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Larval herring distribution in the Bay of Fundy

by

W.T. Stobo and T.D. Iles

Fisheries Research Board of Canada  
Biological Station, St. Andrews, N.B.

Introduction

Iles (1971) presented a hypothesis of larval retention in the Bay of Fundy whereby herring larvae spawned in the Trinity-Lurcher area off southwest Nova Scotia, sub-division 4Xa, were carried into the Bay of Fundy by the residual non-tidal currents on the Nova Scotia side, but were not transported out of the Bay along the New Brunswick coast by the same gyral system. It was suggested that the head of the Bay of Fundy was an overwintering area for the bulk of the larval population of the Nova Scotia stock and that post-larval movement was to the Nova Scotia rather than the New Brunswick side. This in turn implied that the Nova Scotia stock did not contribute to the New Brunswick sardines (two year old herring) fishery, a possibility that had been suggested earlier on other grounds (Iles 1970). It was also suggested that a larval concentration found to the immediate south of Grand Manan Island on the Maine-New Brunswick border, represented a separate small local stock spawning in that area.

Coverage of the area was insufficient both spatially and temporally to determine larval distribution throughout the Bay of Fundy and its approaches and thus to test the hypothesis thoroughly. In particular, late or post winter sampling had not been carried out to determine post-winter distribution. In view of the large tidal fluctuations and currents in the area, dispersion throughout and transport out of the Bay of Fundy might be extensive over the winter.

A program of larval surveys in the area has been designed to give more complete spatial and temporal coverage and preliminary results of two of these are presented here.

## Methods

The cruises were undertaken by the St. Andrews Biological Station of the Fisheries Research Board of Canada on the M/V E.E. Prince during the periods November 16-25, 1972 and February 28-March 14, 1973. Both cruises occupied 116 stations at the entrance to, and inside the Bay of Fundy. The November cruise additionally occupied ICNAF stations #112-124.

Sampling was based on a rectangular grid, station distances between 5-10 miles (see Fig. 1.). Since a prime purpose of the cruises was to investigate movement across the Bay, the station sequence was designed to subdivide the long axis of the Bay into three parts. This method made the results within each area more comparable, since the time interval was reduced. As well the station sequence maximized the number of tows being made on the long side of each rectangle, thus decreasing the real distance between successive stations to about 5 miles. The designated track was adhered to as much as possible, although on both cruises weather conditions forced some modifications.

Paired Bongo nets (.333 and .505 mm mesh) were used at all stations and towing speed varied from 2-3 knots. A telemetering device was attached to the Bongo frame to obtain depth measurements and most of the water column was sampled. The gear was lowered rapidly to the maximum depth of the tow and hauled at a set rate to obtain an oblique tow.

Bathythermograph records were taken at each station and surface temperatures and salinities measured.

Plankton samples were sorted at the St. Andrews laboratory. Fish larvae were sent to the Canadian Oceanographic Identification Centre for total length and individual weight measurements to be taken. This analysis is currently underway.

## Results and discussion

The number of herring larvae captured in each mesh size at each station and the calculated number of larvae per 10 m<sup>2</sup> surface are presented in Table 1. The total number of larvae captured at each station was used in the calculations and we used the actual depth fished (max: 186 m) rather than assuming that the larvae were restricted to the upper 40 m. The calculations essentially followed the formula of Dragesund (1968):

$$\text{No. per } 10 \text{ m}^2 = \frac{\text{No. of larvae} \times \text{sampling depth in m.} \times 10}{\text{Volume of water filtered in m}^3}$$

The calculated larval abundance at each station was then plotted and contour lines drawn to give an overall distribution of larvae in the Bay of Fundy (Figs. 2-3).

Both cruises indicate that larvae are dispersed throughout the Bay in varying concentrations. The November cruise data agrees with Iles (1971) that herring larvae spawned in southwest Nova Scotia are concentrated along the south side of the Bay and that there is a separate spawning area south of the Grand Manan channel. Similar concentrations existed at the time of the February-March cruise, but were much more localized. The presence of such localized concentrations in the spring, and the numbers of larvae found throughout the Bay during both cruises do support the hypothesis of larval retention to some extent, but more rigorous tests of the hypothesis await more detailed information and quantitative analysis of the data.

However, the data also indicate that the larval concentrations are continuous across the Bay, north of Grand Manan Island, throughout the winter. This indicates that a proportion of the larvae on the New Brunswick side are of Nova Scotia origin and thus the possibility of genetic interchange across the Bay cannot be dismissed.

