 754
47	1 965	2 521	1 613	1 701	1 585	2 184	3 004	2 323	2 240	1 202	880	2 112	1 441
48	1 170	1 206	1 021	956	1 149	1 325	2 100	1 261	1 477	754	628	1 274	953
49	581	523	591	549	374	742	1 113	877	832	426	390	669	549
50	289	315	299	263	214	284	462	431	458	341	288	320	362
51	106	178	223	195	87	118	189	159	179	142	103	157	141
52	78	29	180	95	71	105	57	60	102	49	79	84	77
53	31	29	73	67	51	37	18	40	66	36	69	43	57
54	12	38	68	69	35	32	9	21	47	21	20	36	29
55		42	48	46	8	26	1	24	15	19	20	24	18
56		11	15	20	14	4	-	8	6	5	8	9	6
57			3	3		6	2		6	3	5	2	5
58						-			-	3	5		3
59						6			3	3	6	1	4
60									2				1
Σ	43 516	48 511	41 102	35 189	34 276	38 961	39 128	35 735	93 318	369 292	30 980	39 854	161 309
$\overline{W}$	1.104	1.185	0.972	1.053	1.073	1.140	1.159	1.148	0.468	0.258	.934	1.098	.340
Corresp. catch in tons	48 045	57 479	39 962	37 051	36 784	44 421	45 347	41 027	43 674	95 279	28 920	43 765	55 958

Table 25. Calculation of average weights per age.

Age	Sebastes marinus			Sebastes mentella			
	Weight (g)	ln $\overline{W}$	Calcul. $\overline{W}$ (g)	Weight (g)	ln $\overline{W}$	Calcul. $\overline{W}$ (g)	Range of cm-groups
9	454	6.118	399	178	5.182	260	23-24
10	494	6.203	440	269	5.595	292	25-29
11	431	6.066	486	285	5.652	327	25-30
12	503	6.221	536	362	5.892	367	26-34
13	557	6.323	591	476	6.165	410	29-36
14	666	6.501	652	527	6.267	460	30-37
15	714	6.571	720	618	6.426	516	32-39
16	795	6.678	794	717	6.575	578	34-41
17	875	6.774	876	770	6.646	648	35-42
18	961	6.868	966	870	6.768	726	37-44
19	1 045	6.952	1 066	900	6.802	813	38-44
20	1 141	7.040	1 176	953	6.860	912	39-45
21	1 218	7.105	1 297	966	6.873	1 022	39-46
22	1 409	7.251	1 431	1 051	6.957	1 145	41-46
23	1 537	7.338	1 579	1 066	6.972	1 284	41-47
24	1 828	7.511	1 742	1 135	7.034	1 438	42-50
25	1 980	7.591	1 924			1 614	
26	2 257	7.722	2 120			1 809	
27	2 461	7.808	2 339			2 028	
28	2 502	7.825	2 580			2 272	
29			2 846				
30			3 140				
31			3 464				
32			3 822				
33			4 216				
34			4 651				
35			5 131				
36			5 661				
37			6 245				
38			6 889				

Table 26. Cohort Analysis using length data

	Sebastes marinus								Sebastes mentella							
	M = 0.1; K = 0.0192, L_∞ = 101.67; $\frac{F}{Z}$ = 0.8								M = 0.1; K = 0.0082; L_∞ = 173.7; $\frac{F}{Z}$ = 0.8							
	1967–1974				1975–1977				1967–1974				1975–1977			
cm	Catch (No.) x 10^{-3}	FΔt	F (Year)	Stock (No.) x 10^{-6}	Catch (No.) x 10^{-3}	FΔt	F (Year)	Stock (No.) x 10^{-6}	Catch (No.) x 10^{-3}	FΔt	F (Year)	Stock (No.) x 10^{-6}	Catch (No.) x 10^{-3}	FΔt	F (Year)	Stock (No.) x 10^{-6}
9													37	.000043	.000058	662.4
10													37	.000046	.000062	618.9
11													28	.000034	.000050	583.1
12													206	.00030	.00040	544.5
13													340	.00053	.00070	508.0
14													1 169	.002	.003	473.7
15													4 406	.008	.010	440.9
16													7 339	.015	.019	407.7
17													8 211	.018	.023	374.3
18													11 233	.027	.035	342.5
19													9 645	.026	.033	310.3
20	1	.000003	.000004	236.5	44	.0001	.0002	231.1					13 106	.039	.049	281.4
21	4	.000012	.000018	224.7	40	.0001	.0002	219.6					9 534	.032	.040	251.6
22	1	.000003	.000005	213.3	98	.0003	.0005	208.5					7 947	.030	.037	226.6
23	4	.00001	.00002	202.4	131	.0005	.0007	197.8					5 904	.025	.030	204.3
24	10	.00004	.00005	192.0	529	.002	.003	187.5					9 965	.047	.057	185.2
25	7	.00003	.00004	181.9	816	.003	.005	177.3					4 369	.023	.028	164.0
26	9	.00004	.00005	172.3	895	.004	.006	167.4					5 324	.031	.038	148.7
27	33	.0001	.0002	163.0	1 600	.007	.011	157.8					6 352	.042	.051	133.7
28	54	.0003	.0004	154.1	1 438	.007	.010	148.1					7 197	.054	.065	118.8
29	121	.0006	.0009	145.6	2 064	.011	.015	139.0					7 239	.063	.075	104.3
30	370	.0020	.0028	137.4	2 142	.012	.017	129.8	15	.00012	.00014	114.8	4 589	.046	.054	90.7
31	506	.003	.004	129.4	2 942	.019	.025	120.9	41	.00034	.00040	106.2	2 614	.029	.035	80.1
32	992	.006	.008	121.6	4 334	.030	.041	111.9	84	.0008	.0009	98.2	1 656	.021	.024	72.0
33	1 646	.011	.015	118.8	4 337	.034	.045	102.3	169	.002	.002	90.7	1 343	.019	.022	65.2
34	2 335	.018	.023	105.9	4 804	.042	.055	93.0	310	.003	.004	83.7	1 285	.020	.023	59.1
35	2 998	.025	.032	97.8	5 123	.050	.065	83.9	480	.006	.007	77.0	1 680	.029	.033	53.5

continued

Table 26 (continued)

	Sebastes marinus $M = 0.1$; $K = 0.0192$, $L_\infty = 101.67$; $\frac{F}{Z} = 0.8$								*Sebastes mentella* $M = 0.1$; $K = 0.0082$; $L_\infty = 173.7$; $\frac{F}{Z} = 0.8$							
	1967-1974				1975-1977				1967-1974				1975-1977			
cm	Catch (No.) x 10^{-3}	FΔt	F (Year)	Stock (No.) x 10^{-6}	Catch (No.) x 10^{-3}	FΔt	F (Year)	Stock (No.) x 10^{-6}	Catch (No.) x 10^{-3}	FΔt	F (Year)	Stock (No.) x 10^{-6}	Catch (No.) x 10^{-3}	FΔt	F (Year)	Stock (No.) x 10^{-6}
36	3 467	.032	.041	89.6	5 071	.057	.072	74.9	770	.010	.011	70.6	2 016	.040	.045	47.9
37	3 852	.040	.050	81.4	4 976	.064	.080	66.4	1 068	.016	.017	64.5	2 291	.051	.058	42.5
38	4 111	.049	.060	73.4	4 888	.073	.090	58.4	1 618	.026	.029	58.5	2 676	.070	.078	37.2
39	3 897	.052	.064	65.4	4 184	.073	.089	50.8	1 898	.035	.038	52.5	2 280	.070	.077	31.9
40	4 117	.064	.076	58.1	4 325	.089	.106	44.2	3 117	.066	.072	46.7	2 463	.089	.098	27.4
41	3 723	.067	.079	50.9	3 920	.097	.113	37.8	3 608	.090	.098	40.2	2 216	.096	.105	23.1
42	3 652	.077	.089	44.5	3 117	.092	.106	32.0	4 432	.135	.146	33.8	2 358	.126	.136	19.3
43	3 349	.084	.095	38.4	2 842	.101	.114	27.2	4 707	.185	.198	27.1	2 344	.158	.169	15.6
44	2 851	.085	.094	32.9	2 451	.105	.118	22.9	4 929	.266	.282	20.7	2 350	.209	.222	12.2
45	2 815	.100	.110	28.1	2 126	.111	.122	19.6	4 395	.354	.371	14.5	2 160	.267	.281	9.1
46	2 581	.112	.121	23.6	1 708	.110	.118	16.0	3 482	.462	.477	9.4	1 754	.319	.332	6.4
47	2 307	.124	.131	19.6	1 518	.120	.127	13.3	2 112	.499	.509	5.4	1 441	.415	.426	4.3
48	2 107	.142	.147	16.1	1 318	.130	.135	10.9	1 274	.563	.567	3.0	953	.470	.477	2.6
49	1 836	.158	.161	12.9	1 102	.137	.139	8.9	669	.578	.576	1.6	549	.481	.483	1.5
50	1 552	.174	.174	10.2	1 101	.176	.176	7.1	320	.534	.530	.8	362	.597	.589	.8
51	1 153	.170	.167	7.9	737	.154	.151	5.5	157	.484	.478	.4	141	.434	.431	.4
52	861	.167	.160	6.1	620	.169	.162	4.4	84	.459	.451	.2	77	.398	.393	.2
53	612	.155	.146	4.8	449	.160	.151	3.4	43	.401	.393	.1	57	.512	.497	.1
54	332	.106	.098	3.7	234	.106	.098	2.6	36	.612	.583	.1	29	.474	.458	.1
55	306	.123	.111	3.1	243	.139	.126	2.2	24	.980	.884	<.1	18	.540	.514	<.1
56	121	.060	.053	2.5	167	.122	.108	1.7	9	1.194	1.031	<.1	6	.309	.297	<.1
57	108	.063	.055	2.1	59	.053	.046	1.4	2	.855	.772	<.1	5	.408	.386	<.1
58	34	.023	.020	1.8	28	.029	.025	1.2	0	0	0	<.1	3	.409	.384	<.1
59	19	.015	.012	1.6	35	.043	.035	1.1	1		$\boxed{.4}$	<.1	4	1.378	1.120	<.1
60	24	.022	.018	1.5	27	.039	.031	.9					1		$\boxed{.4}$	<.1
61	22	.023	.018	1.3	14	.024	.019	.8								
62	20	.025	.019	1.1	14	.027	.021	.7								
63	26	.038	.028	1.0	6	.014	.010	.6								
64	21	.036	.026	.9	10	.027	.020	.6								
65	24	.049	.035	.7	25	.081	.058	.5								

