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Review of the Environmental conditions in the Neva Bay and Eastern Gulf of Finland

By:

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REVIEW OF THE ENVIRONMENTAL CONDITIONS IN THE NEVA BAY AND EASTERN GULF OF FINLAND

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MANAGEMENT PERSPECTIVE

The subject of this review is the environmental situation in the Neva Bay and the Eastern Gulf of Finland - two connected water basins forming the eastern extremity of the Baltic Sea. Efforts are being made to assess this situation as reliably as possible and a way to direct its improvement are also being considered. An insight into the activity of certain Russian research organizations is given. Some proposals concerning the Canada/Russia cooperation in relevant research under the Baltic Floating University (BFU) and the 1996 Gulf of Finland Year (GOF-96) initiatives are also suggested.

ABSTRACT

A review of the environmental conditions in the Neva Bay and the eastern Gulf of Finland- two interconnecting water bodies forming the eastern extremity of the Baltic Sea was undertaken in preparation for the planning of the 1996 Gulf of Finland Year (GOF-96) and the ongoing UNESCO sponsored Baltic Floating University (BFU). Research proposals of Russian scientific organizations in GOF-96 and BFU activities are briefly summarized. National Water Research Institute, Canada, initiatives for participation in GOF-96 and BFU research programmes under the umbrella of the Canada/Russia bilateral MOA are also presented.

SUMMARY

The subject of this review is the environmental situation in the Neva Bay and the Eastern Gulf of Finland - two connected water basins forming the eastern extremity of the Baltic Sea. Efforts are being made to assess this situation as reliably as possible and a way to direct its improvement are also being considered. An insight into the activity of certain Russian research organizations is given. Some proposals concerning the Canada/Russia cooperation in relevant research under the Baltic Floating University (BFU) and the 1996 Gulf of Finland Year (GOF-96) initiatives are also suggested.

1. INTRODUCTION

This paper discusses the present environmental conditions of Neva Delta/Neva Bay and Eastern Gulf of Finland, in preparation for the proposed Gulf of Finland Year-96 (GOF-96) by Finland/Russia/Estonia. The water bodies mentioned represent the western part of a larger water system including the Neva River, Ladoga Lake, Svir River and Onega Lake with their catchment areas. Also, the connection with the main Gulf of Finland and the Baltic Proper with their catchments is not to be overlooked. Regardless, the eastern extremity of the Baltic Sea will be the subject of this review.

The location of the Neva Bay and the Eastern Gulf of Finland can be seen from Fig. 1 while their main natural characteristics are presented in Table 1 shows the dependence of the Gulf of Finland, and especially that of the Neva Bay, on the impact produced by waste discharge of the Neva River must be highly significant. The City of St. Petersburg and its surrounding areas (Leningrad District) are the main sources of pollution for the Gulf of Finland.

The City of St. Petersburg was founded in 1703 and since that time the problem of flooding has been of great concern for its population and authorities. The main cause of the flooding is a long surge wave produced by a deep meteorological depression in the Baltic Proper coming from the west and being reinforced by a decrease in a cross-section of the Gulf and local stormy winds. The level rise of 1.6 m above mean is considered as flooding because of the city's low-lying position; since 1703 up to now the city has been flooded more than 280 times, i.e., a probability of flooding is about once a year. In Table 2 the list of the highest (catastrophic) flooding is presented.

First, proposals concerning flood defence were made as early as the XIX century but only in the 1960's was the final decision was taken on the construction of a protective barrier (the "dam"). The building of the dam started at the beginning of the 1980's and by the end of 1988 the main part of the construction was principally erected (Fig. 2).

The building of the dam coincided in time with considerable degradation of the environmental situation in the City of St. Petersburg as well as in surrounding areas including the Neva River and Neva Bay. The problem arose: to what degree can the dam be responsible for this aggravation? Public opinion was, quite understandably, highly excited. A number of commissions of experts were established to assess the situation and propose relevant recommendations. By this time, a considerable amount of field data, as well as results of modelling, were made available by the State Hydrological Institute, State Oceanographic Institute, North-West Hydrometeorological Service, Institute "Gidroproekt", and others, showing that the hydrographical and hygrochemical features vary in time and space with m.s.r. dispersive variances commonly exceeding means several times. As an example, the pattern of currents for Neva Bay and Eastern Gulf of Finland with the main axes of dispersive ellipses and mean (averaged over periods from two weeks to six months) vectors is given in Fig. 3 (Belyshev and Preobrazhensky, 1988). It is seen from this figure that deviations conditioned primarily by wind and long waves can occasionally form actual circulation quite different from the mean conditions predominantly from the Neva River discharge.