#### References

- Dragesund, O. 1968. On herring larvae of Norwegian spring spawners: effect of time and location of spawning on year-class strength in the period 1959-1965. *Coun. Meet. Int. Explor. Sea*, 1968(6): 1-41.
- Iles, T.D. 1970. Vertebral numbers of the Bay of Fundy herring and the origin of New Brunswick sardines. *Int. Comm. Northw. Atlant. Fish.*, Redbook 1970, Part III, p. 148-150.
- Iles, T.D. 1971. The retention inside the Bay of Fundy of herring larvae spawned off the southwest coast of Nova Scotia. *Int. Comm. Northw. Atlant. Fish.*, Redbook 1971, Part III, p. 93-103.

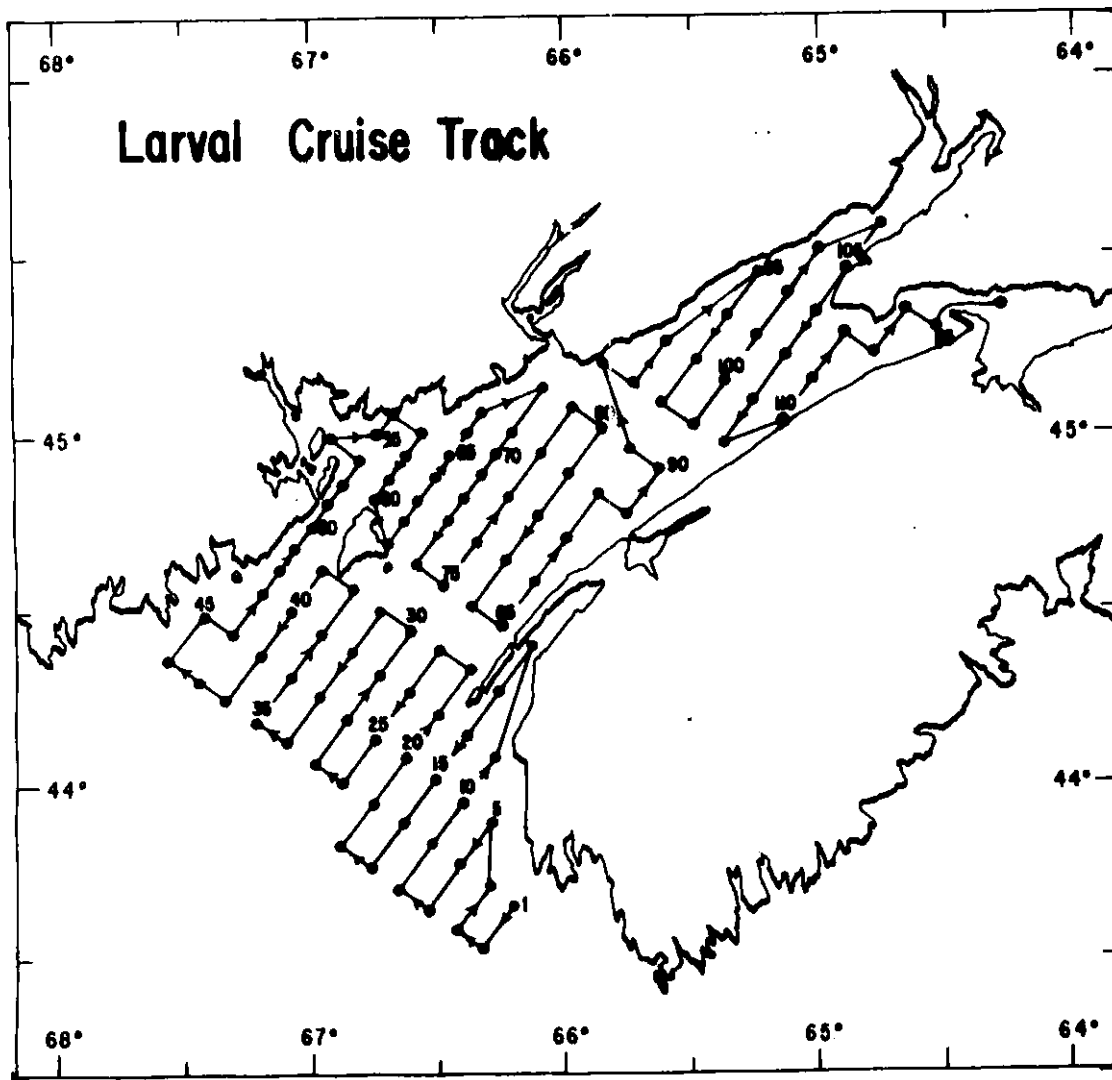


Fig. 1. The larval sampling stations in the Bay of Fundy are presented along with the proposed cruise track. Selected station numbers are also given for reference.