Table 26 (Continued)

	Sebastes marinus $M = 0.1$; $K = 0.0192$, $L_{\infty} = 101.67$; $\frac{F}{Z} = 0.8$								*Sebastes mentella* $M = 0.1$; $K = 0.0082$; $L_{\infty} = 173.7$; $\frac{F}{Z} = 0.8$							
	1967-1974				1975-1977				1967-1974				1975-1977			
cm	Catch (No.) $\times 10^{-3}$	$F \Delta t$	F (Year)	Stock (No.) $\times 10^{-6}$	Catch (No.) $\times 10^{-3}$	$F \Delta t$	F (Year)	Stock (No.) $\times 10^{-6}$	Catch (No.) $\times 10^{-3}$	$F \Delta t$	F (Year)	Stock (No.) $\times 10^{-6}$	Catch (No.) $\times 10^{-3}$	$F \Delta t$	F (Year)	Stock (No.) $\times 10^{-6}$
66	21	.052	.036	.6	14	.056	.039	.4								
67	21	.064	.043	.5	10	.049	.033	.3								
68	23	.088	.058	.4	9	.053	.035	.3								
69	20	.098	.062	.4	6	.044	.028	.2								
70	19	.122	.075	.3	10	.091	.056	.2								
71	15	.129	.077	.2	13	.158	.094	.2								
72	14	.165	.095	.2	6	.099	.057	.1								
73	12	.202	.113	.1	20	.528	.288	.1								
74	9	.225	.121	.1	5	.236	.127	<.1								
75	7	.270	.140	.1	3	.214	.111	<.1								
76	6	.391	.193	<.1	2	.215	.107	<.1								
77	9		$\boxed{.4}$	<.1	6		$\boxed{.4}$	<.1								
Total	59 167				78 756				39 854				161 304			

Table 27. Results of the Cohort Analysis using length data

		Sebastes marinus		Sebastes mentella	
		1967-74	1975-77	1967-74	1975-77
Mean F weighted by stock size	Adults	.067	.089	.075	.090
	Spawners	.091	.108	.137	.144
Stock size in numbers (millions)	Adults	892	697	611	395
	Spawners	517	379	315	192
Stock size in weight (1 000 tons)	Adults	852	624	490	314
	Spawners	611	420	298	183

Adults = 34 cm and longer

Spawners = 38 cm and longer

Table 28. Sebastes marinus Sub-areas XIV and V combined 1967-77. Input data catch in numbers by year and by age.

AGE	1967	1968	1969	1970	1971	1972
9	0.0	0.0	0.0	8.0	4.0	59.0
10	0.0	0.0	0.0	15.0	5.0	65.0
11	154.0	138.0	137.0	183.0	102.0	503.0
12	1166.0	1101.0	1108.0	1148.0	803.0	3066.0
13	2075.0	1996.0	2141.0	1826.0	1565.0	4539.0
14	4546.0	3971.0	4891.0	3599.0	3713.0	5998.0
15	4159.0	3519.0	4354.0	3133.0	3323.0	4044.0
16	6810.0	5373.0	6617.0	4706.0	5081.0	4469.0
17	3563.0	2718.0	3200.0	2352.0	2424.0	1928.0
18	9205.0	6618.0	7746.0	5814.0	5798.0	4269.0
19	7317.0	5272.0	6047.0	4824.0	4712.0	3003.0
20	2682.0	1964.0	2245.0	1908.0	1841.0	1020.0
21	8153.0	6025.0	6567.0	5844.0	6152.0	3217.0
22	5533.0	4252.0	4608.0	4592.0	4939.0	2304.0
23	7410.0	5892.0	6240.0	6596.0	7342.0	3269.0
24	6970.0	5619.0	6204.0	6856.0	7233.0	3066.0
25	2966.0	2502.0	2868.0	3076.0	3189.0	1268.0
26	1882.0	1630.0	1894.0	1956.0	2205.0	726.0
27	829.0	774.0	910.0	916.0	981.0	303.0
28	650.0	527.0	717.0	683.0	762.0	211.0
29	382.0	210.0	324.0	275.0	259.0	59.0
30	143.0	117.0	284.0	184.0	121.0	29.0

AGE	1973	1974	1975	1976	1977
9	21.0	48.0	273.0	2023.0	49.0
10	28.0	68.0	374.0	2715.0	69.0
11	402.0	533.0	878.0	6229.0	542.0
12	2624.0	3292.0	3009.0	19819.0	3450.0
13	4017.0	4987.0	3320.0	19604.0	5262.0
14	5652.0	7437.0	4282.0	15776.0	7623.0
15	4106.0	5261.0	3620.0	8889.0	5192.0
16	4873.0	6152.0	5536.0	9193.0	5749.0
17	2074.0	2518.0	2704.0	3780.0	2331.0
18	4287.0	5159.0	6545.0	8440.0	4979.0
19	2883.0	3322.0	4744.0	5596.0	3423.0
20	934.0	1028.0	1570.0	1844.0	1192.0
21	2786.0	3096.0	4799.0	5552.0	3658.0
22	1798.0	1956.0	2973.0	3389.0	2421.0
23	2349.0	2537.0	3724.0	4348.0	3239.0
24	2536.0	2549.0	3763.0	3817.0	2761.0
25	1239.0	1229.0	1740.0	1751.0	1141.0
26	783.0	845.0	1160.0	1283.0	778.0
27	360.0	407.0	558.0	587.0	355.0
28	255.0	306.0	425.0	429.0	264.0
29	84.0	118.0	197.0	173.0	109.0
30	11.0	12.0	110.0	73.0	67.0

Table 29. Sebastes marinus Sub-areas XIV and V combined 1967-77.
Fishing mortalities by year and by age.

