International Commission for the Northwest Atlantic Fisheries

Serial No. 5363

ICNAF Res. Doc. 79/II/37

SPECIAL MEETING OF STACRES - FEBRUARY 1979

Assessment of *Illex illecebrosus* (LeSueur, 1821) stocks in ICNAF Div. 4W determined by area-density method

by

Marek Lipinski
Sea Fisheries Institute
Gdynia, Poland

Introduction

The area-density method was used by the author in 1977 for the assessment of Illex stocks in Div. 4W /Lipiński, 1978/. The same method has been repeated for the 1978 data. Despite the inaccuracies of the metod reviewed and illustrated by Sissenwine /1976/, Mari et al. /1978/ and Hurley and Waldron /1978/, the author still believes it is safer to use it instead of the Leslie or Cohort Analysis methods. One can not avoid assumptions concerning lack of migration and/or natural mortality = 0 or constant /uncertainty of the latter is connected with emigration; see Ulltang, 1977/. The "wave" migration of schools of squids is well known among fishermen and fairly well documented in the scientific literature /Squires, 1957; Sato, 1974/. One may however easily agree with Hurley and Waldron /op.cit./ that too little is known about emigration and immigration of Illex illecebrosus.

Polish Fleet fishing operations in Div. 4W

The Polish Fleet's fishing operations in Div. 4W were similar to those previously described for 1977 /Lipiński, op. cit./. Fishing for squid started on 13 July and finished on 2 September with only three stern trawlers participating. Fishing was also conducted by the same ships in Div. 3 NO. These operations are described elsewhere /Lipiński, 1979 a/.

The details of the Polish squid fishery in Div. 4W are shown in Fig. 1 and Table 1. These data are taken from the logbooks of the ships and would therefore seem to be the best source available for further analysis.

Table. 1. Catches and fishing effort in the Polish squid fishery in Div. 4W, July- September 1978, by individual vessels.

Vessel type and name	Capacity /GRT/	Fishing gear[1]	Weeks	No. of tows	Hours fished	Days fished	Total catch	Squid catch	Catch per day	By-catches: Silver hake	By-catches: Mackerel	By-catches: Swordfish
B-18 "Orka"	2495	MWT	Jul. 09-15	6	27.0	2	20.0	20.0	10.0	-	-	-
			16-22	16	103.4	7	176.0	174.0	24.0	-	2.0	-
			23-29	15	97.4	7	111.0	111.0	15.9	-	-	-
			30-Aug. 05	10	63.9	5	143.0	143.0	28.6	-	-	-
B-18 "Sejwal"	2480	MWT	Jul. 16-22	5	27.0	3	66.0	65.0	21.7	1.0	-	-
			23-29	14	64.0	7	102.0	102.0	14.6	-	-	-
			30-Aug. 05	14	85.0	7	144.1	143.3	20.5	0.8	-	-
			06-12	8	50.0	4	79.0	79.0	19.7	-	-	-
B-29 "Likowal"	1434	MWT	Jul. 09-15	5	19.0	2	3.8	3.8	1.9	-	-	-
			16-22	17	118.0	7	160.8	159.9	22.8	-	-	0.9
			23-29	14	102.0	7	206.9	206.9	29.6	-	-	-
			30-Aug. 05	5	25.0	2	40.0	40.0	20.0	-	-	-
			06-12	6	39.0	3	9.8	8.6	2.9	-	-	1.2
			13-19	17	84.0	7	187.0	186.1	26.6	-	-	0.9
			20-26	9	45.0	7	113.2	113.2	16.2	-	-	-
			27-Sep.02	17	70.0	7	105.7	105.7	15.1	-	-	-

1/ During fishing operations the fishing gear had the following dimensions: spread 35 m, height 15 m, length 80-85 m, codend mesh size 44 mm.

The total Polish catch for Div. 4W was 1661.5 t. By-catch was considerably lower than that reported for 1977 /Lipiński, 1978, op.cit./ and there was no need to report it in the form given by Nagasaki and his associates /see Redbook 1978, p. 73/.

The area of Polish squid fishery in 1978 was similar to that previously described /Fig. 1/ but the depth range differed slightly /115 - 190 m, mainly 140 m, instead of 120-230 m, mainly deeper than 180 m/.