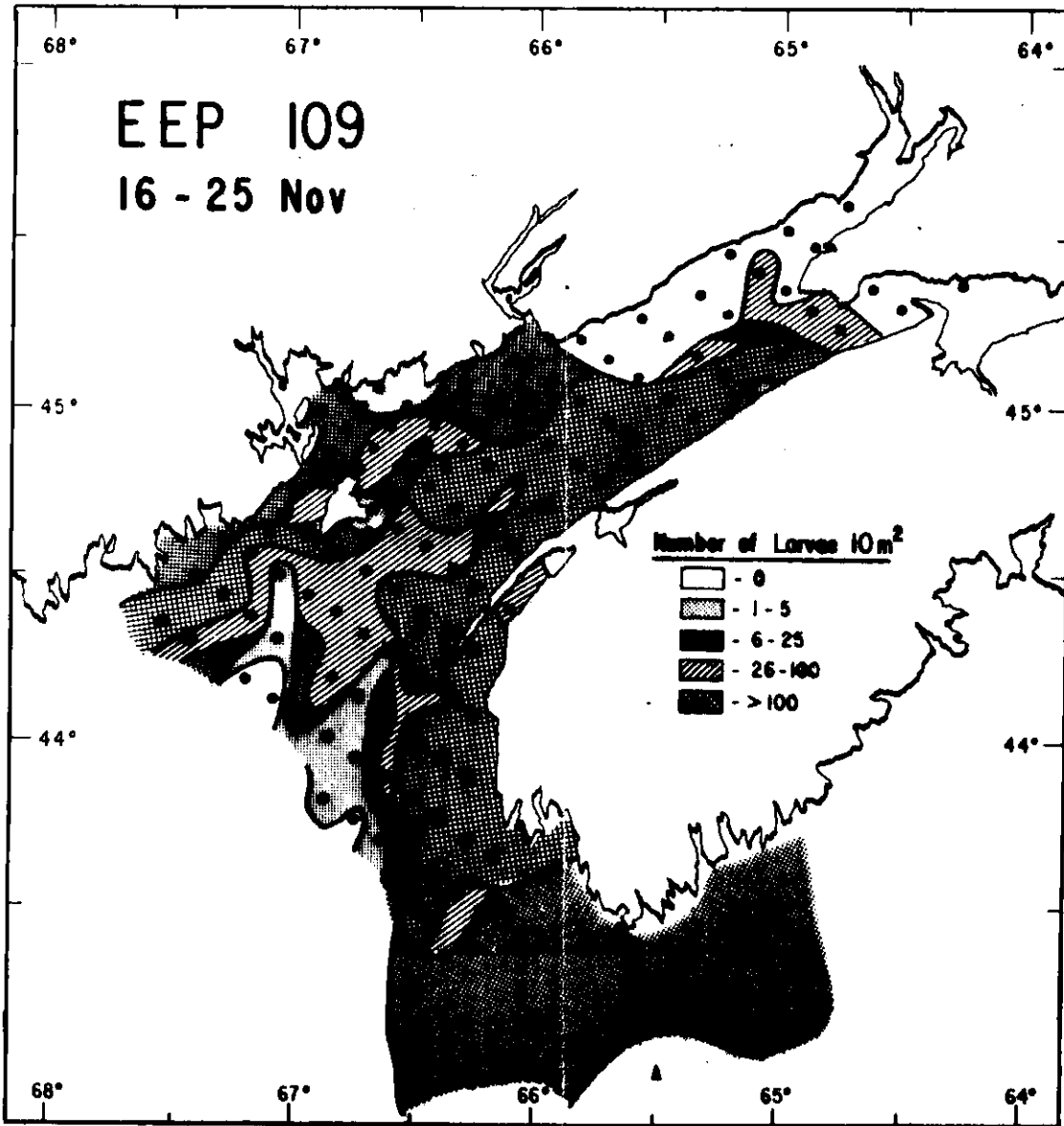


Fig. 2. The distribution of herring larvae in the Bay of Fundy is presented along with the stations occupied. ICNAF plankton stations are indicated by triangles.

