



Serial No. 2690
(B.g.7)

ICNAF Res.Doc. 72/7
(also ICNAF SAC No. 72/6)

ANNUAL MEETING - JUNE 1972

AUTUMNAL DISTRIBUTION, ABUNDANCE AND DISPERSION OF
LARVAL HERRING, *CLUPEA HARENGUS HARENGUS* LINNAEUS,
ALONG THE WESTERN COAST OF THE GULF OF MAINE IN 1971.

by
Joseph J. Graham, Clarence W. Davis, Stanley B. Chenoweth, and Bruce C. Bickford
National Marine Fisheries Service Biological Laboratory
W. Boothbay Harbor, Maine 04575

INTRODUCTION

This is a preliminary report on four autumn cruises to survey the distribution, abundance and dispersion of larval herring along the western coast of the Gulf of Maine (Table 1). The cruises were part of a cooperative survey of the Northwestern North Atlantic (U.S., France, Federal Republic of Germany, U.S.S.R., and Canada). The purpose of the coordinated survey was to delineate the spawning areas of herring, to provide evidence of the discreteness of the stocks, and to obtain a measure of their relative abundance.

MATERIALS AND METHODS

Collections were made from 49 coastal stations during four autumn periods: Sept. 9-16, Sept. 22 - Oct. 1, Oct. 13 - 25, and Oct. 28 - Nov. 8. The time required to complete a cruise varied from 8 to 13 days and the interval between cruises varied from 2 to 11 days. The average depth of the stations was 59 m. and the depth range among the stations was 13-113 m., which included most of the coastal area suitable for spawning by herring. The positions of the stations (Fig. 1) were determined by examining previous autumn distributions of the larvae. Stations were sampled in the same sequence (1 to 49) during each cruise. Paired Bongo nets^{1/} were towed obliquely from 200 m. to the surface or from as near the bottom as thought prudent, usually 10 to 15 m. above the bottom. Tows were made at 4 knots and the nets retrieved at 20 m. per minute until 40 m. depth was reached. The tow was then stepped to the surface at intervals of 2 m., one minute for each step. A flow meter was placed within the nets to determine the distance towed in meters and the volume of water strained was calculated by multiplying this distance times the mouth area of the bongo which had a diameter of 60 cm. The number of larvae per 1000 cubic meters of water strained was used as a measure of the catch rate. Mesh sizes of the paired Bongo nets were .333 and .505 mm.; in this report catches from the .505 mm. mesh were used except in two instances when only samples from the .333 mm. nets were available. Samples were split into fourths to facilitate counting for three stations where larval catches were very large. Clogging of the nets by phytoplankton during two cruises and by salps during another cruise affected the straining efficiency of the nets at some stations. The effect of such clogging on the catch was not determined, but we do not believe it would significantly alter the conclusions of this document.

^{1/} Posgay, J. A., R. R. Marak, and R. C. Hennemuth. 1968. Development and test of new zooplankton samplers. Int. Comm. Northwest Atl. Fish. Res. Doc. 68-34, 7 pp.

Measurements of larva' length were made from the tip of the jaw to the end of the caudal peduncle (standard length). Conversion of this measurement, for larvae that measured over 20 mm., to total length (T.L.) may be made by:

$$TL = 3.47 + 1.24 SL$$

RESULTS

Larval Distribution

Larval herring appeared first in the catches from the eastern sector of the coast and then progressively westward with time (Figs. 2-5). This shift in distribution was attributable to three larval concentrations (>1000/1000m³) which occurred along the coast; 1) centered between Penobscot and Machias Bays (44°10'N., 68°10'W.), 2) centered between Penobscot Bay and Cape Ann (48°30'N., 70°10'W.), and 3) northeast of Cape Ann (42°40'N., 70°30'W.). The first concentration occurred during the first and second cruises; the second, during the second and third cruises; and the third, only during the third cruise. Larval catch rates were usually lowest at the offshore stations and frequently no larvae were captured beyond the 50-fathom isobath. During the first three cruises isolines of catch rates often paralleled the 50-fathom isobath and the coastline.

