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The Gulf of Maine Northern Shrimp Stock: Current Research Initiatives and Assessment

by

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INTRODUCTION

While the existence of the northern shrimp population in the Gulf of Maine had been known since at least 1883 (Rathbun, 1883), and exploratory fishing was conducted in the mid-1920's, a directed fishery and recorded landings did not start until 1938 (Scattergood, 1952). Since then, landings have shown periodic fluctuations with peak landings occurring in the late 1940's, late 1960's and mid-1980's. Landings averaged 11,000 MT during 1969-1972 and rose to 5253 MT in 1987 from very low levels in the late 1970's. Management of the stock was instituted in 1973 with the formation of a tri-state board under the auspices of the Atlantic States Marine Fisheries Commission (ASMFC). Now called the Northern Shrimp Section of the ASMFC, management has utilized the concepts of a minimum mesh size of 1-3/4 inches stretched mesh for shrimp trawls and a limited fishing season of December 1 through May 31 as methods of controlling effort in the fishery. Biological advice to management has been provided by the Northern Shrimp Technical Committee (NSTC) in the form of annual assessments

of the stock. The NSTC uses information gathered by the National Marine Fisheries Service (NMFS) port sampling program, state port sampling programs, and the NMFS sea sampling program to evaluate the fishery and the status of the resource. The NSTC also conducts an extensive summer shrimp cruise and uses the length frequency data and indices of northern shrimp abundance by weight and number from this cruise and from NMFS groundfish cruises to complete the assessment (Diodati et al, 1988,1989).

The abundance of shrimp, as estimated from the numbers per area swept by the research trawl and expanded to the total survey area, is much higher than landings in the fishery. To address this disparity, current research in the Gulf of Maine is designed to estimate the density of shrimp over various bottom types through the use of submersibles and remotely operated vehicles (ROV's) and to compare these estimates with catch per area swept estimates from the shrimp summer survey research net. Comparisons of shrimp density from ROV transects over bottom that can and cannot be trawled will indicate availability of shrimp to the research trawl. Further work with the ROV will compare shrimp densities over trawlable and untrawlable bottom in a commercial fishing location to determine availability of shrimp to capture in comercial trawls.

The fishery for northern shrimp in the Gulf of Maine is conducted primarily with small mesh otter trawls. Catch other than shrimp is divided into marketable species (bycatch) and unwanted species that are dumped overboard (discard). The bycatch of finfish during the shrimp fishery (as recorded by the NMFS port sampling agents) and often makes the difference between a paying trip and a loss. The discard of numerous juvenile finfish by the shrimp fishery has been less well documented, but occurs nonetheless. A 1989 study of the bycatch of finfish in the shrimp fishery showed varying amounts of bycatch by area and season with higher total catches in most areas during January, February and March, but higher catches relative to the pounds of shrimp landed during December, April and May. While not recorded, the discard levels are presumed to show similar trends, making the latter three months a dirtier fishery in terms of juvenile finfish mortality.

The stocks of several commercially important groundfish have greatly decreased in recent years in the Gulf of Maine. The conservation of juveniles of these species has received much greater emphasis as a result of these declines. Small mesh fisheries such as shrimp can cause high mortalities of juvenile groundfish. One method of reducing this mortality is to utilize a net that retains the shrimp, but allows the juvenile fish to escape, a so-called separator trawl. During the summer and fall of 1988 the NSTC was requested to evaluate separator trawls as a means of reducing fishing mortality on juvenile groundfish and to conduct experiments on the two most promising types of separator trawls. To this purpose, the NSTC formed the Ad Hoc Shrimp Gear Committee comprised of gear experts from the three states and the NMFS. Recent trials with several types of separator trawls (Averill, 1988) were reviewed and two of these were chosen as likely candidates for use in the Gulf of Maine northern shrimp fishery. Further research on these two types was deemed necessary. The Ad Hoc committee conducted the experiments during November and December, 1988, analyzed the data during January and February, 1989, and reported the results to the Northern Shrimp Section in March, 1989 (Schick, et al, 1989). The result was that the use of separator trawls was required in the shrimp fishery during April and May, 1989. Several trips aboard commercial vessels were made during April and May by the NMFS sea sampling program in order to quantify catch, bycatch and discard.

CURRENT RESEARCH INITIATIVES

EFFECTS OF SHRIMP DISTRIBUTION ON AVAILABILITY

Availability of shrimp to capture in commercial and research trawls on different types of bottom is an unknown that is probably quite variable. This variability may have a dramatic impact on the accuracy of biomass estimates derived from trawl surveys. Commercial and research trawling operations are limited to fairly smooth bottom. The distribution patterns of shrimp on towable versus untowable bottom types are unknown. Shrimp probably seek out certain bottom types and depths and thus are not evenly distributed. They may also be unevenly distributed according to size. This patchiness of distribution may affect the availability of shrimp to the trawl and may affect the representativeness of any one tow.

The first objective of current research is to estimate the density and characterize the distribution patterns of shrimp by size over bottom that is towable versus bottom that is untowable. This will be done first in an offshore area that is included in the summer shrimp survey and later at an inshore commercial fishing location during the fishing season in order to estimate what proportion of the shrimp population is actually available to the fishery. The second objective is to estimate the availability of shrimp of different sizes to capture in the research trawl used in the summer survey and in commercial trawls. This will be accomplished by comparing <u>in situ</u> density estimates derived from ROV and submersible transect surveys with catches per unit area of bottom swept by both types of trawl. The results of this research will be used to establish some measure of error for biomass estimates for entire survey strata that are based on research trawl catch rates on towable bottom only. Whether or not a bottom is towable is determined by a competent trawl captain, but even so is subjective. Trawlability will be corroborated by using the video and 35mm slides from the ROV and submersible for a visual assessment of the bottom and by analyzing sediment from core samples taken from the submersible. Shrimp density and distribution by size will be determined by counting and (where possible) measuring shrimp in both the video and 35mm slide transects conducted by both the ROV and submersible.

