

**Intergovernmental Oceanographic Commission  
Russian State Hydrometeorological University**

*Baltic Floating University Facility*



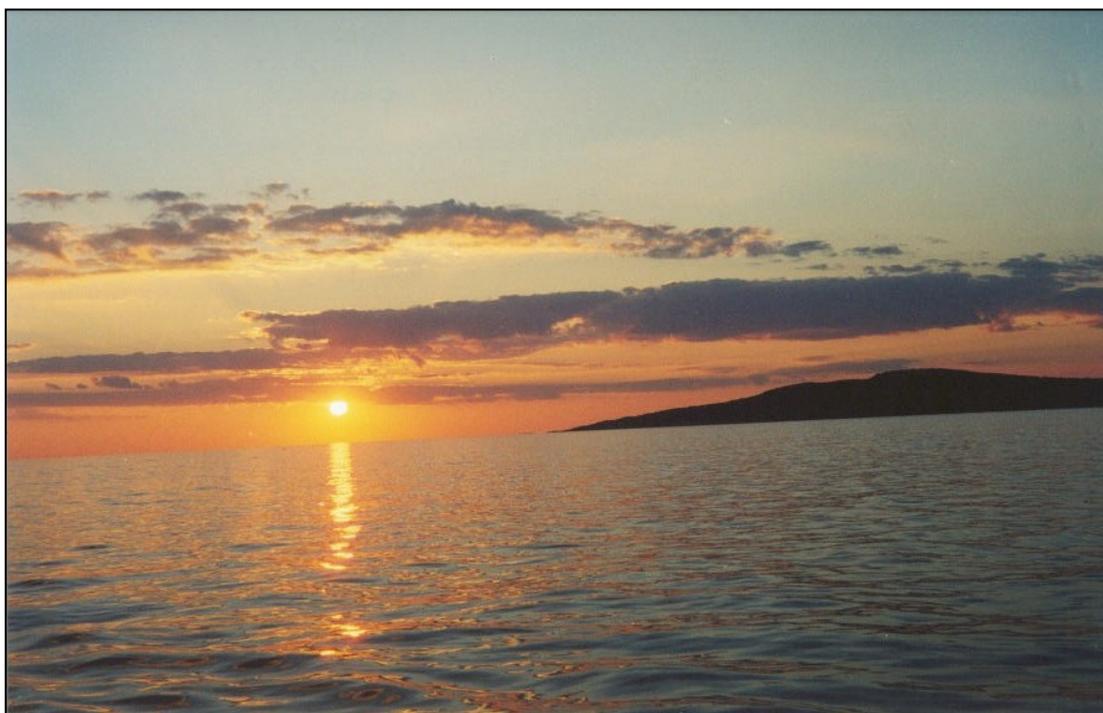
**SUMMARY REPORT**

**RV “Sibiryakov”**

X International Training through Research Cruise (August 7 - August 18, 2002)

**Sailing catamaran “Centaurus-II”**

VIII and IX International Cruises (June 4 – July 11; July 12 – August 16, 2002)



**St. Petersburg**

**2002**

## **RV “SIBIRYAKOV” X INTERNATIONAL TRAINING THROUGH RESEARCH CRUISE**

Annual survey in the Proper part of the Baltic Sea and its coastal areas was held in August 2002 onboard HRV ‘Sibiriakov’. Fieldwork fulfilled the subprogram ‘Research of the World ocean nature’ of the Federal Program ‘World ocean’, international IOC-UNESCO program ‘Floating University’, international project of the Russian Ministry of Science ‘Estimation of the Baltic Sea ecosystem variability under natural and anthropogenic factors’, contract with ‘Sevmorgeo’ geological company and some other programs.

### **Objectives to fulfil**

The main scientific direction of the expedition was the research of hydrophysical, hydrochemical and hydrobiological processes and their variability in the Proper and coastal parts of the Baltic Sea; geoecological monitoring in the Gulf of Finland and on the Kaliningrad shelf; estimation of ecological state of the Baltic Sea waters; research of dumped chemical munitions influence on state of marine environment.