It was assumed that areas A and B /9.300 km^2 each/ were egually fished and sampled. The mean duration of each haul - 4 hours, mean number of hauls per day - 3, trawl towing speed - 3,5 knots. The spread between the net wings was 35 m and during a single haul covered 0.91 km^2.

The mean proportion between sexes was 57.5 males and 42.5 % females, and remained relatively constant during the period investigated /Table 2/.

Table 2. Basic biological data concerning Polish squid fishery for the period investigated in 1978.

Week	Number of samples	Proportion of sexes ♂ number of individuals	♂ %	♀ number of individuals	♀ %	ML ♂	ML ♀
Jul. 09-15	-	-	-	-	-	-	
16-22	2	610	57.5	450	42.5	18.3	18.5
23-29	3	880	54.8	725	45.2	18.7	19.1
30-Aug.05	2	643	60.5	419	39.5	18.9	19.2
06-12	1	304	58.5	216	41.5	19.1	19.2
13-19	-	-	-	-	-	-	-
20-26	-	-	-	-	-	-	-
27-Sep.02	-	-	-	-	-	-	-

Mean weight at the beginning of the season - males 115 g and females 105 g. Mean weight in the middle of the season was 135 g and 122 g, respectively*/.

*/ The mean weights were calculated from W.P. 78/II/7 /1978/. This is the weight for the mean length of the squids.

The mean catch per day was 20.4 t and remained relatively constant during the whole fishing period, with only two major fluctuations. This was equal to 11.7 t for males /1.017×10^5 and 0.867×10^5 individuals at the beginning and at the middle of the season, respectively/, and 8.7 t for females /0.829×10^5 and 0.713×10^5, respectively/.

The mean density of squids per 1 km^2, extracted by net, was as follows : $0.373 \times 10^5 - 0.318 \times 10^5$ individuals /males/ and $0.304 \times 10^5 - 0.261 \times 10^5$ ones /females/. The total number of squids in the areas analysed was as follows : $3.469 \times 10^8 - 2.957 \times 10^8$ individuals /males/ and $2.827 \times 10^8 - 2.427 \times 10^8$ ones /females/.

Biomass of Squids in the Area Investigated

The total Polish catch constituted 1661.5 t, 955.4 t males /$0.083 \times 10^8 - 0.071 \times 10^8$ individuals/ and 706.1 t females /$0.067 \times 10^8 - 0.058 \times 10^8$ individuals/. The ratio of this catch to the total number of squids in each area investigated was as follows:

a/ males:

$$P_1 = \frac{0.083 \times 10^8}{3.469 \times 10^8} = 0.024$$

$$P_2 = \frac{0.071 \times 10^8}{2.957 \times 10^8} = 0.024$$

b/ females:

$$P_I = \frac{0.067 \times 10^8}{2.827 \times 10^8} = 0.024$$

$$P_{II} = \frac{0.058 \times 10^8}{2.427 \times 10^8} = 0.024$$

The biomass in each area equalled:

$B_{/males/} = \frac{955.4}{0.024} = 39.800$ t, and $B_{/females/} = \frac{706.1}{0.024} =$

$= 29.400$ t.

It was assumed /as for 1977 fishery/ that squid generally migrate from south-west areas to north-east ones. In 1978, however, the Polish fishery moved in the opposite direction /from north-east to south-west/ in the main. The total biomass in Div. 4W during the summer months of 1978 had been therefore about 138.400 tons /i.e. /39,800 t + 29,400 t/2/.

This is a considerable decline as compared with the 1977 estimate /205,500 t/.

Discussion

The causes of the decline in biomass of the Illex stock should be explained here but it should first be noted that due to the lack of some facts of paramount importance the explanations are biased by speculations. For example it was assumed that it would be fairer to compare the Polish estimates for 1977 and 1978 instead of that for 1978 and the one adopted by STACRES /ICNAF Sum. Doc. 78/VI/3, p.6/.

The biomass estimation presented here was probably influenced mainly by three factors:

1. true decline of the biomass, caused by environmental factors and/or fishery operations in 1977;
2. the differences in availability between 1977 and 1978 squid on the continental shelf of Nova Scotia;
3. migration.

