

A Study of Trawl Mesh Selectivity for English Sole and Rock Sole in Hecate Strait, August 1-5, 1980

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A STUDY OF TRAWL MESH SELECTIVITY FOR ENGLISH SOLE AND ROCK SOLE
IN HECATE STRAIT, AUGUST 1-5, 1980

by

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ABSTRACT

Stanley, R. D., and D. Davenport. 1982. A study of trawl mesh selectivity for English sole and rock sole in Hecate Strait, August 1-5, 1980. Can. MS Rep. Fish. Aquat. Sci. 1637: vii + 48 p.

The selectivity of trawl mesh for English and rock sole was examined, using three different codend (108-, 133-, and 152-mm) and four different intermediate (108-, 111-, 130-, and 146-mm) mesh sizes, internal measure.

The small number of tows and various sampling difficulties precluded quantifying the selectivity ogives, but the 152-mm (6-in) codend retained fewer undersized rock and English sole. A similar mesh size in the intermediate seemed to increase escapement of juvenile English sole although this effect was not observed for rock sole.

Catch per tow was too variable and the sample size was too small to determine accurately how larger meshes would affect commercial catches.

Key words: Rock sole, English sole, selectivity, mesh size, trawl.

RÉSUMÉ

Stanley, R. D., and D. Davenport. 1982. A study of trawl mesh selectivity for English sole and rock sole in Hecate Strait, August 1-5, 1980. Can. MS Rep. Fish. Aquat. Sci. 1637: vii + 48 p.

La sélectivité du maillage de chalut pour la sole anglaise et la sole du Pacifique a été étudiée, en utilisant trois grandeurs différentes de mailles (108, 133 et 152 mm) dans le cul-de-chalut et quatre grandeurs dans la partie intermédiaire (108, 111, 130 et 146 mm), mesure interne.

Le petit nombre de traits et des difficultés d'échantillonnage ont empêché la quantification des courbes de fréquences cumulées de sélectivité, mais le cul-de-chalut aux mailles de 152 mm retenait moins de soles anglaises et de soles du Pacifique de taille inférieure. Une grandeur de maille semblable dans la partie intermédiaire semblait permettre à plus de soles anglaises juvéniles de s'échapper, bien que cet effet n'ait pas été remarqué dans le cas de la sole du Pacifique.

Les prises d'un trait à l'autre variaient trop et l'échantillon était trop petit pour déterminer avec précision de quelle manière de plus grosses mailles influenceraient les prises commerciales.

Mots-clés: sole du Pacifique, sole anglaise, sélectivité, grandeur de maille, chalut.

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INTRODUCTION

Increasing the mesh size in a trawl fishery is one way to reduce the catch of undersized fish. Because the small fish are returned to the sea in poor condition representing a possible loss in potential yield, fishermen and fishery managers often request minimum mesh-size regulations. Consideration of such regulations however necessitates information on the size specific retention of various mesh sizes.

The purpose of this study was to quantify the selectivity of various trawl mesh sizes for English sole (Parophrys vetulus) and rock sole (Lepidopsetta bilineata). Staff of the Pacific Biological Station conducted the study with funding support from the Industrial Development Branch.

This report presents and discusses the procedure, analyses and results of this study and some previously unpublished work. With the results is a consideration of how some of the procedures used in the present study may have limited the usefulness of the data. Included in the appendix are some procedural recommendations for future selectivity studies.

METHODS

VESSEL AND NET DESCRIPTION

The M/V SUNNFJORD is a 26 m stern trawler powered by a 425 hp diesel engine. The boat has a double stern net drum which facilitated the switching of nets during the study.

Two polypropylene "Dan" trawls of similar specifications were used for comparative fishing. These were the nets normally used by the M/V SUNNFJORD during commercial fishing. One of the trawls was kept intact and used at various times throughout the experiment whereas codend and intermediate sections of various mesh sizes were interchanged on the second trawl. General specifications of the nets' designs are provided in Appendix

Table 1. Meshes were measured with a calibrated plastic wedge. Values given represent the stretched internal mesh size when wet.

SAMPLING OF CATCHES

Total catch per tow was estimated from the number of splits and fullness of the codend. Weight by species was estimated visually as a percent of the total catch.

Samples of 100-200 fish from each tow provided size composition information. Observers attempted to collect as random a sample as possible by sorting vertically through a portion of the total catch on deck. The fork length of each fish was measured to the nearest centimetre then the entire sample was weighed to the nearest kilogram.

ANALYTICAL METHODS

The analysis of trawl selectivity information is reviewed in Pope, Margetts, Hamley, and Akyuz (1975). For the paired or alternate trawl methods, catch rate per length class of the net with larger meshes (experimental net) is divided by the catch rate per length class of the net with smaller meshes (control net). These ratios are then plotted against length to yield the selectivity ogive.

It is assumed that for two nets of dissimilar mesh size the control net retains 100% of the specimens in the size range vulnerable to the experimental net. The ratio of the two catch rates for each length class therefore reflects the length specific retention rates of the larger mesh. The point of 50% retention for the experimental net can be estimated directly from the ogive by an eye-fitted curve, linear regression, or maximum likelihood analysis.

If the two nets are of a similar mesh size such that it is suspected that the control net is itself not retaining 100% of the sizes vulnerable to the larger net, a modification in the general procedure is then required since the basic analysis would tend to overestimate the ratios. In the present study, a modification proposed by Kimura (1978) was used for comparison of nets with similar mesh sizes. This procedure fits a logistic model for overlapping ogives by maximum likelihood estimation.

RESULTS

GENERAL RESULTS

The experimental trawling was conducted August 1-5, 1981 on the "Two Peaks" Grounds in Hecate Strait. The distribution of tows by net configuration and date is summarized in Table 1. Tows were numbered consecutively from 1-40 over the five days of the study. Tow specifications are provided in Appendix Table 2. Sample data on length composition by species are given in Appendix Tables 3 and 4. Appendix 5 provides the estimated total catch by species for each tow.

Selectivity information is summarized in Tables 2, 3, 4, and 5 and Figures 1 and 2. Numbers shown are the ratios of catch in numbers per 30 min tow of the larger meshed net (experimental net) to the catch rate of the smaller meshed net (control net). Entries are included for those 1-cm size classes for which at least 10 specimens were measured. Only one tow was conducted with the 152 mm codend and 146 mm intermediate net configuration. Data from this tow are included in the Appendix Tables but omitted from the calculations.

The catches of sole were generally small by commercial standards. The production of the 108 mm codend averaged about 250 kg/hr of English sole. The size composition of the marketable component (≥ 33 cm; 13 in.) also appeared smaller than what is normally observed in commercial landings (Bennett and Stocker, 1980; Chilton, Stocker, and Fargo, 1979). Neither of these factors should necessarily have biased the analysis, but it is possible that selectivity may vary with these factors.

Table 6 presents the average numbers of discards, and total weights of marketable-sized fish for each net configuration. Figures 1 and 2 show the selectivity ogives for English and rock sole respectively. The eye-fitted curves shown are for those comparisons which approximated an alternate tow format and which represented a reasonable sample size (≥ 10 per 1-cm size class).

ANALYTICAL CONSIDERATIONS

While the present study attempted to follow the general format for selectivity experiments as reviewed by Pope, Margetts, Hamley and Akyuz (1975), there were some changes from the recommended procedures. These changes, which tended to reduce the quality and quantity of the results, are discussed below in conjunction with the results. Suggested procedural changes for future work are provided in the Appendix.

Pairing of tows

The general analysis assumes that during the experiment the two nets being compared are exploiting a stock of identical abundance and size composition. This situation is usually approximated by towing the two nets side by side (paired trawl) or by alternating one of two nets. In this way, changes in stock abundance or size composition during the experiment affect the results of all nets.

It is apparent from Table 1 that an alternate tow format was not followed in the present study. Selectivity was usually confounded with whatever variation was occurring in the stocks within or among days.

The control net (108 mm codend and 108 mm intermediate) was used throughout the experiment but in an intermittent fashion. On August 2 for example, the first of the seven tows made that day used the control net while the rest of the tows involved the 108 mm codend and 130 mm intermediate net. The selectivity of the latter net can therefore be examined only through comparison with the one early tow of the control net, thereby mixing selectivity effects with whatever stock variation occurred during that day and relying on only one control tow or, through comparison with the five days of control tows. This would provide a larger sample size but the results of one day would then be compared with the averaged results of five days.

