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REPORT
on the USSR Participation in the Investigations under the Norwestlant Programme in 1963

In the period from 10 to 21 April 1963, two Soviet research vessels " Academician Knipovich" and " Topseda" participated in the investigations under the Norwestlant I programme, and in the period from 1 to 21 July 1963, the " Ac. Knipovich" took part in the Norwestlant III surveys. In April, V.V. Rossov was in charge of the surveys and in July the investigations were headed by V. Pakhorukov.

The scope of operations was in line with the programme proposed, except that the R.V. " Topseda" did not fish with the Stramin net.

This report is a systematic account of the preliminary research data collected on board the vessels " Academician Knipovich" and " Topceda " during the Norwestlant I and III in 1963.

Systematuc research data are presented in the form of charts, diagrams, tables as well as of brief description of the observed oceanographic characteristics.

Scientific analysis and conclusions on the results of researches will be submitted during June- August 1964.

Hydrological Conditions

Water temperature

In April, the distribution of the surface temperature was characterized by the presence of a narrow belt of waters

with the temperature of about zero off South West Greenland and by a considerably wider zone with the negative temperatures off the Labrador coast. High horizontal gradients of water temperature were observed in these areas.

The surface temperatures of about 3.5° C prevailed in the central part of the Davis Strait. The highest temperatures (above 7°C) were recorded in the southern part of the section along the meridian from Cape Farewell.

Vertical gradients of water temperatures were small in all the sections (except the Labrador coast where waters with a temperature above 2°C lay under the cold waters of the Labrador Current with a temperature below - 1°C). In the central part of the Davis Strait the temperature at depths of 1500 - 2500 m was only 0.2 - 0.5°C less than that found at the surface. In the stream of the West- Greenland Current, well noticeable on all the vertical sections, the temperature was above 4° C.

In July, the April surface temperatures (about 0°C) were still observed near the coast of South West Greenland. In the central part of the Davis Strait and off Labrador the surface temperatures increased by 2.5 - 3°C and reached 10°C in the southern part of the section along the meridian from Cape Farewell and 1°C near Central Labrador. However, the heating, especially off Labrador, was registered only in the surface layer, less than 50 m thick, lying over the waters with negative temperatures both off South West Greenland and Labrador and with a temperature of about 5°C in the central part of the Davis Strait. At depths above 200 m the water temperature did not practically change and was still about 3.5°C. Like in April, the West- Greenland and Labrador Currents were relatively well developed as to their temperatures and salinity.

Salinity

After the April survey salinity determinations were made with the Auto Lab Salinometer in Lowestoft on the kind proposal of Dr.A. Lee. In July,salinity was determined mainly with the Jayco (I.M.C.) Salinometer,but a small number of samples were titrated by the method of Knudsen.

due to the disrepair of the apparatus.

Both in April and July, zones of the decreased salinity were observed near Greenland and Labrador. In April, no great changes in salinity were recorded in the central part of the Davis Strait from 2500 m up to the surface, and salinity was about 34.9‰. On the section along the meridian south of 57°N salinity in the surface layers was 0.1 - 0.2‰ lower. In April, the minimum salinity at the surface off the Labrador coast was 32.8‰ (near the bottom 34.5‰) and in the Ivigtut area 33.6‰

In July, a decrease in salinity by 0.1 - 0.2‰ occurred almost everywhere in the surface layer in the open part of the Davis Strait, but at depths above 100 m salinity did not practically change. In the period from April to July, salinity decreased by 0.8 - 1.2‰ near Labrador and the south-western coast of Greenland due to the ice melting and the overflow from the shores.

Oxygen

Oxygen content was determined by the Winkler's method.

In April, oxygen content at the surface was between 8.3 ml/l (in the cold waters off Greenland and Labrador) and 6.8 ml/l (in the southern part of the section along 44°W). In the coastal areas the content of oxygen at a depth of 100 m was 0.5 - 0.8 ml/l less than near the surface, whereas in the open sea the content of oxygen did not almost change with depth. Both at the surface and at depths up to 100 m the oxygen content was close to saturation almost everywhere, and the greatest saturation was observed in the waters of the West-Greenland Current (up to 103 % at the surface), while the least saturation (90-91%) was found near the ice edge off Labrador.

In July, the development of photosynthesis resulted in the increase of the oxygen content by 0.2 - 0.4 ml/l in most of the areas (except the southern part of the section along 44°W). The maximum content of oxygen up to 8.5 - 8.6 ml/l was observed off the Labrador coast and Greenland. In the central part of the Davis Strait the content of oxygen decreased gradually with depth. Near Labrador and Greenland where the warmer waters were found under the cold surface waters (like in April) the oxygen content was almost 1 ml/l less in the 50 - 100 m layer than near the surface.