Considering the first factor it should be noted that length frequencies of Illex in the first half of the 1978 fishing season were considerably lower and more polymodal than those of 1977 /Lipiński, 1979 b/. This probably means that the spawning period was late in winter-spring 1977/1978 and/or growth rate was slower. The considerable delay in the spawning was most probably 1/ due to the high water temperatures in the fall of 1977 /Furtak, 1978/. High water temperatures usually mean that the period of availability of food is extended /Lipiński, unpubl. data/. On the other hand starvation may cause the acceleration of maturity of Illex, and higher water temperature may not, as was shown by Mangold et al. /1973/ and Rowe and Mangold /1975/.

The delayed spawning probably caused higher natural mortality in spring and summer 1978 because of higher predation upon younger animals and/or lower food availability for these. It should also be noted that 1978 temperatures were considerably lower than those of 1977 ones /Fig. 2 - 5 and Table 3/.

It is believed the 1977 fishery at the 50.000 t level did not seriously affect the Subarea 4 stock of squid; if the hypothesis of Hurley and Waldron /1978, op. cit./ were correct - it would imply virtually of no squid for the 1978 fishery/. their hypothesis was that biomass for 11 Dec. 1977 was 3.8 t of squid; it was assumed here that these squid /females/ were immature/.

1/ The great increase of the biomass in October 1978 /ICNAF Res. Doc. 79/II/8/ also suggests a delay in the spawning of the 1977 stock.

Table 3.

Comparison between 1977 and 1978 mean water temperatures in Div. 4W, as measured by Polish commercial trawlers.

Week	Surface /°C/		Bottom /°C/	
	1977	1978	1977	1978
Jul. 09-15	.	.	.	.
16-22	.	15.9	.	8.5
23-29	17.3	14.7	9.3	7.4
30-Aug.05	17.0	14.7	9.2	7.7
06-12	17.4	15.0	8.7	8.2
13-19	17.3	.	7.6	.
20-26	.	.	.	.
27-Sept.02	.	.	.	.

Considering the second factor it should be noted that due to lower temperatures, lesser food availability and delay of the spawning period of the 1977 generation /probably extended to May or later/ - the total availability and migration pattern of Illex on the Nova Scotia shelf was unfavourable for the 1978 offshore fisheries.

The third factor /migration/ was mentioned earlier; the increase of fishing effort and day-to-day variations in the catch indicated that the mobility of the squid was considerably greater.

Conclusion

1. A catch yield of 55,000 tons of Illex in Div. 4W does not seem to be excessive for the existing stock.

2. The drop in the Illex stock in Div. 4W was primarily due to natural factors /i.e. natural mortality and availability of squid to the offshore fisheries/.

Literature Cited

Furtak, A., 1978. Hydrological situation in the area of Georges Bank and Nantucket shoals in autumn of 1977. Int. Counc. Explor. Sea, C.M. 1978/C 13 : 14 pp.

Hurley, G.V. and Waldron, D.E., 1978
1977 Population Estimates for Squid /Illex illecebrosus/ in ICNAF Subarea 4 from the International Fishery in 1977. ICNAF Res. Doc. 78/VI/61 : 10 pp.

Lipiński, M., 1978
Stock assessment of Illex illecebrosus /Lesueur, 1821/ in ICNAF Div. 4W determined by the area-density method. ICNAF Res. Doc. 78/II/10 : 7 pp.

Lipiński, M., 1978
Length-weight Relationship of the Illex illecebrosus /Lesueur /1821/ from Div. 4W. W.P. 78/II/7 : 2 pp.

Lipiński, M., 1979 a
The Polish Squid Fisheries in ICNAF Div. 3NO in 1978. W.P., Feb. 1979 Meeting.

Lipiński, M. 1979 b
1978 Length Frequencies of Illex in Div. 4W. W.P., Feb. 1979 Meeting.

Mangold, K., Froesch, D., Boucher- Rodoni, R. and Rowe, L., 1975.
Factors affecting sexual maturation in Cephalopods. Pubbl. Staz. Zool. Napoli 39 Suppl: 259-266.

Mari, A., Terré, J.J. and Dominquez, R., 1978
Stock assessment of Illex illecebrosus in ICNAF Subareas 3 and 4. ICNAF Res. Doc. 78/II/5/ : 16 pp.

