

**Intergovernmental Oceanographic Commission
Russian State Hydrometeorological University**

Baltic Floating University Facility

SUMMARY REPORT

8th International Training through Research Cruise onboard RV Sibiriyakov
(July 26 - August 9, 2000)

4th and 5th International Cruises of sailing catamaran Centaurus-II
(July, 15 – August, 9 and August, 29 – September, 5, 2000)



**St. Petersburg
2000**

Part 1.

Multidisciplinary research in the Baltic Sea and its coastal areas conducted in July - August, 2000 was carried out within the framework of cooperation between the Russian State Hydrometeorological University (RSHU) and the Head Department of Navigation and Oceanography of the Ministry of Defence of the Russian Federation, within the international IOC/UNESCO “Floating University” program (part of IOC/TEMA), the TEMPUS-TACIS Project on “Development of Integrated Coastal Management training and education” (EU-COMET), Federal target program “World ocean”, international project of the Ministry of science and technologies of the Russian Federation on “Complex research of a coastal area and training of personnel within the framework of UNESCO programs”, programs of the Ministry of general and professional education of the Russian Federation, cooperation agreement with “Sevmorgeo” company on “Improvement of a technique of hydrological, hydrochemical and biological research for the purposes of geocological monitoring on two surveys in the Baltic Sea (eastern part of the Gulf of Finland and Kaliningrad)”, state budget themes of RSHU, and a plan of educational and industrial practical studies for students of the Oceanography Department at RSHU.

Objectives of the expedition

Basic *scientific* objectives of the expedition were to study hydrophysical, hydrochemical and hydrobiological processes and conduct geomonitoring of the Baltic Sea and its coastal areas. Among the main research items were:

- data collection and analysis of hydrophysical, hydrochemical and hydrobiological characteristics in research areas;
- study of spatial-time variability of hydrophysical characteristics along the selected transects and at points of the Baltic monitoring system (HELCOM-stations);
- study of conditions of water masses distribution and formation of vertical stratification resulting from thermodynamic processes and interaction with the atmosphere;
- study of spatial-time variability of basic hydrochemical parameters, such as content of dissolved oxygen, hydrogen parameter, alkalinity, nutrients;
- estimation of the ecological situation in the eastern part of the Gulf of Finland and of a character of the anthropogenic load spreading from the Neva Bay (St. Petersburg region) up to the open part of the Gulf of Finland (using data from stations in the eastern and western parts of the Gulf of Finland);
- study of bottom sediments, near-bottom and silt waters pollution in the main sedimentation basins of the eastern part of the Gulf of Finland and comparison of results obtained with the results of the previous years;

- monitoring of water and bottom sediments pollution, in particular estimation of pollution level in the near-bottom layers in different parts of the Baltic Sea and determination of pollutants content in the bottom sediments;
- study of species structure and spatial distribution of phytoplankton biomass, and chlorophyll 'a' definition.

Educational tasks of the expedition included:

- application of the “training through practice and research” principal by involving students in field research;
- thematic lectures and seminars, including using of video materials;
- discussion of results obtained during the concluding seminar.

Expedition was held onboard the RV “Sibiriakov” from July 26 till August 9 (see Appendix 1 for positioning). During the expedition a port call to Stockholm was made (July 31 – August 3).

Expedition participants

Scientific crew included 38 members: teachers and technicians of the Oceanography Department at RSHU (11 persons), “Sevmorgeo” state company (4 persons), Scientific research institute of television (1 person), students of the Oceanography Department at RSHU (9 persons), students at the Universities of Cadiz (Spain) and of Aveiro (Portugal) (8 and 2 persons, accordingly), 1 observer and 1 student from the Abo Academy (Finland), 2 students from Turku university (Finland), 2 students from Uppsala university (Sweden). In Stockholm, 2 persons from Finland and 1 person from Sweden left the vessel and new participants from the same countries joined the expedition.

