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The Fishery for Striped Pink Shrimp, Pandalus montagui, in Ungava Bay and Eastern Hudson Strait in 1986

by

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Abstract

Details of limited commercial fishing in eastern Hudson Strait and Ungava Bay in 1986 are reviewed. Catch and effort data show that catch rates in both areas were extremely high (5000-8000 kg/hr) and that much of the time on the grounds was spent processing the catch. The 1986 catch rates were substantially higher than reported previously for these areas. In Ungava Bay there appears to have been an increase in abundance from 1982 levels, as well as a shift in distribution. In Hudson Strait, distribution appears to have shifted to more southerly and deeper waters than in 1982 but it was difficult to interpret changes in abundance. These changes and apparent changes in size composition indicate a dynamic system in which the key parameters are not understood. Advice on exploitation is provided.

Résumé

On a examiné les particularités de a pêche commerciale restreinte pratiquée dans la baie d'Ungava et l'est du détroit d'Hudson en 1986. Les données sur les prises et l'effort révèlent des captures extrêmement élevées (5000 à 8000 kg/h) et qu'une part importante du temps passé sur les lieux de pêche est consacrée à la transformation des prises. Les taux de prise en 1986 étaient substantiellement plus élevés que ceux signalés dans ces régions pour les années antérieures. Dans la baie d'Ungava il semble y avoir eu un accroissement de l'abondance par rapport aux niveaux de 1982 ainsi qu'une modification de la répartition. Dans le détroit d'Hudson les espèces semblent s'être déplacées vers le sud et vers les eaux plus profondes par rapport à 1982, mais il était difficile d'interpréter les modifications de l'abondance. Ces changements et changements apparents de la composition par tailles indiquent l'existence d'un système dynamique dans lequel les paramètres clés ne sont pas compris. On fourni des conseils quant à l'exploitation.

Introduction

History of the Fishery

Concentrations of Pandalus montagui have been known to occur in the Ungava Bay-Hudson Strait area for some time (e.g. Squires 1970) but it was not until the late 1970's that exploratory/experimental fishing revealed that these concentrations could be harvested commercially (Parsons et al. 1981, 1983). Based on the results obtained from experimental fishing in 1979 (total catch about 90 t), industry requested access to the area in 1980. Three management zones were established, two enclosing areas of concentration from which 100 t of shrimp could be taken in each and an additional area outside the former two from which another 100 t could be taken. The catch for 1980 (about 240 t) was taken primarily in one area of concentration in Hudson Strait, just west of Resolution Island (Fig. 1). A small amount of exploratory fishing was conducted in 1981 but only 3.7 t were taken in Ungava Bay and 9.1 t in Hudson Strait.

Since 1981, there had been no commercial fishing activity in these areas until 1986. The catch levels advised for 1980 remained in effect for 1981 and 1982. The TAC for 1983 in eastern Hudson Strait was increased to 750 t based on the results of a 1982 research survey which provided an estimate of biomass of 3000 t in a previously-defined commercial zone. Because little was known about the productivity of these stocks, a more conservative exploitation rate of 25% was used rather than the 35% for P. borealis. Biomass over the whole area surveyed in eastern Hudson Strait was estimated at 6600 t. Research catches throughout Ungava Bay were so low in 1982 that it was doubtful that the observed densities would attract commercial effort. The previously advised, pre-emptive TAC of 100 t was maintained, however, to control exploitation, should a fishery develop. These TAC's have remained in effect up to and including 1986.

One large, modern trawler was permitted to fish in these areas in 1986. Preliminary catch statistics suggest that 377 t were taken in eastern Hudson Strait and 99 t in Ungava Bay. Early reports indicated that catch rates were extremely high and that fishing effort was concentrated outside the previously identified commercial zones, in areas where densities were low during the 1982 research survey. An observer from the Quebec Region was onboard the vessel during this period and provided data on catch rates, discards, and size composition of shrimp catches as well as biological samples.

This paper reviews the data from the 1986 fishery and compares the findings to the limited amount of information from activities in these areas in previous years.

Results

Effort and Catch Per Unit Effort

The distribution of fishing effort in 1986 as determined from vessel logs is shown in Figures 2 and 3 for Ungava Bay and Hudson Strait, respectively. A total of 3 days was spent in Ungava Bay during which 15 fishing sets were made in an area extending from 60°26'N, 65°56'W to 60°41'N, 65°39'W, in depths of 350-370 m. The catch of 99.8 t was taken in only 20 hours of fishing for a mean catch rate of 5000 kg per hour. Effort decreased from about 14 hours on the first day to less than 1 hour on the third.

CPUE increased from 2,150 kg/hr on day one to 11,500 and 17,360 kg/hr on days two and three (Table 1). Recorded discards were less than 1%.

In Hudson Strait, a total of 57 sets were made in 11 fishing days in a small area around 61°20'N, 65°25'W (Fig. 3). Depths ranged from about 300 to 370 m. Daily fishing effort never exceeded 7 hours, indicating that most of the time on the grounds was spent processing the catch. Catch rates were variable, ranging from 2,800 to 15,700 kg/hr. These are likely to be more reflective of vessel activities rather than daily variations in shrimp density. Discards were less than 1% of the total shrimp catch on most days and the average for the 365 t reported in logs was 0.6%, similar to Ungava Bay.

Observer data on CPUE and discards agreed well with those from vessel logs. Catch per hour was estimated at 5077 kg and 8801 kg for Ungava Bay and Hudson Strait, respectively. Discards for both areas averaged 0.7% of the total shrimp catch.

Size Composition

The composite length distribution of shrimp taken in Ungava Bay (Fig. 4) shows most shrimp occurring in the size range of 18-26 mm carapace length (CL). About 27% of all shrimp sampled were ovigerous with a single mode at 22 mm CL. Non-ovigerous shrimp showed a strong mode at 21 mm with indications of smaller components at 15-16 and 18-19 mm.

