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Distribution and Abundance of Demersal Juvenile Cod from Inshore to Offshore Locations on the Northern Grand Bank and NE Newfoundland Shelf in December, 1992

by

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INTRODUCTION

One result of recent reviews (eg. Harris 1990) of the state of the Northern cod stock is that the paucity of biological information available on this species, particularly its early life stages, was highlighted. A recommendation of the Harris Report was that scientific efforts be expanded to understand the integrity and interrelationship of spawning aggregations as they relate to recruitment. There has been little research carried out to link progeny of specific spawning units to subsequent recruitment to the fisheries. This remains a near impossible task at this stage since the preferred nursery areas of juveniles of this large stock complex have not been delineated.

Some small cod (younger than age 4) are captured by the Engels high lift trawl (180 mm. mesh in wings tapering to 110 mm. in the codend) and large light weight bobbin ground gear used during the annual resource surveys for Northern cod. (Anderson, this meeting) However, the Engels trawl was designed to capture larger (commercial-size) fish and allows the smaller length groups to pass through large meshes or otherwise escape capture by the gear. (Godo and Walsh, 1992) In addition to this, the resource surveys have not examined any of the large inshore bays, or within twelve miles of the headlands.

Prior to the commencement of the Northern Cod Science Program (NCSP), which was initiated in response to recommendations of the Harris Report, many outstanding questions concerning the early life history of cod had not been addressed. Existing models of the drift of cod eggs and larvae had not been tested, nor had there ever been a systematic survey to delineate nursery areas of pelagic and demersal early life history stages. Even basic information on the preferred habitats is wanting. The Juvenile Initiative of NCSP is to provide advice regarding the feasibility of surveys to monitor abundance of juvenile cod. At a workshop held in March 1991, on Northern Cod Juveniles, it was recommended that surveys be carried out to determine the distribution and abundance of both pelagic and demersal juvenile cod over the extensive geographic range of the species. As a result of this recommendation the first systematic survey to determine distribution and abundance of demersal juvenile Northern Cod, from the large inshore bays, out to the edge of the continental shelf was carried out, in December 1992. Preliminary results of this survey are reported here. Distribution and abundance data is presented for all size groups combined as well as for length groups approximating age groups 0 to 3 years.

METHODS AND MATERIALS

In considering a design for the demersal survey a trade-off was made between 1) more intensive spatial coverage to examine spatial variability within any given area and 2) the necessity to cover a large geographic area in a relatively short time. A line transect method was utilized to sample from inshore bays and headlands to offshore areas. (Fig 1). An effort was made to sample all available depths along a transect and generally distance

between stations on a line did not exceed 30 nautical miles. Sampling was also carried out in the five large bays along the Northeast coast where again an effort was made to sample the range of bottom depths available.

The sampling trawl was a three-bridle Campelen 1800 mesh shrimp trawl with 80 mm. stretched meshes in the front which gradually decrease to 40 mm. in the codend. (Engas and Godo, 1989). The capture efficiency of the Campelen trawl is higher for smaller fish than the Engels, which has a close to zero efficiency for individuals less than 20 cm. (Godo and Walsh, 1992). A liner of 6.5 mm. mesh was used in the codend of the Campelen and it was outfitted with 14 inch rubber disc rockhopper groundgear and 1400 kg. polyvalent doors. Headline height, wing spread and door spread were monitored using Scanmar. On average the vertical height of the trawl was approximately 4.5 m. and the wing spread was approximately 13 m. Effort was standardized by fishing for 30 minutes along bottom once the trawl had settled, as observed from the Scanmar readings. Temperature along the tow path was monitored using a trawl mounted CTD. All cod were sorted from the catch prior to onboard length and weight measurements, sex determination and otolith and stomach sampling. Catch by species was determined by sorting, enumerating, and weighing the entire catch, or a representative sample.

Abundance data is presented using expanding symbol plots of log10 raw values for each set, assumming the data are normally distributed.

RESULTS AND DISCUSSION

Juvenile cod were sampled in all but five trawl sets. The number and weight of juvenile and larger cod caught in relation to depth and bottom temperature is shown in Table 1. Bottom depth of the sets ranged from 60 to 637 meters, mean bottom temperature ranged from -1.26 to 3.76 degrees Celcius, and juvenile cod catches ranged from 0 to 664. (Table 1) Simple correlation analysis indicated no correlation between juvenile cod catch and either bottom depth, or temperature, although no juvenile cod were taken at the deepest station sampled on the shelf slope (637m).

Of 2,338 fish that were sexed, 1188 (50.8%) were male and 1150 (49.2%) were female, indicating a sex ratio that was not different from the expected 1:1.