The conclusions of the first three commissions were substantially different and sometimes conflicting in principal points. The most justifiable is the fourth report prepared by the International Commission of Experts headed by Ir. H. Engel (Civil Engineering Water Resources Management, the Netherlands). The main conclusion concerning the barrier (dam) was that "during the 10 years the Barrier has been under construction, its effects on the water quality of Neva Bay have been negligible" compared to other impacts, primarily: the discharge of untreated or inadequately treated waste water; the destruction of wetlands for urban expansion; dredging and dumping of spoil (Rodenhuis, 1992).

2. ENVIRONMENTAL ISSUES

At the same time, the Commission confirmed the belief that the ecology of the whole system, Ladoga Lake-Neva River-Neva Bay-Eastern Gulf of Finland, had already, over a long period of time, been adversely impacted by man's activities, including the above mentioned factors. The most dangerous are the high concentration levels of heavy metals in water, sediments and fish along with the bacterial pollution. The concentration of nutrients was recognized as being within international standards, though its level was obviously high enough and also influenced by impact. Some quantitative characteristics presented below can give a notion of the situation as it was in 1991 (Rodenhuis, 1992):

Waste Water Discharge

During the period 1980-1987, the total volume of waste water discharged into Neva Bay ranged between 1.7 and 1.9 km^3 per year (about 55 m^3 per second), that is, about 2% of the total Neva discharge. Approximately 80% of waste water discharged is originating from the City of St. Petersburg and about 35-40% of the total is of industrial origin.

It should be noted that many individual discharges are spread throughout the delta and, to a large extent, uncontrolled. During recent years considerable effort has been directed toward reducing waste pollution by commencing the operation of new treatment plants. Figure 4 shows some improvement attained over the period 1980-1987. Biological waste water treatment has increased from 3% to 35%. Nevertheless, the treatment efficiency remains, obviously, inadequate.

Heavy Metal Concentrations

The concentration levels for heavy metals such as Pb, Cu, Hg and Cd, are very high in Neva Bay as well as in the Gulf of Finland (see Fig. 5 and Table 3) exceeding commonly existing standards. The actual concentrations vary considerably in time and space and some of them are certainly caused by local sources. It should be noted that this type of pollution (heavy metals) is not restricted to Neva Bay: in fact levels of concentrations are often higher outside the dam than inside. Moreover, even higher levels of heavy metals are found in the Baltic Proper indicating that it is a problem throughout the region.

The accumulation of heavy metals in fish organisms is also a problem of great importance. In particular, the increasing occurrence of diseased fish in the Gulf of Finland may be attributed to high concentrations of heavy metals. In Table 4 the maximum accumulation levels of heavy metals in fish found in the open Neva Bay and near the northern coast (Zelenogorsk), as well as in the Gulf of Finland, are presented.

Bacterial Pollution

Bacterial pollution in Neva Bay has reached a critical level resulting from untreated effluents. By the end of the 1980's, measured values in the Bay ranged from 10^5 to 10^7 coliform-bacteria/l. This is much higher than in the Gulf of Finland (10^3-10^4) and in the upper Neva River (10^3). [Note that the Russian standard for swimming water is 25.10^3 if no pathogenic bacteria are present.] The coli-index also displays considerable variations in time and space. There are strong indications on very high levels of pathogenic bacteria accumulated in bottom sediments and they may again enter into the water column through dredging or strong winds. It is known that a catastrophic situation was officially recognized in 1984 because of an enormously high bacterial pollution.

Nutrients and Eutrophication

An estimation of nutrient concentrations for 1991 show levels not exceeding European water quality standards (see Table 5). Eutrophication symptoms are fairly moderate. Blue-green algae are mainly brought from Ladoga Lake, the local primary production in the Bay being low because of high turbidity resulting in poor penetration of sunlight. The additional cause of low primary production in the Bay is the high flushing rate implying a low residence time of the water in this basin (about 7 days, see Table 1). To the west from the dam the eutrophication processes are much more effective and, for the Eastern Gulf of Finland, eutrophication represents a real problem.

During the three years following the final report of the International Commission of Experts, a number of field and modelling studies have been conducted in Neva Bay and the Gulf of Finland. Some conclusions are given based mainly on results of field observations made in Neva Bay and along the Neva River (see Figs. 6, 7) by the Research Institute of Ecological Safety (Preoprazhensky, pers. comm.).