Both scientific and educational tasks were solved successfully.

**Research** of hydrophysical, hydrochemical factors influence on state of the Baltic Sea and the Gulf of Finland ecosystem included

- collection and analysis of data on hydrophysical, hydrochemical and hydrobiological characteristics in the areas under research;
- study of hydrophysical characteristics spatial-time variability on oceanographic sites and at the HELCOM stations;
- study of water masses distribution, conditions of vertical stratification formation;
- study of hydrochemical characteristics and pollutants spatial-time variability on oceanographic sites and at the HELCOM stations;
- study of pollution with oil hydrocarbons in the surface and near-bottom waters;
- study of quantitative composition and qualitative distribution of phyto- and zooplankton and zoobenthos;
- estimation of bottom sediments and near-bottom waters pollution in the main sedimentation basins in the eastern Gulf of Finland, Bornholm Deep and Kaliningrad shelf;
- estimation of ecological situation in the eastern Gulf of Finland and character of anthropogenic load from the Neva estuary (St. Petersburg region) spreading to the Gulf of Finland Proper;
- estimation of bottom sediments pollution in the main sedimentation basins of the western Gulf of Finland and character of the Baltic Proper pollution with technogenic products incoming from the Russian Gulf of Finland;

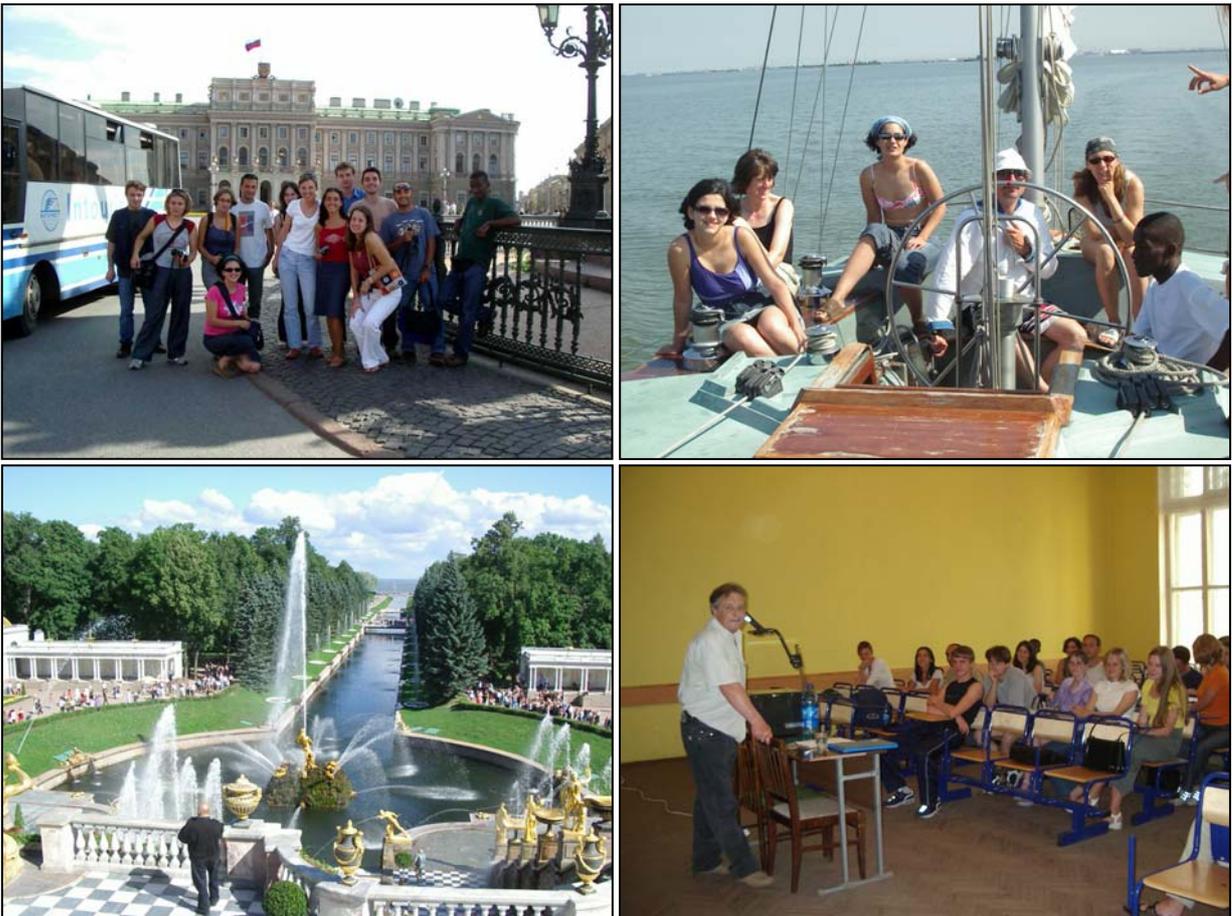
- estimation of poisonous substances outflow and intensity of corrosion processes through determination of arsenic content and total content of metals in bottom sediments and near-bottom layers of water on dumping sites of chemical munitions in the Bornholm Deep.

