Canadian Atlantic Fisheries
Scientific Advisory Committee

CAFSAC Res. Doc. 81/6

Estimates of potential yield for shrimp (Pandalus montagui) in the Eastern Hudson Strait and Ungava Bay

by

D. G. Parsons, G. E. Tucker and P. J. Veitch
Department of Fisheries and Oceans
Research and Resource Services
P.O. Box 5667
St. John's, Newfoundland
A1C 5X1

ABSTRACT

Concentrations of Pandalus montagui were found west of Resolution Island (Eastern Hudson Strait) and off Port Burwell (Ungava Bay) during an exploratory/experimental fishing survey in 1979. Data obtained from this survey were used to estimate biomass by areal expansion techniques and provide preliminary advice on potential yield. Patterns of distribution, stock composition, catch rates and by-catch were also investigated. Mean biomass estimates were 2235 and 2538 MT for the former area and 1166, 1600 and 1769 MT for the latter. Potential yield was estimated between 479 and 762 MT and 292 and 442 MT for the two areas, respectively. Catch rates in the area west of Resolution Island compare favourably with those of other shrimp fisheries and by-catches are relatively small. Shrimp discards averaged approximately 10% of the total shrimp catch but an increase in discards was expected since the limited fishery exploited a virgin stock comprising an accumulation of large, old animals. These would be reduced proportionately under sustained exploitation.

RESUME

Au cours d'un relevé de pêche expérimentale et d'exploration effectué en 1979, on a découvert des concentrations de Pandalus montagui à l'ouest de l'île Résolution (est du détroit d'Hudson) et au large de Port Burwell (baie d'Ungava). Les données recueillies ont servi à estimer la biomasse par expansion des aires et à offrir des conseils préliminaires quant au rendement potentiel. Nous avons également étudié la distribution de l'espèce, la composition des stocks, les taux de capture et les prises fortuites. Les estimations de biomasse moyenne sont de 2 235 et 2 538 tm dans la première région et de 1 166, 1 600 et 1 769 tm dans la seconde. Les estimations du rendement potentiel se situent entre 479 et 762, et 292 et 442 respectivement dans les deux régions. Les taux de capture à l'ouest de l'île Résolution se comparent favorablement avec ceux des autres pêcheries de crevettes, et les prises fortuites sont relativement faibles. Les quantités de crevettes rejetées à la mer représentent en moyenne environ 10% des prises totales de ces dernières, mais on s'attend à une augmentation. En effet, le stock exploité par une pêche limitée comprend une accumulation de crevettes âgées et de grosses taille. Une exploitation soutenue entraînerait une diminution proportionnelle de ces grosses crevettes.

INTRODUCTION

Imaqpik Fisheries Inc. (Halifax, N.S.) conducted an exploratory/experimental fishing survey in Ungava Bay and Eastern Hudson Strait from August 15 to October 6, 1979. As part of an agreement between this company and the Department of Fisheries and Oceans, Canada the data from this survey were made available to Research and Resource Services, St. John's, Newfoundland. Also, the Department supplied an observer for the duration of the cruise who contributed significantly to the collection of the data and the overall success of the cruise.

Two relatively small areas of shrimp (Pandalus montagui) concentration (Fig. 1) produced good catch rates some of which exceeded 1000 kg per hour. In response to this success, industry requested access to these areas in 1980 and accordingly three management areas were established. Two enclosed the areas of concentration from which 100 MT of shrimp could be taken in each and the third included grounds outside the former two from which an additional 100 MT could be taken. Preliminary catch statistics indicate that the total catch from these areas in 1980 was approximately 236 MT most of which was taken just west of Resolution Island.

This exercise was designed to compile and interpret the data available on shrimp from this region for 1979 and 1980 and produce preliminary estimates of potential yield. Since very little biological data exist, results can only be considered in very general terms.

METHODS AND MATERIALS

The vessel chartered for the survey, M.V. Torsbugvin, used a Sputnik 1600 shrimp trawl which has a codend mesh size of approximately 40 mm (stretched). The horizontal opening of this trawl has been estimated at 22 m (Parsons et al. 1980) and the vessel's towing speed averaged 1.8 knots.

Minimum trawlable biomass was estimated using the swept area (volume) technique and incorporated all sets within the two areas of shrimp abundance. Biomass was not calculated for the remaining survey area because of relatively low densities. Stratification of the areas off Port Burwell and West of Resolution Island was based on depth and shrimp density (Fig. 2-5). Depth in metres and kilograms of shrimp per hour fished were plotted for each fishing set and contoured by computer. In a few cases anomalously large catches would heavily influence the density contours and were omitted. They were, however, included with other sets within the depth stratification. Slight adjustments were made in the positioning of two sets where depth data were lacking.

Additional information on catch composition and catch per unit effort for 1980 was interpreted from observer's reports and vessel logs. Carapace lengths for shrimp were recorded to the nearest 0.5 mm and are available from both the survey in 1979 and commercial fishing in 1980.

RESULTS AND DISCUSSION

1. BIOMASS

An area of 120-130 sq. n. miles off Port Burwell produced biomass estimates of 1166 and 1600 MT for density and depth stratifications, respectively (Tables 1 and 2). Variance associated with both methods was relatively high with 95% confidence limits occurring at ±55% of the mean figure. Sample density was approximately 1 set for every 5 sq. n. miles. Confidence limits are improved slightly (±42%) if the area is treated as a single unit using all sets. The estimate of biomass, however, then increases to 1769 MT.

The area west of Resolution Island was roughly 190 sq. n. miles and biomass estimates were 2,235 and 2,538 MT for density and depth methods, respectively (Tables 3 and 4). Sampling density averaged 1 set for every

4 sq. n. miles and variance associated with these results was much lower than in the other area. The depth stratification produced 95% confidence limits ±20% of the mean and the density technique only ±14%. Considering both methods and their confidence limits, minimum trawlable biomass could be between 1916 and 3049 MT.

Estimates of trawlable biomass considered here have been described as minimum for two main reasons. Firstly, the assumption that the net is completely efficient and catches all shrimp in its path is highly unlikely. Secondly, diel vertical migration patterns (demonstrated for many shrimp stocks) have not been accounted for and sets made in both darkness and daylight have been used in the calculations. In relation to the latter, an initial inspection of the catch data indicated considerable variability even within daylight hours. Sets made in darkness were relatively few and also showed high variability. For these reasons it was felt that the inclusion of sets made during darkness would, in fact, improve precision of the estimates by increasing sample size and not contribute greatly to underestimating biomass.