In general, no fundamental changes occurred during 1992-1994. In the vicinity of the dam, a zone characterized by reduced exchange and horizontal gradients of phyto- and zooplankton, temperature, bacteria, and wastes, was sometimes observed depending on the weather conditions (primarily wind direction). Certain changes in currents occurred in the south-east part of Neva Bay due to the recent construction of two new canals. The most significant changes concern two parameters: transparency and bacteria pollution. Transparency increased throughout the Bay peaking at about 2.2-2.3 m which is very high for Neva Bay being close to values observed at the beginning of this century. This is caused by the termination of land-fill works within some coastal localities in the Bay. As for bacteria pollution, it has decreased considerably with the iso-line 10^4 coliform-bacteria/l (corresponding approximately to a boundary between "normal" and "polluted" waters) being largely shifted to the east and penetrating into Neva Bay in 1992. During the following two years the situation was somewhat aggravated, but the general

improvement is unambiguous. The reason is not mainly the increase in efficiency of treatment plants but primarily the degradation of the food industry in St. Petersburg and the decline of agriculture in the surrounding areas. Mean concentrations of heavy metals and nutrients, as well as the level of eutrophication, did not change noticeably though some peaks in many-fold excess of standards have been repeatedly observed for Hg as well as for other heavy metals in different localities of the Bay (in October 1993 a state of emergency was announced).

For Neva River the environmental situation also remains, in general, as it was in eighties. One can note only the significant decrease in bacteria pollution within the city of St. Petersburg due to reasons already explained. Concentrations of chemicals show peaks along the river near places where tributaries inflow or populated localities are situated.

3. GULF OF FINLAND YEAR - 96

It may be said that the existing estimates of the environmental situation in the Neva Delta/Neva Bay and the Eastern Gulf of Finland testify that the ecological state of this water system, in spite of the recent partial improvement, remains highly unsatisfactory. The same can be said for the whole Gulf of Finland for which additional serious consideration must be given to the eutrophication processes. The supporting evidence is available from the HELCOM monitoring stations, as well as from observations being made by Finnish, Russian and Estonian oceanographers in accordance with their own scientific and technical programmes. At present, it becomes obvious that a joint effort of all three countries should be mounted to get an integrated and sufficiently detailed view of the real environmental and ecological state of the Gulf of Finland. Two years ago Finnish oceanographers put forward a proposal to consolidate the forces of three countries in an international project - Gulf of Finland Year - 96 (GOF'96) - following the example of the Gulf of Bothnia Year - 91. Based on the knowledge that

the condition of the Gulf of Finland is deeply unsatisfactory and may become much more aggravated, it was proposed to adopt as a basic goal of the Project "to create a uniform picture of the condition of the Gulf of Finland, its development and the required water pollution control measures to improve the condition". Hence, the full appellation of the project is "Gulf of Finland - 96: Pollution load criteria for sustainable development in the Gulf of Finland".

In the course of realization of this project the actual condition of the Gulf of Finland is assumed to be estimated along with its possible evolution under different conditions to be in a position to determine:

- what final condition of the Gulf is attainable and by which means,

- what relevant measures on pollution reduction and regulation are to be recommended for authorities.

It is agreed that research must be based on ecosystem modelling. A number of models have been developed in Russia, Finland and Estonia (for example the Finnish-Estonian ecosystem model FINEST, as well as well as Russian models developed at the State Oceanographic Institute, Research Institute of Ecological Safety, Russian State Hydrometeorological Institute and others can be tested) and certain preliminary results have already been obtained by some of them. Several meetings have been arranged for the coordination of preparatory work by the participants. As a result that the following main research components are to be undertaken:

- Pollution loads (discharges: point, diffuse and atmospheric);

- Large-scale transportation of fluxes (circulation and exchange of waters and matter between and within particular areas of the Gulf; Gulf of Finland - Baltic Proper; coastal - open sea; water - bottom);

- Critical biological and chemical processes;

- Ecosystem modelling.

In addition the questions of data base creation, waste reduction techniques and quality assurance of experimental methods works are to be included in the project.

The preparatory and coordinating work is time consuming and a number of difficulties must be overcome. A list of some organizations in St. Petersburg dealing with the study of the Gulf of Finland

1. State Oceanographic Institute (SOIN);

2. State Hydrological Institute (SHI);

3. Institute of Lakes Research (ILR);

4. All-Russian Geological Institute (ARGI);

5. Russian State Hydrometeorological Institute (RSHI);

6. Research Institute of Ecological Safety (RIES);

7. Krylov Shipbuilding Research Institute (KSRI);

8. Zoological Institute (ZIN);

9. Institute "Gidroproekt";

10. North-West Territorial Hydrometeorological Service or Russian Hydrometeorological Institute of North-West (RHINW);

11. Lenmorzashita;

12. Scientific Production Firm "Everest".

Principally, all these organizations may take part in the GOF-96 Project and some have developed specific plans aimed mostly at an extension of their past research. Below is a short summary of some of these studies.