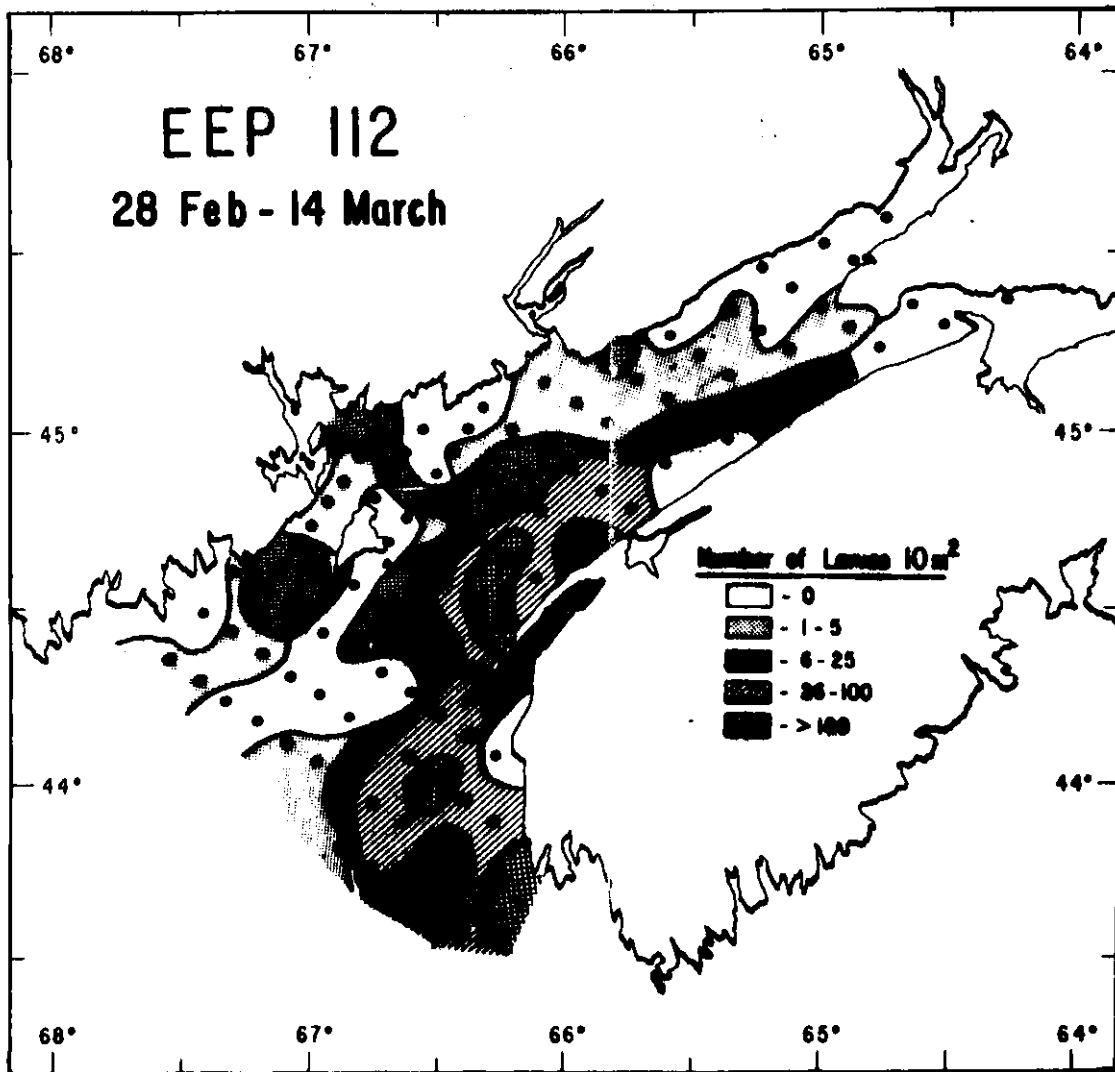


Fig. 3. The distribution of herring larvae in the Bay of Fundy is presented along with the stations occupied.

TABLE 1. Station positions and the number of herring larvae captured in each of the paired Bongo nets (mesh sizes #333 and #505) in the Bay of Fundy in November, 1972 and February-March, 1973 are presented below. The total number of larvae captured at each station was used to calculate the number per 10 m<sup>2</sup>. No adjustments were made for mesh size or larval length.