The distribution and abundance of juvenile cod, by sex, (all sizes combined) is shown in Figures 2 and 3 and indicates quite striking similarities over the entire survey area. This similarity of the sexes has been used as the basis to combine both sexes in subsequent examinations. Figure 4 shows the abundance distribution of the total catch of juvenile cod both sexes and all sizes combined. It is similar to the distributions shown for either sex.

Figure 5 shows the length frequency of combined catch (both sexes) from all sets combined and indicates that the sampling trawl is capable of capturing young cod as small as 55 mm. An upper limit of size for juvenile cod has been set at 390 mm. This upper size limit was chosen from available age length keys from historical research survey data to assure the inclusion of age 3 fish. From this frequency distribution, modes for 0+ and 1+ groups are obvious at 75 - 80 mm. and approximately 155 -160 mm. respectively. From 1) this length frequency distribution and 2) age length keys from unpublished inshore juvenile trap data, 4 length groups were chosen to approximate age groups as follows: LG0 = <116 mm., LG1 = 116 - 215 mm., LG2 = 216 - 310 mm., and LG3 = > 310mm.

Figures 6 to 9 show the distribution and abundance of the four length groups throughout the survey area. Length group 0 (LG0), except for 1 individual captured approximately 90 miles from the coast on the most southern line, were restricted to the inshore bays and not distributed further out on the shelf. (Fig.6) Length group 1 on the other hand was widely distributed throughout the survey area, from the inshore areas out to the edge of the shelf, with the highest abundances being found in Conception and Trinity Bays. Occurrence of LG1 was generally more frequent in the northern transect lines than in the south, and except for one area (around 49 degrees North), occurred more frequently on the shelf than near the edge. (Fig.7). LG2 (Fig. 8) also had highest abundances in Conception and Trinity Bays, were found in the other bays and, except for the the most southerly line, were widespread on the shelf with the center of distribution extending further offshore than the LG1 group, and extending to the shelf edge. LG3 (Fig 9)

was found to be abundant at one station in Conception Bay but highest abundances were found to be near the shelf edge on the most northern transect and on the transect off from Bonavista Bay.

In summary the results indicate a tendency for the smallest fish (LG0) and to a lesser extent LG1's to be more restricted to the inshore than offshore areas. With increasing size there is a tendency for the juveniles to be more widely distributed on the shelf and in the case of LG3, some of the larger catches were taken near the shelf edge. The fact that nearly all LG0 were restricted to the inshore supports the hypothesis that inshore area is seeded early in the life history of the cod. However, this may have originated from spawning on the edges of more northerly offshore banks as hypothesized by Templeman (1981) or it may well have originated from more local inshore spawning. (Templeman, 1989). It is obvious that the whole of this survey area is a nursery area for Northern Cod. It is a fair assumption that the area would be more heavily utilized as a nursery area when the spawning stock biomass is above its present low levels. In 1981 (a relatively good yearclass), for example, pelagic juveniles were widely distributed over the survey area (Anderson et al., in prep.) in September and likely resulted in a more widespread settling of demersal 0+ juveniles. Further investigation is required to determine the variability in spatial distribution by more intensive sampling within given areas.

