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REPORT ON THE JOINT INVESTIGATIONS BY ICELAND, NORWAY AND
U. S. S. R. ON THE DISTRIBUTION OF HERRING IN RELATION TO
HYDROGRAPHY AND PLANKTON IN THE NORWEGIAN SEA MAY/ JUNE
1969.

INTRODUCTION

The Cooperative study on distribution, migration and behaviour of the Atlanto-Scandian Herring was in 1969 as in previous years made during May-June with the participation of Icelandic, Norwegian and Soviet research vessels.

The survey area extended from $60^{\circ}30'$ N to 78° N between 23° W and 20° E.

Icelandic observations began in early May when the "Arni Fridriksson" surveyed the southwestern half of the Norwegian Sea. In June a standard hydrographical survey was made of the shelf area off north and northeast Iceland. Icelandic observations were supplemented by the scouting vessel "Haftor" during the period 15 May-15 June.

The Norwegian research ship "Johan Hjort" covered the area between northwestern Norway and Spitsbergen as far west as the border of polar waters.

Three Soviet research ships, "Academician Knipovich", "Fritjof Nansen" and "Professor Somov" operated from the Shetland Islands in the south to 78° N. In addition observations were made from several Soviet scouting vessels equipped with sonar.

The detection of herring concentrations was carried out by sonar and echo sounders. Besides qualitative characteristics of the herring shoals the number of shoals of different size per $0,5^{\circ}$ longitude and $10'$ latitude were calculated.

All plankton observations include samples from the uppermost 50 m with a standard Hensen net. Additional plankton samples were taken with Juday

net and high speed samplers.

Secchi disc was used on all stations and a continuously recording transparency meter was used by the Norwegian vessel during the whole cruise.

A full scale hydrographic survey (standard depth to 500 m) was made by the Soviet and Norwegian vessels in their respective areas and the same applies for the Icelandic work to the north and northeast of Iceland. Elsewhere hydrographical observations included only temperature readings with bathythermograph down to 275 m, occasionally down to 450 m.

The joint meeting was held in Tromsø 3 - 4 July 1969.

Temperature condition

In June 1969 the heat content of the Atlantic Stream running through the Faroe-Shetland Channel to the Norwegian Sea was at about the long-term mean level.

Along the eastern branch of the Norwegian Current a negative temperature anomaly with depth. In the 0-200 m layer the negative anomaly was about -0,30 whereas in the 200-500 m layer it was -0,60. Further north on the section along $74^{\circ}30'N$ and $76^{\circ}30'N$ small negative anomalies (0,15) was observed in the surface layers (0-50m.).

The observations in May-June 1969 show that on all sections the surface temperature were higher than in 1968 and temperature as high as $8^{\circ}C$ was recorded north of the Torsvåg-section. Such high temperatures was last year recorded only in a narrow band on the Gimsøy-section. The temperature is however, of the same magnitude as in 1966 and 1967, being slightly less in the southern areas.

A higher temperature was also observed in the sub-surface layers as compared with the previous year. For example the isotherm of 5° at a depth of 50 m along the eastern branch reached in 1968 only to $74^{\circ}N$ whereas in 1969 it extended to $76^{\circ}30'N$.

In the western branch of the Norwegian Current the heat content of water masses was also below the normal, with the exception of the 200-500 m layer on the section along $72^{\circ}50'N$ and $74^{\circ}30'N$, with a temperature about $0,50^{\circ}$ above normal. In the middle branch of the Norwegian Current the temperature was normal in the 0-200 m layers.

In the shelf area north of Iceland the temperature in June was on the whole below normal. At Køgur on the north western peninsula the influx of Atlantic waters was about or slightly above normal. At Siglunes no Atlantic water was observed and cold water reached north east of Langanes no trace of Atlantic water could be found either. The cold water of the East-Icelandic Current was found to be very extensive to the east but not hugging the coastline quite so closely as last year. Otherwise the temperature situation off Northeast Iceland is similar to that of 1965, 1967 and

1968 but the influx of the cold East-Icelandic waters was somewhat smaller than in 1968.

Thus, preliminary analysis of the temperature data obtained in 1959 showed an increased influx of the Norwegian Current as compared with 1968, while that of the cold East-Icelandic Current was reduced. However, the heat condition of the water masses remained lower than the long-term mean level and this year may be classified as a cold year.