Since no relevant biological data have been interpreted for these areas the only model available to predict yield is that of Fréchette (described by Labonté, 1980). Based on the history of the Sept-Iles shrimp fishery, removals of 40% of the exploited biomass appear sustainable. This corresponds to 25% of a virgin biomass.

The grounds off Port Burwell in Ungava Bay provide highly variable catch rates of shrimp and confidence limits are too wide for use in any practical application of TAC. The mean values themselves range from 1166 to 1769 MT and by the above approximation a catch between 292 and 442 MT might apply.

Data from the area west of Resolution Island are much less variable and provide a rare opportunity when a reasonable range can be obtained by using

the confidence limits from two mean estimates. The extreme lower and upper levels of 1916 and 3049 MT when applied to the same formula indicate that catches between 479 and 762 MT may be sustainable.

2. CHARACTERISTICS OF A LIMITED FISHERY - 1980

Most fishing in 1980 occurred in the area west of Resolution Island. Limited effort in other areas including the grounds off Port Burwell produced very low catch rates. There is a possibility that effort in the latter was at unfavourable depths (Jones pers comm.) and may not be applicable as an index of change in abundance between 1979 and 1980. Areas of greatest shrimp density occur at different depths in the two regions of concentrations, vis. between 200 and 300 m in the Hudson Strait and 300 and 400 m in Ungava Bay. The relationship is probably due to temperature and/or substrate.

Catch rates in the more northerly area compared favourably with those obtained in the initial survey in 1979, although they are not directly comparable. Observer data indicate catch rates of 750 kg and 900 kg for September and October. Information from vessel logs (Table 5) suggests high variation in fishing success both between days and between vessels.

No discards of shrimp were reported on vessel logs, however, observer reports indicated discards ranged between 0 and 60% of the total shrimp catch. The average from the available data was 10%.

By-catch also appears variable but is small relative to shrimp catches. Main species of by-catch include Greenland halibut, Arctic cod and thorny skate with lesser amounts of wolffishes, roughhead grenadier, cod, American plaice and redfish. Odd specimens of Greenland shark also occur.

3. SIZE COMPOSITION OF THE SHRIMP STOCKS

Pandalus montagui attains a smaller average size than does P. borealis. Data from 1979 and 1980 represent conditions of a virgin stock and an accumulation of large, old animals. Under sustained fishing pressure the average size obtained will decrease.

Length frequencies from the 1979 survey in the southern area are presented in Figure 6. A higher proportion of smaller animals occurred in the shallowest depth stratum while in the area where most biomass was found (326-350 m) the majority were in the 22-23 mm (carapace length) range. Approximately 30% of all animals were ovigerous at the time of the survey.

In 1980 commercial activity in this area was minimal. Size distribution (Fig. 7) shows modes at 20 mm and 22-24 mm and a scarcity of animals from 15-18 mm. The samples, taken in October, were around 35% ovigerous.

The area off Resolution Island (Fig. 8) produced samples which showed a bimodal distribution (20 and 24 mm) in the 1979 survey. Notably absent in this area are shrimp in the 15-18 mm range which occurred frequently in the former area. Ovigerous animals comprised roughly 30% of the total in this area as well.

The 1980 commercial data are available for September and October (Fig. 9 and 10). Distribution in September was again bimodal at 20 and 24 mm and 30% of the animals were ovigerous. Samples for October show the same modes but the ovigerous animals increased to 40%.

The limited data for both areas suggest spawning is ongoing during August to October with the proportion of ovigerous animals increasing during this time. The data also indicate that a significant proportion of the larger animals, presumably females, will not spawn in the current year. Seasonal data on catch composition and biological samples for maturity are lacking, but

there are indications that some females, at least, may spawn every second year.

CONCLUSIONS

Research and commercial data for 1979 and 1980 show two relatively small areas of shrimp (Pandalus montagui) concentrations in and around the Hudson Strait-Ungava Bay area. Biomass estimates have been made and indicate that removals of 300-450 MT annually may be sustainable on the grounds off Port Burwell while the area of Resolution Island could support an annual harvest of 500-750 MT. As in any pandalid resource the concept of sustainability is questionable and it is interesting to note that limited effort in the area off Port Burwell in 1980 did not produce catch rates obtained in the 1979 survey.

The size of shrimp caught by commercial vessels in 1980 are of good marketable size, however, under exploitation the average size can be expected to decrease. This species is smaller than P. borealis and, using the discarding practices in Labrador fisheries as a model (Parsons et al. 1981), the potential for considerable discarding becomes obvious. On the other hand, by-catch of other species does not appear to be a problem at this time.

The interaction of these shrimp resources with other species of marine fish and mammals is not known. Over-exploitation could result in serious environmental and social problems. Until these interactions are further investigated a cautious approach to exploitation is suggested.

REFERENCES

Labonté, S.S.M. 1980. An assessment of shrimp stocks off southeast Cape Breton, south Esquiman and north Anticosti. CAFSAC Res. Doc. 80/67, 46 p.

Parsons, D. G., G. E. Tucker, and P. J. Veitch. 1980. Status of the Labrador pink shrimp resources, Divisions 2H and 2J. CAFSAC Res. Doc. 80/14, 44 p.

1981. Review of abundance indices and stock assessment for shrimp (Pandalus borealis) in the Labrador Channels. CAFSAC Res. Doc. 81/7, 40 p.

Table 1. Minimum trawlable biomass stratified by shrimp density and 95% confidence limits in Port Burwell (Ungava Bay) 1979.

Stratum	C/HR (kgs)	Area (sq. n. mi)	No. sets	Biomass (m tons)
21	>800	9.5	3	274
22	401-800	10.2	2	202
23	201-400	38.7	5	489
24	<200	60.8	11	190
25	201-400	1.3	3	11
Total		120.5	24	1,166±637

Table 2. Minimum trawlable biomass stratified by depth and 95% confidence limits in Port Burwell (Ungava Bay) 1979.

Stratum	Depth Range (m)	Area (Sq. n. mi.)	No. sets	Biomass (m tons)
31	>350	6.5	2	4
32	326-350	65.1	8	956
33	>375	1.5	3	30
34	>350	0.5	2	10
35	301-325	30.1	5	260
36	>350	4.0	2	124
37	<300	19.1	2	68
38	>325	6.4	2	148
Total		133.2	26	1,600±832
All sets combined, all depths		133.2	26	1,769±741

Table 3. Minimum trawlable biomass stratified by shrimp density and 95% confidence limits in Resolution I. (Hudson Strait) 1979.