During the summer of 1989 three types of bottom were examined. One was hard, untowable bottom, one was hard, towable bottom and the third was soft towable bottom. The research was carried out in four stages. First, side scan sonar mapping of the proposed bottom was carried out and sites for the research tows were selected based on depth and bottom type. Second, the selected sites were judged towable or not by a professional trawl captain and each site was examined by several video and 35mm slide transects using a MINI-ROVER MARK II remotely operated vehicle (ROV). Third, each site was examined during video and 35mm slide transects conducted by a submersible, the JOHNSON SEA LINK I. Sediment samples were also collected on these transects. These submersible and ROV dives were supported by the Northeast Underwater Research Center at the University of Connecticut at Avery Point (NURC-UCAP) with funds from the National Oceanic and Atmospheric Administration's (NOAA) National Underwater Research Program (NURP). The fourth stage was to be conducted during the summer shrimp survey when the towable sites were to be sampled by the standard survey gear. For best comparative data, the last three phases of the research were to be conducted one immediately following the other, preferably on the same day. In reality, they were each separated by several days and the fourth stage was not done due to weather and time constraints.

The preliminary results from the ROV video transects show an insignificant difference in shrimp density between the soft and hard towable sites and significant differences between these two sites and the hard untowable site with no shrimp at all on the the hard untowable bottom (Table 1). Work on the distributional characteristics of shrimp and the ground truth calibration of the shrimp survey gear will continue into 1990 and 1991 with both the ROV and submersible technologies.

Availability of shrimp to capture in commercial trawls will be examined by a similar series of events during February, 1990. Side scan sonar mapping will identify trawlable versus untrawlable bottom and ROV video and 35mm camera transects will document shrimp distributional differences between these two areas at a site near Pemaquid Point, Maine.

FISHERIES INTERACTIONS

Bycatch of finfish in the shrimp fishery have been monitored through landings data for several years. A comparison of the bycatch reported by month in the 1987-88 shrimp season with that of the 1988-89 season shows that the months of December, April and May produced higher finfish bycatch relative to the shrimp catch than did the months of January, February or March for both seasons (Figure 1). The lower reported monthly bycatches during the 1988-89 season were the result of a regulation limiting bycatch to 25% of the shrimp landings by weight per month during that season that was not in effect during the previous season. Even though the bycatch in pounds of fish per pound of shrimp is lowest during January, February and March, providing the cleanest shrimp fishing of the season, the shrimp landings are so much higher during that time that the total bycatch of finfish is highest during these months. The reason for the cleaner catches during the winter months is that there is a spatial separation of shrimp and finfish at that time. The female shrimp migrate inshore to release their larvae and the finfish move offshore and are less available to the shrimp fishery. Hacunda (1979) documented this seasonal variation in the abundance of fish in John's Bay, in mid-coastal Maine and more recently, Langton et al. (1989) showed a similar seasonal change in the Sheepscot River estuary, a nearby mid-coastal Maine embayment (Figure 2). In 1989, on the basis of this information and other corroborating evidence, the State of Maine closed its territorial waters to the use of small mesh otter trawls from April through December to protect juvenile groundfish.

Another method of protecting juvenile groundfish in small mesh fisheries is the use of separator trawls that allow finfish to escape and yet retain shrimp. These nets contain devices that take advantage of either physical or behavioral differences between shrimp and various fish species. The combination net has a diamond-shaped escape hole with a polypropylene flapper in the top of the extension piece that allows non-schooling roundfish to seek it out and escape the net and a panel of large mesh in the lower belly behind the footrope that allows small flatfish to dive through and escape the net (Figure 3). The radial escape section is a series of mesh funnels forward of the cod end that allow fish to escape due to their greater swimming ability while retaining shrimp that are unable to escape the rapid water flow through the section (Figure 3). The Normoere grate is a sloping aluminum grill that allows shrimp to pass through, but forces fish up and out of the net through an escape hole over the grate (Figure 3). The large mesh belly is designed for maximum release of flatfish (Figure 3).

Development and testing of the various separator trawl designs is ongoing in a number of countries, including Canada, Iceland, Norway, the United Kingdom and the USA. The radial escape section and the Normoere grate were developed in Norway and testing of the Normoere grate is continuing in Canada. The large mesh belly net was tested briefly during the summer of 1989 by the NMFS and will continue to be tested. Of the two designs tested by Averill (1988) that were further tested by the Northern Shrimp Technical Committee in November, 1988, the combination net proved much more popular with the shrimp fishermen than did the radial escape section net when the use of either of these as a separator trawl became mandatory in April and May, 1989. The lack of results of the November, 1988 paired tow trials for the radial escape section net proved how difficult it is to rig this gear at present. The results of the November, 1988 paired tow trials for the combination net were mixed with minimal separation of discard roundfish (hakes and cod) and flatfish (dabs and grey sole)(Figure 4). The results from the testing of both nets indicated further developmental work was necessary, but political pressure to start some means of conserving juvenile groundfish caused the mandatory use of these separator trawls during the high bycatch months of April and May. Separator trawl development will continue with greater financial support in the near future in the Gulf of Maine.

ASSESSMENT OF THE GULF OF MAINE NORTHERN SHRIMP STOCK: 1989

The Gulf of Maine fishery for northern shrimp (Pandalus borealis) is managed under the auspices of the Atlantic States Marine Fisheries Commission (ASMFC). Under the organizational framework of the Commission's Interstate Fisheries Management Program (ISFMP), the Northern Shrimp Technical Committee, consisting of biologists from the marine resource agencies of Maine, New Hampshire, Massachusetts and the National Marine Fisheries Service Northeast Fisheries Center (NEFC), has provided annual stock assessments and related information to the ASMFC Northern Shrimp Section. Analyses and recommendations are based on: 1) commercial landings and effort data collected by NEFC port agents, 2) biological sampling of the commercial landings by personnel from the participating states and the NEFC and, 3) research vessel survey data collected by the Committee during summer and by NEFC during spring and autumn.

LANDINGS

Annual landings of Gulf of Maine northern shrimp declined from an average of 11,400 metric tons (t) during 1969-1972 to about 400 t in the late 1970's, increased steadily to slightly over 5,000 t in 1987 and then dropped to less than 3,100 t in 1988; the total for the 1989 season was about 3,300 t (Table 3). Landings during December, April and May tend to come from offshore, in strata 1, 2, 3 and 6 of the summer survey, whereas the January, February and March landings come from inshore of the shoreward boundary of these strata (Figure 5).