In Hudson Strait, length distributions were separated by depth, 301-350 m and 351-400 m (Fig. 4). In the shallower water, two modal groups were obvious, non-ovigerous shrimp at 19 mm and ovigerous females at 22 mm. In the deeper water, non-ovigerous shrimp again showed a strong mode at 19 mm with indications of another at 22 mm. Ovigerous females were slightly larger with a prominent mode at 22-23 mm.

Length distributions for discards (Fig. 5) show high proportions of shrimp in the smaller modal sizes (16 and 18 mm) in Ungava Bay. In Hudson Strait, a mode at 17 mm is evident in the discard data, which was not observed in the catch data.

Biological Sampling

One preserved (10% formalin) sample was analyzed for each of Ungava Bay and eastern Hudson Strait. Animals were measured and sex and maturity stages were determined. A total length frequency and a separation into male, non-ovigerous female and ovigerous female groups for Ungava Bay are given in Figure 6. Mature males (13.5-22 mm CL) comprised 31% (n = 132) of the 425 shrimp sampled; there were no transitional stages and only 1 of 231 non-ovigerous females possessed sternal spines (McCrary 1971). Most (210) non-ovigerous females (18.5-26 mm CL) had small ovaries and would not have spawned in 1986. The remaining 20 (20.5-27 mm CL) had large ova and, most likely, would have laid eggs later in the season. Ovigerous shrimp (n = 62) ranging in size from 19.5 to 27 mm CL, comprised 21% of the total number of females.

Similar data for eastern Hudson Strait are shown in Figure 7. Males were mature (13-22.5 mm) and comprised 41% (n = 168) of the sample of 412 shrimp. There were 3 transitionals (19.5-20.5 mm) with small ovaries and no females with prominent sternal spines were observed. A total of 46 non-ovigerous females ranging in size from 19.5 to

27.5 mm CL had reduced or no spines and 39 (85%) of those possessed small ovaries. Most females (195 or 80%) were ovigerous and ranged in size from 19.5 to 27.5 mm.

Age Composition

No attempt was made to interpret the actual ages of the shrimp in these commercial samples because data from the smallest sizes were lacking. The Macdonald and Pitcher (1979) method for separating normal components was applied to the samples from both areas to provide a breakdown by possible age classes.

Results of the analysis for the Ungava Bay sample (Table 2, Fig. 6) suggest three age groups of males with average lengths of 15.3, 17.6, and 19.1 mm CL. The non-ovigerous females were split into two groups at 21.0 and 23.4 mm. Ovigerous females were essentially unimodal with an average size of 22.5 mm. All non-ovigerous females lacked sternal spines and could be interpreted as multiparous (F^2). Therefore, all primiparous females must be included in the ovigerous group (F^0). Given the above, the age composition of the sample from Ungava Bay in 1986 might be:

Age class	1	2	3	4	5	6+	Total
Sex	M	M	M	F^0	F^2	F^2	-
Av. length	15.3	17.6	19.1	22.5	21.0	23.4	-
No.	44	41	47	62	198	33	425
%	10.4	9.6	11.1	14.6	46.6	7.8	100.0

The average length of age class 4 is likely an overestimate because of the possible inclusion of some multiparous ovigerous females. Age class 5 average length could also be underestimated because of the inclusion of some primiparous females which have lost spines just prior to egg extrusion. The 6+ group likely represents more than one cohort.

If one interprets the peaks at 17 and 21 mm for males in the Hudson Strait sample as 'noise' (Fig. 7), then two age groups of males can be objectively estimated by the Macdonald and Pitcher analysis (Table 3) which agree well with the two older age groups from the previous analysis. Average lengths were estimated at 17.3 and 19.3 mm. Non-ovigerous females were separated into two groups with mean lengths of 21.3 and 23.6 mm. At least two groups also can be interpreted from the ovigerous females with average lengths of 21.2 and 23.8 mm. The two age classes of males might correspond to age classes 2 and 3 from the Ungava Bay sample, but the explanation of the age structure for females is more difficult. Primiparous females might be represented within the ovigerous component with average length of 21.2 mm but there is, as well, a multiparous non-ovigerous group at almost the same size. The ovigerous group at 23.8 mm appears to coincide with the non-ovigerous group at 23.6 mm and if so, likely represent a number of cohorts. Using the same designation as for Ungava Bay we have:

Age class	1	2	3	4	5	6+	Total
Sex	-	M	M	F^0	F^2	F^2+F^0	
Av. length	-	17.3	19.3	21.2	21.3	23.8	
No.	-	96	72	95	24	125	412
%	-	23.3	17.5	23.1	5.8	30.3	100.0

Discussion

Effort and Catch Per Unit Effort

The areas fished in Ungava Bay in 1986 (Fig. 2) were farther north than areas fished previously during commercial operations. Most fishing in 1986 occurred at depths greater than 350 m where highest densities were found in 1979. However, limited commercial effort in the area in 1980 and 1981 produced low catches as did research effort in 1982. Catch rates from previous years are not comparable to the 1986 data because of differences in vessels, gear and type of fishing (i.e. commercial vs exploratory/research). Thus, changes in abundance are not quantifiable but it is obvious from the very high catch rates that abundance in 1986 was higher than observed during the research survey of 1982.

Fishing effort west of Resolution Island in 1986 (Fig. 3) was concentrated in a relatively small area (<75 sq km) which was south of the previously defined commercial zone. Depths fished (300-370 m) were deeper than those reported as areas of highest density during the 1979-82 period (200-300 m). Commercial catch rates in 1980 varied from 300 to 3000 kg/hr but were quite different between the two vessels that fished the area. In 1981, one catch of over 7 t was reported from one hour of fishing but other catch rates were much lower (25 kg to 872 kg/hr). The extremely high catch rates of 1986 (Table 1) cannot be used to determine changes in abundance from previous years for the same reasons as given above for Ungava Bay. It appears, however, that distribution might have changed in that effort was concentrated farther south and in deeper water than areas of highest abundance determined from data of previous years.

The low rates of discards reported both by the observer and in the vessel logs indicate that no problem exists under current market conditions. However, if a preference for the larger sizes again emerges, the potential for substantial discarding is high.