Theoretical part of the educational process

The following lectures have been given during the expedition:

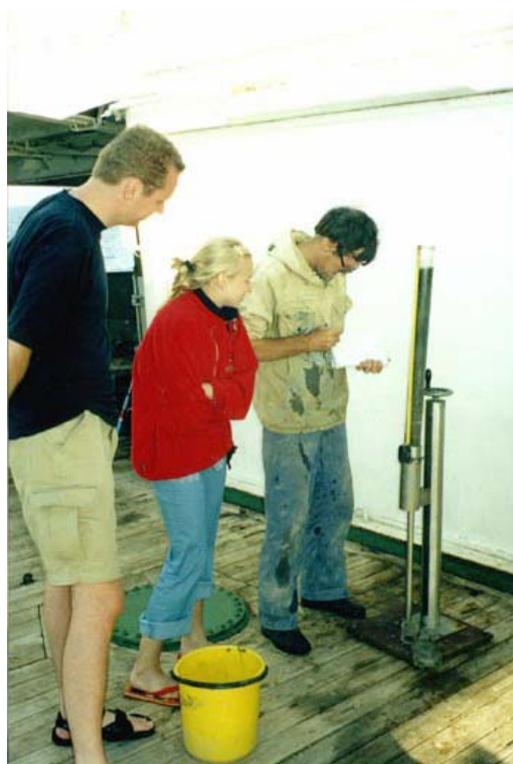
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| Dr. T. Eremina | Hydrological and hydrochemical regimes of the Baltic Sea.
Recent environmental problems of the Baltic region. |
| Dr. M. Shilin | Phytoplankton and eutrophication of the Baltic Sea.
Biological diversity of benthic communities in the Baltic Sea.
Problems of sustainable development of the coastal zone of the northern seas (slide show). |
| Prof. A. Rybalko | Sedimentation processes in the Baltic Sea. |

- Prof. O. Korneev Methods and equipment used in marine geological research.
- Dr. G. Gogoberidze Comparison of the Baltic Sea ecosystem state according to BFU '98, BFU '99 and BFU'2000 results.
- PhD student A. Isaev Cloud systems of various baric formations and principles of short-term weather forecasting.
- PhD student D. Gustoev “Isayaki” effect and water grasses degradation in the coastal zone (video show).
- Dr. O. Savchuk Eutrophication problems of the Baltic Sea. Implementation of mathematical modelling methods for research of the Baltic ecosystem evolution. (The lecture was given read during a seminar in Stockholm).

Works in laboratories onboard the vessel

All the students were involved in a work in laboratories onboard the vessel. Everyone had the opportunity to get acquainted with equipment and was provided with the theoretical background in every laboratory and expressed real interest in participating in fieldwork. On board the ship, there are 5 main laboratories for: geology, chemistry, hydrology, biology and meteorology.

Geology lab. Geoecological works included complex study of bottom sediments, near-bottom and silt waters. Samples were taken with a grab and a core sampler, to obtain sediments column and near-bottom waters. Samples taken were used to carry out geochemical analyses of sediments, oil content analyses and heavy metals analyses. All samples were fixed with nitrogen acid. Express-analytical studies of bottom sediments, silt and near-bottom waters onboard the vessel included determination of water temperature, dissolved oxygen content, pH, Eh conductivity.



Chemistry lab. There was a big diversity of work in this laboratory. The following characteristics were determined: dissolved oxygen concentration, alkalinity, pH, concentration of phosphates, nitrites, nitrates and silicates. Knowledge of methodology and practical skills of students were widely used there.

Hydrology lab. SBE-19 SeaCat CTD-system was used to obtain continuous temperature, salinity and density profiles. CTD was accomplished by automatic bottle cassette SBE-32. It consists of 12 bottles with volume of 1.7 litres each. Students learned how to work with software designed to operate CTD-system, how to extract data from CTD's memory and to process them.