- SOIN, RHINW and SHI are planning to continue during 1995 and 1996 to monitor the hydrographical, hydrochemical and hydrobiological conditions in the Neva Bay (22 stations) and in the Gulf of Finland (25 stations) shown in Fig. 8. Observations include meteorological, physical (water temperature, transparency, waves), chemical (oxygen, pH, nutrients, some pollutants) parameters along with biological sampling for the determination of structural parameters of phytoplankton, zooplankton and zoobenthos. All these stations principally are to be made every month during May-November and once in winter.

- SHI, in addition to the above mentioned field surveys, also plan to carry out observations of currents with current meter mooring stations placed at six sites within the Koporskaya Bay (southern coast of the Eastern Gulf of Finland) for 2-4 months using the R/V "Priboi". Winter observations from ice are also envisaged.

- Programme of KSRI includes: (a) the automatic measurements of chlorophyll-a concentration along with temperature and salinity on the ferry-boat "Konstantin Simonov" on line between St. Petersburg - Helsinki from

April to November; and (b) the systematic research trips on R/V "Krylovets" from June to October (one, 4-day trip per month) with hydrophysical measurements (including current measurements by the ADCP) to the west from the dam and along the route of "Konstantin Simonov".

- ARGI plan to continue its large programme entitled "Marine Ecological (Geoecological) Patrol" (MEP) started in 1990 and aimed at "evaluation of momentary ecological (geoecological) situation in the Baltic Sea". The MEP-95 cruise on board R/V "Professor Logachev" is to be carried out from May 25 to July 2-4 covering the distance from St. Petersburg to Bornholm with three main working regions: Gulf of Finland, Gotland Basin and Bornholm Deep. Research studies in the Eastern Gulf of Finland are scheduled for May 26-31 mostly geological and geophysical measurements and sampling in combination with some hydrochemical, optical and radiometrical sounding.

- Firm "Everest" project different types of ice cover research including aerocosmic surveying compatible in time with observations from ice-breakers in the Eastern Gulf of Finland.

4. BALTIC FLOATING UNIVERSITY

With a few exceptions, the activities of all the above mentioned organizations depends on government financial support. In spite of the decision for Russian participation in the GOF-96 was taken at the governmental level, the financial support does not presently exist. Therefore all the potential participants are only able to plan their work without any certainty that it will really be made. In these circumstances the Russian State Hydrometeorological Institute (RSHI), an educational establishment, participates in the preparatory work to GOF-96 within the framework of the UNESCO Floating

University (FU) Programme. Last year they initiated the creation of the northern branch of FU entitled "Baltic Floating University"

The cooperative research and training project Floating University was launched by UNESCO in 1991 following the initiative of several universities in eastern and western Europe. Basically, the project seeks to achieve more effective training of students through their participation in advanced multi-disciplinary marine research programmes (the "Training-through-Research principle). The activity of FU must include:

- annual "training-through-research" cruises (the "core" of the entire Programme);
- mid-cruise field workshops;
- post-cruise scientific seminars;
- publications of initial results and presentations at scientific meetings

In addition support for specialized courses at some UNESCO centres and for processing cruise data are provided. This activity falls within the overall context of such UNESCO programmes as COMAR, PROMAR, TREDMAR, Global Faculty.

Noting the close connection with the proposed Gulf of Finland Year-96 Project, the main points of the Baltic Floating University field activity, developed in cooperation with the Zoological Institute (ZIN), can be designated as follows:

(1) Ecological state of the Gulf of Finland and adjacent parts of the Baltic Sea

This is implemented through the estimation of existing hydrographical, chemical and biological conditions in related areas on the basis of actual data observed with their subsequent use for prognostic modelling of ecological state evolution at different versions of anthropogenic impact. This ensures an intimate connection between BFU and GOF-96. Similar links are to be developed between BFU and other international (BALTEX, Baltic Monitoring - HELCOM, Baltic Project, Baltic) and national Russian (World Ocean - Ministry of Science, GIDROMET-2000 - State Committee of Higher Education) programmes.