Rowe, L. and Mangold, K., 1975
The effect of starvation on sexual maturation in Illex illecebrosus /Lesueur/ Cephalopoda: Teuthoidea/.
J. exp. mar. Biol. Ecol. 17 : 157 - 163.

Sato, T. 1974.
Report of the exploratory squid jigging in the waters off New York to Newfoundland, 1973. Rep. Jap. Mar. Fish. Resour. Res. Cent., Tokyo, 48 /5/ : 131 pp.

Sissenwine, M.P., 1976.
A review of stock size estimate of squid in Subarea 5 and Statistical Area 6. ICNAF Res. Doc. 76/VI/31 : 4 pp.

Squires, H.J. 1957.
Squid, Illex illecebrosus /Lesueur/, in the Newfoundland Fishing Area. J. Fish. Res. Bd. Canada 14 /5/ : 693 - 728.

Ulltang, Ø., 1977
Sources of errors in and limitations of VPA /Cohort Analysis/. J. Cons. int. Explor. Mer. 37 /3/ : 249-260.

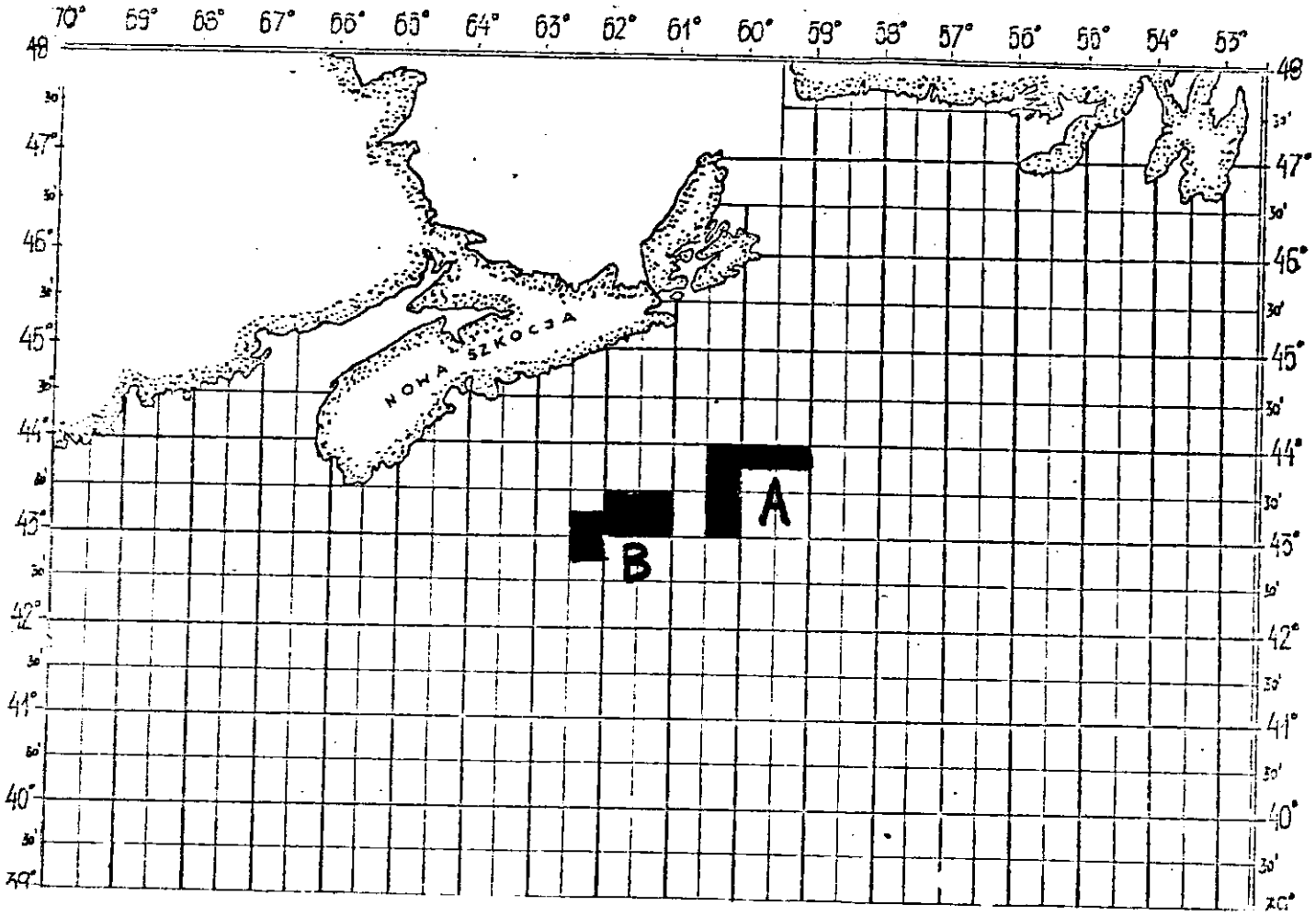

Fig. 1. Fishing grounds operated by Polish trawlers during summer 1978. Details concerning catch and effort are shown in Table 1.

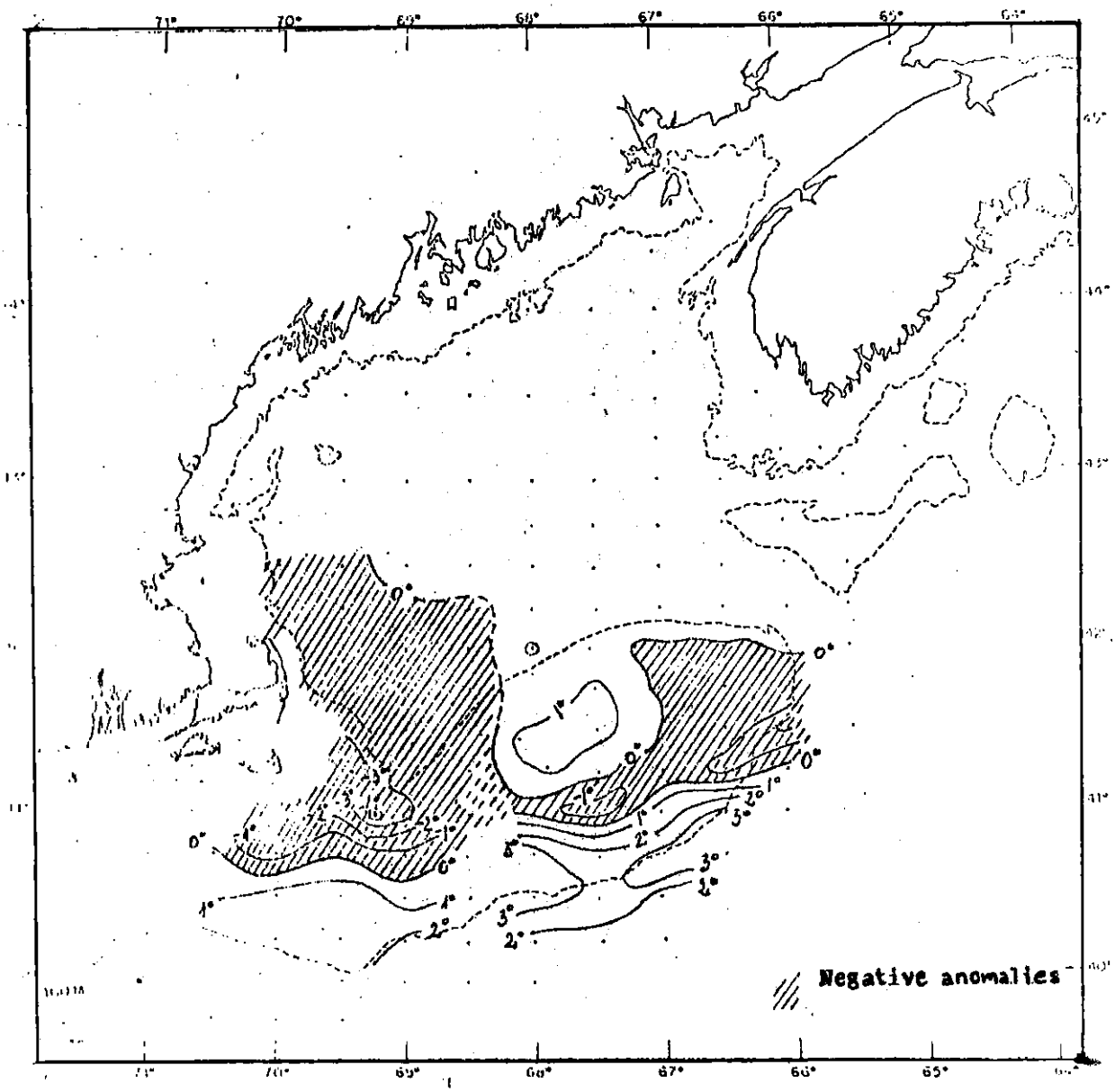

Fig. 2. Anomalies of the surface water temperatures in October 1977 (from Furtak, 1978).