Unlike the spring period, in July the oxygen content in the surface layer exceeded 100% (the maximum content up to 109% was observed in the Ivigtut area and up to 113% off Central Labrador). The saturation gradually decreased with depth and at 100 m it was between 83% (in the extreme south-west of the area) and 99% (off Labrador). Oxygen content was expressed as a percentage according to Fox's tables.

Silicates

The content of silicic acid was visually determined according to blue silicate- molybdenum complex (variant of VNIRO).

During the April survey, the silicate-s. content at the surface was mainly 8-10 µg-at/l, and the minimum content of silicate-s. was found in the Ivigtut area (< 7 µg-at/l), while the maximum one (>12 µg-at/l) was observed in the Labrador Current and in the waters of the Irminger Current south of Cape Farewell. The silicate-s. content increased slightly with depth at most stations of Sections VIII and IX (1 µg-at/l at 100 m), while on Section VII the silicate-s. content did not almost change with depth.

In comparison with April, in July a sharp decrease of the Si content occurred due to the intensive development of the biological processes. In the surface layer the silicate-s. content of about 4-5 µg-at/l prevailed, whereas off the south-western coast of Greenland Si was practically absent. The greatest silicate-s. content at the surface was found in the southern part of the section along the Cape Farewell meridian (> 7 µg-at/l) and near the Labrador coast (~6 µg-at/l). At 100 m the Si content off South West Greenland composed about 4 µg-at/l, in the central part of the Strait 7-8 µg-at/l and near the Labrador coast it reached even 14 µg-at/l.

Phosphates

The content of PO_4^{P-} was determined by the method of Denigès-Atkins. The analysis of the data obtained showed that the phosphate determinations made on Section IX in April were not quite reliable and therefore these data are not presented in the corresponding charts and diagrams.

In April, the phosphorus content in the whole 100 m layer ranged from 0.6 to 1.2 µg-at/l. The changes on the phosphorus content with depth were insignificant due to the vertical mixing of waters. The decreased content of P_{-PO_4} (< 1 µg-at/l) was registered in the southern part of the section along the Cape Farewell meridian and in the Ivigtut area. In the waters of the central part of the Davis Strait and Labrador Current the content of P_{-PO_4} was above 1 µg-at/l.

Comparedwith April, in July the content of P_{-PO_4} decreased sharply in the 0-50 m layer (near the surface it decreased almost by two times in the greatest part of the area, excluding the area south

and south-west of Cape Farewell where in some places the content of $P\text{-}PO_4$ somewhat increased and constituted about 1.2 µg-at/l). The minimum content of $P\text{-}PO_4$ (0.4 µg-at/l) was recorded in the Ivigtut and Labrador areas.

In July, at 100 m level the content of $P\text{-}PO_4$ and its distribution over the area were almost the same (0.7 - 1.2 µg-at/l) as in April. This indicates that the summer biological processes are not intensive even at this level.

The distribution of the hydrological and hydrochemical components are presented in the applied charts and diagrams.

Biological Investigations

he biological investigations were carried out almost at all the ions /at 101 out of 113/ worked during the cruises under the "westlant" I and III programmes. The number of the samples col-ed is presented in the Table.

Table

Number of the plankton samples collected during the investigations carried out under the "Norwestlant" I and III programmes

Gear	April 1963	July 1963
ensen net	42	51
Icelandic High Speed Sampler	42	52
tramin net	16	39
otal number of samples	100	142
otal number of stations	48	53

The depth to which the stramin net and Icelandic High Speed pler were dropped was determined by means of the Kelvin tubes. stramin net was put to the depth ranging from 38 to 110 m in ndence on weather and speed of the ship. As a rule, the stramin was towed 20 minutes with the ship's speed of about 3 knots.

The catches with the stramin net were washed with a weak am of water into the 10 l tank and then the excess of water was ered through the silk No.23/3/.

For the preliminary determination of the composition of zoo-kton and ichthyoplankton the whole catch was placed in parts o the cuvette. The samples were fixated with formalin and hexa-e. Then the eggs and larvae of fishes were taken from the samples

and treated separately. The volume of plankton in all the samples was determined in ml aboard the ship in the measuring cilinders /by water displacement/.

Zooplankton collected with stramin nets was separated from water by filtration in the laboratory, then dried on the filter paper and weightened as a whole on the technical scales. Then a part of zooplankton was taken from the sample, number of organisms were counted and the volume of the whole sample and of the 30 minutes' haul was calculated on the basis of the results obtained from the study of its part.

