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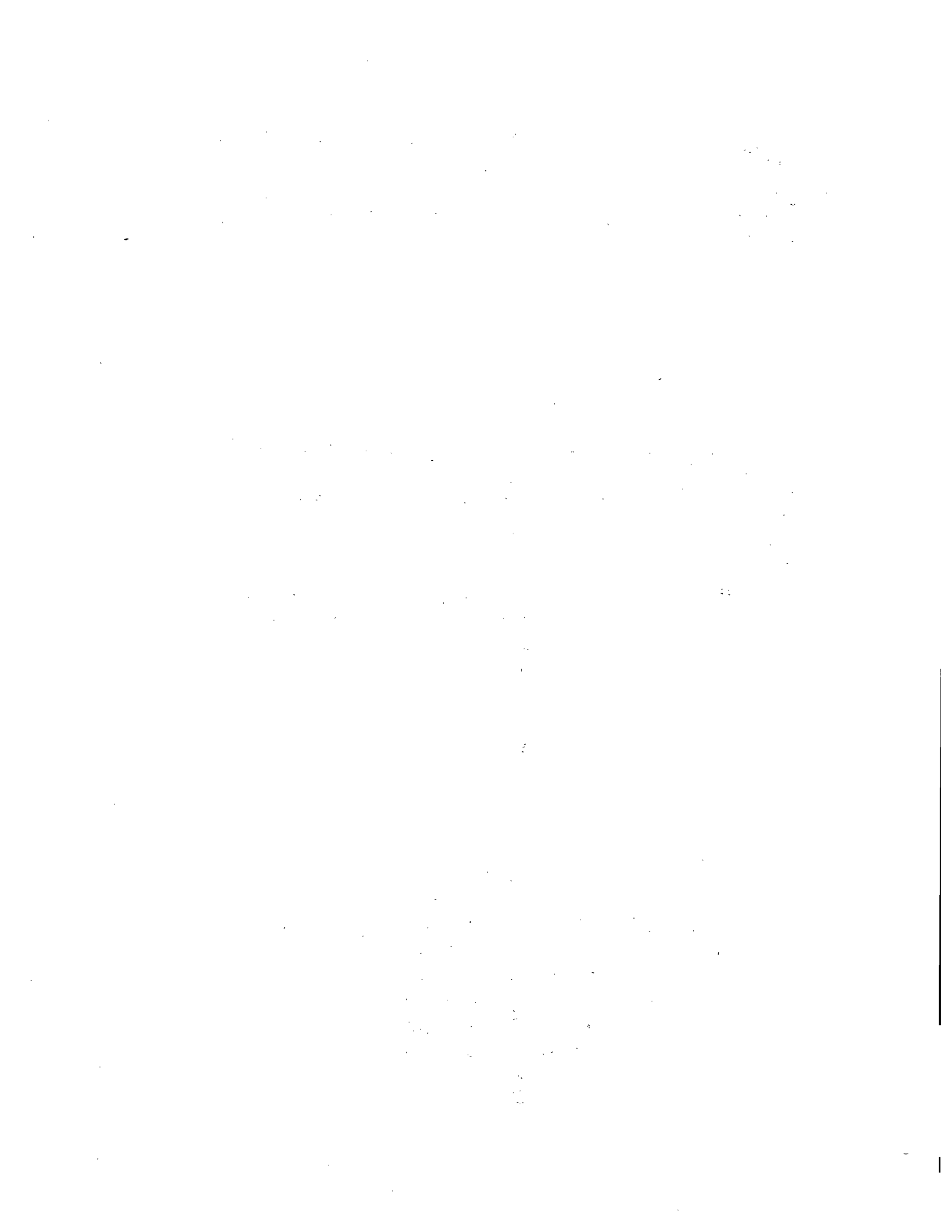
# The 1988 Experimental Whiting Fishery: A NMFS/Industry Cooperative Program

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## EXECUTIVE SUMMARY

An experimental fishery for whiting (silver hake) was conducted in cooperation with the New England commercial whiting industry on Georges Bank during July - November 1988. During the fishery, 17 vessels from four ports made 119 trips totaling 1,014 tows and 1,668.8 hours fished. Ten of the trips in the fishery were monitored through the use of technicians placed aboard the vessels to collect scientific information.

The fishery was conducted primarily on the northwestern edge of Georges Bank in waters averaging 52 fathoms. Based on catch-per-unit-effort statistics and discard rates, the major portion of the fishery began in the third week of July and continued until about the third to fourth week in September.

Over 5 million lb [2,270 metric tons (mt)] of whiting were caught during the fishery, of which 4.9 million lb (2,237 mt) were landed. The total catch of regulated species was about 68,000 lb (31 mt), primarily white hake and Atlantic cod, of which 37,000 lb (17 mt) were landed, while about 1.2 million lb of other species were caught with only 136,000 lb landed.

Whiting accounted for 80.2 percent of the total catch; however, whiting made up 96.6 percent of the total landings. The overall discard rate was 18.2 percent. The primary species discarded were red hake, skates, northern shortfin squid, Atlantic herring, and spiny dogfish. Only 1.1 percent of the total catch was composed of regulated species, and only 0.7 percent of the total landings were of regulated species. Length-frequency analysis indicated that the whiting catch was primarily made up of individuals averaging about 11.4 inches, age 3 fish from the strong 1985 year class. Examination of historical catch data from the commercial fishery and research vessels indicate that the area where the experimental fishery was conducted was an area where few regulated species had been caught in the past.

A comparison of landings data from mandatory tow-by-tow logbooks and data from the Northeast Fisheries Center (NEFC) weighout system indicated that while whiting landings from the weighout system corresponded quite well with totals recorded in the logbooks, the landings of regulated species recorded in the logbooks were 36.5 percent less than those in the weighouts. However, while the percentage differences appear quite high, absolute differences in weight were generally low.



## INTRODUCTION

Between July 1 and November 4, 1988, an experimental fishery for whiting (silver hake, *Merluccius bilinearis* Mitchell) was conducted on Georges Bank by vessels from the ports of Pt. Judith, Rhode Island; Newport, Rhode Island; Portland, Maine; and Gloucester, Massachusetts. The Experimental Whiting Fishery (hereafter called the Experimental Fishery) was authorized as a research exemption under the Northeast Multispecies Fishery Management Plan (Federal Register 50 CFR Part 651, Section 651.24) and designed with the intention that historical fisheries, excluded under current regulations, would be allowed to operate under supervision to determine their feasibility.

The objectives of the Experimental Fishery were to determine the feasibility of conducting a small-mesh fishery for whiting in the offshore waters of Georges Bank where large-mesh (*i.e.*, 5-1/2 inch) trawl gear is currently required of all vessels. Further objectives were to determine the fishery's location and spatial extent, seasonality, and impact on species regulated by the Northeast Multispecies Fishery Management Plan (hereafter called regulated species).

Additional objectives of the Experimental Fishery were to: (1) determine how closely catches from trips with observers aboard compared to those from which detailed data were acquired through operator-completed tow-by-tow logbooks; and (2) compare landings data from logbooks to NEFC weighout system data.

## HISTORICAL BACKGROUND

A whiting fishery has historically taken place during June-October, with largest catches taken during July-September, on the northern and northwestern edges of Georges Bank [Statistical Areas (SA) 522 and 561] and east of Cape Cod (SA 521) (Figure 1). Catch data from interviewed trips in the NEFC database indicate that during July-September, commercial catch per unit effort (CPUE) (summarized by 10-minute square) frequently exceeded 55,000 lb/day for the period 1965-80. NEFC bottom trawl survey data, summarized from surveys conducted intermittently during the summer (1963-81), indicate persistent concentrations of whiting in this area over time. Through examination of gonads and food habits information, the area has been identified as a site where intensive post-spawning feeding aggregations consistently occur (Almeida 1987).

Several sea sampling trips have been conducted in this fishery since the inception of the Magnuson Fishery Conservation and Management Act. In 1978, a single trip was conducted aboard the F/V *Capt' Scrod* on the northwestern edge of Georges Bank (SA 522) during August; and in 1987, seven trips were made aboard the F/V *Gloucesterman* on the northern edge of Georges Bank (SA 561) and the Nauset area east of Cape Cod (SA 521) during August-

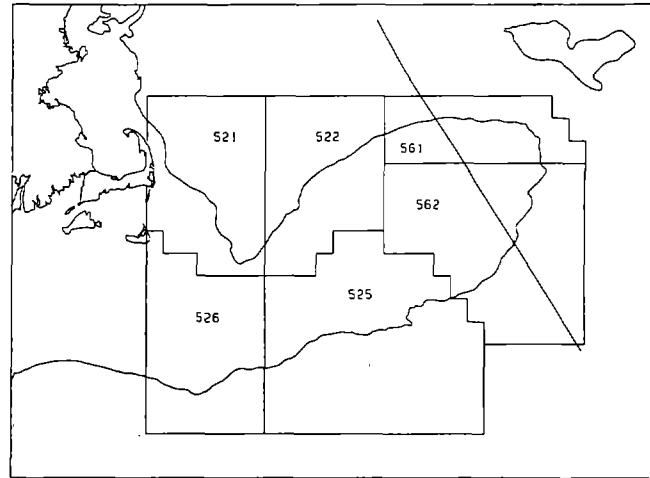


Figure 1. Fishery statistical reporting areas in the Georges Bank region.