Size Composition

The commercial catch in Ungava Bay in 1986 was dominated by ovigerous and non-ovigerous females which formed a mode in the length frequency distributions at 21-22 mm. In Hudson Strait, male shrimp, with a mode around 19 mm, were well-represented in catches from both deep and shallow water. In Ungava Bay, it appears that many females would not have spawned in 1986 whereas in Hudson Strait, most females were ovigerous.

Commercial length frequency data for Ungava Bay in 1980 showed a prominent mode around 23-24 m. The following year, catches from the area consisted of a wide range of sizes about 19-26 mm. The 1986 data are more similar to the 1980 data in that one size (age) group dominated but the modal size was smaller in 1986.

Fishing data from Resolution Island in 1980 showed that large (female) shrimp, greater than 21 mm CL, dominated in the catches in September and October, although smaller animals (males) were more abundant in catches from depths of less than 250 m in September. In 1981, the situation reversed. In all depths fished, large (female) shrimp were noticeably lacking in the catches which consisted mainly of male shrimp from 17-22 mm CL. Again, the 1986 data are more similar to the 1980 situation in that the larger (female) shrimp were dominating in the catches.

Although fisheries in these areas have been virtually non-existent, major differences in size compositions have been noted for both areas in years when sampling data were obtained. This would suggest that recruitment is quite variable or that mortality and/or migration of larger animals is highly significant. In any case, providing advice on sustainable yields does not appear to be appropriate.

Based on the size distributions of discarded shrimp, it appears that most discarding occurs at the smaller sizes. However, because significant numbers of larger (>17 mm) shrimp were found in the discards, some culling of damaged shrimp also is indicated.

Biological Samples

The analysis of biological samples from both areas provided some interesting data on spawning patterns in the two areas. From previous analyses, the high proportions of non-ovigerous females led to the conclusion that females may not spawn every year. The sample from Ungava Bay in 1986 showed that only 28% of females were likely to have spawned compared to 83% in Hudson Strait. It is difficult to draw conclusions from such limited data but it is possible that biennial spawning does occur in Ungava Bay whereas this may not be the case in Hudson Strait.

Although there were substantial numbers of non-ovigerous females in samples from both areas, virtually none possessed sternal spines. This would suggest that all primiparous females had already laid their eggs and would be included in the ovigerous group. The other possibility is that separation of primiparous and multiparous females on the basis of sternal spines is not appropriate for this species. McCrary (1971) used the technique for P. borealis, P. goniurus and P. hypsinotus but was not able to apply the rule to P. dispar. Seasonal sampling data for P. montagui from the Ungava Bay-Hudson Strait areas are necessary to determine whether or not sternal spines can be used to separate female maturity (age) groups.

Age Composition

It appears that conventional shrimp ageing techniques might be suitable for male P. montagui. Modes can be identified and analyses by the Macdonald and Pitcher method for both areas estimated mean sizes for two age groups at approximately 17.5 and 19 mm CL. An additional mode of younger males (15 mm) was observed in the sample from Ungava Bay. For females, however, the convention breaks down. It is difficult to explain, for example, why the mean size of the presumed primiparous females is as large or larger than older multiparous females and why the primiparous cohort in Ungava Bay and the youngest multiparous cohort in Hudson Strait are so poorly represented. Different growth rates among cohorts and highly variable year-class strength might be valid reasons but the problem of interpreting sternal spines, as described above, could also be an important factor. Also, if spawning is biennial or if a substantial number of females within a year-class do not spawn every year, these non-spawners can continue to grow. Thus, identification and separation of modal groups for females might be entirely academic and mean very little in terms of actual age composition. At this stage, ageing of the species from these areas is uncertain and attempts should be made to obtain a time series of data, both within and between years, to study growth more closely and develop appropriate techniques.

Conclusions

The 1986 fishery for P. montagui in Ungava Bay and eastern Hudson Strait produced catches rates previously unimagined in northern shrimp fisheries. Isolated high catches were reported during the early 1980's, but essentially there was nothing that can compare to the fishing success achieved in 1986. Over 350 t were taken in Hudson Strait in 11 fishing days but only 45 hours of fishing. About 100 t were taken in 20 hours in Ungava Bay where in 1982, research catch rates were so low that it was felt that such densities would not attract commercial effort. In Hudson Strait, distribution appears to have shifted from 1982 to more southerly and deeper waters. It is difficult to interpret changes in abundance. In Ungava Bay, there appears to have been a large increase in abundance from 1982 levels as well as some shift in distribution. Such variations in abundance appear to be possible. Good catch rates obtained in 1979 were followed by poor fishing performance in 1980, 1981 and 1982. Major changes in size distributions from both areas under, essentially, virgin conditions suggest a highly dynamic system in which the key parameters are not understood.

Previous CAFSAC advice for these areas has cautioned that general biological information is lacking and that little is known about abundance levels and productivity of the species. Consequently, the more conservative exploitation rate of 25% has been advised.

The data accumulated since 1979 suggest that the concept of sustainability for managing these concentrations is not appropriate. During periods of very low and no fishing effort, there have been apparent changes in distribution, abundance and stock composition. The 1986 fishery data do not provide a basis for advising a change in the previously estimated TAC levels but strongly indicate that the advice is dated. Given that there is no research survey planned for 1987 and that several years of fishery data are necessary to determine trends, the following options could be considered in the interim:

1) Status quo - 100 t in Ungava Bay, 750 t in Hudson Strait and 100 t in other areas.

2) Being less cautious than in 1983 and applying a 35% exploitation rate rather than a 25% rate - 160 t in Ungava Bay and 1,050 t in Hudson Strait.

3) Using the biomass estimate of 6600 t for the whole survey area in eastern Hudson Strait in 1982 and applying the appropriate rate - i.e. 6600 x 25% = 1650 t; 6600 x 35% = 2300 t.

4) Using estimates of biomass from 1979 for Ungava Bay rather than 1982 estimates when abundance was low and applying the appropriate rate - i.e. approximately 1500 t x 25% = 375 t; 1500 t x 35% = 525 t.

5) Advising no TAC given the uncertainties about recruitment and abundance levels but limiting participation in the fishery to one or two vessels until responses (or lack of) to sustained fishing pressure become evident.