EFFORT AND CPUE

Effort in the northern shrimp fishery (measured by numbers of trips in which shrimp gear is used) has increased considerably since the late 1970's, reaching a peak of 11,100 trips in 1987 (Figure 6). Increases in season length, shrimp abundance, and record ex-vessel prices coupled with reduced abundance of groundfish, have all contributed to recent increases in effort. Total effort during the 1988 season declined to about 8,900 trips but increased slightly to 9,200 trips during the 1989 season.

Catch per unit of effort (CPUE) data have been consistent in indicating a decline in abundance in recent years. Catch per trip data (t/trip) based on coastwide information by season has declined from 0.604 t in 1985 to 0.339 t in 1988; the 1989 value was 0.357 t per trip (Figure 6). The CPUE maximum represents an abundance peak from the strong 1982 year class and agrees with the research indices from the summer shrimp survey (Figure 6). Landings peaked in 1987 from this year class due to the large increase in effort in 1987.

SIZE COMPOSITION OF LANDINGS

Length frequency and sex information from dockside sampling in Maine are given in Figure 7. The 1989 season harvest was dominated by large females (assumed age 3 and 4+) and mature males (assumed age 2+). Occasional catches of male shrimp during winter most likely reflect shifts in fishing patterns, but may also reflect changes in seasonal distribution of shrimp. Landings in Maine exhibited relatively high proportions of males during April and May and were dominated by females during February and March (Figure 8). The number of males taken during January in Maine was not as great as during April and May, but was greater than normal for the month (Figure 7).

TRENDS IN ABUNDANCE

Trends in abundance have been monitored since the late 1960's using data collected in NEFC spring and autumn bottom trawl surveys and a summer survey by the state of Maine (discontinued in 1983). Survey efforts for this stock were substantially expanded in 1983 by implementation of a stratified random survey directed specifically towards northern shrimp. This survey is conducted by the Northern Shrimp Technical Committee each summer in the western Gulf of Maine aboard the NEFC's 65 foot stern trawler, the R/V GLORIA MICHELLE. Gear consists of a modified west coast 4-seam commercial trawl equipped with "rockhopper" ground gear to make it suitable for use on rough bottom; strata used are given in Figure 5. This survey is considered to provide the most reliable information we have on abundance, distribution, population age structure and other biological parameters for the Gulf of Maine northern shrimp resource.

Indices of abundance and biomass (stratified mean catch per tow in numbers and weight) for 1984-1989 are presented in Figure 6. In all survey cruises efforts have been made to cover all strata, although the above indices are based on those strata which have been judged to be most significant from a fishery-related standpoint and have therefore been sampled most intensively and consistently over time (strata 1, 3 and 5-8). Generally speaking, survey catches have been highest in strata 1, 3, 6 and 8; the region from Jeffreys Ledge and Scantum Basin eastward to Penobscot Bay (Figure 5). For both numbers and weight, the abundance indices presented here consist of catch per tow of individuals greater or equal to 22mm mid-dorsal carapace length (Figure 6). These values represent shrimp that will be fully recruited to the winter fishery during the coming season (primarily age 3 and older individuals) and serve as a better indicator of available resource conditions during the coming season than do total numbers and weight values. After a steady decline from 1985-1988, index values increased in 1989 due to recruitment of age 3 shrimp and faster growing individuals from the 1987 year class. This trend is indicative of a continued improvement in fishery conditions as the 1987 year class moves through the selection range of commercial gear, although full benefit of this year class will not be realized before the 1990-1991 season. The strong 1982 and 1987 year classes can be seen to advance through the summer survey length frequency curves

for 1984-1989 (Figure 9). Based on total catch per tow data for strata 1, 3 and 5 (sampled in 1983) the 1987 year class is comparable in size to the celebrated 1982 year class; 3,700 shrimp per tow at age 1 in 1988 as compared to 3,000 in 1983. The 1987 year class will recruit to the commercial gear by size during the 1989-1990 season. However, because the bulk of the fishery will occur inshore, and the 1987 year class will remain offshore while it goes through transition into females, this year class will not fully recruit to the fishery until the 1990-1991 season. At that time they will be egg-bearing females and migrate inshore. Some portion of this year class will be taken during April and May, 1990, when the larger vessels move offshore.

SUMMARY AND CONCLUSIONS OF ASSESSMENT

Gulf of Maine northern shrimp landings declined from 5,300 t in 1987 to 3,100 t in 1988; the 1989 season total (December 1, 1988 - May 31, 1989) was 3,300 t. The decline observed since 1987 appears to reflect declining abundance of older females and a modest decline in fishing effort. Biological samples collected at dockside during the 1988-1989 season indicated that winter landings were composed primarily of (assumed) age 3 and 4+ females, although smaller age 2 males from the strong 1987 year class were taken on occasion. This year class made a significant contribution to landings in April and May and is expected to dominate catches during the 1990 spring fishery.

Total effort (number of trips) declined by 20% between 1987 and 1988 but increased slightly in 1989. Effort by Maine vessels declined slightly during the 1989 season compared to 1988, but the number of trips made by Massachusetts and New Hampshire vessels increased by more than 40%. Changes in distribution of effort have been observed in recent years, particularly in the case of Maine vessels which have tended to fish a greater distance from shore. A general westward shift has also been evident for the Maine fishery in inshore areas although in 1989 more effort was documented east of Penobscot Bay. Given the general tendency for higher ex-vessel prices in recent years and the lack of alternative target species in wintertime it is expected that amount and distribution of effort will continue to vary.

Commercial catch per unit effort (CPUE) and research vessel survey data are consistent in indicating a decline in stock size since 1985, although catch per tow in number and weight from the R/V GLORIA MICHELLE summer survey increased sharply in 1988 in response to recruitment from the strong 1987 year class. Catches of this year class were high again during the 1989 survey and in both years were comparable to those observed for the very strong 1982 year class (at ages 1 and 2). Since this year class will recruit strongly during the coming year a significant increase in exploitable biomass and landings is expected; but the full benefit from this year class will not be realized before 1991.

Total mortality and exploitation rates have remained relatively low in recent years and appear to have been well within acceptable levels. Survey indices and catch per tow at age are consistent with fishery trends and provide no indication that the fishery is adversely affecting the resource. Given this information and the potential for greatly improved recruitment from the 1987 year class during the 1989-1990 season, it would seem that a December through May season (comparable to that of 1988-1989) would have no detrimental long-term impacts on the Gulf of Maine northern shrimp resource.

