DIVISION OF COMMERCIAL AND SPORTS FISHERIES

NORTH CAROLINA DEPARTMENT OF NATURAL AND ECONOMIC RESOURCES

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PINK-BROWN SHRIMP DISCARD STUDIES IN THE CORE-PAMLICO SOUND AREA

by

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ABSTRACT

The objective of this phase of the study was to document the occurrence and extent of the effect on the resulting commercial catch when pre-commercial size pink shrimp are harvested and discarded while fishing for commercial size brown shrimp. It is apparent that a large percentage of the fall population of pink shrimp do not attain commercial size during the fall fishery. Discard of total catch varied in Core Sound from 85.3 to 43.3 percent, in Pamlico Sound from 65.9 to 25.3 percent. Total catch discard was dependent upon pink shrimp size and the availability of browns. Maximum biological yield has been determined while maximum economical yield is still unknown.

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INTRODUCTION

The objective of this phase of the study was to document the effect on the commercial catch when pre-commercial size pink shrimp are discarded from trawlers fishing for commercial size brown shrimp. This report includes results of pink and brown shrimp discard ratio data obtained from 1970 through 1972 in Core and Pamlico Sounds.

In many estuarine areas of North Carolina, two species of Penaeid shrimp are present simultaneously in commercially significant numbers, but with only one species of commercial size. The smaller, pre-commercial sizes are usually discarded overboard during shrimping activities for the commercial sizes. Application of management techniques resulting from shrimp research has reduced the discard or loss of small, pre-commercial shrimp in most of the smaller estuarine areas (McCoy, 1972). This loss still occurs, however, primarily in the larger Pamlico and Core Sound estuaries during late summer and fall when pre-commercial size pink shrimp enter the catches during the brown shrimping season.

The annual loss of pre-commercial shrimp discarded or otherwise destroyed under the above conditions is not known. It is reported that, at times, as much as 50% (by weight) of catches in Pamlico Sound may consist of pre-commercial size pink shrimp that are usually discarded overboard during the period of late August to November. Many of the pink shrimp reach commercial size during the late fall season and are utilized.

It has been determined that pink shrimp overwinter in North Carolina estuaries, with major commercial concentrations remaining in Core, Bogue, and southern Pamlico Sounds the following spring (Purvis and McCoy, 1972). The entire spring pink shrimp fishery is dependent on the overwintering survivors. The extent of the wasteful practice of discarding pre-commercial shrimp while fishing for commercial size shrimp has not been documented.

STUDY AREAS

Two of the more important shrimp areas in the state, Pamlico and Core Sounds, were selected to observe the discard ratio of pre-commercial size pink shrimp to commercial size pink and brown shrimp. Pamlico Sound, North Carolina's largest estuary, is bordered by the mainland and its tributary rivers on the western side, and by the outer banks with their three inlets (Oregon, Hatteras, and Ocracoke Inlets) on the eastern side. At its northern end it connects with Albemarle Sound via Croatan and Roanoke Sounds, which are separated by Roanoke Island. At the southern end it is continuous with Core Sound.

Pamlico Sound is approximately 60 miles long and 15 to 20 miles wide, being narrowest at the northern end (9 miles) and widest opposite Hatteras Island (26 miles). The maximum water depth of the main body of the sound is about 22 feet. The mean depth, however, is not more than 15 feet because extensive shoals are present around the margin and project into the sound.

Core Sound, near the center of the North Carolina coast, extends along a northeast-southwest axis for about 36 miles from Pamlico Sound on the north to the Beaufort area on the south. Beaufort and Barden (at Cape Lookout) Inlets connect Core Sound to the Atlantic Ocean on the south, while Drum Inlet provides an intermittant connection between the ocean and central Core Sound. Total surface area of Core Sound and its tributary bays and tidal creeks is approximately 120 square miles.

METHOD AND PROCEDURES

Collection of Shrimp

The discard ratio of pre-commercial size pink shrimp to commercial size pink and brown shrimp was obtained in the Pamlico-Core Sound areas during 1970 by sampling catches and landings of commercial shrimping operations. During 1971

and 1972, data were obtained aboard Division vessels captained by personnel with commercial fishing backgrounds and considerable shrimping experience. Pink shrimp are nocturnal and all samples were taken at night. A random sample of approximately 10% of each catch was examined. Species composition and length-frequency distribution data were obtained. Salinity and water temperature data were also recorded.

RESULTS AND DISCUSSION

Summaries of pink and brown shrimp discard ratio data, obtained during the three-year study period (1970-1972) in Core and Pamlico Sounds, are presented in Tables 1 through 3, and 4 through 6, respectively. The tables include: Pink and brown shrimp total length distribution; ratio by number and weight; number per pound; percent discard by total catch and pink shrimp only; and mean water temperature and salinity data. Pink-brown ratio and discard similarities observed the month of September in Core and Pamlico Sounds are presented in Figures 1 through 3, and 4 through 6.

Discard of total catch varied in Core Sound from 85.3 to 43.3% (Tables 1 through 3). The higher discard ratios were attributed to early season, high pink shrimp counts, and mature brown shrimp not being available to the fishery. The lower discard ratios observed during October and November were attributed to pink shrimp growth, resulting in lower counts, and thus a slightly greater number entering the commercial fishery.

Data presented in Figures 1, 2, and 3 clearly show that at no time did brown shrimp enter the discard. These data indicate that total catch discard is entirely dependent upon pink shrimp size and the availability of browns. The discard of pre-commercial sized pinks reached alarming limits, as much as 92.9% in September, 1971 (Figure 2). In terms of number, 23 pink shrimp would be destroyed in order to harvest 1 commercial size brown shrimp; in terms of weight, 9.2 pounds of pink shrimp would be lost in order to gain 1.0 pound of brown shrimp.