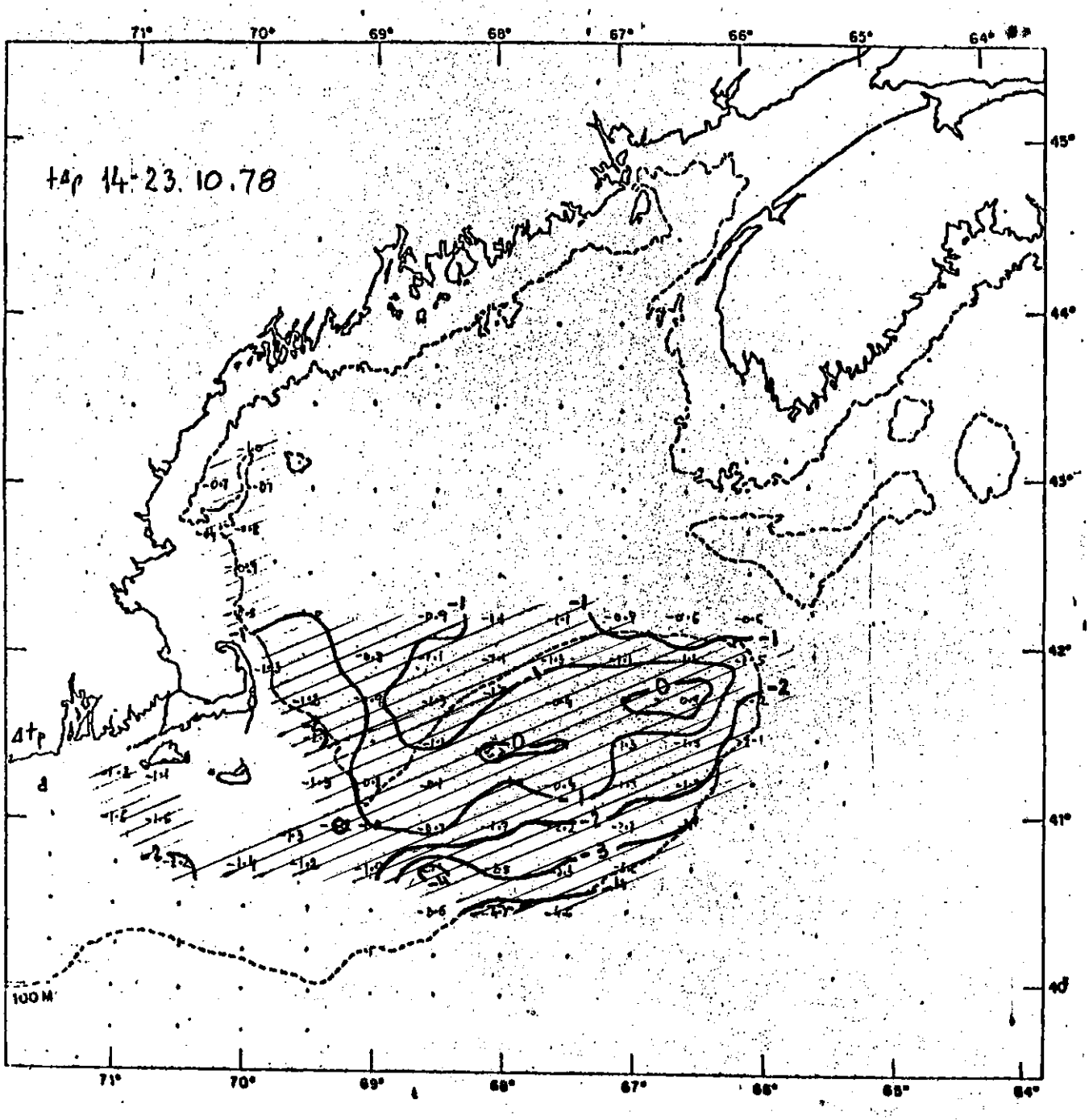

Fig. 3. Anomalies of the surface water temperatures in October 1978 (from Furtak, unpublished).