September. The results of these studies indicated that it might be possible to conduct a fishery for whiting with minimal levels of by-catch of regulated species in very specific areas and times of the year. During the 1978 sea sampling trip, whiting accounted for 98 percent of the total trip landings (1978 NEFC internal report by F. Almeida), while in 1987, whiting made up 96 percent of the total from Georges Bank and 75 percent of the total from the Nauset area [1988 Northeast Regional Office (NERO) internal report by P. Gerrior]. During these trips, regulated species by-catch was approximately one percent of the total landings.

## METHODS

### OPERATIONAL PLAN

The operational plan for the experiment was to conduct a small-mesh fishery for whiting in the large-mesh area during the summer of 1988 with sea samplers aboard randomly selected vessels to monitor performance. Specific plans for the Experimental Fishery included the following:

1. Vessels in the Experimental Fishery were required to fish only for whiting while participating. A whiting trip, defined *a posteriori*, was one in which at least 75 percent of the total landings were whiting.
2. No restrictions were placed on the area in which vessels participating in the Experimental Fishery could tow.
3. There were no restrictions governing the prosecution of the fishery, *i.e.*, when, where and the number of tows per trip were determined by vessel operators.
4. No limits were placed on the number of vessel permits or trips, however. Vessels were required to obtain a

permit for each trip made during the experiment. (Weekly permits were also issued for vessels making several short trips during any one week.)

5. All vessels participating in the fishery were required to complete detailed tow-by-tow logbooks during each trip.
6. A selected sample of trips were assigned sea samplers. Trips to include sea samplers were chosen at random.
7. Vessels selected to take a sea sampler were required to do so. As a requirement to obtaining a permit, each vessel agreed to provide reasonable accommodations for a sea sampler and obtain suitable insurance coverage for the sea sampler while aboard.
8. Vessels designated to take a sea sampler were required to notify the appropriate NEFC representative of trip departure date/time with enough advance notice to allow sea sampler coverage to be arranged. Selected vessels were not allowed to depart without a sea sampler aboard unless notified by a NEFC representative that a sea sampler was not available.
9. A randomly selected sample of trips with no sea sampler aboard were required to provide samples of by-catch and/or discard species, generally from the last tow of the trip.
10. Sea samplers aboard a vessel were allowed to designate one tow during the trip in a specified area in an adjacent 10-minute square.
11. Sea samplers were required to monitor tows made during different times of day and night.
12. Vessels were permitted to retain legal-sized regulated species taken in the Experimental Fishery.

By not limiting the number of vessels or the area in which the fishery operated, market conditions were allowed to determine the appropriate number of trips made in the fishery. However, with only one sea-sampled trip per week scheduled, and no inspection of the catches from other vessels in the fishery, the data and results concerning the amount and size composition of the regulated species by-catch were almost entirely dependent on accurate logbook reporting. Consequently, results may have been compromised since vessels could fish outside the area of whiting concentrations indicated from historical catches and survey results, and it was possible for vessels to land regulated species without reporting this catch in logbooks. It was intended that this possible shortcoming in the design be partially addressed by the use of random boardings and inspections at sea, however, only one vessel was boarded during the Experimental Fishery.

There was generally excellent cooperation in completing the detailed logbooks required for each vessel/trip. Many vessel operators not only supplied the required data, but also provided anecdotal information concerning vessel operations and observations about the fishery.

## DATA PROCESSING AND ANALYSIS

Information from each trip during the Experimental

Fishery was monitored at the NEFC's Woods Hole Laboratory to determine whether: (1) areal coverage of the experiment was adequate to define a suitable area for a small-mesh fishery, and (2) logbook information was consistent with data obtained from sea samplers and weighout data.

Tow-by-tow logbooks from each trip were forwarded to Woods Hole for data entry and audit. A microcomputer-based data entry system was designed and implemented which allowed for very rapid entry and preliminary analysis of the data. Summaries of each trip were produced and examined, and at the end of each month, each vessel's summaries were forwarded to its operator.

Analysis of the data included the determination of: (1) the area in which the fishery took place, (2) the seasonality of the fishery, (3) the impact of the fishery on regulated species, (4) species composition of the by-catch, (5) catch composition by mesh size, and (6) size composition of the landings and discards.

Determination of the location of the small-mesh fishery in the large-mesh zone was completed through a spatial analysis of the logbook data and a comparison of this data with historical trends in the fishery. Each tow was plotted as soon as logbook data were available, and the monthly whiting catch was summarized by 10-minute square and plotted to define the area where the Experimental Fishery was being conducted.

The seasonality of the fishery was defined through an analysis of daily and weekly CPUE indices and weekly discard rates. Catch per unit effort was defined as whiting caught (in pounds) per hour fished. Discard rates (the proportion of the total catch discarded at sea) were calculated for regulated species and for all species combined.

We evaluated the likely past and present impact of this small-mesh fishery on regulated species in terms of the quantity and size composition of the regulated species by-catch based on an analysis of historical catch statistics during July-September from the Georges Bank area. Commercial landings data for each regulated species for 1982-87 were used to represent current conditions in the Georges Bank fishery. NEFC research vessel bottom trawl data from summer surveys during 1977-81 represented a period of higher overall abundance of regulated species on the bank. Survey data were used for the earlier period since comprehensive detailed landings data do not exist for many species prior to 1982.

Landings data were collected from the commercial fishery through the standard NEFC weighout system. Landings from all vessel classes and mesh sizes combined, originally reported by quarter-degree square (30' latitude by 30' longitude square), were allocated to 10-minute squares (10' latitude by 10' longitude) based on detailed catch information obtained from vessels interviewed by NEFC port agents at dockside [after Wigley (1987)].

To examine the effects of the Experimental Fishery on separate size categories of the regulated species, we subdivided monthly landings into 'large' and 'small' using market categories (*i.e.*, landings from the smallest category).



ries such as snapper and scrod were considered 'small' and the larger categories considered 'large') (see Appendix Table 1). The data were then summarized and plotted with monthly Experimental Fishery area windows overlaid. Catches from summer bottom trawl surveys conducted during 1977-81 were subdivided into legal and sub-legal categories based on length-frequency data. For regulated species with specified minimum legal sizes, those values were used as cutoff lengths between categories (e.g., Atlantic cod or haddock sub-legals were defined as individuals less than 19 inches, legals greater than or equal to 19 inches). Otherwise, catches of species without minimum legal sizes were subdivided into sub-legals and legals utilizing approximate biological cutoff lengths between juveniles and adults. These data were also summarized by 10-minute square (all surveys combined) and plotted with a window overlying the area in which the Experimental Fishery was conducted.

The size composition of the catch and by-catch from the fishery was determined based on data provided by sea samplers (10 trips) and from data obtained from six trips in which 100-lb samples from the last tow of the trip were collected.

## RESULTS

A total of 119 trips were completed by 17 vessels from Pt. Judith and Newport, Rhode Island; Portland, Maine; and Gloucester, Massachusetts (Table 1). While the fishery was scheduled to end on October 1, the duration was

extended through November 4 because of favorable market conditions.

An overall summary of the fishery is provided in Table 2. Catches, landings, and discards by species are listed in Table 3, catch and effort by week are summarized in Table 4, and a summary of weekly discards (Table 5) is also given. Catches totaling 6,237,461 lb [2,829.3 metric tons (mt)] of which whiting made up 5,004,546 lb (2,270.0 mt), approximately 80.2 percent, were taken during 1,668.8 hr of fishing. Total landings from the fishery were 5,105,249 lb (2,315.7 mt) of which 4,931,725 lb (2,237.0 mt), or 96.6 percent, were whiting. The total catch of regulated species was only 67,706 lb (30.7 mt) of which 37,287 lb (16.9 mt) were landed. Discards totaled 1,132,212 lb (513.6 mt), about 18.2 percent of the total catch, made up primarily of red hake (390,035 lb), skates (140,279 lb), and northern shortfin squid (127,891 lb).

