RESTRICTED

INTERNATIONAL COMMISSION FOR THE NORTHWEST ATLANTIC FISHERIES

Serial No. 2086
(D.c.8)

ICNAF Res. Doc.68/91

ANNUAL MEETING - JUNE 1968

Codend Mesh Selection Studies of Yellowtail Flounder *Limanda ferruginea* (Storer)

by

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INTRODUCTION

The yellowtail flounder is the most important flatfish in New England otter trawl fishery. United States landings in 1966 were 30,000 metric tons. Most of the catch comes from Subarea 5Z and from grounds just to the west of 5Z. The fish are caught on sandy bottoms in depths of 30 to 60 m. When vessels are fishing for yellowtail this species is the predominant food fish taken although at times small amounts of summer flounder and winter flounder also are caught. Non-food species taken, which are discarded by yellowtail draggers, consist largely of sculpins, spiny dogfish, and red hake.

About 75% of the yellowtail are landed at New Bedford, Massachusetts. Most vessels fishing yellowtail from there are medium otter trawlers of 50 to 85 gross tons. The trawls used, for the most part, are fitted with single nylon codends of 114 mm mesh (internal, stretched measure). This mesh retains large numbers of yellowtail less than 340 g (about 35 cm), currently the minimum market size. The undersize yellowtail, which frequently are 50% of the catch by weight, are discarded overboard. My very limited information on survival of discarded fish, obtained by placing discards in tanks of running seawater aboard commercial trawlers, indicates that about 25% survive.

Yellowtail of discarded sizes are growing rapidly (ICNAF Res. Doc. 67/67) and available information indicates that natural mortality is relatively low (ICNAF Res. Doc. 67/28). A savings of fish presumably would result if the discards could be effectively released by increasing codend mesh size. To obtain release information we therefore examined mesh selection for yellowtail aboard commercial otter trawlers in September 1967.

METHODS

The work was done aboard 2 New Bedford otter trawlers. Pair tows were made during a part of the trip, using a codend of the mesh to be tested on one vessel and a lined codend or different size codend on the other. The catches from a series of tows were compared (large mesh versus liner) to obtain selection data. The liner was of 38 mm mesh nylon, which retained all sizes of yellowtail present on the grounds.

Mesh measurements were made on wet, after use, codends with an ICES mesh gauge set at a tension of 4 kg. Two rows of meshes, from head end to purse ring end of the codend, were measured, and the mean of these measurements was taken to be the mean mesh size for the codend.

The vessels were diesel powered medium side trawlers which normally fish for yellowtail. The Catherine and Mary was 56 gross tons, 19.8 m long and had 180 horsepower. The Moonlight was 71 gross tons, 23.8 m long and had 200 horsepower. Both vessels used a No. 36 otter trawl with 127 mm mesh nylon twine in net parts forward of the codend. This is their standard gear. Aside from very minor variations, the nets were similarly rigged. Towing speed was the same for the 2 vessels. This was estimated by the captain of the Moonlight to be 2.5 to 3 k, depending on current and wind conditions.

I assumed that the 2 vessels had equal fishing power, given the mild weather conditions prevailing during the experiments. For this trip, for equal amounts of effort, the comparative weighouts in metric tons of commercial fish caught were as follows: Catherine and Mary: yellowtail flounder, 12.76, summer flounder, 0.32; Moonlight: yellowtail flounder, 11.05, summer flounder, 0.31. Since the vessels fished within sight of each other during the trip, even when pair tows were not being made, they presumably were working on the same body of fish.

We examined selection characteristics of 2 nylon codends: one with a mesh opening of 129 mm made of single, twisted nylon twine 5 mm in diameter, and one with a mesh opening of 145 mm made of single, braided nylon twine 6 mm in diameter. We made pair tows of each of these nets versus lined nets, and, in addition, we made several pair tows with the 129 mm versus the 145 mm codend, and with the 129 mm versus a 116 mm codend, the latter being that which normally was used aboard the Moonlight. The latter codend was of single nylon twine (braided) of 6 mm diameter.

Chafing gear was used only on the bottom of the codend, in the after part where the bag of fish dragged on the sea floor. It was the same on both vessels and consisted of 114 mm mesh nylon tied at the knots with short lengths of polypropylene twine which frayed out in use to form a protective mat. This chafing gear is the kind most used on New England trawlers, although bull hides continue to be used by some fishermen.

