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Mesh selection of hake, blue whiting, horse-mackerel, megrim, sole and Nephrops in nylon codends on Galicia and Portugal shelf.

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Demersal fisheries in NEAFC Region 3 (Area VIII and Division IX a) show a series of characteristics among which stand out the almost total absence of good statistical data, the scarcety of biological information, the use of small mesh sizes in the codend of trawl nets and the relative importance of a group of species (mixed fisheries) in which any change in mesh size may have different influence.

As far as Subarea VIII c and Division IX a is concerned where the current mesh size is in the order of 40 mm and even less, the necessity of inceasing it considerably is day by day more urgent, since the target species of the fishery, the hake, has shown in the last years signs of possible collapse, following repeated failures in their recruitment (PEREIRO et al.,1980). Trawl fishery in these waters is still profitable because of the continual rise in price, since the catches of the species which are valued highly have been gradually decreasing and the by-catches, above all horse-mackerel and blue whiting, are those that despite their low price contribute to the economic viability of the fishery. Therefore, there is a pressing need for regulation which necessarily must have in mind an increase in the codend mesh size and a control of the fishing effort.

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With the object of the increase of the mesh size over the last years, a set of cruises were undertaken on the Galician and Portuguese shelves, where the selectivity studies were one of the principal objectives.

In this way, RODRIGUEZ et al. (1963-1964) carried out the first experiments using hemp twine, very common at that time, obtaining valid results for hake and blue whiting; MONTEIRO (1966) provides new data for hake with hemp and polyamide material. DARDIGNAC et al. (1967) expand their selectivity experiences on hake from the Bay of Biscay till Lisbon, testing different meshes on double polyamide twines.

VAZQUEZ et al. (1975) and ROBLES et al. (1975) present more data on hake and horse-mackerel referring to polypropilene and polyethelene nets. ALONSO-ALLENDE et al. (1976) and FUERTES et al. (1977) extend their works to other important species of the fishery such as norway lobster, blue whiting, bib and megrim using polyethelene, polyamide and polypropilene twine and carrying out their experiments with commercial vessels of different sizes. Finally ROBLES and PORTEIRO (1978) give new data on blue whiting with polyethelene meshes.

In this paper we collect the selectivity experiments made in 1979 where we got acceptable results on hake, norway lobster, blue whiting, horse-mackerel, megrim and senegalese sole.

METHODOLOGY

The experiments were made on board R/V CORNIDE DE SAAVEDRA stern trawler of 1000 GRT with two engines of 625 HP.

In the surveys "Selectivity 79" and "Selectivity 79 bis" carried out along the Galician coast in April and June respectively, a net of "baka" type was used whose design can be seen in Figure 1; due to tears and damage another net of "bou" type was substituted. Both gears are frequently employed in the fishery although the number of commercial trawlers using the "baka" type is larger than the "bou" type.

In "Cigala 79" survey made in August all along Division IXa a "baka" type net normally used by commercial trawlers was employed (Figure 2) instead of the "baka" type net used previously.

We intended to test nylon codends for 43, 56, 61, 74 and 110 mm. mesh size but we only got acceptable results for 61 and 74 mm., the first during the "Cigala 79" survey and the second grouping all together the valid hauls of the three cruises.

The cover method in polyamide and with 20 mm. mesh size was used and the attachment of the cover to the codend can be seen in Figure 3. In the "Selectivity 79" survey a set of floats was placed along the topside of the cover in order to get a slight increase in its buoyancy.

The measurements were made with an ICES gauge and a strain of 4 Kg. was taken. These measurements were taken over the wet net in two series of 25 each along the two sides of the codend.

Amongst all the fish caught the total lenght was measured to the centimeter below except in Nephrops where we employed the carapace length measured to the millimeter below.

We apply the logistic fit by the standard method and by the technique described by PALOHEIMO & CADIMA (1964) to all the valid hauls (Figures 4 to 10).

In the case of hake and in order to act as a check on the calculated selection factor, a series of 291 lenght-girth measurements were taken. These were collected in the April survey from three samples of fish between the lenghts of 14 and 62 cm. The unconstricted maximum girth was measured by a loop of sinthetic twine.

In all the surveys the copious presence of the swimming crab Polybius henslowii in the majority of the hauls obscured the results to a great extend and many hauls were invalidated and therefore were excluded from this study.

In "Cigala 79" survey hauls with more than 70% in weight of this crustaceous or with more than 1 metric ton of total catch were ignored. Besides, in "Selectivity 79" and "Selectivity 79 bis" cruises few acceptable data were obtained taking into account the scarcity of individuals of nearly all the species, except horse mackerel, and the absence of relation between the length range caught and the mesh size of the codend in question.

In Tables 1 the technical data of the investigations carried out for each species and mesh size are presented.

RESULTS & DISCUSSION.-

In Table 2 it is compared the slope, 50% retention length, selection factor and selection range of the curves obtained by the two methods of fitting and in the figures 5 to 11 the selection curves and the real points for each species and mesh size are represented.

HAKE (Merluccius merluccius) Figure 4

The results obtained with the mesh of 61 mm, which have a good number of individuals in the retention range, give a selection factor of 4.04-4.11 that is equals to the average selection factors described until 1978 for the NE Atlantic stocks of this species with the same mesh size and material and that are cited in the ICES Hake Working Group (Anon., 1979), although their variability be from 3.4 to 5.6, knowing that this fact is quite normal in all the selectivity experiments where plenty of factors can influence the results (see ICES Coop. Res. Rep. Series A Nc 2,1964 and POPE et al.,1975).

The selection factor of 4.69-4.85 found out for 74 mm mesh size must, on the contrary, be taken with some reserve because those values have necessarily been affected by the abundance of the crab Polybius henslowii in the catches (despite extracting from this study the hauls with more than 70% in weight of this crustaceous).

A revision of the selectivity data of the different species of hake published up to now are presented in Table 3.

Girth-length relationship obtained in the April survey fit the equatio

$$\text{Girth} = .44\ \text{Total length} - .93$$

that is in accordance with the bibliography over these parameters refe red to the different species of hake (Table 4).

HORSE-MACKEREL (Trachurus trachurus) Figure 5

Taken into account the swimming capacity of this species one can admit the possibility of some escaping through the fore parts of the codend or even from the belly (MARGETTS, 1963; BEVERTON, 1963), as it has been verified by ourselves, but the reality is that the major part of the selectivity operates in the after part of the codend.

Accepting this, it can be pointed out that the selection factors now attained of 4.30 - 4.38 and 4.55 - 4.59 for 61 and 74 mm. meshes respectively seems to be consistent not only for the high number of individuals caught in codend and cover and in the selection range but also for the homogeinity of the hauls grouped.

From the bibliography revised we have found references for polypropilene in 48 mm. mesh size with a selection factor of 3.8 and polyethelene in 53 and 67 mm. meshes with selection factors of 2.75 and 3.4 respectively (VAZQUEZ et al., 1975, in Galician waters.), that show the greater retention produced by this materials. In polyamide, the results presented by LARRAÑETA et al. (1969) in the Mediterranean Sea, indicate a selection factor of 2.8 for 40 mm. mesh size, which is a value really low for this type of twine; in the case of hake these authors also found out very low selection factors for polyamide; ALONSO-ALLENDE et al. (1976) point out a selection factor of 4.25 for polyamide mesh of 64mm. in Galician waters, very close to our data with the same mesh and material.

BLUE WHITING (Micromesistius poutassou) Figure 6

In figure 7 appears the selection curves obtained fitting the points to a logistic by the standard method and by PALOHEIMO & CADIMA (1964) technique, that is to say, weighting the length classes inversely to their variance. As it can be seen in the figure the differences of both fittings are rather large. The likely explanation can be that the estimation of the variance depends on the number of individuals in the corresponding length

class. When the number of individuals caught in the lower part of the selectivity curve is very high compared with those caught in the higher part, the points of this last part are not practically taken into account in the fitting and the right part of curve is constructed by symmetry with the left part.
The conclusion can be that, in this case, the use of this type of weighting produces distortion and misleading (PEREIRO,J.A. in press). This does not occur in the other experiences presented in figures 5 to 11 because the catches of each length-class in numbers along the range of selection is distributed more homogeneously.
In any case, and according to the available bibliography over this species (Table 5) it seems that our selection factor of 4.84 is in close agreement with the published data that are slightly lower (3.9 and 4.4 for 67 and 48 mm. mesh size by FUERTES et al., 1977, and 4.23 for meshes of 40 mm. by ROBLES & PORTEIRO, 1978) though the fact that these data are referred to polyethelene can explain these differences.

MEGRIMS (Lepidorhombus boscii and Lepidorhombus whiff-iagonis) Figures 7 and 8.

The abundance of these two species, above all the second, is only relative in Galician and Portuguese waters. However, in the fishing grounds of Grand Sole and West coast of Ireland they provide, particularly L. whiff-iagonis, an important fishery for the Spanish fleet working in those waters.
The selection factor found for both species, 2.1 and 2.4 for L. boscii in 61 and 74 mm. mesh size and 2.2 for L. whiff-iagonis in mesh of 61 mm. show enough homogeneity and are in close agreement with the only case encountered in the bibliography, for L. boscii, that is of 2.3 for meshes of 74 mm. in polyethelene (FUERTES et al.,1977).

SENEGALESE SOLE (Solea senegalensis) Figure 9

The data we have are referred to the southern part of Iberian

Peninsula and were gathered during the "Cigala 79" survey in August.

The selection factor for the 74 mm. mesh was 3.3. Although we have not found selectivity data of this species, the value of 3.3 is very close to those published relative to the common sole (GILIS, BOEREMA , MARGETTS, FURNESTIN and ROESSING, in ICES Coop. Res. Rep. Series A No. 2, 1964) that oscillate between 3.2 and 3.6 for 70-80 mm. mesh size and with different materials and it is not far from the values of 3.6-3.7 found by GUICHET (1979) also for the common sole.

NORWAY LOBSTER (Nephrops norvegicus) Figure 10

The value we have got of .49- .48 for 61 mm. mesh size corresponds very well with the majority cited in the bibliography. Thus, CHARUAU (1979) in different experiences arrives at figures of .44 for meshes of 51.5 mm.; this author finds variations with the weight of the accomplished total catch. Therefore a considered normal catch (70 K_g.) gives a selection factor of .5. Former experiences by the same author (1977,1978) and by ABBES & WARLUZEL (1970) always provide figures comprising between .46 and .54. Scottish experiments calculate values between .47 and .55 as well and ERIKSSONS in Iceland reach results between .49 and .52.

For meshes of 74 mm. we get selection factors of .68 - .66 that coincides exactly with CHARUAU's value of .67 for 73.7 mm. mesh size. Nevertheless our results must be taken with caution given the absence of points above the 50% retention length despite the good fitting and the great number of individuals below the said central point.