Station No.	Lat.	Long.	November 11-25 1972			February 28-March 14 1973		
			Mesh #333	Mesh #505	Number per 10 m <sup>2</sup>	Mesh #333	Mesh #505	Number per 10 m <sup>2</sup>
1	43 38 30	66 14 00	53	69	175	-	-	Not done
2	43 31 30	66 19 00	23	21	71	-	-	Not done
3	43 35 00	66 25 00	195	166	678	13	1	36
4	43 41 30	66 18 00	83	100	291	84	94	271
5	43 53 30	66 17 00	157	140	569	6	20	48
6	43 46 00	66 25 00	94	100	720	9	11	20
7	43 39 00	66 32 00	0	5	15	10	0	18
8	43 42 00	66 39 00	2	0	3	2	2	6
9	43 50 00	66 28 00	85	98	434	6	7	18
10	43 57 00	66 25 30	60	63	237	15	10	32
11	44 05 00	66 16 00	114	127	353	0	0	0
12	44 24 00	66 08 00	23	15	51	6	3	9
13	44 16 00	66 15 00	46	50	304	3	4	12
14	44 09 00	66 23 00	14	7	69	8	4	32
15	44 05 00	66 26 00	67	38	295	8	21	113
16	43 53 00	66 38 00	15	16	72	24	20	83
17	43 45 00	66 45 00	0	0	0	1	23	49
18	43 49 00	66 52 00	0	1	4	1	0	2
19	43 57 00	66 44 30	2	0	3	10	22	43
20	44 04 30	66 37 00	3	5	22	10	14	43
21	44 12 00	66 29 00	32	35	192	6	17	45
22	44 19 30	66 20 30	23	51	212	1	15	49
23	44 23 00	66 29 00	0	0	0	2	1	7
24	44 15 30	66 36 30	0	0	2	0	0	0
25	44 08 00	66 44 00	2	0	4	2	3	10
26	44 01 00	66 51 00	2	0	5	2	1	18
27	44 04 00	66 58 00	2	1	10	0	1	2
28	44 12 00	66 50 30	15	13	63	0	0	0
29	44 19 00	66 43 00	14	12	52	0	0	0
30	44 27 00	66 35 00	60	41	225	1	3	9
31	44 30 30	66 42 00	12	7	30	1	4	10
32	44 23 00	66 50 00	6	4	35	5	2	21
33	44 15 00	66 57 00	3	2	19	0	0	0
34	44 07 30	67 05 00	0	3	0	1	0	3
35	44 11 00	67 12 00	0	0	0	0	0	0
36	44 19 00	67 04 00	1	0	2	0	0	0
37	44 26 00	66 56 00	12	7	52	0	0	0
38	44 32 00	66 54 30	3	4	14	0	0	0
39	44 37 00	66 56 00	21	16	111	3	10	23
40	44 29 30	67 03 30	1	0	2	8	3	19
41	44 22 30	67 11 00	13	0	37	1	0	2
42	44 15 00	67 19 00	1	5	17	0	0	0
43	44 18 00	67 25 00	2	8	28	1	0	3
44	44 21 00	67 32 00	25	43	139	0	2	3
45	44 29 00	67 24 00	6	3	18	0	0	0
46	44 26 00	67 17 30	53	54	234	0	1	3
47	44 33 00	67 10 00	3	13	36	4	2	15
48	44 37 00	67 07 00	17	16	126	4	2	14
49	44 41 00	67 03 00	0	2	12	2	4	12
50	44 44 30	66 59 00	6	2	39	0	1	2

TABLE 1 (CON'T)