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TABLE 1

In Situ Northern Shrimp Density Estimates Derived from Remotely Operated Vehicle Video Transects on Hard and Soft Trawlable and Hard Untrawlable Bottom near the Northwestern Tip of Jeffrey's Ledge (Gulf of Maine) in Depths of 150 to 175 m, August, 1989.

	TRAWLABLE BOTTOM				UNTRAWLABLE BOTTOM	
TRANSECT NUMBER	SOFT BOTTOM		HARD BOTTOM		HARD BOTTOM	
	TOTAL* #/SQ.M	BETWEEN** RUNNERS #/SQ.M	TOTAL #/SQ.M	BETWEEN RUNNERS #/SQ.M	TOTAL #/SQ.M	BETWEEN RUNNERS #/SQ.M
1	.95	1.22	.69	.49	.00	.00
2	.98	1.38	2.23	2.51	.00	.00
3	.70	.85	1.36	1.04	.00	.00
4	.52	.69	1.79	1.59	.00	.00
5	1.06	.81	.36	.48		
6	1.86	1.43	.50	.68		
7	1.16	.93	.52	.45		
8	1.93	1.64	.24	.25		
9	1.57	1.29	.49	.51		
10	2.33	1.95	.78	1.06		
11			.55	.61		
12			.52	.45		
13			.71	.74		
14			.76	.50		
15			1.53	1.36		
16			1.33	1.30		
17			.49	.38		
18			.84	.55		
19			1.03	.76		
20			.74	.61		
21			1.31	1.89		
MEAN #/SQ.M	1.30	1.22	.89	.87	.00	.00

* Total number of shrimp observed in the video/total square area (square meters) observed in the video.

** Number of shrimp passing through the plane of the area between the runners, or skids of the ROV/square area (square meters) of bottom passing through the same plane.

Table 2.
Commercial Landings (Metric Tons) of Northern Shrimp in the Western Gulf of Maine, 1958-1989.

Year	Maine		NH		Mass		Total	
1958	2.3		0.0		0.0		2.3	
1959	5.4		0.0		2.3		7.7	
1960	40.4		0.0		0.5		40.9	
1961	30.4		0.0		0.5		30.9	
1962	159.7		0.0		16.3		176.0	
1963	244.0		0.0		10.4		254.4	
1964	419.4		0.0		3.1		422.5	
1965	947.0		0.0		8.0		955.0	
1966	1737.8		18.1		10.5		1766.4	
1967	3141.1		20.0		10.0		3171.1	
1968	6515.0		43.1		51.9		6610.0	
1969	10992.9		58.1		1772.9		12823.9	
1970	7712.8		54.4		2902.1		10669.3	
1971	8354.7		50.8		2723.8		11129.3	
1972	7515.6		74.8		3504.5		11094.9	
1973	5476.7		59.9		3868.2		9404.8	
1974	4430.7		36.7		3477.3		7944.7	
1975	3177.0		29.5		2080.2		5286.7	
1976	617.2		7.3		397.8		1022.3	
1977	148.0		2.3		236.9		387.2	
1978	0.0		0.0		0.0		0.0	
1979	32.9		2.3		451.3		486.5	
1980	71.4		7.4		260.3		339.1	
1981	528.6		4.5		538.1		1071.2	
1982	883.2	*(853.3)	32.8	(21.6)	658.5	(655.3)	1574.5	(1530.2)
1983	1022.0	(892.5)	36.5	(46.2)	508.0	(458.4)	1566.5	(1397.1)
1984	2564.7	(2394.9)	96.8	(30.7)	565.3	(525.1)	3226.8	(2950.7)
1985	2956.9	(2946.4)	207.4	(216.5)	1030.6	(968.0)	4194.9	(4130.9)
1986	3407.3	(3268.2)	191.1	(230.5)	1085.6	(1136.3)	4684.0	(4635.0)
1987	3534.2	(3673.2)	152.5	(157.8)	1338.7	(1422.2)	5025.4	(5253.2)
1988	2272.4	(2257.2)	173.1	(154.5)	631.5	(619.6)	3077.0	(3031.3)
**1989		(2369.8)		(231.5)		(685.2)		(3286.5)

*Numbers in parenthesis are computed on a seasonal basis, e.g.
1983 includes December 1982 but does not include December 1983.