The increase in the slope of the selectivity curve with the mesh size that we find out is also quantified by CHARUAU (1979) and our data fit rather well with the proportionality equation developped by him.

CONCLUSIONS

As far as the authors or this papers are members of the Hake Working Group of ICES where it has been proposed the increase of the mesh size till 80 mm. as a measure to intend to improve the european hake stocks, measurealso adopted by the ACFM for all the Region 3 of NEAFC (ACFM Report 1979), it seems adecuate to give somefirst indications over the incidence of the possible enforcementof this mesh size over the other important species of the fishery in Subarea VIIIc and Division IXa, in spite of the lack of data that are in a certain extent function of the current exploitation pattern of the different species and admitting that the nylon nowadays is the most utilized material by the fishing fleet.

Therefore, from the results obtained in this paper and from the consulted bibliogrphy is deduced the following:

Hake.- The current state of the european hake stocks, with tremendous percentages of individuals smaller than 3 years caught, with estimates of 75% in numbers of the total fish being undersize and having to be discarded and with indications of recruitment overfishing in the Southern stock (Subarea VIIIc+Division IXa) have made the ICES Hake Working Group to recommended in 1979 and to insist in 1980 in the necessity of increasing up to 80 mm. the mesh size in the codend of the trawl nets, taking also into account that the changes in effort and mesh size analyses carried out indicate better long-term gains with greater meshes.

On the other hand, the virgin biomass per recruit curves give the highest values for ages comprised between 7 and 9 years (7.6 years for males and 8.9 years for females), which also indicates the need to defer as much as possible the age at first capture which actually is between 1 and 2 years old.

Horse-Mackerel.- The mode of the trawl catches of this species is clearly located above 34 cm., between 32 and 35 in the data of this study, noting that these sizes correspond to the adult part of the stock because juvenile fish are normally available to the purse-seine fishery.

A possible mesh change up to 80 mm., with a selection factor of 4.5 would lead to a length of first capture of 36 cm. only slightly higher to the above mentioned mode. Thus, in the species and even from a commercial point of view the mesh of 80 mm. would not be very perjudicial as far as inmediate capture is concerned.

Blue- Whiting.- This species, fished only with bottom trwling in this area, present the mode of the catches between 18 and 20 cm. and, on the other hand, its Linf. is not far above from 40cm. The 80 mm. mesh size, with a likely selection factor of 4.8 would implicate a 50% retention length of 38 cm. rarely reached in the commercial landings; therefore, in this case, the 80 mm.mesh size would suppose the nearly impossibility of catching the species. We want to point out that, in reality, the almost 30.000 metric tons anually landed are essencially composed by inmature fish. It is clear that the spawning concentrations of this species, evaluated in several millions tonnes (see ICES Blue Whiting Working Group, 1979,1980), have only been located up to now in Porcupine Bank and they are caught with pelagic trawling in mid-water over 300-500 meters depth.

Every year juvenile fish from 14 to 18 cm. are recruited to the Galician fishery in the Autumm-Winter period. The adult stock to which these fish recruit is not known. In any case, it seems clear that the future of this fishery would be in the fishing with pelagic trawl that, appropiately regulated, it would not have to coincide with bottom trawling.

Megrim.- The scarce data we have available are referred to Lepidorhombus boscii because L. whiff-iagonis is much more rare in these waters.

The modal distributions of the catches are between 13-15 cm. and 20-22 cm. in this study, with a selection factor of 2.3, the length at first capture for 80 mm. mesh size would be over 18 cm which would indicate little influence in the inmediate capture of the species. The increase in mesh size seems that, it would be very beneficial, taking into account the actual structure of the stock.

Senegalese-Sole.- Even thought it only appears in the southern limit of the fishery, with the few data we dispose one can say only that, with a selection factor of 3.3 the mesh of 80 mm. would lead to a 50% retention length of 26 cm. which seems to be in a length range usually fished and so, this increase does not likely imply inmediate losses.

Norway-Lobster.- The 50% retention carapace length with 74 mmm. mesh size, approximately 50 mm., corresponds to the biggest individuals caught in this zone. The carapace length at first capture concerning 60 mm. mesh size of 30 mm. seems to be appropriate for these Nephrops fisheries with the present structure , although thought it presents the problem of being smaller mesh size than the recommended of 80 mm.. This question could perhaps be solved restricting the mesh of 60 mm., as a first step,to the localized main areas, where Nephrops lives given the sedentary, territorial and subterranean habits of the species and controlling strictly the by-catch of the Nephrops trawlers.

Then, as a colophon of this concise review over the possible effects that the mesh size increase up to 80 mm. would produce in the most important species of the atlanto-iberian shelf demersal fisheries, we could say that being evident the clear benefits of the measure as a whole, neither, even under an overall strictly point of view can the measure be considered as prejudicial,at least in the period close to the mesh increasing, since only the Nephrops and Blue Whiting catches will be clear affected. Both species,however, could be regulated apart because the Blue Whiting is able to be fished with pelagic trawl, possibly with better yields whereas Nephrops, being their more important concentrations, the most of the times clearly defined, could have, a special regulation.

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TABLE 1.- Selectivity data for grouped hauls

1.1 HAKE (61 mm)

Material	Single polyamide
No. of hauls	23
Average duration of tow (minutes)	60
Average towing speed (nautical miles)	2.5
Average depth (meters)	186
Codend mesh opening, mean (mm)	60.79
Range	53 - 68
No. of measurements	150
Selection range (cm)	20.7 - 28.5
No. of individuals in selection range	651
Codend	305
Cover	346
Total number caught	4189
Codend	1348
Cover	2841
Average weight per haul (kgs)	15.4
Codend	11.5
Cover	3.9
Average weight of total catch per haul (kgs)	472
Codend	209
Cover	263
Range of total catch per haul (kgs)	
Codend	36 - 483
Cover	5 - 652
50% retention length (cm)	24.6 - 25.1
Selection factor	4.04 - 4.11

TABLE 1.- Selectivity data for grouped hauls

1.2 HAKE (74 mm)

Material	Single polyamide
No. of hauls	12
Average duration of tow (minutes)	77
Average towing speed (nautical miles)	2.5
Average depth (meters)	262
Codend mesh opening, mean (mm)	73.92
Range	63 - 86
No. of measurements	311
Selection range (cm)	28.2 - 43.6
No. of individuals in selection range	499
Codend	220
Cover	279
Total number caught	1448
Codend	333
Cover	1115
Average weight per haul (kgs)	17.9
Codend	9.1
Cover	8.8
Average weight of total catch per haul (kgs)	536
Codend	221
Cover	315
Range of total catch per haul (kgs)	
Codend	8 - 530
Cover	25 - 828
50% retention length (cm)	34.7 - 35.9
Selection factor	4.69 - 4.85

TABLE 1.- Selectivity data for grouped hauls

1.3 HORSE-MACKEREL (61 mm)

Material	Single polyamide
No. of hauls	18
Average duration of tow (minutes)	60
Average towing speed (nautical miles)	2.5
Average depth (meters)	116
Codend mesh opening, mean (mm)	60.79
Range	53 - 68
No. of measurements	150
Selection range (cm)	23.6 - 28.8
No. of individuals in selection range	221
Codend	49
Cover	172
Total number caught	2371
Codend	653
Cover	1718
Average weight per haul (kgs)	15.0
Codend	9.6
Cover	5.4
Average weight of total catch per haul (kgs)	524
Codend	230
Cover	294
Range of total catch per haul (kgs)	
Codend	36 - 364
Cover	71 - 576
50% retention length (cm)	26.2 - 26.7
Selection factor	4.30 - 4.38

TABLE 1.- Selectivity data for grouped hauls

1.4 HORSE-MACKEREL (74 mm)

Material	Single polyamide
No. of hauls	15
Average duration of tow (minutes)	114
Average towing speed (nautical miles)	2.5
Average depth (meters)	182
Codend mesh opening, mean (mm)	73.92
Range	63 - 86
No. of measurements	311
Selection range (cm)	31.0 - 36.6
No. of individuals in selection range	2685
Codend	1346
Cover	1339
Total number caught	5967
Codend	2069
Cover	3898
Average weight per haul (kgs)	96.6
Codend	55
Cover	41.6
Average weight of total catch per haul (kgs)	672
Codend	268
Cover	404
Range of total catch per haul (kgs)	
Codend	57 - 714
Cover	154 - 828
50% retention length (cm)	33.7 - 34.0
Selection factor	4.55 - 4.59

TABLE 1.- Selectivity data for grouped hauls

1.5 BLUE WHITING (61 mm)

Material	Single polyamide
No. of hauls	17
Average duration of tow (minutes)	60
Average towing speed (nautical miles)	2.5
Average depth (meters)	225
Codend mesh opening, mean (mm)	60.79
Range	53 - 68
No. of measurements	150
Selection range (cm)	25.7 - 33.3
No. of individuals in selection range	348
Codend	145
Cover	203
Total number caught	60802
Codend	3714
Cover	57088
Average weight per haul (kgs)	109.4
Codend	7.6
Cover	101.8
Average weight of total catch per haul (kgs)	452
Codend	194
Cover	258
Range of total catch per haul (kgs)	
Codend	45 - 364
Cover	5 - 576
50% retention length (cm)	29.5 - 31.1
Selection factor	4.84 - 5.10

TABLE 1.- Selectivity data for grouped hauls

1.6 MEGRIM (61 mm) (L. boscii)

Material	Single polyamide
No. of hauls	14
Average duration of tow (minutes)	60
Average towing speed (nautical miles)	2.5
Average depth (meters)	225
Codend mesh opening, mean (mm)	60.79
Range	53 - 68
No. of measurements	150
Selection range (cm)	9.5 - 14.3
No. of individuals in selection range	775
Codend	406
Cover	369
Total number caught	2066
Codend	1632
Cover	434
Average weight per haul (kgs)	3.5
Codend	2.9
Cover	.6
Average weight of total catch per haul (kgs)	520
Codend	219
Cover	301
Range of total catch per haul (kgs)	
Codend	36 - 483
Cover	5 - 652
50% retention length (cm)	11.9 - 12.9
Selection factor	1.95 - 2.11

TABLE 1.- Selectivity data for grouped hauls

1.7 MEGRIM (L. boscii) (74 mm)

Material	Single polyamide
No. of hauls	2
Average duration of tow (minutes)	60
Average towing speed (nautical miles)	2.5
Average depth (meters)	192
Codend mesh opening, mean (mm)	73.92
Range	63 - 86
No. of measurements	311
Selection range (cm)	13.8 - 22.1
No. of individuals in selection range	179
Codend	115
Cover	64
Total number caught	406
Codend	230
Cover	176
Average weight per haul (kgs)	13.9
Codend	11.8
Cover	2.1
Average weight of total catch per haul (kgs)	1011
Codend	558
Cover	453
Range of total catch per haul (kgs)	
Codend	102 - 1013
Cover	230 - 675
50% retention length (cm)	17.0 - 18.0
Selection factor	2.29 - 2.43