## MESH SIZE ANALYSIS

Vessels participating in the fishery used otter trawls almost exclusively; a Scottish seine was used during two trips. Mesh sizes ranged from 1-3/8 to 4-1/2 inches, although two mesh sizes, 2-1/4 inch, used primarily by vessels from Portland, and 3 inch, used by Pt. Judith vessels, were dominant (Table 1). A total of 615.2 hr of effort were expended using 3-inch mesh, while 2-1/4 inch nets accounted for 493.6 hr, about 37 and 30 percent of the total effort, respectively (Table 6). The dominance of these mesh sizes was also reflected in the catch statistics. Vessels

Table 1. Vessels participating in the 1988 Experimental Whiting Fishery

Port	Vessel	Permit Number	Mesh Size (in)	Number of Trips	Effort (hr)
Gloucester	<i>Gloucesterman</i>	330384	2 & 2-1/4	11	167.1
	<i>Morning Star</i>	330372	2-3/8	15	73.5
	<i>St George</i>	410244	1-3/8	4	53.2
	<i>Lady Francesca</i>	320608	2-3/4	6	23.3
Portland	<i>American Eagle</i>	330454	2 & 2-1/4	14	433.9
	<i>Kit Kat</i>	320617	4-1/2 <sup>1</sup>	2	18.4
Newport	<i>Ingtoffer II</i>	410222	3-1/8	8	109.7
Pt. Judith	<i>Lightning Bay</i>	410410	3	16	204.9
	<i>Catherine Louise</i>	330322	3	10	124.9
	<i>Vic-Ter-Rae</i>	410349	3	8	114.2
	<i>Katrina Lee</i>	410318	3 & 4 <sup>2</sup>	8	86.7
	<i>Thunder Bay</i>	410384	2-1/2	5	80.7
	<i>J.B.J.</i>	330485	2-1/4	3	59.7
	<i>Excalibur</i>	330339	3	4	58.4
	<i>Green Arrow</i>	330538	2-1/2	3	30.1
	<i>Min Terse</i>	410392	3	1	20.1
	<i>Alliance</i>	330098	3	1	10.0

<sup>1</sup> Scottish seine.

<sup>2</sup> Four tows made with 5-1/2 inch mesh net with 4-inch liner.

Table 2. Summary statistics for the 1988 Experimental Whiting Fishery

	Pt. Judith	Gloucester	Portland	Newport	Total
Number of Trips	59	36	16	8	119
Number of Vessels	10	4	2	1	17
Number of Tows	616	188	132	78	1,014
Sea-sampled Trips	3	4	3	-	10
Tows/trip	10.4	5.2	8.3	9.8	8.5
Ave. Tow Time (hr)	1.3	1.7	3.4	1.4	1.6
Ave. Depth (fathoms)	48.3	42.9	91.8	38.3	52.2
Total Effort (hr)	789.7	317.1	452.3	109.7	1,668.8
Total Catch (lb)	3,889,443	1,271,471	615,876	460,671	6,237,461
Whiting	2,990,915	1,106,045	555,986	351,600	5,004,546
Regulated Species	34,854	4,564	26,972	1,316	67,706
Others	863,674	160,862	32,918	107,755	1,165,209
Total Landings (lb)	3,076,935	1,106,005	571,669	350,640	5,105,249
Whiting	2,934,955	1,102,025	546,645	348,100	4,931,725
Regulated Species	14,921	1,655	20,316	395	37,287
Others	127,059	2,325	4,708	2,145	136,237
Total Discards	812,508	165,466	44,207	110,031	1,132,212
Percent Discards	20.9	13.0	7.2	23.9	18.2

using these two mesh sizes produced 63 percent of the total catch for all species combined, 63 percent of the whiting catch, and 75 percent of the regulated species catch. These percentages were also consistent in the landings and discard statistics (Table 6). There was little evidence that the smaller meshes used in the fishery contributed to higher discard rates than the larger sizes. For all species combined, an average of 79 percent of the catch was landed over all mesh sizes, with 21 percent discarded; for whiting only, 99 percent of the catch was landed (Table 7). For regulated species, an average (over all mesh sizes) of 58 percent of the catch was landed. Only 15 percent of the catch garnered by 2-1/2 inch mesh was landed, but 100 percent of the catch by 3 inch was landed. However, since the actual weight of the regulated species catch was so low, it is difficult to interpret these data since no consistent trend was seen. Indeed, vessels using 2-1/4 inch mesh nets landed 76 percent of their total regulated species catch, but this was primarily large white hake, while 3-inch mesh discarded 52 percent of its regulated species catch, primarily small cod.

Analysis of whiting landings per hour fished by mesh size indicated that most of the gear used fished with the same efficiency with the exception of the 2-1/4 inch mesh (substantially below the mean), 4-1/2 inch mesh Scottish seine, fished for only 18 hr (substantially below the mean), and 4 inch, actually a 5-1/2 inch net with 4-inch liner fished for only 4 hr, (substantially above the mean) (Table 6).

## LOCATION OF WHITING WINDOW

During the first two weeks of the fishery, six trips were

made with very little success, except for a single trip that located a concentration of whiting in Powell Canyon south of Georges Bank. Catches on Georges Bank were light, averaging only about 24,000 lb per trip. These catches were scattered on the northwestern edge, but included several single tows on the southern part of the bank. By the third week of the fishery, while catches still averaged only 30,000 lb per trip, trips were more concentrated on the northwestern edge of the bank with only a single trip fishing the southern edge. By the fourth week of the fishery, the last week of July, all vessels had concentrated their effort along the northwestern edge of the bank, with vessels from Pt. Judith and Gloucester fishing in the shallower waters of the bank proper, and vessels from Portland consistently fishing waters slightly deeper and to the north. During August and to a great extent during the rest of the fishery, all vessels concentrated their effort in generally the same area as defined in the last weeks of July, although during September, two trips were made in the area north of the Great South Channel (Figure 2). The window defined by the Experimental Fishery is an area of consistently high concentrations of whiting that has been identified by analyses of historical catches from both commercial fishery and bottom trawl survey data (Figure 3).

## SEASONALITY

To define the seasonality of the fishery, we calculated its beginning and duration, weekly whiting CPUE (daily during July), and weekly total species discard rates. During the first 13 days of July, discard rates were quite high,

averaging 30.5 percent of the total catch, while whiting CPUE was quite low, approximately 773.2 lb/hr (but only 455.0 lb/hr with the single large catch south of Georges Bank excluded from the estimate) (Figure 4). The primary species making up the discard during this period was spiny dogfish (Table 5). By day 14 and through the remainder of the month, whiting catch rates remained high, averaging 3,217.3 lb/hr, with discard rates dropping sharply to 11.1 percent. During August, whiting CPUE averaged 4,363.4 lb/hr, while discard rates remained low, averaging only 9.8 percent of the total catch. By mid-September and continuing through mid-October, CPUE declined to average 2,462.6 lb/hr, while discard rates increased sharply, averaging 33.6 percent (Table 4, Figure 5). During this time, the primary discard species were red hake, Atlantic herring, and northern shortfin squid.

### IMPACT ON REGULATED SPECIES

During the fishery, a total of 67,706 lb of regulated species were caught, of which 37,287 lb were landed (55 percent) (Table 8). Atlantic cod was the most frequently caught species (26,023 lb, 11.8 mt) while white hake was most frequently landed (17,447 lb, 7.9 mt). These two species made up approximately 77 and 74 percent of the total catch and landings of regulated species, respectively. The overall by-catch rate of regulated species was only 1.1 percent of the total catch, while their landings made up only 0.7 percent of the total. The overall regulated species discard rate was only 0.5 percent. Vessels from Pt. Judith recorded the highest catch (34,854 lb, primarily Atlantic cod), while vessels from Portland reported the highest landings (20,316 lb, primarily white hake).

The likely effects of this fishery on regulated species, both juveniles and adults, from historical commercial and research vessel survey catches were evaluated. The analyses indicated that within the confined area in which the Experimental Fishery was conducted, the effects of a small-mesh fishery on regulated species appear to be relatively insignificant. The location in which the fishery took place was not an area from which large commercial landings (*i.e.*, averaging greater than about 100 tons/yr) of any of the regulated species have been taken in the last 5 yr (1982-87). Research vessel survey data demonstrated that the area is one of low abundance for most of the species, with the important exception of legal and sub-legal cod, sub-legal haddock, and legal and sub-legal American plaice. For these species, it is apparent that during the summer months the northwestern portion of the bank is an important nursery area. A complete set of plots describing the distribution of commercial landings and survey catches is available in Almeida *et al.* (1989).

### SIZE COMPOSITION OF THE CATCH

During the fishery, 8,427 length measurements were

Table 3. Summary of catch statistics (lb) from logbook data for the 1988 Experimental Whiting Fishery

Species	Catch	Landings	Discards
Whiting (silver hake)	5,004,546	4,931,725	72,821
Red hake	475,201	85,166	390,035
Skates, unclass.	142,349	2,070	140,279
Northern shortfin squid	128,016	125	127,891
Atlantic herring	119,341	40	119,301
Hake, unclass.	116,102	25,380	90,772
Spiny dogfish	104,544	5	104,539
Atlantic cod <sup>1</sup>	26,023	9,995	16,028
White hake <sup>1</sup>	25,854	17,447	8,407
Longhorn sculpin	21,795	50	21,745
Other groundfish	13,080	-	13,080
Herring, unclass.	10,591	500	10,091
Blueback herring	9,461	4,000	5,461
Longfin squid	8,930	1,188	7,742
American plaice <sup>1</sup>	7,875	5,226	2,649
Monkfish (goosefish)	5,214	4,878	336
Atlantic mackerel	4,249	3,374	875
Butterfish	3,482	3,274	208
Bluefish	3,323	3,253	70
Haddock <sup>1</sup>	2,938	157	2,781
Other fish	2,244	-	2,244
Winter flounder <sup>1</sup>	1,822	1,766	56
Yellowtail flounder <sup>1</sup>	1,429	1,391	38
Pollock <sup>1</sup>	1,234	947	287
Cusk	783	680	103
Porbeagle shark	770	770	-
Fourspot flounder	651	-	651
Squid, unclass.	639	37	602
Ocean pout	630	-	630
Sharks, unclass.	620	540	80
Flounder, unclass.	365	365	-
Witch flounder <sup>1</sup>	337	308	29
Redfish <sup>1</sup>	181	48	133
Atlantic halibut	113	113	-
Shortfin mako shark	60	60	-
Alewife	55	-	55
Northern searobin	38	-	38
Atlantic wolffish	33	33	-
American lobster	31	3	28
Sea scallops	24	11	13
Other shellfish	20	-	20
Windowpane flounder <sup>1</sup>	13	2	11
Cunner	12	12	-
Scallops, unclass.	10	10	-
Summer flounder	1	-	1
Crab, unclass.	4	-	4
<b>Total</b>	<b>6,237,461</b>	<b>5,105,249</b>	<b>1,132,212</b>

<sup>1</sup> Regulated species.