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STATION	LOCALITY	DEPTH	TEMP	#JCOD	WTJCOD	#LCOD	WTLCOD
1	nr. stn. 27	170	-1.14	25	5.76	1	1.34
2	In 6-2	176	-0.87	10	1.75	0	0
3	In 6-3	126	-0.97	0	0	3	2.3
4	In 6-4	114	-0.98	4	0.75	1	0.65
5	In 6-5	97	-0.96	24	0.5	0	0
6	In 6-6	143	-0.79	5	2.05	2	2.5
7	In 6-7	209	-0.74	11	0.58	2	4.8
8	CB - 1	181	-1.26	1	0.78	2	2.6
9	CB - 2	76	2.23	288	30.83	8	8.9
10	CB - 3	94	-1.1	528	21.9	0	0
11	CB - 4	120	0.16	31	1.78	0	0
12	TB - 1	325	0.35	5	0.8	1	0.75
13	TB -2	251	-0.96	6	1.6	1	1
14	In 5-1	185	-1.14	6	1.7	4	3.5
15	In 5-2	122	-1.19	11	3.09	3	3.58
16	In 5-3	207	-0.91	10	3.01	2	1.05
17	TB - 3	116	-0.51	28	3.35	0	0
18	TB - 4	90	1.47	664	33.5	0	0
19	TB - 5	127	-0.68	107	4.75	3	3.35
20	TB - 6	91	-0.32	355	37.9	4	3.25
21	TB - 7	144	-0.83	282	23.4	9	6.9
22	TB - 8	99	0.52	49	3.98	0	0
23	In 4-1	307	0.8	38	6.69	2	1.8
24	In 4-2	327	1.7	38	4.15	7	6.15
25	In 4-3	366	2.63	40	0.55	3	2.05
26	In 4-4	347	2.97	9	1.65	3	2
27	In 4-5	458	3.78	9		2	
28	In 3-6	405	2.92	9	2.7	3	2.85
29	In 3-5	315	2.12	18	4.65	6	4.45
30	In 3-4	313	1.75	10	2.5	2	1.7
31	In 3-3	276	0.73	8	1.9	1	0.75
32	In 3-2	428	1.94	92	14.95	3	2.45
33	BB - 1	280	-0.27	0	0	0	0
34	BB - 2	320	-0.62	3	0.21	0	0
35	BB - 3	154	-0.27	47	4.55	0	0
36	BB - 4	122	-0.45	3	0.23	0	0
37	NDB - 1	60	0.98	47	2.11	0	0
38	In 2-3	308	0.54	21	3.33	1	0.85
39	In 2-4	274	0.47	4	0.4	0	0
40	In 2-5	227	0.47	0	0	0	0
41	In 2-6	254	0.85	0	0	1	0.85
42	In 2-7	261	1.77	8	3.25	4	3.3
43	In 2-8	548	3.63	5	1.75	4	2.85
44	In 1-7	335	3.2	28		14	
45	In 1-6	468	2.45	24	8.2	10	7.35
46	In 1-5	441	2.74	12	3.06	4	3.4
47	In 1-4	378	2.28	32	3.83	0	0
48	In 1-3.5	401	2.57	44	3	0	0
49	In 1-3	210	-0.78	3	0.49	0	0
50	In 1-2.5	275	-0.7	5	0.65	0	0
52	In 1-2	185	-0.8	3	0.2	0	0
53	In 1-1	184	-0.7	2	0.05	0	0
54	WB - 1	199	-0.53	7	2.58	0	0
55	WB - 2	161	-0.27	39	1.7	0	0
56	WB - 3	152	0.2	24	3.5	0	0
57	BVPEN	214	-1.02	2	0.28	0	0
58	NDB - 2	170	0.78	63	3.1	0	0
59	NDB - 3	378	-1.08	27	3.02	2	1.84
60	NDB - 4	200	-0.98	25	3.25	0	0
61	In 2-1	239	-1.26	11	1.25	0	0
62	NDB - 5	187	-0.63	78	4.75	1	0.95
63	In 2-2	288	-1.08	27	3.1	0	0
64	In 5-4	276	1.81	111	1.98	3	2.4
65	In 5-5	637	3.58	0	0	0	0
66	TBNPT1	277	1.49	27	6.3	6	5
67	TBNPT2	399	2.79	44	12.1	8	4.95
68	TBNPT3	292	1.9	35	8.8	6	7.45
69	TBNPT4	270	1.47	52	10.2	9	9
70	TBNPT5	251	1.32	30	6.1	1	1.2
71	TBNPT6	242	0.16	11	1.95	3	2.65

Table 1. Summary of fishing sets during W. Templeman 131 showing depths, mean temperature along bottom, and catch of juvenile and larger (>390 mm.) cod at each station.