Total catches and length frequency distributions for each tow were estimated from samples. We obtained a sample of 2 or 3 one-bushel baskets of unculled yellowtail from each tow. These fish were measured to the nearest centimeter and separated into baskets of markets (kept catch) and discards, using the cull point length of 35 cm. This gave estimates of the length frequency distribution and the ratio, by volume, of the catch of markets to discards for the tow. The total amount of market yellowtail caught per tow, in bushels, was obtained from the crew who measure their catch by busheling it. Using the above ratio and the total volume of markets in the tow, we calculated the total number of bushels of discards in the catch and added this to the bushels of market fish to get total catch.

We measured the actual volume to total discards in 5 tows and compared this with estimated values to obtain a measure of the error in the above technique. The actual and estimated percentages for these tows are given in Table 1. The total difference was less than 2%.

Table 1. Comparison of actual and estimated proportions of yellowtail discards in 5 tows.

Tow	% Discard Yellowtail		Total Catch (Bushels)
	Actual	Estimated	
1	58	67	26.0
2	65	60	23.0
3	62	50	26.0
4	62	65	10.5
5	69	65	24.5

Since towing time varied from 35 to 90 minutes and was usually not exactly the same for each of the vessels in a given pair tow, we adjusted catches to a one hour tow length. The length frequency distribution for the measured sample was applied to the estimated total number of yellowtail in the catch for each (one hour equivalent) tow, to obtain the length frequencies of the total catch per one hour tow. In each pair tow series, the length frequency data for all tows with the one codend were combined and compared with the equivalent data for the other codend. The percentage retention for each 2 cm interval was computed and selection curves, based on smoothed retention percentages, were constructed.

RESULTS

Fourteen pair tows were made in 4 series (Table 2). All were made on yellowtail grounds 7 to 10 miles north and northwest of Nantucket Shoals lightship (40°33'N, 69°28'W). Water depth was 45 to 55 m.

Table 2. Number of tows and codend mesh sizes in each series of yellowtail mesh selection experiments.

Series	Number of Tows (each vessel)	Codend Mesh Size (mm)	
		Catherine and Mary	Moonlight
1	6	129	38 liner
2	3	38 liner	145
3	2	129	145
4	3	129	116

The numbers of large and small yellowtail present on this ground were too few to provide precise selection information at the upper and lower ends of the selection curves. This should be kept in mind when interpreting the data.

Series 1 (mesh size 129 mm).

Selection data for the 129 mm codend, based on 6 pair tows, are given in Table 3. Some market fish near the cull length (35 cm) were released. A selection curve, drawn by eye to the percentage retention points, is shown in Figure 1. The 50% selection length of approximately 29.5 cm gives a selection factor of 2.29. The 25% to 75% selection range is approximately 5 cm.

Table 3. Estimated yellowtail length frequency distributions and percent retained for a 129 mm mesh codend compared with a lined codend (38 mm mesh) for 6 one hour pair tows.

Length Interval (cm)	Numbers Caught		% retained 1/
	129 mm	38 mm	
14-15	0	2	
16-17	0	39	0
18-19	0	259	0
20-21	0	319	2
22-23	12	87	8
24-25	10	29	20
26-27	31	200	30
28-29	389	764	37
30-31	1022	1615	62
32-33	1015	1376	81
34-35	1040	916	108
36-37	635	424	125
38-39	149	128	120
40-41	20	20	78
42-43	9	22	66
44-45	8	11	16
46-47	0	2	
Total	4340	6213	

1/ Smoothed by 3's, using geometric means.

The estimated yellowtail catches for the 129 mm mesh and the lined codend, for the 6 pair tows, are given in Table 4. The 129 mm mesh caught relatively more market yellowtail than the lined codend while releasing some of the undersize fish. The ratio of market to discard catch increased from 37 to 87 percent.

Table 4. Comparison of yellowtail catch for the 129 mm mesh and the lined (38 mm) codend.

Size Category	Catch - bushels/hour	
	129 mm	38 mm
Market	3.9	2.5
Discard	4.5	6.8
Ratio, Market to Discard	.87	.37

Series 2 (mesh size 145 mm).