Table 1.—Summary of pink and brown shrimp discard ratio data obtained in Core Sound, North Carolina, 1970.

LENGTH FREQUENCY DISTRIBUTION - PINK SHRIMP

Date	Mean water Temp. °F	Mean water Sal. ppt.	(*)	Midpoint of 10-mm size groups 55	65	75	85	95	105	115	125	135
9-1	82	33			2.7	17.3	38.7	26.0	8.7	6.7		
9-9	81	33			4.7	18.7	35.3	26.7	13.3	1.3		
10-15	75	32			7.5	9.5	26.0	23.0	17.5	14.5	2.0	
11-10	60	31			2.6	14.7	20.5	24.4	19.9	14.1	3.9	
11-20	58	30			4.0	9.0	21.0	26.0	22.0	10.0	7.0	1.0

(*) Percent of total number by size groups (total length-mm). All shrimp in size groups less than 105-mm (70-per-pound, headless) are considered pre-commercial.

LENGTH FREQUENCY DISTRIBUTION - BROWN SHRIMP

Date	Mean water Temp. °F	Mean water Sal. ppt.	(*)	Midpoint of 10-mm size groups 105	115	125	135	145	155	165	175	185
9-1	82	33		6.6	14.8	21.3	16.4	14.8	6.6	9.8	8.2	1.6
9-9	81	33					no brown shrimp					
10-15	75	32					no brown shrimp					
11-10	60	31					no brown shrimp					
11-20	58	30					no brown shrimp					

(*) Percent of total number by size groups (total length-mm). All shrimp in size groups less than 105-mm (70-per-pound,headless) are considered pre-commercial.

PINK-BROWN RATIO AND DISCARD DATA

Date	Pink-Brown ratio No.	Pink-Brown ratio Wt.(lb)	No. lb. headless Pink	No. lb. headless Brown	Percent discard by number Tot.	Percent discard by number Pinks only
9-1	2.4:1	0.6:1	107	25	60.2	84.7
9-9			105		85.3	85.3
10-15			86		66.0	66.0
11-10			82		62.2	62.2
11-20			78		60.0	60.0

Table 2.—Summary of pink and brown shrimp discard ratio data obtained in Core Sound, North Carolina, 1971.

LENGTH FREQUENCY DISTRIBUTION - PINK SHRIMP

Date	Mean water Temp. °F	Mean water Sal. ppt.	(*)	Midpoint of 10-mm size groups 55	65	75	85	95	105	115	125	135
9-17	81	31		3.5	10.7	23.8	29.7	25.0	4.7	1.1	1.1	
10-12	72	12			2.0	7.3	19.1	30.6	28.5	10.6	1.6	
10-26	73	12			.2	3.8	11.7	27.4	33.7	17.9	4.7	.2
11-1	68	12			2.3	4.6	15.0	33.3	31.6	8.6	4.0	.3
11-10	63	12			1.7	5.1	16.0	23.7	34.8	13.0	4.6	.7

(*) Percent of total number by size groups (total length-mm). All shrimp in size groups less than 105-mm (70-per-pound, headless) are considered pre-commercial.

LENGTH FREQUENCY DISTRIBUTION - BROWN SHRIMP

Date	Mean water Temp. °F	Mean water Sal. ppt	(*)	Midpoint of 10-mm size groups 105	115	125	135	145	155	165	175
9-17	81	31		9.5	19.0	38.0	19.0	9.5	4.7		
10-12	72	13				no brown shrimp					
10-26	73	12				no brown shrimp					
11-1	68	12				no brown shrimp					
11-10	63	12				no brown shrimp					

(*) Percent of total number by size groups (total length-mm). All shrimp in size groups less than 105-mm (70-per-pound, headless) are considered pre-commercial.

PINK-BROWN RATIO AND DISCARD DATA

Date	Pink-Brown ratio No.	Pink-Brown ratio Wt.(lb)	No. lb. headless Pink	No. lb. headless Brown	Percent discard by number Tot.	Percent discard by number Pinks only
9-17	24.9:1.0	9.9:1.0	93	37	74.2	92.9
10-12			78		59.1	59.1
10-26			66		43.3	43.3
11-1			76		55.3	55.3
11-10			73		46.6	46.6

Table 3.—Summary of pink and brown shrimp discard ratio data obtained in Core Sound, North Carolina, 1972.

LENGTH FREQUENCY DISTRIBUTION - PINK SHRIMP

Date	Mean water Temp. °F	Mean water Sal. ppt.	(*) 45	55	65	75	85	95	105	115	125	135
			Midpoint of 10-mm size groups									
9-28	80	29	1.1	2.6	5.2	16.6	33.3	27.7	9.3	2.6	.8	.2
10-30	68	28		.4	1.3	11.6	20.6	36.3	21.9	6.7	.8	

(*) Percent of total number by size groups (total length-mm). All shrimp in size groups less than 105-mm (70-per-pound, headless) are considered pre-commercial.

LENGTH FREQUENCY DISTRIBUTION - BROWN SHRIMP

Date	Mean water Temp. °F	Mean water Sal. ppt.	(*) 105	115	125	135	145	155	165	175
			Midpoint of 10-mm size groups							
9-28	80	29	17.7	31.1	26.6	6.6	6.6	6.6	2.2	2.2
10-30	68	28	no brown shrimp							

(*) Percent of total number by size groups (total length-mm). All shrimp in size groups less than 105-mm (70-per-pound, headless) are considered pre-commercial.