**Preliminary.

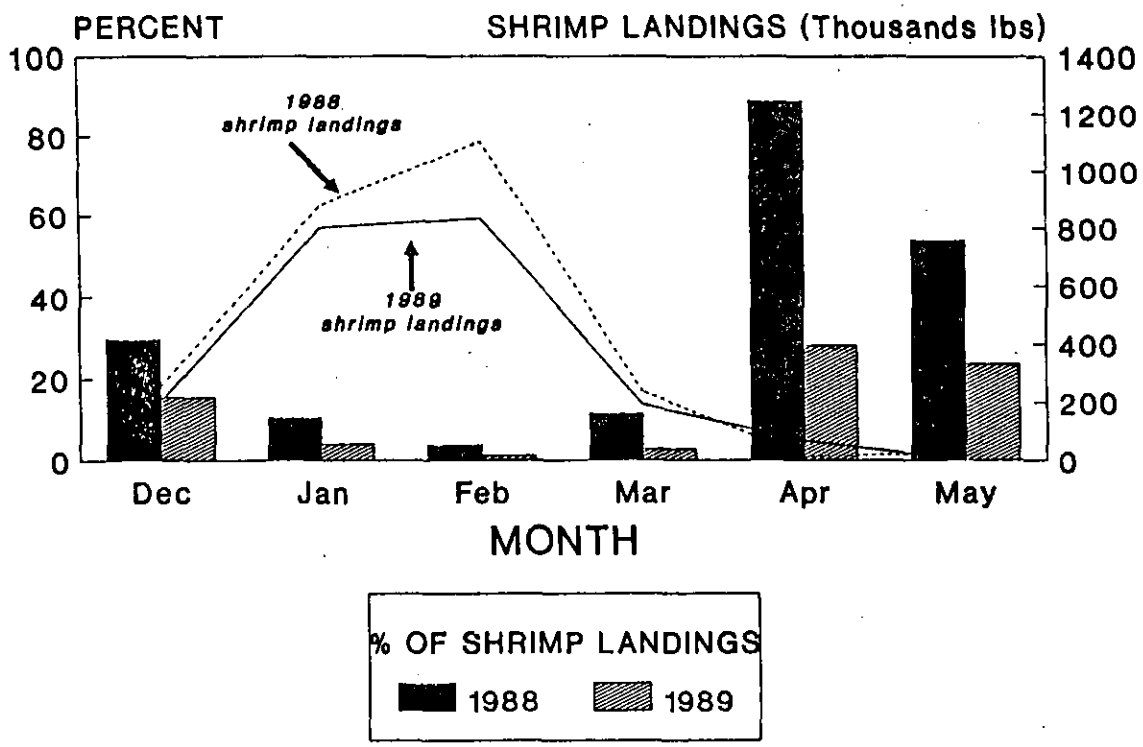
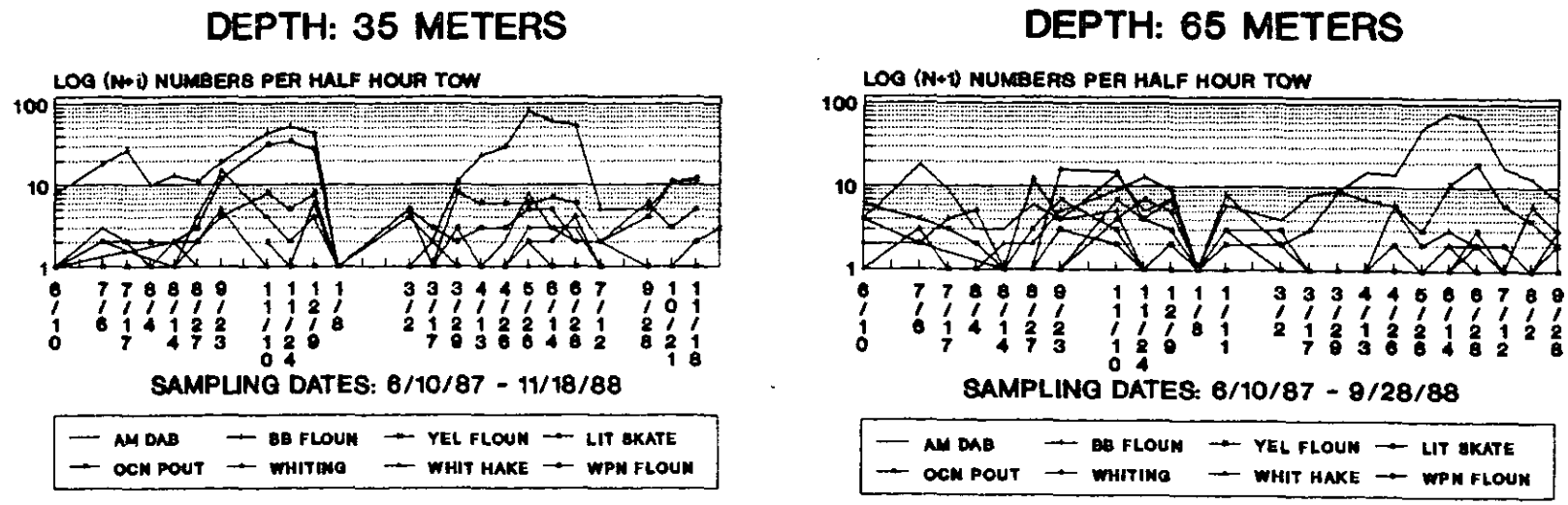


Figure 1. Monthly Shrimp Landings and Bycatch of Atlantic Demersal Finfish (ADF) Regulated Species from Area 1 (Coastal Maine) in the Gulf of Maine Northern Shrimp Fishery. 1988 vs 1989.



From: Langton, Knowles and Ward (1989)

Figure 2. Seasonal Abundance of Finfish at Two Depths in Sheepscot Bay, Maine from June, 1987 to November, 1988. From Langton et al., (1989).

