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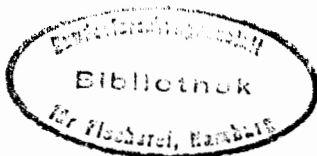
REPORT OF THE WORKING GROUP ON ASSESSMENT OF HAKE STOCKS

Charlottenlund, 28-31 May 1979

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REPORT OF THE WORKING GROUP ON ASSESSMENT OF HAKE STOCKS

0. INTRODUCTION

The Working Group met at Charlottenlund from 28 to 31 May 1979.
The terms of reference established during the 66th Statutory Meeting
of the Council (C.Res.1978/2:46) were:

1. Assess a TAC for hake;

2. Assess more efficiently, if possible, the effect of changes in
   mesh sizes on the catches of hake and other associated species.

According to the guidance given by the ACFM, the Working Group should
carry out assessments on the following alternative assumptions:

a) No mesh increases in 1979 or 1980;

b) That a mesh increase to 60 mm will be enforced in Region 3, in-
   cluding Nephrops in 1980, and one to 75/80 in Region 2, but that
   the mesh sizes in these regions will remain unchanged in 1979;

c) That in both regions, the mesh sizes will be increased to these
   levels in 1979 and maintained in 1980.

The ACFM has also asked the subsidiary questions to the items speci-
fied in the terms of reference and which should be discussed only if
time permits:

1) Are there any sequential tagging experiment data available which
   should be re-examined with a view to estimating the natural mor-
   tality rate and to obtaining better insight into the terminal F
   problem?

2) What are the present effective mesh sizes in use, as estimated
   from the age of recruitment in cohort analysis?

3) Is there a common stock in the Bay of Biscay on the French and Spanish coasts; are the nursery grounds fully known?

4) What will be the change in F_{max} as a consequence of the possible mesh changes referred to above for hake?

The following participated in the Meeting:

J. Bridger	UK
E. Cadima	Portugal (Chairman)
S. Clark	USA
J. Dardignac	France
M. Lima Dias	Portugal
J. Pereiro	Spain
R. Robles	Spain
C. de Verdelhan	France

Catches trends

Historical data of the total hake landings of the fisheries in Regions 2 and 3, as given in the Bull.Stat., are presented in Table 0.1 for the period 1936 up to 1977.

The annual mean landing of 51.8 thousand tons, during the period 1936-38 before the II World War, was almost one third of the mean landing (177.8 thousand tons) during the period 1946-48, just after the War. For recent years, 1974-76, the annual mean landing was 97.6 thousand tons, that is, approximately equal to half the post war landings.

In Summary, table 0.1 gives an indication of the potentialities of the hake stocks in Regions 2 and 3 and the reduced level of the recent catches.

Statistical tables from the previous report of the Working Group have been updated. Table 0.2 provides the nominal landings (in thousand tons)

by countries and by Subareas as reported to ICES.

Stock boundaries

A previsious Working Group (Nantes, 77) chose to split the European hake population into three parts viz: Divisions IVa+VIa, VII+VIIIa,b and VIIIc+IXa. After some discussion this Working Group decided to combine the two northern parts and to refer to the "Northern Stock" (that is fish caught in the Community waters) and to the "Southern Stock", those caught outside Community waters in the coastal waters of Spain and Portugal. The reasons for this decision were:

a) - There is as yet no good biological basis for the existence of sub-stocks.

b) - In the past to a somewhat lesser extent at present, the allocation of catches to ICES Subareas and Divisions is far from precise.

c) - Although some spawning grounds and nursery areas are known to exist in Divisions IVa and VIa there is no evidence for the existence of large quantities of immature hake on these groun ds where as there is ample evidence of their presence in Subareas VII and VIII (Guichet, CM 1977/G:II, for example). The conclusion is that at least a part, and possibly the major part of the hake caught off the West Coast of Scotland are de rived from nursery grounds further south.

d) - Evidence from Spain and Portugal on the state of the Southern Stock suggests serious recruitment failure. This is not apparent in the Northern Stock.

Assessments

The lack of adequate landing data and length and age composition data, have greatly hindered assessment of these stock. Yield per recruit ana lyses were performed for both stocks; general production modelling and cohort analysis of length composition data were also performed for the Southern Stock.

1. NORTHERN STOCK

1.1. Catches trends and Fleet changes

Table 1.1 provides nominal catches (000's tons) for the Northern Stock by countries and Subareas as reported to ICES. Table 1.2 provides corrected values in view of the latest available data.

Tables 1.3 to 1.5 show the evolution of catches, fishing effort and c.p.u.e. for selected fisheries in the Northern Stock area, for the period 1961 up to 1978. Catch per unit effort increased in Division VII for Spain (La Coruña) and France; French catch per unit effort also increased in Division VIII.

Figure 1.1 provides U.K and France catches of hake and efforts in Division IVa+VIa from 1961-78 and Figure 1.2 provides catches per unit effort for the same countries, division and period.

Figure 1.1 shows the decline of the U.K catches of hake under a steady English effort. French catches declined more slowly despite a rapid increase of effort since 1969.

Figure 1.2 shows that the c.p.u.e. of both nation's fleet has declined in a similar way.

Figure 1.3 shows the c.p.u.e. of French "hauturiers" (offshore trawlers) in Divisions IVa+VIa against the increase of U.K and French total effort as a percentage of the 1961 level. The effect of increased effort on c.p.u.e. is shown.

Figure 1.4 shows the relationship between the c.p.u.e. of the French artisan fleet in VII and VIIIa,b and the c.p.u.e. of French "hauturiers" in IV+VIa two years later. From 1961 to 1969 there is a reasonable relationship which tend to support the conclusion of this Working Group that the hake in Community waters form a unit stock, and that events in the Celtic Sea and Bay of Biscay are reflected on the grounds off Scotland some years later. From 1970 onwards,

however, evidence is confliting. French data suggest that the c.p.u.e. of young hake in the South remained reasonably constant for a number of years, yet the c.p.u.e. of older hake further North continued to decline. Table 1.6, drawn from tables 1.3 to 1.5 of this report shows the catch and effort of French artisans in Subarea VII and Divisions VIIIa,b both separately and combined and their c.p.u.e. for the two areas combined. At the foot of the table the mean values for 1961-69 and 1970-75 are given. For the combined areas catch, effort and c.p.u.e. remained constant but the shift of effort from Subarea VII to Division VIIIa,b beginning in 1970 is clearly shown. This shift of effort southwards coincides precisely in time with the breakdown of the relationship in Figure 1.4. No information on the distribution of Spanish effort in Subarea VII and Division VIIIa,b was available to the group. The decreasing c.p.u.e. of large hake in the north could as well be the result of increased fishing pressure on the main nursery areas as generated by increased effort applied in the north. No long series of length compositions on catch in numbers for the ar tisan fleet were available. Table 1.7 shows the percentage of small hake of 25-44cms total length for the years 1961-78. From 1961-68 this percentage declined slowly with a mean values of 21.3%. In 1969, 70 and 71 there was a marked death of these small fish followed by perhaps some recovery in late years yielding a mean of 8.3%. The de-cline in recruitment to the English fishery in Division VIa should not have occurred until 1972 or 73 if it was solely due to increased french artisan activity in Division VIIIa,b. In fact it appears to have declined a year before the effort shift occurred.
With the evidence available, the Working Group could not separate the effect of two approximately simultaneous changes in the distri-bution of effort. The fact that only 3 times in the last eleven

years has recruitment to the English fishery in VIa reached the
pre-1968 level is some indication of the effect of the artisan
fishery in Biscay.

Fleet composition has been relatively stable in recent years al
though significant reductions in effort have occurred.

A slight increase in activity by large British trawlers has oc-
curred in Division IVa and VIa beginning in 1976 due to elimina-
tion of the Iceland fishery, but this was offset by declines in
the remainder of the fleet. Sharp increase in the French "arti-
san"fishery in Subarea VII and Divisions VIIIa,b during the ear-
ly 1960's resulted in a northward shift in activity by French
"hauturiers", however, effort by"hauturiers"has been declining in
all areas since 1973 partly due to rising fuel costs. Since 1960
Spanish fisheries in Divisions VIIIa,b have been characterized
by a significant increase in fishing power. This has also been
true to a much lesser extent for vessels fishing in Subarea VIII
and in addition an increase has occurred in numbers of long-line
and gillnet vessels in the area in the last few years. Other than
for these trends, fleet compositon has remained generally stable
in all areas although effort has declined in Division IVa, Suba-
rea VII and Divisions VIIIa,b in response to restrictions imposed
by the EEC.

1.2. Length composition of landings

It should be noted that there are no age compositions for the landings of this fishery.

Length composition data for European hake landings by Subareas, Division, Country and Vessel Class for 1977 and for 1978 are given in Tables 1.8 and 1.9. These data are based upon sampling of landings. In most cases, landing data were collected monthly at major landing ports and applied to reported landings for these ports on a monthly or quarterly basis. Resulting distributions were then prorated on landings for the remaining ports to generate the final distribution. The United Kingdom reported length composition data for Divisions IVa and VIa and Subarea VII both in 1977 and 1978. Distributions are similar between these years and are comparable to those reported by other nations. France provided length composition data for Divisions IVa and VIa, Subarea VII and Divisions VIIIa and b for both years. Fish taken by "hauturiers" (offshore trawlers) tended to be larger than those taken by remaining gear types, apparently reflecting the more offshore distribution of effort as compared to semi-industrial and artisan trawlers. Spain provided length composition data for Subarea VII and Divisions VIIIa and in 1977 and 78. As would be expected gill-net and longline catches have typically been composed of larger fish. Distributions from trawlers in Subarea VII appeared roughly comparable to the distributions provided by France for this Subarea. It should be noted that for Divisions VIIIa and b in 1978, Spanish samples were collected at sea as opposed to 1977, when routine sampling procedures were followed. However, resulting distributions appear comparable.

There has been a significant increase in the size of hake landing by the Spanish trawlers in Subarea VII and Divisions VIIIa, b since increase mesh sizes regulation has been enforced.

1.3. Weight at length

Table 1.10 provides the average weights at length classes which were adopted by the Working Group (La Rochelle, 1978). Taking into consideration the very scarce data available, the Group decided not to separate the sexes for assessment purpose. To obtain the growth parameters it was necessary to combine the most recent results on male and female growth (Decamps et Labastie, CM.1978/G:41). Assuming that natural mortality is the same for both sexes at the same age the easiest way to obtain values of length at age was to take the simple average of the male and female length for the same age and to fit a Von Bertalanffy growth equation to these values.

The growth parameters estimates are summarized in the Table 1.10. The weight-length relationship adopted was the same as in La Rochelle, 1978 meeting of the Working Group (Table 1.10).

1.4. Cohort analysis of length composition

Cohort analysis of length composition data and associated determination of short term losses and long term gains were not performed for this stock due to availability of detailed analysis from the previous meeting of the Working Group (La Rochelle, 1978).

The value of natural mortality adopted in that analyses was M = .20. Figure 1.5 (taken from that report) gives the long effects of F and mesh size variations on the total catches of hake (all gears together) for the "Northern Stock". The Figure shows that increases in mesh sizes produce significant longterm gains.

For a minimum mesh size of the trawler fleet of 80mm the gains were estimated as 60% of the average 1973-76 catches.

It also shows long term gains in yield for reductions in fishing mortality, but less significant when compared with those obtained from increases in mesh size.

1.5. Yield per recruit

As planned mesh assessments,40, 60 and 80 mm mesh sizes selection curves were obtained by fitting the logistic equation to the published data from previous cover codend experiments. Only polyamide twine data for experiments were considered, since most of commercial vessels use this material.

Data for 40 mm mesh size trawls presented by Brabant and Guillou (1976) and given in Dardignac et Verdelhan (1978) were used (average mesh size equal to 42.5cm); for the 60mm mesh trawls data were taken from the R/V Thalassa 1968 and 1974 experiments as given in the 1978 publication above mentioned as well as from earlier Portuguese experiments (Monteiro, 1968), (average mesh size equal to 64.2mm); For 80mm mesh trawls data were taken from the R/V Thalassa 1969 cruises presented by Dardignac et Verdelhan, 1978, (average mesh size equal to 83.7mm).

Data for 70mm mesh sizes collected during the 1979 cruise of the Spanish R/V Cornide de Saavedra were not considered, due to very small catches of hake and very large catches of crabs (Polybius henslowii) which appeared to alter selectivity of the gear. Figure 1.6 provides logistic curves fitted to the above data. Parameters estimates obtained from these analyses are presented in Table 1.11. These results support earlier conclusion of Dardignac et de Verdelhan (1978) that the selection range increases and slopes at the 50% retention point decrease with increasing mesh size over the 40 to 80mm range.

Yield per recruit analyses were completed using parameter estimates
referred to in Table 1.10.

Figures 1.7 and 1.8 present yield and average biomass per recruit
plotted against F for mesh sizes of 60 and 80mm.

F_{max} values obtained were .20 and .21, respectivaly.

Tables 1.12 and 1.13 provides short and longterm gains in yield   as
well as longterm changes in biomass associated with reduction of F
and changes in mesh size up to 80mm.

These calculations have been made under two assumptions relative to
the present fishing pattern (a) trawlers with mesh sizes of 60mm
(t_c =2. year) and F≈.30 or .60 or .80 (b) F not constant but in fact
significantly higher at younger ages in this fishery, with F=.85 at
ages between 1 and 2 and F≈.30 or .60 or .80 at older ages.

This last assumption could take into consideration the distribution
of hake in Subarea VII and Divisions VIIIa, b as discussed in Section
1.1 as well as the use of mesh sizes of 40mm on Divisions VIIIa,b
by the trawl fleets.

These results show a significant increase in yield and biomass asso
ciated with increases in mesh sizes and reduction in fishing mortali
ty.

A plot of biomass against age (Figure 1.9) indicates that, in the
absance of fishing, maximum biomass occurs at an age of approximate
ly 8 years. Again, results suggest significant potential increases
in yield and biomass associated with mesh increases of up to 80mm or
higher.

1.6. Management options

As mentioned in the Report there is a lack of adequate data for asses sment of this stock. In spite of this fact the Group tried to apply methods based on the best available information. All these methods in dicated significant longterm gains in yield for increase in mesh si- zes up to 80mm and higher. They also indicate significant yield incre ases for reduction of fishing effort either associated with mesh in- creases or with no mesh changes.

No management options were evaluated. The Group decided to summarize the results of the assessments made by the different methods for the case of the enforcement of a minimum trawl mesh size of 80mm.

The immediate losses and longterm gains in yield were estimated   as follows:

Assessment method	YIELD CHANGES (in %) Immediate LOSSES	L.Term GAINS	
Cohort analy- sis of length composition	-62	58	
	-25	97	$F(<25cm)=.85$ (minimum mesh size in Division VIIIa, $F(>25cm)=.30$ b = 40mm)
Yield per re- cruit	- 3	6	$F(<25cm)= 0$ (minimum mesh size = $F(>25cm)=.30$ = 60mm)

These results are taken from La Rochelle, 1978, report of the Hake Wor king Group and from the yield per recruitment assessments given in Sec tion 1.5, assumming that at present the fishing mortality for fish smal ler than 25cm in Division VIIIa,b is F=.85 and that for fish larger than 25cm is F=.30.

There are significant differences according to the method or assump
tion adopted.