Stratum	C/hr (kgs)	Area (sq. n. mi)	No. sets	Biomass (m tons)
1	<200	32.1	7	119
2	<200	7.8	3	59
3	<200	16.3	2	39
4	<200	1.8	2	11
5	<200	6.6	3	47
6	201-400	110.4	24	1675
7	401-600	2.2	2	46
8	601-800	3.0	3	106
9	>500	4.8	2	133
Total		185.0	48	2,235±318

Table 4. Minimum Trawlable biomass stratified by depth and 95% confidence limits in Resolution I.(Hudson Strait) 1979.

Stratum	Depth Range (m)	Area (sq. n. mi)	No. sets	Biomass (m tons)
11	<250	27.1	4	201
12	251-275	136.9	32	1980
13	276-300	13.2	2	65
14	>275	1.6	2	48
15	>275	8.6	4	144
16	>275	3.0	3	88
17	>300	4.6	2	12
Totals		195.0	49	2,538±511

Table 5. Resolution Island (Hudson Strait) catch and CPUE, 1980 (from vessel logs).

Date	Catch kgs	CPUE kgs	
Oct.			
2	5221	307	
3	9765	543	
4	9835	579	Vessel A
5	12360	687	
6	8420	468	
7	2660	296	
11	37500	2534	
12	28500	3000	
13	19000	1092	Vessel B
14	10500	955	
Total	143761	960	

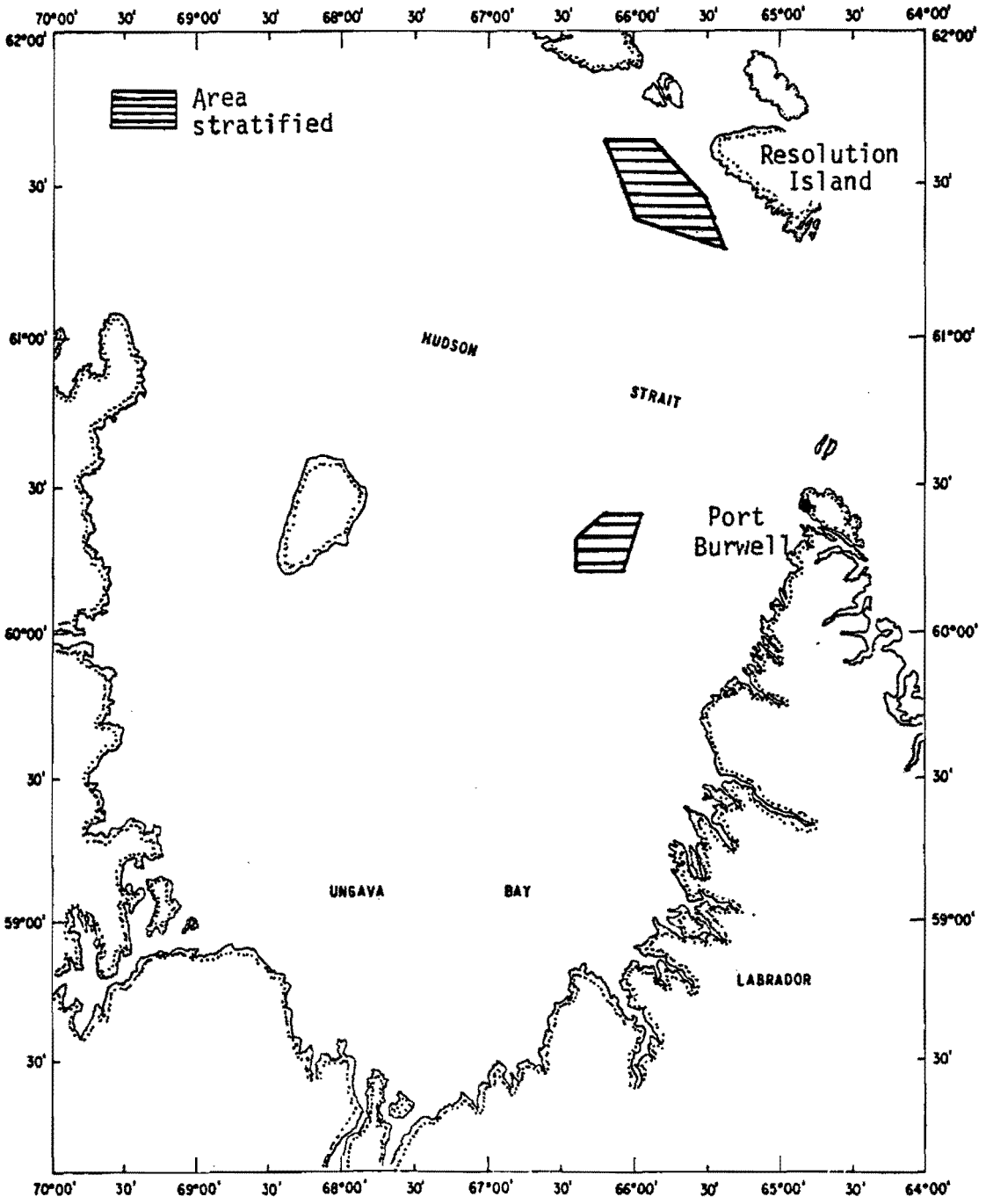

Fig. 1. Areas of shrimp concentrations in Resolution I. (Hudson Strait) and Port Burwell (Ungava Bay).