Biology lab. In this laboratory complex phytoplankton study was convened in order to control eutrophication processes, such as: determination of the phytoplankton biomass and biodiversity, chlorophyll 'a' concentration (using Mini Back Scate fluorimeter), water colour and transparency measurements were carried out. Students participated in sampling and conservation of phytoplankton samples obtained, in measurements of water colour and transparency and in chlorophyll 'a' determinations.

Meteorology lab. Students learned how standard meteorological observations are carried out, how telegrams are drawn up with special codes and where they are sent. They have got acquainted with faximile equipment for receiving the weather charts and with experimental equipment "Syuzhet-M" for receiving satellite images. During the expedition 56 satellite images of the earth surface from NOAA 12 and NOAA 14 satellites and 20 faximile weather charts from Offenbach radio centre (Germany) were obtained. Satellite images were used to make short-term weather forecasts more accurate.

Final seminar. The last day of the expedition all the scientific crew attended a concluding seminar where students presented their findings. During the cruise students worked on certain topics using data of the BFU'2000 cruise. Each report was followed by an open discussion and a speaker had to defend his ideas and points of view.

Seminar in Stockholm

On August 2 a working seminar (BFU'2000 Mid-Cruise Workshop) was held (see Appendix 2). Among the outside participants were the Secretary General of the Swedish National Commission for UNESCO Mr Anders Fallk, consul of the Russian Federation in Sweden Mr M. Zubov, Dr A. Suzyumov of UNESCO, representatives of international educational programs in Sweden in the field of environmental protection of the Baltic region - director of the "Baltic University" program

Prof. Lars Ryden (Uppsala University) and lecturer at the Stockholm university Dr. Oleg Savchuk, rector of RSHU prof. Lev Karlin and vice-rector Dr V. Vorobjov. An exhibition on the BFU works



prepared by the scientific crew together with the crew of the RV “Sibiriakov” was presented, and a video film about the BFU ‘99 expedition was demonstrated. The working part of the seminar was opened by the rector of RSHU L. Karlin, who introduced the BFU program and its objectives. Then the Secretary General Anders Falk made a greeting speech to

the students and participants of the expedition. In his speech, he highly valued international cooperation for solving ecological problems of the Baltic region, and also stressed the importance of personal contacts as a key to successful promotion of international projects. The representative of UNESCO A. Suzyumov pointed to the necessity of permanent search for new forms and directions of work within the frame of the BFU program. Prof. Lars Ryden presented the “Baltic University” program and its possible interaction with BFU. During discussions about the opportunities of extending the cooperation of the “Baltic Floating University” with various international projects and programs while carrying out expedition works during summer 2001 all the participants expressed their support to the BFU program.

The Ambassador of the Russian Federation in Sweden His Excellency A. Nikiforov and the military attache N. Lychak visited RV “Sibiriakov” as well. They got acquainted with the work done within the BFU program. Positively appreciating the results of work the Ambassador recommended to the BFU organisers to prepare a series of scientific - educational projects, which could possibly be presented to the Swedish funding sources.

Preliminary research results

According to the data from oceanographic stations in the axial section across the Gulf of Finland and in the open sea (down to 56°45' N) the following peculiarities in thermohaline structure can be distinguished:

- due to weak radiation heating and strong wind-wave mixing thickness of UML did not exceed 10-20 m, reaching 30 m in some areas. Temperature and salinity in UML was 16-17 °C and 6-7‰

accordingly. Sharp gradient of salinity is observed in the outlet of the Gulf of Finland where salinity increases from 3.5‰ to 6.4‰. Thermocline is weak with gradient of 0.3°C/m, while halocline situating between 70-85 m has a significant gradient of 0.15‰/m and salinity of 10-10.5‰ on the lower boundary;

- on all deep (more than 50 m) stations ICL (intermediate cool layer) is distinguished. Situated between 45-60 m, it is formed during the period of winter convection and is eroded due to interaction with the upper and lower layers;

- deep water (80-225 m in the Gotland deep) is a transformed water from the North Sea with temperature up to 6.0-6.5°C and salinity up to 12.5‰. According to TS-curves and cluster analysis three water masses are distinguished – surface fresh and warm water, intermediate cold water with a salinity deficit and bottom water with increased salinity.