Selection data for the 145 mm mesh codend, based on 3 pair tows, are given in Table 5. A selection curve, drawn by eye to the percentage retention points, is shown in Figure 2. The 50% selection length of approximately 34 cm gives a selection factor of 2.34. The 25% to 75% selection range is approximately 8.5 cm.

Table 5. Estimated yellowtail length frequency distributions and percent retained for a 145 mm mesh codend compared with a lined codend (38 mm mesh) for 3 one hour pair tows.

Length Interval (cm)	Numbers Caught 145 mm	Numbers Caught 38 mm	% retained 1/
16-17	0	7	
18-19	0	124	4
20-21	49	313	8
22-23	21	149	16
24-25	11	56	18
26-27	63	299	23
28-29	361	1277	28
30-31	827	2282	35
32-33	748	1786	41
34-35	528	1124	50
36-37	239	362	93
38-39	141	54	111
40-41	34	42	139
42-43	9	7	
Total	3031	7882	

1/ Smoothed by 3's, using geometric means.

The 145 mm mesh showed less effective release of small fish than did the 129 mm gear (Figures 1 and 2). In view of the low numbers of small fish present, this apparent anomaly probably resulted from sampling error.

The estimated yellowtail catches for the 145 mm mesh and the lined codend, for the 3 pair tows, are given in Table 6. The 145 mm mesh caught fewer of both market and discard fish than the lined codend. The ratio of market to discard catch increased from 45 to 56 percent.

Table 6. Comparison of yellowtail catch for the 145 mm mesh and the lined (38 mm) codend.

Size Category	Catch - bushels/hour 145 mm	Catch - bushels/hour 38 mm
Market	3.6	7.6
Discard	6.5	16.7
Ratio, Market to Discard	.56	.45

Series 3 (mesh size 129 mm versus 145 mm).

Length distribution data for the 129 and 145 mm mesh codends, based on 2 pair tows, are given in Table 7. The 145 mm mesh showed more effective release of small fish in this series than it did in series 2.

Table 7. Estimated yellowtail length frequency distributions and percent retained for a 129 mm mesh codend compared with a 145 mm mesh codend for 2 one hour pair tows.

Length Interval (cm)	Numbers Caught 145 mm	Numbers Caught 129 mm	% Caught by 145 mm
16-17	0	11	0
18-19	5	30	17
20-21	10	70	14
22-23	20	43	46
24-25	0	27	0
26-27	38	109	35
28-29	197	529	37
30-31	620	1318	47
32-33	696	1417	49
34-35	385	968	40
36-37	273	474	58
38-39	132	127	104
40-41	38	32	119
42-43	29	30	97
44-45	0	8	0
46-47	6	0	
Total	2449	5193	

The estimated yellowtail catches for these 2 codends are given in Table 8. The 129 mm mesh caught about twice the volume of both market and discard fish as the 145 mm did, and, hence both meshes had a catch ratio of market to discard of 65 percent.

Table 8. Comparison of yellowtail catch for the 129 mm and 145 mm mesh codends.

Size Category	Catch - bushels/hour 129 mm	Catch - bushels/hour 145 mm
Market	11.0	5.3
Discard	17.0	8.0
Ratio, Market to Discard	.65	.66

Series 4 (mesh size 129 mm versus 116 mm).

Length distribution data for the 129 mm mesh codend and the 116 mm mesh codend (standard commercial gear on the vessel Moonlight), based on 3 pair tows, are given in Table 9. The 129 mm net released some numbers of market yellowtail at or just above the 35 cm cull point, but few larger ones were released. Substantial amounts of discards were released by the larger mesh.

Table 9. Estimated yellowtail length frequency distributions and percent retained for a 129 mm mesh codend compared with a 116 mm mesh codend for 3 one hour pair tows.

Length Interval (cm)	Numbers Caught 129 mm	Numbers Caught 116 mm	% Caught by 129 mm
20-21	0	12	0
22-23	2	0	
24-25	0	5	0
26-27	10	23	43
28-29	50	204	24
30-31	121	528	23
32-33	247	893	28
34-35	316	830	38
36-37	307	397	77
38-39	95	134	71
40-41	22	30	73
42-43	3	0	
44-45	3	3	100
Total	1176	3059	

The estimated yellowtail catches for these 2 codends are given in Table 10. The 129 mm mesh caught, by volume, 81% as much market fish and 26% as much discards as did the 116 mm mesh. The ratio of market to discard was very much higher with the 129 mm mesh, 2.12 versus .68.