**Training and education** in the fields of marine and coastal sciences and in data collection and analyses implied

- training and education of students from the Universities of Russia, Great Britain, Spain and Portugal implementing the ‘training through research’ principle;
- reading lectures and participation of scientists and students in educational-scientific seminars;
- presentation by the students from European Universities of their scientific projects;
- development of international collaboration in the sphere of environmental and marine investigations.

## Before the cruise

Educational and cultural part of the process has started 10 days before the vessel left the port



of Lomonosov (close to St. Petersburg). Lectures were given in the building of Russian State Hydrometeorological University (RSU), guided bus tour around St. Petersburg, visits to the Hermitage and Russian museum, visits to Peterhof and Oranienbaum, yacht trip in the eastern

Gulf of Finland were offered to the participants of the expedition and successfully provided education and entertainment.

Lectures on the following topics were presented onshore:

Dr. G. Glegg (Plymouth University, Great Britain)	1. Environmental impact assessment 2. Eutrophication and the North Sea 3. Hazardous pollutant management
Prof. A. Nekrasov (RSHU, Russia)	1. Research of a coastal zone in the Gulf of Finland within the framework of the Baltic Floating University project 2. Main hydrological features of the Baltic Sea
Prof. G. Frumin (RSHU, Russia)	Introduction to ecological chemistry and ecological toxicology
Dr. A. Bogush (RSHU, Russia)	International co-operation of Russian State Hydrometeorological University

## In the sea

All the students worked in laboratories (geology, chemistry, hydrology, biology, meteorology



and data processing), attended lectures and seminars, made presentations of their own scientific projects, contributed to the discussion of preliminary results of the expedition. Foreign students attended Russian language classes.

List of theoretical studies contains the following:

Prof. G. Frumin (RSHU, Russia)	1. Priority pollutants 2. Ecological and health risks
Prof. A. Rybalko (‘Sevmorgeo’, Russia)	Sedimentation processes in the Baltic Sea
Prof. G. Frumin Prof. A. Rybalko	Influence of chemical munitions dumped into the Baltic Sea on state of marine environment
Dr. M. Shilin (RSHU, Russia)	1. Eutrophication, industrial emissions and toxic pollutants in the Baltic Sea 2. Toxicology - the environmental impact 3. Environmental policy and co-operation in the Baltic region 4. The problems of new harbour construction in the Gulf of Finland
Dr. R. Vankevich (Centre for Ecological Safety, Russia)	1. Organisation of observations data set 2. Filed data processing in GIS 3. Visualisation of data sets
Dr. J. Benavente (University of Cadiz, Spain)	Coastal risks
L. del Rio (University of Cadiz, Spain)	Marine sciences at the University of Cadiz
A. Sanchez Roman (University of Cadiz, Spain)	Mediterranean Sea and climate. The Strait of Gibraltar as a monitoring area
H. Albuquerque A.C. Carvalho (University of Aveiro, Portugal)	Proposal and strategy of action for sustainable development in Porto Santo Island
C. Rodrigues (University of Aveiro, Portugal)	Determination of trophic relationships in the intertidal beach in Ria de Aveiro (NW Portugal) using $\delta^{13}\text{C}$ and $\delta^{15}\text{N}$
S. Canhanga (University of Aveiro, Portugal)	Mathematical model of long wave circulation in coastal area