(2) Studying the Luga-Koporye region

This study envisages the thorough investigation of the relatively small near-coast region in the Eastern Gulf of Finland embracing its shallow part immediately adjacent to the very shoreline. Specific interest in this region consisting of two bights ("Guba"), stems from a large nuclear power plant located on the shore of Koporskaya Guba and the construction of an immense port complex being projected in Luzhskaya Guba. Hydrographical, chemical and biological data obtained for local waters and sea bottom are to be used for the assessment of these bights and diagnostic/prognostic modelling of smaller scale. In particular, the boundaries of this region and station positions were assumed so as to be compatible with requirements of existing hydrodynamical and ecosystem models brought to use of the Gulf of Finland. This region seems also to be appropriate for field experiments for the estimation of characteristics of effective horizontal exchange between the coastal zone and the open central part of Eastern Gulf of Finland.

(3) Studying the marine ecosystems within the coastal shoaliness around islands in the Eastern Gulf of Finland

The ultimate goal of this study is to contribute to the development of a scientific substantiation of establishing and monitoring a marine protected area in the Eastern Gulf of Finland including a group of islands (Seskar, Bolshoi Tuters, Malyi Tuters, Virgins, Gogland), as well as the region of Kurgalsky Peninsula and Kurgalsky Reef with adjacent banks and some skerry areas of the northern coast. In these explorations the central position is held by work of scuba-divers permitting benthos and seabed sampling collections with bottom landscape description and underwater photography. The creation of a protected area in the Eastern Gulf of Finland was proposed by an international group of the Baltic Marine Biologists (BMB) and World Wide Fund for Nature (WWF) in 1992 and also supported by HELCOM and the Local Government of Leningrad District of the Russian Federation in 1994.

(4) Post-expeditionary processing and analysis of data

This study is being implemented within the framework of cooperation with the UNESCO "Global Faculty" Project and envisages the fulfilment of processing and analysis of field data with the use of computer modules developed by UNESCO. Interaction between two Projects (BFU and GF) makes it possible to employ the satellite remote sensing data along with their interpretation. Results of BFU expeditions are used, in particular, for calibration and refinement of SST (sea surface temperature) data.

While the first point applies mainly to future plans, the last three have already been implemented, though in the initial stage, during cruises organized by RSHI during 1993 and 1994. Each year the expedition consisted of two stages corresponding to points 2 and 3 of the above mentioned BFU programme.

In 1993, the first stage (13.07 - 23.07), related to point 2, was carried out within the Luga-Koporye region matching practically the relevant "box" of the ecosystem model FINEST. The oceanographic survey with stations coinciding with the model grid-points spaced 4 km apart (see Fig. 9a) was performed by two RSHI ships of which the larger "Professor Serge Dorofeev" (displacement 2600 t, draught 5 m) worked in a deeper zone, while the smaller one - sailing catamaran "Orients" (displacement 4.2 t, draught 1.8 m) worked within the coastal shallow area performing additional "shore" stations by observers on shore and by this extending the observed area up to the coastline. Measured parameters included physical, chemical and biological ones. At some stations underwater measurements were carried out from "Orients" by scuba-divers, all students. In addition, three of the most eastern HELCOM-stations and one, two-day anchor station with current measurements were made by "Professor Serge Dorofeev".

The second stage (18.08 - 26.08), related to point 3, was performed by "Orients". During this stage of the study the composition and distribution of phyto- and zoobenthos around islands of Bolshoi Tuters and Seskar was attempted. Three underwater traverses from the leeward of each island were made with benthos and seabed sampling and underwater photography.

In 1994, the expedition also consisted of two stages but this year the study of benthos around the islands was first carried out (9.07 - 24.07). A number of traverses positioned roughly radially around the islands of Malyi Tuters, Virgins and Gogland were made along with some additional observations near the islands of Moshnyi, Malyi and Sommers.

The second stage of the 1994 study (9.08 - 19.08), focused on a repeat oceanographic survey in the Luga-Koporye region by again using two research ships: R/V "Persey" (Russian Navy) and "Orients". This time not all the stations were covered and none of the "shore" stations were monitored, primarily because of bad weather conditions (see Fig. 9b). At the same time the information obtained can be considered as

fairly indicative, in particular for comparison between 1993 and 1994. Eight "geological" stations were also undertaken by "Orients" and again, three HELCOM-stations by "Persey".

Based on the results obtained thus far, it seems reasonable to say that some features of thermohaline structure (Figs. 10, 11) give an indication on local dynamic processes (inflow from the central part of the Gulf into Luzhskaya Guba (Fig. 11), upwelling near the western coast of Koporskaya Guba (Fig. 10a)). Amre detailed investigation of the movements in this region seems very desirable.