Observations in the axial section in the Baltic Sea let obtain the picture of spatial variability of main hydrochemical characteristics. Upper layer in the open sea was characterised by relatively low content of dissolved oxygen with concentration changing from 6.6 ml/l up to 7.2 ml/l in the southern areas (90-110%). Spatial variability of pH and alkalinity is weak meaning the decrease of freshwater inflow. Spatial distribution of nutrients in the upper layer is characterised by low (close to zero) content of phosphates, nitrites and nitrates as well as silicates (not more than 250 mg/l). Such situation is typical for the case of strong mixing and points out that during the intensive late summer phytoplankton bloom nutrients were utilised by phytoplankton.

Regarding the vertical structure of water in the central Baltic it is possible to call it as typical. According to dissolved oxygen content three layers are distinguished – upper mixed, intermediate and deep waters. In the upper mixed layer (0-60 m) oxygen content is about 7 ml/l. In the intermediate layer (60-70 m) maximum of oxygen concentration is observed (7.5 ml/l). Lower sharp decreasing of the oxygen concentration takes place. Starting from 90 m oxygen is practically absent and signs of H₂S presence in the water appear. Vertical distribution of nutrients is characterised by the minimum of content in the upper layer, increased concentration in halocline and accumulation in near-bottom layers along the whole section.

Besides the axial section several surveys were done during the BFU'2000 expedition: in the waters off Poland, in the Gotland deep and off Kaliningrad.

In the Gotland deep 11 stations were done with the majority situated within the anaerobic zone and are characterised by specific sediments: thin layer of flocculated silts (from 1 to 5 cm) accompanied by total absence of oxidation zone. Measurements of conductivity showed that