Changes in abundance or length composition did occur during the experiment and can be examined in Table 7, where the catch composition for each tow made with the 108 mm codend and 108 mm intermediate is shown. Reflected by mean length, sample standard deviation, and estimated total catch, the stock varied considerably within and among days.

Most of the pairing of net types resemble the situation described for the 108 mm codend and 130 mm intermediate configuration. Only three pairings resembled an alternate tow format. These are shown in Table 8. All involved codend selectivity and the selection of a sub-sample of tows from the total number of tows for a given net type. They are presented as columns: B, b, C, c, H, and h in Tables 2-5.

Weighting of tows

Pope et al. (1975) recommended that selectivity ratios be calculated for each pair of tows and then averaged among tows across each length interval. Their analysis treats each pairing of tows as a separate and equal comparison and then averages the results. This procedure could not be followed in the present study because the tows were not paired so two different analyses were used.

In the first analysis, the results were weighted by total catch weight of the species. The length distribution of each sample was expanded by the total weight in the tow for the species over sampled weight for the tow. Catch per size class was then summed over all tows and adjusted to a rate per 30 min tow. This procedure clearly increases the relative

importance of the larger tows and treats the results from all the tows for one net configuration as one large sample.

For the three comparisons which approximated an alternate tow procedure, a second method was also used for calculation of the ratios. This procedure averaged the tows regardless of catch sizes. Columns b, c, and h of Tables 2-5 were calculated in the above manner. The proportion of the sample represented by a given length class was averaged among tows, then adjusted to a catch rate per 30 min tow by expansion of total weight for all tows and use of the following length/weight formulae:

English sole (Stocker, unpublished data)

$$\text{males} \quad W(g) = 0.00001363 \times L_{(mm)}^{2.8817}$$

$$\text{females} \quad W(g) = 0.00001317 \times L_{(mm)}^{2.8938}$$

Rock sole (Forrester and Thomson 1969)

$$\text{males} \quad W(g) = 0.00000879 L_{(mm)}^{3.0626}$$

$$\text{females} \quad W(g) = 0.00000114 L_{(mm)}^{3.410}$$

One further adjustment was required for the rock sole results. Weighted and non-weighted ratios both yielded selectivity ratios of greater than 1.0 for the larger fish (38-41 cm). Beverton and Holt (1957) suggested that this effect resulted from greater efficiency of the experimental net and that the selectivity ratios for all lengths could be divided by the ratio of catch rates for these larger fish. Weighted and non-weighted ratios were therefore divided by 1.475 and 1.836, respectively.

It is probably unrealistic to assume that the catchability effects are equal for all sizes but without information regarding the smaller sizes, the Beverton and Holt method is perhaps the best approximation.

DISCUSSION

SELECTIVITY ANALYSIS FOR ENGLISH SOLE

While it is clear in Fig.1 and Table 6 that there was increased escapement by the smaller fish through larger meshes. For example, the 152-mm codend retained about one-third as many undersized fish. It was not possible to rigorously define the length specific retention rates. Both calculations for the 133 mm codend indicate that the point of 50% retention lies somewhere below 26 cm but too few small fish were caught for a more precise estimate. Too few large fish were obtained to determine the size of

50% retention for the 152 mm codend. Weighted by tow volume, 50% retention appears to occur at some length greater than 36 cm while the non-weighted ratios suggest a length of approximately 35 cm.

English sole selectivity ratios for the various intermediates were provided in columns E, F, and G of Table 3. If the 130 mm intermediate allowed increased escapement, the effect must be directed on sizes smaller than were sampled in the present study (<25 cm).

There is a strong indication of increased escapement of small English sole through the 146 mm intermediate (Column F, Table 3) but the point of 50% retention is ambiguous, probably owing to the use of each intermediate on a different day. In comparison with the 111 mm intermediate, 50% of the fish appear to be retained at a length between 32 and 35 cm by the 146 mm intermediate. In comparison with the 130 mm intermediate, the 50% retention length would appear much greater, especially given that the 146 mm and 130 mm meshes probably have overlapping selectivity and thus the ratios of column G are probably overestimated.

While significant escapement of smaller English sole did appear to occur through the 146 mm intermediate, this may have been a result of the hydrodynamic effects of pairing a small meshed codend (108 mm) with a large meshed intermediate. It remains to be established whether significant escapement would occur through a large meshed intermediate if it were matched in mesh size by the codend, a configuration more commonly observed in the fishery.

Previously published material on mesh selectivity for English sole is summarized in Table 9 and Fig. 3. Also included is a re-analysis of experiments previously conducted by staff at the Pacific Biological Station. The data were provided by Dr. Keith Ketchen. Some of the data have previously been presented in a different format in the Annual Reports of the Pacific Biological Station (1949, 1957-58).

Detailed information on the duration or sequence of tows were not available for the older Pacific Biological Station data so totals were used without adjustment to catch rates. Some of the comparisons resulted in ratios which were well below 50% over all lengths. This was assumed to have been a result of sampling problems so these comparisons were excluded from the summary. Because most of the comparisons involved similar mesh sizes, the point of 50% retention was calculated with the assumption that the ogives overlapped, as discussed earlier.

Observations from the present experiment are presented in Fig. 3 as open circles with arrows. It was possible only to identify one boundary of the possible length range for which the two mesh sizes exhibited 50% retention.

The solid line shown in Fig. 3 represents the functional regression fitted to pass through the origin (Ricker 1973). The calculation of the line did not include the results of the present study which involved polypropylene codends.

The effect of mesh material on selectivity was reviewed in Gulland

1964; Holden 1971; and ICES 1965. It is generally believed that polypropylene corresponds with such materials as manila and sisal. These tend to exhibit a lower selection factor (the slope of the regression line) than cotton, hemp, and polyester nets.

Two direct comparisons between cotton and polypropylene were reported for whiting (Merlangius merlangus) by Holden (1971). The selection factors for polypropylene relative to cotton were 0.88 and 0.94. The selection factor of polypropylene codends for English sole would therefore presumably be less than 0.255, the slope of the line shown in Fig. 3 for cotton codends.

Results of the present study as shown in Figure 3 do not agree well with previous work. The calculated point of 50% retention for the 133 mm codend appears too low, probably reflecting the sampling inadequacies discussed earlier. The study does indicate however that selectivity of the polypropylene codend used in the study may be lower than has been recorded earlier for nylon and cotton nets.

SELECTIVITY ANALYSIS FOR ROCK SOLE

Fig. 4 and Table 6 indicate that the 152 mm codend retained between one third and one half as many undersized fish as the 108 mm codend. The two curves, of Fig. 2, based on weighted and non-weighted calculations, indicate that the length of 50% retention for the 152 mm codend lies between 35 and 37 cm.

A larger intermediate mesh size did not appear to increase escapement by rock sole. This may have reflected real differences in escape behaviour between English and rock sole or, more likely, it resulted from not pairing the tows.

No previous selectivity experiments appear to have been conducted on rock sole, although Forrester (1959) examined length-breadth information in comparison with English sole. He suggested on that basis that the selection factor for rock sole should be about 13% lower than that for English sole. Translated in terms of cotton codends, he concluded that for rock sole, 50% retention for 33 cm fish would be realized by a mesh size of 157 mm. For English sole, he suggested a mesh size of 130 mm.

CONCLUSIONS

1. A 152 mm (6.00 inch) bottom trawl codend appeared to retain about one third as many undersized (<33 cm; 13 inch) English sole as a 108 mm (4.25 inch) codend.
2. The retention of undersized English sole by the 133 mm (5.25 inch) codend did not differ greatly from that of the 108 mm codend.
3. A 146 mm (5.75 inch) intermediate retained fewer undersized English sole than a 108 mm intermediate.
4. Observations on rock sole were limited but it did appear that the 152 mm codend retained about one third as many undersized (<33 cm) fish as the 108 mm codend. The larger intermediate did not appear to affect retention rates of rock sole.
5. In comparison with previous selectivity experiments using cotton and nylon codends, the polypropylene codend of the present experiment appeared to exhibit a lower selectivity relationship. More fish were retained for a given mesh size.

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Table 1. Distribution of tows by net configuration.