Ice limit

In the first days of June the ice limit was about 49-45 nautical miles off the northwest peninsula. From $67^{\circ}10'N$ and $21^{\circ}40'W$ it bent southwards into the mouth of Húnaflói which was itself quite crowded with drifting ice. From about 30 nautical miles north of Skagi the ice limit continued east and east-north-eastwards and on June 8 was observed at 11 miles northeast of Langanes. The ice conditions in the waters to the north and northeast of Iceland resembled quite closely those of 1967.

On June 5 small-broken scattered drifting ice was registered 30 miles east of Jan Mayen. The edge of ice had a general direction from NE to SW. Besides, ice was also observed south and west of Bear Island and along the western coast of West Spitsbergen.

Phytoplankton

The results of measurements of transparency with secci disc carried out on all stations onboard the Icelandic and Norwegian vessels gave similar results with an average value of 9 to 11 m and a maximum of 25 m on a few stations in cold water.

The observations show that the spring "bloom" of phytoplankton in the investigated area of the Norwegian Sea started earlier this year than in 1968. But as in previous year a "blooming" was observed on the section Jan Mayen - Langanes, on the N-W coast of Iceland and north of the Faroes and Shetland Islands.

In the eastern part of the Norwegian Sea where the surface waters was relatively warm in the warm Atlantic waters the secci disc readings was relatively high indicating that the spring "bloom" probably had passed.

Zooplankton

The total biomass was much lower this year than in 1968. The greatest concentrations of Zooplankton was found along the Norwegian coast and in a nearly continuous band in the central part of the Norwegian Sea from the Faroes Islands and almost to Bear Island. Low densities of zooplankton was

located in the waters between Iceland and Jan Mayen.

In confirmity with the observation of species composition from previous years the most prominent species besides Calanus finmarchicus were Calanus hyperboreus, Pseudocalanus elongatus along with Sagitta sp. and Themisto sp. Noteably is however, the relatively scarcity of Metridia longa which last year together with C. hyperboreus contributed considerably to the total biomass in the investigated area.

The development stage composition of C. finmarchicus indicate that the time of onset of the biological spring in 1969 was about average but earlier than in 1968, probably because of higher temperatures in the surface layers this year than in 1968.

Herring

The first contacts with herring was made on 28 May in the area between 67°N and 68°N from 5°30'E to 7°E where the shoals stayed in depth of 200-300 m most of the time under observation. No herring were located west of 4°E at all. The shoals were small in size and hardly any shoals larger than 30 m in vertical direction were located during May.

From the area where the herring first was located they migrated in a northeasterly direction with an average speed of about 12-15 nautical miles per day. Higher speed was, however, recorded and on some occasions herring shoals were observed to move as much as 30 miles in 24 hours.

Towards the latter half of June the migration speed decreased and by the end of the month most of the herring were apparently assembled in the area east of Bear Island from 75° to 75°30'N between 10°E and 12°E, showing little migratory trends at all. It is of interest to note that while moving northwards the size of the shoals increased, but nevertheless shoals of comparatively good size were not observed until north of 75°N.

In general the herring kept to deeper water than usual and were mostly recorded at depths between 150-300m. Shoals occasionally occurring in the upper water layers were unstable and went down at slight disturbance. The herring was therefore very difficult to catch and efforts with purse seine ranged from zero to 65 tons, usually from 2 to 10 tons per setting. In 1968 herring shoals of a comparatively good size occurred on and after 20 June in the area west of Bear Island where the fishery continued until middle of July.

In June no herring were observed west of 10°W and despite intensive surveying between 9° and 15°W only very few relatively good shoals were located south of 75°N and the herring seemed to be scattered over rather large an area. On June 22 a number of good shoals (30-60 m) were located just north of 75°N between 10° and 11°E and from then on

the herring seemed to aggregate in that area. By the end of the month herring were observed almost exclusively in an area between 75° and $75^{\circ}30'N$ from $10^{\circ}30'$ to $12^{\circ}30'E$. The behaviour of the herring remained much the same in as much as the shoals stayed in deep water (150-300 m) most of the time. When the herring occasionally approached the surface the shoals were very unstable and practically impossible to catch with purse seine.

Samples of herring catches showed an average length of about 35 cm and almost the same year-class composition as last year e. g. year-classes 1959-1960 and 1961 of which the 1959 was predominant.

In May the herring were first located in waters with temperature of $6^{\circ}-7^{\circ}C$ (20 m) and followed roughly these isotherms migrating northwards to $73^{\circ}N$ where they entered colder waters and thereafter remained in water of about $3^{\circ}-4^{\circ}C$. The feeding migration of the Atlanto Scandian herring during May-June was thus similar to the migration in the same period last year except that the migration speed was somewhat higher and that good shoals did not appear until further north.