Station No.	Lat.	Long.	November 11-25 1972			February 20-March 14 1973		
			Mesh #333	Mesh #505	Number per 10 m <sup>2</sup>	Mesh #333	Mesh #505	Number per 10 m <sup>2</sup>
51	44 48 00	66 55 00	4	2	18	1	1	4
52	44 52 00	66 51 00	2	1	8	2	0	3
53	44 56 00	66 48 00	6	2	21	1	0	2
54	45 00 00	66 51 00	3	1	9	2	3	15
55	45 00 00	66 42 00	1	0	4	6	0	12
56	45 04 00	66 37 00	0	0	0	0	0	0
57	45 00 00	66 33 00	0	1	3	0	0	0
58	44 56 00	66 37 00	8	12	49	0	0	0
59	44 52 00	66 41 00	10	8	65	2	1	9
60	44 49 00	66 44 00	11	9	65	0	0	0
61	44 41 00	66 39 30	1	0	4	0	0	0
62	44 45 00	66 37 00	2	1	12	0	0	0
63	44 49 00	66 34 00	2	5	18	1	1	6
64	44 53 00	66 30 00	1	5	16	0	0	0
65	44 56 30	66 26 00	8	7	49	1	1	4
66	45 00 00	66 22 45	4	2	20	0	0	0
67	45 04 00	66 19 00	4	1	16	0	0	0
68	45 08 00	66 04 00	2	3	10	1	0	2
69	45 00 30	66 12 00	3	4	19	0	2	3
70	44 57 00	66 15 30	2	0	7	0	2	6
71	44 53 00	66 19 00	2	18	64	2	2	10
72	44 49 00	66 23 00	31	42	150	0	2	6
73	44 45 00	66 27 00	73	52	203	1	0	3
74	44 38 00	66 35 00	12	9	35	1	4	10
75	44 34 30	66 28 00	16	13	65	5	8	29
76	44 42 00	66 22 30	63	54	239	19	21	88
77	44 49 00	66 13 00	49	54	267	14	2	23
78	44 57 00	66 05 00	5	4	18	1	7	19
79	45 03 30	65 57 00	2	2	8	0	2	4
80	45 01 00	65 51 00	24	27	136	0	1	2
81	44 53 00	65 58 00	45	50	255	8	20	43
82	44 46 00	66 06 00	4	16	62	19	21	77
83	44 39 00	66 13 00	4	2	17	51	69	247
84	44 31 00	66 21 00	4	9	38	26	41	126
85	44 28 30	66 14 30	12	42	177	38	34	108
86	44 35 00	66 07 00	29	32	142	13	11	35
87	44 42 30	65 59 00	261	235	888	6	3	19
88	44 50 00	65 51 00	432	419	1342	8	12	53
89	44 47 00	65 44 00	131	171	514	20	0	34
90	44 54 00	65 37 00	50	74	273	0	0	0
91	44 57 00	65 44 00	20	19	107	6	3	18
92	45 12 00	65 50 00	0	0	0	3	6	9
93	45 08 00	65 43 00	9	2	34	1	0	2
94	45 16 00	65 35 00	1	0	3	0	0	0
95	45 27 00	65 14 00	0	0	0	0	0	0
96	45 19 30	65 22 00	0	0	0	1	0	1
97	45 12 00	65 29 00	2	4	21	0	1	1
98	45 03 00	65 37 00	4	7	27	0	1	1
99	45 01 00	65 29 30	44	50	231	4	3	14
100	45 09 00	65 22 00	18	30	85	1	0	2
101	45 16 00	65 14 30	1	1	4	0	0	0
102	45 23 00	65 07 00	3	0	5	0	0	0
103	45 31 00	64 59 00	0	0	0	0	0	0
104	45 35 00	64 45 00	0	0	0	0	0	0
105	45 28 00	64 53 00	0	0	0	0	0	0
106	45 19 00	65 01 00	0	0	0	0	1	2
107	45 13 00	65 08 00	5	3	14	0	1	2
108	45 05 00	65 15 00	32	21	174	3	2	15
109	44 58 30	65 23 00	13	48	142	0	0	0
110	45 02 50	65 09 00	4	8	29	5	6	15



TABLE 1 (CON'T)

Station No.	Lat.	Long.	November 11-25 1972			February 28-March 14 1973		
			Mesh #333	Mesh #505	Number per 10 m <sup>2</sup>	Mesh #333	Mesh #505	Number per 10 m <sup>2</sup>
111	45 09 00	65 01 00	17	13	116	8	12	22
112	45 15 00	64 53 30	1	1	2	1	2	4
113	45 13 00	64 47 00	1	1	4	0	0	0
114	45 18 30	64 40 00	0	0	0	0	0	0
115	45 17 00	64 32 30	0	0	0	0	0	0
116	45 20 30	64 17 00	0	0	0	0	0	0
<u>ICNAF STATIONS</u>								
112	44 20 00	66 30 00	50	59	231			
113	44 00 00	66 30 00	53	39	679			
114	43 45 00	66 30 00	18	107	219			
115	43 30 00	66 30 00	27	50	128			
116	43 30 00	66 10 00	15	13	23			
117	43 15 00	66 30 00	8	9	13			
118	43 00 00	66 30 00	2	0	11			
119	43 00 00	66 00 00	0	2	8			
120	43 10 00	66 00 00	10	10	22			
121	43 15 00	65 30 00	4	5	9			
122	43 00 00	65 30 00	0	0	0			
123	43 10 00	65 00 00	1	2	15			
124	43 30 00	65 00 00	5	4	12			