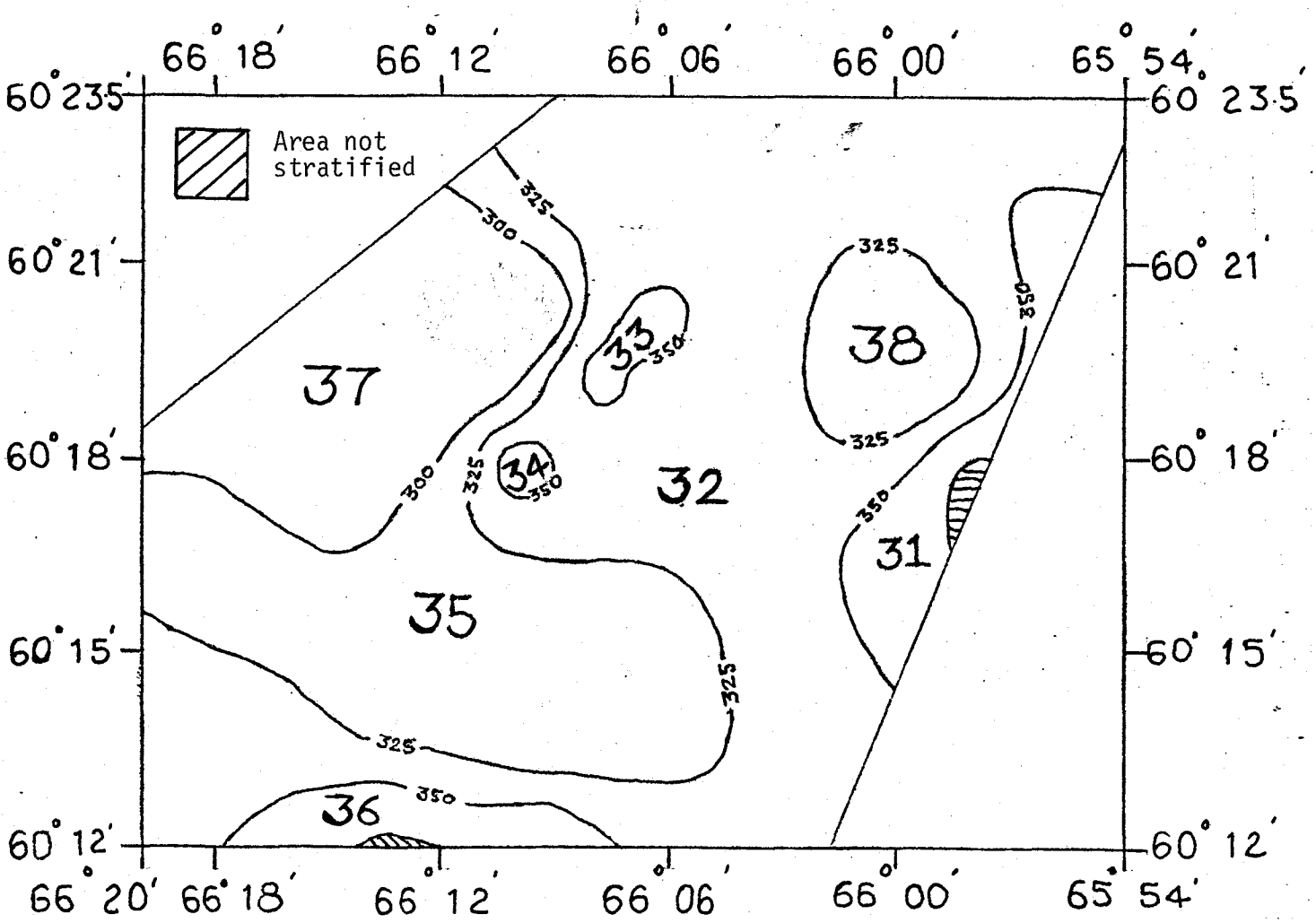

Fig. 2. Port Burwell (Ungava Bay). Depth stratification, metres. Depth is indicated on the contour lines and strata numbers are given between.

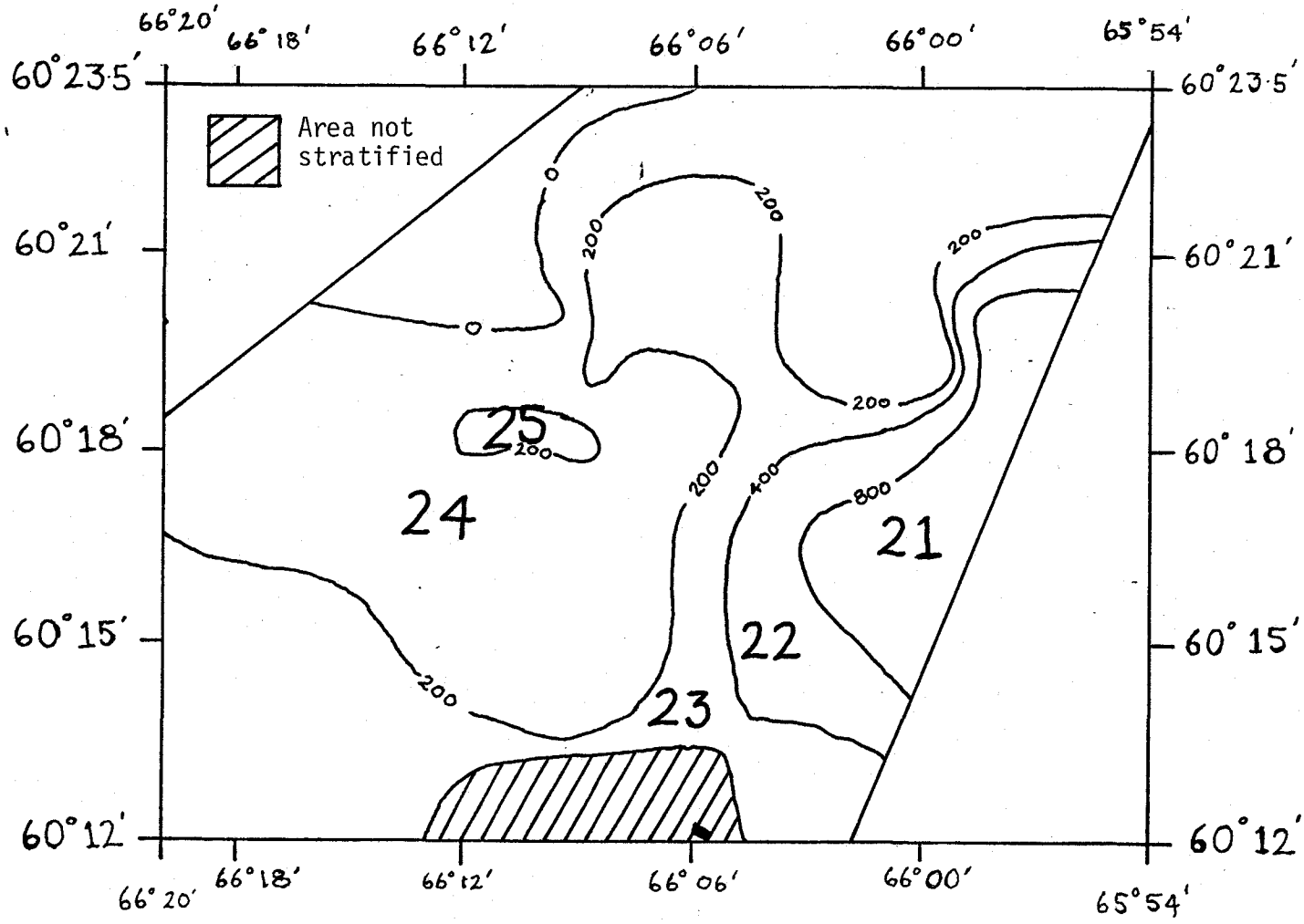

Fig. 3. Port Burwell (Ungava Bay). Density stratification (kg/hr). Density is indicated on the contour lines and strata numbers are given between.