Larval Lengths

Larval herring varied in length from approximately 4 to 29 mm. during all cruises and their modal lengths during a given cruise depended upon the time at which they hatched (Fig. 6). Length frequency plots suggested that recently hatched larvae (<9 mm) were abundant during the second and third cruises.

Larvae appeared first in the eastern sector of the coast, however, they had modal lengths of 11 and 15 mm. and thus were not recently hatched. The larger modal length was present in the eastern sector during the second cruise as well. Two modal lengths, 14 and 20 mm., were again encountered during the third cruise and data from the final cruise suggested a reduction almost to a single curve with a modal length of 17 mm. During this final cruise a small group of recently hatched larvae was sampled in the eastern sector.

In the central coastal sector, larval lengths were distributed similarly to those in the eastern sector during the first two cruises, but resembled those in the eastern and western sectors during the last two cruises. Only traces of recently hatched larvae occurred, during the first through third cruises.

The western sector was the only area where recently hatched larvae dominated the catch. The decline in the two larval concentrations coincided with the disappearance of recently hatched larvae from the catch. The distribution of larvae recently hatched and those older appeared similar when catch rates for the two size groups were contoured (Figs. 7 and 8).

DISCUSSION

Two major spawning areas were delineated by the occurrence of recently hatched larvae within the larval concentrations in the western coastal sector (Fig. 7). The agreement between the contours of catch rates for recently hatched and older (>9 mm.) larvae suggested that these two concentrations were the sources of larvae in the western coastal sector (Fig. 8). This would include those larvae captured in Massachusetts Bay. The main source of larvae in the eastern coastal sector is in doubt because the larvae were not recently hatched. However, their location in shallow inshore waters suggested that their source was local. Indeed few and often no larvae were captured along the 50-fathom isobath bordering the survey area.

Hatching of larvae in the two spawning areas lasted no longer than 35 days. Recently hatched larvae appeared within the concentration centered between Penobscot Bay and Cape Ann on September 25. No older larvae were captured suggesting that this date approximated the first hatching. Recently hatched larvae were not captured there on October 29. Recently hatched larvae were captured within the concentration northeast of Cape Ann on October 14, but some older larvae were obtained. No larvae were present in this area on September 23 and only older larvae on October 27.

Table 1. Station data for four cruises during the autumn of 1971.