In order to avoid an increase of fishing effort, possible to occur
for compensating the immediate losses, the establishment of a 80mm
minimum mesh size should be associated with the setting of a TAC.
According to the cohort analysis of the 1973-76 average length com-
position, the immediate catch will be of the order of 40%, that is
30 000 tons, and according to the yield per recruit analysis, will
be 75% of the equilibrium yield per recruit for F=.30 for lengthes
larger tham 25cm and F=.85 for lenthes below 25cm.

1.7. Associated species

Unless for nephrops, no new information was available to the
group on associated species. Therefore only general indications
will be presented in this report.

It should be pointed out that for some of the trawl fisheries
the hake is not the main searched species. Other species, such
as horse mackerel, mackerel and blue whiting sometimes are mo-
re then 3/4 of the total catch. The associated species give an
important contribution to the rentability of the fishery. As a
general indication, associated species can be mentioned for the
following Divisions:

a) - Subarea VII: megrim, monkfish, seabreams, mackerel,
(Spain, France), blue whiting (France), nephrops (French
artisan, La Coruña fleet) and horse mackerel (Spain).

b) - Divisions VIIIa,b: nephrops, sole (French artisan), blue
whiting, mackerel (Spain, France), pout, horse mackerel
(Spain).

Seabreams - Under this general designation are grouped several
species with different behaviour. Although no infor
mation is available about selectivity, it appears
that a moderate increase of the trawl mesh size
will not have significant consequences on this fi-
shery.

Megrim - Most of the catches of this species after 1972 co-
me from Subarea VII, accordingly to Bull.Stat.
French data (N'Jock, 1977) show a significant de-
crease on the catches of this species for the Celtic
area (Subarea VII) but the Spanish data for 1972 to
76 do not confirm this tendance. There is no informa
tion about selectivity.

Monkfish – It is improbable, due to the morphology, that a chan-
ge on the mesh sizes causes changes in the catches of
these species.

At present small monkfishes are taken in considerable
quantities, but in view of their shape it could be ne
cessary a great increase in mesh size to allow signi-
ficant escape.

Nephrops – For most of the French artioanal trawlers based main-
ly in South Britanny, the hake is a by-catch of the
nephrops fishery rather than the contrary. It is the
same situation in parts of West Scotland.

The result of an increase of mesh size up to 80mm on
the nephrops catches has been studied by the Nephrops
Working Group (CM.1979/K:2).

It shows that the immediate losses and the longterm
gains remain uncertain due to the lack of biological
data necessary to calculate them. Therefore it is
clear that an increase of mesh size to 80mm or more
which may prove to be necessary for the proper mana-
gement of the hake stocks will be in conflict with
the interests of the directed small mesh nephrops
trawl fisheries.

2. SOUTHERN STOCK

2.1. Catches trends and Fleet changes.

Table 2.1 provides nominal catches, in thousand tons, for the Southern
Stock by countries and Subareas as reported to ICES, for the   period
1967-78

Table 2.2 provides corrected values in view of the latest available
data.

Table 2.3 provides data on effort and catch per unit effort for Portu
gal and Spain, for the period of 1956-78.

The 1977 and 1978 catches show a sharp decline for all years as compa
red with the catches of the years before. The catch per effort of the
Portuguese trawlers show a similar decline. The fishing effort, howe-
ver, has been at the level of the recent years. Portuguese fleet com-
position and activity appears to have been stable since the early
1960's. France occasionally have fished in Divisions VIIIc or IXa
during 1977 and 1978.

2.2 Length compositions of landings

No age compositions are available for the landings of this fishery.
Length composition data for hake landings by Divisions,countries and
vessel classes for 1977 and for 1978 are given in tables 2.4 and 2.5.
These data are based upon sampling of landings. In most cases, landing
data were collected monthly at major ports and applied to reported lan
dings for these ports on a monthly or quarterly basis. Resulting dis-
tributions were then prorated on landings for the remaining ports to
generate the final distribution.

Portugal and France provided length compositions data for Division
IXa both in 1977 and 1978.

Spain did not provided length composition data for 1977 and in 1978 only for the Fleet based in Galicia.

Spanish trawl catches in Divisions VIIIc and IXa and Portuguese trawl catches in Division IXa have been dominated by young fish, reflecting small mesh sizes currently in use in these Divisions.

A summary of length compositions data for the years 1974-78 is given in table 2.6.

The "carioca", very young hake, almost did not appear in the Spanish catches during 1977 and 78. Information from Spanish Research Vessels also indicated very reduced quantities of "carioca" at sea during the last two years.

Gill nets and longline catches have been composed of larger fish.

2.3. Weight at length

There are no data on average weights at ages or lengths in this stock. The Group decided to adopt the average weights at lengths, the growth parameters estimates and the weight length relationship obtained for the Northern Stock. Table 2.7 gives these values. (See section 1.3 for details).

Research projects in Spain and Portugal are being prepared to develop length and biological sampling of landings and to initiate stractified random sampling for hake in the Division IXa or board of Research Vessels. If these projects will materialise it is expected to have adequate information on hake in the Southern Stock in the near future.

2.4. Cohort analysis of length composition·

The average length compositions of the 1974-78 landings (table 2.6) by Portuguese trawlers, Spanish trawlers and artisanal fisheries (Spanish and Portuguese gillnets and longline fisheries combined) were taken as the basis for applying the length cohort analysis tec niques (R. Jones 1974).

The value of $K=.20$ for natural mortality and the growth parameters referred to in Section 2.4 (table 2.7) were also used in the analysis. A terminal rate of exploitation of $E=0.8$ was adopted.

The estimated immediate losses and longterm gains in yield for selec ted combinations of reduction of fishing effort and mesh sizes in- crease to 60mm are summarized in Table 2.8.

The results indicate significant longterm gains in yield for mesh si zes increase to 60mm and for reductions in fishing effort.

With the present fishing effort, the increase in mesh size to 60mm would produce longterm gains for the whole fishery of 50%, being the gains for the Portuguese trawl fleet of 51%, for the Spanish trawl fleet 24% and for the gillnets and longlines fisheries 69% of their average landings during 1974-78. The immediate losses would be 9% for the Portuguese trawlers and 22% for the Spanish trawlers.

The reduction of 25% in fishing effort of all fleets could also pro- duce longterm gains of 49% (38% for Portuguese trawlers, 26% for Spa nish trawlers and 69% for the gillnets and longline fisheries) but immediate losses for every fleet would be higher, 25%.

The table also shows that reduction of 50% in fishing effort of the Spanish trawl effort would cause a longterm gain of the same magni- tude (52%) and immediate losses of 18%. This reduction would however give lossses at longterm for the Spanish trawlers.

2.5. Yield per recruit

The 40,60 and 80mm mesh size selection curves were obtained as mentioned in section 1.5 related to the Northern Stock. Figure 2.1 and Table 2.9 summarize this information. The growth parameters estimates used are reproduced in table 2.7.

Figures 2.2 and 2.3 present yield and average biomass per recruit plotted against F for mesh sizes of 40 and 60mm.

F_{max} values obtained were .15 and .20 respectively.

In adtition to the case of a constant F over all recruited ages the calculations were also made for different F values applied to fish under 25cm $(t_t=2.1)$ and above. That last case could better be adjusted to the situation where only the trawlers, with the 40mm mesh sizes, fish individuals of age below 2 years.

From table 2.6 it was calculated that approximately 70% of the total catch, in numbers of fish of length larger than 25cm has been caught by trawlers, during 1974-78 period. Then the value of F for lengths below 25cm was taken as 70% of the F value for lengths above 25cm (or 2 years).

Table 2.10 provides short and longterm gains in yield as well as long term gains in biomass associated with reduction of F and changes in mesh size up to 60mm, for the two cases mentioned.

The results show a significant increase in yield and biomass associated with increases in mesh size and reduction in fishing mortality, over a range of F values from .30 to 1.00. It did not show big differences between the two assumptions on F.

The plot of biomass against age (Figure 2.4) indicates that, in the absence of fishing, maximum biomass occurs at an age of approximately 8 years. Again, results suggest significant potential increases in yield and biomass associated with mesh increase of up to 60mm and higher.

2.6. Yield curve (General production model)

Table 2.11 provides data or landings for Spain, Portugal and France, for the period 1956-78.

It was indicated that the Spanish landing data for the period 1956-70 include also hake from other regions such as the Northern Divisions an South African waters. The annual fractions of the total Spanish hake landings that were caught in Divisions VIIIc and IXa during 1972-78 are around 30%. It was decided to take as Spanish catches from the Southern Stock, during the years 1956 up to 1970 values between 25% and 50% of the reported total Spanish hake landings.

In the table 2.12 are given the calculated total catches by countries for the Southern Stock, for the period 1956-78 under those two assumed limits, which were designated as hypotheses- I and II.

Tables 2.13 and 2.14 indicate the total catches, the Portuguese catch per effort and the derived total effort, under the two hipotheses.

In figures 2.5 and 2.6 annual catches per effort were plotted against the 3 years average of total fishing effort (Gulland's method).

Curves were fitted by eye and the equilibrium yield curves were then derived.

They show that YMAX is between 21500 and 25250 tons corresponding to f_{max} between 1600 and 1260 thousand Portuguese trawl-hours.

In 1978 the total catch was 14202 tons corresponding to a total effort of 3300 thousand Portuguese trawl-hours.

These results indicate that, maintaining the same pattern of exploita tion, a reduction of about 50% to 60% of the 1978 fishing effort is needed to obtain YMAX.

2.7. Management options

As mentioned in this Report there is a lack of adequate data for asses

sing this stock. In spite of this fact the Group decided to try asses-

sment methods based on the best available information.

The methods indicated significant longterm gains in yield for increases

in mesh sizes to 60mm and higher. They also indicated significant yield

increases for reduction of fishing effort associated or not with mesh

size increases.

It seems clear that this stock is over exploited. The failures in 1977

and 1978 recruitments indicated in Section 2.2 and the small proportion

of large hake in recent years could suggest that there are serious

risks that the stock is in a state of "recruitment overfishing".

Any management option adopted should take those risks into considera-

tion.

Management option 0 — No regulation measure enforced.

When evaluating management options it is important to indicate what

are the expected consequences of not taking any action.

The situation of this fishery is an example of the great risks of not

taking any action or of delaying effective regulamentations. It   is

true that the assessments done, do not permit to evaluate with the

required precision the consequences of different management actions

but all the available information indicate that to maintain this fi-

shery unregulated will cause further declining in the catches and cat

ches per effort and even could cause the deplection of the stock.

Management option 1 — Enforcement of the minimum mesh size of 60mm.

The estimated immediate losses of this option vary between 9%   to

27% according to the assessment method and the assumed levels of

present values of F. The estimated long term effects were gains in

yield of magnitude between 34% to 65%. The fishing of young hake

smaller than 25cm (2 years old) is pratically eliminated.

To avoid probable increases in fishing effort for compensating expected immediate losses, a TAC should be associated to this option. The 1978 total catch was 14200 tons and it is not expected that the 1979 catch will be bigger.

The immediate losses of 9% to 27% would indicate TAC for 1980 of 10000 to 13000 tons.

No other options were analysed by the Group. However attention is called for (a)- higher increases of mesh size and reduction of fishing effort will cause larger longterm gains (b) - there could be risks of this stock to be in over-exploited state (c)- there is a urgent need to improve collection of commercial statistics and biological sampling and research on this stock.

2.8. Associated species

Only general indications will be given in this report.

For some trawl vessels the hake is not the main searched species.

Other species such as nephrops and horse mackerel give important con

tribution to the rentability of the fishery.

The nephrops Working Group has studied the effect of increases in mesh

sizes on the nephrops catches (CM 1979/K:2). It shows that the imme-

diate losses and the longterm gains remain uncertain due to lack of

biological data necessary to calculate them. Moderate increases in

mesh size such as from 40 to 60mm which appears to be necessary for

the management of the hake stock does not seem to have significant

consequences on the nephrops catches.

The horse mackerel stock in Division IXa has been considered as fully

or over exploited (CM 1978/H:61).

The increase in trawl mesh size to 60mm appears to have some positive

effects on the stock of this species.

Large by-catches of blue whiting are occurring in recent years. The

interess for this species is expected to increase in Spain and Por-

tugal. Mesh sizes increases will have effects on the catches but no

evaluation was done on their magnitudes.

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oeuvre, apports et répercussion sur les stocks exploités.
Thèse de 3ème cycle, Université de Marseille.

YEARS	CATCH
1936*	43.2
1937*	52.5
1938*	59.9
1939	
1940	
1941	
1942	
1943	
1944	
1945	
1946	194.3
1947	179.7
1948	158.0
1949	130.6
1950	114.9
1951	128.1
1952	119.7
1953	109.8
1954	105.9
1955	143.0
1956	101.5
1957	113.3
1958	112.6
1959	110.9
1960	114.2
1961	133.8
1962	128.9
1963	133.2
1964	130.2
1965	120.6
1966	107.2
1967	107.0
1968	107.4
1969	100.6
1970	117.0
1971	62.4
1972	94.9
1973	110.6
1974	98.3
1975	102.9
1976	91.7
1977	64.9

Mean 1936-38=51.8 Before II World War

Mean 1946-48=177.8 After II World War

Mean 1974-76=97.6 (Before 200 miles jurisdiction)

TABLE 0.1 - EVOLUTION OF THE TOTAL HAKE LANDINGS (THOUSAND TONS) FROM REGIONS 2 AND 3 FROM 1936 UP TO 1977, ACCORDING TO BULL.STAT..

* Spanish catch assumed nil.

YEARS	TOTAL	FRANCE					PORTUGAL	SPAIN					U. K.			OTHERS		
		TOTAL	IV+VI	VII	VIII	IX	IX	TOTAL	IV+VI	VII	VIII	IX	TOTAL	IV+VI	VII	TOTAL	IV+VI	VII
1967	.	25.9	2.9	9.6	11.0	2.4	7.6	.	.	.	31.6	45.1*	4.9	4.1	0.8	1.4	0.9	0.5
1968	.	22.5	2.5	7.8	10.2	2.0	7.2	.	.	.	32.2	37.5*	5.4	4.5	0.9	1.6	1.3	0.3
1969	.	21.3	2.9	7.9	8.8	1.7	6.6	.	.	.	27.1	38.6*	4.3	3.9	0.4	1.7	0.5	1.2
1970	.	25.7	1.5	9.8	12.8	1.5	9.3	.	.	.	34.3	41.8*	3.2	2.7	0.5	2.1	1.9	0.2
1971	.	23.6	0.8	9.1	13.1	0.6	8.0	.	0.9	7.8	14.0	2.1*	2.6	2.2	0.4	2.6	2.1	0.5
1972	93.3	21.8	0.4	8.8	12.6	–	8.7	57.7	6.1	20.2	16.3	15.1	2.9	2.4	0.5	2.2	2.2	–
1973	108.4	24.2	2.2	10.7	11.3	–	15.3	62.8	6.5	19.8	15.6	20.8	2.8	2.2	0.6	3.3	2.9	0.4
1974	96.5	21.7	2.5	11.8	7.2	0.1	7.8	61.7	7.1	21.9	18.5	14.1	2.7	2.1	0.6	2.6	2.3	0.3
1975	101.4	22.2	3.2	11.0	7.9	0.1	9.4	63.9	6.4	20.5	18.0	19.0	2.6	2.3	0.3	3.3	2.4	0.9
1976	90.7	19.1	3.8	10.4	4.8	0.1	7.9	58.8	4.1	20.8	20.2	13.7	2.3	1.7	0.6	2.6	1.8	0.8
1977	64.9	15.3	2.6	6.1	6.6	–	5.5	41.0	1.6	5.3	16.6	17.5	1.9	1.6	0.3	1.2	0.8	0.3

TABLE 0.2 - NOMINAL HAKE CATCHES (IN THOUSAND TONS) BY COUNTRIES AND SUBAREAS, DURING 1967-1978, AS REPORTED TO ICES.