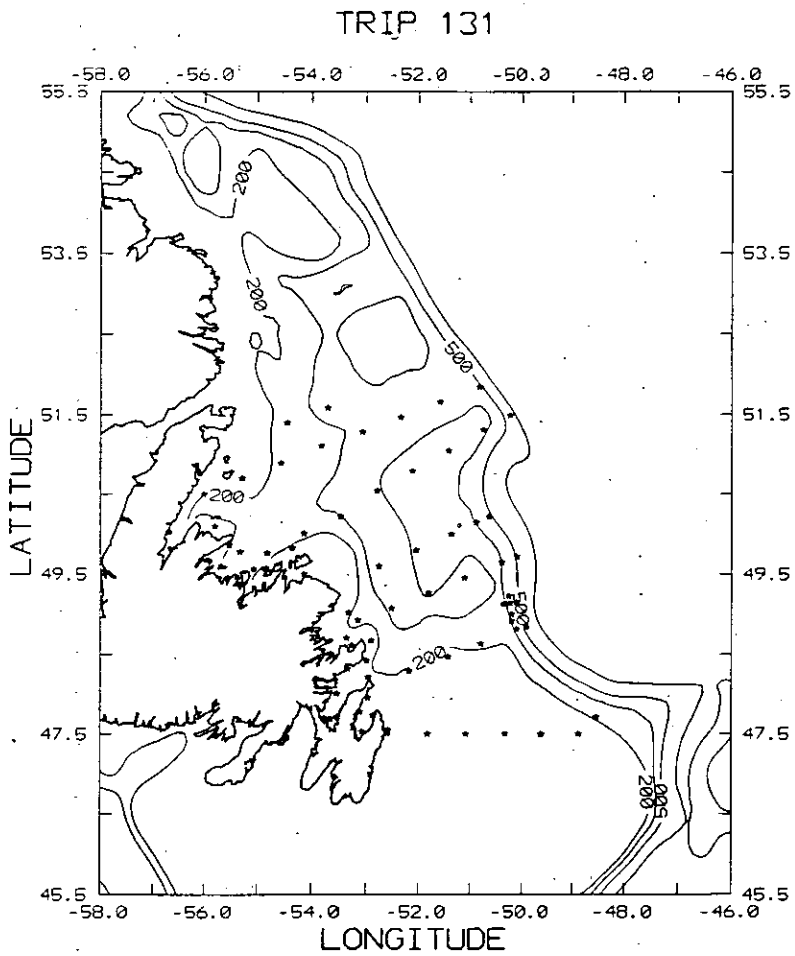

Figure 1. Map of the northeast Newfoundland shelf area showing the positions (stars) of stations sampled during Wilfred Templeman 131.

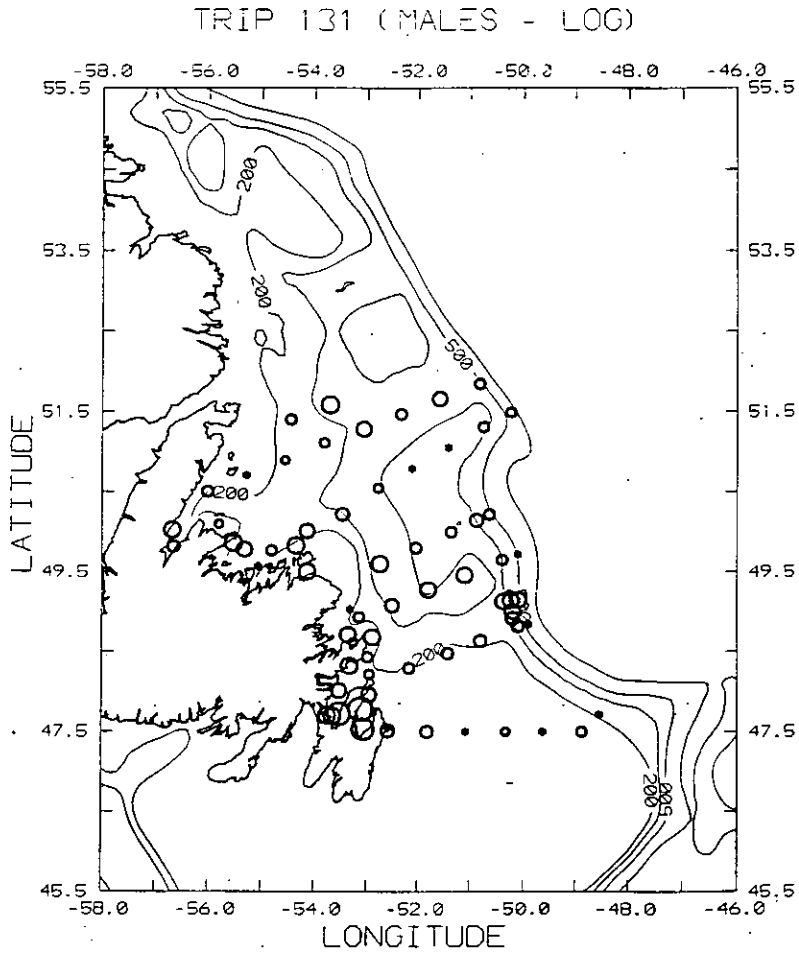

Figure 2. Abundance of male juvenile cod (all length groups) sampled during December 1992. The expanding symbols represent a linear scale based on log10 catches per 30 minute tow, scaled from 0.30 - 2.42. Stars represent zero catches.