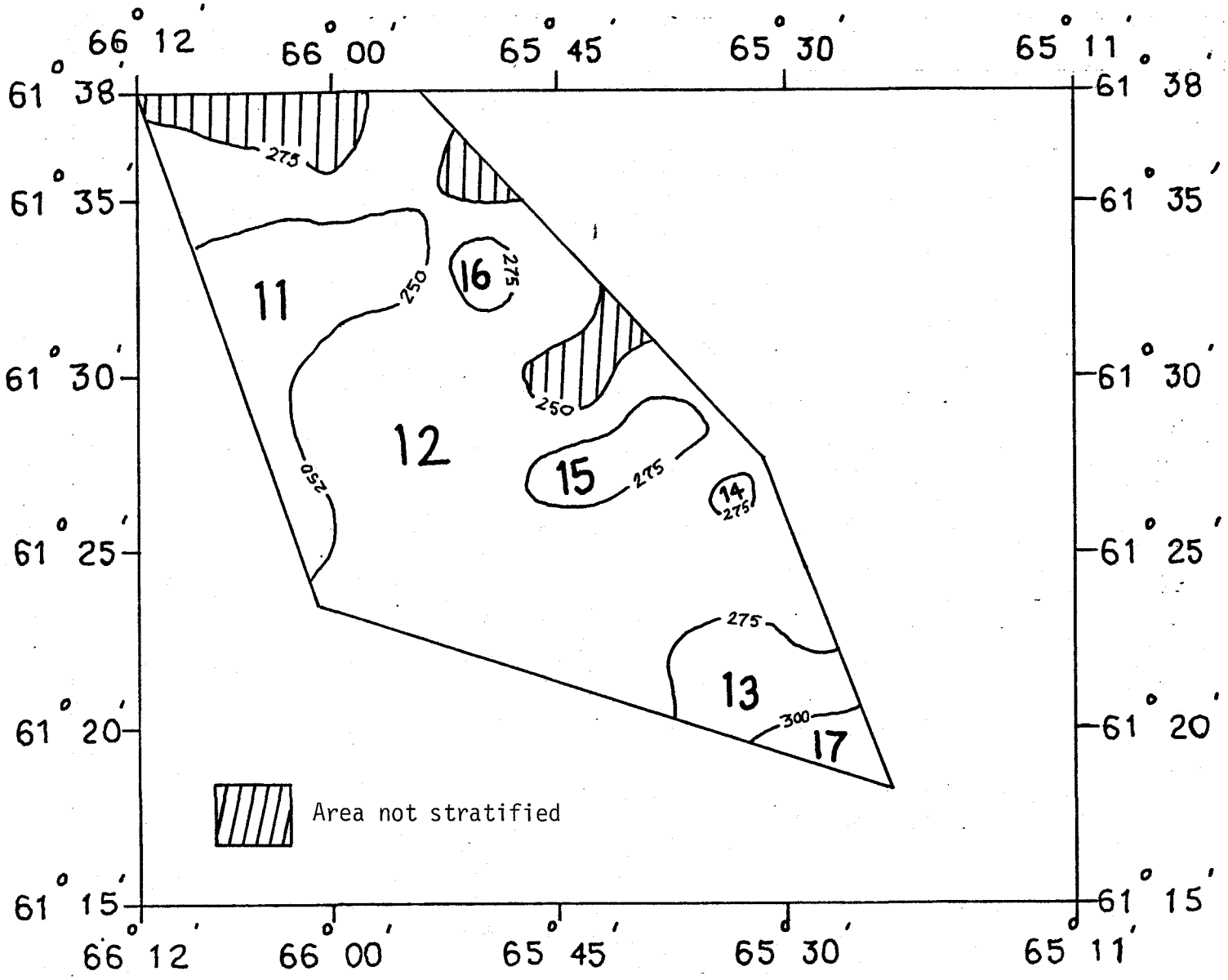

Fig. 4. Resolution I. (Hudson Strait). Depth stratification, metres. Depth is indicated on the contour lines and strata numbers are given between.