* Data refer to port of landing, not area of capture (includes African catches).

YEARS	TOTAL	FRANCE				SPAIN				U.K.			OTHERS		
		TOTAL	IVa+VIa	VII	VIII[1]	TOTAL	IVa+VIa	VII	VIII[1]	TOTAL	IVa+VIa	VII	TOTAL	IVa+VIa	VII
1967	61.4	23.5	2.9	9.6	11.0	31.6	–	–	31.6	4.9	4.1	0.8	1.4	0.9	0.5
1968	59.7	20.5	2.5	7.8	10.2	32.2	–	–	32.2	5.4	4.5	0.9	1.6	1.3	0.3
1969	52.7	19.6	2.9	7.9	8.8	27.1	–	–	27.1	4.3	3.9	0.4	1.7	0.5	1.2
1970	63.7	24.1	1.5	9.8	12.8	34.3	–	–	34.3	3.2	2.7	0.5	2.1	1.9	0.2
1971	50.9	23.0	0.8	9.1	13.1	22.7	0.9	7.8	14.0	2.6	2.2	0.4	2.6	2.1	0.5
1972	69.5	21.8	0.4	8.8	12.6	42.6	6.1	20.2	16.3	2.9	2.4	0.5	2.2	2.2	–
1973	72.2	24.2	2.2	10.7	11.3	41.9	6.5	19.8	15.6	2.8	2.2	0.6	3.3	2.9	0.4
1974	74.3	21.5	2.5	11.8	7.2	47.5	7.1	21.9	18.5	2.7	2.1	0.6	2.6	2.3	0.3
1975	72.9	22.1	3.2	11.0	7.9	44.9	6.4	20.5	18.0	2.6	2.3	0.3	3.3	2.4	0.9
1976	69.0	19.0	3.8	10.4	4.8	45.1	4.1	20.8	20.2	2.3	1.7	0.6	2.6	1.8	0.8
1977	41.8	15.3	2.6	6.1	6.6	23.5	1.6	5.3	16.6	1.9	1.6	0.3	1.1	0.8	0.3
1978															

(1) INCLUDES VIII a, b and VIIIc

TABLE 1.1 - HAKE CATCHES (NOMINAL WEIGHT IN THOUSAND TONS) FROM NORTHERN STOCK, BY COUNTRIES, SUBAREAS AND DIVISIONS AS REPORTED TO ICES, DURING 1967-78.

YEARS	TOTAL	IVa+VIa	VII	VIIIa,b
1973	78.7	10.7	31.2	36.8
1974	74.0	10.8	29.0	34.2
1975	74.4	12.9	29.1	32.4
1976	67.5	11.5	27.4	28.6
1977	50.3	5.9	20.9	23.5
1978	47.1	5.2	19.9	22.0

TABLE 1.2 - CORRECTED VALUES OF HAKE CATCHES ADOPTED BY THE WORKING GROUP, DURING 1973-78, BY SUBAREAS AND DIVISIONS (NOMINAL WEIGHT IN THOUSAND TONS).

YEAR	CATCH		EFFORT		C.P.U.E.	
	FRANCE	U.K.	FRANCE(1)	U.K.(2)	FRANCE (3)	U.K.(4)
1961	5.3	7.1	34.3	41.8	155	151
1962	4.9	7.1	39.4	41.7	124	162
1963	4.0	6.4	40.2	41.4	101	150
1964	4.6	5.8	61.1	44.3	74	128
1965	3.3	4.6	37.4	43.5	89	104
1966	3.2	2.6	86.5	42.2	37	61
1967	3.2	1.8	58.1	38.2	54	48
1968	2.5	1.9	49.4	46.3	50	41
1969	3.5	1.6	81.7	36.4	43	44
1970	4.3	1.0	90.2	23.2	48	45
1971	3.3	0.5	77.5	29.4	42	17
1972	3.7	0.4	88.7	48.7	42	9
1973	3.2	0.2	99.1	41.3	33	6
1974	2.8	0.2	108.6	35.7	26	6
1975	3.3	0.2	119.3	37.5	27	5
1976	3.8	0.2	131.5	46.5	29	4
1977	2.8	0.2	122.8	55.8	23	4
1978	2.2	0.2	127.1	61.1	17	3

TABLE 1.3-EVOLUTION OF CATCH (IN THOUSAND TONS) EFFORT AND C.P.U.E. FOR TRAWL FISHE
RIES IN DIVISIONS IVa + VIa, DURING 1961-78, BY COUNTRIES.

YEAR	CATCH				EFFORT				C.P.U.E.			
	FRANCE		SPAIN	U.K.	FRANCE(1)		SPAIN	U.K.	FRANCE(3)		SPAIN	U.K.
	HAUTU-RIERS	ARTI-SANS	(o)		HAUTU-RIERS	ARTI-SANS	(1)(o)	(2)	HAUTU-RIERS	ARTI-SANS	(3)(o)	(4)
1961	14.7	6.0		1.2	103.4	143.3		13.5	142.2	41.9		88.9
1962	13.1	6.2		1.2	118.2	168.9		11.4	110.8	36.7		105.3
1963	11.3	4.9		1.1	135.7	166.2		14.7	83.3	29.5		74.8
1964	10.8	4.4		0.4	164.9	172.4		11.8	65.5	25.5		33.9
1965	9.0	4.0		0.3	209.5	150.3		20.0	43.0	26.6		15.0
1966	8.7	4.3		0.4	163.4	196.2		20.0	53.2	21.9		20.0
1967	6.5	3.4	5.2	0.7	165.2	200.7	93.4	35.0	39.4	16.9	47.3	20.0
1968	7.0	2.2	6.9	0.7	171.8	188.2	102.4	9.5	40.7	11.7	57.4	73.7
1969	8.7	2.2	7.9	0.4	164.7	158.8	121.7	11.4	52.8	13.9	55.8	35.1
1970	9.3	2.2	11.4	0.3	154.5	129.8	128.0	10.7	60.2	17.0	76.0	28.0
1971	8.6	2.1	18.1	0.3	150.3	126.5	156.5	12.5	57.2	16.6	98.9	24.0
1972	6.9	2.7	11.8	0.2	146.8	138.8	187.2	8.3	47.0	19.5	54.0	24.1
1973	9.5	2.8	11.7	0.3	185.8	135.6	178.6	11.1	51.1	20.7	55.8	27.0
1974	9.2	2.7	11.3	0.3	160.9	139.4	186.4	8.3	57.2	19.4	51.9	36.1
1975	9.5	2.6	11.9	0.4	168.0	121.2	224.6	12.1	56.6	21.5	45.1	33.1
1976	8.0	2.3	11.6	0.2	185.6		218.5	9.5	43.1		53.1	21.1
1977	6.2	1.4	9.0	0.2	178.7		160.1	8.7	34.5		56.2	23.0
1978	6.3	1.0	8.8	0.2	152.6		148.2	8.1	41.3		59.4	24.5

TABLE 1.4-EVOLUTION OF CATCH (THOUSAND TONS), EFFORT AND C.P.U.E. FOR TRAWL FISHERIES IN
SUBAREA VII, DURING 1961-78, BY COUNTRIES

(o) FOR LA CORUÑA ONLY
(1) EFFORT AS HP × DAY × 10^5
(2) EFFORT IN TON/HOURS × 10^6
(3) C.P.U.E. AS Kg × 10^{-2} × $(HP × DAY)^{-1}$
(4) C.P.U.E. AS Kg × 10^{-3} × $(TON/HOURS)^{-1}$

YEARS	CATCH FRANCE		EFFORT FRANCE		C.P.U.E. FRANCE		CATCH SPAIN	
	HAUTURIERS	ARTISANS	HAUTURIERS	ARTISANS	HAUTURIERS	ARTISANS	BAKAS	BOUS AND PAREJAS
1961	12.4	3.6	71.1	96.6	174.4	37.3		
1962	12.4	3.1	78.0	99.4	159.0	31.2		
1963	11.1	2.5	81.5	98.6	136.2	25.4		
1964	10.4	2.4	83.3	101.8	124.8	20.6		
1965	9.4	2.2	88.3	111.8	106.5	19.7		
1966	7.9	2.3	105.2	110.2	75.1	20.9		
1967	8.4	2.7	107.9	119.7	77.8	22.6		
1968	8.4	2.7	111.9	124.9	75.1	21.6		
1969	4.3	3.1	61.5	131.6	69.9	23.6		
1970	3.8	5.7	48.5	140.5	78.4	40.6		
1971	5.4	4.0	56.7	156.1	95.2	25.6		
1972	5.4	3.4	59.6	160.9	90.6	21.1		
1973	4.1	4.4	49.1	171.3	83.5	25.7	MEAN VALUES 1974-76	
1974	3.1	3.5	37.6	194.6	82.4	18.0		
1975	1.9	4.9	30.4	223.2	62.5	22.0	8.00	17.8
1976	1.8	2.4	27.4	-	63.3	-		
1977	1.2	5.6	23.3	-	53.7	-		
1978	1.0	6.9	13.5	-	74.7	-		

TABLE 1.5 - EVOLUTION OF HAKE CATCHES (THOUSAND TONS), EFFORT AND C.P.U.E. FOR TRAWL FISHERIES IN DIVISIONS VIII a,b,BY COUNTRIES, DURING 1961-78.

- EFFORT AS H.P.xDAY x 10^5

- C.P.U.E. AS Kg x 10^{-2} x $(H.P. \times DAY)^{-1}$

YEARS	CATCH OF ARTISANS			EFFORT BY ARTISANS			C.P.U.E. OF ARTISANS	C.P.U.E. FRENCH HAUTURIERS TWO YEARS LATER
	VII	VIIIa,b	TOTAL	VII	VIIIa,b	TOTAL	VII+VIIIa,b	IVa + VIa
1961	6.0	3.6	9.6	143.3	96.6	239.9	40.0	101
1962	6.2	3.1	9.3	168.9	99.4	268.3	34.7	74
1963	4.9	2.5	7.4	166.2	98.6	264.8	27.9	39
1964	4.4	2.4	6.8	172.4	101.8	274.2	24.8	37
1965	4.0	2.2	6.2	150.3	111.8	262.1	23.7	54
1966	4.3	2.3	6.6	196.2	110.2	306.4	21.5	50
1967	3.4	2.7	6.1	200.7	119.7	320.4	19.0	43
1968	2.2	2.7	4.9	188.2	124.9	313.1	15.6	48
1969	2.2	3.1	5.3	158.8	131.6	290.4	18.2	42
1970	2.2	5.7	7.9	129.8	140.5	270.3	29.2	42
1971	2.1	4.0	6.1	126.5	156.1	282.6	21.6	33
1972	2.7	3.4	6.1	138.8	160.9	299.7	20.4	26
1973	2.8	4.4	7.2	135.6	171.3	306.9	23.5	27
1974	2.7	3.5	6.2	139.4	194.6	334.0	18.6	29
1975	2.6	4.9	7.5	121.2	223.2	344.4	21.8	23
MEAN 61-69	4.2	2.7	6.9	171.6	110.5	282.2	25.0	60
70-75	2.5	4.3	6.8	131.9	174.4	306.3	22.5	30

TABLE 1.6 - FRENCH ARTISAN CATCH, EFFORT AND C.P.U.E. IN VII AND VIIIa,b AND C.P.U.E. OF FRENCH HAUTURIERS IN IVa + VIa TWO YEARS LATER, FROM 1961 UP TO 1975.

YEARS	1961	1962	1963	1964	1965	1966	1967	1968	1969	1970	1971	1972	1973	1974	1975	1976	1977	1978
Nos 25-44 cm	1322683	1377838	805752	261698	160626	218100	84690	82061	17299	6694	3039	7344	6024	6487	8870	4523	5470	10352
TOTAL Nos	3845999	4181142	3056647	1991051	1337140	906212	606832	629671	400877	250232	103031	89392	63437	48250	70214	74036	84691	62306
% <45 cm	34.4	33.0	26.4	13.1	12.0	24.1	14.0	13.0	4.3	2.7	2.9	8.2	9.5	13.4	12.6	6.1	6.5	16.6
	$\bar{x} = 21.25$								$\bar{x} = 8.3$									

TABLE 1.7 - U.K. PERCENTAGE OF HAKE OF 25-44cm LENGHT CAUGHT IN SUBAREA VIa, DURING 1961-78.

LENGTH CLASSES (cm)	IVa + VIIa				VII						VIII a,b			
	FRANCE HAUTU-RIERS	ENGLAND AND WALES	SCOTLAND	SPAIN	FRANCE			U. K.	SPAIN		FRANCE			SPAIN BAKAS, BOUS AND PAREJAS
					HAUTU-RIERS	SEMI-INDUS-TRIALS	ARTI-SANS		GILL-NETS + LON-GLINES	TRA-WLERS	HAUTU-RIERS	ARTI-SANS	FILLETS MAILLAN-TS, PA-LANGRES	
5-9														
10-14														
15-19										4				
20-24					1	16	39			313	8	1600	0	1243
25-29	4	1	(1)	(1)	21	458	799	2		273	145	8132	3	3875
30-34	27	2			84	1507	1423	18		1854	100	6339	4	3612
35-39	77	3			129	1321	793	33		3785	120	2898	9	2174
40-44	108	3			271	459	294	28	444	3485	140	854	5	2413
45-49	141	7			383	215	131	11	383	2534	160	225	4	2990
50-54	153	17			429	190	38	8	295	1086	154	81	2	1952
55-59	126	23			418	125	20	6	89	744	125	62	4	1743
60-64	144	24			263	78	12	11	75	486	92	90	16	1301
65-69	116	20			94	61	22	12	48	294	43	67	37	827
70-74	101	13			95	61	26	12	40	228	9	27	28	394
75-79	104	6			68	46	19	9	39	220	2	16	23	206
80-84	55	3			38	20	6	5	26	87	3	5	15	140
85-89	45	2			34	27	3	3	25	44	2	4	4	55
90-94	44	1			14	11	3	3	15	19	6	2	13	3
95-99	25	1			14	7	4	2	9	13	2	2	26	0
100-104	16	1			9	3	2	-	6	13	1			4
105-109	6	1			1	3	1	2						
110-115	3	-			1	4								

(1) SAMPLE DATA NOT AVAILABLE

TABLE 1.8 - LENGTH COMPOSITION DATA FOR EUROPEAN HAKE LANDINGS FROM NORTHERN STOCK (THOUSANDS OF FISH) BY SUBAREA, DIVISION, COUNTRY AND VESSEL CLASS, FOR 1977.