TABLE 1.- Selectivity data for grouped hauls

1.8 MEGRIM (L. wiff-iagonis) (61 mm)

Material	Single polyamide
No. of hauls	11
Average duration of tow (minutes)	60
Average towing speed (nautical miles)	2.5
Average depth (meters)	231
Codend mesh opening, mean (mm)	60.79
Range	53 - 68
No. of measurements	150
Selection range (cm)	10.3 - 17.2
No. of individuals in selection range	332
Codend	179
Cover	153
Total number caught	618
Codend	462
Cover	156
Average weight per haul (kgs)	1.5
Codend	1.2
Cover	.3
Average weight of total catch per haul (kgs)	493
Codend	248
Cover	345
Range of total catch per haul (kgs)	
Codend	36 - 364
Cover	5 - 576
50% retention length (cm)	13.8 - 13.7
Selection factor	2.26 - 2.25

TABLE 1.- Selectivity data for grouped hauls

1.9 NORWAY LOBSTER (64 mm)

Material	Single polyamide
No. of hauls	11
Average duration of tow (minutes)	60
Average towing speed (nautical miles)	2.5
Average depth (meters)	269
Codend mesh opening, mean (mm)	60.79
Range	53 - 68
No, of measurements	150
Selection range (mm)	22.6 - 37.3
No. of individuals in selection range	3350
Codend	1817
Cover	1533
Total number caught	4382
Codend	2701
Cover	1681
Average weight per haul (kgs)	9.8
Codend	6.9
Cover	2.9
Average weight of total catch per haul (kgs)	306
Codend	139
Cover	167
Range of total catch per haul (kgs)	
Codend	36 - 364
Cover	5 - 362
50% retention length (mm)	30.0 - 29.5
Selection factor	.49 - .48

TABLE 1.- Selectivity data for grouped hauls

1.10 NORWAY LOBSTER (74 mm)

Material	Single polyamide
No. of hauls	9
Average duration of tow (minutes)	73
Average towing speed (nautical miles)	2.5
Average depth (meters)	350
Codend mesh opening, mean (mm)	73.92
Range	63 - 86
No. of measurements	311
Selection range (mm)	34.7 - 63.5
No. of individuals in selection range	2702
Codend	867
Cover	1835
Total number caught	8914
Codend	2023
Cover	6891
Average weight per haul (kgs)	20.5
Codend	5.5
Cover	15.0
Average weight of total catch per haul (kgs)	267
Codend	93
Cover	174
Range of total catch per haul (kgs)	
Codend	8 - 530
Cover	29 - 772
50% retention length (mm)	50.4 - 49.1
Selection factor	.68 - .66

TABLE 1.- Selectivity data for grouped hauls

1.11 SENEGALESE SOLE (74 mm)

Material	Single polyamide
No. of hauls	4
Average duration of tow (minutes)	60
Average towing speed (nautical miles)	2.5
Average depth (meters)	172
Codend mesh opening, mean (mm)	73.92
Range	63 - 86
No. of measurements	311
Selection range (cm)	20.9 - 26.4
No. of individuals in selection range	299
Codend	130
Cover	169
Total number caught	386
Codend	192
Cover	194
Average weight per haul (kgs)	12.9
Codend	9.4
Cover	3.5
Average weight of total catch per haul (kgs)	575
Codend	237
Cover	338
Range of total catch per haul (kgs)	
Codend	30 - 530
Cover	44 - 777
50% retention length (cm)	23.6 - 24.2
Selection factor	3.19 - 3.27

	b (slope)		l_{50} (cm)		S.F.		Δ_{25-75}	
	Standard	Pal & Cad.	Standard	Pal.& Card.	Standard	Pal.& Cad.	Standard	Pal.& Cad.
Hake 61 mm	0.28	0.25	24.6	25.1	4.04	4.11	7.8	8.7
Hake 74 mm	0.16	0.14	34.7	35.9	4.69	4.85	13.5	15.4
Nephrops 61 mm	0.15	0.13	30.0 mm	29.6 mm	0.49	0.48	14.7	17.2
Nephrops 74 mm	0.09	0.08	50.4 mm	49.1 mm	0.68	0.66	25.7	28.8
Blue Whiting 61 mm	0.29	0.19	29.5	31.1	4.84	5.10	7.6	11.4
Horse Mackerel 61 mm	0.42	0.35	26.2	26.7	4.30	4.38	5.6	6.3
Horse Mackerel 74 mm	0.40	0.41	33.7	34.0	4.55	4.59	5.4	5.3
Megrims L.boscii 61 mm	0.45	0.43	11.9	12.9	1.95	2.11	4.8	5.2
Megrims L.boscii 74 mm	0.32	0.26	17.0	18.0	2.29	2.43	6.8	8.3
Megrims L.wiffiagonis 61 mm	0.32	0.18	13.8	13.7	2.26	2.25	6.9	12.2
Solea senegalensis 74 mm	0.40	0.39	23.6	24.2	3.19	3.27	5.5	5.6

Table 2.- Slope, l_{50}, selection factor and selection range results obtained with standard and Paloheimo and Cadima (1.964), logistic fit for 61 and 74 mm mesh size.

TABLA III

Summary of selectivity data for European hake (Merluccius merluccius)

Author	Area	Experimental method	Gauge Press (Kg)	Cod end		50% retention lenght (cm)	Selectio Factor
				Material	Average mesh open (mm.)		
Ancellin 1956	Biscay (off Belle-Ile)	Full cover	?	Single hemp	53.6	20.5	3.8
	Celtic Sea	"	"	"	72.4	31.7	4.4
	"	"	"	Double polyamide	78.7	39.5	5.0
	"	"	"	Single polyamide	59.4	32.0	5.4
	"	"	"	Double manila	76.0	34.0	4.5
Dardignac, Hédé-	Biscay(46º30'N:110m)	"	"	Double polyamide	62.8	29.1	4.6
Hauy & Portier	"	Alternate hauls	4 Kg	"	62.8	28.9	4.6
1968	"	Trouser cod-end	"	"	62.8	35.0	5.6
Dardignac et al.	Biscay(46º30'N:140m)	Topside cover	4 Kg	Double polyamide	63.4	21.9	3.5
1968	"	"	"	"	84.4	30.6	3.6
	"	"	"	"	102.2	39.3	3.8
	Biscay(46º37'N:105m)	"	"	"	62.2	21.3	3.4
	"	"	"	"	83.8	35.0	4.2
	"	"	"	"	100.6	39.3	3.9
	Biscay (off Port Estaca)	"	"	"	83.4	28.9	3.5
	"	"	"	"	99.2	38.8	3.9
	Portuguese coast(off Berlingues)	"	"	"	84.1	26.9	3.2
	"	"	"	"	99.5	35.9	3.6
	"	Alternate hauls	"	"	99.5	48.8	4.9

TABLA III

Author	Area	Experimental method	Gauge Press (Kg)	Cod end		50% retention lenght (cm)	Selection Factor
				Material	Average mesh open (mm.)		
Davis	Celtic Sea (?)	Topside cover	?	Double sisal	~64	20.2	~3.2
1934	"	"	"	"	~88	28.1	~3.2
Gulland	"	"	7 lb	"	77	29.7	3.86
1956	"	"	"	"	70	26.1	3.78
	"	Alternate hauls	"	"	77	30.6	3.97
Letaconnaux	Biscay (off Ile de Ré)	"	?	Single hemp	~60	27	~4.5
1955	"	"	"	"	~70	35	~5.0
	"	"	"	"	~80	42	~5.3
Dardignac and	Biscay	Full cover	4 Kg	Double polyamide	66.9	26.6	3.9
Verddhan 1978	"	"	"	"	66.4	26.9	4.0
Brabant and	"	"	"	Single polyamide	42.5	15.0	3.3
Guillou 1976	"	"	"	"	42.5	18.5	4.4
Belvèze H.	Moroccan Atlantic Coast. Off Casablanca	Alternate hauls	4 kg	Double polyester	47	14.5	3.1
	"	"	"	Single polyamide	68	29.5	4.3
Monteiro	Portuguese coast	Full cover	4.95Kg	Double manila	43.8	18.4	4.2
1966	(between Cape Rosso & C. Espichel)	"	"	Single polyamide	63.4	22.8	3.6
		"	"	"	55.3	19.8	3.6
Rddriguez et al.	Spanish Coast(off Vigo)	Cover	?	Single manila	~40	16.5	~4.1
1963 & 1964	Biscay (off San Sebastian)	Alternate hauls	"	"	~60	22.5	~3.8

TABLA III

Author	Area	Experimental method	Gauge Press (Kg)	Cod end		50% retention lenght (cm)	Selection Factor
				Material	Average mesh open (mm.)		
Vazquez et al. 1975	Spanish coast (off Vigo)	Full cover	5 Kg	Single poyethelene	53	12.8	2.42
	"	"	"	"	67	17.7	2.64
	"	"	"	"	74	24.2	3.27
	"	"	"	Polypropylene	48	16.6	3.46
Robles et al. 1975	"	"	4 Kg	Single polyethelene	40	13.6	3.4
	"	"	"	Double polyethelene	46	5.0	3.27
Lozano et al. 1968	Spanish coast (off Santander)	"	"	Single polyamide	~80	32	~4.0
	"	"	"	"	~60	22	~3.7
Larrañeta et al. 1969	Spanish coast (off Valencia-Mediterranean Sea)	"	1.5Kg	Single manila	38-52	12.6-18.4	3.26
		"	"	Single polyethelene	42-52	11.2-15.2	2.76
	"	"	"	Single polyamide	34-52	11.1-16.7	2.80
Vives et al. 1966	Spanish coast (off Tarragona-Mediterranean Sea)	"	1.5Kg	Single manila	34	10	2.94
		"	"	"	40	16.5	4.1
		"	"	"	60	22.5	3.75

TABLA III.