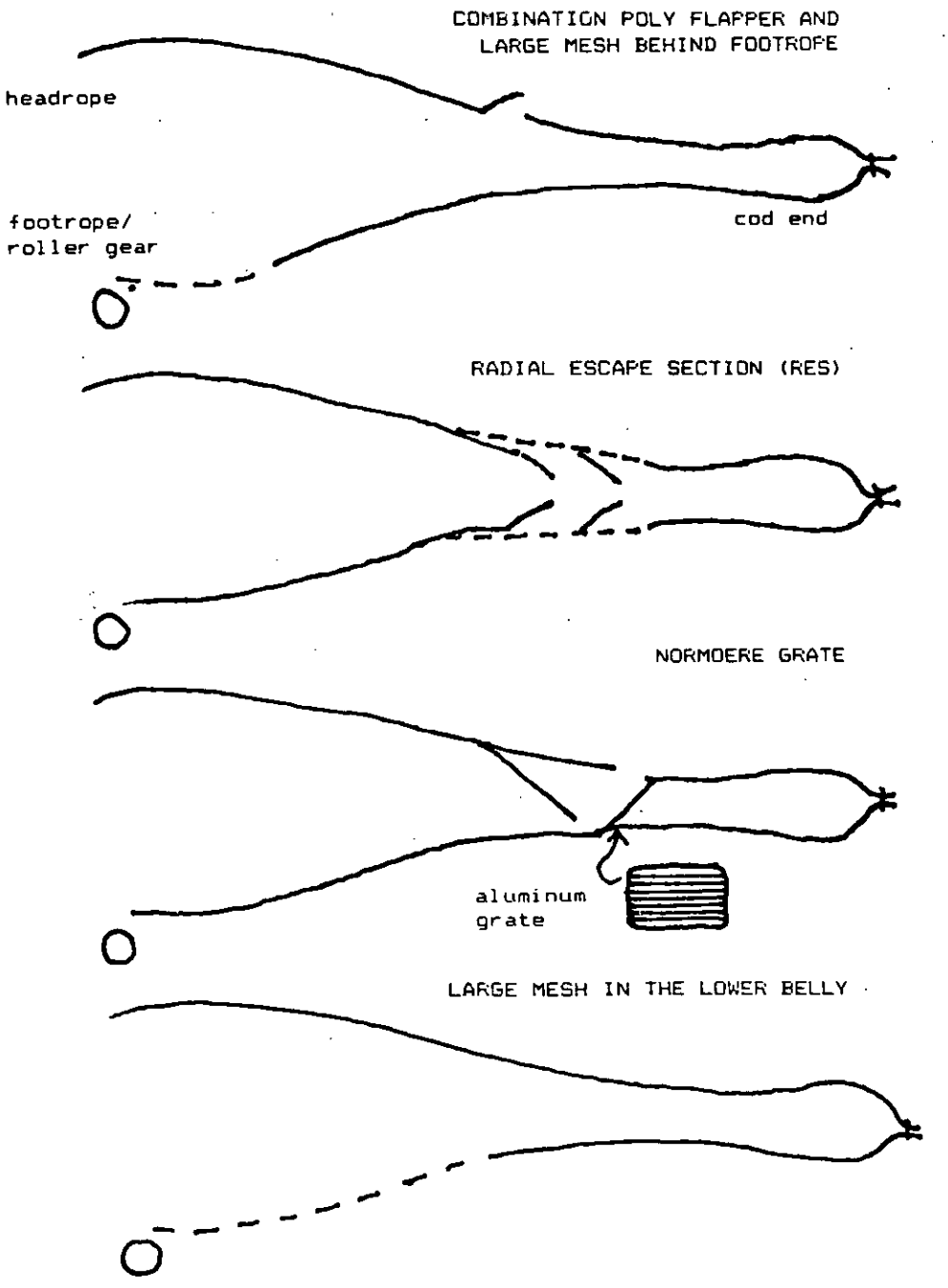


Figure 3. Conceptual Designs of Separator Trawls for Possible Use in the Gulf of Maine Northern Shrimp Fishery.

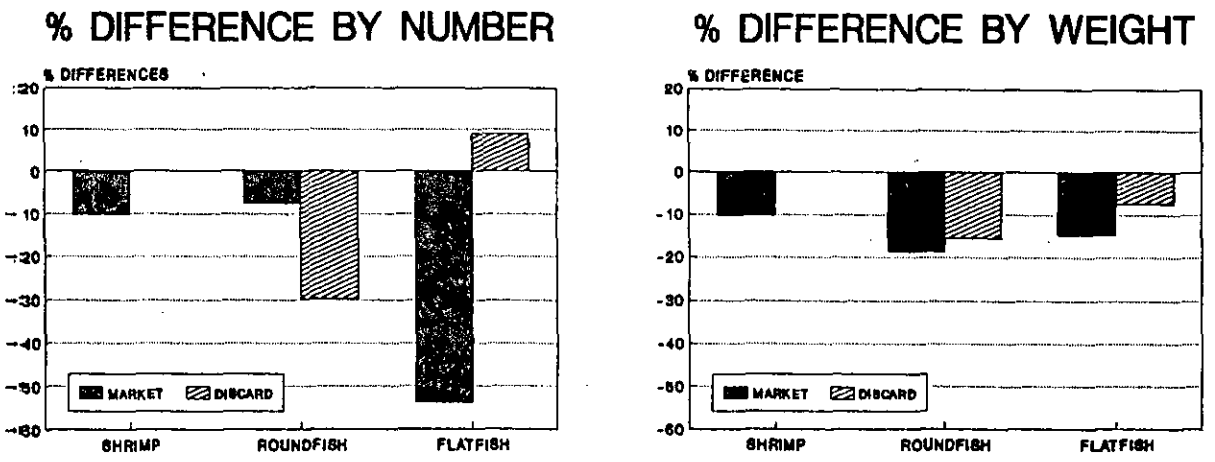


Figure 4. Separator Trawl Trials, 1988: Commercial Combination Net versus Control Net Percent Differences for Shrimp and Market and Discard Roundfish and Flatfish. Numbers and Weight for 18 Paired Tows.

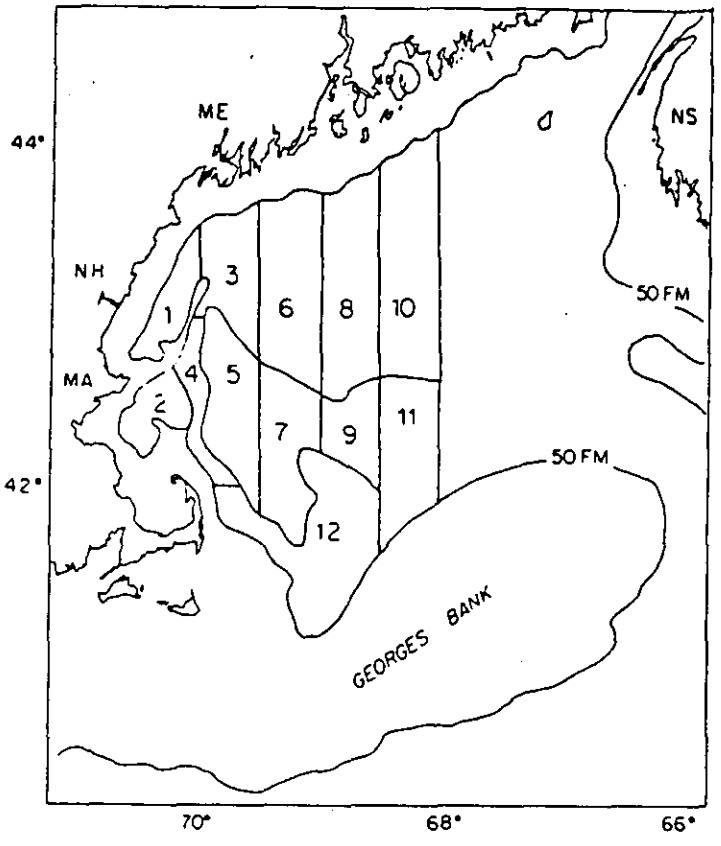


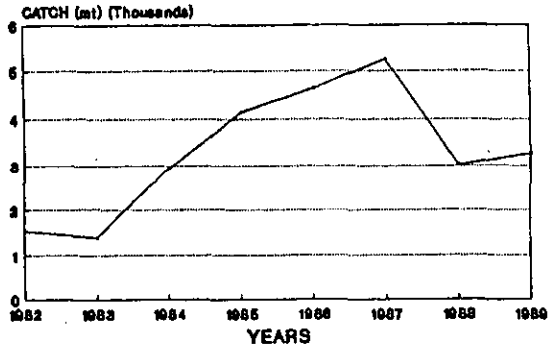
Figure 5. Strata Used During the R/V Gloria Michelle Summer Shrimp Survey. From NSTC, 1989.