PINK-BROWN RATIO AND DISCARD DATA

Date	Pink-Brown ratio No.	Pink-Brown ratio Wt.(lb)	No. lb. headless Pink	No. lb. headless Brown	Percent discard by number Tot.	Percent discard by number Pinks only
9-28	7.25:1.0	2.80:1	106	41	76.5	87.4
10-30					70.4	70.4

Table 4.—Summary of pink and brown shrimp discard ratio data obtained in Pamlico Sound, North Carolina 1970.

LENGTH FREQUENCY DISTRIBUTION - PINK SHRIMP

Date	Mean water Temp. °F	Mean water Sal. ppt	(*)	Midpoint of 10-mm size groups 55	65	75	85	95	105	115	125	135	145
8-21	82	24				25.8	35.5	19.4	16.1	3.2			
8-27	81	24		.6	3.5	17.1	27.0	31.8	15.9	3.1	.8	.2	
9-13	80	23			.3	3.8	17.9	40.8	26.7	10.1	.6		
10-19	63	21					9.0	25.0	29.0	28.0	6.0	1.0	2.0
10-22	60	21			1.9	11.4	8.6	17.1	38.1	19.1	2.9	1.0	

(*) Percent of total number by size groups (total length-mm). All shrimp in size groups less than 105-mm (70-per-pound, headless) are considered pre-commercial.

LENGTH FREQUENCY DISTRIBUTION - BROWN SHRIMP

Date	Mean water Temp. °F	Mean water Sal. ppt	(*)	Midpoint of 10-mm size groups 105	115	125	135	145	155	165	175	185
8-21	82	24		1.7	6.9	32.8	31.0	6.9	6.9	12.1	1.7	
8-27	81	24			2.9	10.0	23.1	17.3	11.6	11.6	21.2	2.9
9-13	80	23		3.2	9.7	19.4	20.0	17.4	11.6	9.7	7.0	1.9
10-19	63	21					no brown shrimp					
10-22	60	21					no brown shrimp					

(*) Percent of total number by size groups (total length-mm). All shrimp in size groups less than 105-mm (70-per-pound, headless) are considered pre-commercial.

PINK-BROWN RATIO AND DISCARD DATA

Date	Pink-Brown ratio No.	Pink-Brown ratio Wt.(lb)	No. lb. headless Pink	No. lb. headless Brown	Percent discard by number Tot.	Percent discard by number Pinks only
8-21	1.0:1.9	1.0:6.9	107	29	28.1	80.6
8-27	4.7:1.0	1.0:1.0	109	23	65.9	80.0
9-13	2.1:1.0	0.7:1.0	80	27	42.2	62.7
10-19			61		34.0	34.0
10-22			71		39.1	39.1

Table 5.—Summary of pink and brown shrimp discard ratio data obtained in Pamlico Sound, North Carolina 1971.

LENGTH FREQUENCY DISTRIBUTION - PINK SHRIMP

Date	Mean water Temp. °F	Mean water Sal. ppt	(*)	Midpoint of 10-mm size groups 55	65	75	85	95	105	115	125	135	145
9-7	80	22		3.2	7.6	16.9	24.5	32.8	12.8	1.5	.4		
9-16	80	21		1.6	5.1	14.9	33.8	25.7	11.3	5.6	1.4	.1	
10-11	70	16		.6	.6	5.0	8.1	27.0	38.6	15.4	3.1	1.2	
11-1	59	15			.3	2.3	8.6	17.3	36.6	21.6	11.6	1.3	

(*) Percent of total number by size groups (total length-mm). All shrimp in size groups less than 105-mm (70-per-pound, headless) are considered pre-commercial.

LENGTH FREQUENCY DISTRIBUTION - BROWN SHRIMP

Date	Mean water Temp. °F	Mean water Sal. ppt	(*)	Midpoint of 10-mm size groups 105	115	125	135	145	155	165	175	185
9-7	80	22		.9	16.7	30.9	19.5	12.9	12.3	6.1	.1	
9-16	80	21		1.0	15.5	30.3	14.1	20.1	13.4	3.8	1.4	
10-11	70	16		6.0	16.0	22.0	30.0	18.0	2.0	6.0		
11-1	59	15		10.2	17.9	38.4	23.0	7.6	2.5			

(*) Percent of total number by size groups (total length-mm). All shrimp in size groups less than 105-mm (70-per-pound, headless) are considered pre-commercial.

PINK-BROWN RATIO AND DISCARD DATA

Date	Pink-Brown ratio No.	Pink-Brown ratio Wt.(lb)	No. lb. headless Pink	No. lb. headless Brown	Percent discard by number Tot.	Percent discard by number Pinks only
9-7	1.0:1.05	1.0:3.71	106	30	40.7	85.2
9-16	3.05:1.0	1.0:1.0	90	28	57.3	81.4
10-11	6.84:1.0	3.41:1.0	72	36	35.8	41.5
11-1	7.48:1.0	4.86:1.0	60	40	25.3	28.7

Table 6.—Summary of pink and brown shrimp discard ratio data obtained in Pamlico Sound, North Carolina 1972.

LENGTH FREQUENCY DISTRIBUTION - PINK SHRIMP

Date	Mean water Temp. °F	Mean water Sal. ppt	(*) 45	Midpoint of 10-mm size groups 55	65	75	85	95	105	115	125	135	145
8-28	82	15	1.5	6.9	26.1	36.9	22.3	6.1					
9-27	70	17	1.2	2.5	2.5	10.3	23.3	44.1	14.2	1.2			

(*) Percent of total number by size groups (total length-mm). All shrimp in size groups less than 105-mm (70-per-pound, headless) are considered pre-commercial.

LENGTH FREQUENCY DISTRIBUTION - BROWN SHRIMP

Date	Mean water Temp. °F	Mean water Sal. ppt	(*)	Midpoint of 10-mm size groups 105	115	125	135	145	155	165	175	185
8-28	82	15		4.0	17.3	40.0	32.0	4.0	1.3	1.3		
9-27	70	17			17.2	37.9	31.0	6.8	6.8			

(*) Percent of total number by size groups (total length-mm). All shrimp in size groups less than 105-mm (70-per-pound, headless) are considered pre-commercial.