Table 10. Comparison of yellowtail catch for the 129 mm and 116 mm mesh codends.

Size Category	Catch - bushels/hour 129 mm	Catch - bushels/hour 116 mm
Market	3.4	4.2
Discard	1.6	6.2
Ratio, Market to Discard	2.12	.68

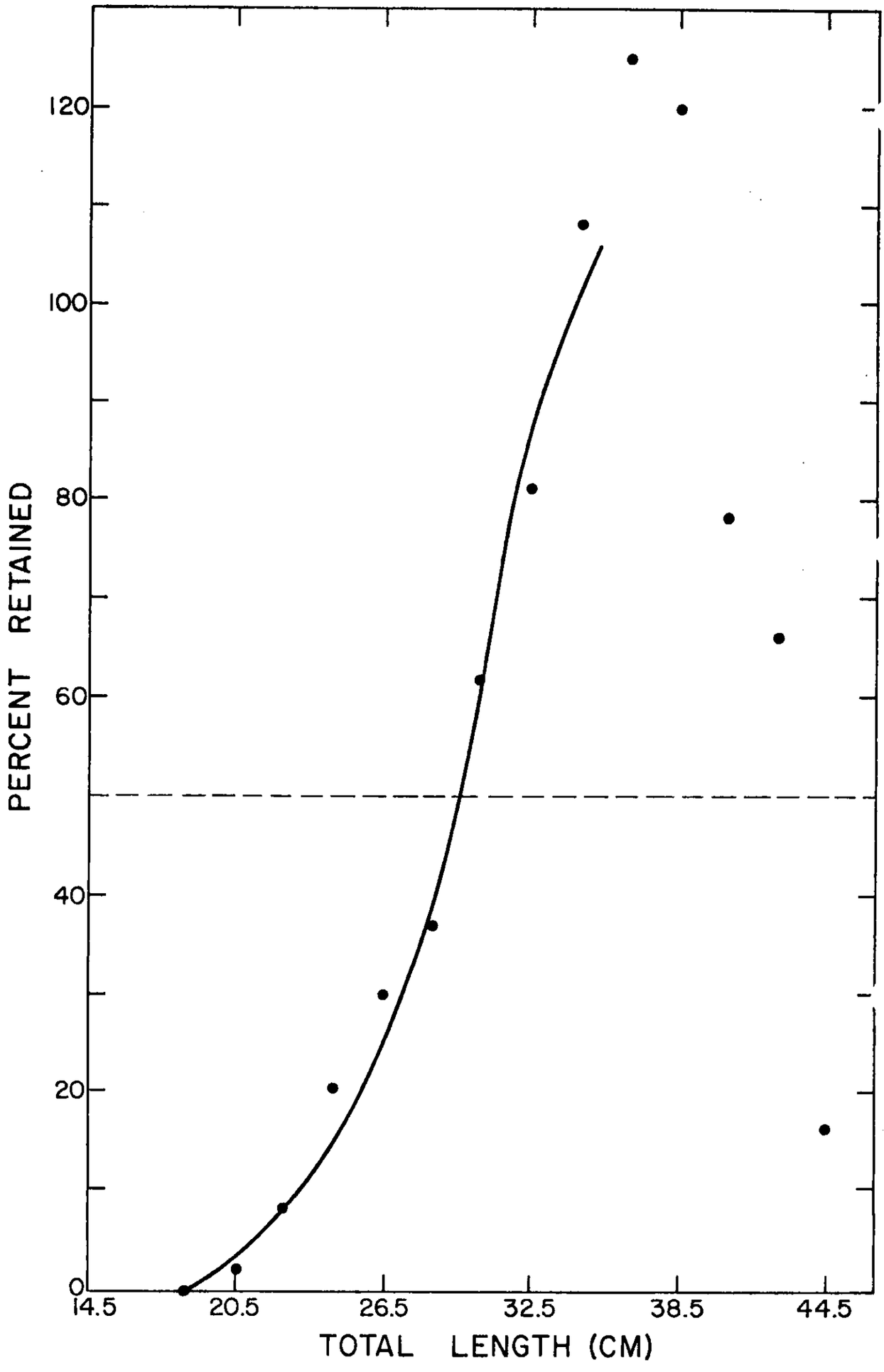

Figure 1. Selection curve for yellowtail for a 129 mm nylon codend.