Table 4. Weekly statistics from the 1988 Experimental Whiting Fishery

Dates	Number of				Effort (hr)	CPUE	Catch (lb)	
	Week	Vess.	Trips	Tows			Whiting	Reg. Spp.
7/1 - 7/9	1	3	3	29	93.0	1,158.1	107,700	4,414
7/10 - 7/16	2	3	3	32	90.8	388.3	35,256	3,475
7/17 - 7/23	3	6	8	53	106.3	2,532.3	269,290	4,424
7/24 - 7/30	4	8	15	90	130.7	3,902.5	510,060	8,037
7/31 - 8/6	5	7	10	65	109.3	4,898.0	535,350	5,833
8/7 - 8/13	6	9	12	82	125.6	4,100.7	515,050	3,869
8/14 - 8/20	7	4	6	51	82.7	3,731.6	308,600	1,999
8/21 - 8/27	8	6	12	87	127.8	3,275.0	418,549	5,092
8/28 - 9/3	9	7	10	55	76.9	5,775.1	444,106	1,483
9/4 - 9/10	10	8	12	88	147.2	2,726.1	401,280	2,742
9/11 - 9/17	11	9	12	98	136.2	2,140.2	291,490	6,704
9/18 - 9/24	12	9	10	95	137.3	2,694.1	369,905	9,208
9/25 - 10/1	13	4	5	51	89.2	2,626.7	234,300	4,527
10/2 - 10/8	14	4	5	54	82.6	2,569.0	212,200	1,321
10/9 - 10/15	15	4	4	32	51.7	1,923.8	99,460	3,370
10/16-10/22	16	3	5	33	52.5	2,821.9	148,150	968
10/23-10/29	17	1	1	8	12.0	4,208.3	50,500	50
10/30-11/5	18	1	1	11	17.0	3,135.3	53,300	190
<b>Total</b>				<b>1,014</b>	<b>1,668.8</b>		<b>5,004,546</b>	<b>67,706</b>

made from a total of 33 species. All regulated species with the exception of windowpane flounder were represented in the length samples; however, in many cases, very few individuals were measured. A total of 3,306 individuals of landed species were measured, while 5,121 discarded individuals were measured. A summary of the length-frequency analysis for whiting, all of the regulated species, and primary by-catch species is provided in Table 9. The results indicate that the whiting landings were made up primarily of individuals from the strong 1985 year class which had an average length of about 11.4 inches; however, observed lengths ranged from 7.9 to 31.9 inches (Table 9 and Figure 6). The whiting discard was also made up of individuals of about the same lengths, probably the result of poor quality fish and not due to size. For Atlantic cod, the primary regulated by-catch species, the range in lengths of landed individuals was 15.7 to 35.4 inches with an average of 22.4 inches. Discarded individuals ranged from 10.2 to 21.3 inches, averaging 14.6 inches (Table 9 and Figure 7). Red hake, the primary discard species, ranged in length from 14.7 to 21.7 inches. The average length of landed red hake was 14.6 inches, while discarded individuals averaged 12.6 inches (Table 9 and Figure 8).

### COMPARISON OF SEA-SAMPLED VERSUS NON-SEA-SAMPLED CATCH DATA

A comparison of catch statistics from data obtained through vessel-operator-compiled logbooks of trips that did not have an NEFC observer aboard (unobserved catch; 91.5 percent of the total trips) and those trips from which

data were collected while an observer was aboard was carried out to determine the relative quality of the unobserved catch data. The results, presented in Table 10, indicate that correspondence between the two data sets was generally good. For example, whiting catch from sea-sampled trips was approximately 85 percent of the total compared to about 80 percent from non-sea-sampled trips. Whiting landings were virtually identical from both data sets (about 96 percent of the total landings). Data for other species show no significant differences in percentage of catch or landings except for white hake and red hake. This may have been due to misidentification of the two species. From sea-sampled trips, regulated species contributed 2.0 and 1.2 percent of the catch and landings, respectively, while non-sea-sampled trips reported 1.0 and 0.7 percent of their catch and landings made up of regulated species. For the regulated species, with the exception of white hake, no individual species had catches or landings exceeding 0.5 percent of the total from either data set.

### COMPARISON OF LOGBOOK LANDINGS DATA WITH WEIGHOUT DATA

Landings data reported through the tow-by-tow logbook system designed for the Experimental Fishery were compared to data collected through the standard NEFC weighout system for two purposes: (1) to determine accuracy (i.e., at-sea estimation errors), and (2) to verify whether or not vessel operators were keeping complete records. Comparisons of the logbook data with weighout data (landings that were actually sold) were completed for each



Table 6. Percentages of landings, discards, and total catch, the amount of effort expended, and whiting landings per hour by mesh size in the 1988 Experimental Whiting Fishery

Mesh (in)	Landings	Discards	Total	Effort (hr)	Percent
<b>All Species</b>					
1-3/8	4.9	3.0	4.5	53.2	3.2
2	6.8	2.5	6.1	167.1	10.0
2-1/4	12.8	9.3	12.1	493.6	29.6
2-3/8	7.1	5.0	6.7	73.5	4.4
2-1/2	6.8	13.7	8.1	110.8	6.6
2-3/4	2.9	2.1	2.8	23.3	1.4
3	51.0	52.7	51.3	615.2	36.9
3-1/8	6.9	9.7	7.4	109.7	6.6
4	0.6	0.5	0.6	4.0	0.2
4-1/2	0.2	1.4	0.4	18.4	1.1
<b>Total</b>				<b>1,668.8</b>	
<b>Whiting Only</b>					
				<b>Landings/hour</b>	
1-3/8	5.0	-	5.0	4,664.5	
2	7.0	1.1	6.9	2,680.6	
2-1/4	12.5	18.5	12.6	1,266.4	
2-3/8	7.3	-	7.3	4,919.7	
2-1/2	6.9	14.8	7.1	3,049.0	
2-3/4	3.0	2.7	3.0	6,158.7	
3	50.3	57.4	50.4	4,021.7	
3-1/8	7.1	4.8	7.0	3,265.5	
4	0.6	0.1	0.6	7,317.1	
4-1/2	0.2	0.6	0.2	1,272.1	
<b>Mean</b>				<b>3,861.5</b>	
<b>Regulated Species</b>					
1-3/8	2.1	8.4	4.9		
2	6.4	5.9	6.2		
2-1/4	50.6	17.8	35.9		
2-3/8	<0.1	<0.1	<0.1		
2-1/2	2.8	19.1	10.1		
2-3/4	0.3	0.3	0.3		
3	34.1	45.0	39.0		
3-1/8	1.1	3.0	1.9		
4	0.9	0.1	0.5		
4-1/2	1.8	0.2	1.1		

vessel, aggregated by port, and then over all ports and vessels. Only the results of the overall analysis (and percentages from the port-by-port analysis) are presented because the weighout data are confidential. Comparisons were not possible for all trips in the fishery since several vessels from Gloucester landed their catches in boxed form and had the catch transported to the Fulton Fish Market in New York. Weighouts from these trips were compiled by counting the number of boxes landed and multiplying by 125 (assumed weight of each box). Data from Gloucester for other species in the catch were not recorded. Two

vessels (the *Morning Star* and *Lady Francesca*) processed all of their landings in this manner, while the *Gloucesterman* trucked seven of its 11 trips. Data from these trips were eliminated from this portion of the analysis.

Results indicated that overall compliance was good in that the total landings from the logbook system were only 0.2 percent less than the weighout data (Table 11). Whiting landings were very close with only a 0.1 percent difference. However, landings of regulated species recorded by the logbooks were 36.5 percent lower than reported through the weighout system. This may have been due to the small amount of regulated species caught during the fishery. While there were often large discrepancies in the percentage differences between the two systems, they were probably the result of small errors (possibly individual fish) summed over the 4-mo period of the fishery. Discrepancies in white hake and Atlantic cod landings made up the largest portion of the total with 11,027 lb of white hake and 4,452 lb of cod sold but not recorded in logbooks. Several species had higher percentages of landings unrecorded in the logbooks, but the total weight of those landings were insignificant (e.g., witch and windowpane flounder). All ports with the exception of Gloucester had far higher discrepancies between landings of regulated species than with all species combined since whiting catches were so much larger than other species and masked other differences (Gloucester had very high differences both with and without whiting included in the analysis) (Figure 9). Point Judith was the only port in which any logbook landings were higher than those in the weighout system. This was probably due to dockside discarding after logbooks were completed.