PINK-BROWN RATIO AND DISCARD DATA

Date	Pink-Brown ratio No.	Pink-Brown ratio Wt.(lb)	No. lb. headless Pink	No. lb. headless Brown	Percent discard by number Tot.	Percent discard by number Pinks only
8-28	1.0 :1.15	1.0 : 6.29	197	46	46.4	100
9-27	2.65:1.0	.95: 1.0	95	34	61.3	84.2

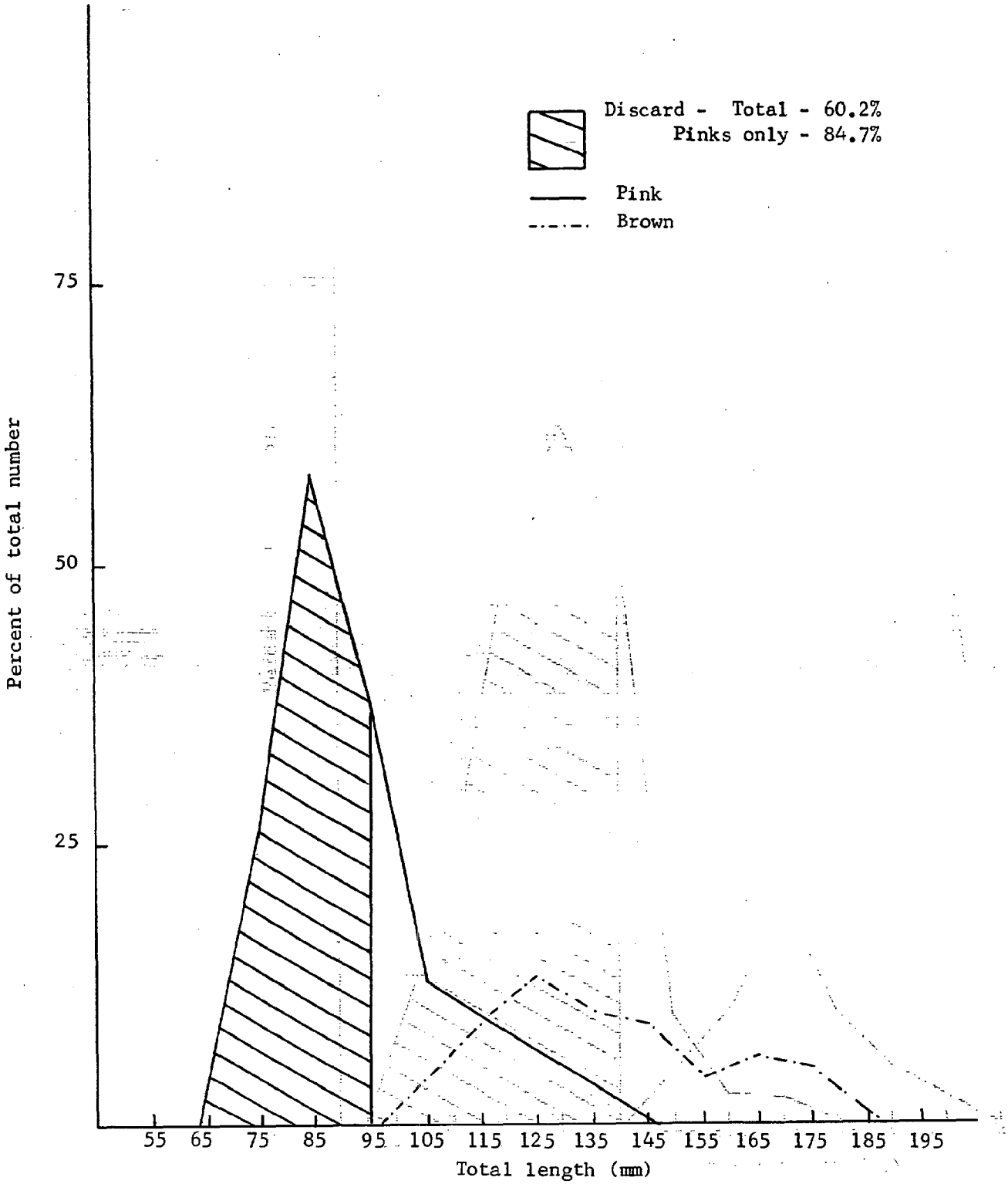

Figure 1.—Pink and brown shrimp length-frequency distribution curves and discard of pinks and total catch as obtained from samples collected in Core Sound during September of 1970.