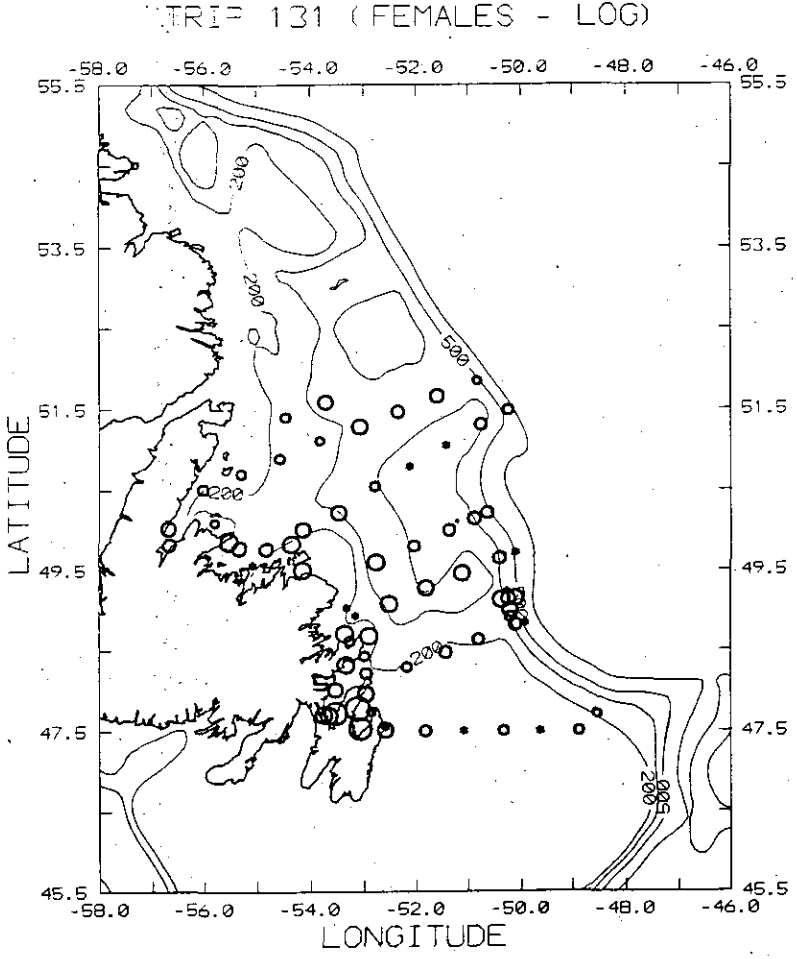

Figure 3. Abundance of female juvenile cod (all length groups) sampled during December 1992. The expanding symbols represent a linear scale based on log10 catches per 30 minute tow, scaled from 0.30 - 2.41. Stars represent zero catches.

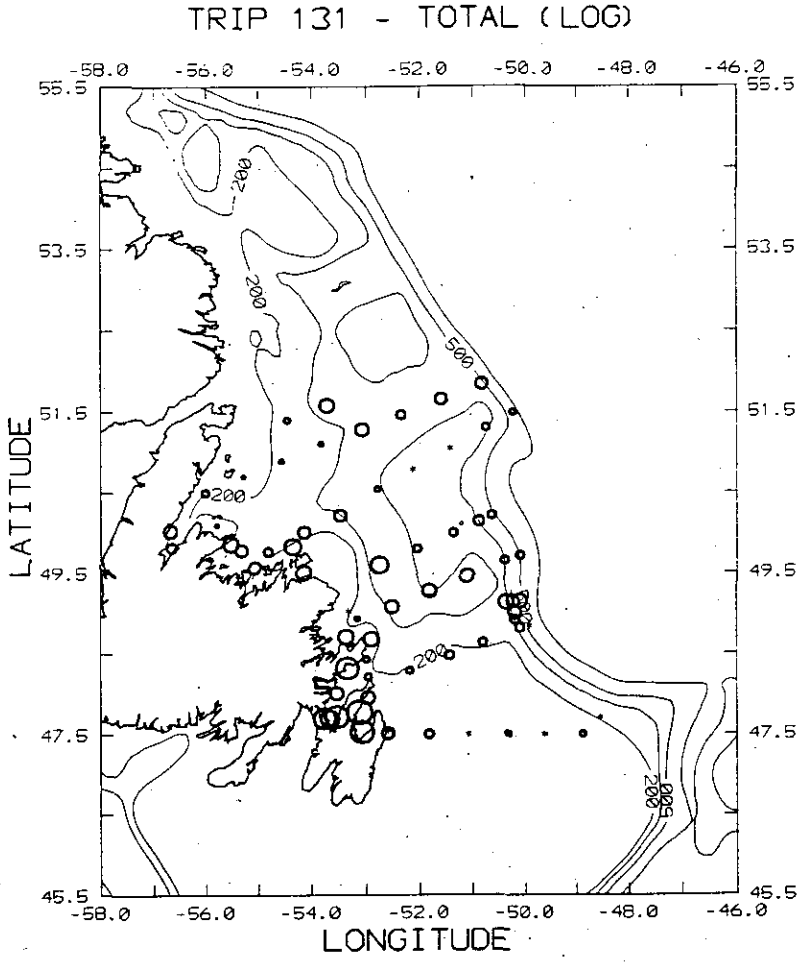

Figure 4. Abundance of juvenile cod (sexes combined) sampled during December 1992. The expanding symbols represent a linear scale based on log10 catches per 30 minute tow, scaled from 0.30 - 2.74. Stars represent zero catches.