AGE	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
9	0.00	0.00	0.00	.00	.00	.00	.00	.00	.01	.10	.00
10	0.00	0.00	0.00	.00	.00	.00	.00	.00	.00	.07	.00
11	.00	.00	.00	.00	.00	.00	.00	.00	.00	.05	.02
12	.01	.01	.02	.01	.01	.04	.02	.03	.02	.13	.03
13	.02	.02	.02	.03	.02	.04	.06	.04	.03	.12	.04
14	.04	.04	.06	.04	.07	.07	.06	.14	.04	.17	.06
15	.05	.03	.05	.04	.04	.09	.06	.06	.08	.11	.07
16	.10	.08	.08	.06	.08	.06	.13	.10	.08	.28	.08
17	.06	.05	.06	.03	.03	.03	.03	.08	.05	.06	.09
18	.18	.14	.16	.12	.09	.07	.09	.09	.29	.20	.10
19	.16	.13	.17	.13	.12	.06	.05	.09	.10	.37	.11
20	.07	.05	.07	.07	.06	.03	.02	.02	.05	.05	.11
21	.24	.19	.23	.24	.28	.13	.10	.08	.12	.21	.11
22	.21	.17	.20	.22	.28	.15	.09	.09	.09	.11	.12
23	.42	.33	.37	.43	.59	.28	.19	.16	.21	.16	.13
24	.65	.57	.61	.77	1.02	.46	.32	.30	.33	.31	.13
25	.53	.46	.56	.61	.91	.43	.30	.22	.30	.22	.13
26	.58	.54	.66	.84	1.11	.47	.45	.31	.30	.34	.13
27	.47	.44	.59	.69	1.31	.37	.39	.40	.30	.22	.13
28	.58	.54	.83	1.09	2.26	1.03	.54	.61	.83	.36	.13
29	1.01	.33	.66	.79	1.75	1.35	1.55	.45	.89	.87	.13
30	.13	.13	.13	.13	.13	.13	.13	.13	.13	.13	.13

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

	.19	.15	.17	.16	.18	.09	.09	.10	.12	.17	.11

Table 30. *Sebastes marinus* Sub-areas XIV and V combined 1967-77.
Stock in numbers at beginning of year.

AGE	1967	1968	1969	1970	1971	1972
9	159877.3	181481.9	110710.3	187507.8	182723.4	282428.4
10	93161.0	144663.0	164211.6	100174.8	169656.5	165331.2
11	149855.1	84295.6	130896.5	148584.8	90627.6	153506.8
12	119400.4	135448.1	76142.6	118309.8	134271.1	81906.3
13	133709.4	106929.4	121511.7	67843.3	105959.7	120730.0
14	126098.8	119012.6	94856.2	107912.9	59651.3	94388.4
15	86800.9	109777.8	103912.4	81181.0	94222.6	50446.3
16	75827.3	74587.9	95986.0	89885.5	70477.7	82097.5
17	61029.2	62141.5	62384.4	80564.0	76859.2	58942.8
18	58141.0	51835.5	53644.6	53406.5	70661.6	67240.9
19	50726.7	43869.0	40617.6	41184.6	42801.6	58428.4
20	42569.3	38951.7	34687.1	31010.8	32683.5	34252.8
21	39450.6	35969.6	33378.4	29252.8	26246.5	27823.7
22	30008.7	27960.0	26827.1	23969.9	20923.3	17913.0
23	22760.0	21901.4	21362.2	19899.9	17330.8	14247.1
24	15200.1	13572.8	14230.3	13323.7	11756.6	8734.2
25	7595.3	7161.9	6963.4	7006.7	5578.1	3817.8
26	4484.8	4064.6	4110.3	3586.5	3430.0	2037.5
27	2330.1	2277.0	2134.9	1928.1	1398.2	1025.8
28	1536.7	1323.2	1327.1	1070.7	878.5	342.2
29	626.9	775.4	698.4	523.7	325.1	82.8
30	253.0	207.0	502.5	325.5	214.1	51.3

AGE	1973	1974	1975	1976	1977
9	229798.5	174019.0	47259.3	22196.8	128752.4
10	255495.7	207910.3	157413.3	42502.4	18162.5
11	149536.1	231155.5	188060.4	142077.8	35877.7
12	138420.4	134923.6	208651.3	169329.3	122636.9
13	71197.6	122753.4	118954.5	185934.8	134391.5
14	104926.7	60604.7	106331.8	104478.5	149618.9
15	79706.3	89570.1	47774.2	92143.0	79557.2
16	41803.3	68219.0	76046.7	39788.2	74930.0
17	70037.7	33196.9	55882.4	63549.5	27281.0
18	51501.0	61401.2	27645.2	47994.5	53909.8
19	56785.3	42526.9	50656.6	18806.0	35415.8
20	50014.2	48641.5	35323.5	41329.1	11712.0
21	30023.6	44366.8	43035.4	30469.9	35643.5
22	22120.4	24519.7	37202.8	34381.7	22300.5
23	14020.3	18307.0	20327.9	30837.7	27890.4
24	9790.1	10456.2	14155.8	14858.8	23774.4
25	4998.8	6453.5	7043.4	9240.4	9824.9
26	2253.1	3348.0	4672.9	4722.8	6699.2
27	1156.0	1297.0	2228.0	3128.0	3056.8
28	641.0	704.8	787.8	1486.8	2273.3
29	110.6	338.6	348.2	311.5	938.6
30	19.5	21.2	194.6	129.2	118.5

Table 31. *Sebastes marinus* Sub-areas XIV and V combined 1967-77. Weights at beginning of year.

AGE	1967	1968	1969	1970	1971	1972
9	63791.1	72411.3	44173.4	74815.6	72906.7	112688.9
10	40990.9	63651.7	72253.1	44076.9	74648.8	72745.7
11	72829.6	40967.7	63615.7	72212.2	44045.0	74604.3
12	63998.6	72600.2	40812.4	63414.0	71969.3	43901.8
13	79022.3	63195.3	71813.4	40095.4	62622.2	71351.4
14	82216.4	77596.2	61846.2	70359.2	38892.7	61541.2
15	62496.6	79040.0	74816.9	58450.3	67840.3	36321.3
16	60206.9	59222.8	76212.9	71369.0	55959.3	65185.4
17	53461.6	34436.0	54648.8	70574.1	67328.7	51633.9
18	56164.2	30073.1	51820.7	51590.7	68259.1	64954.7
19	54074.7	46764.3	43298.4	43902.8	45626.5	62284.7
20	50061.4	45807.2	40792.1	36468.7	38435.9	40281.3
21	51167.5	46652.5	43291.8	37940.9	34041.7	36087.3
22	42942.4	40010.8	38339.5	34300.9	29941.2	25633.5
23	35938.0	34582.3	33573.0	31422.0	27365.3	22496.1
24	26478.5	23643.7	24789.2	23209.9	20420.1	15215.0
25	14598.2	13765.2	13383.7	13467.0	10721.1	7337.8
26	9507.7	8616.9	8713.9	7603.3	7271.6	4319.6
27	5450.1	5326.0	4993.5	4509.7	3270.3	2399.4
28	3964.6	3413.7	3423.9	2762.4	2266.6	882.8
29	1784.1	2206.7	1987.6	1490.4	925.3	235.8
30	946.2	774.2	1873.2	1217.5	800.6	191.9
TOTAL BIOMASS	932091.6	904757.7	870529.2	855252.9	845618.2	872294.0
SPAWNING BIOMASS (AGES >= 16)	466746.2	435295.5	441198.1	431829.2	412693.4	399139.3

AGE	1973	1974	1975	1976	1977
9	91689.6	69433.6	18856.4	8856.5	51372.2
10	112418.1	91480.5	69261.8	18701.0	7991.5
11	72674.5	112341.6	91397.3	69049.8	17436.6
12	74193.3	72319.0	111837.1	90760.5	65733.4
13	42077.8	72547.3	70302.1	109887.5	79425.3
14	68412.2	39514.3	68328.3	68120.0	97551.5
15	57388.6	64490.4	34397.4	66343.0	57281.2
16	33191.9	54165.9	60381.0	31591.8	59494.4
17	61353.0	29080.4	48953.0	55669.4	23898.1
18	49750.0	59313.6	26705.3	46362.7	52076.8
19	60533.2	45333.7	53999.9	20047.2	37753.3
20	58816.7	57202.4	41540.5	48603.0	13773.3
21	38940.6	57543.7	55816.9	39519.4	46229.6
22	31654.3	35087.7	53237.2	49200.2	31912.1
23	22138.0	23906.8	32097.7	48692.8	44038.9
24	17054.4	18214.6	24659.4	25884.0	41415.1
25	9607.8	12403.6	13537.4	17760.0	18883.5
26	4776.6	7097.8	9906.6	10012.3	14202.3
27	2703.9	3033.6	5211.3	7316.5	7149.9
28	1653.8	1818.4	2032.6	3335.6	5865.0
29	314.9	963.7	991.1	886.6	2671.2
30	72.8	79.4	727.9	483.0	443.3
TOTAL BIOMASS	911415.8	932372.0	895178.3	837583.0	776598.5
SPAWNING BIOMASS (AGES >= 16)	392561.8	410245.4	429797.8	405864.8	399806.8

Table 32. Sebastes mentella Sub-areas XIV and V combined 1967-77. Input data catch in numbers by year and by age.