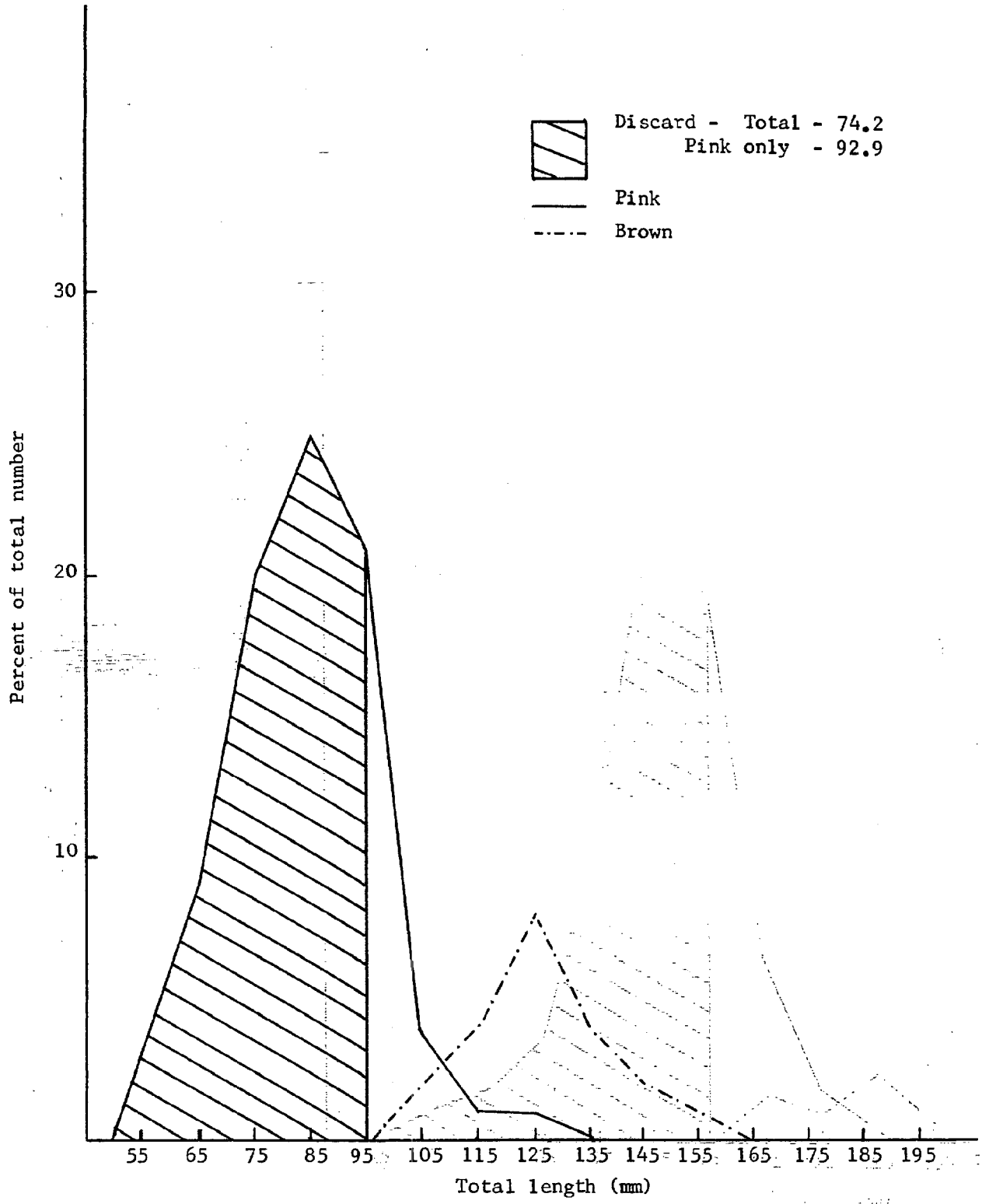

Figure 2.—Pink and brown shrimp length-frequency distribution curves and discard of pinks and total catch as obtained from samples collected in Core Sound during September of 1971.