LENGTH CLASSES (cm)	IVa + VIa				VII						VII a,b			
	FRANCE	ENGLAND AND WALES	SCOTLAND	SPAIN	FRANCE			U. K.	SPAIN		FRANCE			SPAIN
	HAUTU-RIERS				HAUTU-RIERS	SEMI-INDUS-TRIALS	ARTI-SANS		GILL-NETS + LON-GLINES	TRA-WLERS	HAUTU-RIERS	ARTI-SANS	GILL-NETS + LON-GLINES	BAKAS, BOUS AND PAREJAS
5-9														
10-14														
15-19														4075
20-24						16	27				3	1328	0	4800
25-29	1		158	(1)	17	467	331			123	33	7448	5	8507
30-34	10	1	1292		65	1706	572	24		626	25	7020	5	6277
35-39	54	5	966		101	2124	537	29		1337	77	2785	7	4565
40-44	72	6	228		289	687	244	71	352	2348	189	1515	6	2256
45-49	79	4	84		532	181	83	69	308	2326	190	438	5	2389
50-54	65	5	86		528	64	52	45	236	1804	186	330	3	2237
55-59	49	8	61		426	38	28	18	70	1015	101	178	7	1032
60-64	88	10	74		320	44	8	9	60	594	67	118	21	443
65-69	82	11	26		158	37	17	9	36	346	28	67	40	272
70-74	92	12	19		81	43	17	5	30	307	22	47	50	220
75-79	110	7	66		48	34	14	5	28	171	9	29	53	89
80-84	59	7			39	15	10	6	22	95	4	12	30	23
85-89	45	3			30	19	9	3	18	45	2	7	14	14
90-94	38	2			15	6	5	2	12	48	1	2	1	12
95-99	17	2			9	4	3	2	6	30	1	3	1	0
100-104	11	1			5	2	1	2	4	17			-	5
105-109	4	2			1	2				4				
110-114	2				1	1								

(1) SAMPLE DATA NOT AVAILABLE

TABLE 1.9 - LENGTH COMPOSITION DATA EUROPEAN HAKE LANDINGS FROM NORTHERN STOCK (THOUSANDS OF FISH) BY SUBAREA, COUNTRY AND VESSEL CLASS FOR 1978.

LENGTH CLASSES (cm)	$\bar{W}$ (Kg)	GROWTH PARAMETERS VALUES
5 - 9	0.002	
10 - 14	0.012	
15 - 19	0.034	$L_{\infty} = 97.8$
20 - 24	0.073	
25 - 29	0.136	$W_{\infty} = 6.736$ Kg
30 - 34	0.227	
35 - 39	0.352	$K = 0.120$ year^{-1}
40 - 44	0.517	
45 - 49	0.727	$t_o = -0.48$ year
50 - 54	0.989	
55 - 59	1.309	$t_r = 0.91$ year
60 - 64	1.691	
65 - 69	2.142	
70 - 74	2.668	
75 - 79	3.276	
> 80	≈ 5.000	
WEIGHT-LENGTH RELATIONSHIP $W_{(g)} = 0.00513\ L^{3.074}_{(cm)}$		

TABLE 1.10 - GROWTH PARAMENTERS VALUES,WEIGHT-LENGTH RELATIONSHIP AND AVERAGE WEIGHTS AT LENGTH CLASSES FOR EUROPEAN HAKE IN NORTHERN STOCK WHICH WERE ADOPTED BY THE WORKING GROUP (LA ROCHELLE, 1978).

SELECTIVITY	MEAN MESH SIZE		
PARAMETERS	42.5 mm	64.2 mm	83.7 mmm
a	-5.84	-5.85	-5.40
b	0.35	0.23	0.19
l_{50}	16.47 (tc = 1.06)	25.94 (tc = 2.09)	28.79 (tc = 2.43)
S_F	3.88	4.05	3.44
Δ	6.20	9.74	11.70
β	0.376	0.375	0.406
$\left(\frac{dp}{dl}\right)_{L_{50}}$	0.0886	0.0563	0.0470

TABLE 1.11 - RESULTS OF FITTING THE LOGISTIC CURVE TO HAKE
SELECTIVITY DATA FOR 40(42.5) mm, 60(64.2) mm
AND 80(83.7) mm MESH TRAWLS OF FRENCH AND POR-
TUGUESE COVERED COD-END EXPERIMENTS, DURING
1967-1976, FROM NORTHERN STOCK.

a,b = REGRESSION PARAMETERS OF LOGITS OF RETENTION
PERCENTAGES ON LENGTHS

l_{50} = 50% RETENTION LENGTH

S_F = MESH SIZE/l_{50}

Δ = 25% - 75% SELECTIVITY RANGE

β = Δ /l_{50}

$\frac{dp}{dl}\Big|_{l_{50}}$ = SLOPE OF SELECTION CURVE AT l_{50}

PRESENT MESH: 60 mm   PRESENT MESH: 40 mm

REDUCTIONS IN F (%)	F CONSTANT OVER ALL AGES									F $<$ 25 cm = .85								
	F = .30			F = .60			F = .80			F $>$ 25 cm = .30			F $>$ 25 cm = .60			F $>$ 25 cm = .80		
	L	G	ΔB	L	G	ΔB	L	G	ΔB	L	G	ΔB	L	G	ΔB	L	G	ΔB
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	-25	3	38	-25	11	48	-25	12	49	-25	19	66	-24	23	69	-24	23	65
50	-50	2	105	-49	23	147	-50	29	158	-50	37	200	-50	57	231	-50	60	224
75	-75	-16	234	-75	27	409	-75	45	481	-75	32	497	-75	89	709	-75	109	748

TABLE 1.12 - EFFECTS ON YIELD AND BIOMASS OF REDUCTIONS IN F IN THE PRESENT MESH SITUATION

(60 mm AND 40 mm) FOR DIFFERENT HYPOTHESES ON PRESENT F.

MESH CHANGE: FROM 40 mm TO 80 mm

REDUCTIONS IN F (%)	F CONSTANT OVER ALL AGES									F 25 cm = .85								
	F = .30			F = .60			F = .80			F 25cm = .30			F 25cm = .60			F 25cm = .80		
	L	G	ΔB	L	G	ΔB	L	G	ΔB	L	G	ΔB	L	G	ΔB	L	G	ΔB
0	−11	34	34	−26	67	67	−37	87	87	−25	97	131	−33	95	111	−38	92	96
25	−33	37	83	−44	82	143	−52	106	175	−44	101	215	−55	112	207	−54	112	187
50	−55	33	167	−63	98	297	−68	131	363	−62	96	360	−66	131	402	−69	138	384
75	−77	6	327	−81	98	692	−84	150	903	−81	57	636	−83	130	901	−84	157	949

MESH CHANGE: FROM 60 mm TO 80 mm

REDUCTIONS IN F (%)	F CONSTANT OVER ALL AGES								
	F = .30			F = .60			F = .80		
	L	G	ΔB	L	G	ΔB	L	G	ΔB
0	−3	6	6	−9	11	11	−13	13	13
25	−27	8	45	−32	21	61	−35	24	66
50	−51	5	111	−54	31	163	−56	40	180
75	−75	−15	239	−77	31	425	−78	51	506

TABLE 1.13 − EFFECTS ON YIELD AND BIOMASS OF REDUCTIONS IN F WHEN THE MESH SIZE IS CHANGED TO 80 mm, FOR DIFFERENT HYPOTHESES ON PRESENT F.

YEARS	TOTAL	FRANCE			PORTUGAL			SPAIN		
		TOTAL	VIII (1)	IX	TOTAL	VIII (1)	IX	TOTAL	VIII (1)	IX
1967	97.7	13.4	11.0	2.4	7.6	–	7.6	76.7	31.6	45.1*
68	89.1	12.2	10.2	2.0	7.2	–	7.2	69.7	32.2	37.5*
69	82.3	10.5	8.8	1.7	6.6	–	6.6	65.7	27.1	38.6*
1970	99.7	14.3	12.8	1.5	9.3	–	9.3	76.1	34.3	41.8*
71	37.3	13.7	13.1	0.6	8.0	–	8.0	16.1	14.0	2.1*
72	52.7	12.6	12.6	–	8.7	–	8.7	31.4	16.3	15.1
73	63.0	11.3	11.3	–	15.3	–	15.3	36.4	15.6	20.8
74	47.7	7.3	7.2	0.1	7.8	–	7.8	32.6	18.5	14.1
75	54.4	8.0	7.9	0.1	9.4	–	9.4	37.0	18.0	19.0
76	46.7	4.9	4.8	0.1	7.9	–	7.9	33.9	20.2	13.7
77	46.2	6.6	6.6	–	5.5	–	5.5	34.1	16.6	17.5
78										

TABLE 2.1: Hake nominal catches, in thousand tons during the period 1967-78, according to ICES Bull. Stat. for Subareas VIII and IX, by countries.

* = Data refer to port of landing, not area of capture (include african catches).

(1) = Include VIIIa,b and VIIIc.

YEARS	TOTAL	VIIIc + IXa
1973	35.7	35.7
1974	23.4	23.4
1975	30.2	30.2
1976	26.7	26.7
1977	15.6	15.6
1978	14.2	14.2

TABLE 2.2.: Corrected values of Hake catches adopted by the Working Group, during 1973-1978, by sub-areas (Nominal weight in thousand tons).

YEARS	CATCH			EFFORT[*]			C.P.U.E.		
	FRANCE	SPAIN	PORTUGAL	FRANCE	SPAIN	PORTUGAL	FRANCE	SPAIN	PORTUGAL
1961	0.7		4.6	3.2		189.7	174		24.2
62	0.7		5.0	2.7		213.0	151		23.5
63	0.7		5.5	3.3		176.5	123		31.2
64	0.7		6.4	4.1		185.0	102		34.6
65	0.9		8.0	5.6		184.2	107		43.4
66	0.6		5.4	7.1		174.1	78		31.0
67	0.6		4.1	7.3		206.1	63		19.9
68	0.3		3.8	4.2		217.1	54		17.5
69	0.5		2.8	5.1		232.2	69		12.1
1970	0.2		5.7	2.7		257.2	67		22.2
71	0.2		4.8	1.5		290.0	87		16.6
72	0.0	10.2	4.5	0.4		280.9	53		16.0
73	0.2	12.3	7.8	2.0		369.3	108		21.1
74	0.1	8.3	3.7	0.9	47.2	340.0	102		10.9
75	0.1	11.2	4.7	0.9	47.2	350.0	93	36.0	13.4
76	0.1	10.0	3.3	0.9	54.1	340.0	67	30.3	9.7
77	0.2	5.8	1.7	–	49.7	374.0	–	34.3	4.4
78	0.1	5.4	1.5	–	48.4	348.0	–	25.2	4.3

TABLE 2.3: Catches, in thousand tons, effort and c.p.u.e. for trawl fisheries in division IXa +VIIIc, by countries, during the period 1961-78.

(1) SPAIN (only Coruña)
* Effort, France, as $HPxDx10^5$

Effort, Spain, as $D \times 10^3/100HP$

Effort, Portugal, as thousand hours

C.P.U.E., France, Kg x 10^{-2} x $(HPx\ DAY)^{-1}$

C.P.U.E., Spain, Kg/(day x 100HP)

C.P.U.E., Portugal, Kg/hour

Length Classes	VIIIc + IXa*			
	Portugal		France	Spain
	Artisanal	Trawlers	Hauturiers	
5- 9				
10-14		21		
15-19		394		
20-24	1	1 952		
25-29	54	2 125		
30-34	40	1 802	2	
35-39	83	695	8	
40-44	457	249	19	(1)
45-49	666	116	25	
50-54	591	31	57	
55-59	680	13	50	
60-64	494	18	21	
65-69	298	13	7	
70-74	187	1	3	
75-79	90		-	
80-84	25		-	
85-89	13		-	
90-94	4		1	
95-99	4			
100-104	1			
105-109	1			
110-115				

TABLE 2.4: Length compostion, in thousand individuals, of European Hake landings by countries and vessel classes for Divisions VIIIc + IXa, for 1977.

(1) Sample data not available

* - Values do not include discards.

LENGTH CLASSES	VIIIc + IXa (*)				
	FRANCE	SPAIN (1)		PORTUGAL	
	Hauturier	Artisanal	Trawlers	Artisanal	Trawlers
5- 9			46		4
10-14			18 359		510
15-19		8	20 948	7	516
20-24		46	4 799	13	3 032
25-29		285	2 034	12	3 327
30-34		324	2 220	51	941
35-39	2	37	718	131	409
40-44	8	94	674	232	257
45-49	15	338	1 148	316	53
50-54	17	556	984	461	33
55-59	16	799	820	388	70
60-64	8	599	397	244	58
65-69	2	262	62	171	14
70-74		36	17	138	6
75-79		24	2	48	1
80-84		5	1	35	
85-89				31	
90-94				30	
95-99				12	
100-104				2	
105-109					
110-115					

TABLE 2.5: Length composition, in thousand individuals, of European Hake landings by countries, and vessel classes, for Divisions VIIIc + IXa, for 1978

(1) includes data only for the Galician fleet

(*) values do not include discards.

LENGTH CLASSES	TOTAL	PORTUGUESE TRAWL	SPANISH TRAWL	ARTISANAL FISHERIES
5- 9	2 008	2	2 006	–
10-14	39 709	110	39 599	–
15-19	54 192	668	53 514	10
20-24	22 667	4 410	18 048	209
25-29	12 283	4 576	6 661	1 046
30-34	7 343	2 644	3 058	1 641
35-39	3 337	1 630	984	723
40-44	2 152	550	925	677
45-49	1 811	232	685	894
50-54	1 553	84	463	1 006
55-59	1 835	82	314	1 439
60-64	1 571	55	216	1 300
65-69	1 001	24	111	866
70-74	507	7	33	467
75-79	222	1	17	204
>80	133	–	21	112

TABLE 2.6: Mean length – frequency composition of European Hake in Southern stock (N x 10^3), during 1974-1978, for **selected fisheries.**

LENGTH CLASSES (cm)	$\tilde{W}$ (Kg)	GROWTH PARAMETERS VALUES
5 - 9	0.002	
10 - 14	0.012	
15 - 19	0.034	$L_\infty = 97.8$
20 - 24	0.073	
25 - 29	0.136	$W_\infty = 6.736$ Kg
30 - 34	0.227	
35 - 39	0.352	$K = 0.120$ year^{-1}
40 - 44	0.517	
45 - 49	0.727	$t_o = -0.48$ year
50 - 54	0.989	
55 - 59	1.309	$t_r = 0.91$ year
60 - 64	1.691	
65 - 69	2.142	
70 - 74	2.668	
75 - 79	3.276	
> 80	≈ 5.000	

WEIGHT-LENGTH RELATIONSHIP $W_{(g)} = 0.00513 \, L_{(cm)}^{3.074}$

TABLE 2.7: GROWTH PARAMETERS VALUES, WEIGHT-LENGTH RELATIONSHIP AND AVERAGE WEIGHTS AT LENGTH CLASSES FOR EUROPEAN HAKE IN SOUTHERN STOCK WHICH WERE ADOPTED BY THE WORKING GROUP (LA ROCHELLE, 1978).