SUMMARY OF SELECTIVITY DATA FOR SILVER HAKE (Merluccius bilinearis)

Author	Area	Experimental method	Gauge press.	Cod end material	Cod end average mesh open. (mm)	50% retention length (cm)	Selection factor
Clark & Jensen 1953	Off Cape Cod	Topside cover	12-15 lb	Single manila	94	28.4	3.0
	"	"	"	"	64	16.7	2.6
	"	"	"	Double "	115	39.7	3.4
	"	"	"	Single polyamide	103	39.1	3.8
	"	"	"	"	103	38.6	3.7
	"	"	"	"	85	29.8	3.5
	"	"	"	"	82	27.7	3.4
	"	"	"	"	64	17.5	3.2
	"	"	"	Single cotton	96	32.4	3.4
	"	"	"	"	73	19.9	2.7
	"	"	"	"	60	19.4	3.2
Jensen & Hennemuth 1963	Gulf of Maine	"	4.4 kg	Single polyamide	34	15.8	3.2
	"	Alternate hauls	"	"	52	26.4	5.08
	"	"	"	"	73	30.4	4.16
	"	"	"	"	71	31.8	4.27
	"	"	"	"	71	29.3	4.13
Mari 1978	Scotiam Shelf	Full cover	5 kg	Single polyamide (Kapron)	40	18.1	4.5
	"	"	"	"	66	19.0	3.2
	"	"	"	"	90	27.7	3.0
Clay 1979	Off Nova Scotia	Top.side cover	4 kg.	Single polyamide (kapron)	40	17.5	4.4
	"	"	"	"	66	21.6	3.6
	"	"	"	"	90	26.0	2.9
	"	"	"	"	60	22.5	3.8
	"	"	"	"	70	20.5	2.9
	"	"	"	"	124	41.1	3.4

TABLA III

SUMMARY OF SELECTIVITY DATA FOR SOUTHAFRICAN HAKES (*Merluccius m. capensis* and *Merluccius m. paradoxus*)

Author	Area	Experimental method	Gauge press.	Cod end material	Cod end average mesh open. (mm)	50% retention length (cm)	Selection factor
SOUTH AFRICAN HAKE (*Merluccius m. capensis*, *Merluccius m. paradoxus*)							
Bohl et al. 1971	West coast of Southern Africa	Topside cover	4.0 kg	Double polyamide	111	41.2	3.70
	"	"	"	"	125	48.3	3.86
	"	"	"	"	117	36.9	3.15
	"	"	"	"	129	53.9	4.18
	"	"	"	"	117	39.5	3.36

TABLA III : SUMMARY OF SELECTIVITY DATA FOR CHILEAN HAKE (Merluccius m. gayi).

Author	Area	Experimental method	Gauge press.	Cod end material	Cod end average mesh open. (mm)	50% retention length (cm)	Selection factor
Saetersdal & Villegas 1968 - Chilean hake	Golfo de Arauco	Alternate hauls	4 kg	Single polyester	97	37	3.8
	"	"	"	"	97	40	4.1
	"	"	"	"	97	39	4.0
	Off Lebu	"	"	"	97	42	4.3
	Off Valparaiso	"	"	"	96	37	3.9
	Golfo de Arauco	"	"	"	96	39.5	4.1
	Near Isla Mocha	"	"	Double polyester	68	27	4.0
	"						
Arana 1970	Off Valparaiso	Alternate hauls	4 kg	Single polyamide	80	22.9	4.15
	"	"	"	"	80	22.4	2.85
	"	"	"	"	60	23	3.93
	"	"	"	"	60	23	3.93
	"	Full cover	"	"	80	32.5	4.10
	"	"	"	"	80	32	4.04
	"	"	"	"	80	32	4.04
	"	"	"	"	80	31	3.91
	"	"	"	"	80	34	4.29
	"	"	"	"	80	33	4.16
	"	"	"	"	80	28	3.55
	"	"	"	"	80	33.5	4.23

Table 4.- Comparison of length-girth relationship for european hake, silver hake , Cape hake (modified after Bohl et al.,1971) and Chilean hake.

Species and author	Relationship
European hake	
(Gulland,1956)	G = .47 (TL cm) - 1.10
Present study	G = .44 (TL cm) - .93
Silver hake	
(Hennemuth,1964)	G = .44 (FL cm) - .31
(Clay,1979)	G = .48 (TL cm) - 1.99
Cape hake	
(Bohl et al.,1971)	
Cape Grounds	G = .49 (TL cm) - 2.44
Luderitz Grouns	G = .46 (TL cm) - 1.45
Chilean hake	
(Arana,1970)	G = .43 (TL cm) + 1.38

G= girth TL= Total length FL= Fork length

Table-5

Summary of selectivity data for blue whiting

Author	Area	Experimental method	Gauge Press (Kg)	Cod end		50% retention lenght (cm)	Selection Factor
				Material	Average mesh open (mm.)		
Rodriguez et al. (1962)	Galicia	Full cover	?	Single manila	40	16.7	4.2
"	"	"	?	"	60	26.6	4.4
Rodriguez et al. (1963)	Bay of Biscay	Alternate hauls	?	"	50	19.9	4.0
Larrañeta et al. (1969)	Mediterranean coast (Spain)	Full cover	1.5	"	38	17.9	4.71
Fuertes et al. (1977)	Galicia	"	5	Single polyethelene	67	26.1	3.90
"	"	"	"	"	48	21.1	4.40
Robles & Porteiro (1978)	"	"	4	"	40	17.2	4.23
Present paper	Galicia and Portugal	"	"	Single polyamide	61	31.1 (27.7) 29.5	5.1 (4.5) ? 4.84

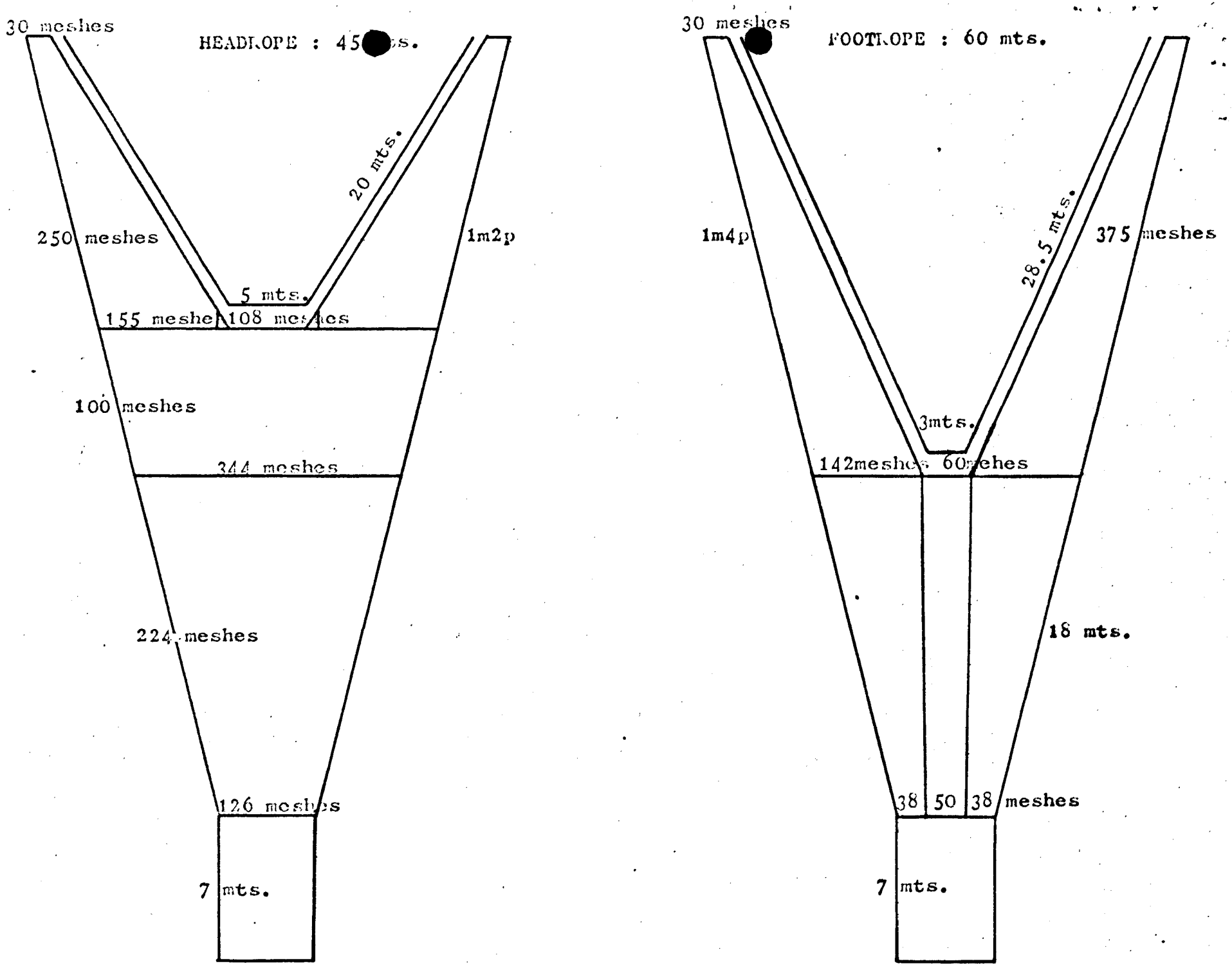


Figure 1 .- Design of "baka" type gear employed in "Selectivity 79" and "Selectivity 79 bis" cruises.