## DISCUSSION

Were the objectives of the 1988 Experimental Whiting Fishery met? Clearly, yes. The results of the analysis of catch data from the experiment indicated that a small-mesh fishery for whiting, in a well defined time and location, could be prosecuted in the large-mesh area on Georges Bank with minimal effects on the regulated species in the area at current abundance levels. Indeed, the overall by-catch rate of regulated species was only 1.1 percent with a discard rate of 0.5 percent. While it can be argued that the reason for such low by-catch and discard rates was the result of the depleted stock abundance of most regulated species, the analysis of research vessel survey data and a review of past sea-sampling trips indicate that the area where the whiting fishery was conducted has generally been one of low abundance of these species during the summer months. A comparison of the 1988 Experimental Fishery with the small (four-trip) fishery conducted in 1987 (1988 NERO internal report by P. Gerrior) produced similar results with the exception of the proportion of whiting in the total catch. In the 1988 experiment, other species,

Table 7. Catch statistics (lb) for mesh sizes used in the 1988 Experimental Whiting Fishery and the percentages of landed versus discarded catch

Mesh (in.)	Landings	Discards	Total	Percent	
				Landed	Discarded
<b>All Species</b>					
1-3/8	249,192	33,940	283,132	88.0	12.0
2	349,569	28,095	377,664	92.6	7.4
2-1/4	651,532	105,590	757,122	86.1	13.9
2-3/8	362,319	57,071	419,390	86.4	13.6
2-1/2	346,713	155,587	502,300	69.0	31.0
2-3/4	149,375	24,201	173,576	86.1	13.9
3	2,603,050	596,186	3,199,236	81.4	18.6
3-1/8	350,640	110,031	460,671	76.1	23.9
4 <sup>1</sup>	31,427	5,682	37,109	84.7	15.3
4-1/2 <sup>2</sup>	11,432	15,829	27,261	41.9	58.1
<b>Total</b>	<b>5,105,249</b>	<b>1,132,212</b>	<b>6,237,461</b>	<b>81.8</b>	<b>18.2</b>
<b>Whiting Only</b>					
1-3/8	248,150	-	248,150	100.0	-
2	345,800	805	346,605	99.8	0.2
2-1/4	617,350	13,465	630,815	97.9	2.1
2-3/8	361,600	-	361,600	100.0	-
2-1/2	342,705	10,765	353,470	97.0	3.0
2-3/4	148,425	2,000	150,425	98.7	1.3
3	2,479,800	41,765	2,521,565	98.3	1.7
3-1/8	348,100	3,500	351,600	99.0	1.0
4	30,000	100	30,100	99.7	0.3
4-1/2	9,795	421	10,216	95.9	4.1
<b>Total</b>	<b>4,931,725</b>	<b>72,821</b>	<b>5,004,546</b>	<b>98.5</b>	<b>1.5</b>
<b>Regulated Species</b>					
1-3/8	784	2,560	3,344	23.4	76.6
2	2,379	1,803	4,182	56.9	43.1
2-1/4	18,862	5,429	24,291	77.7	22.3
2-3/8	15	-	15	100.0	-
2-1/2	1,049	5,825	6,874	15.3	84.7
2-3/4	100	85	185	54.1	45.9
3	12,715	13,691	26,406	48.2	51.8
3-1/8	395	921	1,316	30.0	70.0
4	327	44	371	88.1	11.9
4-1/2	661	61	722	91.6	8.4
<b>Total</b>	<b>37,287</b>	<b>30,419</b>	<b>67,706</b>	<b>55.1</b>	<b>44.9</b>

<sup>1</sup> 5-1/2 inch mesh net with 4-inch liner.

<sup>2</sup> Scottish seine.

primarily red hake, made up a much higher percentage of the catch than in 1987 while the percentage of regulated species catches and landings were comparable in both years. A summary of the two fisheries follows:

Species	Catch		Landings	
	1987	1988	1987	1988
Whiting	95.6%	80.2%	98.6%	96.6%
Regulated Species	1.1	1.1	1.3	0.7
Others	3.3	18.7	0.1	2.7

The area of the "clean" fishery was confined to the northwestern edge of the bank, with an optimal window being the area defined by the fishery during August (see Figure 2). In this area, consistently high catch rates were attained with relatively low by-catch levels.

The optimal period for the fishery to take place as defined in the experiment was from about the third week of July through September. During this 10-wk period, whiting CPUE averaged 3,581 lb/hr, while the discard rate for all species was about 14.5 percent and the rate for regulated species was only 0.4 percent. Prior to the third week in July, catches of whiting were sporadic and very low with high levels of discard, primarily spiny dogfish and red hake. During the last several weeks of the fishery, while whiting CPUE remained fairly constant, discard rates soared to an average of 30 percent (primarily Atlantic herring, squids, skates, and red hake). The timing of the fishery could possibly be adjusted to account for temperature irregularities causing shifts in the timing of whiting spawning, however.

The mandatory logbook system was relatively successful in collecting detailed tow-by-tow data. A comparison of catch and landings data from sea-sampled and non-sea-sampled trips indicated that there was good correspondence between the two data sets. However, the analysis of landings data from logbooks compared with NEFC weigh-out data indicated that while overall correspondence was very good, regulated species landings were 36.5 percent lower in the logbooks than reported in the weighout data base. This may have been due to the low level of catches of regulated species. While there were some large discrepancies in the percentage differences between the two collection systems, they were probably due to small errors summed over the 4-mo period of the fishery. Further analyses of data currently available and possibly collected from future fisheries using mandatory logbooks will be required to determine sources of error of landings estimated at sea.

## ACKNOWLEDGEMENTS

The authors would like to express their gratitude to the following individuals for their collective effort in the 1988 whiting experiment. Without diligent data collection and monitoring in each of the major New England ports, this experiment would not have been possible. Fishery Reporting Specialists April Valliere and Susan Murphy (Pt. Judith, Rhode Island), Lori Lathan (Newport, Rhode Island), Greg Power and Bill Trusewich (Portland, Maine), and

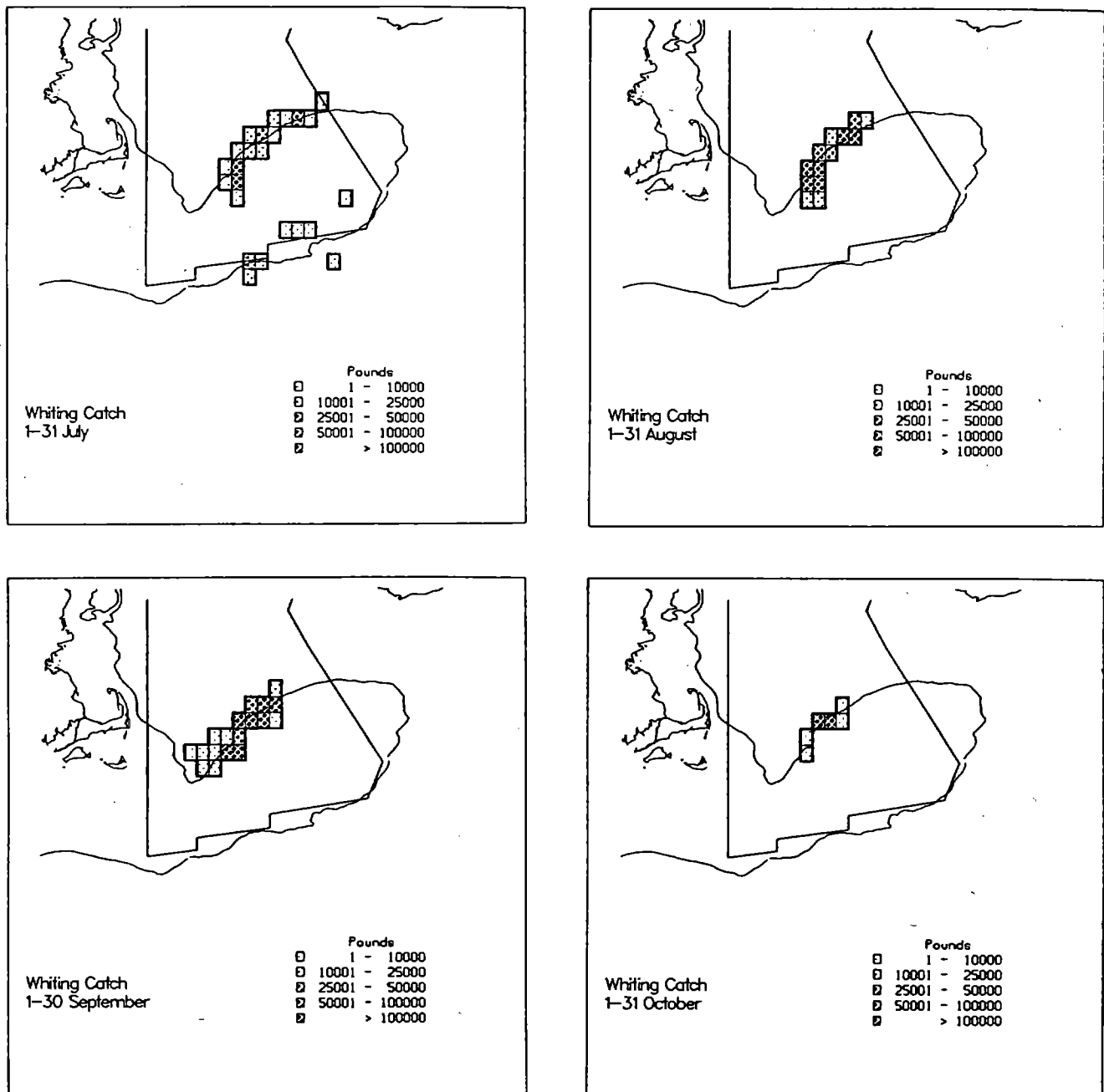


Figure 2. Location of monthly catches of whiting from the 1988 Experimental Whiting Fishery summarized by 10-minute square.