FIGURE 6 GULF OF MAINE NORTHERN SHRIMP

Catch, Effort, CPUE and Research Indices

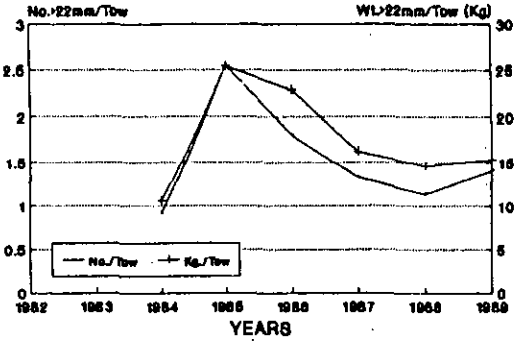
CATCH BY SEASON

December - May: Metric Tons



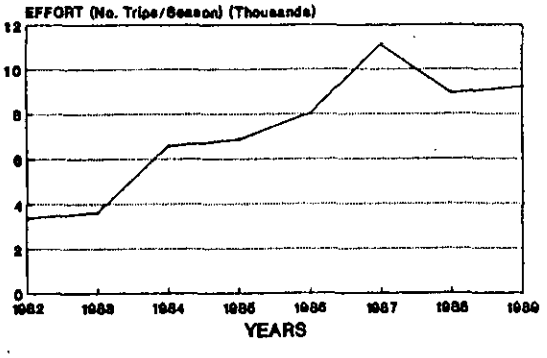
RESEARCH INDICES

Summer Survey: # and Kg>22mm/Tow



EFFORT BY SEASON

December - May: Number of Trips



CATCH PER UNIT EFFORT

December - May: MT/Trip

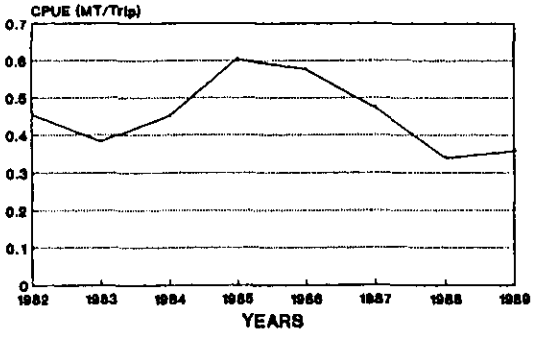


Figure 6. Gulf of Maine Northern Shrimp Fishery: Catch, Effort, and CPUE for 1982-89 and Research Indices for 1984-89. From NSTC, 1989.

Maine Shrimp Fishery: 1989 Length Frequency by Sex of the Sampled Catch

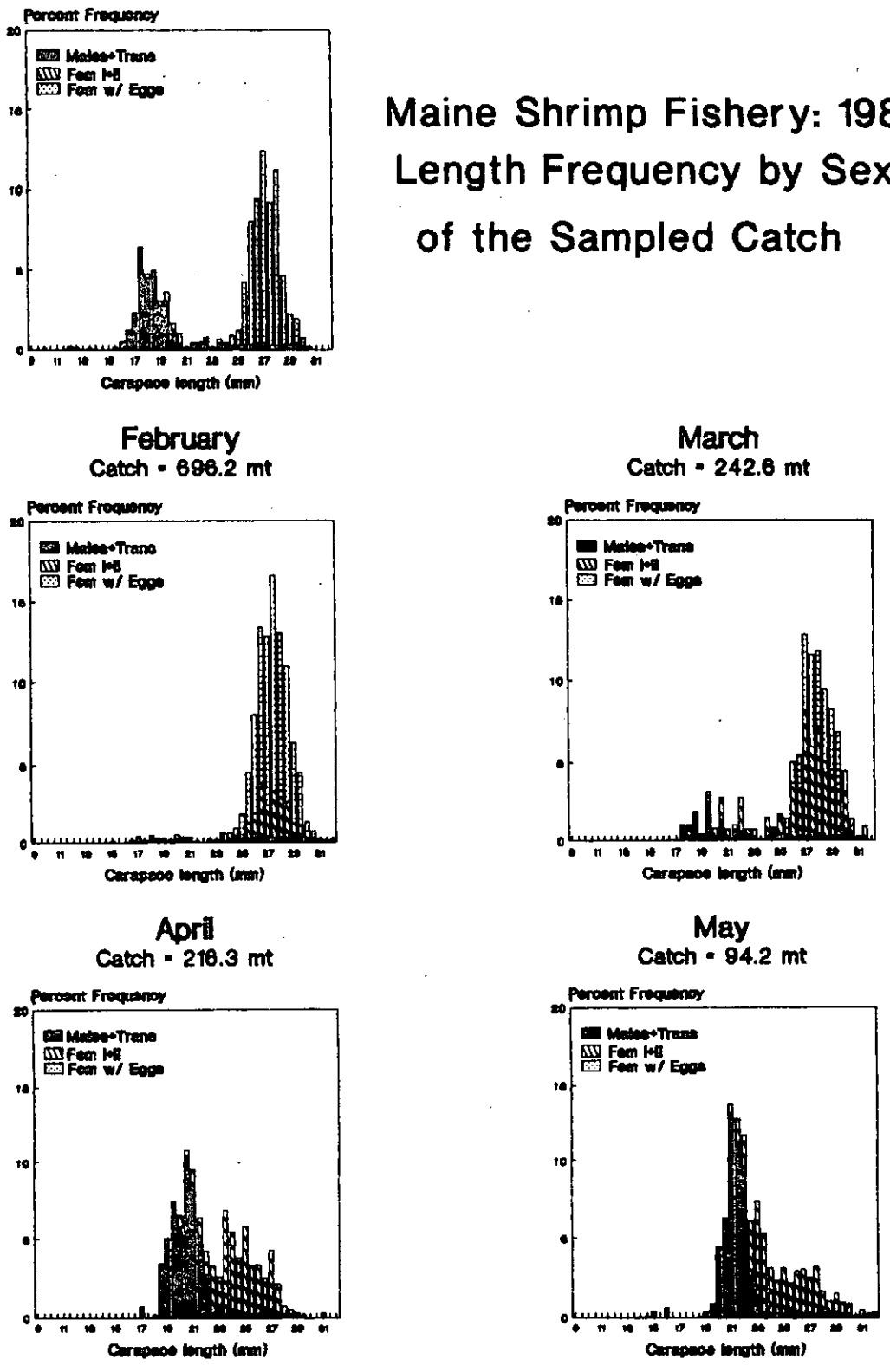


Figure 7. Length Frequency by Sex per Month for the Sampled Catch from the 1989 State of Maine Northern Shrimp Fishery. From NSTC, 1989.