Sta.	Position		Cruise R-4-71		Cruise R-5-71		Cruise R-6-71		Cruise R-7-71	
			Sept. 9-16, '71		Sept. 22-Oct. 1, '71		Oct. 13-25, '71		Oct. 27-Nov. 8, '71	
			No.	C/1000m ³	No.	C/1000m ³	No.	C/1000m ³	No.	C/1000m ³
	North	West	larvae	C/1000m ³	larvae	C/1000m ³	larvae	C/1000m ³	larvae	C/1000m ³
1	42°24'	70°38'	0	0	0	0	194	275.96	58	71.34
2	42°28'	70°31'	0	0	0	0	31	40.58	193	221.08
3	42°32'	70°36'	0	0	0	0	54	77.92	130	164.35
4	42°42'	70°27'	0	0	0	0	1080	1521.13	22	26.13
5	42°44'	70°23'	0	0	0	0	---	---	13	15.64
6	42°47'	70°19'	0	0	0	0	267	392.65	94	115.20
7	42°49'	70°23'	0	0	0	0	1124	1989.38	102	118.06
8	42°52'	70°29'	0	0	0	0	501	728.20	24	29.96
9	42°52'	70°34'	0	0	0	0	1	1.50	50	61.12
10	42°51'	70°41'	0	0	0	0	1	2.34	78	84.78
11	43°00'	70°20'	0	0	0	0	0	0	34	43.15
12	43°04'	70°33'	0	0	20	31.20	14	21.37	123	209.18
13	43°10'	70°34'	0	0	---	---	93	208.05	66	148.31
14	43°11'	70°16'	0	0	---	---	171	252.58	208	220.57
15	43°10'	70°24'	0	0	0	0	10	13.68	210	199.05
16	43°19'	70°06'	0	0	0	0	10	14.12	83	58.16
17	43°20'	70°16'	0	0	6	1.81	152	225.85	260	309.52
18	43°21'	70°22'	0	0	96	223.81	187	599.36	80	119.94
19	43°25'	70°15'	0	0	21	1.63	7072	8429.08	100	168.63
20	43°30'	70°07'	0	0	1140	1587.74	1082	1385.40	128	136.61
21	43°38'	70°01'	0	0	70	256.33	458	1031.53	16	21.14
22	43°31'	69°57'	0	0	0	0	55	53.35	16	17.30
23	43°26'	69°53'	0	0	0	0	233	260.04	2	1.66
24	43°31'	69°40'	0	0	1	1.46	10	12.36	12	9.93
25	43°39'	69°44'	0	0	11	20.99	282	268.31	19	24.05
26	43°47'	69°41'	0	0	5	8.55	54	60.88	18	30.00
27	43°36'	69°22'	0	0	2	2.99	19	21.81	---	---
28	43°43'	69°26'	1	1.08	11	16.54	16	23.36	21	24.08
29	43°48'	69°29'	0	0	20	21.74	52	64.20	22	30.90
30	43°50'	69°07'	11	20.26	45	66.18	75	95.79	9	11.64
31	43°46'	69°06'	1	1.73	26	35.91	32	50.79	33	40.94
32	43°42'	69°06'	6	6.99	26	32.66	31	46.20	1	1.21
33	43°46'	68°50'	1	1.26	26	35.86	13	13.22	40	33.50
34	43°46'	68°37'	0	0	0	0	0	0	9	10.54
35	43°51'	68°38'	2	2.18	103	128.27	2	2.25	7	8.40
36	43°57'	68°42'	70	88.56	283	458.67	127	150.83	26	34.71
37	44°03'	68°28'	154	327.66	81	322.71	402	458.38	434	504.65
38	43°59'	68°26'	159	168.61	116	145.18	156	164.73	21	23.76
39	43°53'	68°22'	2	2.20	0	0	0	0	76	94.88
40	43°59'	68°09'	1	1.37	12	21.20	0	0	0	0
41	44°06'	68°00'	2	2.46	8	10.35	0	0	4	4.09
42	44°13'	68°04'	844	1143.63	354	612.46	121	168.52	68	94.44
43	44°20'	68°07'	368	467.01	754	1306.76	115	162.20	4	5.21
44	44°25'	67°43'	418	765.57	139	329.38	126	420.00	99	7.07
45	44°20'	67°41'	14	16.22	7	10.09	16	19.07	---	---
46	44°15'	67°37'	3	3.67	1	1.29	3	3.76	4	4.41
47	44°21'	67°15'	8	8.47	0	0	4	4.54	14	14.66
48	44°31'	67°18'	19	52.63	18	84.51	73	72.71	27	31.47
49	44°35'	67°20'	57	122.28	0	0	4	5.61	2	4.46
Totals & means			2136	54.92	3388	105.55	14845	405.52	2965	75.18