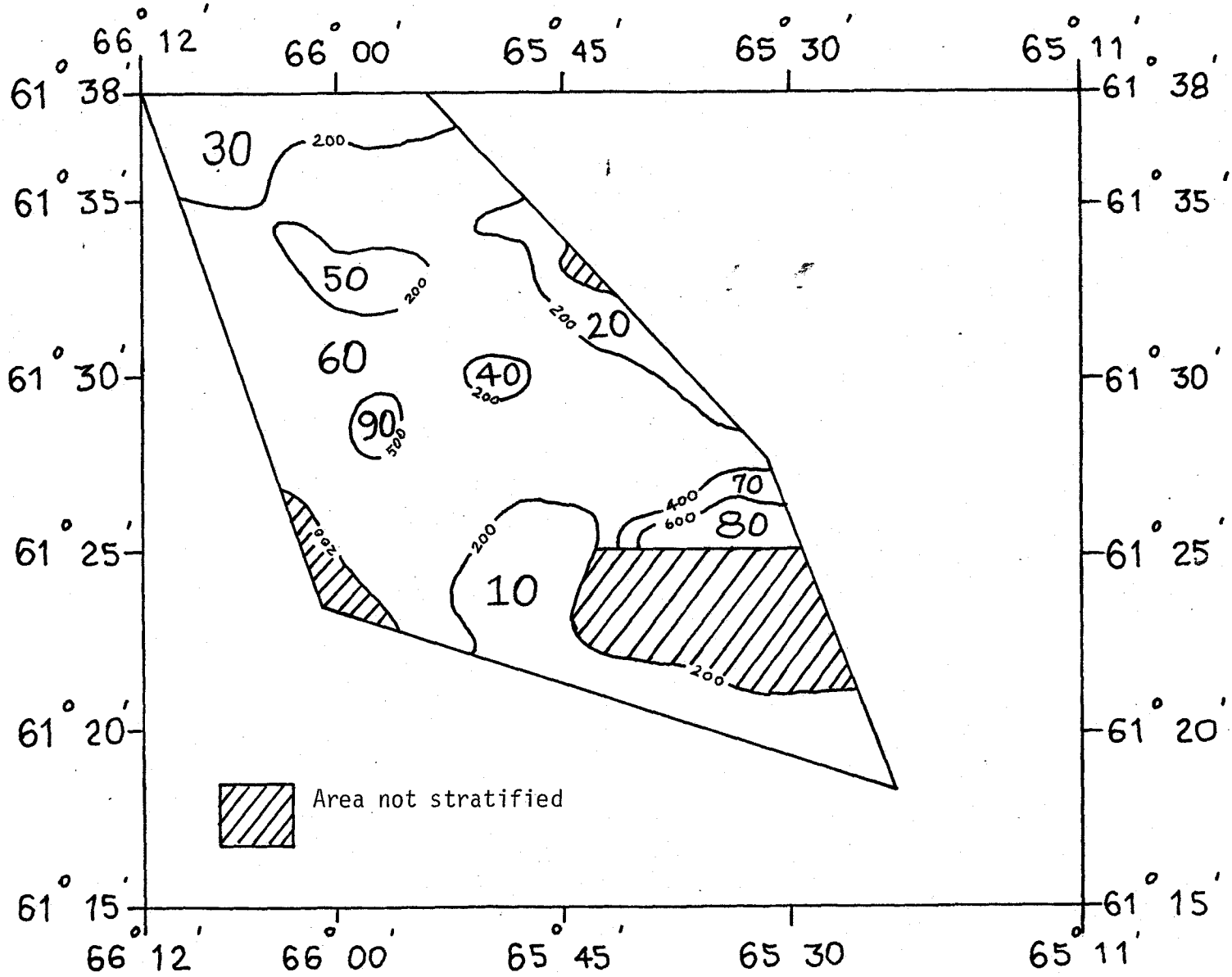

Fig. 5. Resolution I. (Hudson Strait). Density stratification (kg/hr). Density is indicated on the contour lines and strata numbers are given between.

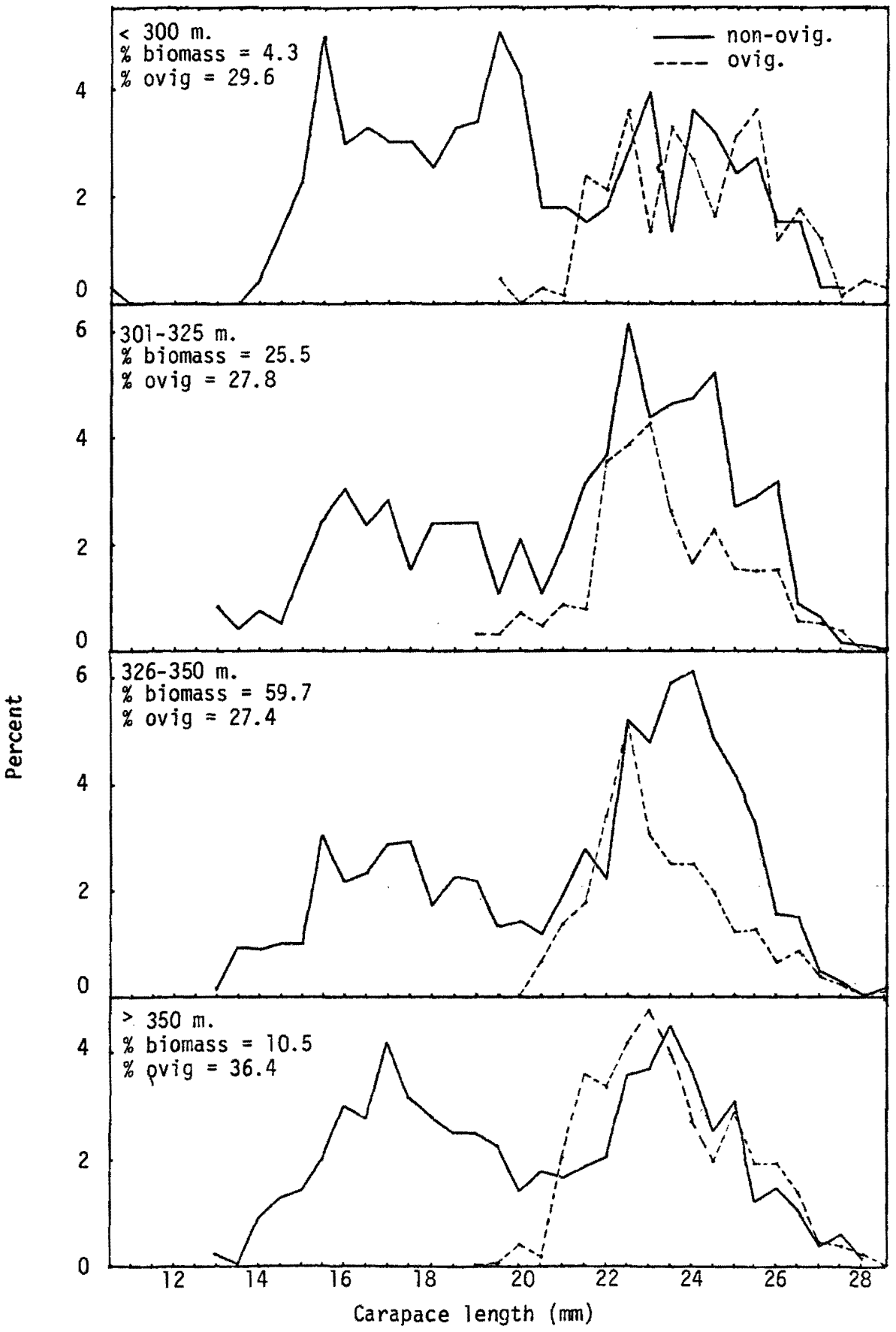

Fig. 6. Length frequencies, 1979, Port Burwell (Ungava Bay).