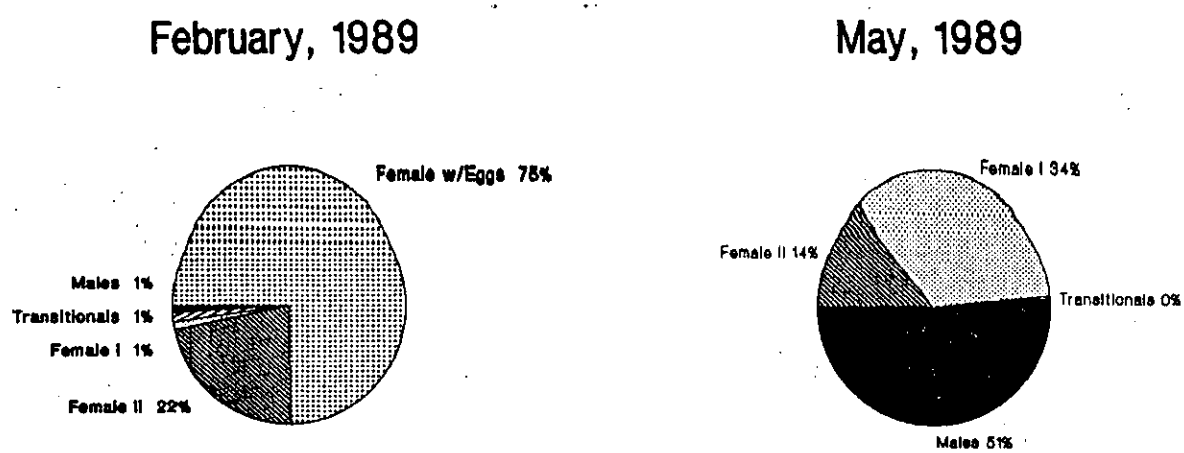


Figure 8. Frequency by Sex for the Sampled Catch from February and May, 1989 State of Maine Northern Shrimp Fishery.

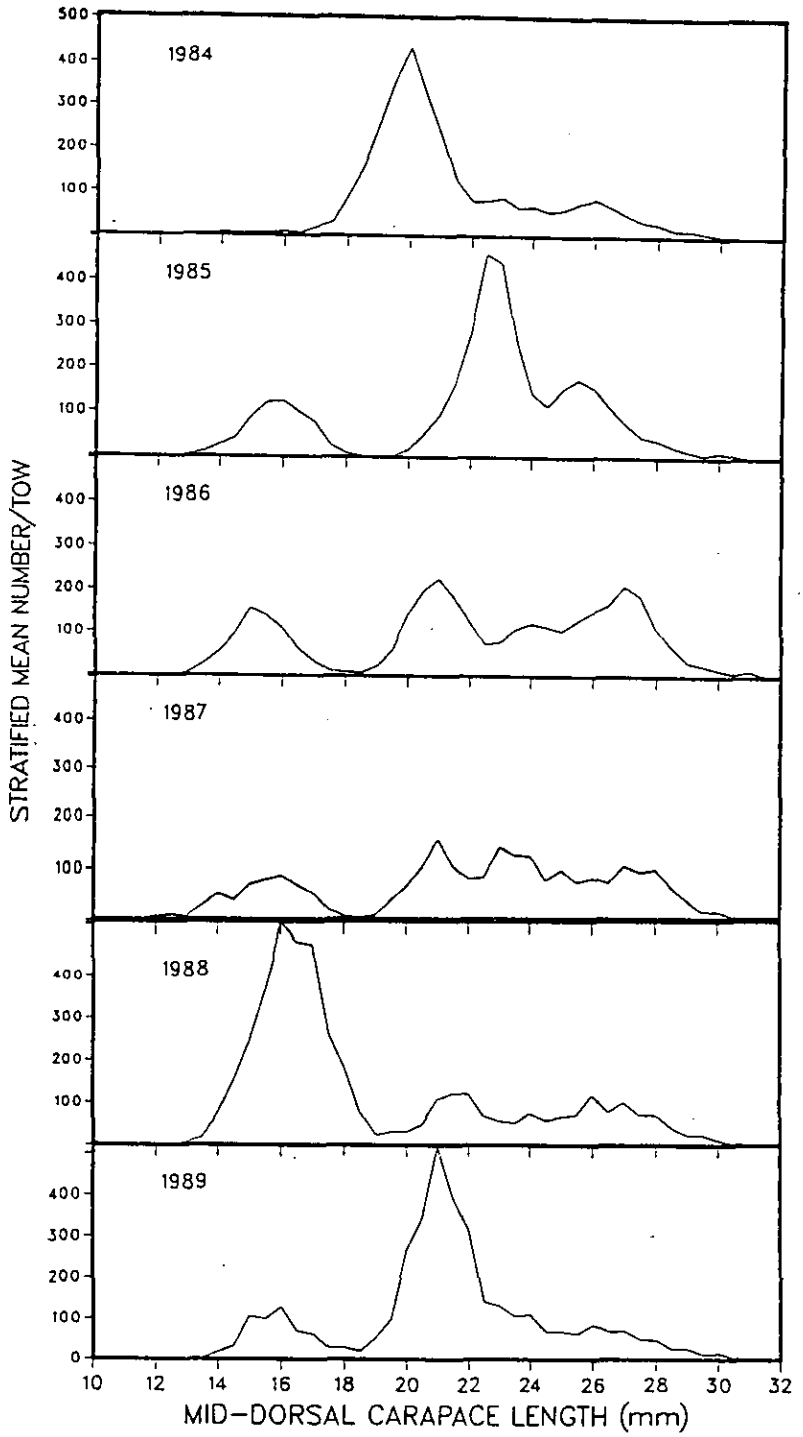


Figure 9. Length Frequency Distributions (Stratified Mean Number per Tow) for Northern Shrimp Collected during Summer Surveys in the Western Gulf of Maine Aboard R/V Gloria Michelle, 1984-1989. From: NSTC, 1989.