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Table 1. Daily catch and effort data for shrimp (P. montagui) in Ungava Bay and eastern Hudson Strait, October 1986 from vessel logs.

Area	Day	Hours fished	Catch kept (kg)	Discards (kg)	Total catch (kg)	Catch per hour	Discards (%)
Ungava Bay	09	13.74	29,397	190	29,587	2,153	0.6
	10	4.86	55,500	320	55,820	11,486	0.6
	11	0.83	14,340	70	14,410	17,361	0.5
Total		19.93*	99,237	580	99,817	5,008	0.6
Hudson Strait	04	4.41	13,508	90	13,598	3,083	0.7
	05	2.83	39,243	110	39,353	13,906	0.3
	06	4.84	54,130	280	54,410	11,242	0.5
	07	5.86	54,137	220	54,357	9,276	0.4
	08	5.49	40,314	100	40,414	7,361	0.2
	11	3.21	30,649	350	30,999	9,657	1.1
	12	1.33	12,860	160	13,020	9,789	1.2
	13	5.01	44,899	360	45,259	9,034	0.8
	14	6.74	30,839	240	31,079	4,611	0.8
	15	2.24	34,942	190	35,132	15,684	0.5
	16	2.75	7,659	50	7,709	2,803	0.6
Total		44.71	363,180	2,150	365,330	8,171	0.6

*Total includes 0.5 hours on October 8th with no reported catch.

Table 2. Results of Macdonald and Pitcher analysis for male and non-ovigerous female shrimp from a sample taken in Ungava Bay, October 1986.

Sex	Group	%	Average length	S.D.	χ^2	D.F.	P
Male	1	33.3	15.3	0.78			
	2	31.2	17.6	0.59	7.54	7	0.37
	3	35.5	19.1	0.77			
Female	1	85.7	21.0	0.93			
(non-ovigerous)	2	14.3	23.4	0.64	4.49	8	0.81

Table 3. Results of Macdonald and Pitcher analysis for male, non-ovigerous and ovigerous female shrimp from a sample taken in eastern Hudson Strait, October 1986.

Sex	Group	%	Average length	S.D.	χ^2	D.F.	P
Male	1	57.3	17.3	1.06			
	2	42.7	19.3	1.07	12.79	9	0.17
Female	1	52.0	21.3	0.60			
(non-ovigerous)	2	48.0	23.6	0.95	6.23	7	0.51
Female	1	47.9	21.2	0.87			
(ovigerous)	2	52.1	23.8	1.16	12.06	9	0.21

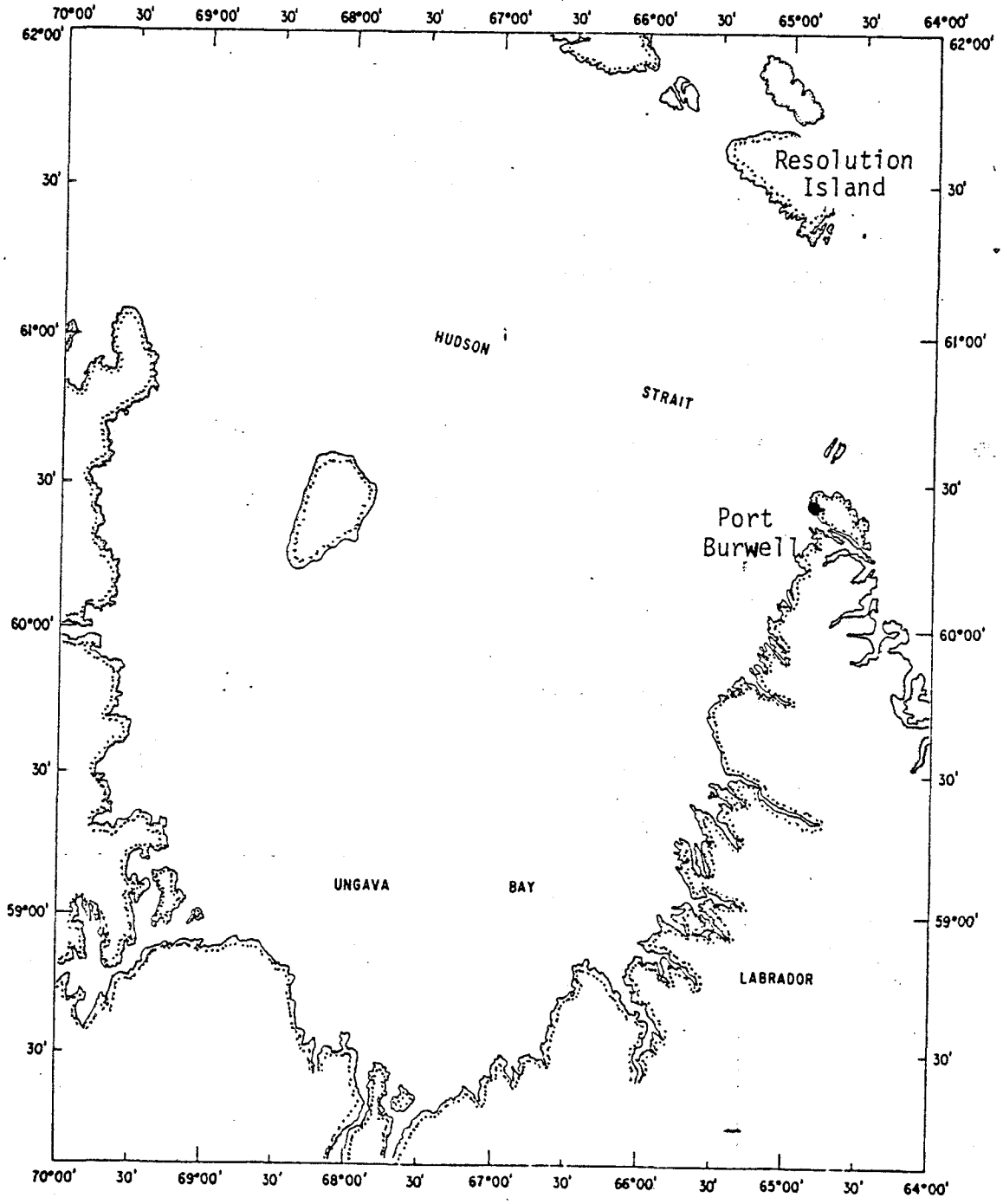

Fig.1. Map of Ungava Bay and Eastern Hudson Strait.