It should be noted that north of $74^{\circ}N$ the herring was often found when also capelin occurred and the identification of the echo traces were often difficult.

Conclusions

As a final conclusion on the work undertaken, it can be stated that the herring followed the same migration as last year in spite of higher temperatures in the regions concerned.

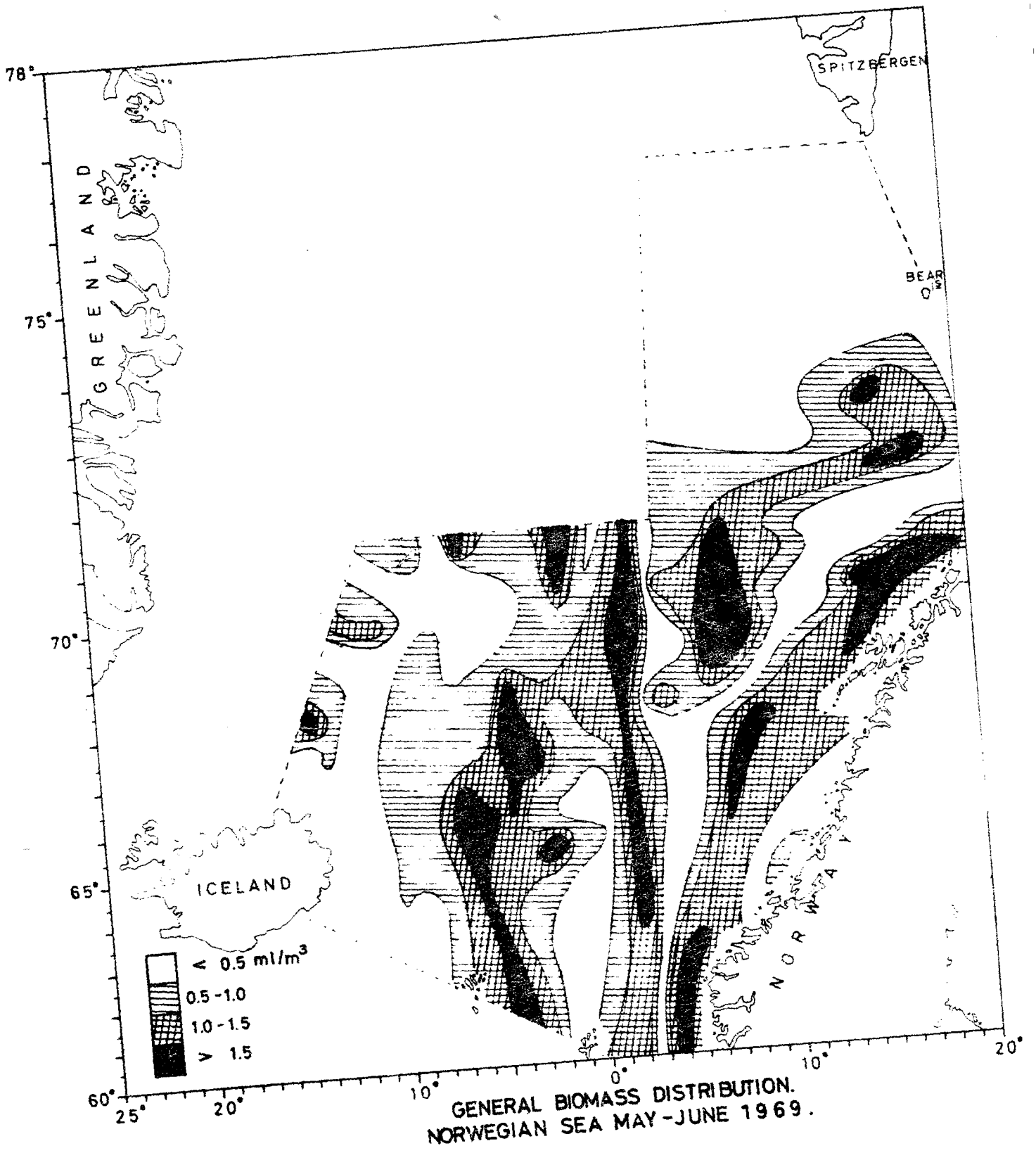
Hydrographical conditions in the region north-east of Iceland showed colder water than normal and probably unfavourably conditions for herring.