AGE	1967	1968	1969	1970	1971	1972
9	0.0	0.0	0.0	0.0	0.0	0.0
10	0.0	0.0	0.0	0.0	0.0	0.0
11	0.0	0.0	0.0	0.0	0.0	0.0
12	32.0	12.0	46.0	75.0	19.0	15.0
13	84.0	40.0	137.0	218.0	66.0	46.0
14	437.0	250.0	649.0	975.0	372.0	320.0
15	479.0	292.0	606.0	891.0	385.0	414.0
16	1452.0	1024.0	1576.0	2142.0	1066.0	1567.0
17	1519.0	1221.0	1492.0	1871.0	1059.0	1685.0
18	2515.0	2260.0	2362.0	2649.0	1691.0	2743.0
19	3349.0	3433.0	3000.0	2923.0	2284.0	3500.0
20	1060.0	1136.0	844.0	820.0	699.0	993.0
21	8121.0	9195.0	6578.0	5822.0	5609.0	6885.0
22	3203.0	3945.0	2610.0	2043.0	2528.0	2483.0
23	10430.0	12819.0	9126.0	6632.0	8854.0	8162.0
24	5339.0	6473.0	5960.0	3673.0	4758.0	4703.0
25	2490.0	2908.0	2390.0	1792.0	2186.0	2285.0
26	1851.0	2149.0	2079.0	1441.0	1647.0	1844.0
27	785.0	914.0	717.0	704.0	666.0	824.0
28	369.0	441.0	899.0	516.0	385.0	492.0

AGE	1973	1974	1975	1976	1977
9	0.0	0.0	0.0	3202.0	2.0
10	1.0	0.0	0.0	2948.0	2.0
11	2.0	0.0	1.0	6533.0	3.0
12	122.0	71.0	87.0	22608.0	134.0
13	269.0	196.0	262.0	21121.0	342.0
14	549.0	802.0	1331.0	14107.0	1360.0
15	408.0	677.0	1161.0	5547.0	1261.0
16	1068.0	1591.0	2384.0	4431.0	3225.0
17	1107.0	1445.0	1797.0	2619.0	2739.0
18	1874.0	2242.0	2285.0	2841.0	3519.0
19	2586.0	2790.0	2202.0	2229.0	3266.0
20	779.0	795.0	605.0	541.0	758.0
21	5741.0	5467.0	4474.0	3625.0	4618.0
22	2379.0	2029.0	1785.0	1192.0	1242.0
23	9044.0	7398.0	6357.0	4050.0	3742.0
24	5862.0	4602.0	4093.0	2403.0	2054.0
25	3063.0	2306.0	2147.0	1232.0	1030.0
26	2551.0	1935.0	1362.0	1061.0	877.0
27	1158.0	900.0	913.0	544.0	454.0
28	565.0	489.0	581.0	331.0	356.0

Table 33. Sebastes mentella Sub-area XIV and V combined 1967-77. Fishing mortalities by year and by age.

AGE	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
9	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00			
10	0.00	0.00	0.00	0.00	0.00	0.00	.00	0.00	0.00		
11	0.00	0.00	0.00	0.00	0.00	0.00	.00	0.00	.00	1.00	
12	.00	.00	.00	.00	.00	.00	.00	.00	.00	1.20	.04
13	.00	.00	.00	.01	.00	.00	.00	.00	.01	.44	.04
14	.01	.00	.02	.01	.02	.01	.01	.01	.02	.37	.04
15	.01	.01	.01	.03	.01	.02	.01	.01	.02	.09	.05
16	.02	.02	.04	.04	.04	.03	.07	.04	.06	.11	.07
17	.03	.02	.03	.05	.02	.07	.02	.11	.05	.07	.08
18	.05	.05	.05	.07	.05	.07	.10	.05	.23	.09	.12
19	.07	.08	.07	.07	.07	.13	.07	.18	.06	.32	.13
20	.03	.03	.02	.02	.02	.04	.03	.03	.05	.02	.16
21	.24	.23	.20	.18	.19	.26	.28	.31	.18	.41	.18
22	.11	.16	.11	.08	.10	.11	.12	.13	.14	.06	.21
23	.56	.67	.57	.39	.50	.48	.59	.57	.68	.46	.24
24	.54	.72	.68	.42	.47	.48	.67	.61	.63	.53	.40
25	.48	.57	.56	.39	.42	.39	.59	.53	.56	.35	.40
26	.59	.87	.94	.69	.67	.66	.87	.83	.98	.53	.40
27	.85	.57	.72	.87	.70	.74	1.02	.78	1.12	.77	.40
28	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40	.40

MEAN-F FOR AGES >= 16 AND <= 28 (WEIGHTED BY STOCK IN NUMBERS)

	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977
	.13	.17	.15	.12	.14	.16	.20	.18	.18	.15	.19

Table 34. *Sebastes mentella* Sub-area XIV and V combined 1967-77. Stock in numbers at beginning of year.

AGE	1967	1968	1969	1970	1971	1972
9	95762.3	93862.5	96683.3	121781.3	79731.4	93187.1
10	32906.8	86649.3	84930.3	87482.7	110192.2	72143.9
11	98254.5	29775.3	78403.6	76848.2	79157.6	99706.1
12	45694.3	88904.4	26941.8	70942.5	69535.1	71624.8
13	80755.8	41315.5	80432.6	24334.2	64120.1	62899.9
14	59546.4	72991.0	37345.7	72648.2	21811.2	57955.5
15	57778.0	53464.3	65807.3	33174.8	64807.8	19382.0
16	63518.2	51824.2	48098.9	58968.7	29170.8	58274.5
17	60879.0	56093.3	45919.0	42023.6	51321.1	25381.6
18	56947.3	53641.6	49594.6	40131.0	36246.2	45430.5
19	51135.0	49137.7	46388.9	42630.2	33794.8	31189.8
20	44225.4	43086.4	41199.5	39123.6	35795.8	28408.4
21	39964.8	39009.1	37906.3	36476.5	34620.9	31724.9
22	33581.6	28455.3	26574.6	28054.9	27478.0	26001.3
23	25520.7	27343.1	22001.3	21566.3	23443.9	22461.4
24	13303.9	13220.5	12619.9	11271.1	13228.4	12829.2
25	6869.7	6984.2	5843.9	5783.7	6718.1	7463.1
26	4364.7	3857.7	3567.6	3025.8	3534.9	4007.5
27	1428.4	2197.9	1461.8	1266.4	1375.5	1641.1
28	461.3	551.3	1123.8	645.0	481.3	615.0

AGE	1973	1974	1975	1976	1977
9	45428.0	13162.8			
10	84319.1	41104.9	11910.2		
11	65278.5	76294.2	37193.3	10776.8	
12	90217.8	59064.6	69033.8	33652.9	3590.0
13	64794.5	81516.4	53376.3	62381.7	9162.5
14	56870.4	58372.7	73572.8	48047.8	36435.5
15	52136.1	50936.5	52055.4	65306.0	30102.9
16	17144.0	46786.8	45445.6	45997.9	53821.2
17	51239.3	14497.6	40822.1	38855.2	37411.3
18	21365.0	45310.9	11745.3	35229.4	32668.9
19	38500.5	17551.5	38868.2	8459.0	29177.5
20	24897.2	32379.3	13232.4	33076.7	5540.3
21	24761.1	21787.4	28542.3	11398.2	29414.7
22	22173.4	16958.7	14529.1	21578.5	6878.3
23	21168.1	17803.5	13417.8	11451.1	18392.2
24	12594.0	10596.4	9108.2	6130.4	6525.3
25	7154.5	5852.3	5234.1	4370.0	3272.2
26	4587.2	3575.5	3112.4	2704.0	2786.1
27	1882.3	1742.4	1407.9	1059.9	1442.3
28	706.3	611.3	726.3	413.8	445.0

Table 35. Sebastes mentella Sub-areas XIV and V combined 1967-77. Weights at beginning of year.