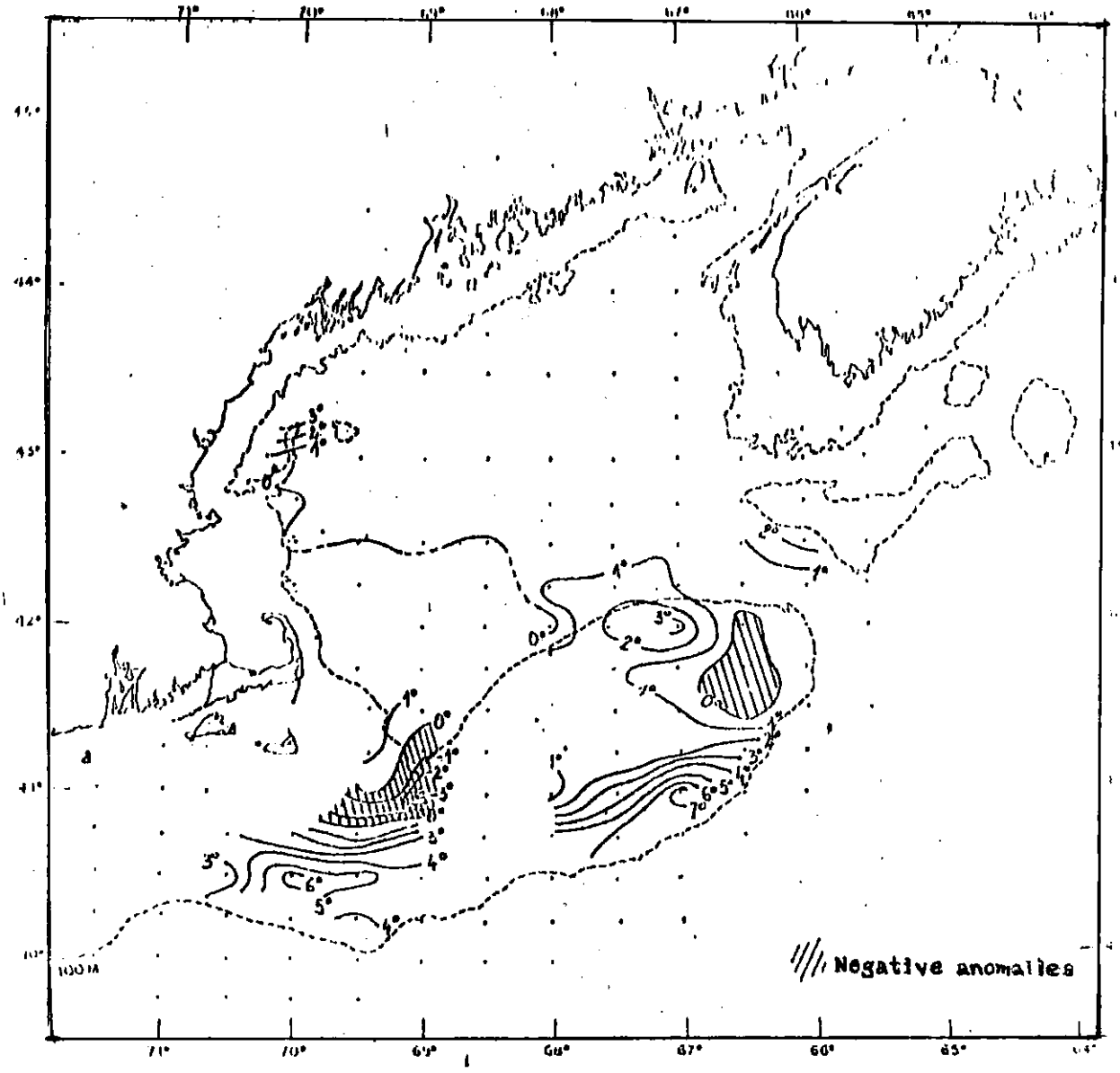

Fig. 4. Temperature anomalies of the near bottom temperature in October 1977 (from Furtak, 1978).