Mesh size		Tows sampled for English sole		Tows sampled for rock sole	
Codend	Intermediate	Tows	Date	Tows	Date
mm (in)	mm (in)				
108 (4.25)	108 (4.25)	7	Aug 2	7	Aug 2
		16,20	3	16, 20	3
		27,28,31,35	4	35	4
		38,39	5	38, 39	5
108 (4.25)	146 (5.75)	1,2,3,5,6	Aug 1	1,2,3,5,6	Aug 1
108 (4.25)	130 (5.10)	9-13	Aug 2	9-13	Aug 2
133 (5.25)	111 (4.40)	14,15,17,18, 19,21,22,23, 24	Aug 3	14,15	Aug 3
152 (6.00)	111 (4.40)	25,26,29,	Aug 4	33,34,	Aug 4
		32,33,34	4	36,37	5
		36,37	5		
152 (6.00)	146 (5.75)	40	Aug 5	40	Aug 5

Table 2. Ratios of English sole catches of large to small meshed codends. All nets with 108 mm intermediates, minimum sample of 10 individuals per length class measured per net configuration.

Ratios of catch in numbers per half-hour of towing time ^a						
Ratio	$\frac{133 \text{ mm}}{108 \text{ mm}}$	$\frac{133 \text{ mm}}{108 \text{ mm}}$		$\frac{152 \text{ mm}}{108 \text{ mm}}$		$\frac{152 \text{ mm}}{133 \text{ mm}}$
Tows	$\frac{14,15,17,18}{19,21}$ 7,16,20,27, 28,31,35,38, 39	$\frac{15,17,19,21}{16,20}$		$\frac{25,26,29,32,33,34,36,37,27,28,31,35,38,39}$		$\frac{25,26,29,32,33,34,36}{14,15,17,18,19,21}$
Length (cm)	A	B	b	C	c	D
24	.103					
25	.128					
26	.330	.582	.660	.08	0.32	.067
27	.351	.601	.889	.05	0.20	.088
28	.524	.709	.643	.08	0.21	.105
29	.804	1.241	1.117	.01	0.23	.079
30	.711	.985	.761	.01	0.21	.100
31	.756	1.063	1.092	.12	0.23	.151
32	.647	.800	.773	.15	0.26	.218
33	.643	.846	.974	.15	0.24	.282
34	1.062			.18	0.27	.296
35	1.670			.29	0.54	.352
36	.330			.21	0.80	.450
37	.380					.719
38						.781

^aThe ratios in columns designated by upper case headings were weighted by individual tow volume. The columns designated by lower case contain non-weighted ratios. The acceptable market size for both sole species at the time of the study was >33 cm.

Table 3. Ratios of English sole catches of large to small meshed intermediates. All nets with 108 mm codends, minimum sample of 10 individuals measured per length class per net configuration.

Ratio	Ratios of catch in numbers per half-hour of towing time ^a		
	$\frac{130 \text{ mm}}{111 \text{ mm}}$	$\frac{146 \text{ mm}}{111 \text{ mm}}$	$\frac{146 \text{ mm}}{130 \text{ mm}}$
Tows	$\frac{9,10,11,12,13}{7,16,20,27,28,31,35,38,39}$	$\frac{1,2,3,5,6}{7,16,20,27,28,31,35,38}$	$\frac{1,2,3,5,6}{9,10,11,12,13}$
Length (cm)	E	F	G
24			
25	.94		
26	1.38	.092	.067
27	1.57	.139	.088
28	1.32	.171	.105
29	2.63	.209	.079
30	2.65	.264	.100
31	1.96	.300	.151
32	1.53	.334	.218
33	1.82	.513	.282
34	1.75	.519	.296
35	1.54	.543	.352
36	1.50	.674	.450
37		.716	
38			

^aThe ratios in columns designated by upper case headings were weighted by individual tow volume. The columns designated by lower case contain non-weighted ratios. The acceptable market size for both sole species at the time of the study was >33 cm.

Table 4. Ratios of rock sole catch of large to small meshed codends. All nets with 108 mm intermediates, minimum sample of 10 individuals measured per length class per net type configuration.

			Ratios of catch in numbers per half-hour of towing time ^a	
Ratio			$\frac{152 \text{ mm}}{108 \text{ mm}}$	
Tows			$\frac{33, 34, 36, 37}{35, 38, 39}$	
Length (cm)	H		h	
30	.267		.220	
31	.214		.214	
32	.220		.213	
33	.412		.345	
34	.336		.327	
35	.513		.390	
36	.473		.475	
37	.657		.500	
38	.946		.721	
39	.860		1.045	
40	1.335		1.263	
41	.893		.991	

^aThe ratios in columns designated by upper case headings were weighted by individual tow volume. The columns designated by lower case contain non-weighted ratios. The acceptable market size for both sole species at the time of the study was >33 cm.

Table 5. Ratios of rock sole catches of large to small meshed intermediates. All nets with 108 mm codend, minimum sample of 10 individuals per length class measured per net configuration.

Ratio	Ratios of catch in numbers per half-hour of towing time ^a		
	$\frac{130 \text{ mm}}{108 \text{ mm}}$	$\frac{146 \text{ mm}}{108 \text{ mm}}$	$\frac{146 \text{ mm}}{130 \text{ mm}}$
Tows	$\frac{9, 10, 11, 12, 13}{7, 16, 35, 38, 39}$	$\frac{1, 2, 3, 5, 6}{7, 16, 35, 38, 39}$	$\frac{1, 2, 3, 5, 6}{9, 10, 11, 12, 13}$
Length (cm)	I	J	K
29			
30	.924	1.268	1.373
31	1.305	1.126	.863
32	1.087	0.819	.753
33	1.110	1.275	1.148
34	1.171	1.115	.952
35	1.340	1.277	.953
36	.951	1.361	1.431
37	1.424	1.782	1.251
38	1.315	2.163	1.644
39	.843	3.049	3.616
40	1.138	.957	.841
41	1.298	.715	.551
42			

^aThe ratios in columns designated by upper case headings were weighted by individual tow volume. The columns designated by lower case contain non-weighted ratios. The acceptable market size for both sole species at the time of the study was >33 cm.

Table 6. Average number of discards and weight of commercial catch per 30 min tow (number of tows in brackets).

	Average number of discards per tow	Average commercial catch weight per tow (kg)
English sole		
<u>152-mm codend (8)</u>	<u>223</u>	<u>47.6</u>
108-mm codend (6)	699	65.9
<u>133-mm codend (4)</u>	<u>3217</u>	<u>193.6</u>
108-mm codend (2)	3951	149.5
Rock sole		
<u>152-mm codend (4)</u>	<u>92</u>	<u>114.4</u>
108-mm codend (3)	224	87.8

Table 7. Mean length and estimated total weight of English sole and rock sole in catches with the 108 mm codend and 108 mm intermediate.

Tow	Date	English sole			Rock sole		
		Length (cm)		Weight (kg)	Length (cm)		Weight (kg)
		Mean	S.D.		Mean	S.D.	
7	August 2	30.3	3.38	2380	33.73	3.02	170
16	August 3	28.9	3.18	1635	33.71	3.70	20
20	August 3	30.4	2.73	205	33.54	2.52	Trace
27	August 4	30.8	2.43	570	-	-	55
28	August 4	30.2	2.76	135	-	-	15
31	August 4	32.2	4.18	200	-	-	300
35	August 4	32.0	2.49	410	33.54	2.52	205
38	August 5	31.6	3.13	270	33.70	3.02	310
39	August 5	31.4	3.04	45	33.76	3.89	180

Table 8. The pairings of tows which best approximated an alternate tow format.

-
1. Selectivity of the 152 mm codend for English sole, Columns C and c of Table 2.

	August 4	August 5
152-mm codend	Tows 25, 26, 29, 32, 33, 34	Tows 36, 37
108-mm codend	Tows 27, 28, 31, 35	Tows 38, 39

2. Selectivity of the 152 mm codend for rock sole, Columns H and h of Table 4.

	August 4	August 5
152-mm codend	Tows 33, 34	Tow 37
108-mm codend	Tow 35	Tows 38, 39

3. Selectivity of the 133 mm codend for English sole, Columns B and b of Table 2.

	August 3
133-mm codend	Tows 15, 17, 19, 21
108-mm codend	Tows 16, 20

Table 9. Previous studies on trawl mesh selectivity for English sole.