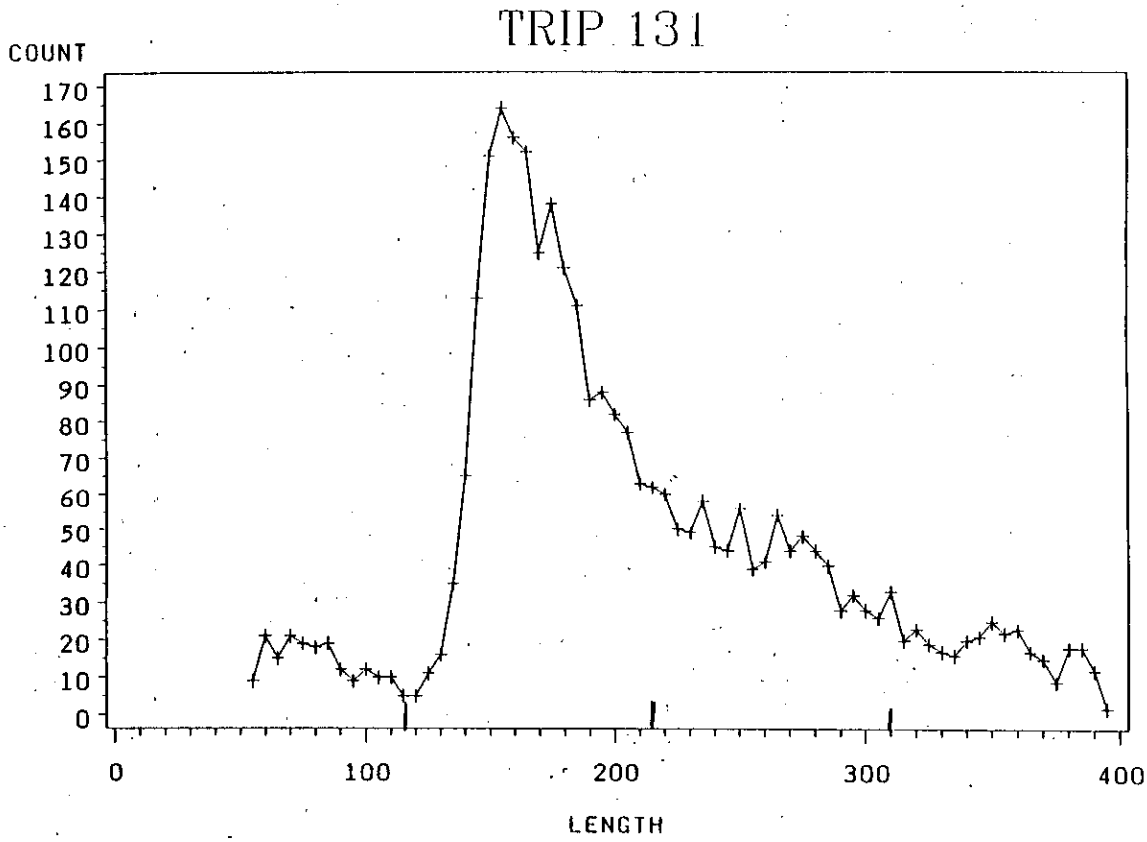

Figure 5. Length frequency of the total combined catch of juvenile cod from all sets, December, 1992..