ACTUAL MESH SIZE (40mm)

	CHANGES IN EFFORT IN %																	
A.P.	0						-25						-50					
A.E.	-25		-50		-75		-25		-50		-75		-25		-50		-75	
	L	G	L	G	L	G	L	G	L	G	L	G	L	G	L	G	L	G
A.P.	0	32	0	74	0	131	-25	5	-25	38	-25	83	-50	-26	-50	-2	-50	30
A.E.	-25	-5	-50	-20	-65	-48	-25	-1	-50	-16	-75	-46	-25	4	-50	-11	-75	-43
a total	0	41	0	99	0	182	0	55	0	119	0	209	0	70	0	140	0	239
TOTAL	-9	23	-18	52	-28	91	-13	28	-22	59	-31	99	-16	33	-25	65	-34	118

(40mm)

	-25		-50		-75	
A.P.	-25		-50		-75	
A.E.	-25		-50		-75	
a total	-25		-50		-75	
	L	G	L	G	L	G
A.P.	-25	38	-50	72	-75	63
A.E.	-25	26	-50	49	-75	40
a total	-25	69	-50	156	-75	193
TOTAL	-25	49	-50	106	-75	120

CHANGE IN MESH SIZE (60 mm)

A.P.	CHANGES IN EFFORT IN %																			
	0								-25						-50					
A.E.	0		-25		-50		-75		-25		-50		-75		-25		-50		-75	
	L	G	L	G	L	G	L	G	L	G	L	G	L	G	L	G	L	G	L	G
A.P.	-9	51	-9	78	-9	110	-9	149	-32	40	-32	66	-32	66	-32	96	-55	16	-55	38
A.E.	-22	24	-42	9	-61	-15	-81	-50	-42	14	-61	-11	-81	-11	-81	-47	-61	-6	-81	-44
a total	0	69	0	112	0	165	0	233	0	129	0	188	0	188	0	261	0	212	0	291
TOTAL	-9	50	-17	69	-24	92	-31	118	-20	75	-27	99	-34	126	-23	81	-30	106	-37	134

(60 mm)

	-25		-50		-75	
A.P.	-25		-50		-75	
A.E.	-25		-50		-75	
a total	-25		-50		-75	
	L	G	L	G	L	G
A.P.	-32	75	-55	107	-77	74
A.E.	-42	41	-61	67	-81	45
a total	-25	133	-50	233	-75	234
TOTAL	-32	91	-55	155	-77	143

TABLE 2.8: Mesh size and effort changes as estimated by cohort analysis of the 1974-78 average length composition of Hake in the Southern Stock.

AP = Portuguese trawl fishery
AE = Spanish trawl fishery

[a]total = Portuguese and Spanish gillnet and longline fisheries

SELECTIVITY	MEAN MESH SIZE		
PARAMETERS	42.5 mm	64.2 mm	83.7 mmm
a	-5.84	-5.85	-5.40
b	0.35	0.23	0.19
l_{50}	16.47 (tc = 1.06)	25.94 (tc = 2.09)	28.79 (tc = 2.43)
S_F	3.88	4.05	3.44
Δ	6.20	9.74	11.70
β	0.376	0.375	0.406
$\left(\frac{dp}{dl}\right)_{L_{50}}$	0.0886	0.0563	0.0470

TABLE 2.9: RESULTS OF FITTING THE LOGISTIC CURVE TO HAKE SELECTIVITY DATA FOR 40 (42.5) mm, 60 (64.2) mm AND 80 (83.7) mm MESH TRAWLS OF FRENCH AND PORTUGUESE COVERED COD-END EXPERIMENTS DURING 1967-1976, FROM SOUTHERN STOCK.

a,b = REGRESSION PARAMETERS OF LOGITS OF RETENTION PERCENTAGES ON LENGTHS

l_{50} = 50% RETENTION LENGTH

S_F = MESH SIZE/l_{50}

Δ = 25% - 75% SELECTIVITY RANGE

β = Δ /l_{50}

$\frac{dp}{dl}\Big|_{l_{50}}$ = SLOPE OF SELECTION CURVE AT l_{50}

MESH CHANGE: FROM 40 mm TO 60 mm

REDUCTIONS IN F (%)	F CONSTANT OVER ALL AGES									F (<25 cm) = 70% F (>25 cm)								
	F=.30			F=.60			F=.80			F<25 cm=.21 F>25 cm=.30			F<25 cm=.42 F>25 cm=.60			F<25 cm=.56 F>25 cm=.80		
	L	G	ΔB	L	G	ΔB	L	G	ΔB	L	G	ΔB	L	G	ΔB	L	G	ΔB
0	-7	26	26	-18	50	50	-27	65	65	-5	17	15	-12	34	27	-19	44	33
25	-30	31	74	-38	67	123	-45	85	147	-28	22	59	-34	49	88	-39	61	99
50	-53	29	158	-59	87	274	-63	114	328	-52	20	136	-56	66	215	-59	86	244
75	-76	5	321	-79	92	668	-81	140	862	-76	-1	285	-78	71	548	-79	109	674

PRESENT MESH SIZE 40 mm

REDUCTIONS IN F (%)	F CONSTANT OVER ALL AGES									F (<25 cm) = 70% F (>25 cm)								
	F=.30			F=.60			F=.80			F 25 cm=.21 F 25 cm=.30			F 25 cm=.42 F 25 cm=.60			F 25 cm=.56 F 25 cm=.80		
	L	G	ΔB	L	G	ΔB	L	G	ΔB	L	G	ΔB	L	G	ΔB	L	G	ΔB
0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
25	-24	9	46	-25	20	60	-25	23	64	-25	8	43	-25	18	54	-25	20	56
50	-50	14	129	-50	48	196	-50	59	218	-49	11	120	-50	41	173	-50	51	188
75	-75	0	298	-75	70	582	-75	105	721	-75	-5	273	-75	57	502	-75	87	602

TABLE 2.10: Effects on yield and biomass of reductions in F, for the case of no change in mesh size (40 mm) and for the case of change in mesh size to 60 mm, for different assumptions of actual F.

YEARS	TOTAL	PORTUGAL (IXa)			FRANCE	SPAIN (VIIIc W + IXa)		
		TOTAL	TRAWLER	ARTISANAL		TOTAL	TRAWLER	ARTISANAL
1956		2 695	1 584	1 111	–	25 000		
57		3 842	2 705	1 137	–	31 600		
58		5 261	3 524	1 737	1 000	23 400		
59		5 070	3 092	1 978	2 100	25 600		
1960		6 844	3 804	3 040	3 500	23 400		
61		7 517	4 615	2 902	700	31 600		
62		7 473	5 064	2 409	700	36 000		
63		8 148	5 508	2 640	600	39 600		
64		10 498	6 436	4 062	700	46 000		
65		12 141	7 915	4 226	800	46 800		
66		9 587	5 393	4 194	600	45 600		
67		7 834	4 062	3 772	600	45 200		
68		7 956	3 764	4 192	400	37 600		
69		7 088	2 772	4 316	500	38 400		
1970		9 880	5 773	4 107	200	41 600		
71		9 508	4 861	4 647	100	12 100*		
72	26 713	9 413	4 405	5 008	0	17 300	10 200	7 100
73	35 462	14 662	7 793	6 869	200	20 800	12 300	8 500
74	23 264	9 164	3 746	5 418	100	14 100	8 300	5 800
75	30 060	11 060	4 624	6 436	100	19 000	11 200	7 800
76	26 552	9 652	3 326	6 326	100	16 900	10 000	6 900
77	15 803	6 423	1 674	4 749	200	9 180	5 800	3 380
78	14 302	5 562	1 504	4 058	100	8 640	5 400	3 240

TABLE 2.11: Nominal landings, in tons, of European Hake from Southern Stock (VIIIc W + IXa) by countries and gears - ICES Bull. Stat.

* the value 2 100 of ICES Bull. Stat. was corrected to 12 100.

one nominal landing tons = 1.17 landing ton.

YEARS	PORTUGAL	FRANCE	SPAIN (1) 25% ICES	TOTAL	SPAIN (2) 50% ICES	TOTAL
1956	2 695	—	6 500	9 195	13 000	15 695
57	3 842	—	7 900	11 742	15 800	19 642
58	5 261	1 000	7 100	13 361	14 200	20 461
59	5 070	2 100	6 400	13 570	12 800	19 970
1960	6 844	3 500	7 100	17 440	14 200	24 544
61	7 517	700	7 900	16 117	15 800	24 017
62	7 473	700	9 000	17 173	18 000	26 173
63	8 148	600	9 900	18 648	19 800	28 548
64	10 498	700	11 500	22 698	23 000	34 199
65	12 141	800	11 700	24 641	23 400	36 341
66	9 587	600	11 400	21 587	22 800	32 987
67	7 834	600	11 300	19 734	22 600	31 034
68	7 956	400	9 400	17 756	18 800	27 156
69	7 088	500	9 600	17 188	19 200	26 788
1970	9 880	200	10 400	20 480	20 800	30 880
71	9 508	100	12 100*	21 708	12 100*	21 708
72	9 413	0	17 300	26 713	17 300	26 713
73	14 662	200	20 800	35 662	20 800	35 662
74	9 164	100	14 100	23 364	14 100	23 364
75	11 060	100	19 000	30 164	19 000	30 160
76	9 652	100	16 900	26 652	16 900	26 652
77	6 423	—	9 180	15 603	9 180	15 603
78	5 562	—	8 640	14 202	8 640	14 202

TABLE 2.12: Nominal landings, in tons, of European Hake from Southern Stocks (IXa + VIIIc W)

- one nominal landing tons = 1.17 x landing ton

= * the value 2 100 of ICES Bull. Stat. was corrected to 12 100

- Spain data for 1956 to 1970 obtained from ICES Bull. Stat. multiplied by factor 25% (1) and factor 50% (2) based on:

  Nominal total landings of European Hake in Spain ports for 1972 to 1976 (ICES, Bull. Stat.) less Africa and division VII landings of ICES is ~30% from total landings of Hake in Spain ports for the period 1972-1976.

YEARS	TOTAL CATCH (Y) (t)	BIOMASS INDEX $(\bar{U})$ Kg/h PORTUGUESE TRAWLERS	TOTAL EFFORT (f_T) PORTUGUESE HOURS TRAWLERS	MEAN EFFORT (3 years) $(\bar{f}_{3\ years})$ PORTUGUESE HOURS TRAWLERS
1956	9 195	13.8	666 300	
57	11 742	26.8	438 130	
58	13 361	27.4	487 630	530 687
59	13 570	19.5	695 900	540 553
1960	17 440	22.8	764 910	649 480
61	16 117	24.3	663 250	708 020
62	17 173	23.8	721 560	716 573
63	18 648	31.2	597 690	660 833
64	22 698	34.7	654 120	657 790
65	24 641	42.9	574 380	608 730
66	21 587	31.0	696 360	641 620
67	19 734	19.7	1 001 730	757 490
68	17 756	17.3	1 026 360	908 150
69	17 188	11.9	1 444 370	1 157 487
1970	20 480	22.5	910 220	1 126 983
71	21 708	16.7	1 299 880	1 218 157
72	26 713	15.7	1 701 470	1 303 857
73	35 662	21.1	1 690 140	1 563 830
74	23 364	11.0	2 124 000	1 838 537
75	30 164	13.2	2 285 150	2 033 097
76	26 652	9.8	2 719 590	2 376 247
77	15 603	4.4	3 546 140	2 850 293
78	14 202	4.3	3 302 790	3 189 507

TABLE 2.13: Total catch, Biomass index, total effort and mean effort (3 years) of European Hake-Southern Stock. (VIIIc W + IXa).

YEARS	TOTAL CATCH (Y) t	BIOMASSA INDEX ($\bar{U}$) Kg/H PORTUGUESE TRAWLERS	TOTAL EFFORT (f_T) PORTUGUESE HOURS TRAWLERS	MEAN EFFORT (3 YEARS) ($\bar{f}_{3\ YEARS}$) PORTUGUESE HOURS TRAWLERS
1956	15 695	13.8	1 137 320	
57	19 642	26.8	732 910	
58	20 461	27.4	746 750	872 327
59	19 970	19.5	1 024 100	834 587
1960	24 544	22.8	1 076 490	949 113
61	24 017	24.3	988 350	1 029 647
62	26 173	23.8	1 099 710	1 054 850
63	28 548	31.2	915 000	1 001 020
64	34 199	34.7	985 560	1 000 090
65	36 341	42.9	847 110	915 890
66	32 987	31.0	1 064 100	965 590
67	31 034	19.7	1 575 330	1 162 180
68	27 156	17.3	1 569 710	1 403 047
69	26 788	11.9	2 251 090	1 798 710
1970	30 880	22.5	1 372 440	1 731 080
71	21 708	16.7	1 299 880	1 641 137
72	26 713	15.7	1 701 470	1 457 930
73	35 662	21.1	1 690 140	1 563 830
74	23 364	11.0	2 124 000	1 838 537
75	30 160	13.2	2 284 850	2 032 997
76	26 652	9.8	2 719 590	2 376 147
77	15 603	4.4	3 546 136	2 850 192
78	14 202	4.3	3 302 790	3 189 505

TABLE 2.14: Total catch, biomassa index, total effort and mean effort (3 years) of European Hake Southern Stock (VIIIc W + IXa).
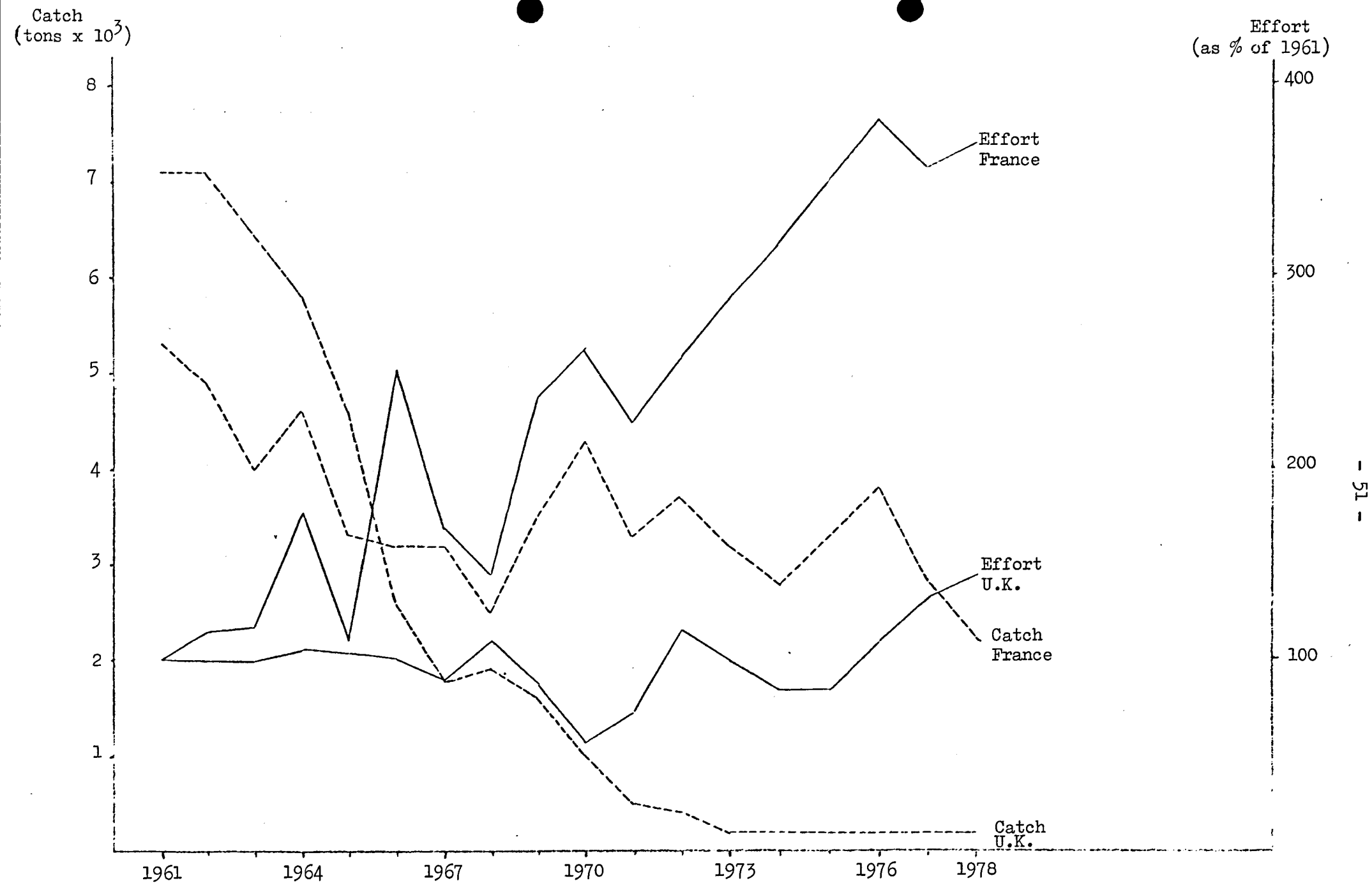
Figure 1.1.   United Kingdom and France hake catches and effort in Divisions IVa + VIa, during 1961-78.