Don Mason (Gloucester, Massachusetts), provided day-to-day monitoring of the fishery, distributed permits, and collected logbooks. John Mahoney, John 'Ace' Nelson, Allen Usinger, Don Mason, Greg Power, Bill Trusewich, Scott McNamara, and Brian O'Gorman provided observer coverage. Pete Colosi and Dave Crestin of the NERO's

Fisheries Management Division assisted in preliminary planning and permit preparation. Otis Jackson of the NEFC's Data Management Support Staff provided assistance in developing the data entry system, and with Joe Idoine of the Population Dynamics Branch, provided the basic programming for the species distribution plots.



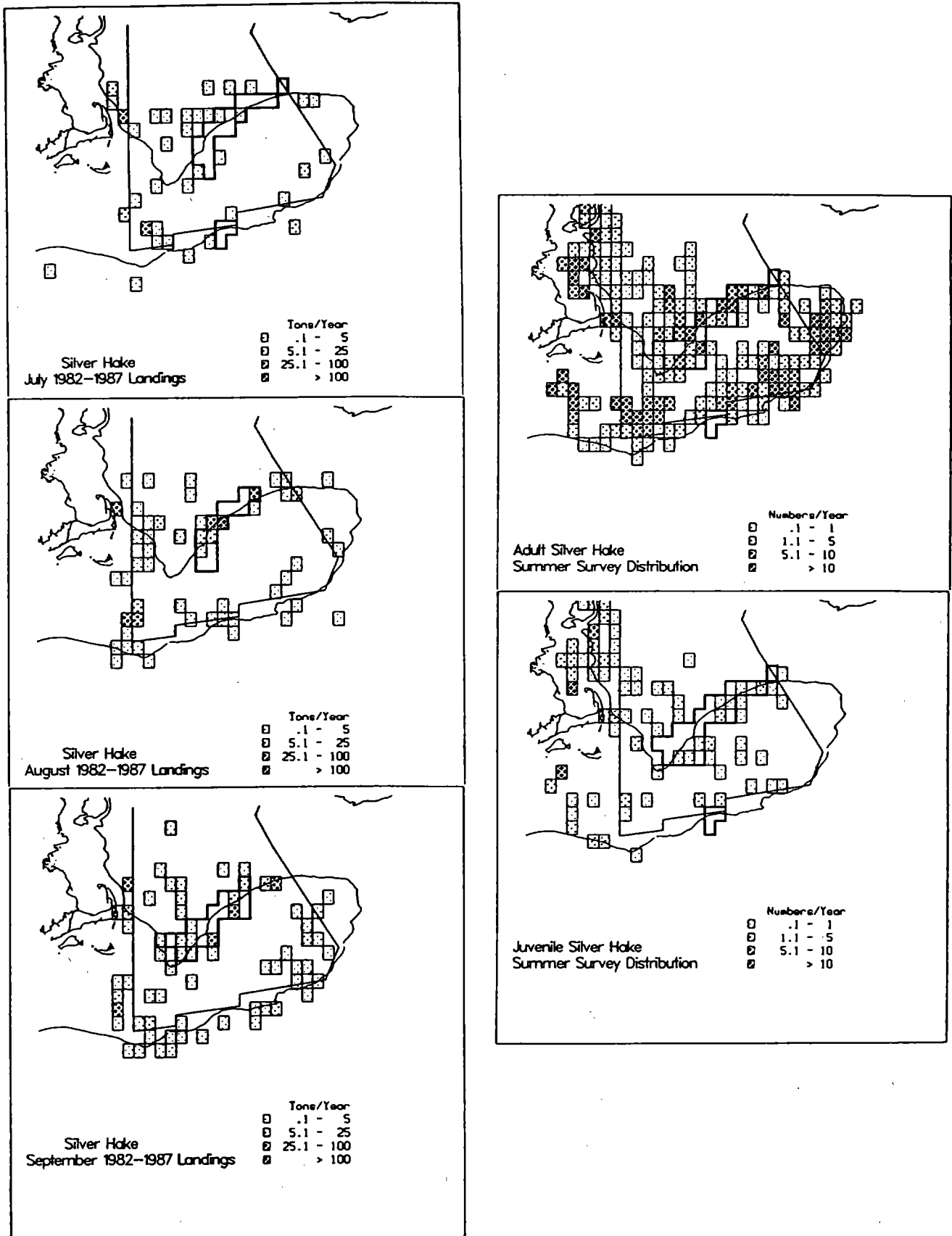


Figure 3. Distribution of whiting from the commercial fishery and research vessel bottom trawl surveys.

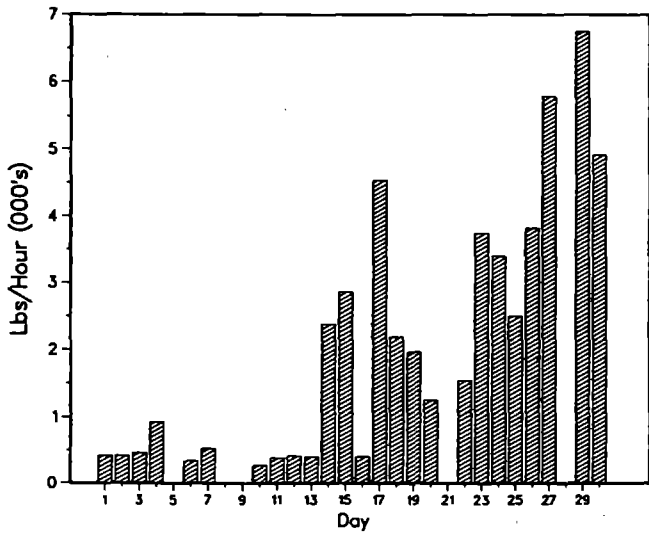


Figure 4. Daily CPUE of whiting during July (first 30 days of fishery).

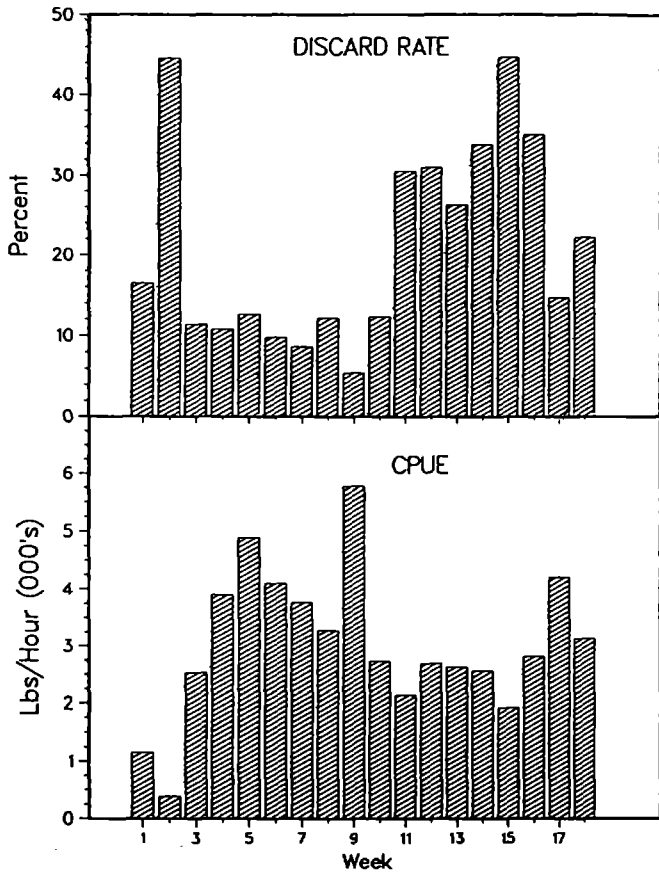


Figure 5. Weekly whiting CPUE and discard rates (all species combined).