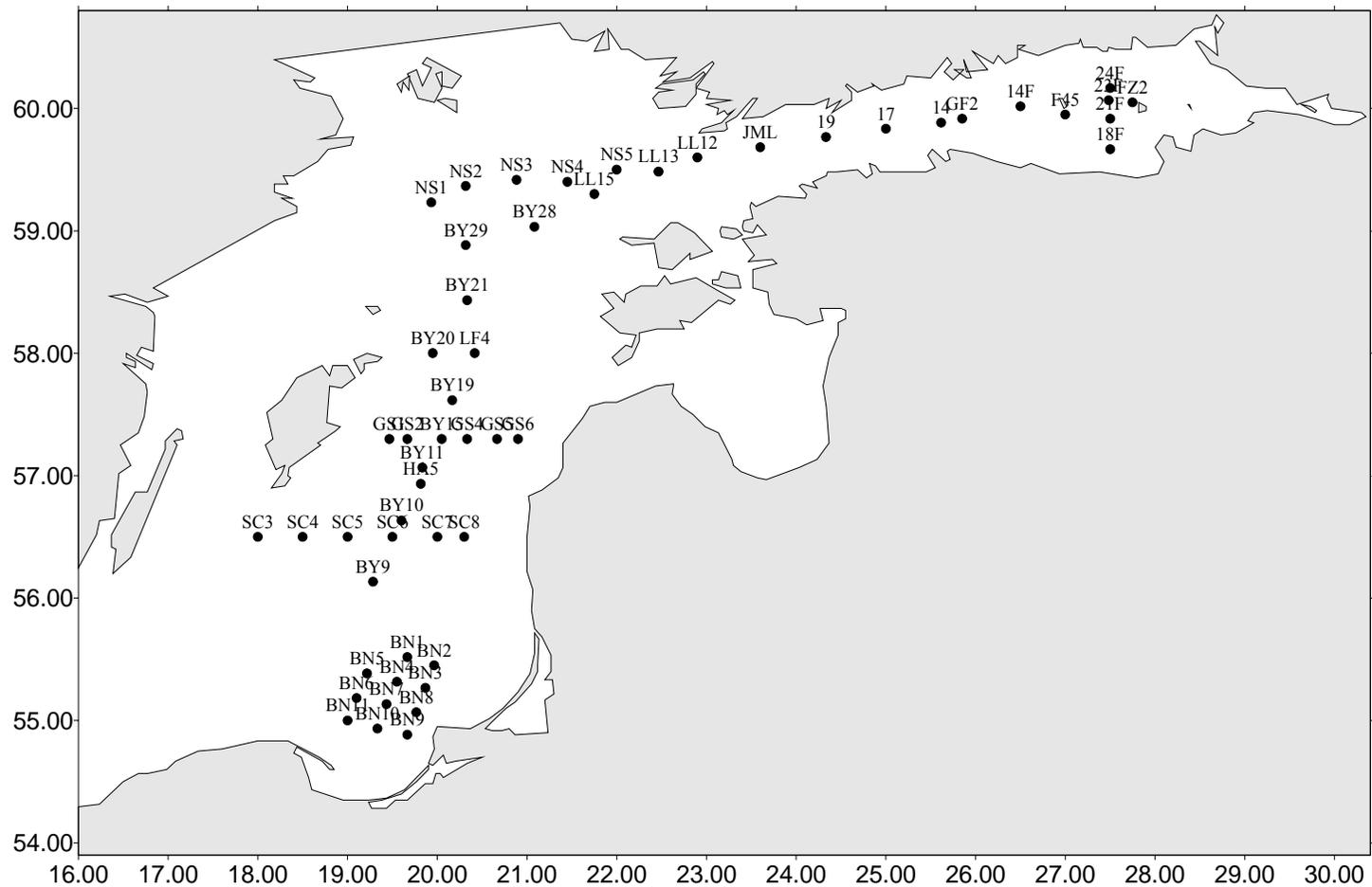
everywhere the highest values are observed in silt waters and the lowest – in bottom sediments. It means that the main reserve of heavy metals is situated in silt waters. Taking into consideration that the “bottom – water” system is not closed (due to absence of oxidation zone) it may lead to constant secondary pollution of near-bottom waters by toxic metals. At the same time it is necessary to underline that the character of anaerobic zones formation is related to natural and not antropogenic processes. Heavy metals are present due to pollutants coming from coastal zones of the Baltic countries. Study of the vertical distribution of physic-chemical parameters in the sediments’ section in the Gotland deep gave a possibility to develop an idea about the thickness of the recent geochemical and sedimentation processes. Sharp change of all parameters takes place in the depth of 3-6 cm where the boundary of modern sediments formation lies. Combination of these measurements with results of laboratory analyses of silt and near-bottom waters and bottom sediments will make possible computation of heavy metals migration and extraction of technogenic component in anaerobic zones.

Off Kaliningrad, observations were carried out on 4 stations. There, physic-chemical characteristics related to vertical distribution of oxidation and reduction zones were measured and materials for the location of geomonitoring stations on the Kaliningrad shelf of the Russian Federation obtained.

The expedition came to its end on August 9. All the participants received official certificates and diplomas. Foreign students stayed in St. Petersburg for 10 more days after the cruise: a cultural program was organised for them.

APPENDIX 1

Scheme of hydrological stations,
BFU'2000 expedition



APPENDIX 2

Program of a Mid-Cruise Workshop

Stockholm, August 2, 2000

- T. Erjomina, Head of the BFU 2000 Cruise: opening remarks
- L. Karlin, RSHU Rector: Training-through-Research at RSHU
- A. Fallk, Secretary General of the Swedish National Commission for UNESCO: welcoming the participants in Sweden
- A. Pyshkin, Commander of the RV “Sibiriakov”: The “Sibiriakov” history
- M. Zubov, Consul of the Russian Federation in Sweden
- Suzyumov, UNESCO: BFU and UNESCO
- L. Ryden, Director of the “Baltic University” Programme: The Baltic University Programme
- O. Savchuk, St. Petersburg University/University of Stockholm: Eutrophication of the Baltic Sea
- O. Korneev, Professor at “Sevmorgeo” (St. Petersburg): Sedimentological studies during the BFU’2000 cruise
- V.-A. Langvik, Expert in Chemistry, Abo Academy (Finland): Summary of the cruise
- M. Hampel, BFU student, UCA (Spain): The students’ view
- L. Ryden, Director of the “Baltic University” Programme: Sustainable Development in the Baltic Sea Region.