$$C.p.u.e \begin{cases} \text{U.K.} & - \text{ Kg x } 10^{-3} \text{ per (ton x hours)}^{-1} \\ \text{France} & - \text{ Kg x } 10^{-2} \text{ per (hp x days)}^{-1} \end{cases}$$
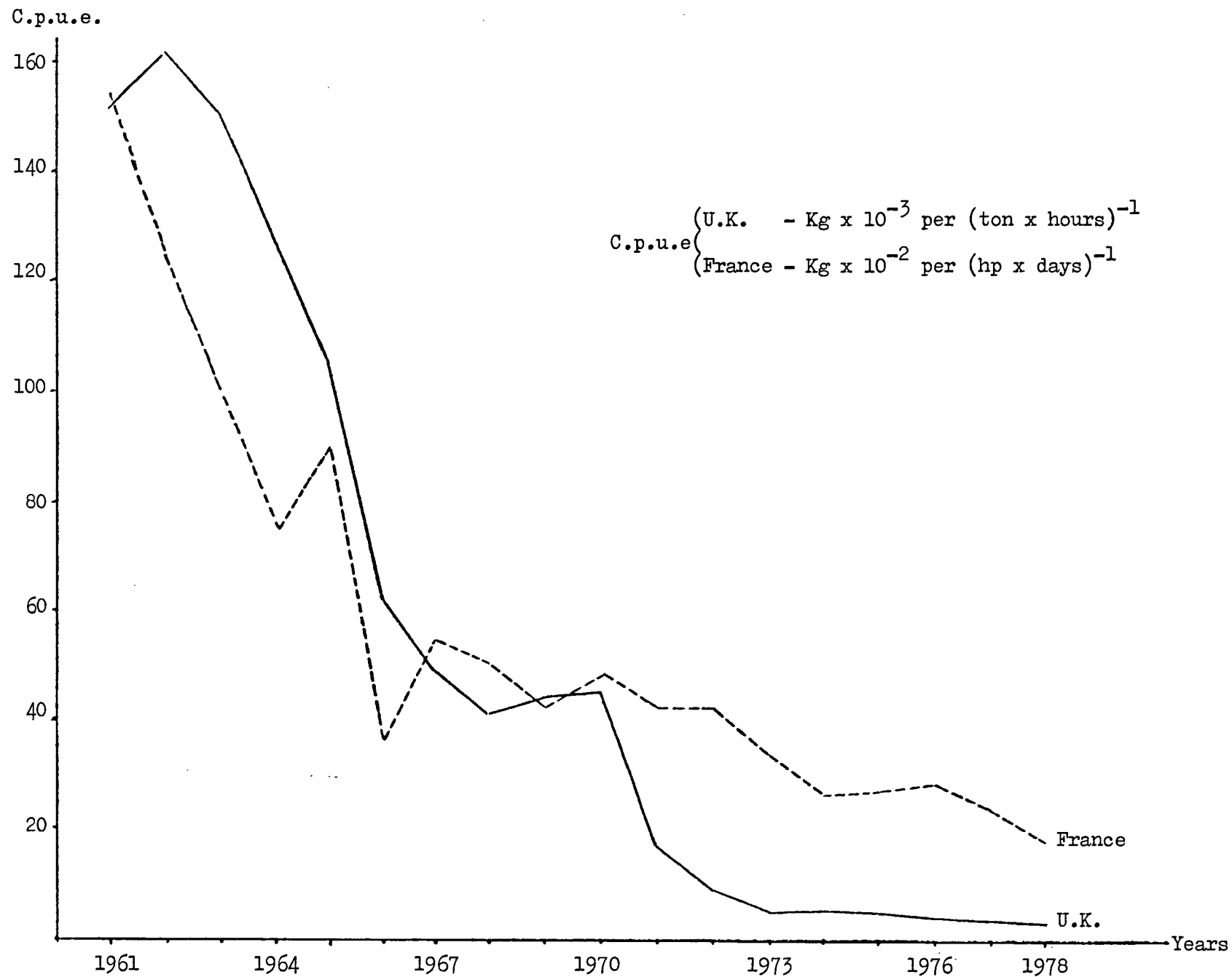
<u>Figure 1.2.</u>   United Kingdom and France c.p.u.e. in Divisions IVa + VIa, during 1961-78 - northern stock.
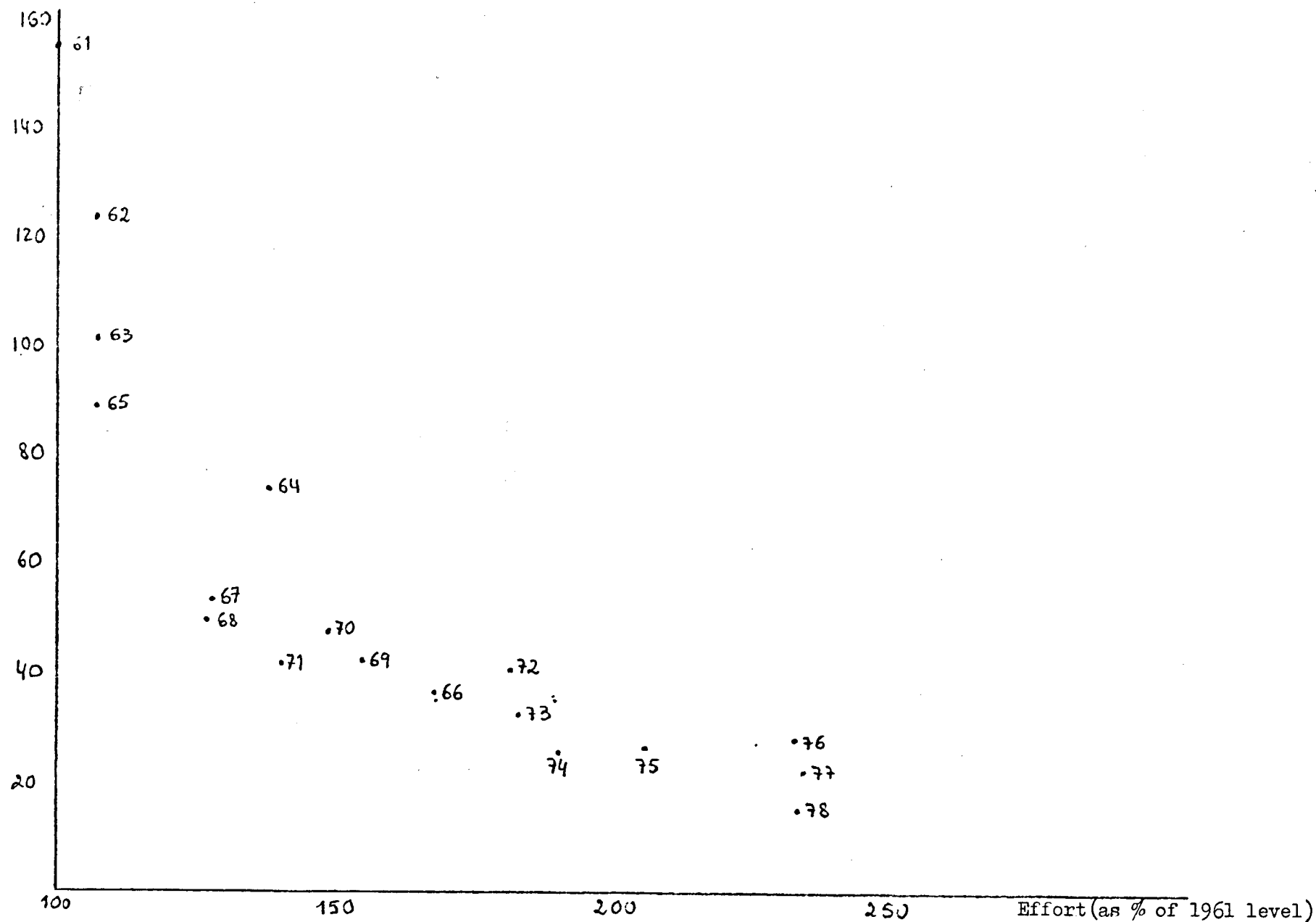
Figure 1.3. C.p.u.e. of French hauturiers in Division IVa and VIa against United Kingdom and French total effort during 1961-78 - northern stock.

Figure 1.4. Relationship between French artisan c.p.u.e. in Divisions VII + VIIIa,b and
c.p.u.e. of French "hauturiers" in Divisions IVa + VIa two years later,
during 1961-1978.
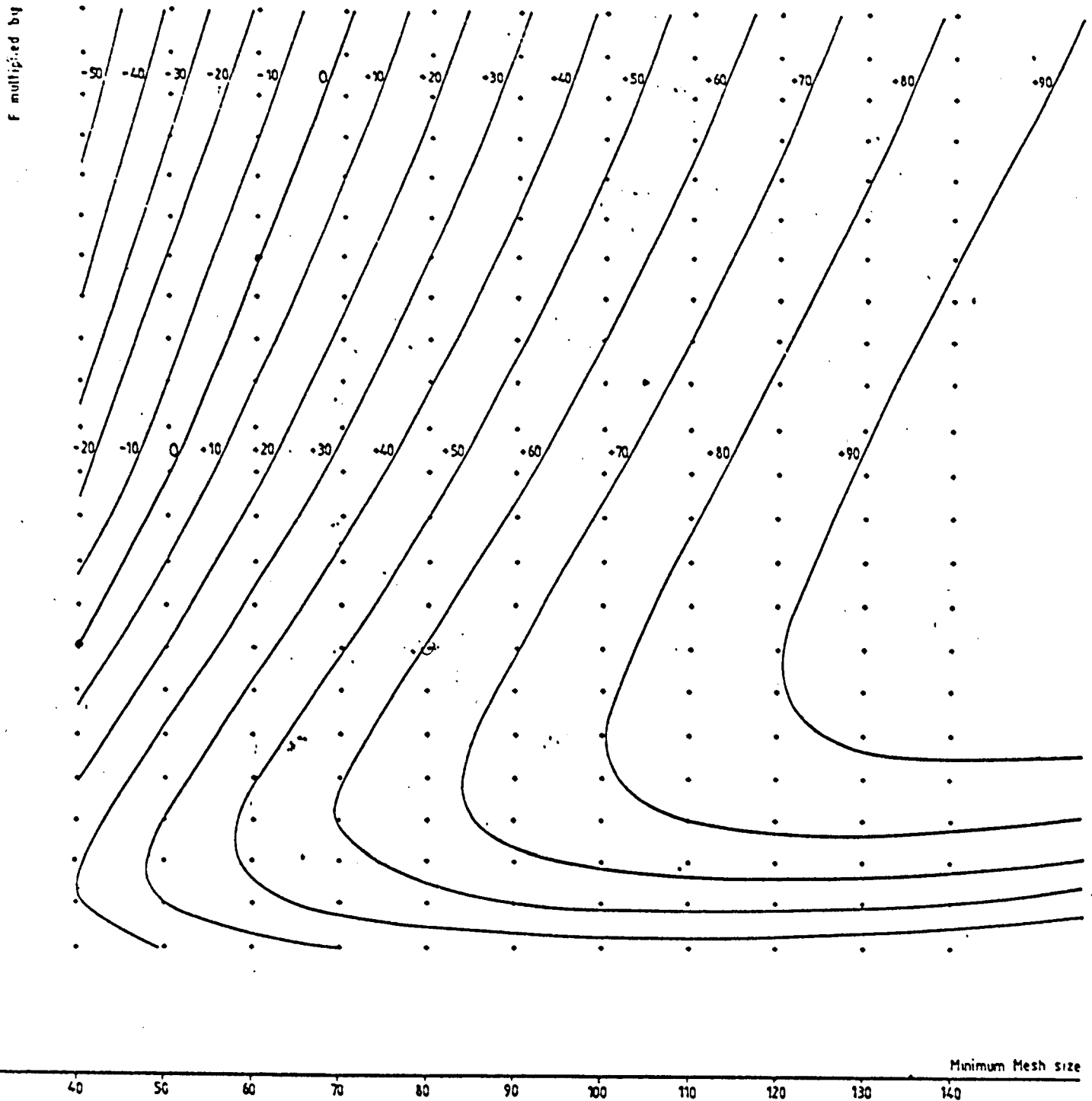
Figure 1.5. Divisions IVa, VIa, VIIa-k, VIIIab together: Long-term effects of F and mesh size variations on the total catches of hake (all gears together).

The gains or losses are expressed in % on the average 1973-76 catches.