It should be noted that the abundant phytoplankton bloom and unusually high summer nitrate concentrations were observed in the Luga-Koporye region, especially in 1993. As these concentrations were generally decreasing with distance from the shore one can imply that the local impact prevails here over that of the Neva River. A more detailed analysis made it possible to reveal considerable anomalies in N:P molar relation in July, 1993, which, along with remarkably high nutrients concentrations, suggests a variance of natural nutrient cycling. Constantly stable oxidizing conditions in the near-bottom waters and upper mud layer have been found in spite of high eutrophication. Certain information was obtained concerning plankton and benthos distribution in the Luga-Koporye region and around islands mentioned above. A summary of the results of BFU expeditions can be found in Nekrasov and Galtsova (1993) and Nekrasov *et al.* (in press).

The preliminary results of BFU field research were discussed at mid-cruise and post-cruise seminars held in St. Petersburg (2), Stockholm and Tallinn in 1993 and then in St. Petersburg (2) and Helsinki in 1994. Research programmes of field studies of BFU in a current year were considered and confirmed at regular workshops held in May, 1994 and March, 1995.

5. PROPOSALS

From the above reasoning and knowledge that the tasks and activities of the Baltic Floating University fit into the aims of the Working Group 2.1 of the Canada/Russia Memorandum of Agreement (MOA), particularly the concerns of its contacts with GOF-96, it seems expedient to propose cooperation between National Water Research Institute and Russian State Hydrometeorological Institute within the framework of the BFU's activity. At the outset, cooperation in the preparation and implementation of a field experiment on the estimation of effective horizontal exchange characteristics between coastal zone and the open central part of the Eastern Gulf of Finland could be envisaged including repeated hydrographic surveys accompanied by current measurements using Eulerian and Lagrangian methods. Luzhskaya Guba, with its appreciable local river discharge, appears to be the appropriate area for an experiment of this nature (Fig. 12). The NWRI contribution could be in preparation of the joint working programme, provision of scientific and methodological guidance in the arrangement of field experiments and interpretation of results as well as participation, as far as possible, in field experiment 5.

During this experiment the emphasis should be placed on the combination of measurements performed within the bight area and along its contour (coast-line and the open "water" boundary) with special observations in the mouth of the Luga River. It seems advisable to involve other Russian scientific organizations with their relevant equipment in this joint activity.

Contacts between NWRI and RSHI on coordination and development of their joint research in the Eastern Gulf of Finland within the framework of the BFU Programme and proposed GOF-96 Project are to be pursued. Provision is made for participation of Prof. C.R. Murthy in BFU activities.

REFERENCES

1. Rodenhuis, G.S. (1992) The St. Petersburg Barrier. The evaluation by the International Commission of Experts; their Findings and Recommendations. June, 32 p.

2. Belyshev, A.P. and Preobrazhensky, L.Y. (1966) Structure of currents in Neva Bay and Eastern Gulf of Finland based on field measurements. Proc. of State Hydrological Institute, No. 321, Leningrad, Gidrometeoizdat, pp. 4-16 (in Russian).

3. Nekrasov, A.V. and Galtsova, V.V. (1993) Marine Environment investigation in inner Gulf of Finland. WWF Baltic Bulletin, No. 6, pp. 7-8.

4. Nekrasov, A.V., Lyakhin, Y. I., Korovin, V. P., Chantsev, V.V., Bezzabotnov, V.S. and Galtsova, V.V. Ecological Research in Coastal Waters of the Gulf of Finland. Proc. of the XIX Conference of Baltic Oceanographers (in press).

Table 1(a): Main Natural Characteristics

		Neva River
Length	-	74 km
Depth (max)	-	24 m
Width	-	400 - 600 m
Surface level drop	-	4.5 m
Discharge (mn)	-	2 500 m^3/s (78 km^3/yr)
winter	-	1 800 m^3/s
summer	-	3 000 m^3/s
Velocity in delta	-	1 - 2 knots
in rapids	-	5 - 6 knots
Navigable (mn)	-	218 days per year
Ice cover duration	-	45 - 180 days per year
Ice thickness	-	40 - 65 cm

		Neva Delta
Number of islands	-	42
Number of branches	-	21
Number of canals	-	19
Main branches	-	5
Water surface/Total surface	-	0.25
Total cross-section	-	6 500 m

Table 1(a) (cont.)