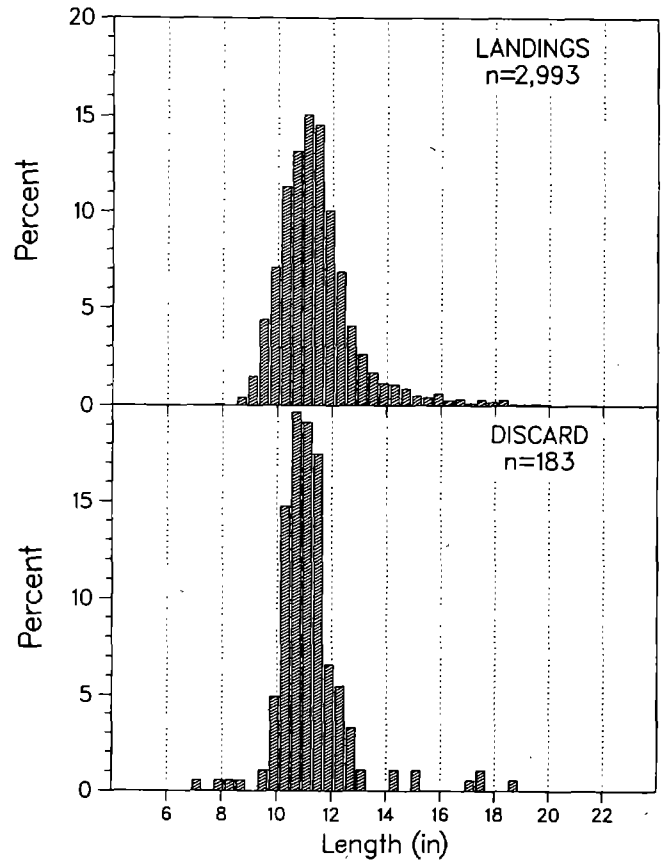


Figure 6. Size composition of the whiting landings and discard.

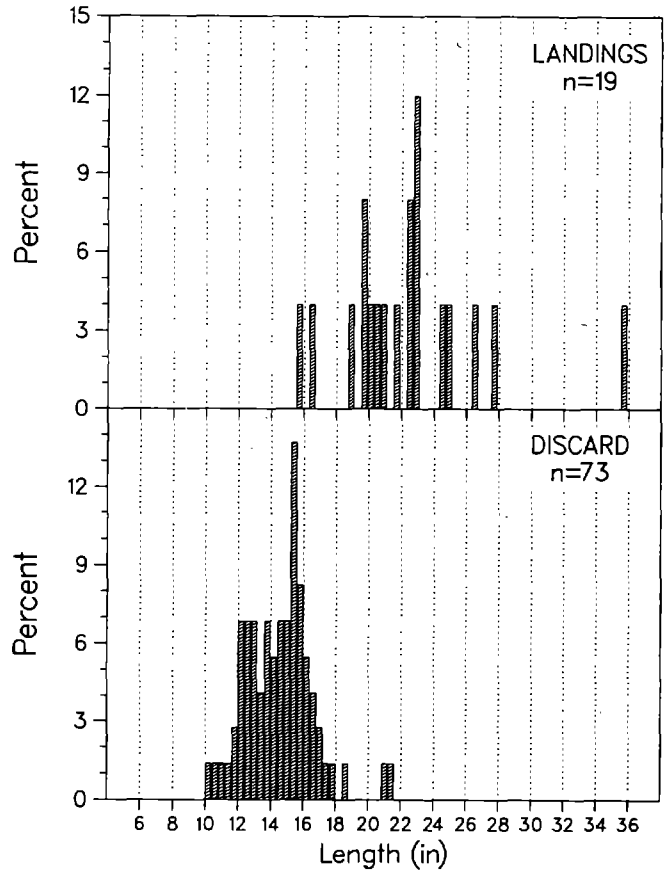


Figure 7. Size composition of the Atlantic cod landings and discard.

Table 8. Catch (lb) of regulated species by port from the 1988 Experimental Whiting Fishery

Species	Pt. Judith			Gloucester		
	Catch	Land.	Disc.	Catch	Land.	Disc.
Atlantic cod	22,312	7,468	14,844	1,129	1,097	32
Haddock	2,798	117	2,681	122	31	91
Pollock	208	203	5	77	77	-
White hake	500	350	150	2,669	4	2,665
Redfish	7	-	7	5	-	5
Winter flounder	1,682	1,626	56	103	103	-
Witch flounder	153	153	-	-	-	-
Yellowtail flounder	1,017	982	35	224	224	-
American plaice	6,175	4,020	2,155	235	119	116
Windowpane flounder	2	2	-	-	-	-
<b>TOTAL</b>	<b>34,854</b>	<b>14,921</b>	<b>19,933</b>	<b>4,564</b>	<b>1,655</b>	<b>2,909</b>
% of Overall Total	0.6	0.2	0.3	0.1	<0.1	<0.1

Species	Portland			Newport		
	Catch	Land.	Disc.	Catch	Land.	Disc.
Atlantic cod	1,325	1,081	244	1,257	349	908
Haddock	17	9	8	1	-	1
Pollock	949	667	282	-	-	-
White hake	22,685	17,093	5,592	-	-	-
Redfish	169	48	121	-	-	-
Winter flounder	5	5	-	32	32	-
Witch flounder	183	154	29	1	1	-
Yellowtail flounder	176	173	3	12	12	-
American plaice	1,452	1,086	366	13	1	12
Windowpane flounder	11	-	11	-	-	-
<b>TOTAL</b>	<b>26,972</b>	<b>20,316</b>	<b>6,656</b>	<b>1,316</b>	<b>395</b>	<b>921</b>
% of Overall Total	0.4	0.3	0.1	<0.1	<0.1	<0.1

All Ports			
Species	Catch	Land.	Disc.
Atlantic cod	26,023	9,995	16,028
Haddock	2,938	157	2,781
Pollock	1,234	947	287
White hake	25,854	17,447	8,407
Redfish	181	48	133
Winter flounder	1,822	1,766	56
Witch flounder	337	308	29
Yellowtail flounder	1,429	1,391	38
American plaice	7,875	5,226	2,649
Windowpane flounder	13	2	11
<b>TOTAL</b>	<b>67,706</b>	<b>37,287</b>	<b>30,419</b>
% of Overall Total	1.1	0.6	0.5

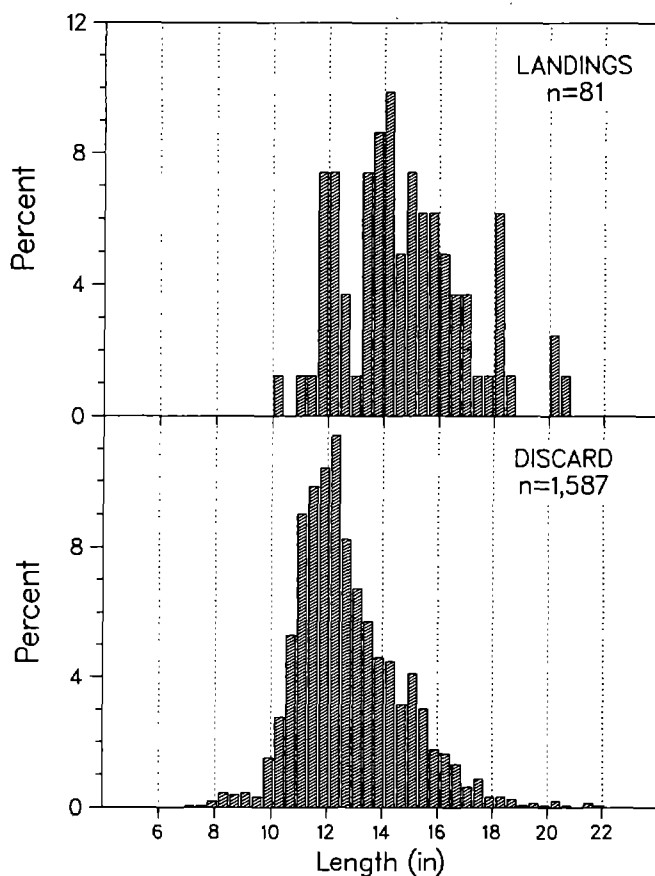


Figure 8. Size composition of the red hake landings and discard.

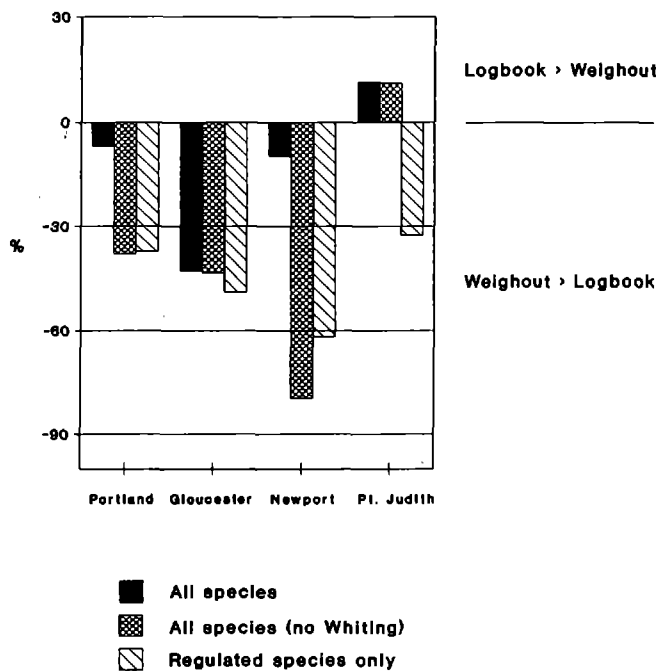


Figure 9. Comparison of landings data between tow-by-tow logbooks and NEFC weighouts for each port (vessels combined) participating in the 1988 Experimental Whiting Fishery.