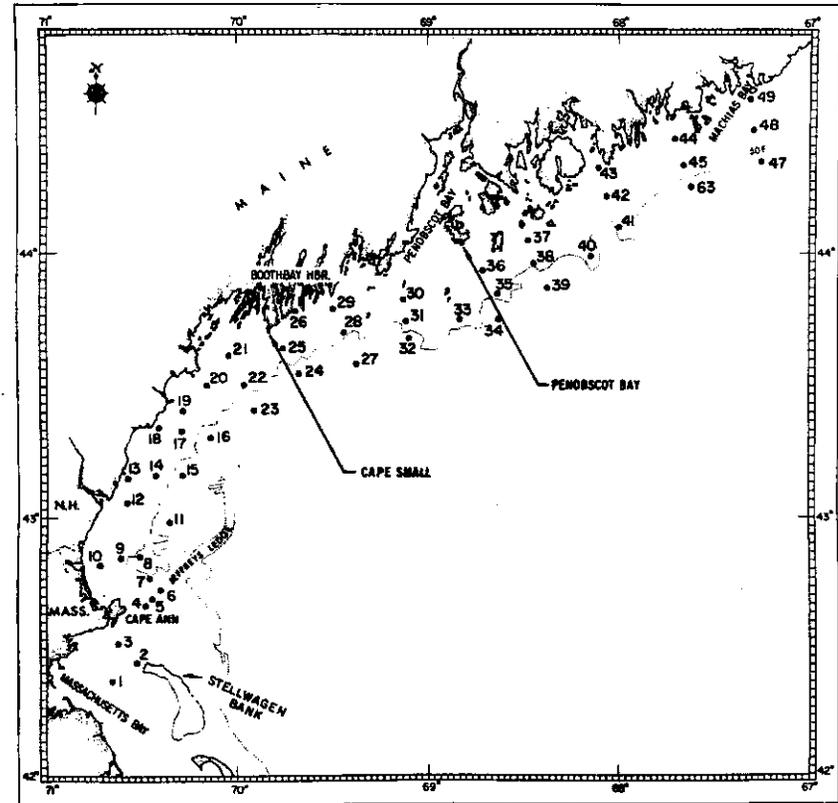


Figure 1. Coastal stations (1 - 49) for autumn herring cruises along the western coast of the Gulf of Maine.

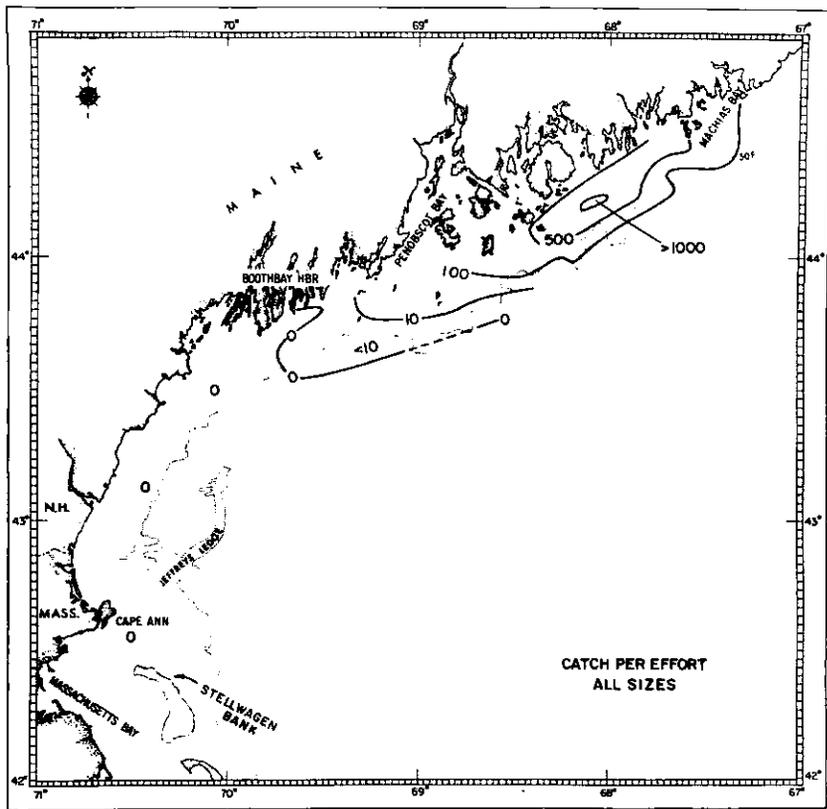


Figure 2. Contours of larval herring catches per 1000m³ during an autumn cruise, Sept. 6 - 16, 1971.