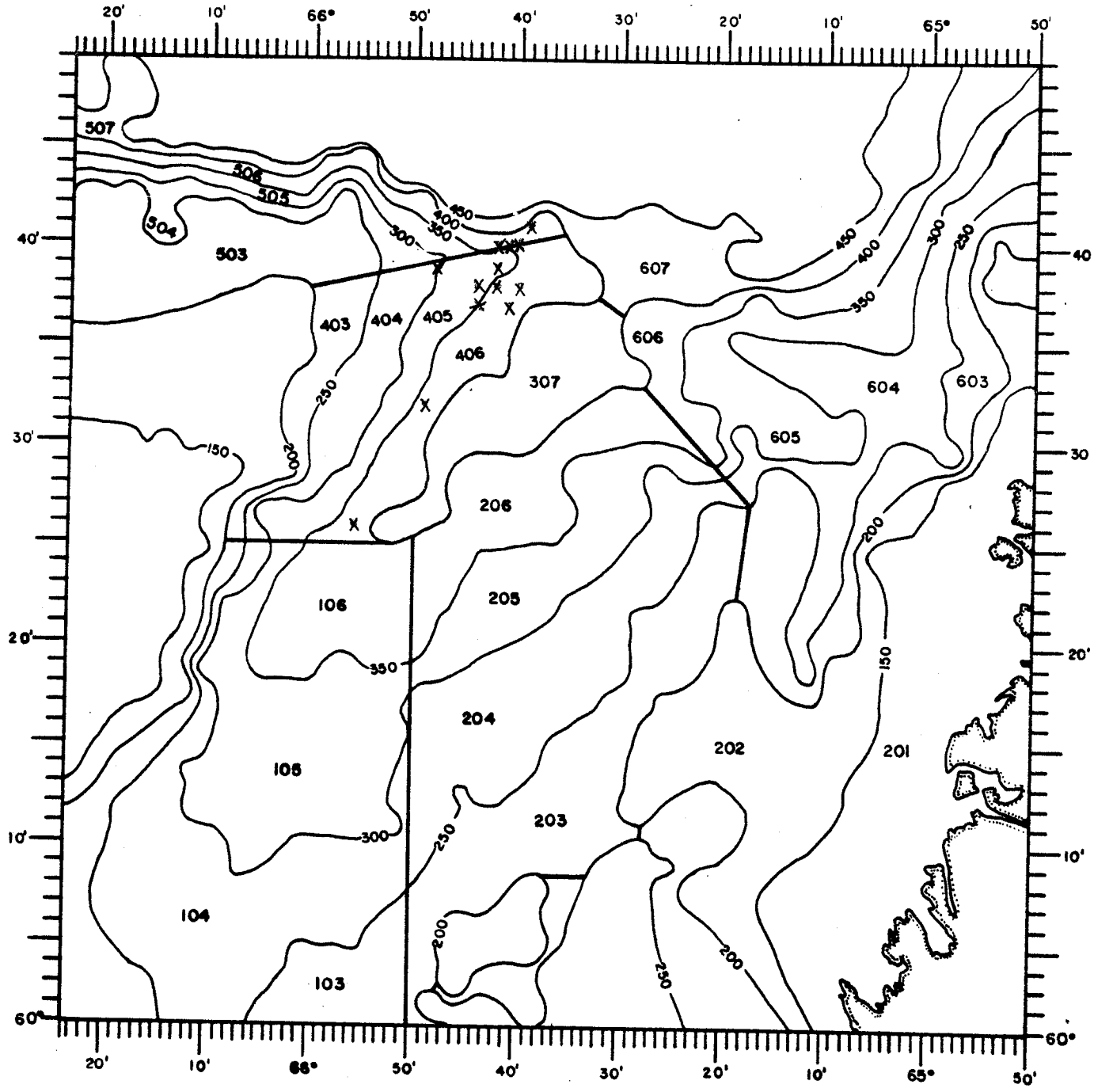

Fig.2. Commercial fishing stations in Ungava Bay,October 1986.