Reference	Codend material	Mesh size (mm)	Length of 50% retention	Location
Best (1961) ^a	Cotton	99	24.7	Washington, Oregon, and California coast.
	"	114	28.7	
	"	114	30.0	"
	"	122	29.3	"
	"	122	33.5	"
	"	124	30.1	"
	"	140	33.6	"
	"	142	35.8	"
Kimura (1978) ^b	Nylon	114	30.6	Washington coast
	"	128	32.2	"
P.B.S. ^c	Cotton	108	25.8	B.C. coast
	"	114	33.9	"
	"	127	33.0	"
	"	127	32.2	"
	"	140	35.5	"

^aMesh size measured with calibrated wedge.

^bMesh measurement technique not specified.

^cMesh size measured with ruler, center knot to center knot.

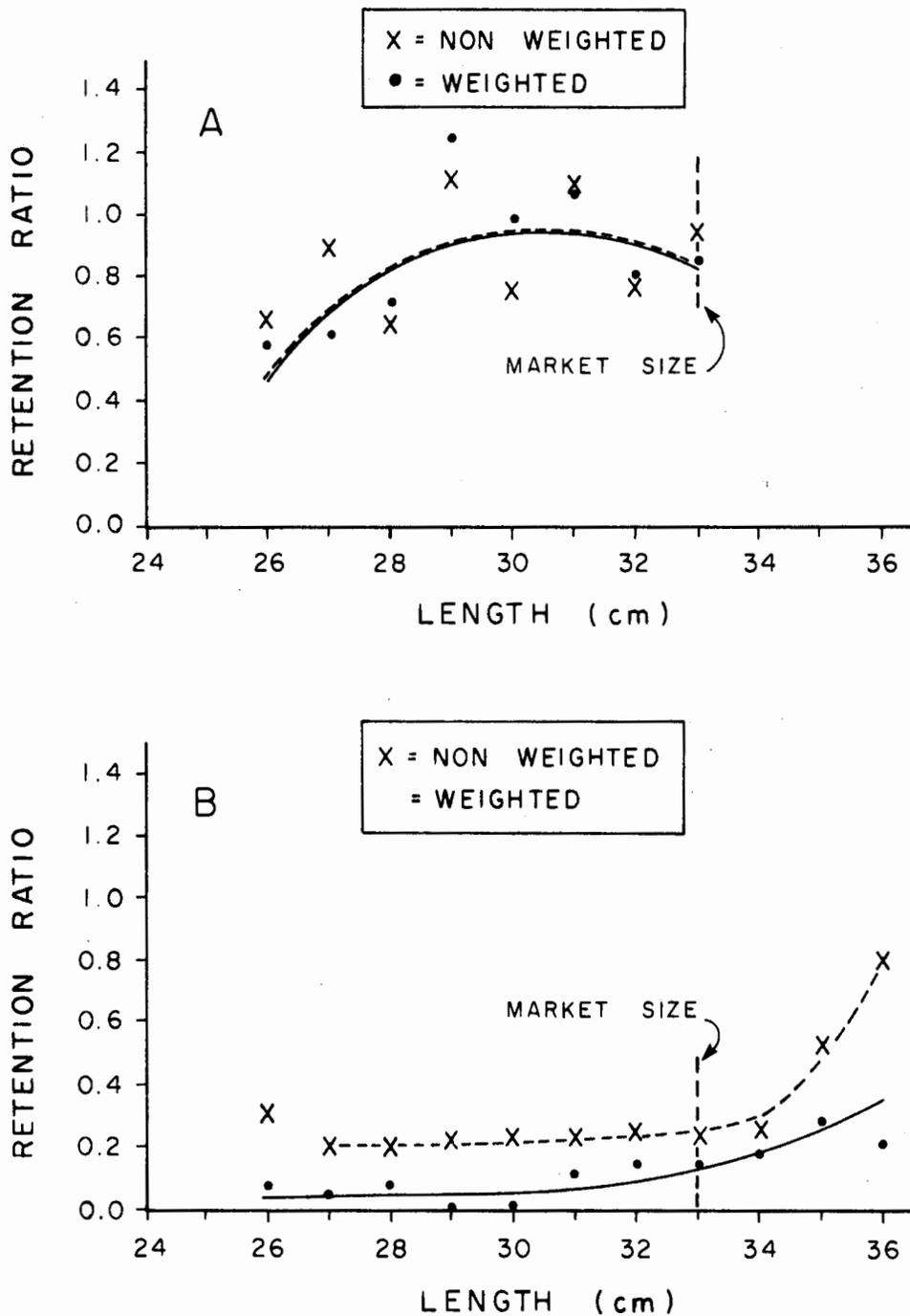
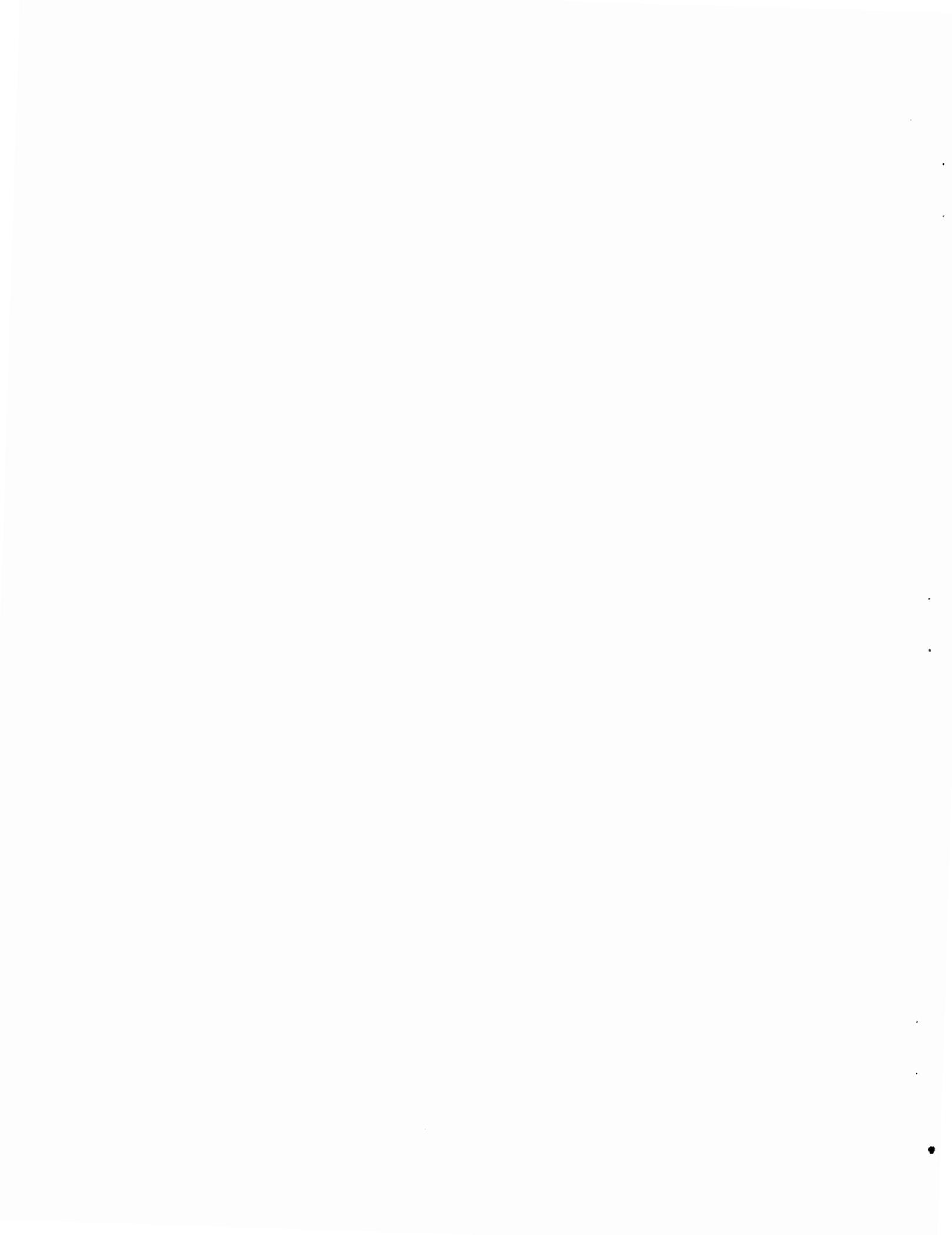


Fig. 1. English sole retention ratios by length for the 133-mm codend (A) and the 152-mm codend (B) in comparison with the 108-mm codend.