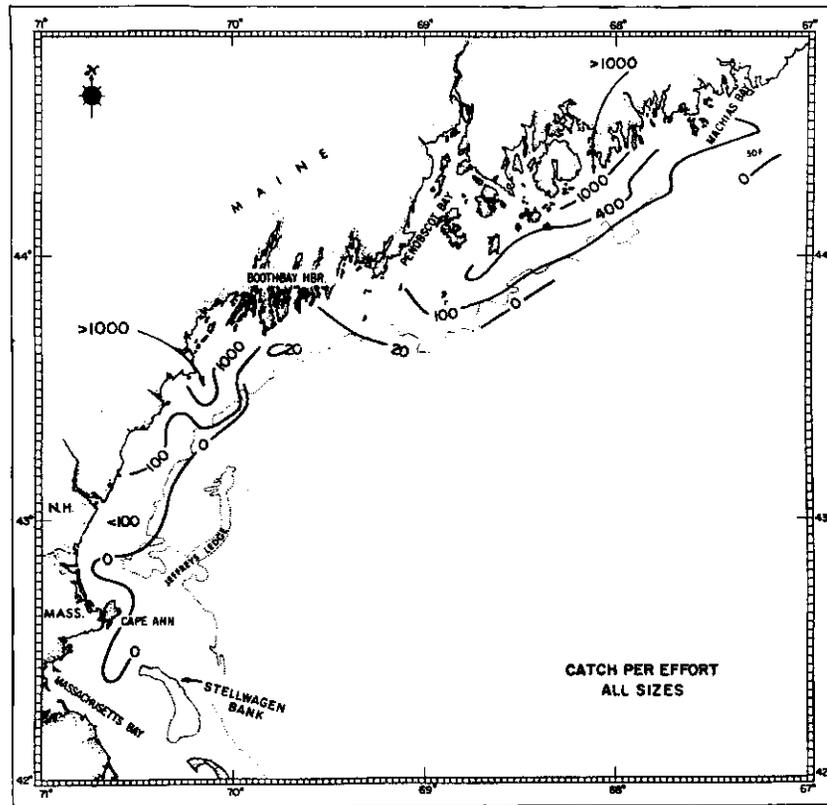


Figure 3. Contours of larval herring catches per 1000m³ during an autumn cruise, Sept. 22 - Oct. 1, 1971.

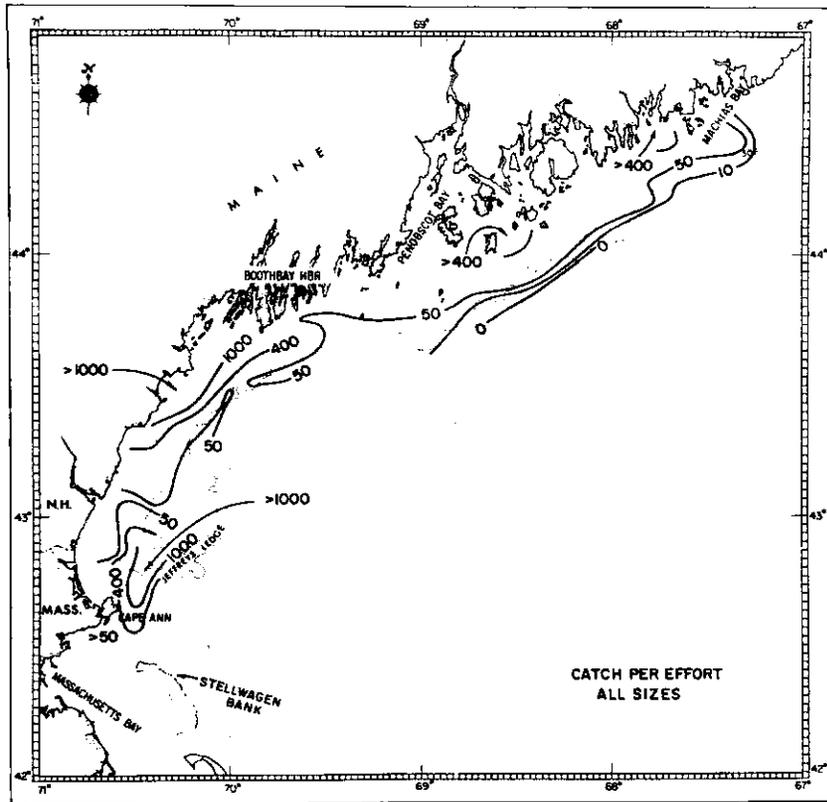


Figure 4. Contours of larval herring catches per 1000m³ during an autumn cruise, Oct. 13 - 25, 1971.