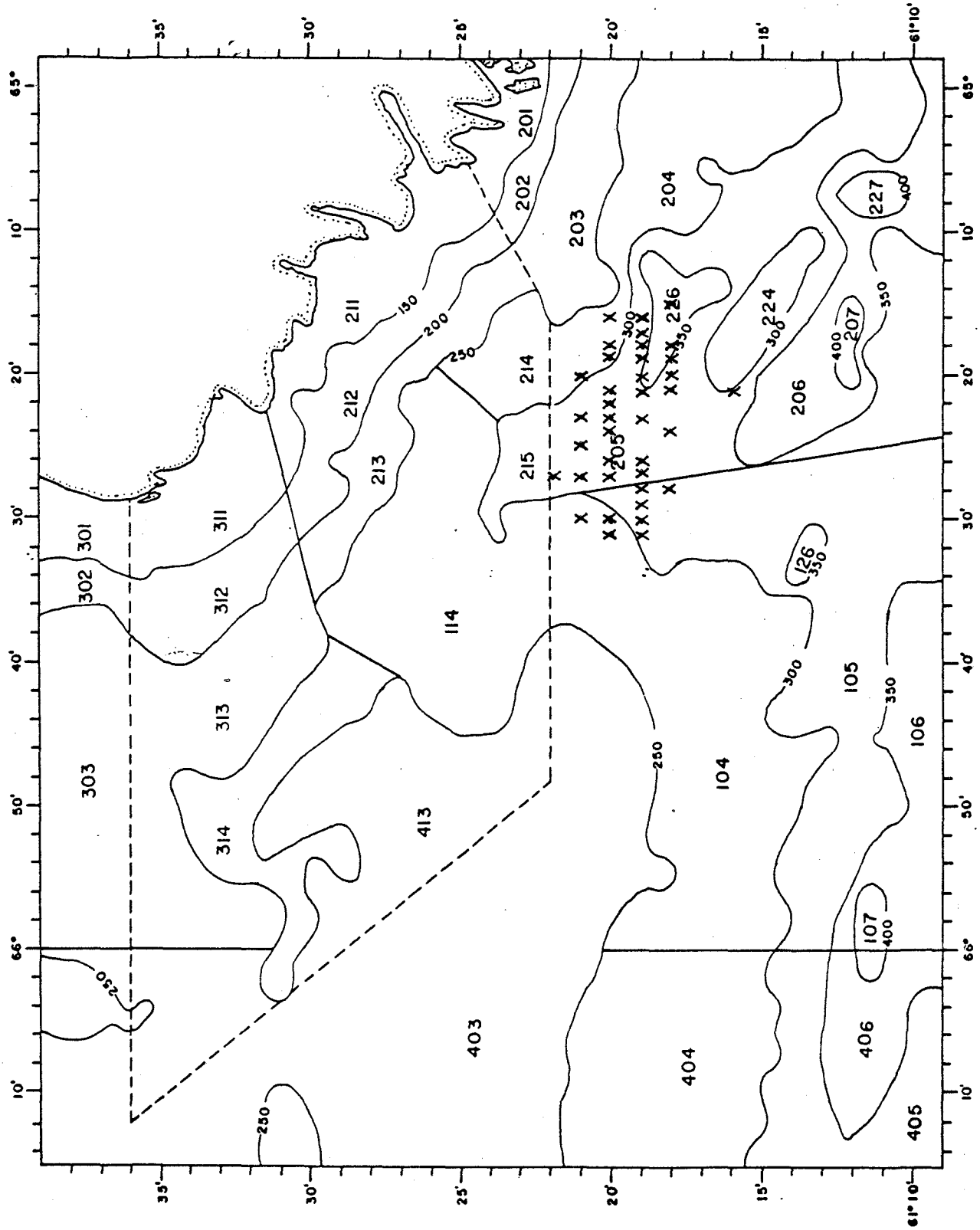

Fig.3. Commercial fishing stations in Hudson Strait, October 1986.

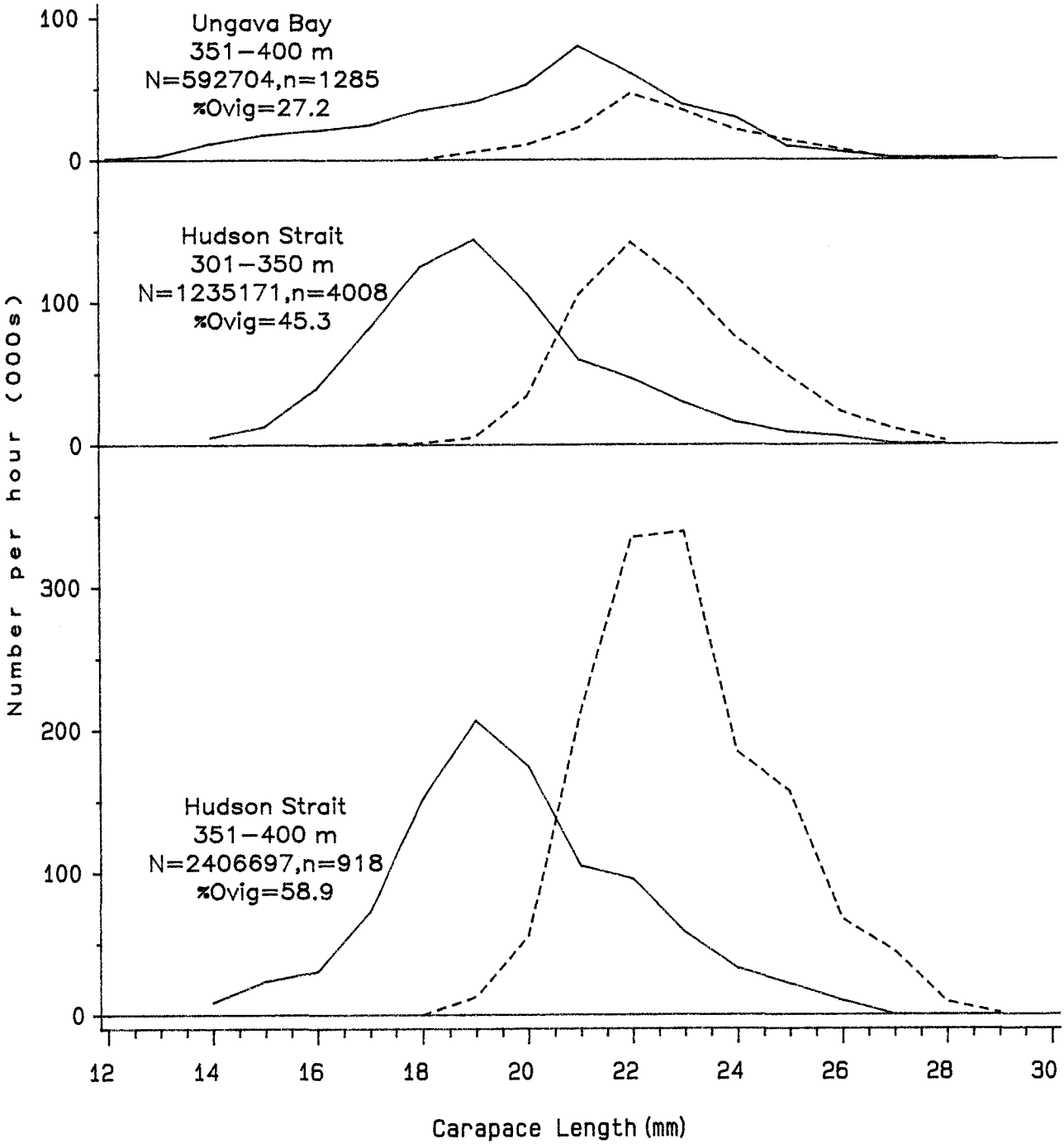

Fig.4 Length distribution of shrimp taken in Ungava Bay and Hudson Strait October 1986. (solid line=non-ovigerous broken line=ovigerous)