By "minimum mesh size" it must be understood that the gears using smaller meshes increase these ones up to the given minimum when the gears using larger meshes keep them. The selectivity of gill nets and lines remains unchanged. For mesh sizes in use during the 1973-76 period, see text or Tables 15-18.
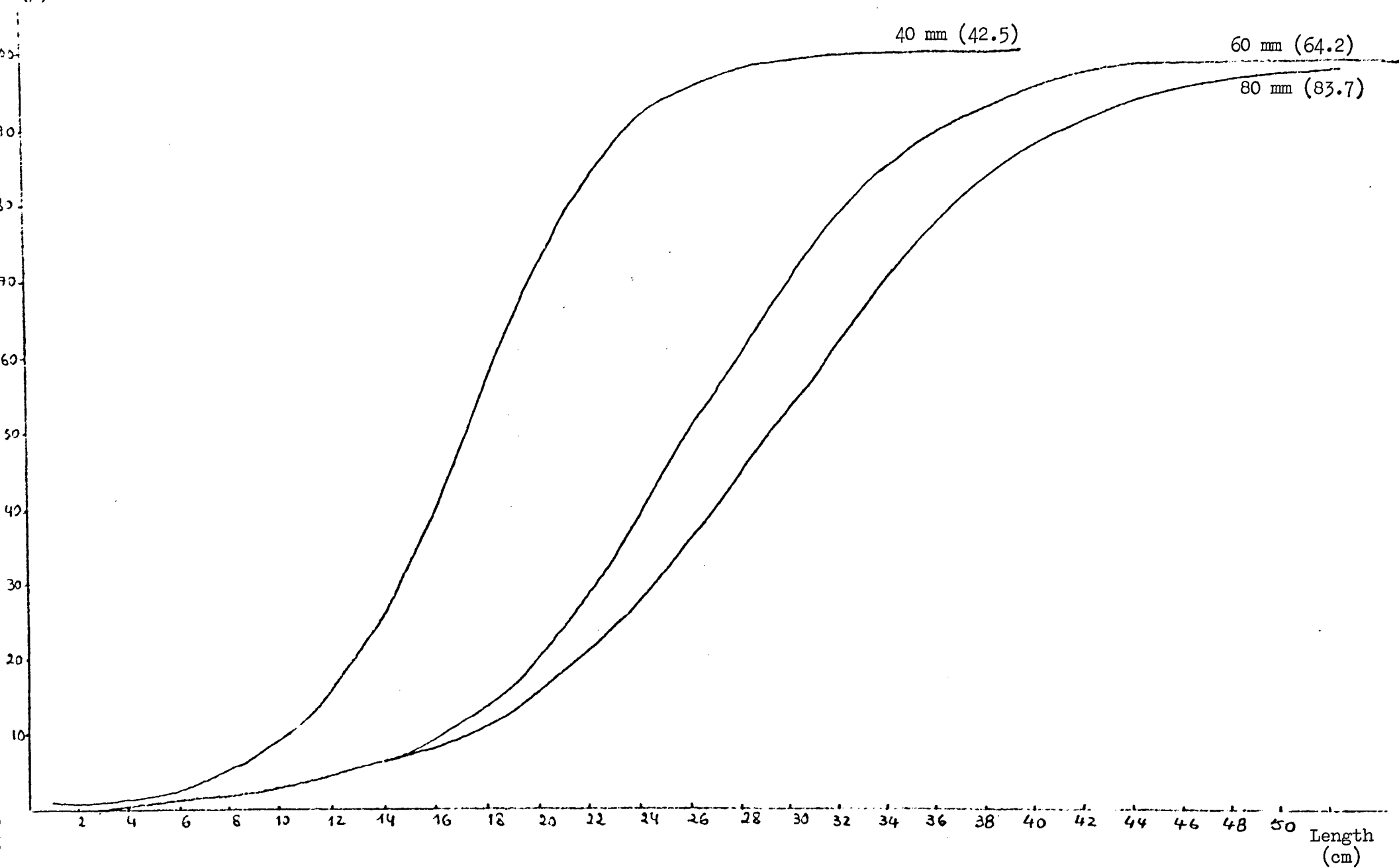
Figure 1.6. Selectivity of _Merluccius merluccius_ L. – fitted logistic retention curves for the different meshes.
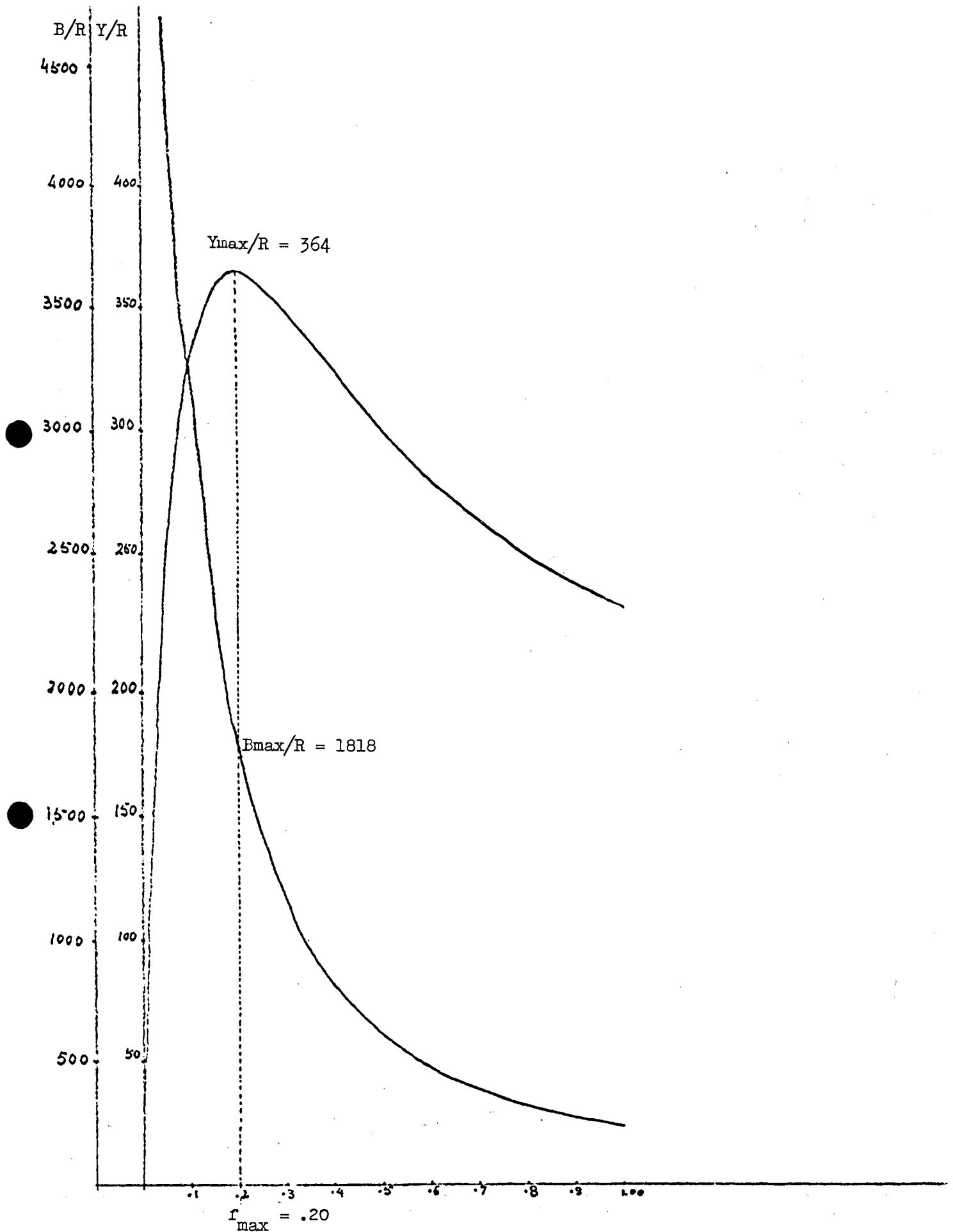
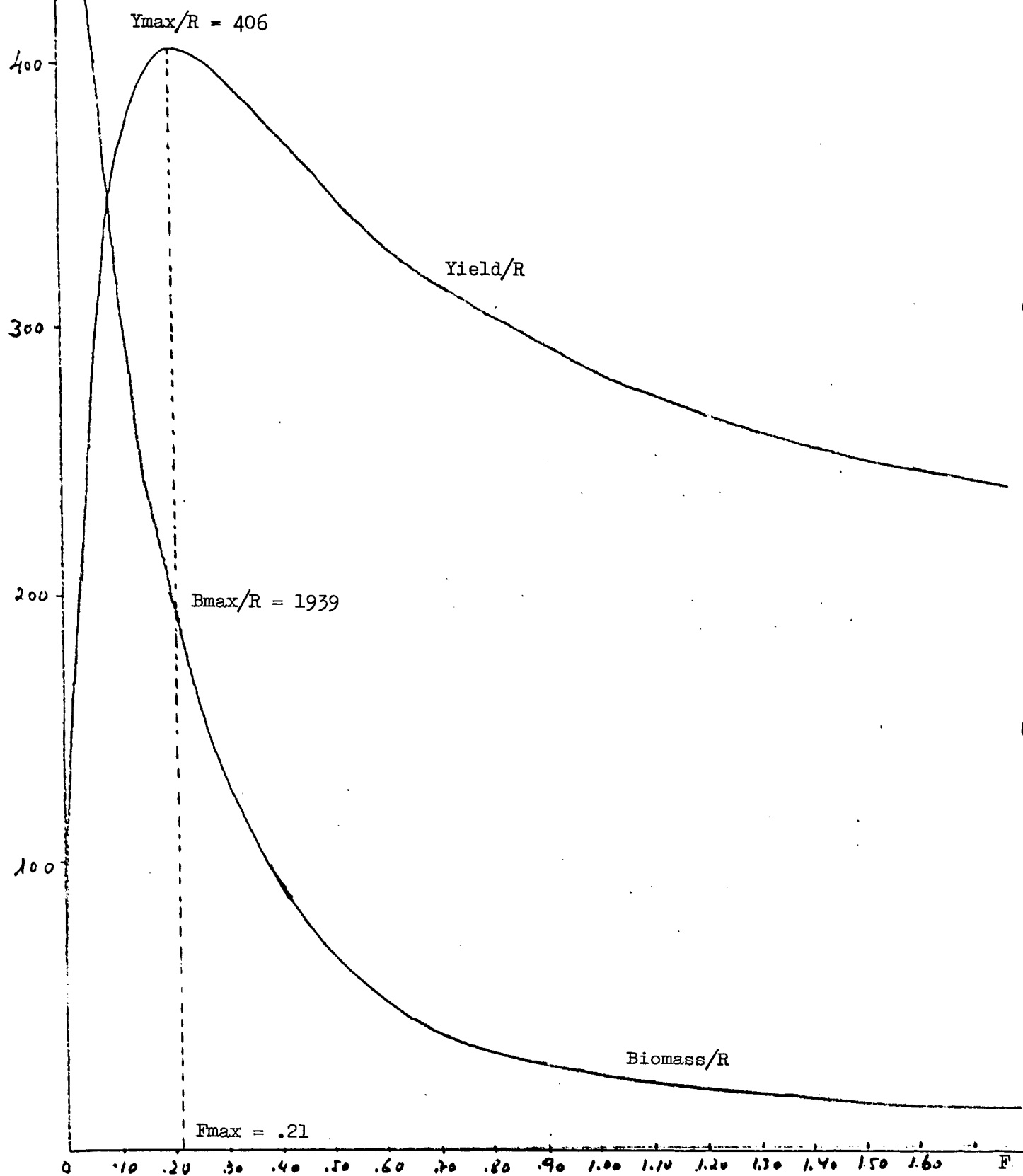Figure 1.7. Yield and average biomasses per recruit curves for 60 mm minimum
mesh size.

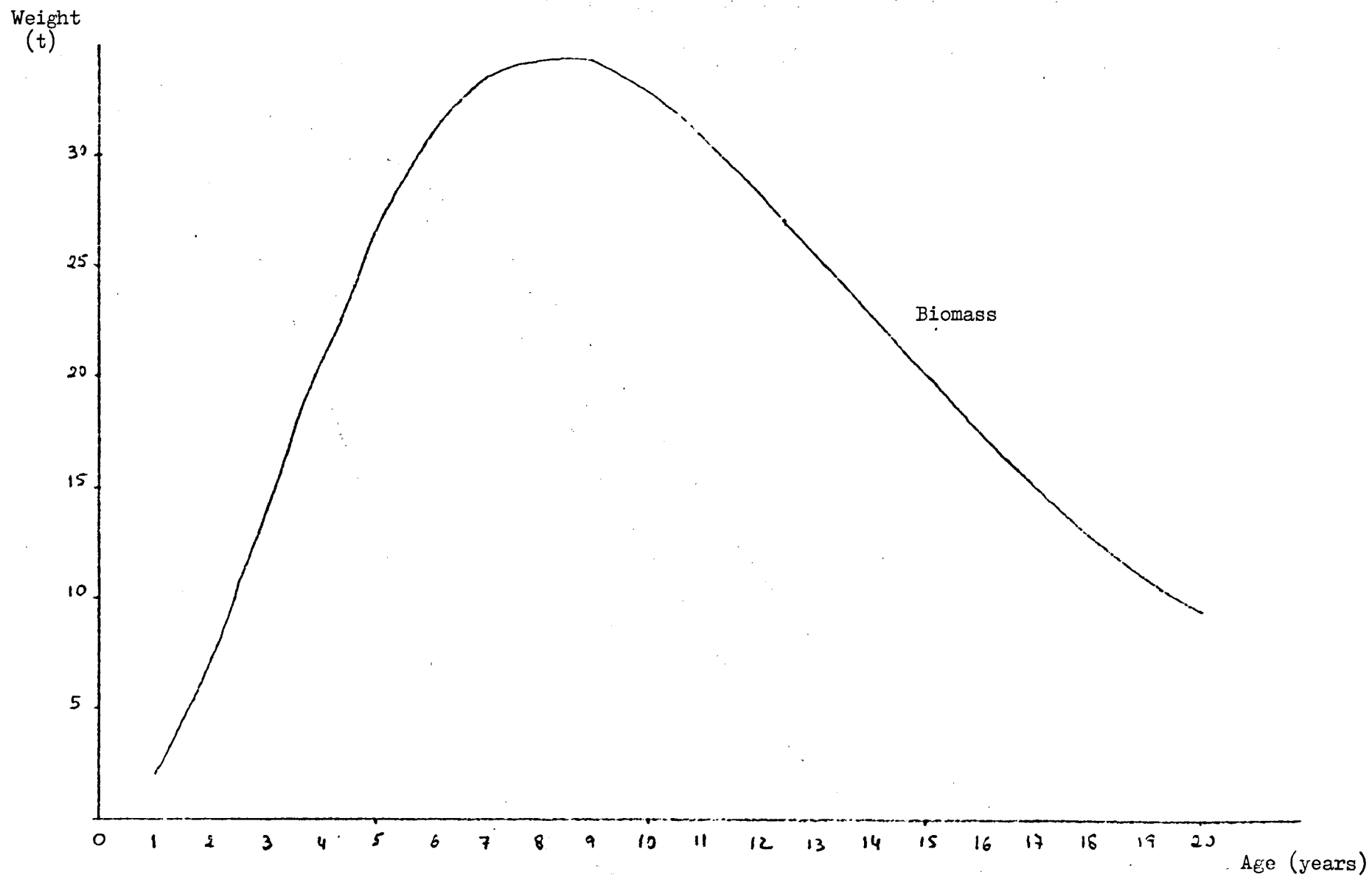Figure 1.8. Yield and average biomass per recruit curves for 80 mm minimum mesh size, plotted against F.