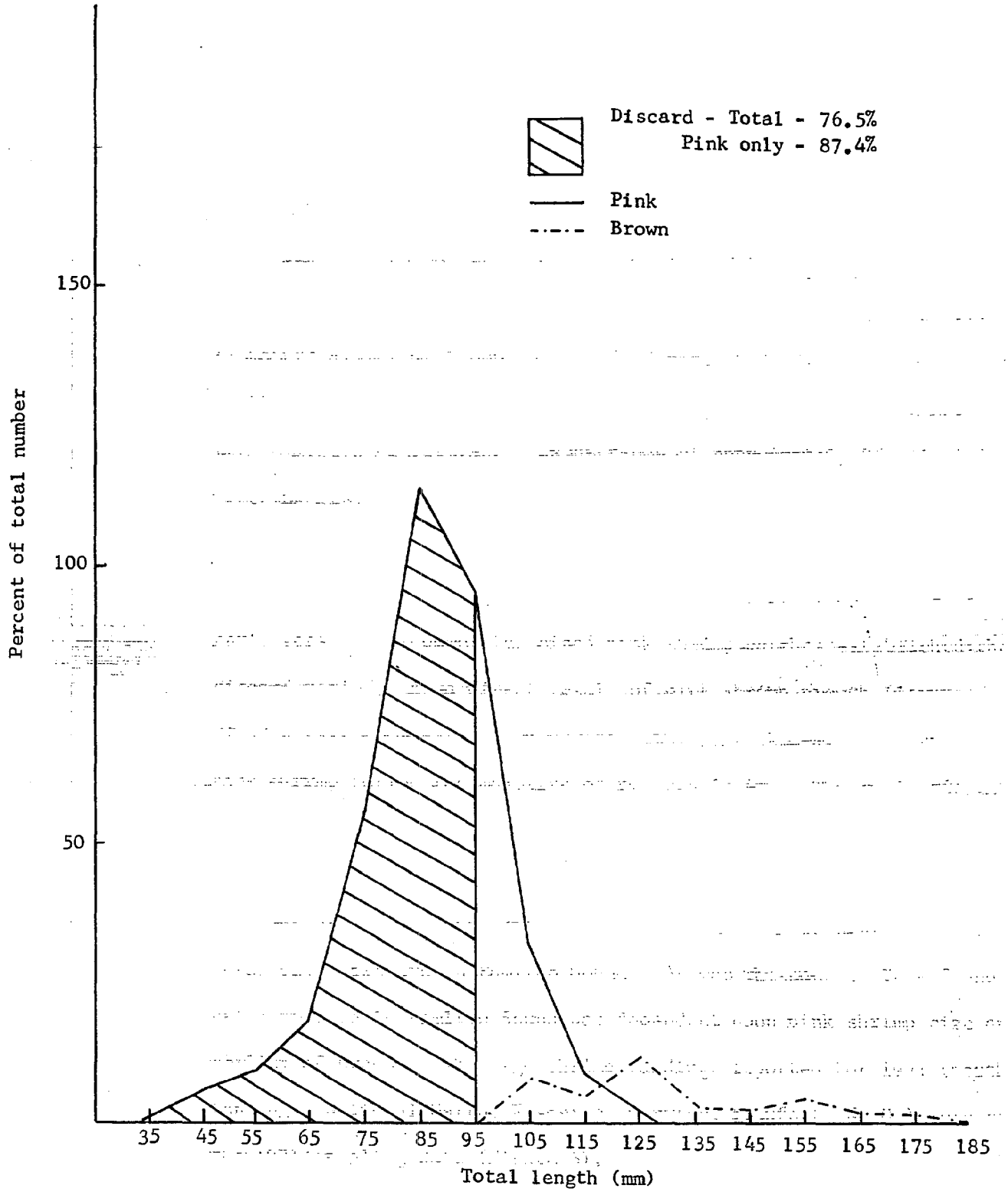

Figure 3.—Pink and brown shrimp length-frequency distribution curves and discard of pinks and total catch as obtained from samples collected in Core Sound during September of 1972.

During the month of September, for three consecutive years, a modal, length-frequency distribution group of 85 mm total length was encountered for pink shrimp in Core Sound (Tables 1 through 3). Modal, length-frequency distribution size groups for October ranged from 85 mm to 105 mm total length depending upon the growth-water temperature relationship (Purvis and McCoy, 1972). At no time during the fall did all pink shrimp reach commercial size.

Sampling indicated no mass migration of brown shrimp from Pamlico Sound through Core Sound; however, reports from Core Sound shrimpers revealed catches of mature migrating browns were made during the fall. Core Sound shrimpers generally agree that the mature migrating browns were capable of traveling the entire length of Core Sound (a distance of apprximately 25 miles) in a period of three nights.

Discard of total catch varied in Pamlico Sound from 65.9 to 25.3% (Tables 4 through 6). Dwindling late season mature brown shrimp catches and increased early season pre-commercial sized pink shrimp catches established the higher discard ratios. As a direct result of pink shrimp growth (lower counts), lower discard ratios were observed during October and November. By early September, pink shrimp formed the majority of the population. The ratio of pink to brown shrimp reached the peak (7.58:1.00) in November, 1971. Each September during the study period a pink-brown shrimp weight equilibrium (1.0:1.0) existed.

Figures 4, 5, and 6 present evidence that brown shrimp did not enter the total catch discard in Pamlico Sound. As was the case in Core Sound, total catch discard in Pamlico Sound was dependent upon pink shrimp size and the availability of browns. The high shrimp landings reported for 1971 (North Carolina Landings, National Marine Fisheries Service, Beaufort, N. C.) were reflected in the 1971 sampling data (Figure 5).

In comparison, during the month of September, a pink shrimp modal length distribution group of 95 mm total length was observed in Pamlico Sound, compared