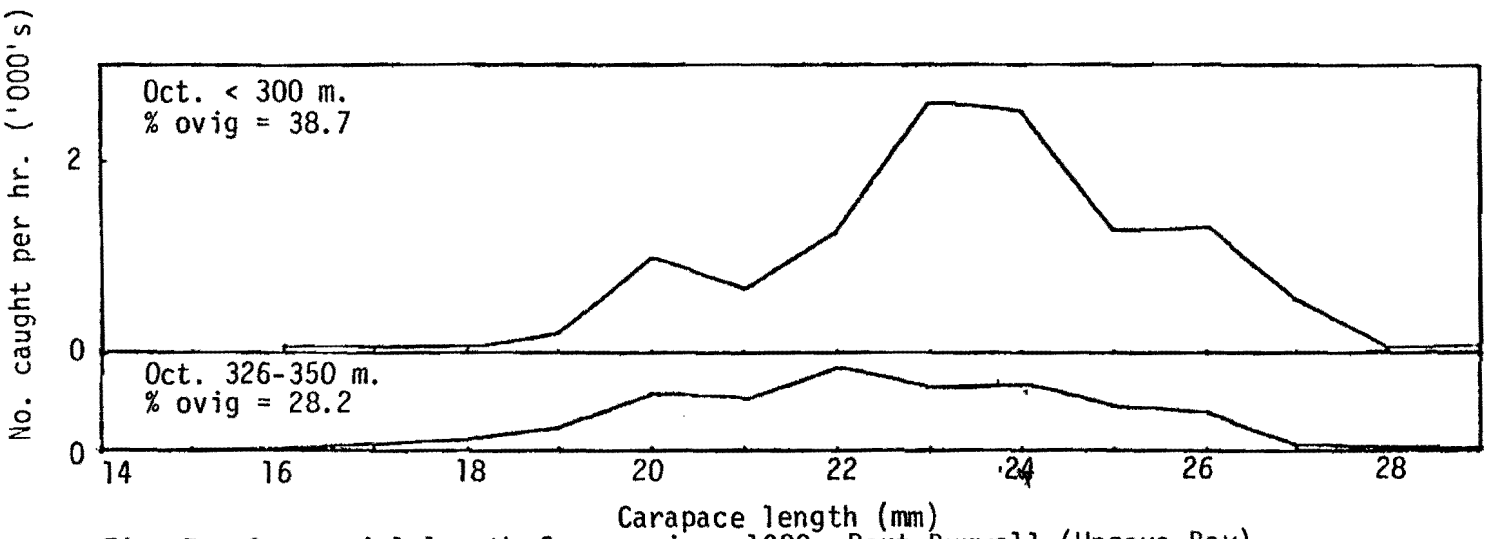

Fig. 7. Commercial length frequencies, 1980, Port Burwell (Ungava Bay).

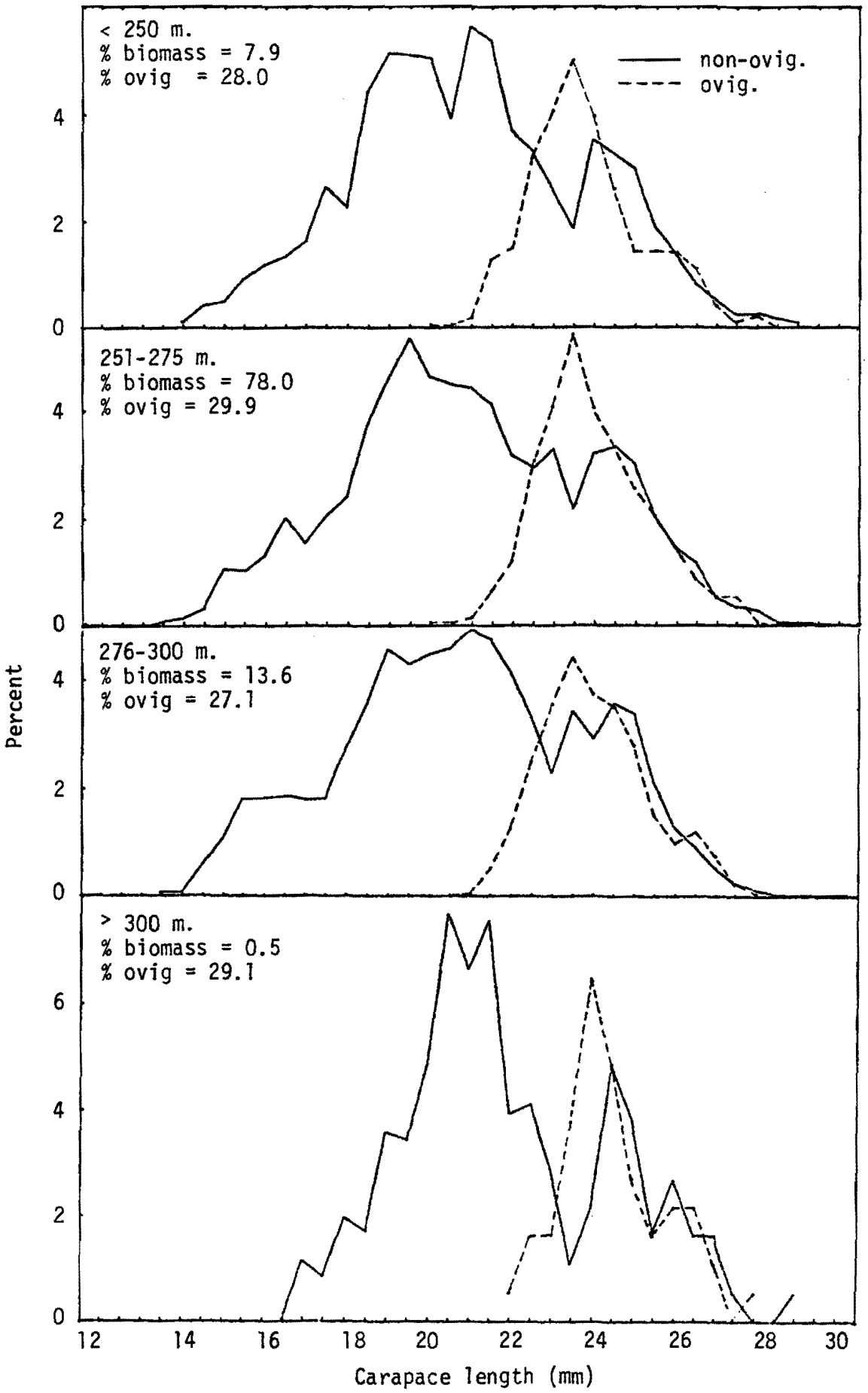

Fig. 8. Length frequencies, 1979, Resolution I. (Hudson Strait).