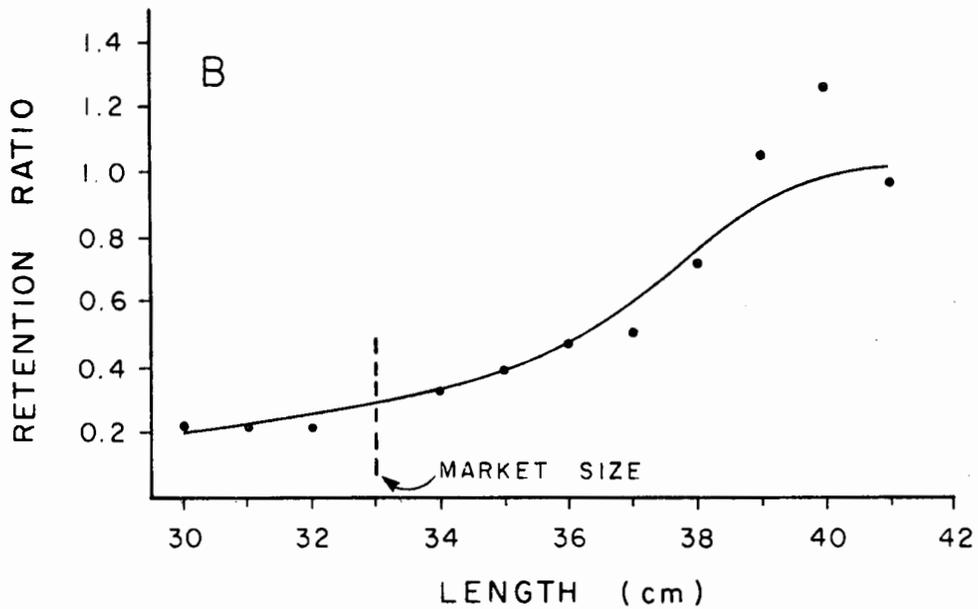
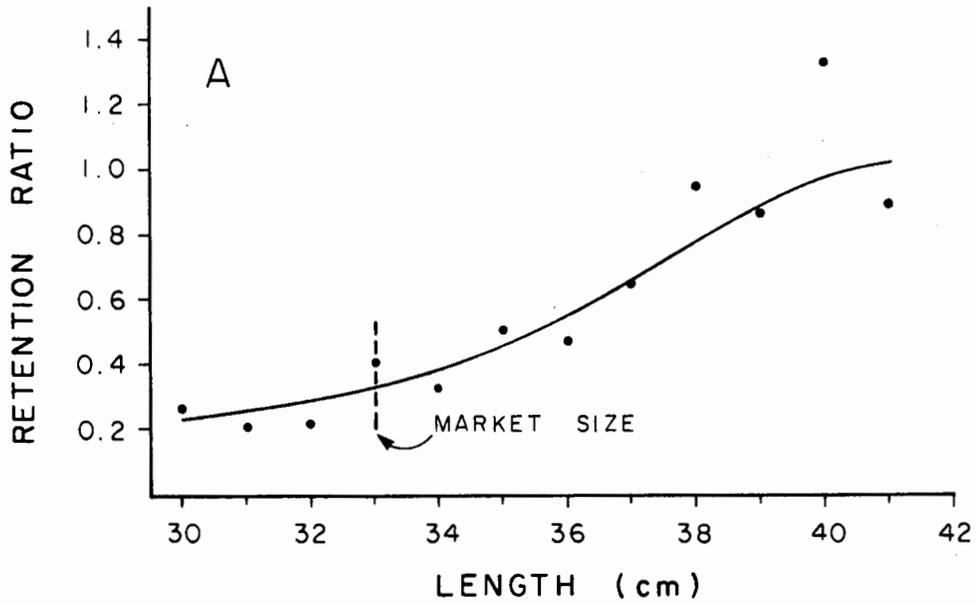


Fig. 2. Rock sole retention ratios by length for the 152-mm codend in comparison with the 108-mm codend, (A) weighted and (B) non-weighted by tow volume.

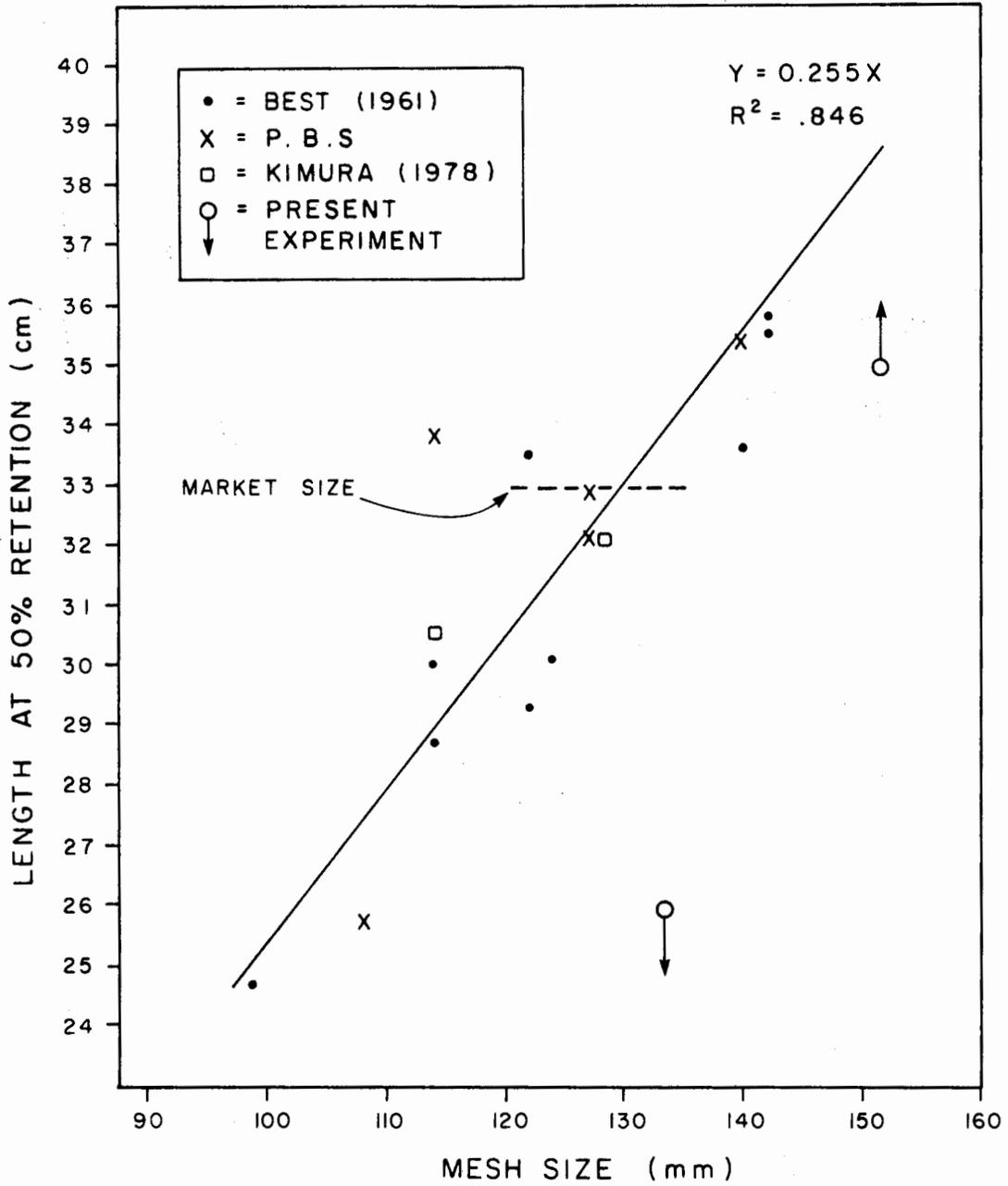


Fig. 3. Summary of mesh selectivity experiments for English sole.

APPENDIX

DESIGN RECOMMENDATIONS FOR FUTURE SELECTIVITY EXPERIMENTS

1. The number of tows required for a proper examination depends primarily on the variability in catch volume and the size composition relative to the mesh size. Given the variability in the present experiment, it should be possible to characterize one experimental mesh with about eight pairs of tows, although 10 or 12 would be better. Basic computations are simple enough however, that one could roughly calculate on a day-to-day basis when enough samples had been obtained.