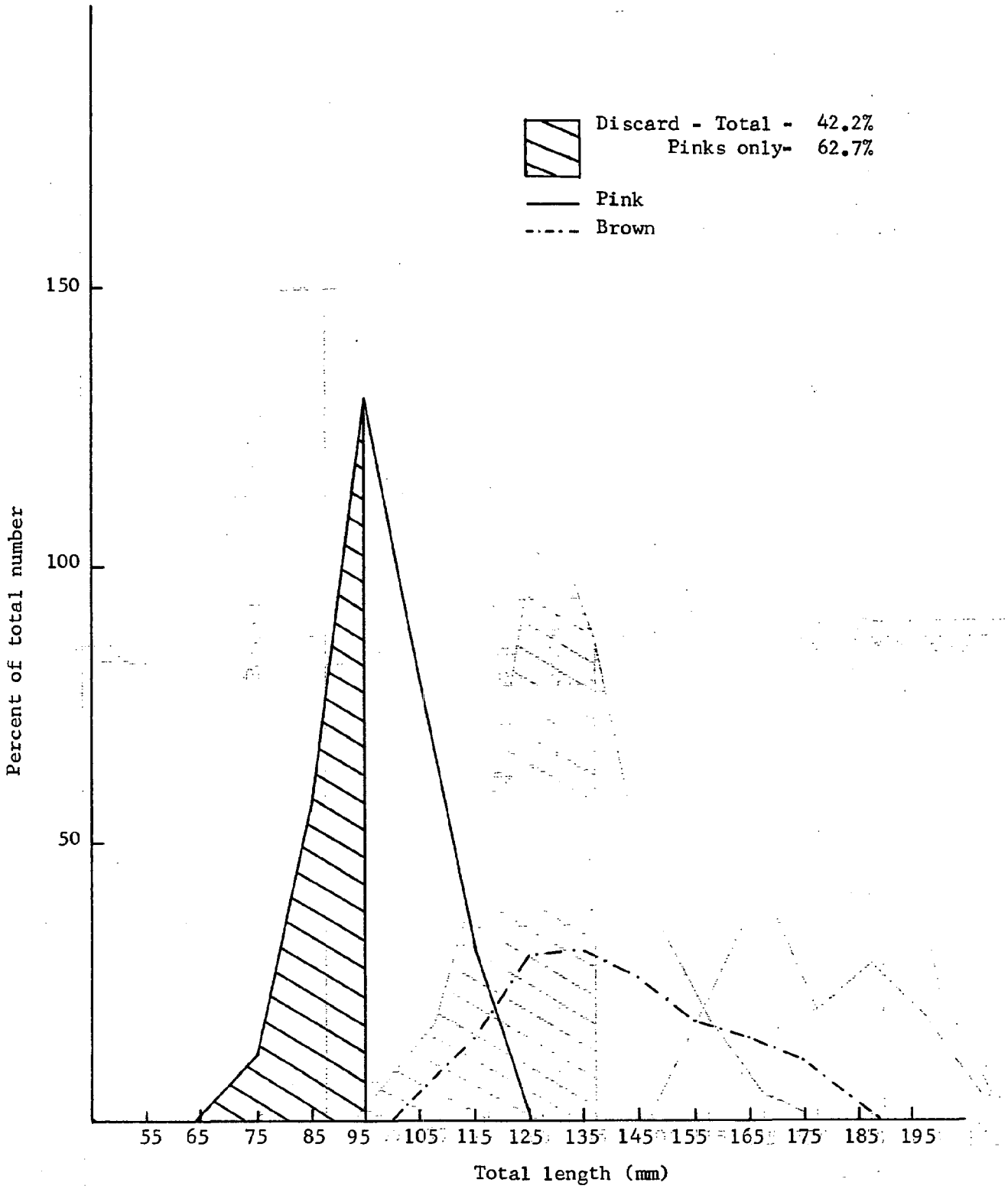

Figure 4.— Pink and brown shrimp length-frequency distribution curves and discard of Pinks and total catch as obtained from samples collected in Pamlico Sound during September of 1970.

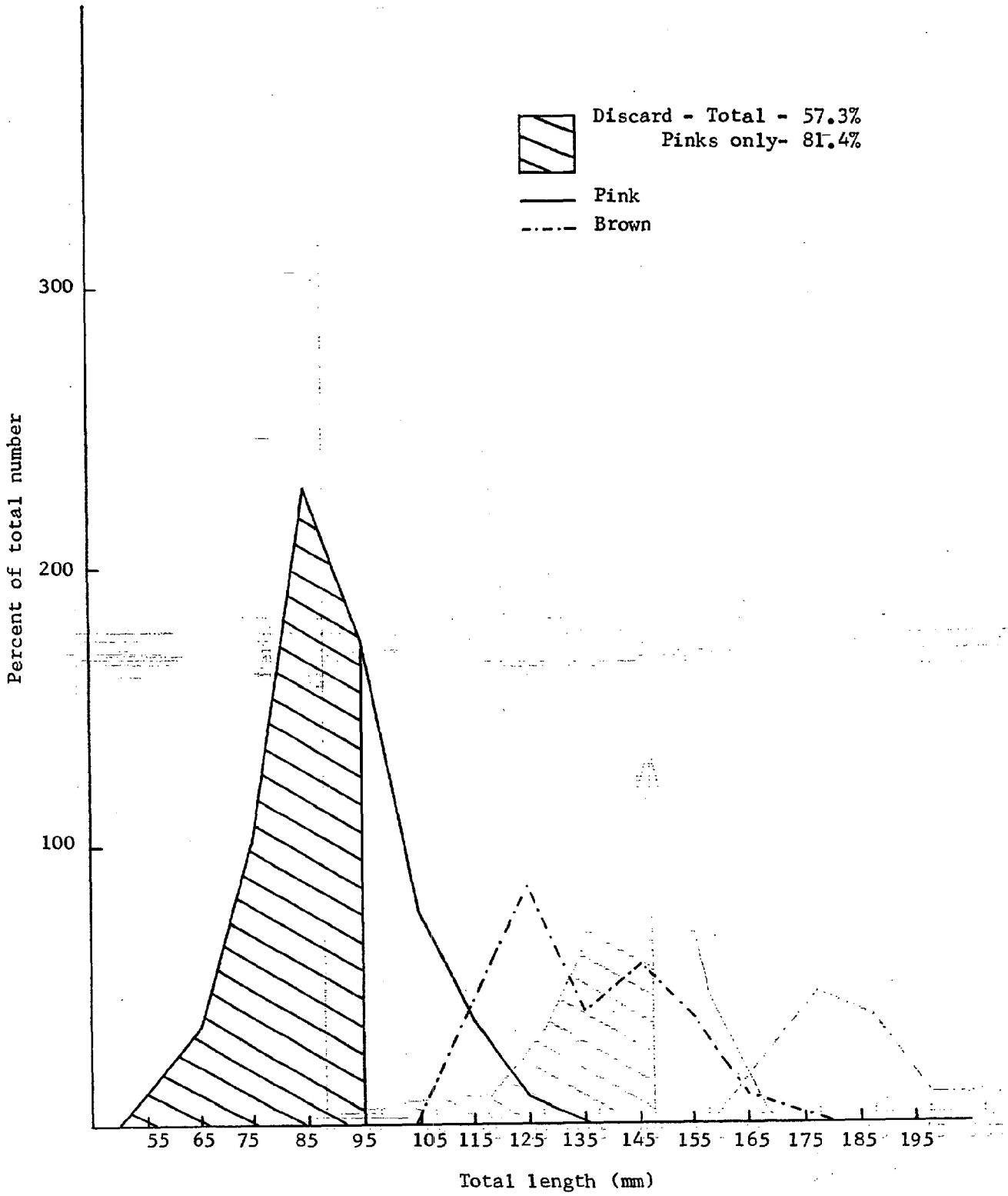

Figure 5.—Pink and brown shrimp length-frequency distribution curves and discard of pinks and total catch as obtained from samples collected in Pamlico Sound during September of 1971.