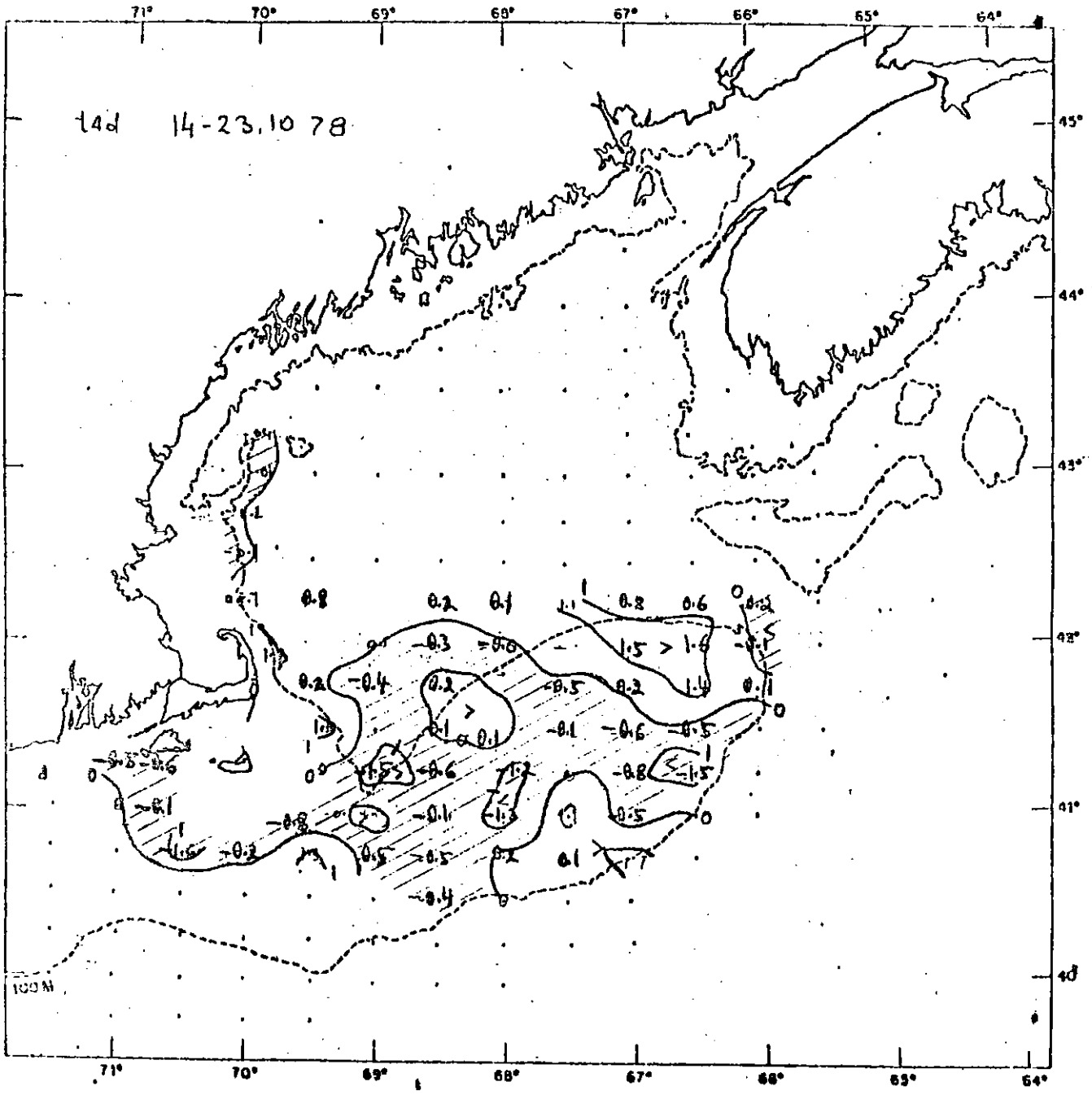

Fig. 5. Anomalies of the near bottom temperatures in October 1978 (from Furtak, unpublished).