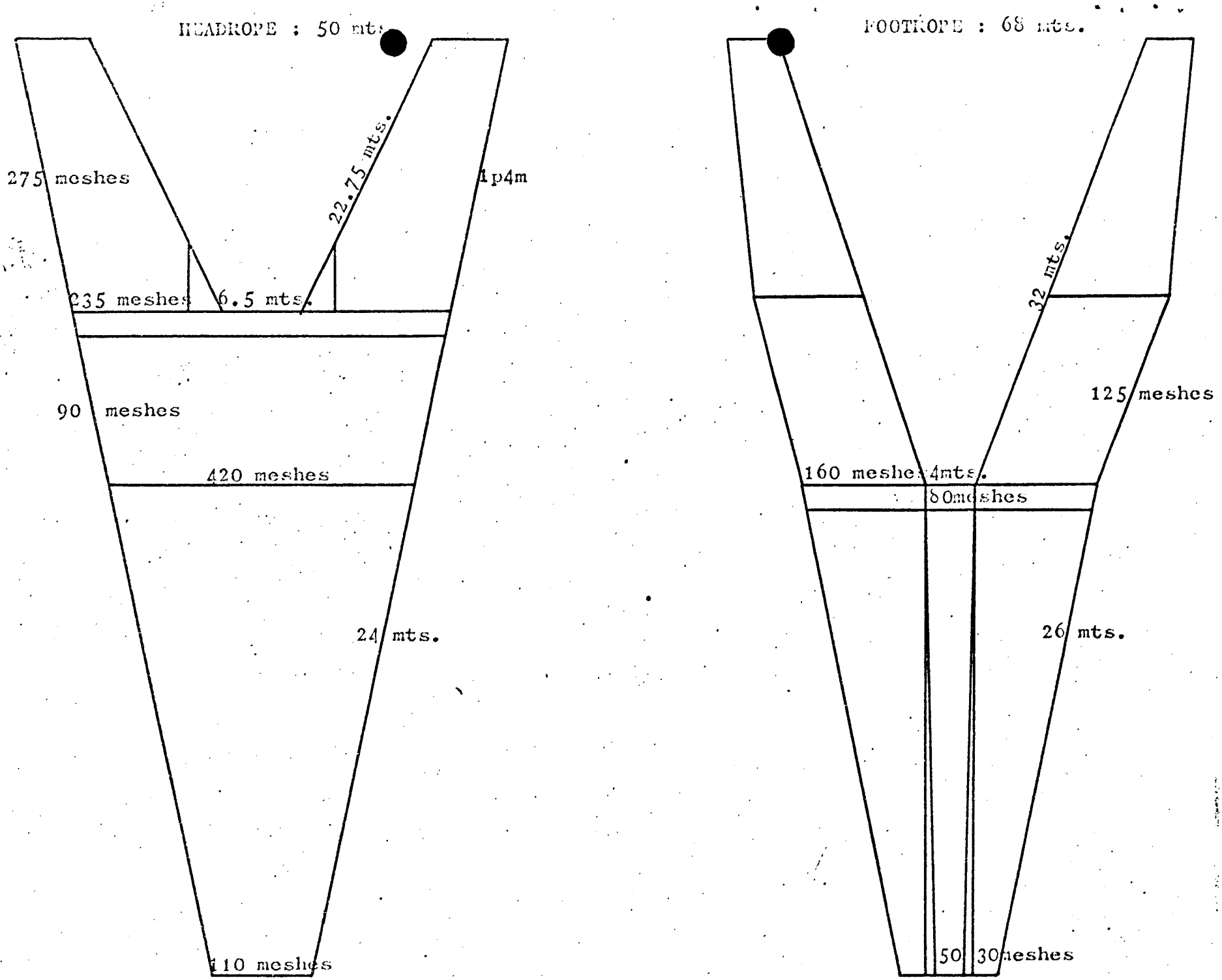


Figure 2.- Design of "baka" type gear employed in "Cigala 79" survey.

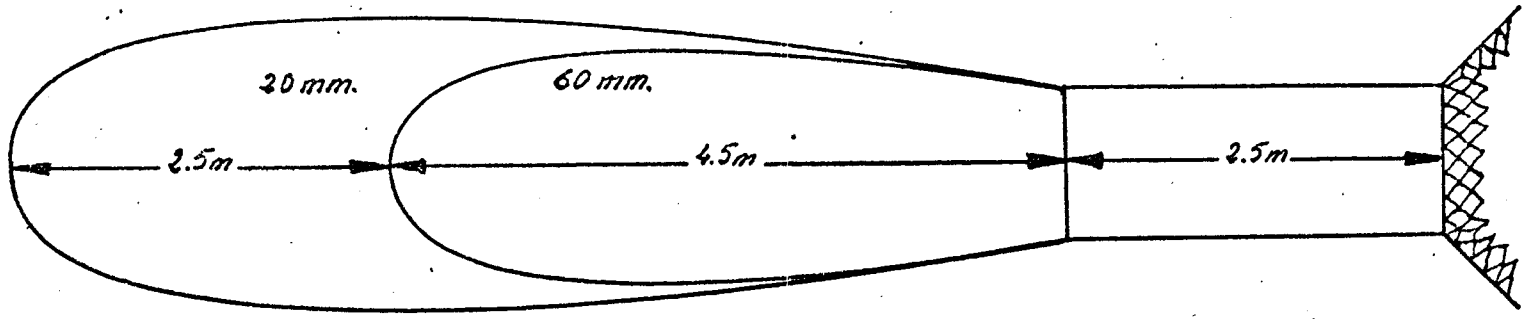
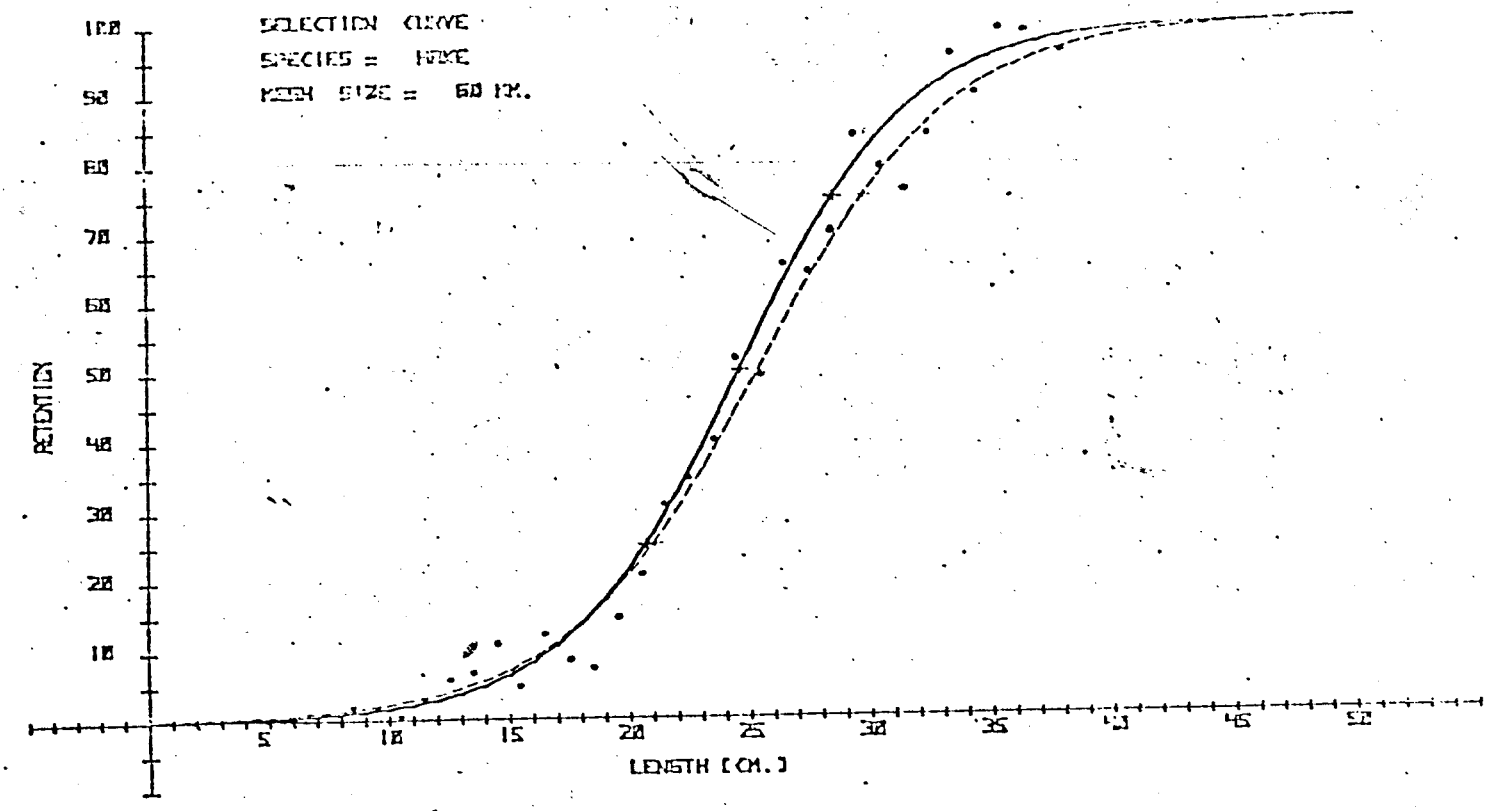


Figure 3 .- Schematic diagram and dimensions of the full covered codend used in mesh selection studies in 1979.