## Scientific results

Preliminary scientific results were obtained and then presented and discussed the last day of the expedition. The main conclusions can be found below.

**Hydrology.** Fields of temperature and salinity in the eastern Gulf of Finland are typical for summer season. Maximum temperature of the upper layer 20.9°C was observed in the central part of the basin, salinity increases westward from 1 to 4‰. Cold intermediate layer (CIL) exists at stations with depths exceeding 50m, corresponding to the depth of autumn-winter convection in the Gulf of Finland. Temperature in CIL is about 2°C, lower than in 2001.

Thermohaline structure of waters on HELCOM section is composed of three (four – at stations with depths exceeding 60m) layers: upper quasihomogeneous, intermediate cold and

near-bottom, formed by transformed water from the North Sea. Intermediate water mass consists of seasonal thermocline and CIL below. Absolute values of temperature and salinity in the near-bottom layer are close to observed in 2001, witnessing of absence of the North Sea waters inflow to the Gotland deep and stagnation of the near-bottom waters. Temperature of the upper layer along the section increased from 19.9°C in the vicinity of the point GF-2 (the beginning of the section) to 20.8°C in the area of BH-2 (the last point of the section). These values are higher if to compare with 2000 and 2001, and approximately correspond to conditions of warm 1999.

Fields of temperature and salinity in the southern Baltic on the Kaliningrad and Bornholm polygons are quite alike with low spatial variability. The same elements of the vertical structure are present as in the central Baltic. The most interesting result on the Bornholm site is intrusion of transformed waters from the North Sea. These waters are present at deep (>100m) stations between 55-80m and are clearly seen on vertical temperature profiles, where values up to 8-10°C are observed, exceeding standard values on 3-4°C. Due to intrusion salinity in the layer 50-100m is 1‰ higher than in 2001.

In general thermohaline structure in August 2002 is typical for summer season. Temperature conditions in the upper layer exceed climatic average. Inflow of waters from the North Sea is evident, but its intensity and ability for further penetration is possible to estimate after careful analysis of data from this expedition and consideration of other surveys data.

**Chemistry.** Oxygen content in the upper layer is close to saturation. Near the bottom concentration of oxygen is sharply decreased, quite often reaching analytical zero. In the eastern Gulf



of Finland in 20% of samples oxygen saturation was below 50%. On the axial section in the Baltic deficit of oxygen was observed in the near-bottom waters. In 40% of samples saturation percent was equal to zero, in 60% - did not exceed 15%. Situation like this was also observed at stations of the Kaliningrad and Bornholm polygons. This

speaks for not good ecological state of these areas. Hydrogen sulphide is found below 100m in the Gotland deep.



Values of biological oxygen consumption in the eastern Gulf of Finland, HELCOM section, Kaliningrad and Bornholm polygons indicate not significant pollution of the upper layers with easily oxidised organic combinations.

Upper layers are characterised by low concentrations of phosphates and nitrates. Below the density jump layer content of phosphates is significantly increased up to maximum near the bottom (433 $\mu$ g/l in the central Baltic).

Due to strong river discharge high concentrations of dissolved silicon are observed.

For the first time correlation is found between content of phosphates and redox-potential in the near-bottom waters.

**Biology.** Benthic organisms are found in the eastern Gulf of Finland and on the Kaliningrad polygon. In the western Gulf of Finland and the most part of the Baltic benthic organisms were absent in samples, like in 2001. In the eastern Gulf of Finland increasing of lifeless zone without benthos (in comparison with 2001) did not occur. But lifeless zone with sediments formed by black silts, marked in 2001 in the vicinity of Island Kotlin, this year was found also.