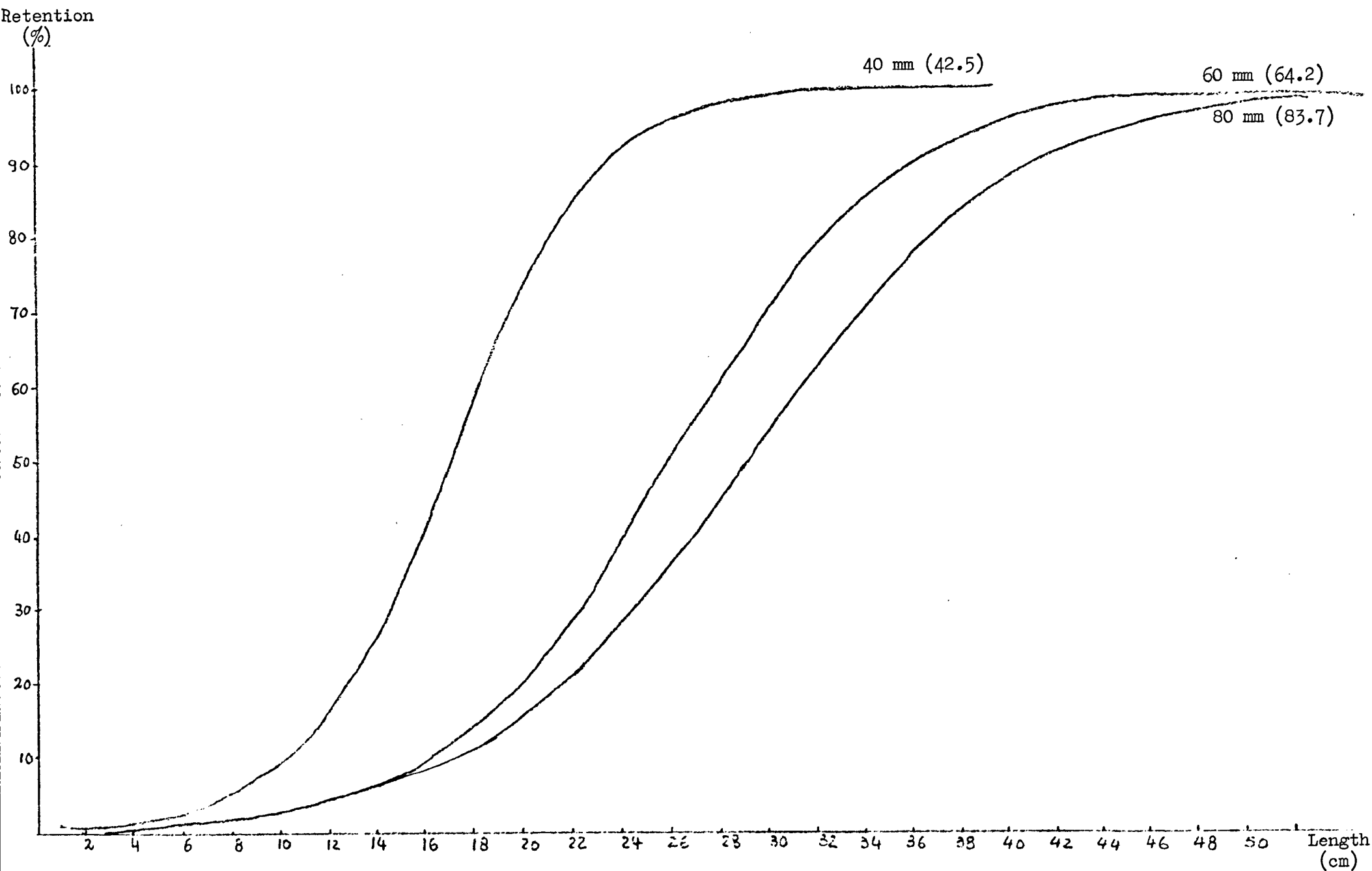Figure 1.9. Weight at age, in absence of fishing of 100 000 recruits at age 0.

Figure 2.1.   Selectivity of <u>Merluccius</u> <u>merluccius</u> L. - fitted logistic retention curves for the different meshes.
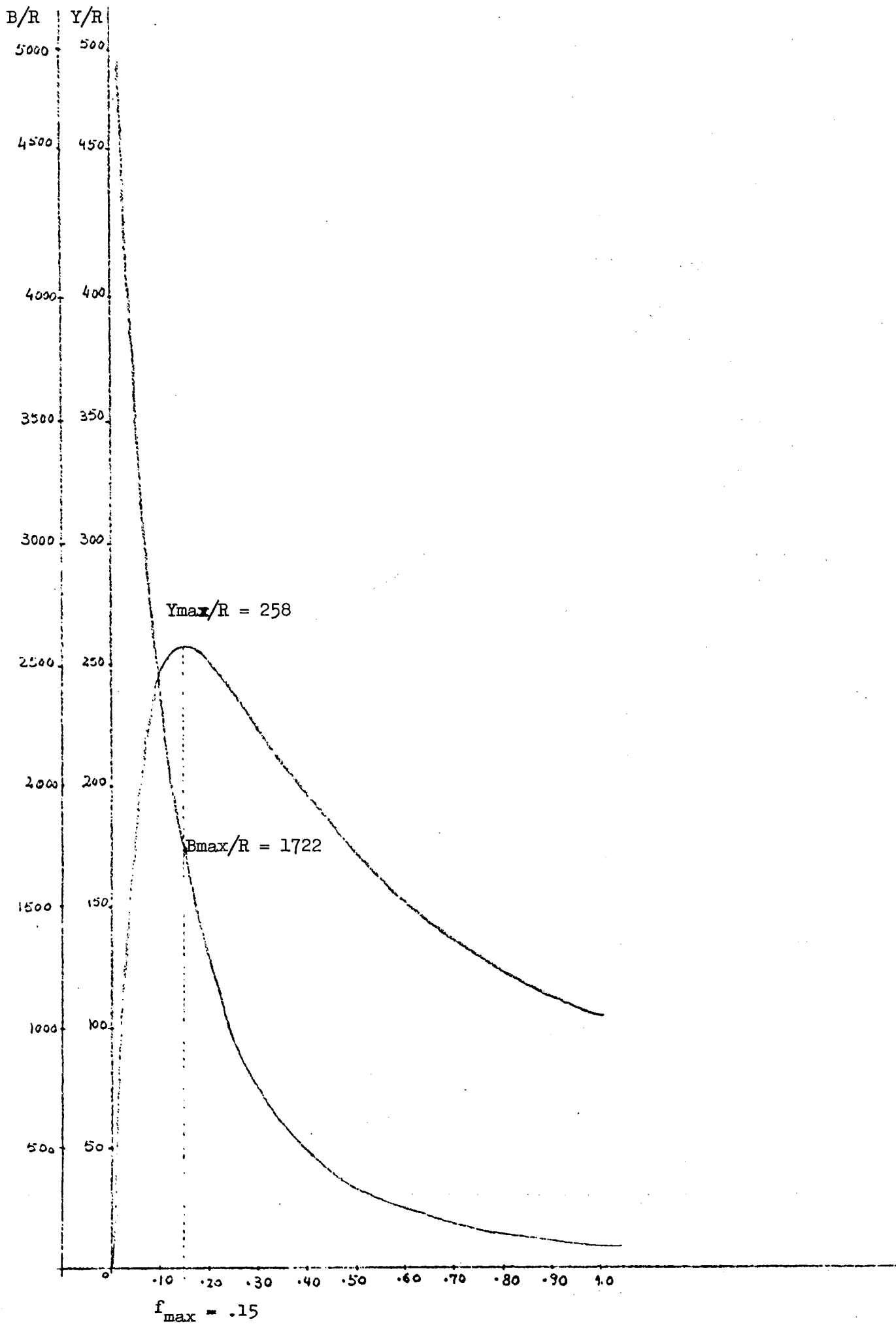
Figure 2.2. Yield and average biomasses per recruit curves for 40 mm minimum mesh size.

B/R Y/R

4500

4000 400

Ymax/R = 364

3500 350

3000 300

2500 250

2000 200

Bmax/R = 1818

1500 150

1000 100

500 50

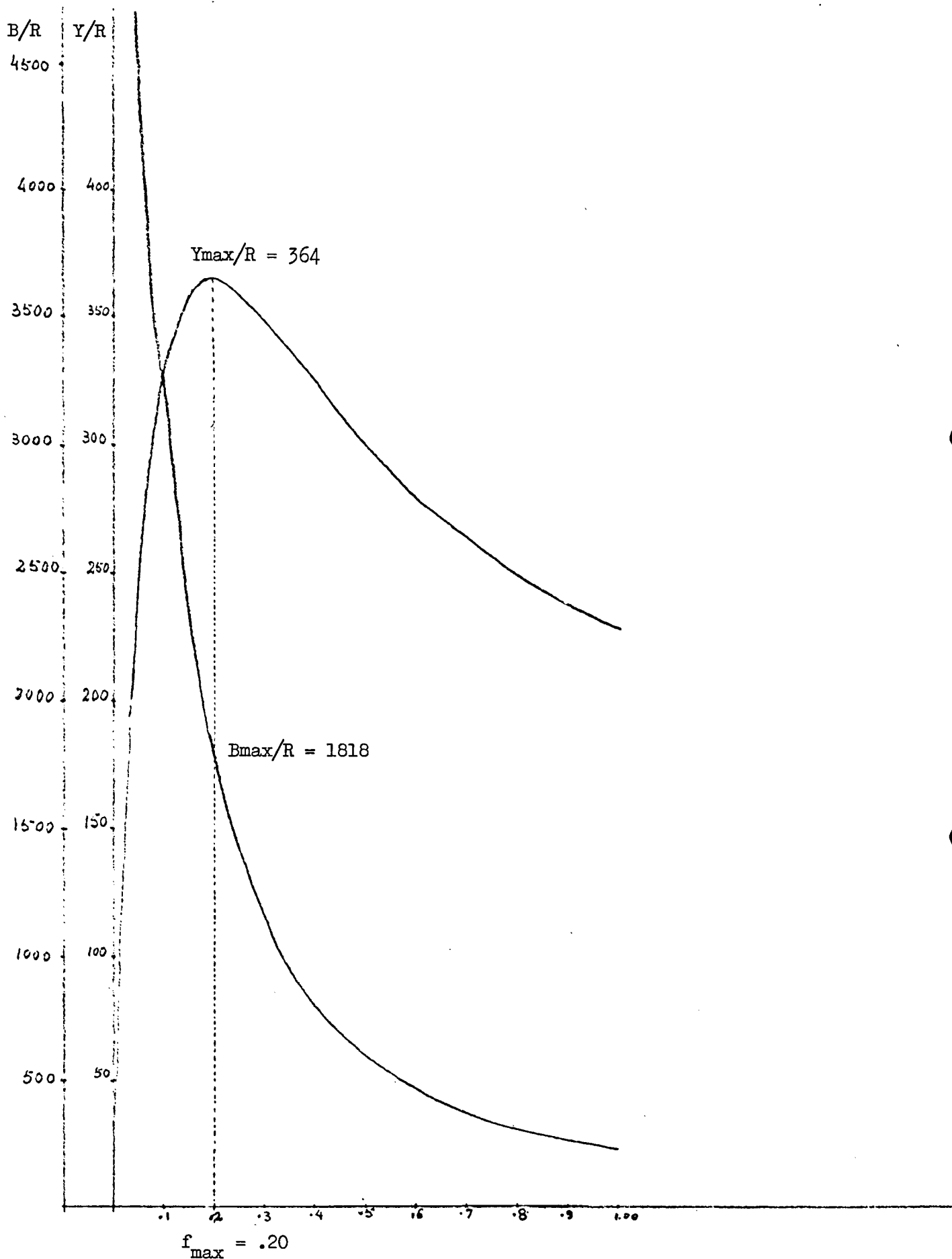.1 .2 .3 .4 .5 .6 .7 .8 .9 1.00

f_{max} = .20

<u>Figure 2.3</u>. Yield and average biomasses per recruit curves for 60 mm minimum mesh size.
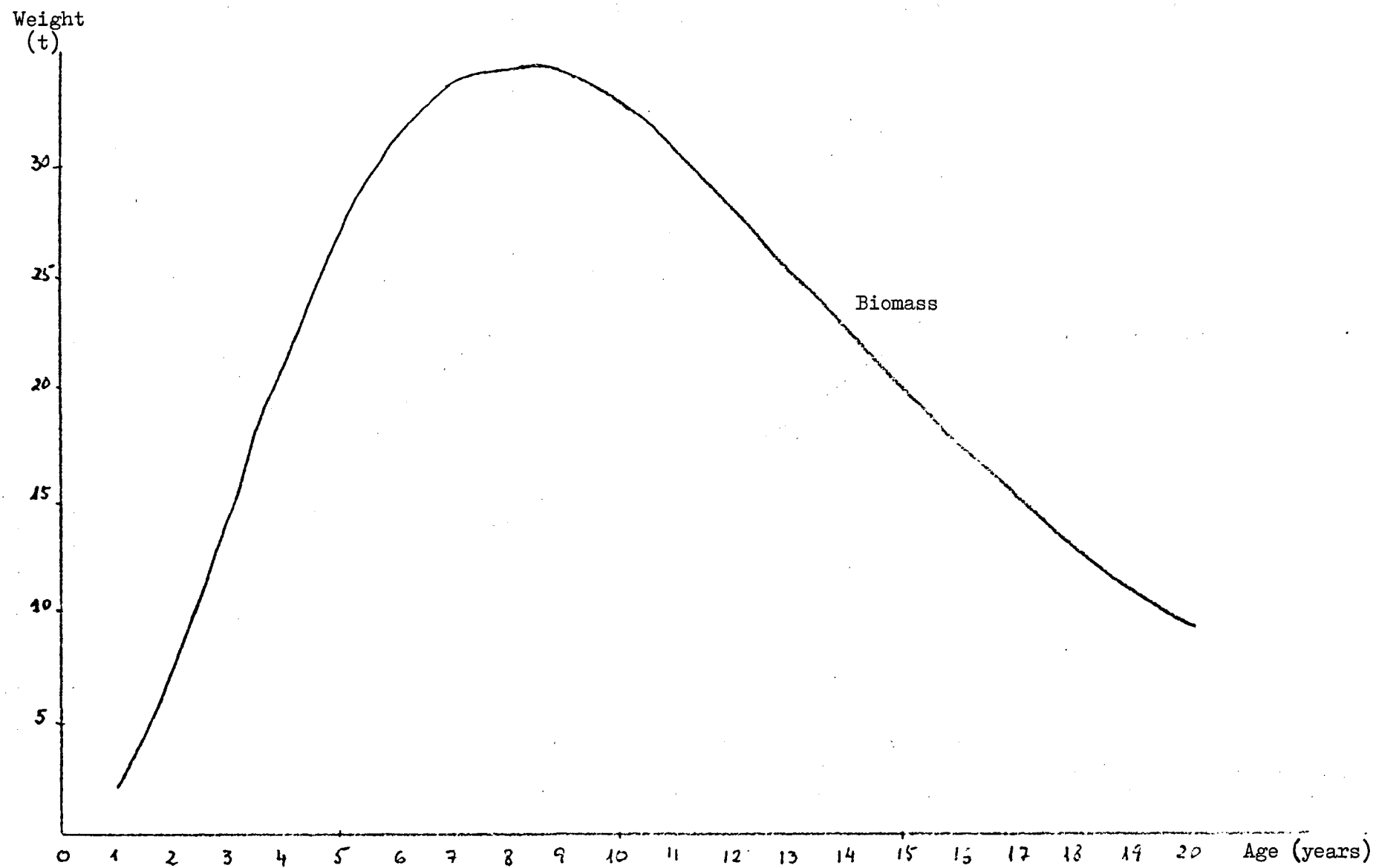
Figure 2.4. Weight at age, in absence of fishing, of 100 000 recruits at age 0.

Figure 2.5. Total catch and c.p.u.e. (Kg/h Portuguese trawlers) against 3 years mean total effort in 10^3 hours of Portuguese trawlers – assumption I, Spanish catches from 1956 to 1970 are 25% of ICES Bulletin Statistique.

Figure 2.6. Total catch and c.p.u.e. (Kg/h Portuguese trawlers) against 3 years mean total effort in 10^3 hours of Portuguese trawlers - assumption II, Spanish catches from 1956 to 1970 are 50% of ICES Bulletin Statistique.

$Y_{max} = 25250$

Ymax

f_{max}

Yield

Catch per effort

⊙78 Observed catch

$\overline{f}$ (3 years) (10^3 hours of Portuguese trawlers)