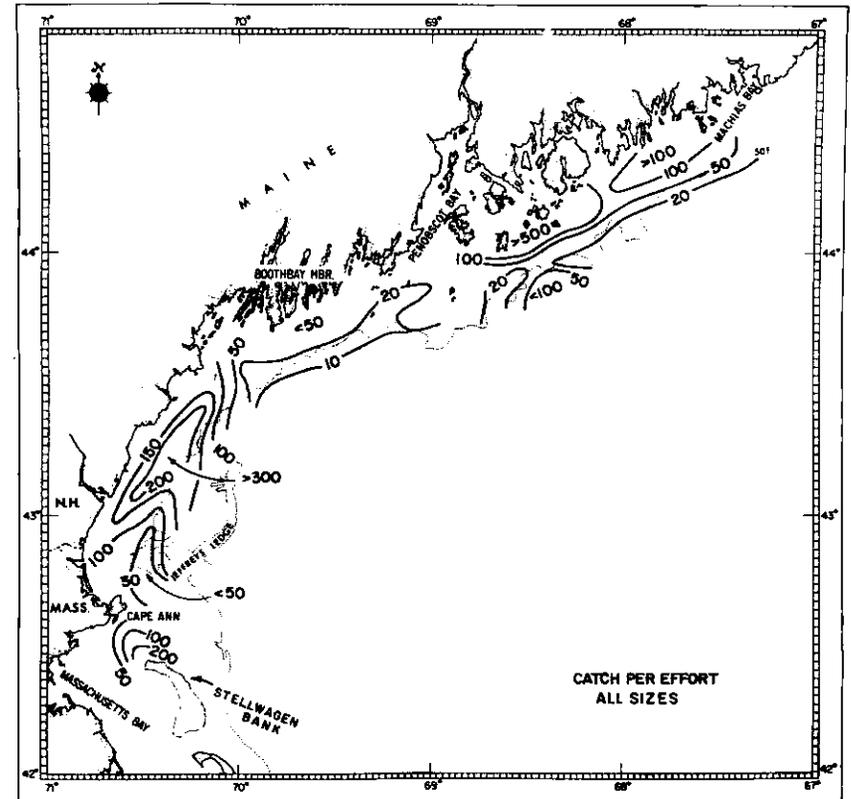


Figure 5. Contours of larval herring catches per 1000m³ during an autumn cruise, Oct. 28 - Nov. 8, 1971.

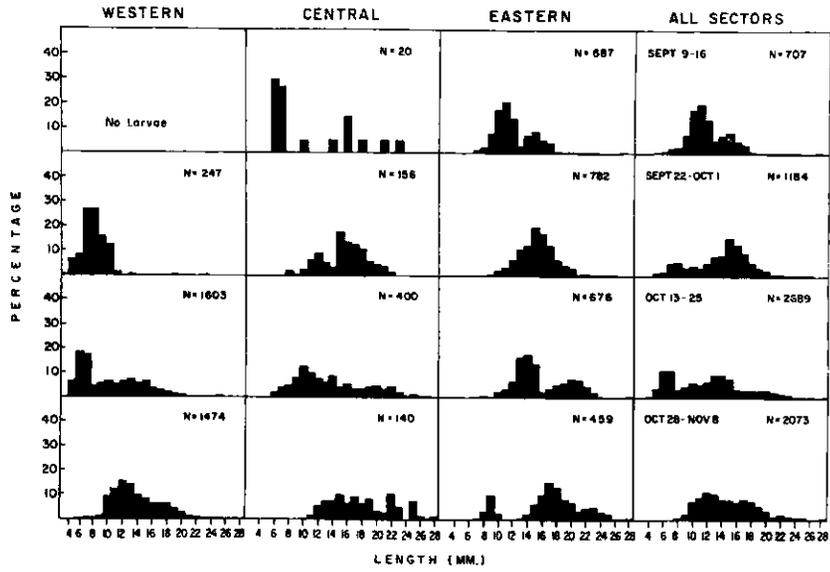


Figure 6. Length frequencies of larval herring in the western, central, eastern and all coastal sectors.