Sample size will have to be increased for analysis of mesh sizes which exhibit selectivity over those fish sizes which are in low abundance in the sampled population.

It is critical that the sample of fish to be measured is representative of the catch. If it is not possible to measure all the fish, then some procedure should be attempted to ensure a "random" sample. This procedure should be verified in a sample of tows.

2. Since the size frequencies of the samples are expanded by the estimated volume in individual tows in order to calculate catch rate by size class, the estimates of total catch volume by species become critical especially for the larger catches. This is of course assumes that not all fish can be measured.

The estimates could be improved through expansion of an estimate of commercial volume for each tow. The "keepers" should be stockpiled in one deck bin until sorting was complete whereupon an estimate of commercial volume could be determined in consultation with fishermen. Total weight by species could then be determined through expansion by the size frequency data and a length/weight formula.

A further improvement would be to store commercial catch from each net type in specific parts of the hold. Total landed weights per net type, a shore length frequency sample, and the boat samples could be combined to yield accurate catch rate per size class for each net.

3. The choice of nets and mesh sizes to be used in the experiment should be determined by what would be applicable in the fishery for English sole and rock sole. It would appear that observations in the 115-150 mm range (4.5-6.0 in) would be the most useful.

Experimentation with various parts of the net should be examined only if it is reasonable to assume that fishermen could or would adopt such modifications.

4. The value of information on the effect of various mesh sizes on commercial catch should be considered in future experiments. The acceptance of a mesh size recommendation or regulation by the fishery will be critically dependent on the fishermen's expectation of the short-term production losses through increased escape of the marginal sizes.

Better estimates of production effects might be achieved by fishing on grounds or depths where larger fish predominate rather than concentrating on juvenile and marginally sized fish. Attempts should be made to closely copy the normal fishery with regard to tow duration, boat type, grounds, and overall net design.

Appendix Table 1. Specifications of the trawl.

Mesh sizes	wings	152 mm
	belly	152 mm
	first intermediate	127 mm
Foot rope	37.2 m with 10-cm rubber rollers in the wings and 15-cm rollers in the center	
Head rope	31.3 m with twenty-one 20-cm plastic floats	
Bridles	27.4 m	
Sweeplines	54.9 m	

Appendix Table 2. Fishing log for M/V SUNNFJORD during mesh selectivity charter, August 1, 1980.

Tow Area		1 5D	2 5D	3 5D	4 5D	5 5D	6 5D
Time start		1240	1355	1500	-	1735	1920
Duration	(min)	30	30	30	30	30	30
Start N. Lat.	(deg.)	54	54	54	54	54	54
	(min)	22	19.30	18	12	13.45	16.45
W. Long.	(deg.)	131	131	131	131	131	131
	(min)	08	10	04	03.30	03.45	04.30
Depth	(fm)	36-41	33-31	48-52	40	43-41	41-30
Codend mesh size	(mm)	108	108	108	108	108	108
Intermediate mesh size	(mm)	146	146	146	146	146	146
Total catch	(kg)	900	425	1550	550	1900	1900
Sample							
English sole		Yes	Yes	Yes	No*	Yes	Yes
Rock sole		Yes	Yes	Yes	No*	Yes	Yes

*Gear malfunction during tow.

Appendix Table 2 cont'd. Fishing log for M/V SUNNEJORD during mesh selectivity charter, August 2, 1980.

Tow Area		7 5D	8 5D	9 5D	10 5D	11 5D	12 5D	13 5D
Time start		0800	1055	1220	1400	1515	1710	1850
Duration	(min)	40	40	40	40	30	30	30
Start N. Lat.	(deg.)	54	54	54	54	54	54	54
	(min)	12.5	14	11	13	10	11.15	12.30
W. Long.	(deg.)	131	131	131	131	131	131	131
	(min)	04	03.45	04.30	04	04.45	04.45	03.45
Depth	(fm)	-	-	41-43	41-40	43-39	42	42-41
Codend mesh size	(mm)	108	108	108	108	108	108	108
Intermediate mesh size	(mm)	108	130	130	130	130	130	130
Total catch	(kg)	3500	275	3200	2300	3200	2000	3200
Sample								
English sole		Yes	No*	Yes	Yes	Yes	Yes	Yes
Rock sole		Yes	No*	Yes	Yes	Yes	Yes	Yes

*Gear malfunction during tow.

Appendix Table 2 cont'd. Fishing log for M/V SUNNFJORD during mesh selectivity charter, August 3, 1980.

Tow Area		14 5D	15 5D	16 5D	17 5D	18 5D	19 5D	20 5D	21 5D	22 5D	23 5D	24 5D
Time start		0835	1000	1110	1225	1355	1510	1615	1715	1820	1910	2010
Duration	(min)	20	20	30	20	20	20	20	20	30	25	25
Start N. Lat.	(deg.)	54	54	54	54	54	54	54	54	54	54	54
	(min)	11.45	11.30	11.30	11.30	13	11	10.15	12.30	13.30	12	10.30
W. Long.	(deg.)	131	131	131	131	131	131	131	131	131	131	131
	(min)	04	04	04.45	04.45	04.30	04.45	04.45	03.30	04	04.15	03.30
Depth	(fm)	42	42-43	39-42	41-43	42	42	43	43-41	40-39	43	41-43
Codend mesh size	(mm)	133	133	108	133	133	133	108	133	133	133	133
Intermediate mesh size	(mm)	108	108	108	108	108	108	108	108	108	108	108
Total catch	(kg)	2000	1600	2750	2275	1600	1400	800	1150	350	700	725
Sample												
English sole		Yes										
Rock sole		Yes	Yes	Yes	No							

Appendix Table 2 cont'd. Fishing log for M/V SUNNFJORD during mesh selectivity charter, August 4, 1980.

Tow Area		25 5D	26 5D	27 5D	28 5D	29 5D	30 5D	31 5D	32 5D	33 5D	34 5D	35 5D
Time start		0850	1001	1100	1150	1245	1330	1435	1525	1625	1750	1910
Duration	(min)	25	30	25	25	25	30	30	25	35	35	30
Start N. Lat.	(deg.)	54	54	54	54	54	54	54	54	54	54	54
	(min)	13	10.30	12.15	13.30	12	13.15	10.45	09.30	11.30	13.30	14.15
W. Long.	(deg.)	131	131	131	131	131	131	131	131	131	131	131
	(min)	03.30	04.45	03.30	03.30	04	04	03.30	03.30	02.30	03.30	03
Depth	(fm)	44-40	39-43	42	42	42	42-45	55-53	56-52	57-55	45	46-49
Codend mesh size	(mm)	152	152	108	108	152	152	108	152	152	152	108
Intermediate mesh size	(mm)	108	108	108	108	108	108	108	108	108	108	108
Total catch	(kg)	550	600	1950	700	700	450	1000	500	1150	925	2050
Sample												
English sole		Yes	Yes	Yes	Yes	Yes	No	Yes	Yes	Yes	Yes	Yes
Rock sole		No	Yes	Yes	Yes							

Appendix Table 2 cont'd. Fishing log for M/V SUNNFJORD during mesh selectivity charter, August 5, 1980.

Tow Area		36 5D	37 5D	38 5D	39 5D	40 5D
Time start		0830	0935	1040	1140	1300
Duration	(min)	30	30	40	40	30
Start N. Lat.	(deg.) (min)	54 14	54 15	54 13	54 14.45	54 12
W. Long.	(deg.) (min)	131 02.30	131 02.30	131 03.30	131 03	131 04
Depth	(fm)	48-45	49-46	48-46	47	48-46
Codend mesh size	(mm)	152	152	108	108	152
Intermediate mesh size	(mm)	108	108	108	108	146
Total catch	(kg)	2050	2250	1820	900	1050
Sample						
English sole		Yes	Yes	Yes	Yes	Yes
Rock sole		Yes	Yes	Yes	Yes	Yes

Appendix Table 3. Length frequency samples, by haul, of English sole, male and female, mesh selectivity charter, August 1-2, 1980.