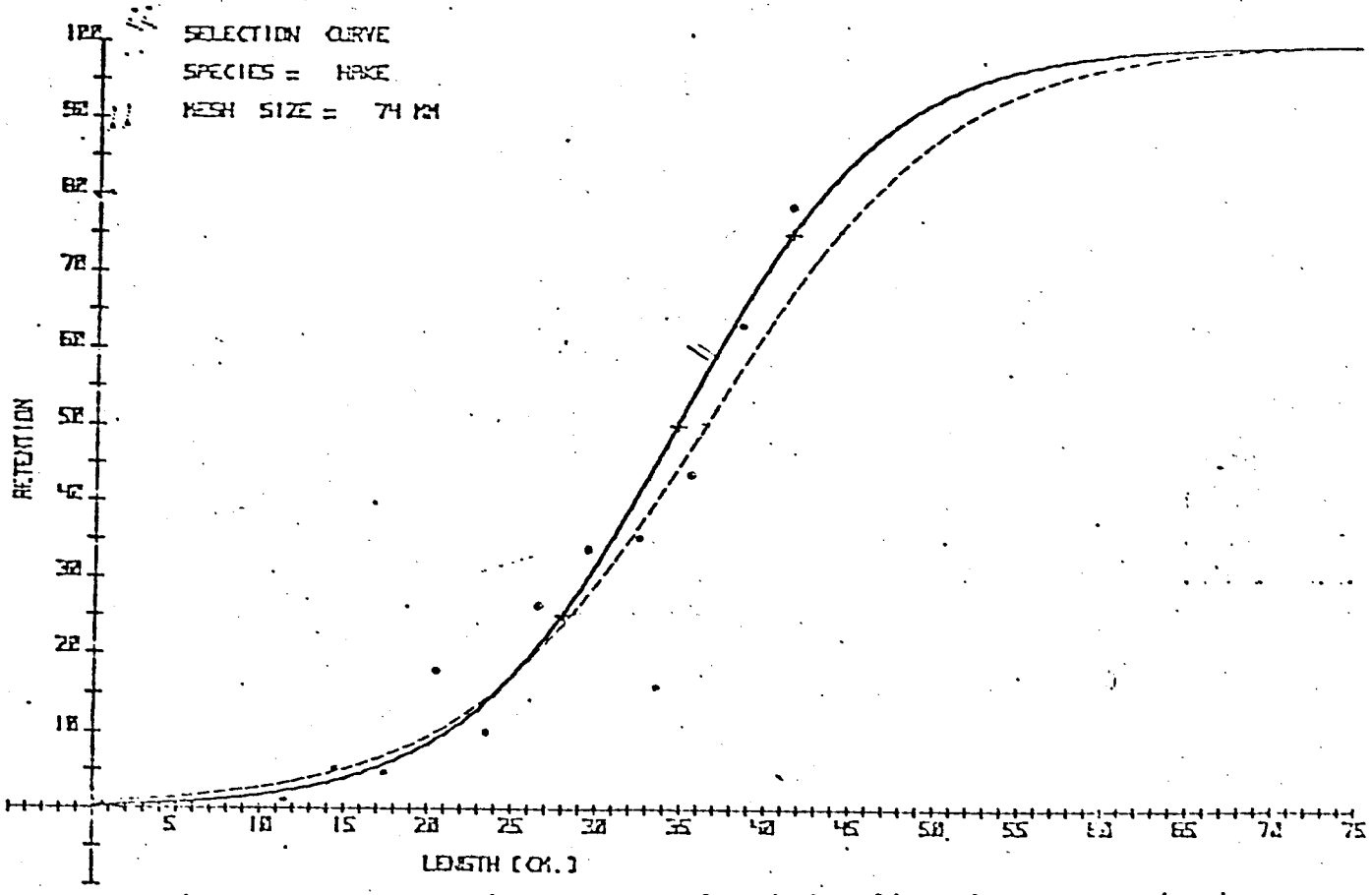
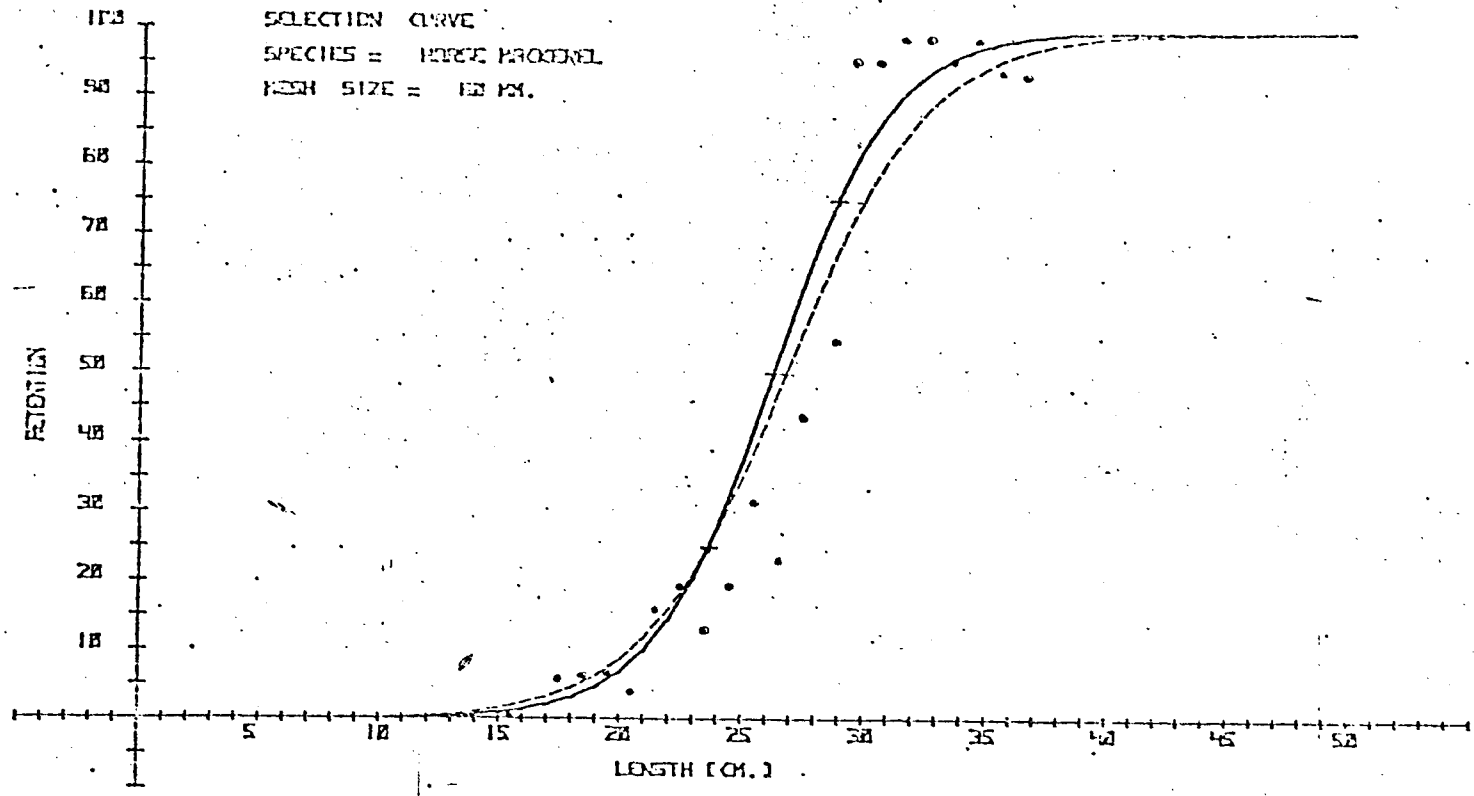


Figure 4.- Selection curves for hake fitted to a logistic curve by the standard method (full line) and by PALOHEIMO & CADIMA (1964) technique (dotted line).



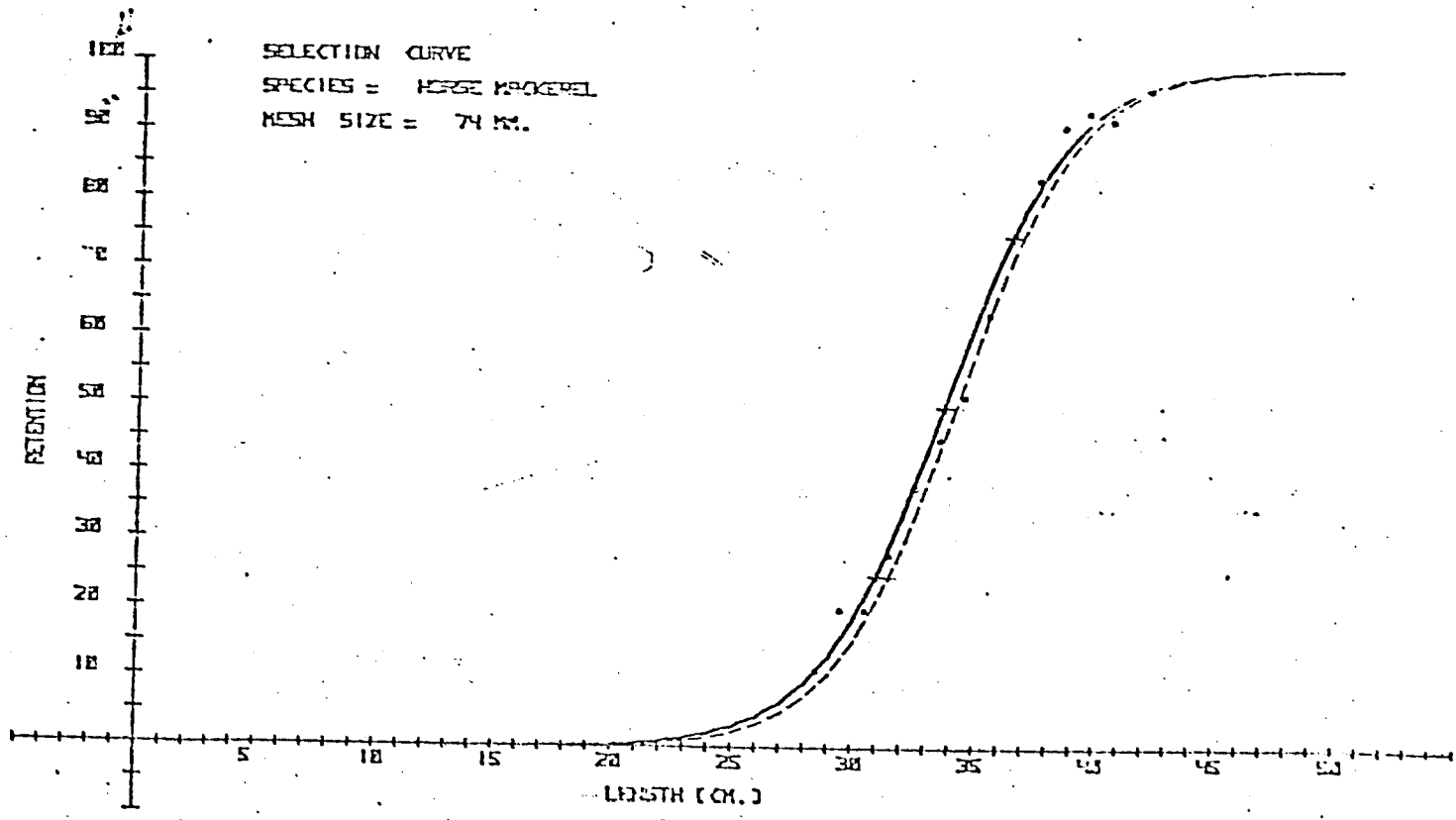


Figure 5. Selection curves for horse-mackerel fitted to a logistic by the standard method (full line) and by PALOHEIMO & CADIN (1964) technique (dotted line).