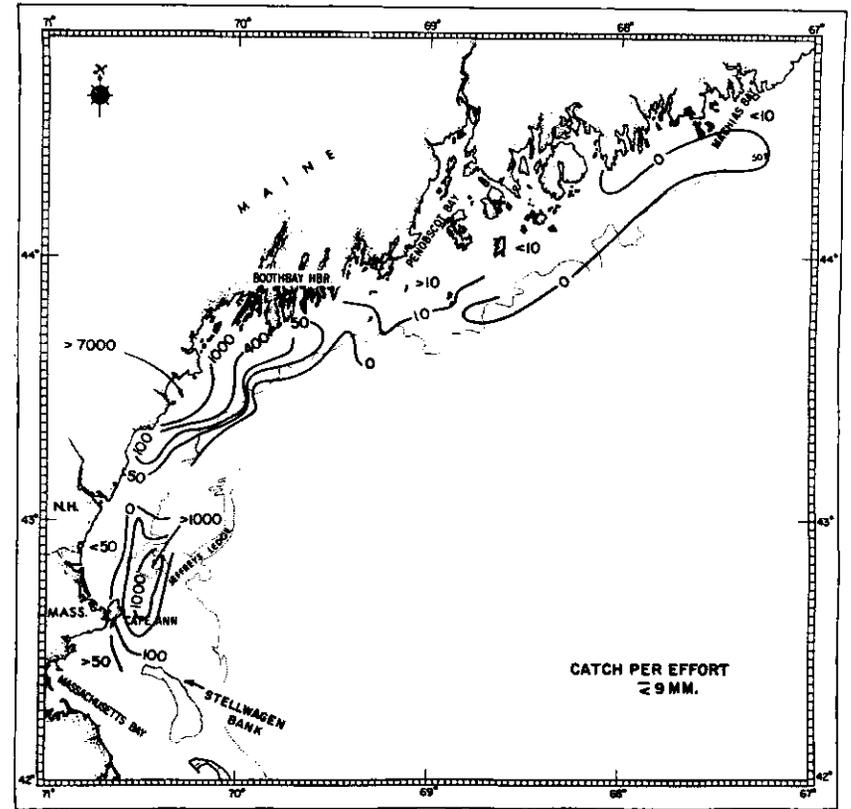


Figure 7. Contours of catches per 1000m³ for recently hatched larvae (<9 mm.) during a cruise from Oct. 13 - 25, 1971.

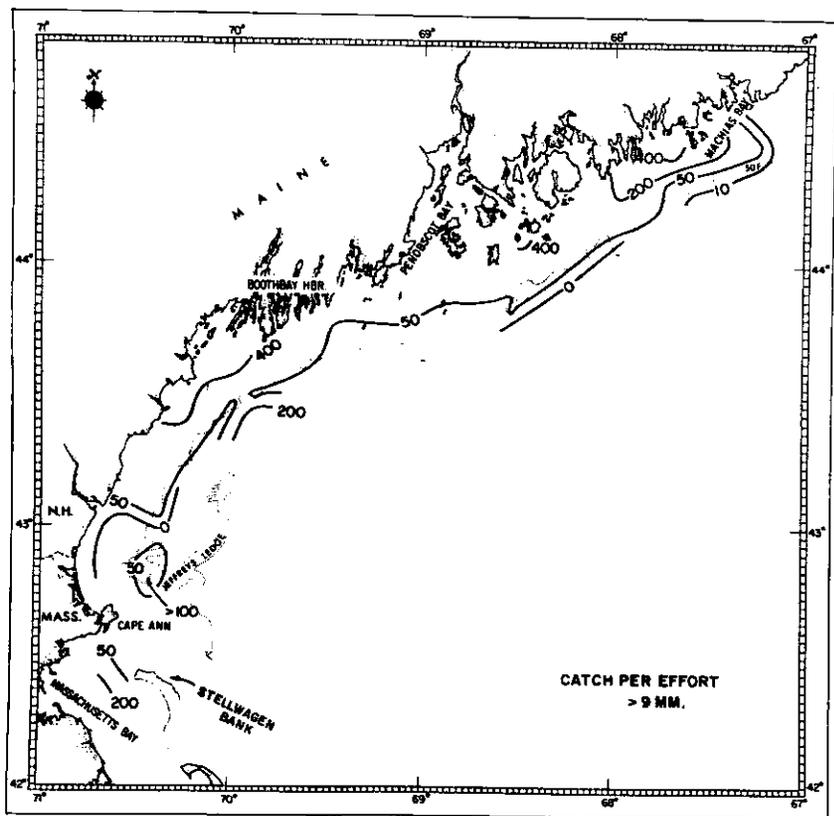


Figure 8. Contours of catches per 1000m³ for older larvae (>9 mm.) during a cruise from Oct. 13 - 25, 1971.