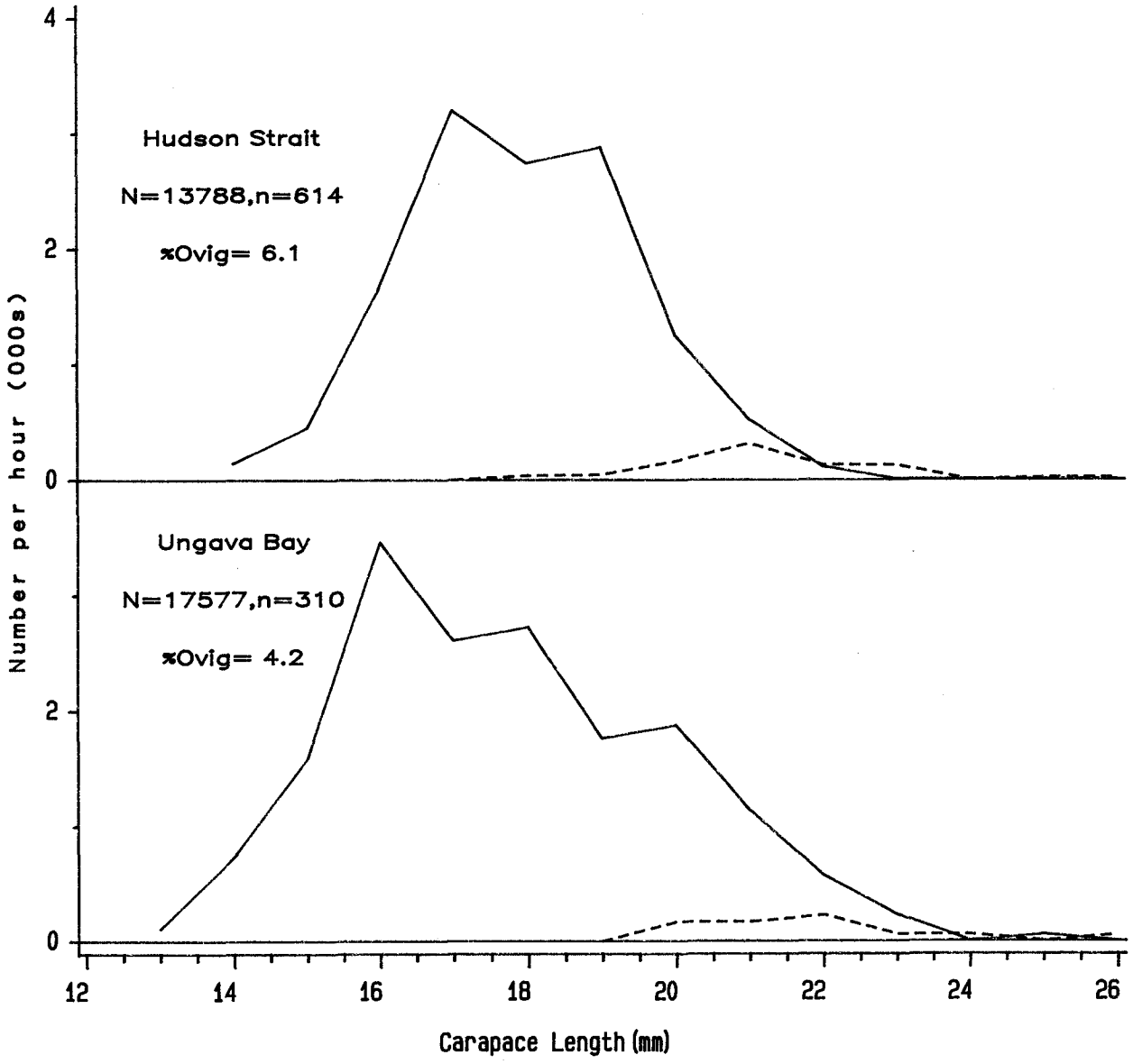

Fig.5 Length distributions of shrimp discards taken in Hudson Strait and Ungava Bay, October 1986. (solid line=non-ovigerous broken line=ovigerous N=number caught, n=number sampled)