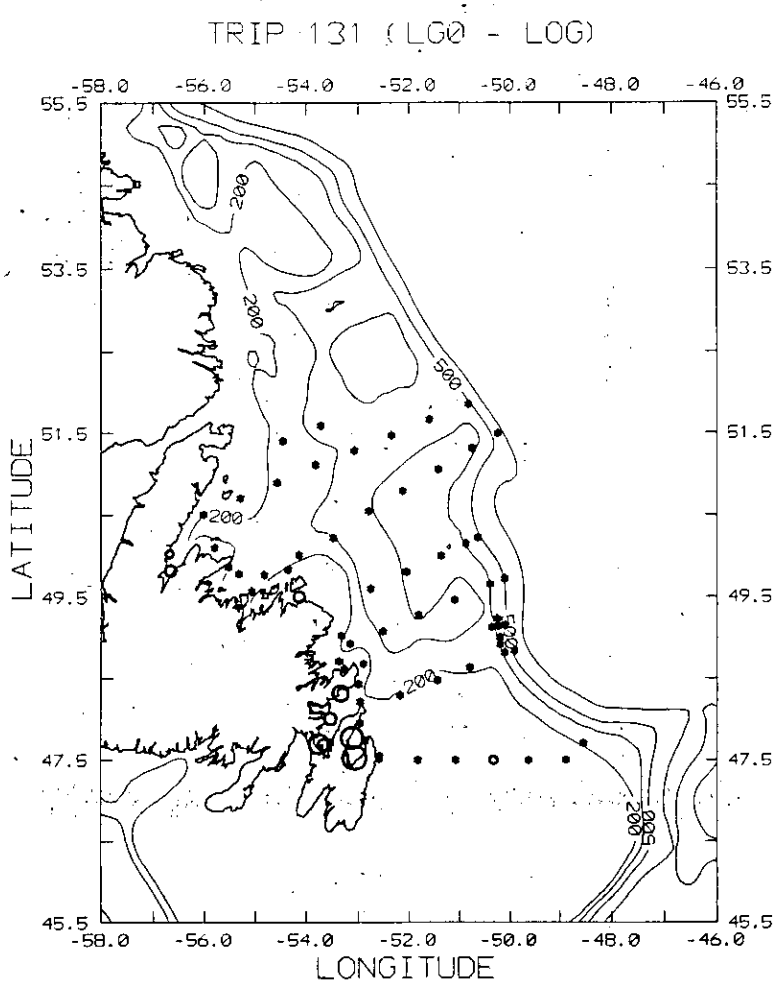

Figure 6. Abundance of LG0 group juvenile cod sampled during December 1992. The expanding symbols represent a linear scale based on log10 catches per 30 minute tow, scaled from 0.30 - 1.89. Stars represent zero catches.

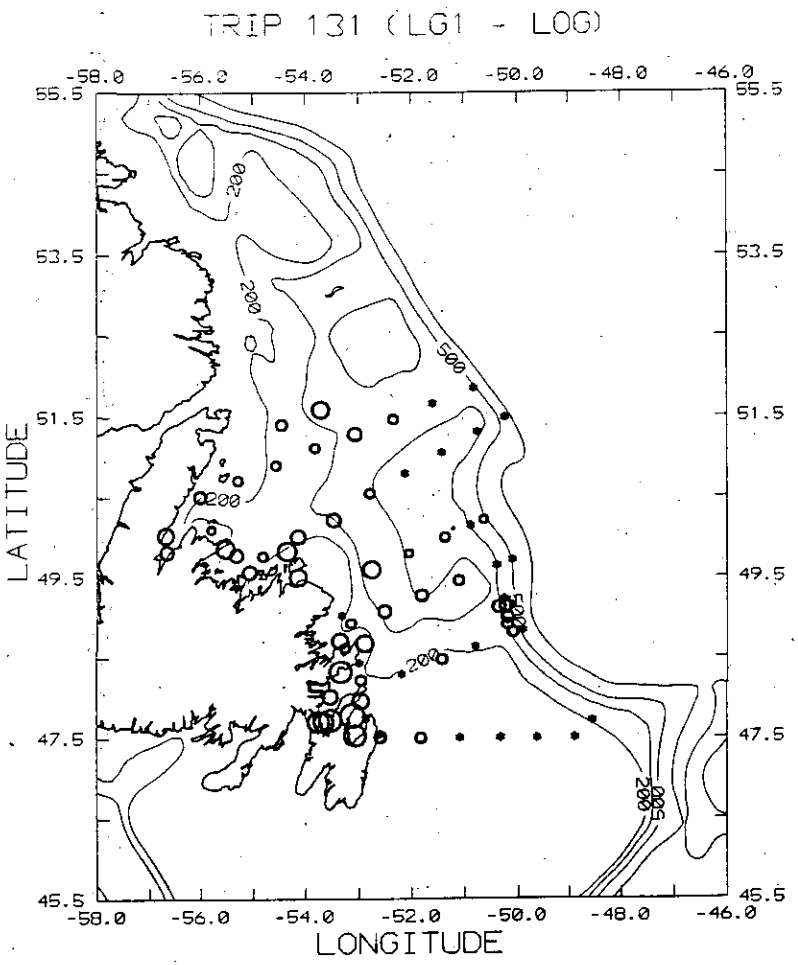

Figure 7. Abundance of LG1 group juvenile cod sampled during December 1992. The expanding symbols represent a linear scale based on log10 catches per 30 minute tow, scaled from 0.30 - 2.66. Stars represent zero catches.