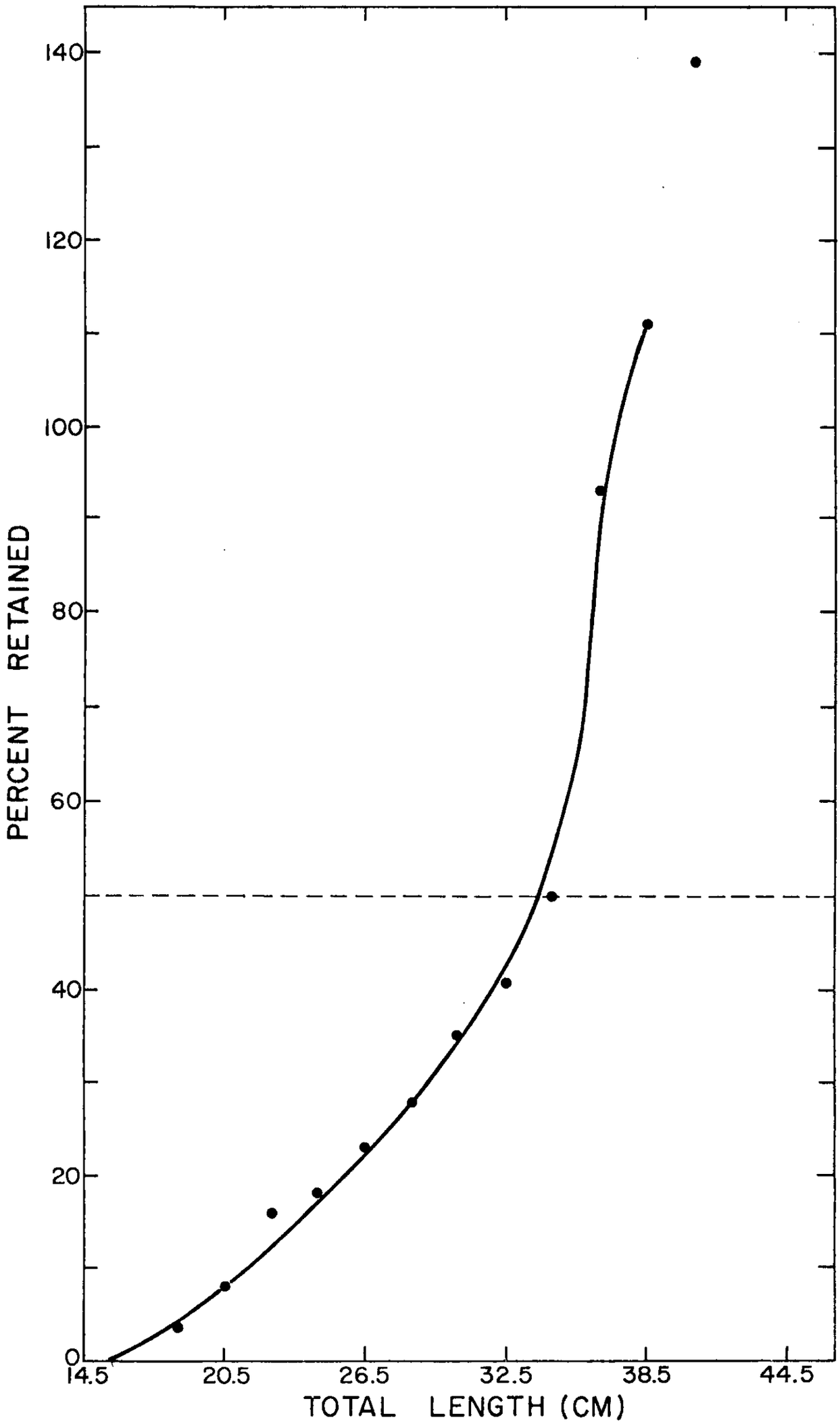

Figure 2. Selection curve for yellowtail for a 145 mm nylon codend.