The Icelandic High Speed Sampler/I.H.S.S./ fastened to the cable 200 m in length was towed as a rule for 20 minutes at the ship's speed of 4-5 knots. When the sea condition was above 3 Bft., the Sampler was towed by means of a 100 m cable due to the lower ship's speed in the periods of rough weather. The zooplankton sampled with the I.H.S.S. was treated as follows: the volume of samples was checked to amount to 100 or 250 cm^3 in the measuring glass, then after mixing, 5 cm^3 was taken with the piston pipette, the quantity of organisms in the part of the sample was determined and the results were calculated for the whole sample.

The Hensen net was used to sample zooplankton in the 100-0 m layer, and those samples were treated in the same way. The number of organisms in the catches taken with the Hensen net was calculated in specimens under 1 m^2.

Phytoplankton

The phytoplankton samples were taken from the Nansen bottle at the request of Dr. Gillbricht. They were fixated with the 20 gr solution KJ + 8 gr J and 250 gr of H_2O.

The phytoplankton composition was determined in the catches of the plankton nets.

In April, single specimens of the following diatoms were met: Thalassiothrix longissima, Pogosira sp., Coscinodiscus sp.

In July, the remnants of the Phaeocystis "blooming" were found at stations 7,8,II off the south-western coast of Greenland and at stations 39 and 40 south of Cape Farewell.

In July, the diatom development occurred in the Irminger Current, mainly in the waters of the Atlantic origin. The mass development of Thalassiothrix longissima was observed at stations 25, 44, 45, 47 and at stations 37, 38 near Cape Farewell /See the route/.

Zooplankton

62 species were found in the composition of zooplankton. The main mass of zooplankton consisted of several species: Calanus finmarchicus, Oithona similis, Thysanoessa longicaudata /young/, Themisto abyssorum /young/ and Limacina retroversa were met at all the stations.

In July, a great number of larvae of the following bottom invertebrates were present in the catches taken off the coast of Greenland: pluteus Echinodermata, nauplii of Cirripedia, larvae of Polychaeta and Gastropoda.

Beside C.finmarchicus and C.hyperboreus, Oikopleura juv., Aglantha digitale and Mertensia ovum. were usually found in the West-Greenland Current.

In April 1963, zooplankton was poor as in winter and consisted of Calanus finmarchicus at stages Y and YI. Near the southern coast of Greenland nauplii of Copepoda were met in plankton which indicates the onset of their spring spawning.

In the period from April to July, the total quantity of zooplankton in the 100-0 m layer was more than 10 times greater. The waters in the north-western branch of the North-Atlantic Current were richest in the biomass of zooplankton while the richest in the abundance was the West-Greenland Current where young Calanus finmar-

chicus occurred in great numbers in July. Young Calanus finmarchicus were abundant off Cape Farewell in July due probably to the onset of spawning of the local population of Calanus finmarchicus and the transportation of red Calanus /III-IY-Y copepodite stages/ into this area by the waters of the Irminger Current. In July, the biological spring was at its height in this area. In July, the spawning of Calanus finmarchicus in the deepwater part of the Davis Strait was rather poor: Calanus in the Y copepodite stage composed over 80% of the population. Nauplii and fry of Calanus finmarchicus /I-III/ were quite scarce.

In the area of the Davis Strait covered by our investigations Calanus finmarchicus started spawning in April in the waters of the Atlantic origin, then in the waters of the West-Greenland Current heated by the Irminger Current /July/, and much later its spawning was registered in the central part of the Davis Strait /probably in August/.

Nauplii and the young stages of Copepoda are known to be the main food of cod and redfish larvae. Thus, the prolonged spawning of Calanus finmarchicus and their presence in plankton for a long time favoured the feeding of cod and redfish larvae in that area. Of Euphausiacea Thysanoessa longicaudata were found everywhere /mainly their young/. In July, especially great numbers of Furcilia-larvae and Cyrtopia-larvae Euphausiacea were taken.

We considered the distribution of Aglantha digitale by the catches taken with the stramin net. Great numbers of these medusae were encountered off the Greenland shores /4, 6, 7, 39, 40, 55/. At stations 38, 39 and 23 Aglantha digitale of orange colour were found, these specimens constituted about 10% of the quantity of usual white Aglantha digitale.

It is characteristic that more than 50% of the samples collected

contained representatives both of cold-water and warm-water plankton forms.

Such a mixed composition of zooplankton is typical for all the subarctic areas.

The tables of abundance of organisms by stations are given as appendixes /number of specimens under I m^2 for the Hensen net and per 30 minutes' haul for the stramin net and Icelandic Plankton Sampler/.