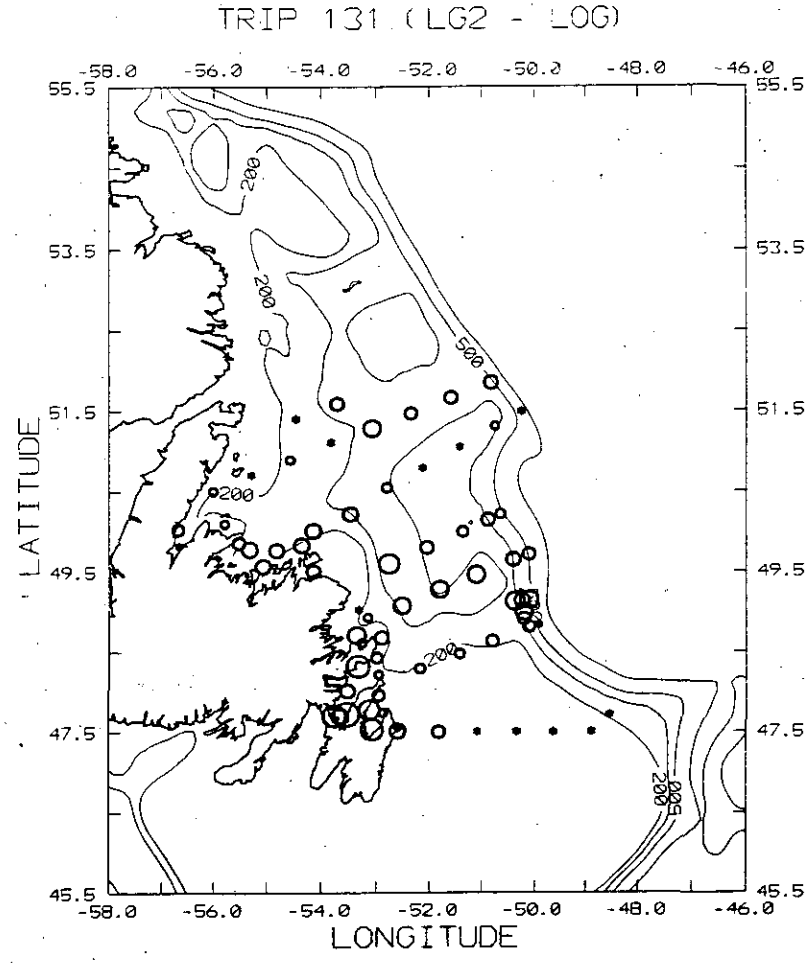

Figure 8. Abundance of LG2 group juvenile cod sampled during December 1992. The expanding symbols represent a linear scale based on log10 catches per 30 minute tow, scaled from 0.30 - 2.12. Stars represent zero catches.

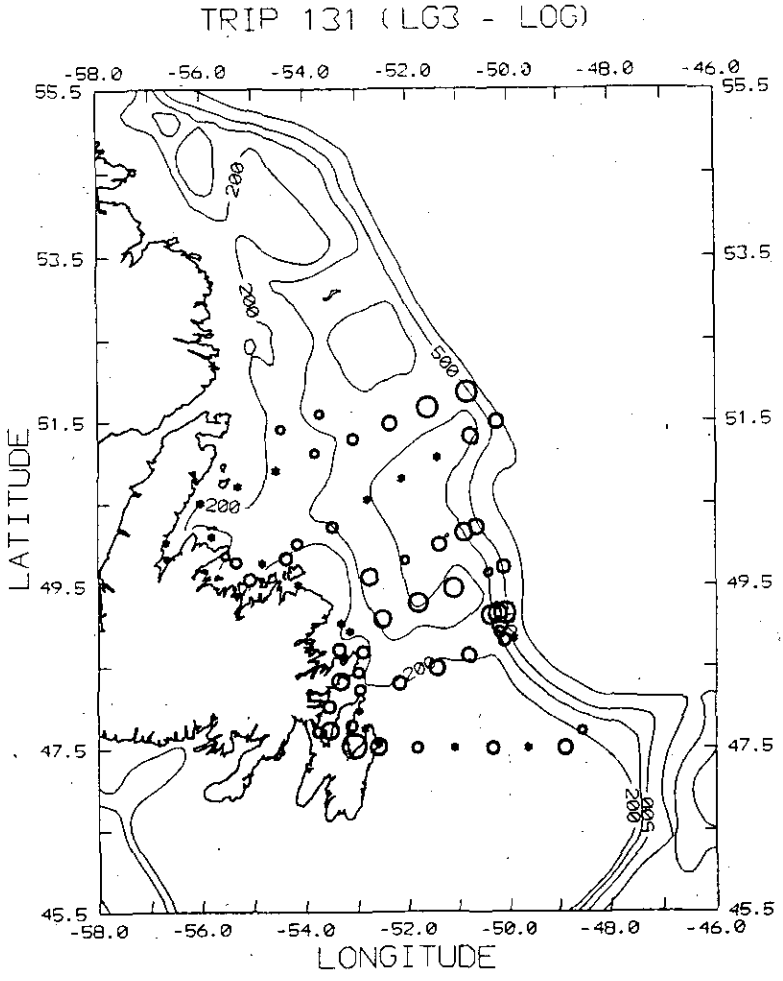

Figure 9. Abundance of LG3 group juvenile cod sampled during December 1992. The expanding symbols represent a linear scale based on log10 catches per 30 minute tow, scaled from 0.30 - 1.53. Stars represent zero catches.