With depth, increasing westward, presence of black silt in samples sharply grows. Thickness of oxidised aerobic layer does not exceed 1.5cm. Bottom sediments samples have a characteristic smell of hydrogen sulphide. Benthos is not found almost everywhere.



In the western Gulf of Finland and in the central Baltic permanent settlements of benthic organisms are not marked.

There is no macrobenthos in the Bornholm deep. In sediments of light colour large quantities of empty shells are present, telling about bivalves living here in recent past. Similar picture is found on the Kaliningrad site.

General picture of benthos distribution is in good correspondence with data from 2001. This proves that benthic organisms are conservative and 'tied' to certain biotops. Some differences were marked in distribution of the bivalve *Macoma balthica*. These bivalves, unlike 2001, were not found in the eastern Gulf of Finland, but appeared in samples from the Kaliningrad polygon. To judge about changes in boundaries of this species habitat increased amount of observations is needed in shallow water parts of corresponding areas.

**Geology.** In the Gulf of Finland 14 geoecological stations were made. The main attention was paid at oxidation-reduction conditions on the geochemical barrier 'bottom-water'. These con-

ditions determine migration of chemical elements and also existence of benthic organisms. In 2001 in most of sedimentation basins of the eastern Gulf of Finland anaerobic conditions were found, expressed in absence of oxidation zone and appearance of the layer of intensively flocculated black mud on the sediments surface. In 2002 situation is essentially different. Most of



the stations are characterised by oxidation zone. Anaerobic conditions existed at one station (GF-6) in the Vyborg Bay and also in Gogland sedimentation basin.

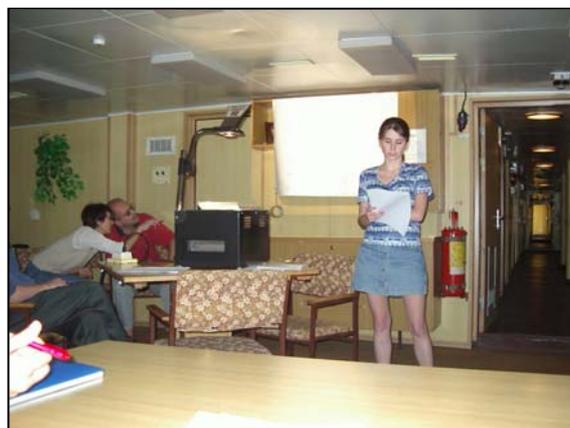
5 stations on the Kaliningrad polygon revealed better physic-chem20

ical conditions than in 2001 on the most part of the polygon except for deep parts of the Gdansk

deep. Situation was approaching the year 2000, when oxidation zones were present at almost all the stations. Again this confirms the leading role of water exchange with the North Sea for geochemistry of sediments formation.

On the Bornholm polygon anaerobic conditions dominated in 2002. Thickness of reduced layer of mud sometimes exceeds 2cm, witnessing of long-term character of anaerobic processes in the Bornholm deep. Hydrochemichal data prove this conclusion. In this case bottom sediments are completely lifeless and conditions for chemical components migration, also products of chemical munitions destruction and corrosion of shells and bombs, are favourable.

**Final seminar.** All the students prepared this traditional activity of the BFU. The speeches were dedicated to their work and preliminary analysis of obtained results.