Number of zooplankton /in the catches taken with the Hensen net/ is presented on the charts in ml under I m^2 in the 100-0 m layer.

Ichthyoplankton

In the samples collected in April 1963 with the stramin net the eggs and larvae of the following 7 species were found: cod, haddock, ousk, dab, catfish, soulpin and luminescent anchovies.

Cod eggs prevailed in the catches while haddock eggs were less numerous. Eggs and larvae of other species were scarce.

Cod eggs appeared to be most numerous near the Central Labrador Shelf. Eggs at early stages of development /I-II/[x] dominated there. A lot of eggs at later stages /II-III/ were taken in the South Labrador area. In April large quantity of cod eggs at all stages /I-IY/ were found off the Greenland coast. There the single specimen of cod larvae, 4.2 mm in length, was taken.

In April in the central part of the Davis Strait and at the section along 44°W over the oceanic depths eggs were in small numbers.

In the samples taken with the stramin net and Icelandic High Speed Sampler in July 1963 eggs and larvae of capelin, luminescent anchovy, redfish, soulpin, stripped catfish and halibut were found. One specimen of larvae was not determined as to its species.

Redfish larvae were most numerous, but the catch per 30 minutes' trawling did not exceed 34 specimens. They were 10-19 mm in length. Almost all redfish larvae were found off the south-western coast of Greenland within 200 miles from the shore.

In the samples taken in July no cod eggs and larvae were recorded.

Quantitative distribution of cod eggs and larvae /in April/ and redfish larvae /in July/ is shown on Charts 7 and 20.

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x/ Stages of eggs development were determined according to "Key to the Pelagic Fishes of the Barents Sea" by T.L.Pertseva, 1936.

Methods used to obtain the data by the R.V."Knipovich" and "Topseda" during Norwestlant I and III, 1963

	Sampling bottle	Filter	Standing time before analysis	Method		Standard
S	Nansen-type bottles	-	Several months	Norwestlant I - Auto-Lab Salinometer Norwestlant III - Jayco (I.M.C.) Salinometer and by partial titration		Copenhagen water
T°		-	-	Reversing thermometer		
O_2		-	< 30 min.	Winkler		KJO_3 0.02 N
PO_4		-	< 1 hour	Denigès - Atkins	visually	Supplied by U.K.
SiO_2		-	< 1 hour	Dienért - Wandenbulcke	visually	Supplied by U.K.

LIST OF CHARTS AND DIAGRAMS ATTACHED

NORWESTLANT I

1. The route of the R/V " Academician Knipovich" and " Topseda".
2. Charts of temperature distribution at depths of 0, 50, 100, 200 m /4/.
3. Charts of salinity distribution at depths of 0, 100m/2/.
4. Chart of dynamic topography 0-1000.
5. Chart of oxygen distribution at 0 m.
6. Chart of silicate distribution at 0 m.
7. Chart of phosphate distribution at 0 m.
8. Chart of the distribution of cod eggs in April 1963 /per 30 min tow with the stramin net /.
9. Chart of the quantity of plankton in ml under 1 m^2 in the 100- 0 m layer in April 1963.
10. Diagrams of vertical distribution of temperature, salinity, oxygen and silicates on Section 9 /4/.
11. Diagrams of vertical distribution of temperature,salinity, oxygen, silicates, phosphates on Section VIII /5/.
12. Diagrams of vertical distribution of temperature, salinity, oxygen, silicates, phosphates on Section VII/5/.

NORWESTLANT III

13. The route of the R/V " Ac. Knipovich ".
14. Charts of the distribution of temperature at depths of 0, 50, 100, 200 m /4/.

15. Charts of the distribution of salinity at 0, 100 m /2/.
16. Chart of dynamic topography 0-1000.
17. Chart of the distribution of oxygen at 0,100 m /2/.
18. Charts of silicates distribution at 0, 100 m /2/.
19. Charts of phosphate distribution at 0, 100 m /2/.
20. Charts of the quantity of plankton in ml under 1 m^2 in the 100-0 m layer (the Hensen net), July 1963.
21. Chart of the redfish larvae distribution (per 30 minutes' tow with the stramin net) on the 2nd cruise of the R/V " Academician Knipovich " (July 1963).
22. Diagrams of the vertical distribution of temperature, salinity, oxygen, silicates, phosphates on Section IX (5).
23. Diagrams of the vertical distribution of temperature, salinity, oxygen, silicates, phosphates on Section VIII (5).
24. Diagrams of the vertical distribution of temperature, salinity, silicates, phosphates on Section VII(5).