	Neva Bay and Gulf of Finland	
	Neva Bay	Gulf of Finland
Length	22 km	400 km
Width	15 km	130 km
Depth (mn)	4 m	37 m
Depth (max)	11 m	123 m
Surface area	400 km^2	29 600 km^2
Volume	1.6 km^3	1 100 km^3
Catchment area		421 000 km^2
Run-off		110-125 km^3/yr

Table 1(b): **Flooding in St. Petersburg**

Year	Level rise
1777	321 cm (3.21 m)
1824	421 cm (4.21 m)
1924	380 cm (3.80 m)
1955	282 cm (2.82 m)
1986	260 cm (2.60 m)

Table 2(a): Heavy metals in Neva River and Bay, compared to occurrence in other regions and to standards: in micrograms per litre

		Lead	Copper	Mercury	Cadmium
Neva River		5	5	<0.1	1
Neva Bay		2-24	3-28	0.05-0.30	0.5-2.0
Gulf of Finland		5-30	3-17	0.05-0.15	0.5-5.0
North Sea		1-3	1-2	0.02-0.10	0.03-0.1
Rhine Delta		2-5		0.01-0.13	0.05-0.4
Standards	• D	25	3	0.03	0.2
	• EPA	3.2	12	0.012	1.1
	• USSR	10	1	0.1	1.0
NOEC		4	0.9	0.13	0.2

Table 2(b): Maximum accumulation levels of heavy metals in fish in Neva Bay, Gulf of Finland and Baltic Sea (all values in mg/kg DW)

		Lead	Cadmium	Copper	Mercury
1967-1974	Neva Bay	0.4	0.04		0.60
	Zelonogorsk	0.4	0.70		0.92
	Finnish Gulf	0.4	0.08		4.70
1989	Neva Bay	1.7 (4.7)	0.16 (0.46)	2.3 (6.2)	2.52 (0.11)
	Zelonogorsk	1.8 (5.8)	2.81 (0.35)	4.6 (4.2)	2.40 (2.63)
	Standards		1.0		0.4

Table 2(c): Nutrient concentrations Neva River, Neva Bay and the Gulf of Finland, with corresponding Dutch standards (in μg/l)

	Neva River	Neva Bay	Gulf (USSR)	Gulf (Finland)	Standard (Dutch)
PO_4-P		1-30			
Total P	5-70	15-30	15-35	15-50	150
NO_3+NH_4-N		100-300		5-200	1200
Total N		900-1200	700-1200	300-500	2200