K. Moskvina	About intrusion of the North Sea water on the Bornholm polygon
A. Storonkin	Distribution of pH in the area of Bornholm polygon
A. Bushenkova	Features of phosphates and silicates distribution in the central and southern parts of the Baltic
O. Pasukova	Preliminary results of biological investigations
N. Guslina	Distribution of nitrates and nitrites on the HELCOM section
C. Rodrigues	My work in chemistry lab
H. Albuquerque A.C. Carvalho	Work of geology lab
K. Lewis	Data processing team

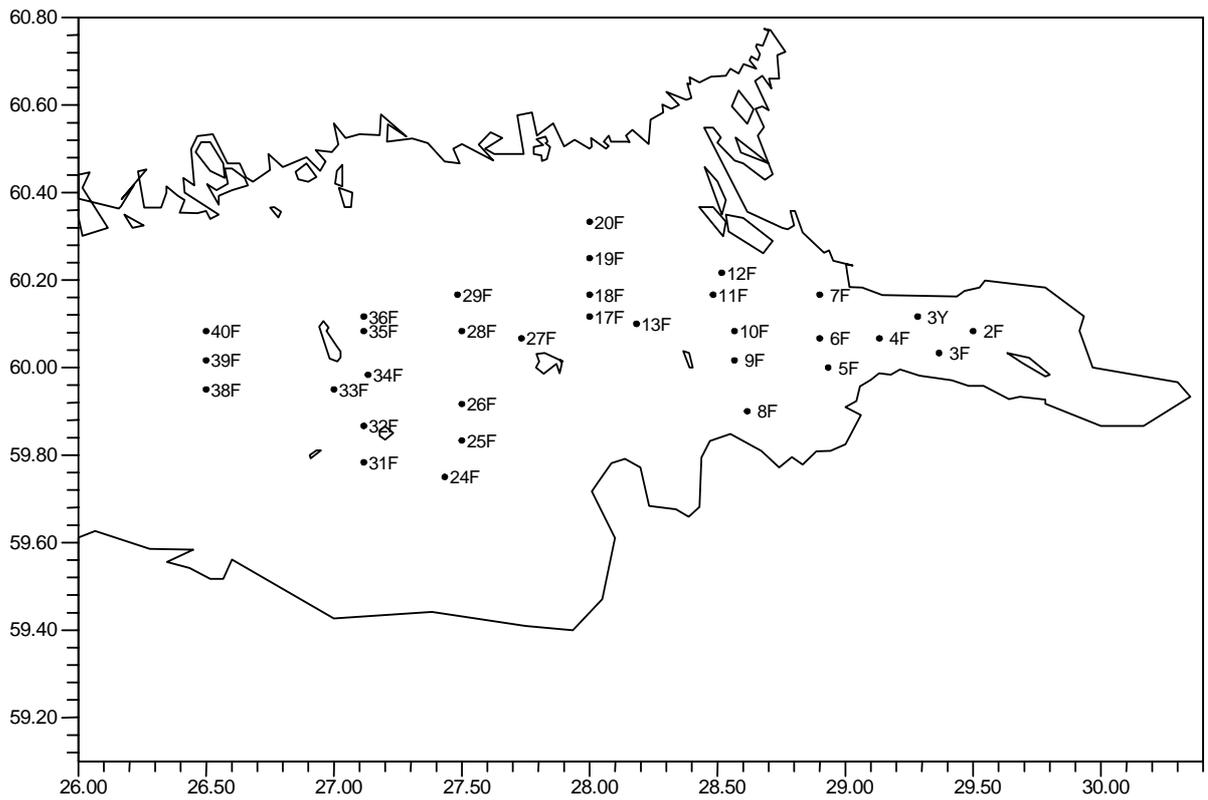


Figure 1. Positions of stations in the Gulf of Finland.