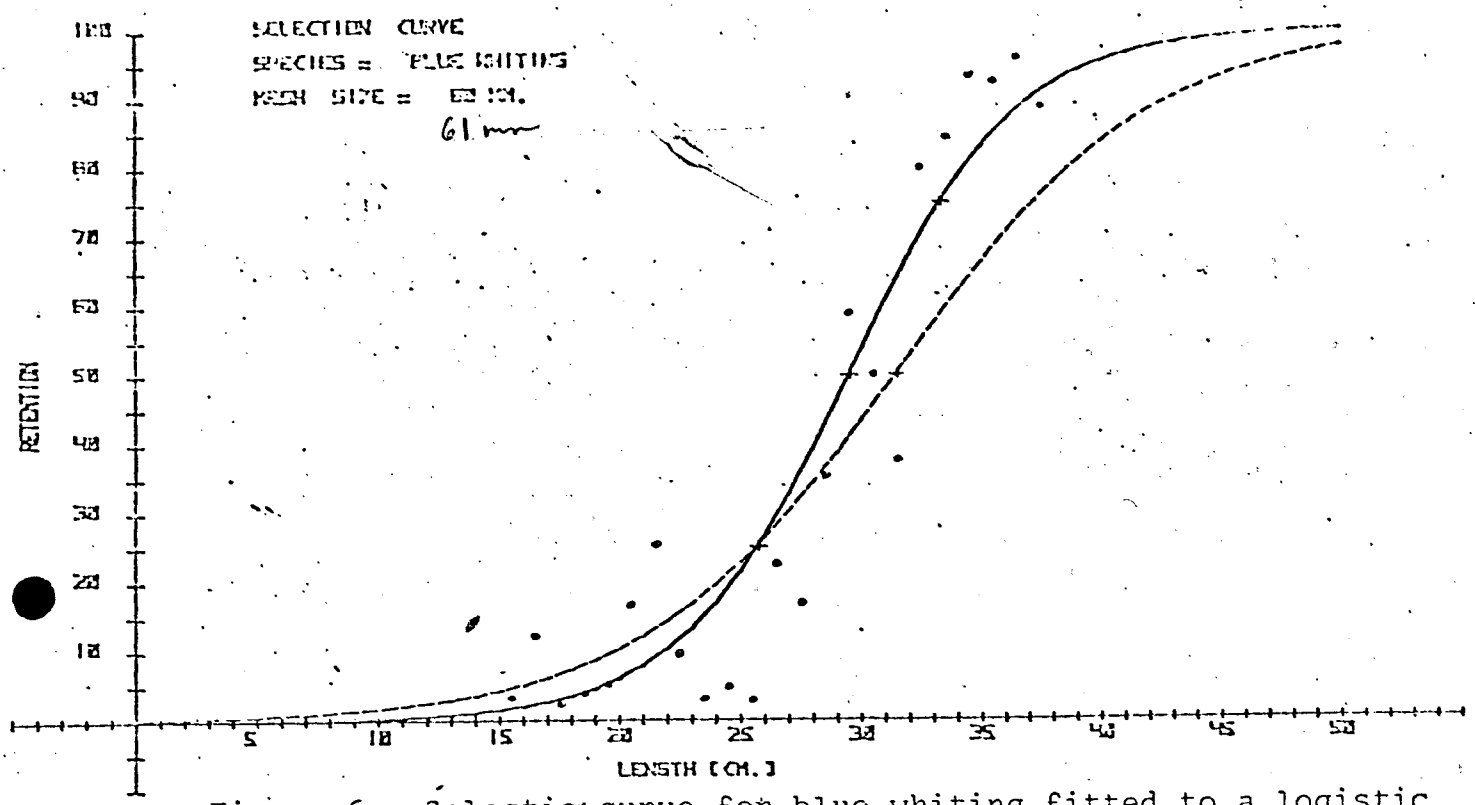


Figure 6.- Selection curve for blue whiting fitted to a logistic curve by the standard method (full line) and by PALOHEIMO & CADIMA technique (dotted line).

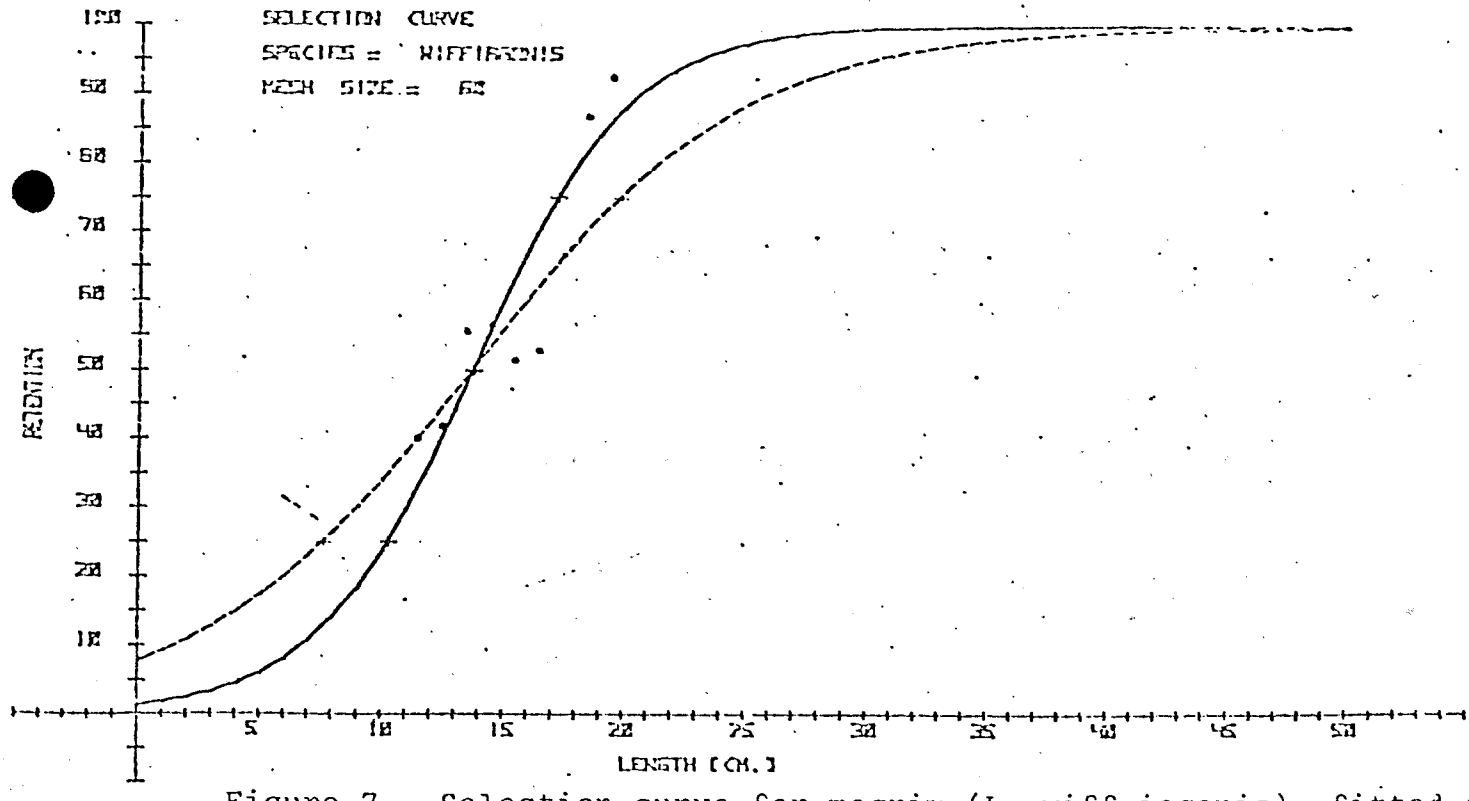
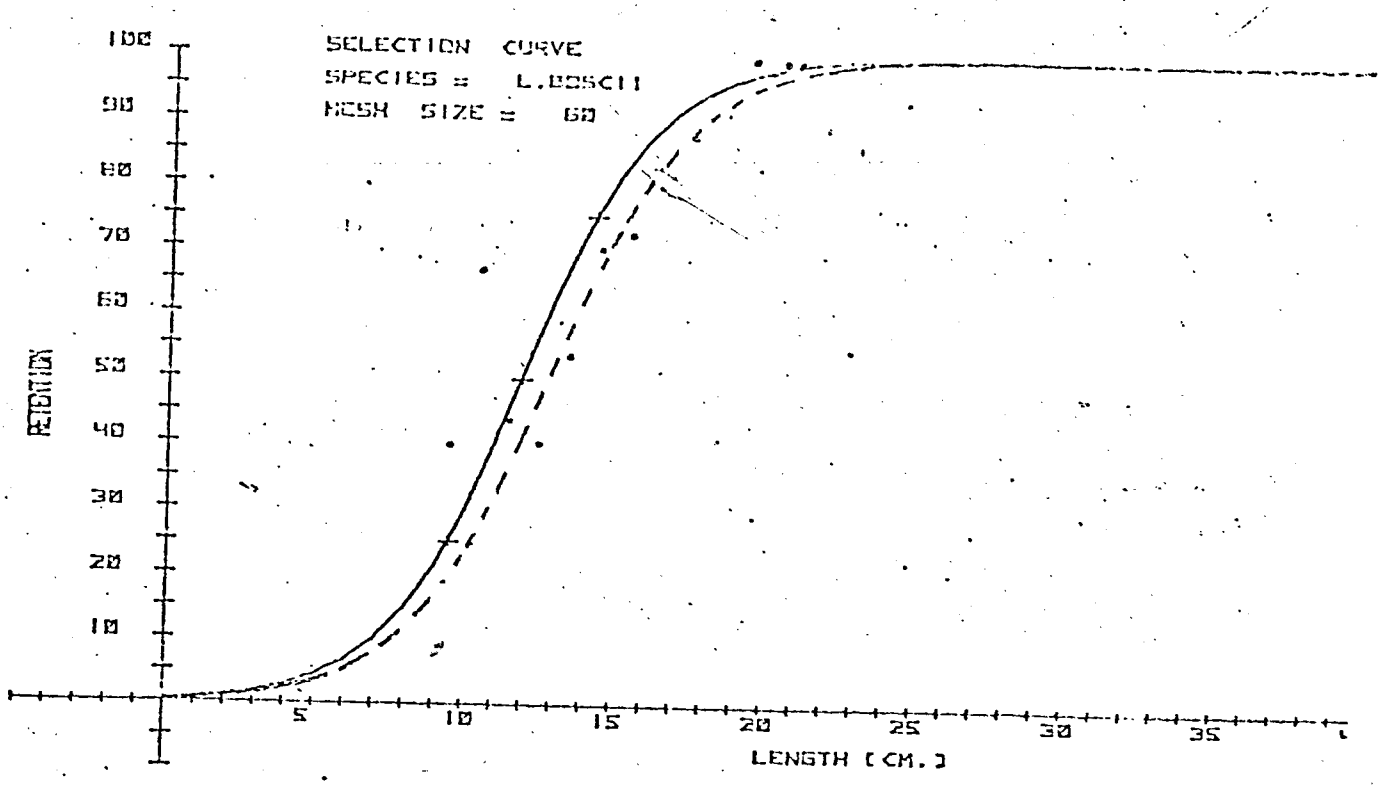


Figure 7.- Selection curve for megrim (L. wiff-iagonis) fitted to a logistic curve by the standard method (full line) and by PALOHEIMO & CADIMA (1964) technique (dotted line).