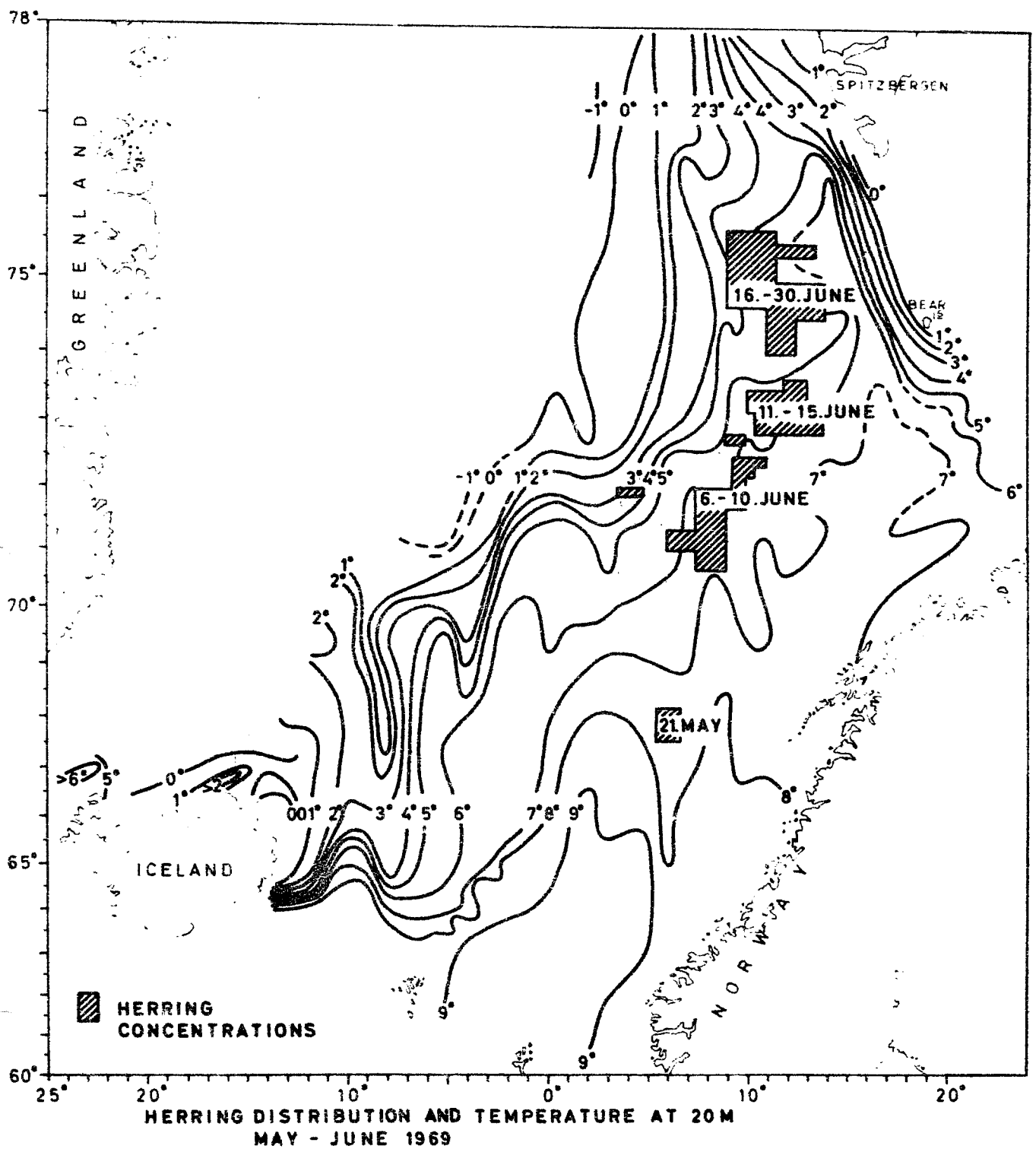
No correlation between the distribution of zooplankton in the 0-50 meters layer and the herring distribution could be found.

In the area west of Bear Island, according to Soviet observations, the shoals were found at rather large depth and probably feeding on small squids.

The possibility for catching herring was very difficult due to unfavourably feeding conditions in the area to the west of Bear Island and West-Spitsbergen and until these conditions improve good catches can not be expected.

The stock size, according to the opinion of the participating scientists, is very small, only some 1 million tons or less.





Participans

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