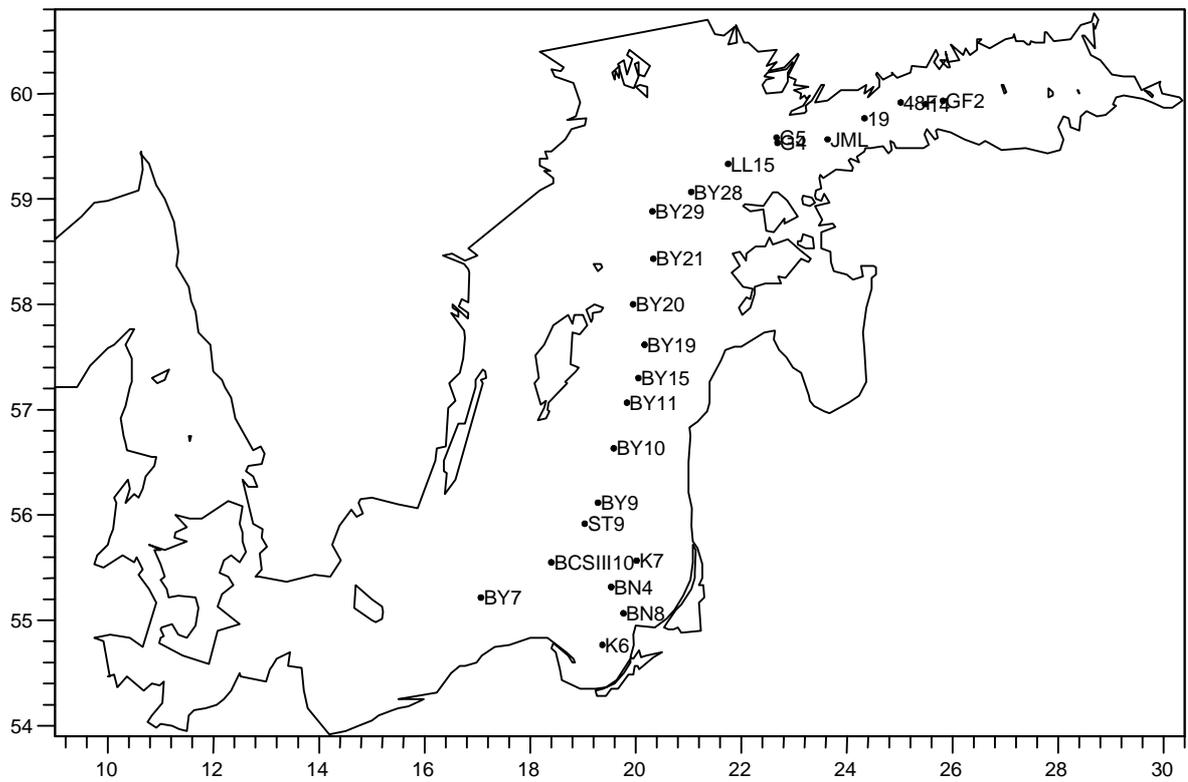


Figure 2. Positions of stations in the Baltic Sea (axial section).

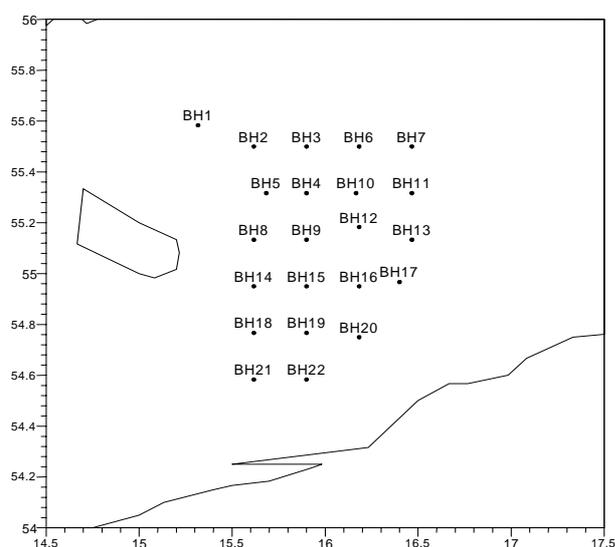


Figure 3. Positions of stations on the Bornholm polygon.