Tow	1	2	3	4	5	6	7	8	9	10
No. sampled	141	100	113	0	158	126	180	0	187	188
Wt. of sample (kg)	53	47	51	0	53	50	49	0	52	53
Total weight of English sole (kg)	270	100	355	110	455	180	2380	25	2065	1360
Length (cm)										
23							2			
24	2				1		3		1	5
25	2	1			1	3	6		1	11
26	2	4			3	1	5		9	11
27	11	3	1		7	2	18		15	11
28	19	3	2		7	6	17		13	19
29	17	7	7		13	17	29		36	36
30	14	9	12		20	20	23		35	28
31	13	5	14		24	21	21		29	23
32	10	9	15		23	17	20		15	14
33	16	8	16		20	10	11		11	9
34	4	10	12		12	7	7		9	6
35	1	8	8		9	8	7		1	4
36	6	12	8		4	3	3		4	1
37	5	5	4		3	1	3		1	1
38	3	1	4		3	1	0		1	1
39	5	4	1		2	4	2		1	0
40	1	1	1		1	0	1		1	1
41	0	3	3		0	1	0		1	0
42	0	0	1		1	3	0		1	2
43	2	1	0		1	0	1		2	1
44	1	3	0		1	0	1			1
45	2	3	2		1	0				0
46	3		0		0	0				2
47	1		1		0	1				0
48	1		0		0					1
49			1		0					
50					0					
51					1					

Appendix Table 3 cont'd. Length frequency samples, by haul, of English sole, male and female, mesh selectivity charter, August 3-4, 1980.

Tow	20	21	22	23	24	25	26	27	28	29
No. sampled	148	159	129	154	114	136	171	154	168	47
Wt. of sample (kg)	42	43	35	47	36	43	47	45	44	13
Total weight of English sole (kg)	205	285	35*	135	36*	45	60	570	135	13*
Length (cm)										
21										
22										
23			1	1						
24			1	1	1		6		2	
25	3		2	3	2	1	4	1	5	2
26	4	3	6	2	1	2	10	4	3	1
27	7	10	9	12	1	6	8	6	11	2
28	22	14	14	11	10	8	22	16	19	6
29	19	17	17	21	12	18	27	19	29	7
30	29	20	21	33	17	26	26	25	28	9
31	20	26	21	22	20	22	21	30	29	7
32	24	28	20	21	15	13	23	20	18	4
33	8	12	6	8	8	13	12	14	11	3
34	2	17	2	9	3	6	6	10	3	2
35	2	2	3	5	6	8	0	6	4	0
36	4	4	0	1	5	3	1	2	3	0
37	1	1	2	2	2	1	0	0	1	1
38	0	4	1	1	4	0	0	0	1	0
39	0	0	0	0	3	0	1	0	0	0
40	2	0	1	0	3	3	0	0	0	1
41	0	0	0	0	0	2	0	0	0	0
42	1	0	0	1	0	0	0	1	0	2
43		0	0		1	2	3		0	
44		0	1			0	0		0	
45		1	0			2	0		0	
46			1				0		1	
--										
55							1			

*Actual weight

Appendix Table 3 cont'd. Length frequency samples, by haul, of English sole, male and female, mesh selectivity charter, August 4-5, 1980.

Tow	30	31	32	33	34	35	36	37	38	39	40
No. sampled	0	137	46	12	100	129	74	122	130	116	94
Wt. of sample (kg)	0	47	23	7	42	42	41	46	42	36	38
Total weight of English sole (kg)	9	200	100	7*	90	410	165	340	270	45	42
Length (cm)											
23		1									
24		1									
25		0									
26		2								1	1
27		4	1						2	4	1
28		8	0		3	3	1	3	9	8	6
29		14	5		4	10	4	7	18	15	4
30		19	6		9	20	2	14	28	23	14
31		24	7	1	11	23	5	22	22	20	17
32		16	4	0	14	23	9	19	16	12	11
33		12	3	0	11	27	6	17	10	10	7
34		13	4	0	9	10	6	11	9	10	4
35		5	1	2	9	4	6	11	6	6	3
36		2	2	2	7	7	4	1	3	3	4
37		1	2	1	1	0	3	2	1	2	2
38		4	0	1	3	0	4	4	0	0	3
39		1	1	1	2	0	8	1	1	0	2
40		0	1	2	5	0	4	4	0	0	4
41		2	1	0	4	1	6	0	2	0	4
42	No sample taken	1	2	0	2	0	1	1	1	0	2
43		2	1	0	2	0	0	2	1	0	0
44		1	0	0	1	0	0	2	0	0	1
45		3	0	1	1	0	2	1	0	0	2
46		1	1	1	0	0	0		1	2	1
47			0		2	0	0				1
48			1			1	2				
49			2				0				
50			0				0				
51			1				1				

*Actual weight

Appendix Table 4. Length frequency samples, by haul, of rock sole, male and female, mesh selectivity charter, August 1-2, 1980.

Tow	1	2	3	4	5	6	7	8	9	10
No. sampled	91	54	87	0	93	92	99	0	85	93
Wt. of sample (kg)	52	34	49	0	52	40	50	0	42	42
Total weight of rock sole (kg)	270	34*	400	80	90	180	170	25	65	115
Length (cm)										
25					1					
26					0					
27					0		**			
28					0		-		1	
29			1		1	3	1		2	3
30	8	1	4		4	3	8		5	6
31	10	6	6		9	15	9		13	15
32	15	5	7		17	19	18		12	18
33	12	8	16		17	16	20		13	9
34	11	3	15		11	6	13		13	10
35	7	7	10		8	4	10		6	8
36	3	3	3		3	6	6		4	3
37	7	2	6		5	4	3		6	5
38	5	5	6		2	4	3		2	5
39	5	1	6		5	7	1		1	2
40	2	3	2		5	1	3		1	3
41	4	1	2		2	1	1		3	5
42	1	3	2		2	1	1		0	1
43	0	2	1		0	0	1		1	
44	1	1			1	1	1		0	
45		1				0			1	
46		1				0			1	
47		0				0				
48		1				1				

*Actual weight

**Torn tail

Appendix Table 4 cont'd. Length frequency samples, by haul, of rock sole, male and female, mesh selectivity charter, August 2-3, 1980.

Tows	11	12	13	14	15	16	17	18	19
No. sampled	76	57	88	37	53	41	0	0	0
Wt. of sample (kg)	21	31	44	15	59	21	0	0	0
Total weight of rock sole (kg)	160	100	320	15*	59*	21*	**	**	27
Length (cm)									
28		2	1						
29		0	1	2	1	3			
30	4	6	3	1	5	3			
31	8	5	12	9	9	5			
32	8	11	19	10	8	10			
33	12	11	19	6	8	4			
34	4	3	14	1	4	6			
35	5	2	10	4	6	0			
36	7	1	1	1	0	2			
37	6	4	1	0	1	0			
38	3	4	2	0	0	2			
39	3	0	2	1	3	0			
40	6	1	2	0	4	2			
41	5	1	0	2	3	2			
42	1	3	1		0	2			
43	2	2			1				
44	1	0					No sample taken	No sample taken	No sample taken
45	0	1							
46	0								
47	0								
48	0								
49	0								
50	1								

*Actual weight

**Too few specimens

Appendix Table 4 cont'd. Length frequency samples, by haul, of rock sole, male and female, mesh selectivity charter, August 3-4, 1980.

Tow	20	21	22	23	24	25	26	27	28	29
No. sampled	0	0	0	0	0	0	0	0	0	0
Wt. of sample (kg)	0	0	0	0	0	0	0	0	0	0
Total weight of rock sole (kg)	*	*	*	*	*	25	40	55	15	*
Length (cm)	No sample									

*Too few specimens.

Appendix Table 5. Estimated total catch (kg) by species, by tow.