Table 9. Size composition of the landings and discards of primary species caught in the 1988 Experimental Whiting Fishery

	Landings				Discards			
	Min <sup>1</sup>	Max	Mean	n	Min	Max	Mean	n
Whiting (silver hake)	7.9	31.9	11.5	2,993	7.1	18.5	11.2	183
Atlantic cod	15.7	35.4	22.4	25	10.2	21.3	14.6	73
Haddock	19.3	34.3	24.8	3	8.3	17.7	12.1	247
Pollock	32.3	32.3	32.3	1	5.1	31.5	16.9	19
White hake	11.4	15.4	12.9	4	8.7	22.4	15.2	398
Redfish				2	4.3	11.4	7.9	85
Winter flounder	18.1	18.5	18.3	2				-
Witch flounder				2	5.9	15.0	10.1	39
Yellowtail flounder				2	9.8	13.4	11.5	8
American plaice				2	3.5	18.9	9.2	755
Red hake	10.2	20.5	14.7	81	7.1	21.7	12.7	1,587
Skates, unclassified				2	10.2	35.4	19.5	15
Squid, unclassified				2	2.4	16.5	7.1	396
Spiny dogfish				2	15.7	24.8	20.1	86
Atlantic herring				2	7.5	12.2	10.6	767

<sup>1</sup> Given in inches.

<sup>2</sup> No samples of landed individuals collected.

The following vessel captains (listed in order of the number of trips made in the fishery) provided the raw data from the fishery through completion of tow-by-tow logbooks:

Capt. Joseph Litchfield	F/V <i>American Eagle</i>
Capt. Bruce Harvey	F/V <i>Lightning Bay</i>
Capt. James Parisi	F/V <i>Gloucesterman</i>
Capt. Craig Huntley	F/V <i>Catherine Louise</i>
Capt. Ray Livernois	F/V <i>Vic-Ter-Rae</i>
Capt. Paul Harvey	F/V <i>Ingtoffer II</i>
Capt. Bill Dykstra	F/V <i>Katrina Lee</i>
Capt. Donald Fox	F/V <i>Thunder Bay</i>
Capt. Carlo Moseri	F/V <i>Morning Star</i>
Capt. Lou Dimon	F/V <i>J.B.J.</i>
Capt. Joel Hovanesian	F/V <i>Excalibur</i>
Capt. Antonio San Fillippo	F/V <i>St George</i>
Capt. Greg Huba	F/V <i>Green Arrow</i>
Capt. Ignazio San Fillippo	F/V <i>Lady Francesca</i>
Capt. Harold Loftus, Jr.	F/V <i>Min Terse</i>
Capt. James Homstead	F/V <i>Kit Kat</i>
Capt. Bob Conley	F/V <i>Alliance</i>

## REFERENCES CITED

- Almeida, F.P. 1987. Stock definition of silver hake in the New England - Middle Atlantic area. *N. Amer. J. Fish. Manage.* 7:169-186.
- Almeida, F.P., S. Chang, and T.S. Burns. 1989. Summer distribution of regulated species on Georges Bank with reference to the 1988 experimental whiting fishery. *NOAA Tech. Mem. NMFS-F/NEC-70*.
- Wigley, S.E. 1987. Data preparation and report summary guide for prorating commercial interviewed landings in 82-format. NMFS, NEFC, Woods Hole Laboratory. Unpublished report available from National Marine Fisheries Service, Woods Hole Laboratory, Woods Hole, MA 02543.

Table 10. Comparison (percent of total) of sea-sampled versus non-sea-sampled catches in the 1988 Experimental Whiting Fishery

Species	Catch		Landings	
	Sampl.	Unsampl.	Sampl.	Unsampl.
Whiting (silver hake)	84.72	79.85	96.37	96.61
Atlantic cod	.16	.44	.13	.20
Haddock	.10	.04	.01	.01
Pollock	.05	.02	.04	.02
White hake	1.48	.32	.77	.30
Redfish	.01	.01	.01	.01
Winter flounder	.02	.03	.02	.04
Witch flounder	.01	.01	.01	.01
Yellowtail flounder	.05	.02	.05	.02
American plaice	.16	.12	.11	.10
Windowpane flounder	.01	.00	.01	.00
Red hake	4.38	7.87	1.97	1.63
Dogfish/skates	7.28	3.67	.10	.04
Other	1.58	7.59	.43	1.03
Number of tows	92	922		
% of total landed	85.60	81.54		
% of total discarded	14.40	18.46		
Regulated species				
% of total catch	2.04	1.00		
% of total landings	1.15	.69		

Table 11. Comparison of landings (lb) statistics obtained from tow-by-tow logbooks with landings reported from the NEFC weighout system and percent difference (logbooks vs. weighouts) in the 1988 Experimental Whiting Fishery

	Weighouts	Logbooks <sup>1</sup>	Percent Difference
Whiting	4,137,084	4,142,700	0.1
Red hake	89,277	84,316	-5.6
Hake, unclassified	1,090	25,380	2,228.4
White hake <sup>2</sup>	28,474	17,447	-38.7
Atlantic cod <sup>2</sup>	14,237	9,785	-31.3
American plaice <sup>2</sup>	8,089	5,226	-35.4
Monkfish (goosefish)	7,819	4,878	-37.6
Blueback herring	-	4,000	
Butterfish	8,688	3,253	-62.6
Bluefish	5,381	3,253	-39.5
Atlantic mackerel	3,790	3,196	-15.7
Skates, unclassified	6,705	2,070	-69.1
Winter flounder <sup>2</sup>	1,680	1,766	5.1
Yellowtail flounder <sup>2</sup>	2,500	1,391	-44.4
Pollock <sup>2</sup>	1,240	947	-23.6
Longfin squid	452	801	77.2
Porbeagle shark	405	770	90.1
Cusk	1,403	680	-51.5
Sharks, unclassified	664	540	-18.7
Herring, unclassified	-	500	
Flounder, unclassified	40	365	812.5
Witch flounder <sup>2</sup>	1,208	308	-74.5
Haddock <sup>2</sup>	250	152	-39.2
Atlantic halibut	2	113	5,550.0
Northern shortfin squid	-	65	
Shortfin mako shark	66	60	-9.1
Longhorn sculpin	-	50	
Redfish <sup>2</sup>	234	48	-79.5
Atlantic herring	-	40	
Squid, unclassified	-	37	
Atlantic wolffish	155	33	-78.7
Sea scallops	-	11	
Weakfish	-	10	
Spiny dogfish	-	5	
American lobster	-	3	
Windowpane flounder <sup>2</sup>	515	2	-99.6
Other fish	190	12	-93.7
<b>TOTAL</b>	<b>4,321,638</b>	<b>4,314,213</b>	<b>-0.2</b>
<b>TOTAL (non-whiting)</b>	<b>184,554</b>	<b>171,513</b>	<b>-7.1</b>
<b>TOTAL (reg. species)</b>	<b>58,427</b>	<b>37,072</b>	<b>-36.5</b>

<sup>1</sup>Sums do not equal those from Table 3 since weighouts were not available from every trip (see text).

<sup>2</sup>Indicates regulated species.

Appendix Table 1. Market categories and minimum legal lengths used to define age categories in distribution plots

	Commercial Catch		Minimum Legal Size from Survey
	Large	Small	
Atlantic cod	Whole Large Market Steaker (dressed) Unclassified	Scrod Snapper	19 in (49 cm) <sup>1</sup>
Haddock	Large Unclassified	Scrod Snapper	19 in (49 cm) <sup>1</sup>
Pollock	Large (round/drawn) Steaker Unclassified (round/drawn)	Small(round)	19 in (49 cm) <sup>1</sup>
Silver hake	Large (round) King (round) Unclassified (round/dressed)	Small(round)	7 in (18 cm)
White hake	Large (round/dressed) Medium (round/dressed) Unclassified	Small (round/dressed)	15 in (38 cm)
Redfish	Large Unclassified	Small	8 in (20 cm)
Winter flounder	Medium Large Large/mix Lemonsole XLarge Unclassified	Peewee Small	11 in (27 cm) <sup>1</sup>
Witch flounder	Medium Large Jumbo Unclassified	Peewee Small	14 in (36 cm) <sup>1</sup>
Yellowtail flounder	Large Unclassified	Small	12 in (31 cm) <sup>1</sup>
American plaice	Medium Large Jumbo Unclassified	Peewee Small	12 in (31 cm) <sup>1</sup>
Windowpane flounder	Unclassified		11 in (27 cm)
Atlantic herring	Unclassified		9 in (23 cm)

<sup>1</sup>Minimum legal sizes (Multispecies FMP, 50 CFR Part 651, Section 651.23).