AGE	1967	1968	1969	1970	1971	1972
9	24898.2	24404.3	25137.7	31663.1	20730.2	24228.6
10	9608.8	25301.6	24799.7	25545.0	32176.1	21066.0
11	32129.2	9736.5	25638.0	25129.3	25884.5	32603.9
12	16769.8	32627.9	9887.6	26035.9	25519.4	26286.3
13	33109.9	16939.3	32977.4	9377.0	26289.2	25789.0
14	27391.3	33575.8	17179.0	33418.2	10033.2	26659.5
15	29813.4	27587.6	33956.5	17118.2	33440.8	10001.1
16	36713.5	29954.4	27801.2	34083.9	16860.7	33682.7
17	39449.6	36348.5	29755.5	27231.3	33256.1	16447.3
18	41343.8	38943.8	36005.7	29135.1	26314.8	32982.5
19	41572.7	39948.9	37714.2	34658.3	27475.2	25357.3
20	40333.6	39294.8	37573.9	35680.7	32645.8	25908.5
21	40844.0	39867.3	38740.2	37279.0	35382.6	32422.8
22	38451.0	32581.4	30427.9	32122.9	31462.3	29771.5
23	32768.5	35108.5	28249.7	27691.1	30101.9	28840.5
24	19131.0	19011.1	18147.3	16207.8	19022.4	18448.4
25	11087.7	11272.5	9432.1	9334.9	10843.1	12045.5
26	7895.8	6978.6	6453.8	5473.7	6394.7	7249.5
27	2896.7	4457.3	2964.6	2568.3	2789.5	3328.2
28	1048.0	1252.4	2553.2	1465.4	1093.4	1397.3
Biomass (ages ≥ 12)	460620.3	445750.2	399819.7	379481.6	368925.0	356617.9
SPAWNING BIOMASS (AGES >= 16)	353535.9	335019.6	305819.3	292932.3	273642.3	267882.0

AGE	1973	1974	1975	1976	1977
9	11811.3	3422.3			
10	24621.2	12002.6	3477.8		
11	21346.1	24948.2	12162.2		
12	33109.9	21676.7	25335.4	12350.6	1317.5
13	26565.8	33421.7	21884.3	25576.5	3756.6
14	26160.4	26851.5	33843.5	22102.0	16760.3
15	26902.2	26283.3	26860.6	33697.9	15533.1
16	9909.2	27042.7	26267.6	26586.8	31108.6
17	33203.1	9394.4	26452.7	25178.2	24242.5
18	15511.0	32895.7	8527.1	25576.5	23717.6
19	31300.9	14269.3	31599.8	6877.2	23721.3
20	22706.3	29529.9	12068.0	30166.0	5052.8
21	25305.9	22266.8	29170.2	11648.9	30061.9
22	25388.5	19417.7	16635.8	24707.3	7875.6
23	27179.9	22859.8	17228.4	14703.3	23615.5
24	18110.1	15237.6	13097.5	8815.6	9383.4
25	11547.3	9445.6	8447.9	7053.2	5281.3
26	8298.3	6468.1	5630.3	4891.6	5040.1
27	3817.2	3533.5	2855.3	2149.4	2925.0
28	1604.6	1388.8	1650.0	940.0	1011.0
Biomass (ages ≥ 12)	346620.6	321938.1	307554.4	283021.0	230404.1
SPAWNING BIOMASS (AGES >= 16)	233882.4	213750.0	199630.6	189294.0	193036.6

Table 36. Parameters used in TAC calculations *Sebastes marinus* in Sub-areas V and XIV.

Age	Stock size beginning of 1978 x 10^{-6}	Proportion of fishing mortality	Mean weight year age (kg)
12	117.4	.23	.536
13	107.7	.32	.591
14	116.7	.42	.652
15	128.2	.55	.720
16	66.2	.65	.794
17	62.3	.72	.876
18	22.5	.78	.966
19	44.1	.82	1.066
20	28.8	.87	1.176
21	9.5	.88	1.297
22	28.7	.93	1 431
23	17.9	1.00	1.579
24	22.2	1.00	1.742
25	18.9	1.00	1.922
26	7.8	1.00	2.120
27	5.3	1.00	2.339
28	2.5	1.00	2.580
29	1.8	1.00	2.846
30+	.8	1.00	3.905

Table 37. Parameters used in TAC calculations *Sebastes mentella* in Sub-areas XIV and V.

Age	Stock size beginning of 1978 x 10^{-6}	Proportion of fishing mortality	Mean weight year age (kg)
12	65.4	.10	.367
13	46.9	.10	.410
14	43.0	.10	.461
15	31.6	.13	.516
16	25.9	.18	.578
17	45.4	.20	.648
18	31.2	.30	.726
19	29.5	.33	.813
20	23.1	.40	.912
21	4.2	.45	1.022
22	22.2	.53	1.145
23	5.1	.60	1.284
24	13.1	1.00	1.438
25	4.1	1.00	1.614
26	2.0	1.00	1.809
27	1.7	1.00	2.028
28	1.1	1.00	2.272

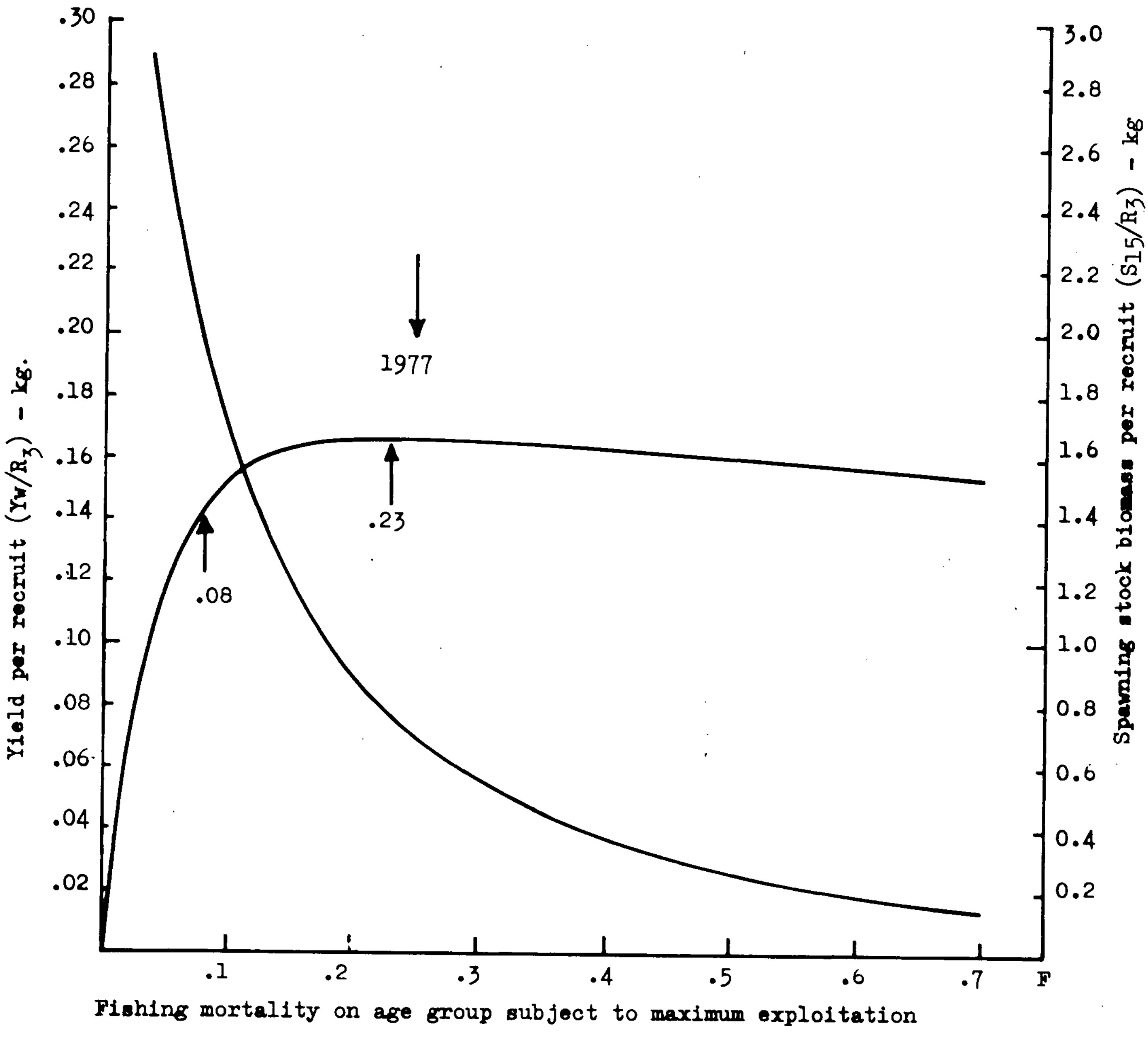


Figure 1. *Sebastes marinus* in Sub-area I and Division IIa.
Yield per recruit curve for present exploitation pattern
(M = 0.10).