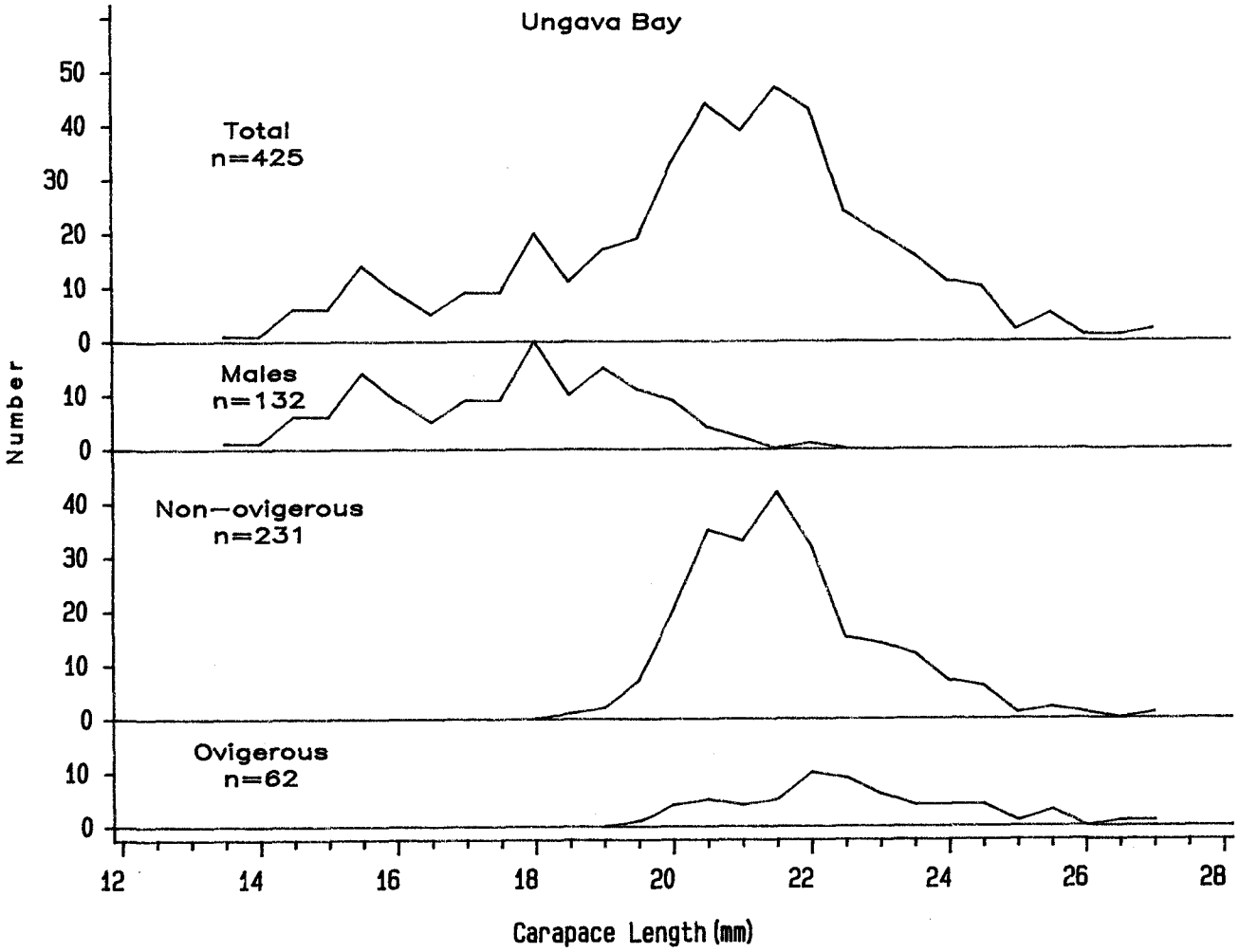

Fig.6 Sex and maturity stages of shrimp from Ungava Bay October, 1986 (commercial).

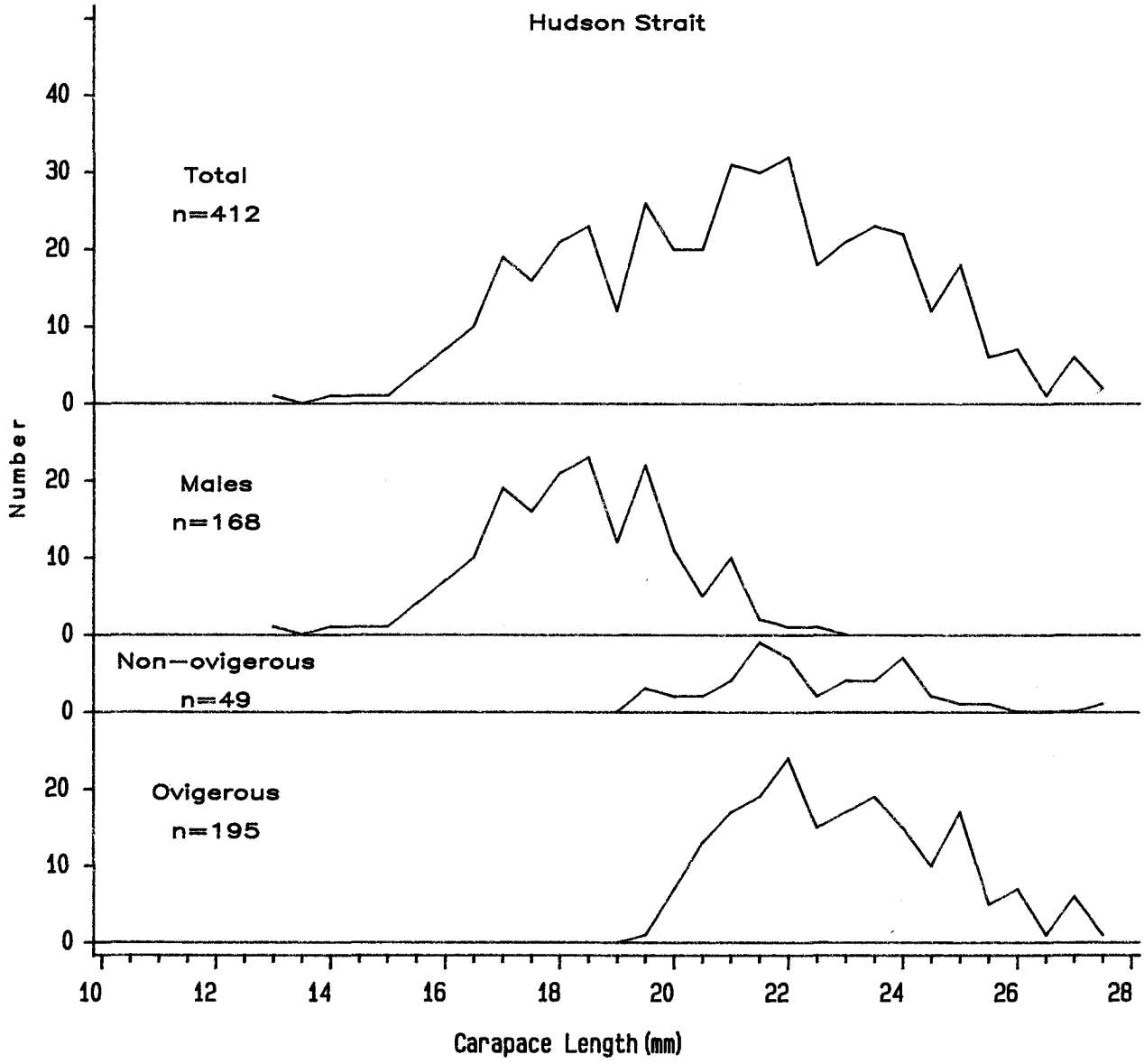

Fig.7 Sex and maturity stages of shrimp from Hudson Strait October, 1986 (commercial).