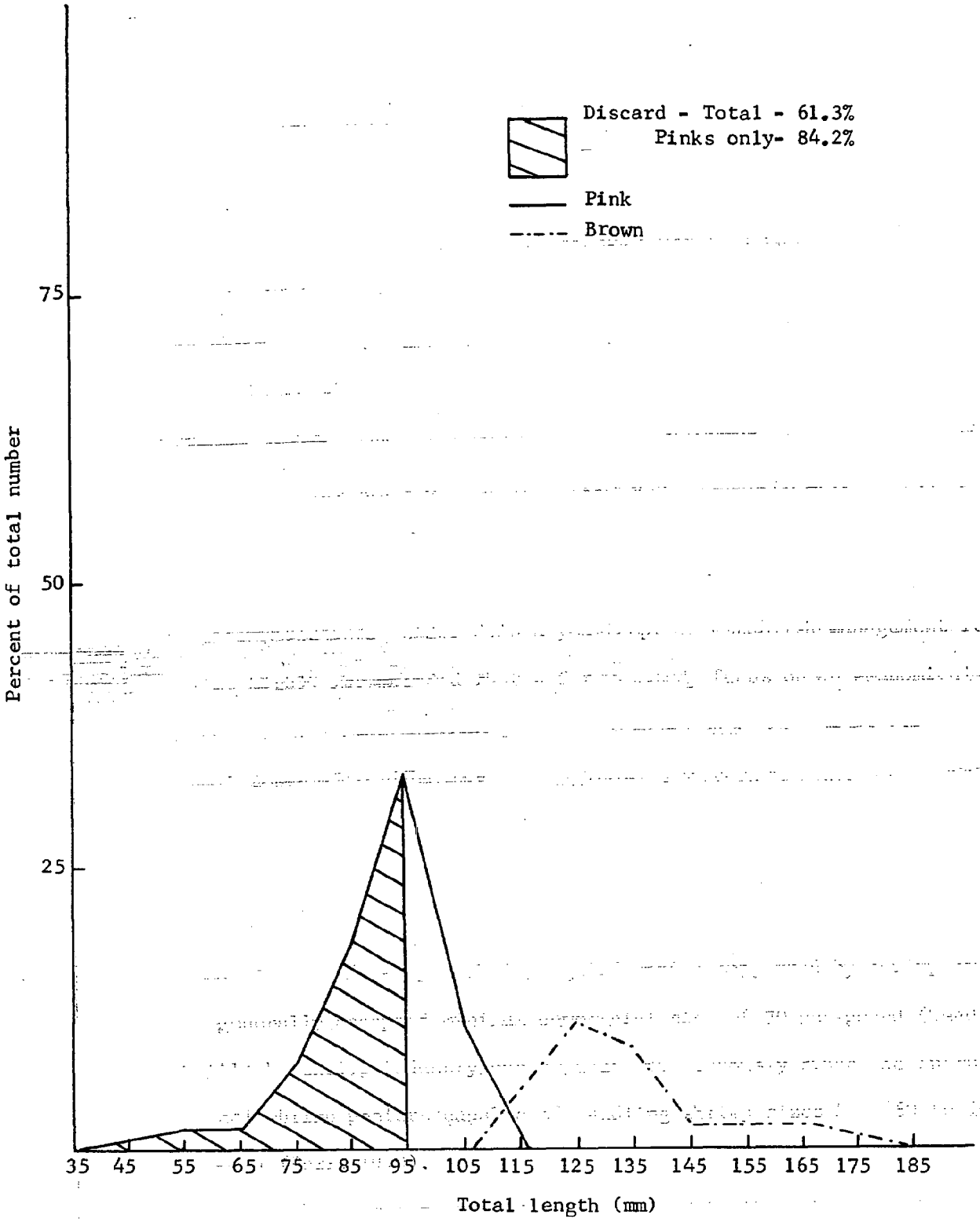

Figure 6.—Pink and brown shrimp length-frequency distribution curves and discard of pinks and total catch as obtained from samples collected in Pamlico Sound during September of 1972.

with the 85 mm total length group in Core Sound. Brown shrimp were available in Pamlico Sound in November whereas all had migrated from Core Sound by early October. The percent discard was less in Pamlico Sound because more brown shrimp were available, and pink shrimp apparently grew faster. At no time did brown shrimp enter the discard in either Core or Pamlico Sounds.

MANAGEMENT IMPLICATIONS

It is apparent that a large percentage of the fall population of pink shrimp that are taken by commercial gear presently in use do not attain commercial size during the fall fishery. It also appears that both Core and Pamlico Sounds function as nursery areas for pink shrimp during a part of the year; therefore, regulations protecting the pre-commercial size shrimp should be considered. The value of the pink and brown shrimp resource to the fishermen should be determined for the period in which significant discard occurs, and it should be considered in any attempt to establish management regulations. It is highly recommended that a future study focus on an economical evaluation of this problem, with much consideration being given to utilization of the discard. It appears feasible that through the combined efforts of the Division of Commercial and Sports Fisheries, the Department of Food Science at North Carolina State University, and the expertise available through seafood marketing specialists, the shrimp now being discarded can be utilized commercially. Both Alaska and Maine have developed shrimping industries supported by shrimp smaller than the generally accepted minimum commercial size of 70-per-pound (headless). The Alaska shrimp industry has expanded tremendously since the introduction of mechanical shrimp peelers capable of handling shrimp sizes from 60 to 160 per-pound (headless) (Barr, 1970).

The questions tentatively answered by this phase of the overall shrimp study have far greater implications from a biological than from an economical

standpoint. Of much interest is the general observation that maximum biological yield has been determined, while maximum economical yield is still unknown when dealing with the discard problem.

Since pink shrimp are nocturnal, prohibiting shrimping at night during the period of significant pink shrimp discard should be considered. Another approach to improved management of this resource would be to consider larger minimum mesh size restrictions during the period these areas are functioning as nursery areas.

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