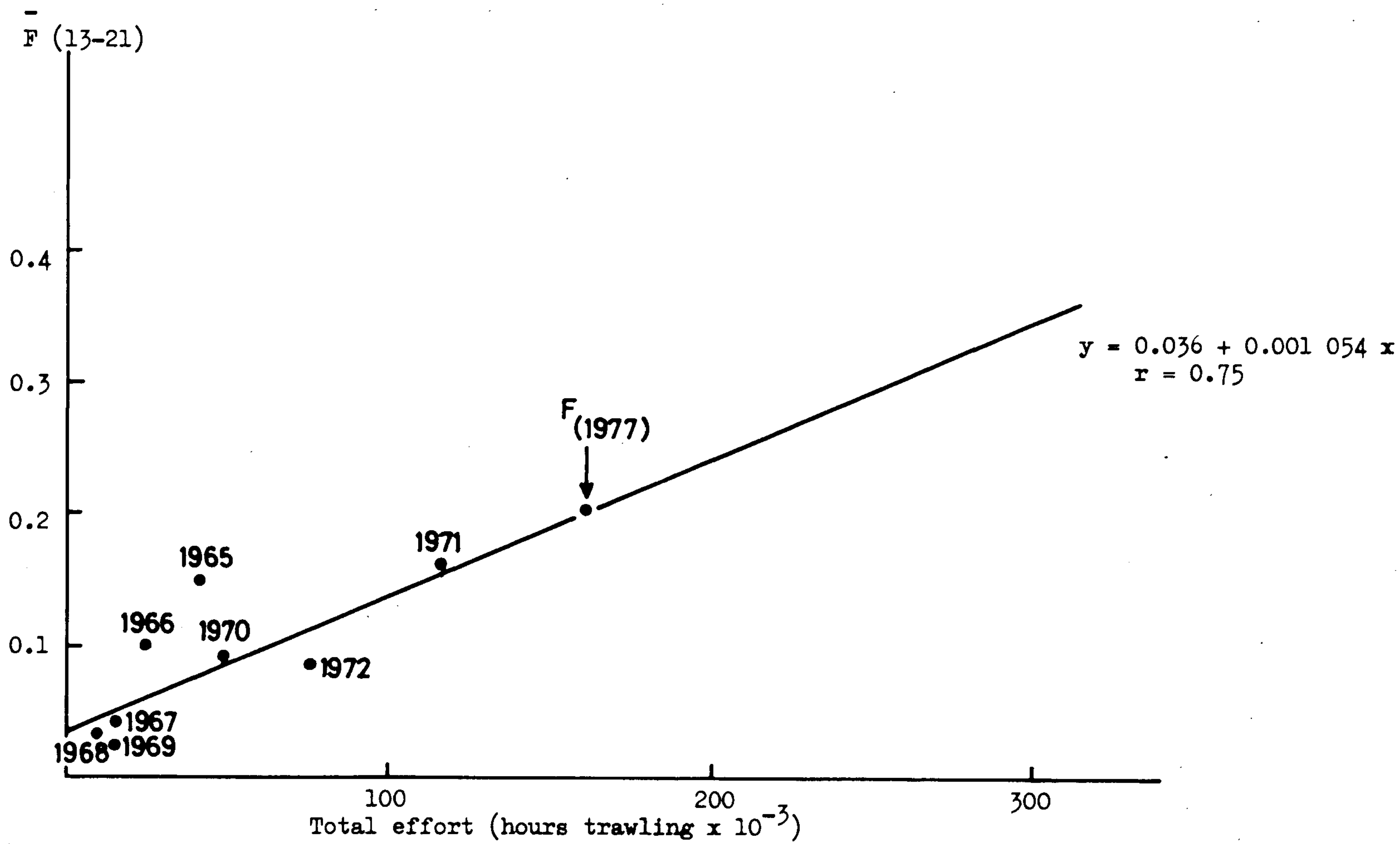


Figure 2. Sebastes mentella in Divisions IIa and IIb.
Relation of weighted mean fishing mortality (ages 13-21) to total effort.

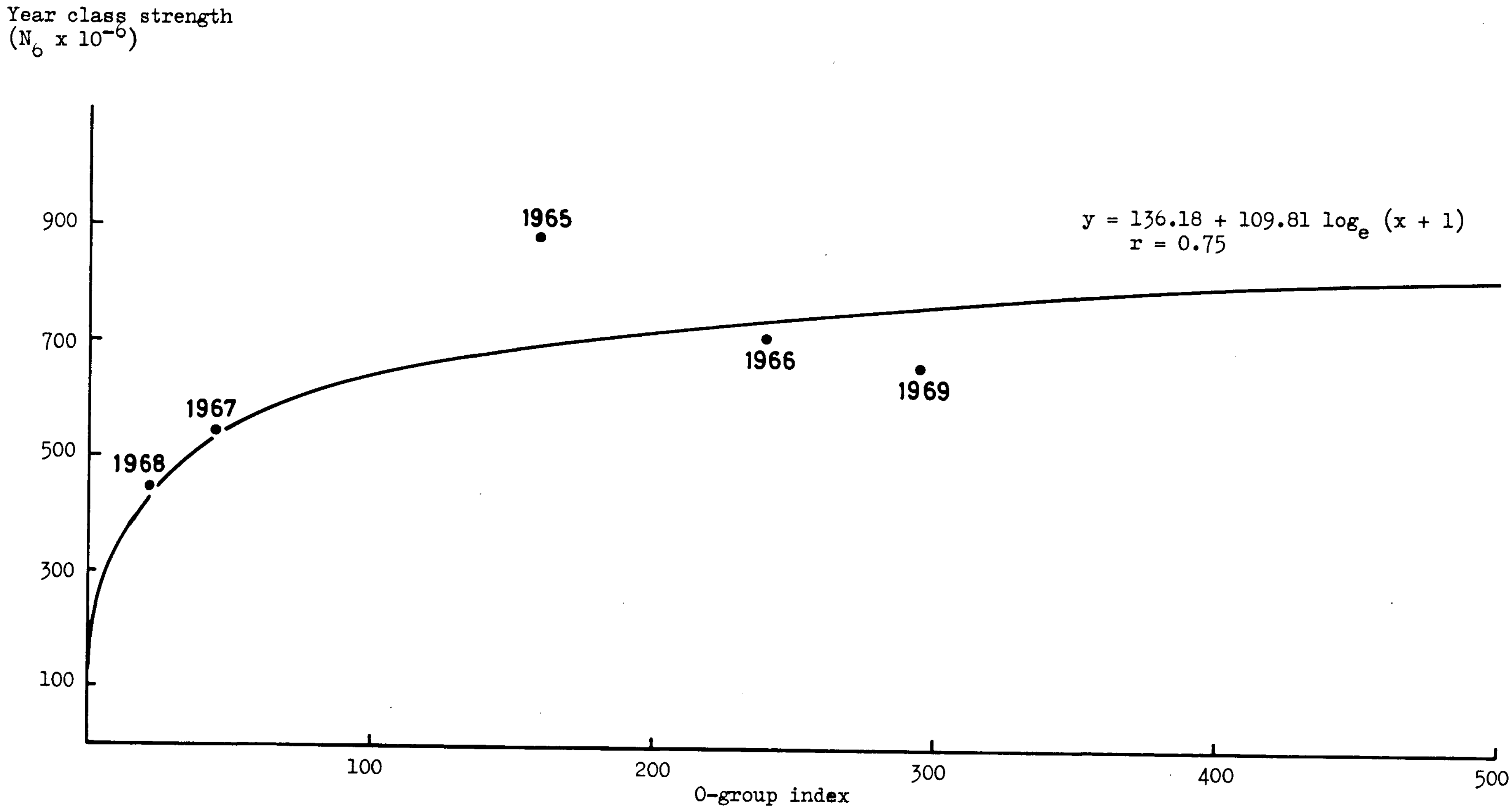
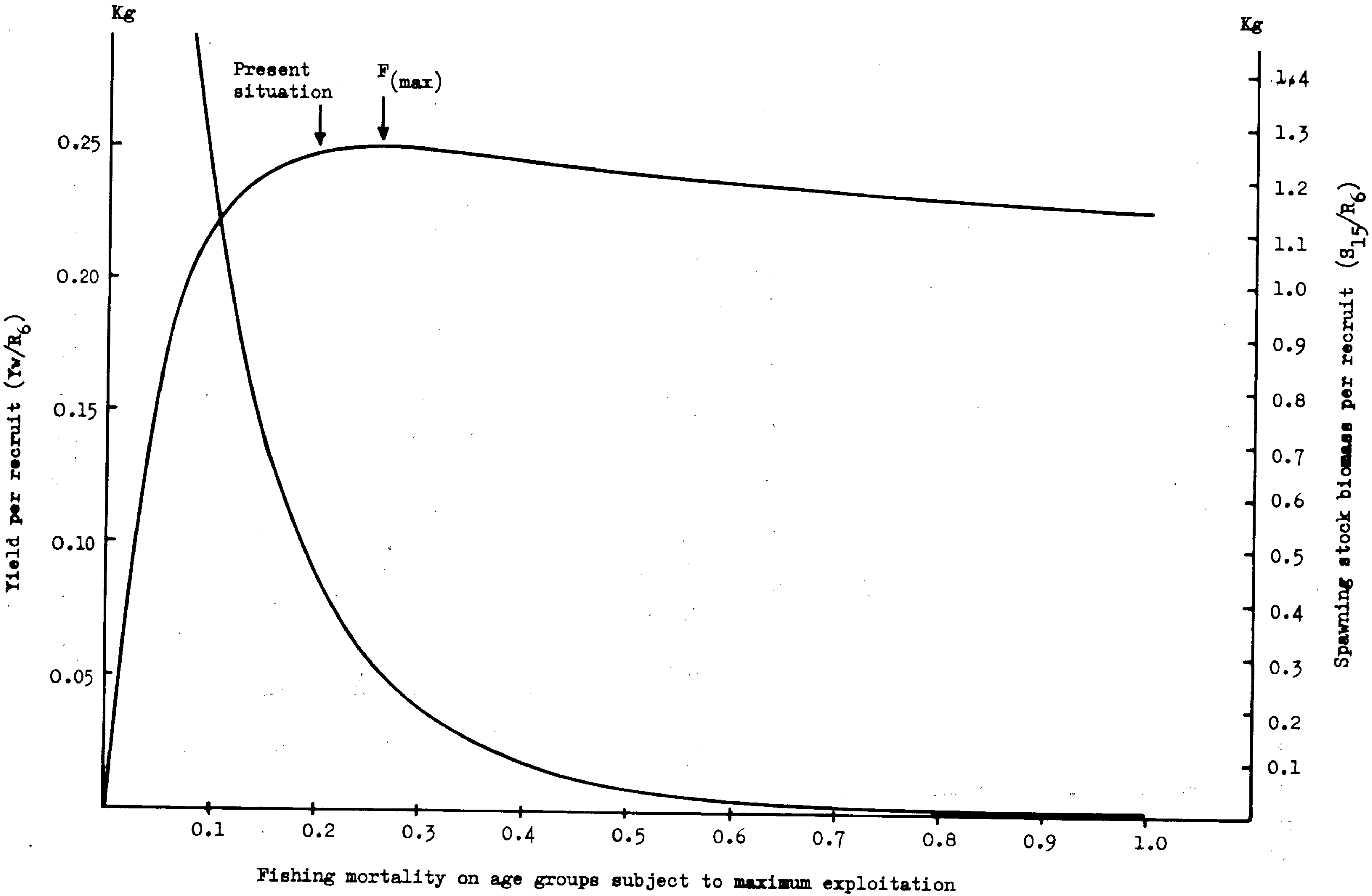