Part 2

4th research cruise of sailing catamaran Centaurus-II in coastal waters of the eastern Gulf of Finland (July 15 - August 9, 2000)

The BFU field research programme for the coastal areas of the eastern Gulf of Finland has been implemented by the IV research cruise of the sailing catamaran Centaurus-II in July - August, 2000. The expedition activities were concentrated in the areas adjacent to the southern and northern coasts of the eastern Gulf of Finland and situated in close vicinity to Leningrad Nuclear Power Plant (Koporye Bight) and to the site of large-scale engineering works related with Ust-Luga Port construction (Luga Bight). The programme of the expedition was agreed with the Finnish Institute of Marine Research, Helsinki.

Objectives of the expedition

The main objectives of the expedition were as follows:

- study of thermohaline structure of the Luga-Koporye region and determination of spatial distribution of basic hydrochemical characteristics (concentration of dissolved oxygen, hydrogen ions, nutrients) through performing a complex surveying over the standard grid of oceanographic stations with the aim of estimating the regime of mentioned parameters and their variation from year to year;
- collection of plankton, benthos and sea bottom samples in Koporye Bight, Luga Bight and Viborg Bay with the purpose:
 - to estimate the taxonomic composition as well as the biomass and abundance of dominant plankton species at the grid of hydrobiological stations to study their inter-annual variations in the area under investigation;
 - to estimate the taxonomic composition and abundance of dominant benthos species with special attention to supposed introducents (invasive species);
 - to assess the occurrence of toxic phytoplankton species and to study the presence and bioaccumulation of algal toxins in the tissues of molluscs and other marine organisms;
 - to analyse sea bottom samples and the tissues of marine organisms for the presence and concentration of heavy metals (HM).

Expedition participants

The scientific crew partially changed during the cruise. The total amount of participants was 42, including 32 students from RSHU. Together with RSHU specialists and students two pupils from Ecological School no.7 (Sosnovy Bor) took part in the expedition.

Educational work

Educational work during the cruise included:

- lectures onboard the catamaran on environmental and ecological problems of the Gulf of Finland;
- training in practical field oceanographic works;
- diving instructive exercises within the coastal shallow areas in combination with seabed and benthos samples collection;
- training field work with the pupils of the ecological school № 7 (Sosnovyi Bor).

Conclusion.

The expedition ended in Kronstadt. The students submitted and defended their reports. Some amount of samples was prepared for transportation to Finnish Institute of Marine Research for analyses according to the joint programme.

5th International cruise of sailing catamaran Centaurus-II (cruise to Kotka, Finland, with organizing and conducting an international meeting on co-operation in the Gulf of Finland)

August, 29 – September, 5, 2000

The 5th cruise of Centaurus-II was initiated by RSHU for visiting Finland with arrangement of international meeting onboard the catamaran to discuss the ways of further BFU-aided Russian-Finnish cooperation in research, educational and socio-cultural areas within the Gulf of Finland region.

The programme of meeting included:

- Discussion of main sectors of joint activities.
- Meeting with Mr R.Thompson-Coon, the Chairman of the Gulf of Finland Environment society (SULA).
- Seminar for the participants of the international seminar “Clean Air”.
- visit to Finnish research vessel.

In total 9 participants from Russia and 12 from Finland had attended the meeting.

The meeting in Kotka made it possible to give more concrete expression to the ways of further cooperation with Finnish partners.