### People who did the BFU'02

	Name	Country	Institution	Position
1	Tatyana Eremina	Russia	RSHU	Dr., chief of the expedition
2	Alexander Averkiev	Russia	RSHU	Dr., vice-chief of the expedition
3	Jury Scherbakov	Russia	RSHU	Hydrologist
4	Sergey Vilenkin	Russia	RSHU	Data manager
5	Alexey Isaev	Russia	RSHU	Ph.D., hydrologist
6	Larisa Rusina	Russia	RSHU	Chemist
7	Mikhail Shilin	Russia	RSHU	Dr., biologist
8	Alexander Rybalko	Russia	Sevmorgeo, Russia	Prof., geologist
9	Natalia Fedorova	Russia	Sevmorgeo, Russia	Dr., geologist
10	Grigory Frumin	Russia	RSHU	Prof., chemist
11	Dmitry Gustoev	Russia	RSHU	Dr., hydrologist
12	Tagir Lakhov	Russia	RSHU	Hydrologist
13	Svyatoslav Tyuryakov	Russia	RSHU	Ph.D.
14	Roman Vankevich	Ukraine	Centre for Ecological Safety, Russia	Dr., data manager
15	Sabir Asadov	Azerbaijan	RSHU	Ph.D.
16	Javier Benavente	Spain	University of Cadiz, Spain	Dr.
17	Antonio Sanchez	Spain	University of Cadiz, Spain	Ph.D.
18	Laura Rodriguez	Spain	University of Cadiz, Spain	Ph.D.
19	Maria Luisa Perez	Spain	University of Cadiz, Spain	Student
20	Ana Catarina Carvalho	Portugal	University of Aveiro, Portugal	Student
21	Helena Albuquerque	Portugal	University of Aveiro, Portugal	Student
22	Clara Rodrigues	Portugal	University of Aveiro, Portugal	Student
23	Sinibaldo Canhanga	Mozambique	University of Aveiro, Portugal	Student
24	Sarah Allen	Great Britain	University of Plymouth, GB	Student
25	Katy Lewis	Great Britain	University of Plymouth, GB	Student
26	Olga Pasyukova	Russia	RSHU	Student
27	Anna Bushenkova	Russia	RSHU	Student
28	Alexey Bannikov	Russia	RSHU	Student
29	Natalia Guslina	Russia	RSHU	Student
30	Konstantin Moskvina	Russia	RSHU	Student
31	Alexander Storonkin	Russia	RSHU	Student
32	Alexandra Ershova	Russia	RSHU	Student
33	Olga Voinova	Russia	RSHU	Student

## **SAILING CATAMARAN “CENTAURUS-II” VIII – IX INTERNATIONAL CRUISES**

1) VIII International Cruise (June 4 – July 11, 2002). Work in Central and Southern Baltic.

The cruise was organized together with Atlantic Branch of Institute of Oceanology in Kaliningrad. The activities included fieldwork and fulfillment of the subprogram “Research of the nature of the World Ocean” of the Federal Target Program, and participation of catamaran in “Kieler Woche” (Kiel week – annual activity in Kiel, Germany).

The main scientific tasks of the cruise were to research the presence of toxic substances in some deepwater areas of central and southern Baltic (sites of the World War II chemical munitions dumping), as well as monitoring of the water exchange between deepwater areas to estimate probability of penetration of the near-bottom water, carrying products of chemical munitions decay into adjacent basins.

Education played an important role as sound and unique field practice for students studying oceanography at RSHU was provided.

International cooperation was strengthened due to participation in Kiel Week and presentation of the Centaurus-II and its activities to a wide public. The programme of the catamaran’s and its staff’s participation in the Kiel Week was focused on environmental knowledge dissemination and local inhabitants (above all the pupils) acquainting with methods of environment studying and protection. This programme was developed together with the Hohe Tied and the representatives of the Applied Ecology Centre (Sillamäe, Estonia).

2) IX International Cruise (July 12 – August 16, 2002)

Another cruise of the sailing catamaran “Centaurus-II” was held in the coastal zone of the Gulf of Finland. The main objective of the cruise was the complex study of the state of the marine ecosystem on the basis of hydrophysical, hydrochemical, hydrobiological characteristics, including the data on sediments state and the level of their pollution and also the level of pollution of the water environment. 19 students from RSHU and 3 students from University of Cadiz (Spain), 1 from Plymouth (UK) and 1 from Aveiro (Portugal) took part in this cruise.