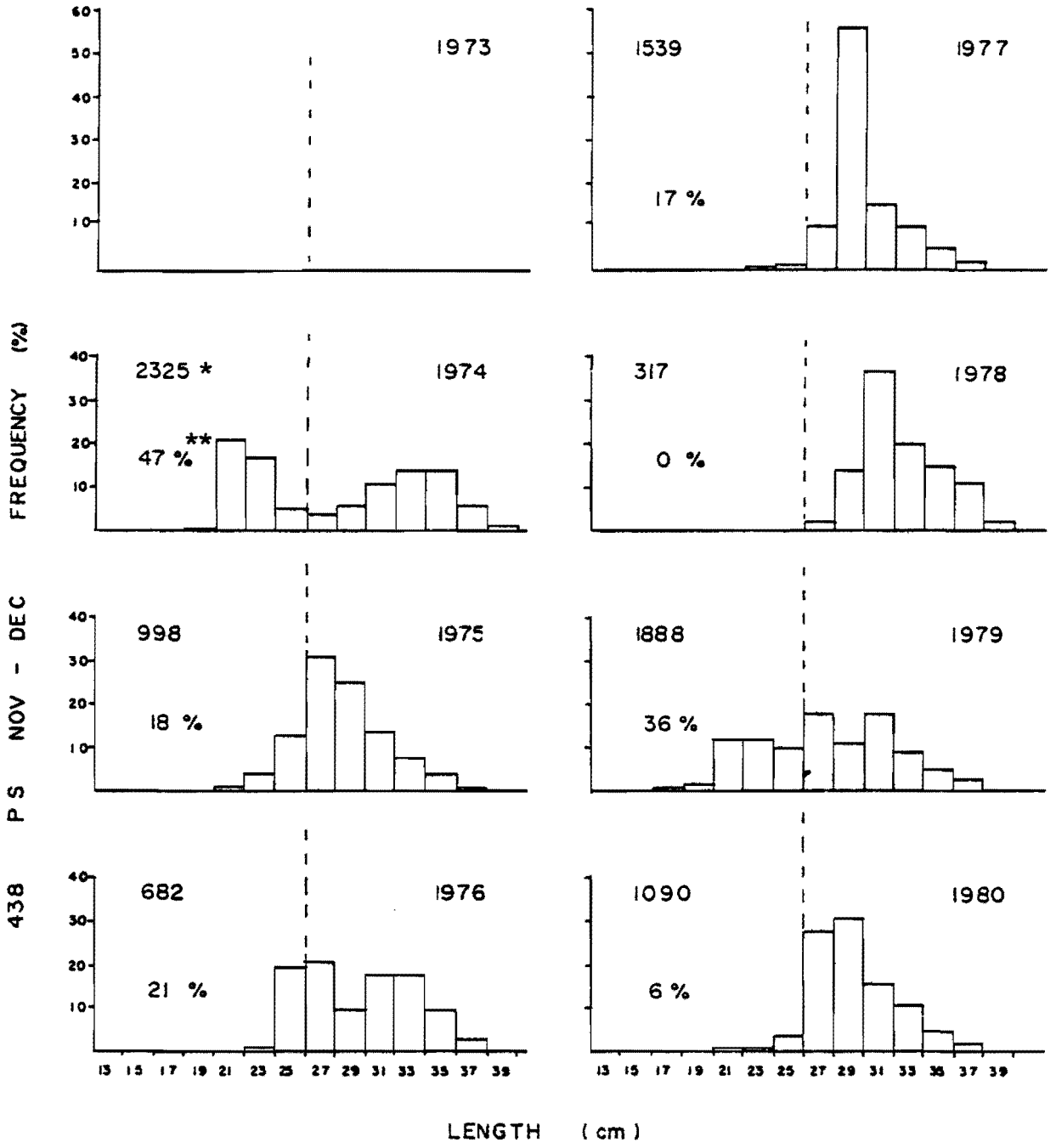

Fig. 5. Length frequency of herring caught by purse seiners in NAFO area 438, in November- December.

* number of observations
** percentage of fish smaller than 270mm.

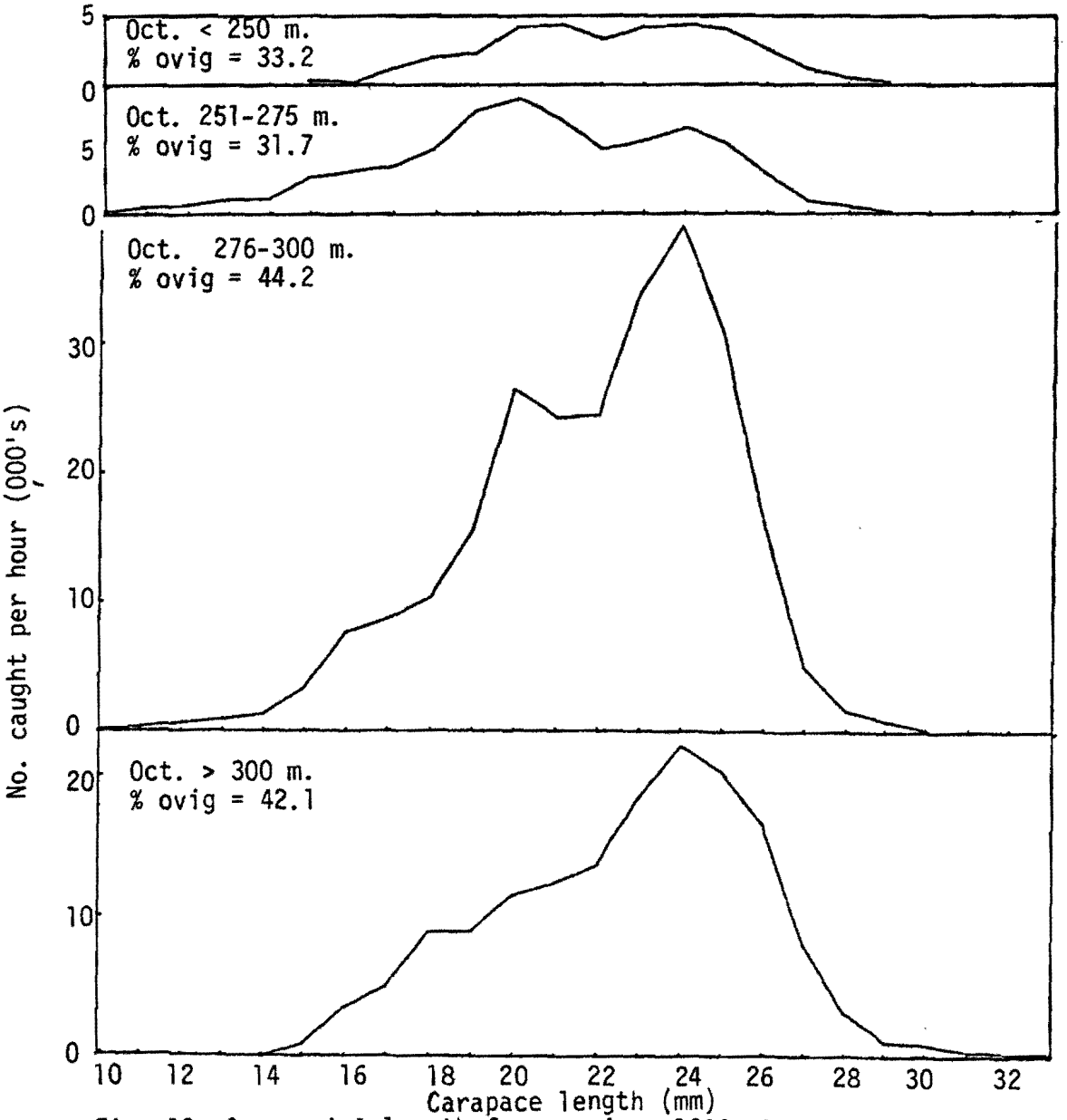

Fig. 10. Commercial length frequencies, 1980, Resolution I. (Hudson Strait).