Figure 3. *Sebastes mentella* in Divisions IIa and IIb.
Relation of year class strength at age 6 (from VPA) to corresponding 0-group survey abundance indices.

Figure 4. Sebastes mentella in Divisions IIa and IIb.
Curves for yield per recruit and spawning stock biomass per recruit for present exploitation pattern (M = 0.1).



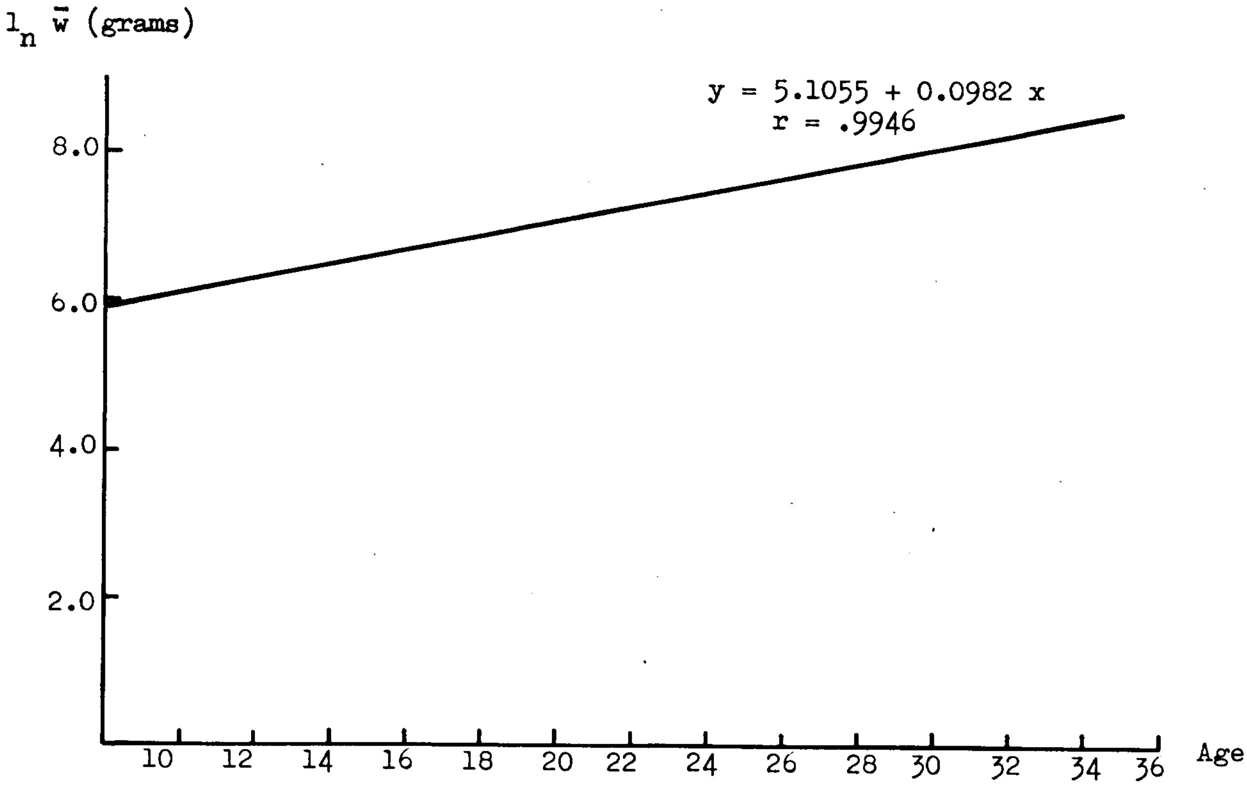


Figure 5. Sebastes marinus in Sub-area XIV and Division Va. The natural log of the mean weight per age against age.