Tow No.	1	2	3	4	5	6	7	8
Date	Aug. 1	Aug. 1	Aug. 1	Aug. 1	Aug. 1	Aug. 1	Aug. 2	Aug. 2
Catch Total	900	425	1550	550	1800	1900	3500	275
Flatfish								
Dover sole	10	-	trace	trace	trace	-	trace	-
English sole	270	100	355	110	455	180	2380	25
Flathead sole	-	-	-	-	-	-	-	-
Pacific halibut	70	45	80	25	160	90	50	75
Petrale sole	-	-	-	-	-	-	-	-
Rex sole	20	8	trace	trace	36	trace	170	25
Rock sole	270	34	460	80	90	180	170	25
Sand sole	trace	80	80	trace	50	trace	trace	-
Starry flounder	-	-	trace	10	50	55	35	trace
Turbot	160	40	120	27	75	450	170	65
Rockfish								
<u>S. brevispinis</u>	-	-	-	-	-	-	-	-
<u>S. maliger</u>	-	-	-	-	-	-	-	-
<u>S. paucispinis</u>	-	-	-	-	-	trace	-	-
<u>S. pinniger</u>	-	-	-	-	-	-	-	-
Other Roundfish								
Blackcod	trace	-	-	trace	35	18	35	trace
Greycod	20	80	45	40	35	180	70	trace
Lingcod	trace	-	30	-	20	35	trace	-
Pollock	-	-	150	16	55	trace	70	trace
Selachii								
Dogfish	-	-	30	trace	90	trace	-	-
Ratfish	-	-	-	-	-	-	-	-
Skate	90	50	185	16	240	360	170	trace
Invertebrates								
Anemones	-	-	-	50	90	75	-	-
Octopus	-	-	-	-	-	-	-	-
Scallop	-	-	-	-	-	-	-	-
Starfish	-	-	-	165	325	180	82	55

Appendix Table 5 cont'd. Estimated total catch (kg) by species, by tow.

Tow No.	9	10	11	12	13	14	15	16
Date	Aug.	Aug.	Aug.	Aug.	Aug.	Aug.	Aug.	Aug.
	2	2	2	2	2	3	3	3
Catch Total	3200	2300	3200	2000	3200	2000	1600	2750
Flatfish								
Dover sole	-	-	-	-	65	trace	-	trace
English sole	2065	1360	2065	1120	790	950	795	1635
Flathead sole	-	-	-	-	-	-	-	-
Pacific halibut	160	70	30	165	125	60	65	55
Petrale sole	-	trace	-	-	-	-	-	-
Rex sole	95	115	225	205	250	40	320	410
Rock sole	65	115	160	100	320	15	59	21
Sand sole	trace	trace	trace	trace	30	20	16	trace
Starry flounder	65	trace	30	trace	95	100	30	55
Turbot	95	115	225	100	65	190	160	270
Rockfish								
<u>S. brevispinis</u>	-	-	-	-	-	-	-	-
<u>S. maliger</u>	-	-	-	-	-	-	-	-
<u>S. paucispinis</u>	-	-	-	-	-	-	-	-
<u>S. pinniger</u>	-	-	-	-	-	-	-	-
Other Roundfish								
Blackcod	65	25	65	40	65	trace	18	80
Greycod	30	115	95	40	130	60	30	27
Lingcod	-	-	-	-	30	-	trace	trace
Pollock	65	135	65	100	65	40	18	55
Selachii								
Dogfish	30	-	-	trace	95	trace	-	-
Ratfish	-	-	-	-	-	-	-	-
Skate	225	20	30	40	475	290	30	80
Invertebrates								
Anemones	-	-	-	-	-	-	-	-
Octopus	-	-	-	-	-	-	-	trace
Scallop	-	-	-	-	-	-	trace	-
Starfish	225	205	190	125	570	150	80	55

Appendix Table 5 cont'd. Estimated total catch (kg) by species, by tow.

Tow No.	17	18	19	20	21	22	23	24
Date	Aug. 3							
Catch Total	2275	1600	1400	800	1150	350	700	725
Flatfish								
Dover sole	trace	-	trace	trace	-	-	-	-
English sole	1360	475	270	205	285	35	135	36
Flathead sole	-	-	trace	-	-	-	trace	trace
Pacific halibut	70	80	70	15	30	35	50	50
Petrale sole	-	-	-	-	-	-	-	-
Rex sole	340	475	275	205	170	17	70	20
Rock sole	trace	trace	27	trace	trace	trace	trace	trace
Sand sole	trace							
Starry flounder	45	50	27	20	60	-	140	180
Turbot	45	30	205	35	225	17	50	30
Rockfish								
<u>S. brevispinis</u>	-	-	trace	-	-	-	trace	-
<u>S. maliger</u>	-	-	-	-	-	-	-	-
<u>S. paucispinis</u>	-	-	-	-	-	-	-	-
<u>S. pinniger</u>	-	-	-	-	-	-	-	-
Other Roundfish								
Blackcod	trace	30	trace	14	10	-	-	7
Greycod	45	trace	27	40	35	50	35	30
Lingcod	trace	-	trace	trace	trace	-	20	-
Pollock	70	50	55	14	115	50	14	30
Selachii								
Dogfish	trace	-	-	-	-	-	-	-
Ratfish	-	-	-	-	-	-	-	trace
Skate	225	320	275	70	95	70	100	180
Invertebrates								
Anemones	-	-	-	-	-	-	-	-
Octopus	-	-	-	-	-	-	-	-
Scallop	-	-	-	-	-	-	-	-
Starfish	70	80	135	170	115	60	70	180

Appendix Table 5 cont'd. Estimated total catch (kg) by species, by tow.

Tow No.	25	26	27	28	29	30	31	32
Date	Aug.							
	4	4	4	4	4	4	4	4
Catch Total	550	600	1950	700	700	450	1000	500
Flatfish								
Dover sole	trace	trace	trace	trace	-	trace	trace	-
English sole	45	60	570	135	13	9	200	100
Flathead sole	-	trace	-	-	-	-	-	-
Pacific halibut	90	50	95	50	35	45	40	10
Petrale sole	-	-	-	-	-	-	-	-
Rex sole	80	30	380	140	40	-	50	100
Rock sole	25	40	55	15	trace	-	300	100
Sand sole	trace							
Starry flounder	9	60	100	35	27	4	40	25
Turbot	80	50	135	55	27	-	70	trace
Rockfish								
<u>S. brevispinis</u>	-	-	-	-	-	-	-	-
<u>S. maliger</u>	-	-	-	-	-	-	trace	-
<u>S. paucispinis</u>	-	-	-	-	-	-	-	-
<u>S. pinniger</u>	-	-	-	-	-	-	-	-
Other Roundfish								
Blackcod	27	12	trace	14	7	-	20	trace
Greycod	16	20	40	30	40	5	50	40
Lingcod	-	-	trace	14	-	-	trace	-
Pollock	27	40	trace	28	14	-	20	-
Selachii								
Dogfish	-	-	-	trace	-	-	trace	-
Ratfish	-	-	-	-	-	-	-	-
Skate	110	120	190	102	140	90	150	75
Invertebrates								
Anemones	-	-	-	-	-	-	-	-
Octopus	-	-	-	-	-	-	-	-
Scallop	-	-	-	-	-	-	-	-
Starfish	30	120	340	75	340	270	60	50

Appendix Table 5 cont'd. Estimated total catch (kg) by species, by tow.

Tow No.	33	34	35	36	37	38	39	40
Date	Aug. 4	Aug. 4	Aug. 4	Aug. 5	Aug. 5	Aug. 5	Aug. 5	Aug. 5
Catch Total	1150	925	2050	2050	2250	1820	900	1050
Flatfish								
Dover sole	trace	-	40	100	-	75	trace	trace
English sole	7	90	410	165	340	270	45	42
Flathead sole	-	-	-	-	-	-	-	-
Pacific halibut	115	45	100	80	115	75	65	55
Petrale sole	-	-	-	-	-	-	-	-
Rex sole	70	18	100	165	70	360	135	55
Rock sole	180	90	205	205	225	310	180	65
Sand sole	-	trace	20	60	45	75	trace	trace
Starry flounder	-	-	200	200	225	55	45	20
Turbot	90	55	100	200	180	90	90	155
Rockfish								
<u>S. brevispinis</u>	-	-	-	-	trace	-	-	-
<u>S. maliger</u>	-	-	-	-	-	-	-	-
<u>S. paucispinis</u>	-	-	-	-	-	-	-	-
<u>S. pinniger</u>	-	-	-	-	-	-	-	-
Other Roundfish								
Blackcod	11	18	40	100	45	55	18	20
Greycod	205	70	200	100	135	55	75	40
Lingcod	-	-	trace	40	45	35	9	20
Pollock	70	70	100	100	45	35	9	trace
Selachii								
Dogfish	-	-	-	-	-	-	-	-
Ratfish	-	-	-	-	trace	-	-	-
Skate	90	275	200	200	225	180	90	50
Invertebrates								
Anemones	-	-	-	-	-	-	-	-
Octopus	-	-	-	-	-	-	-	-
Scallop	-	-	-	-	-	-	-	-
Starfish	300	175	305	300	570	145	145	520