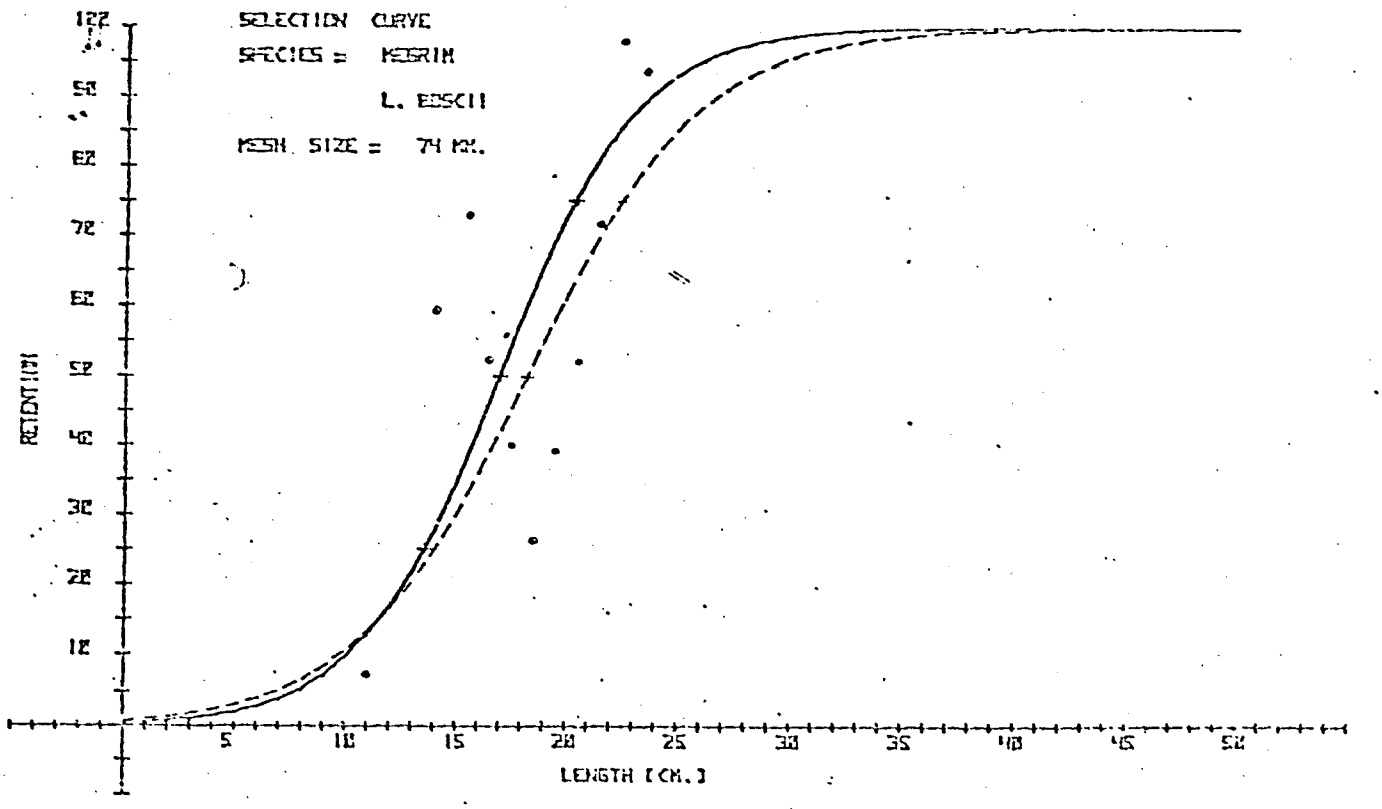


Figure 8.- Selection curves for megrim (L.boscii) fitted to a logistic curve by the standard method (full line) and by PALOHEIMO&CADIMA (1964) technique (dotted line)

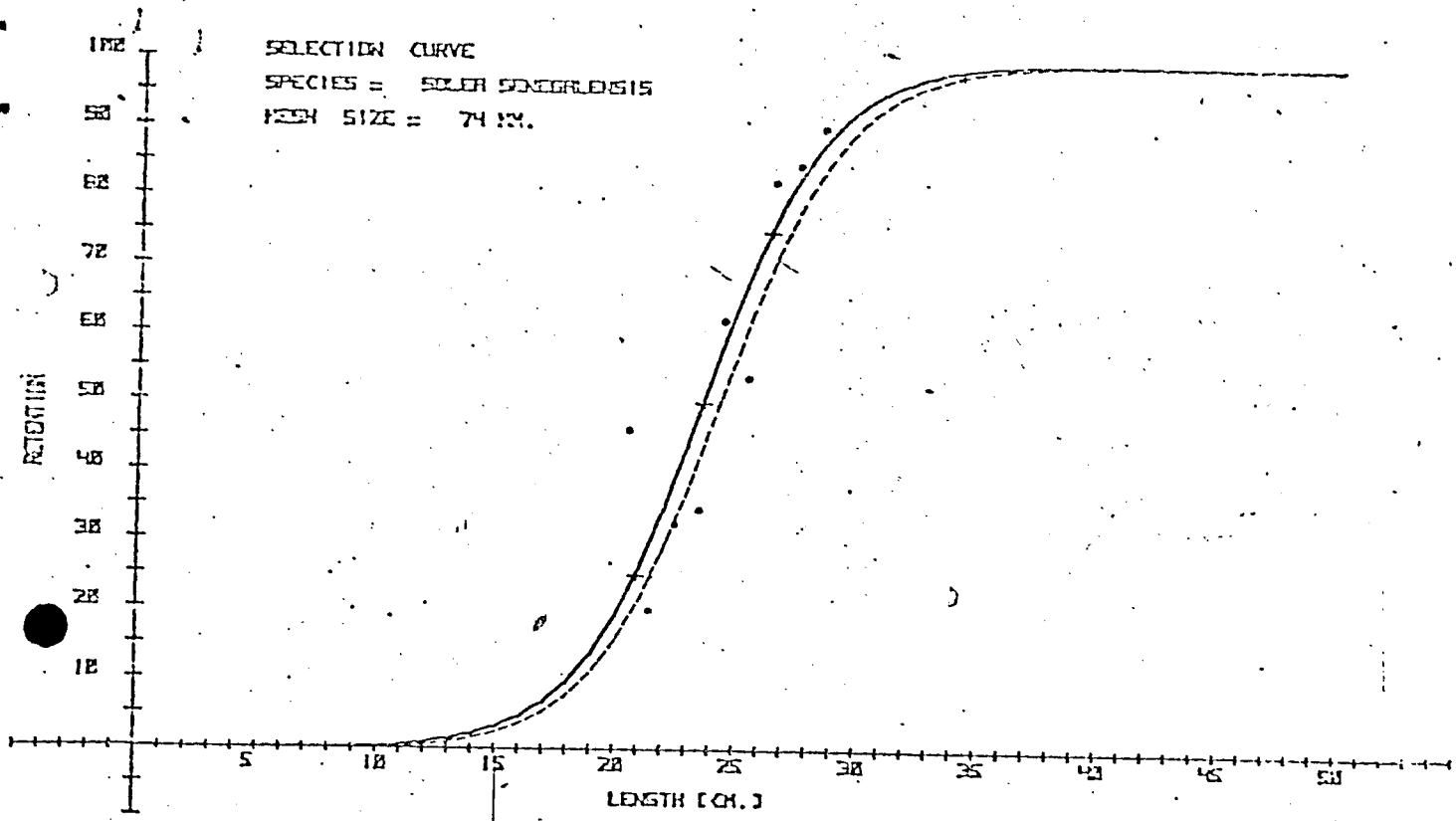


Figure 9.- Selection curve for senegalese sole fitted to a logistic by the standard method (full line) and by PALOHEIMO&CADIMA technique (dotted line).

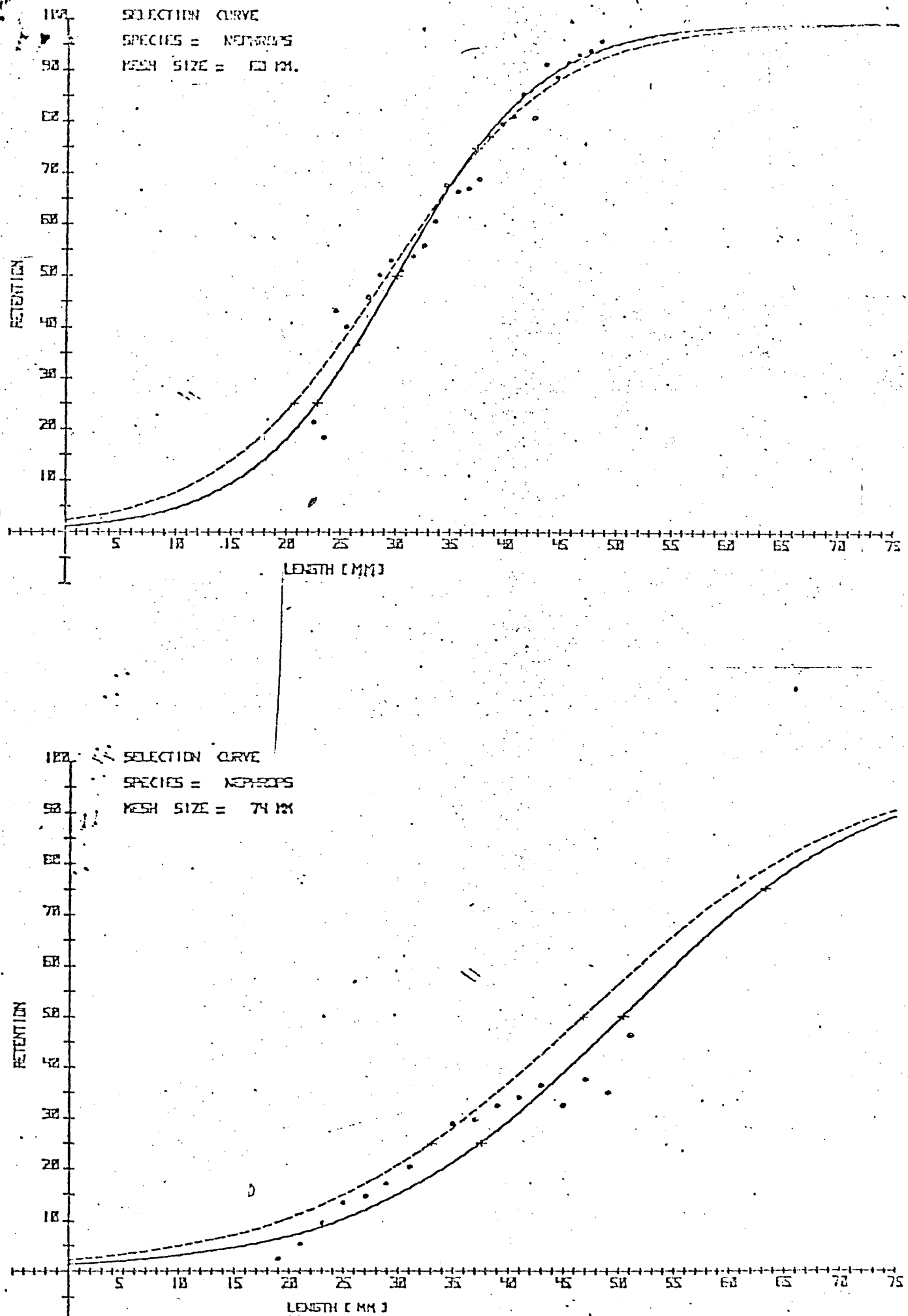


Figure 10.- Selection curves for Nephrops fitted to a logistic curve by the standard method (full line) and by PALOHEIMO & CADIMA (1964) technique (dotted line).