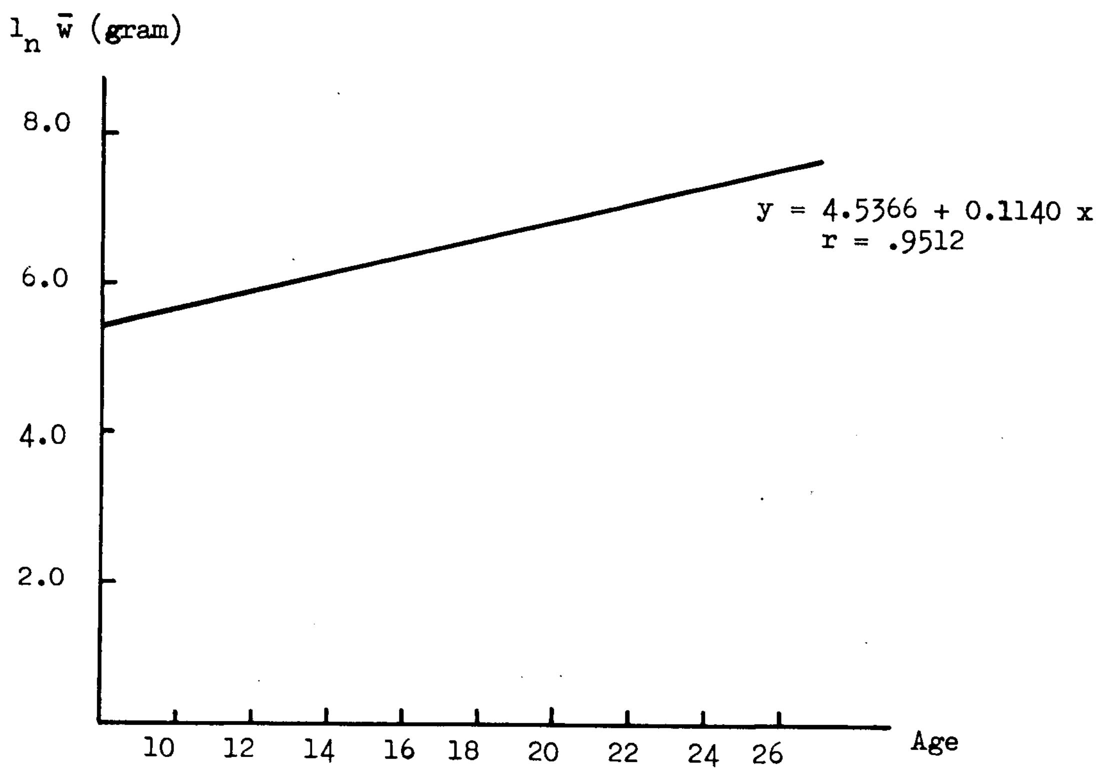
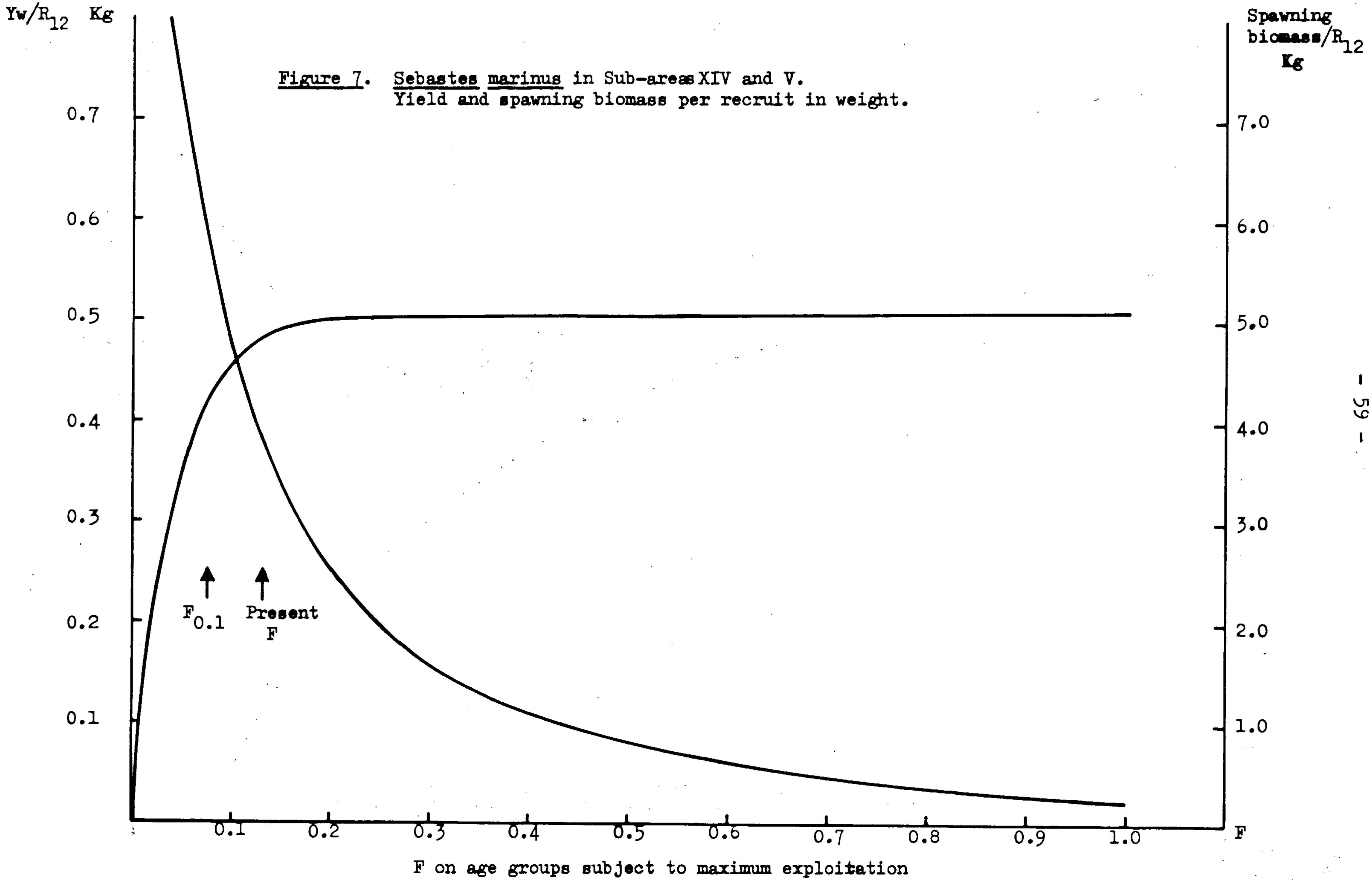


Figure 6. Sebastes mentella in Sub-area XIV and Division Va. The natural log of the mean weight per age against age.



<u>Figure 7</u>. <u>Sebastes marinus</u> in Sub-areas XIV and V.
Yield and spawning biomass per recruit in weight.

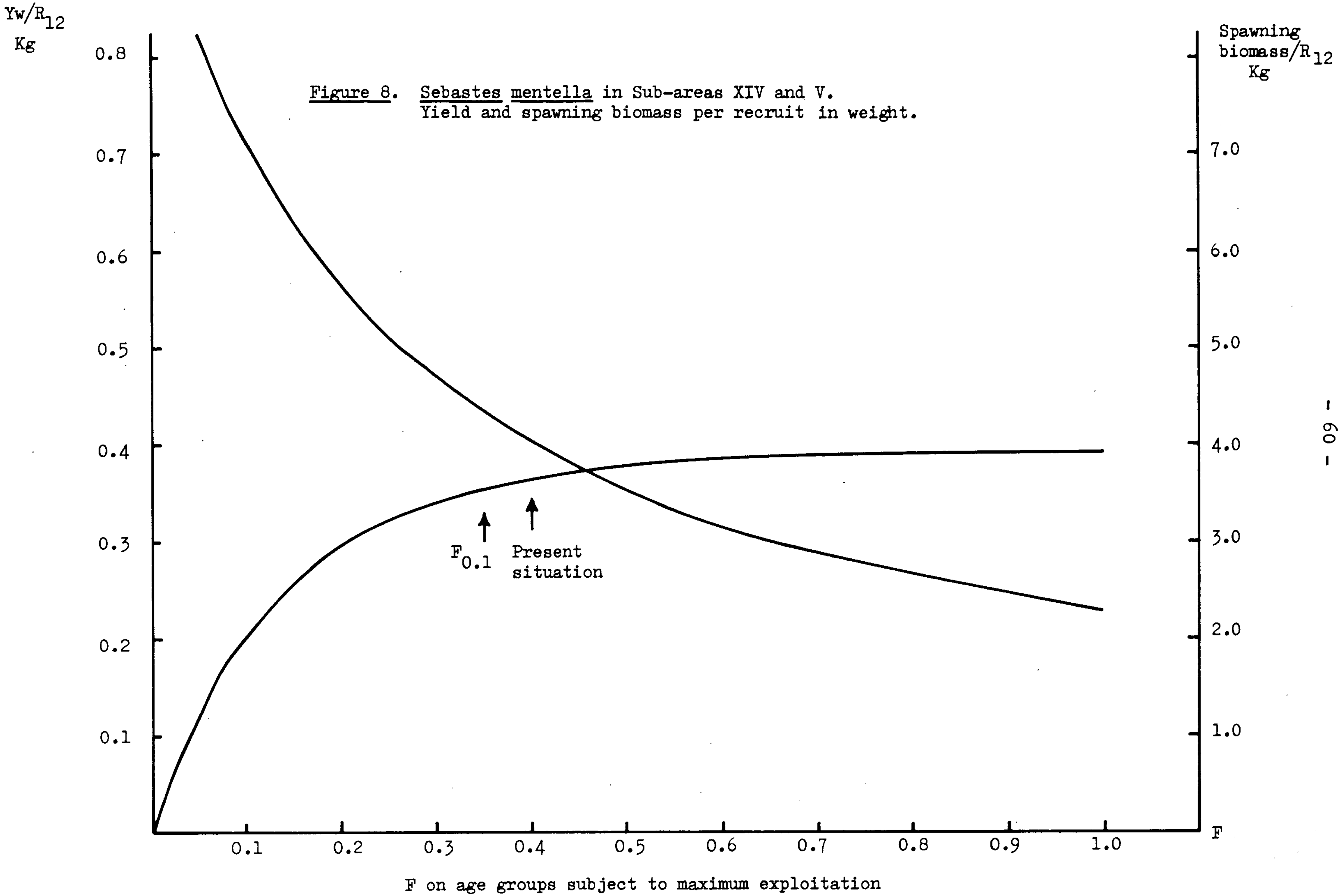


Figure 8. Sebastes mentella in Sub-areas XIV and V.
Yield and spawning biomass per recruit in weight.