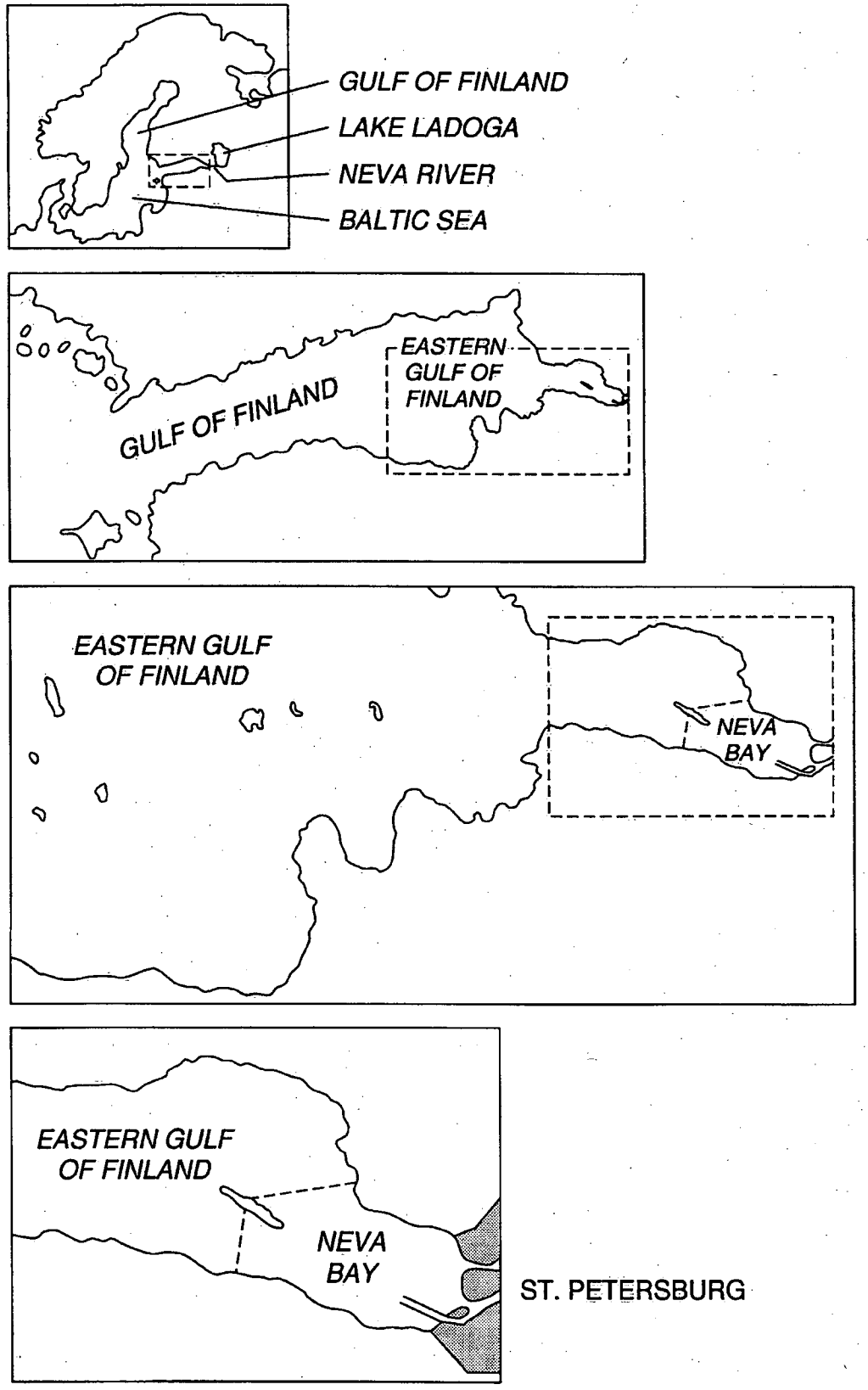


Fig. 1. Location of Neva Bay and the Eastern Gulf of Finland

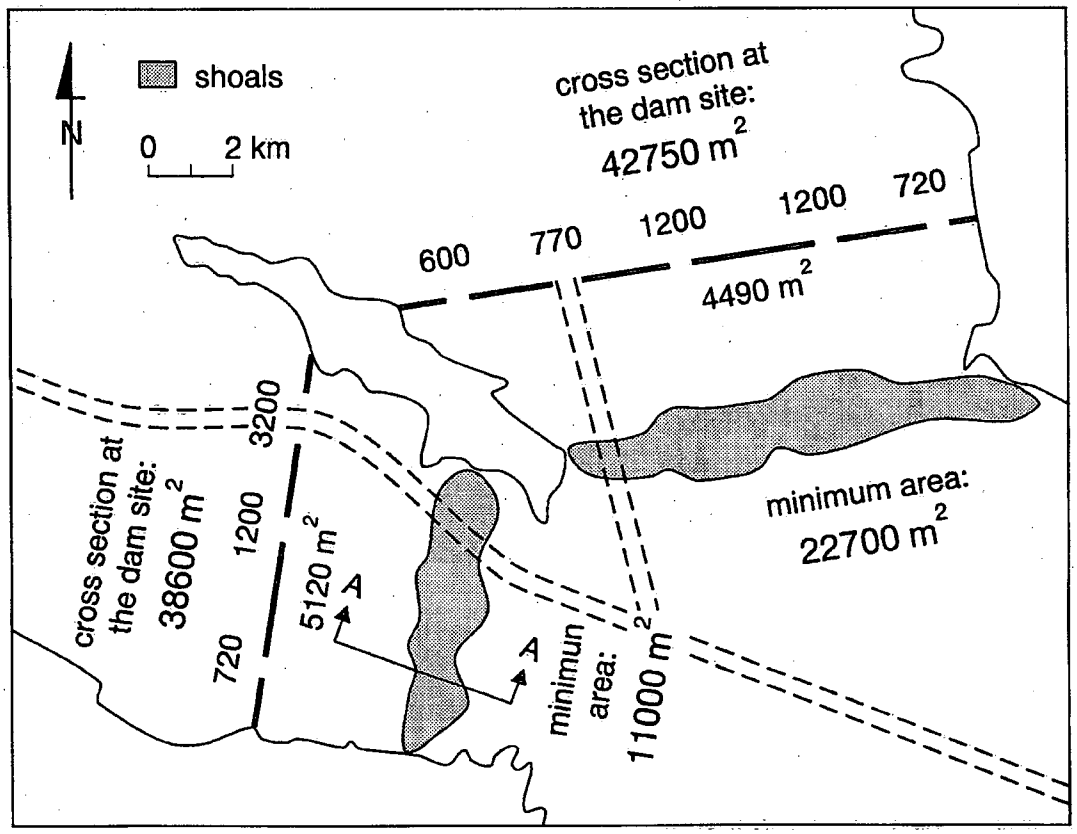


Fig. 2. Arrangement of the Flood Protection Barrier (from Rodenhuis, 1992)

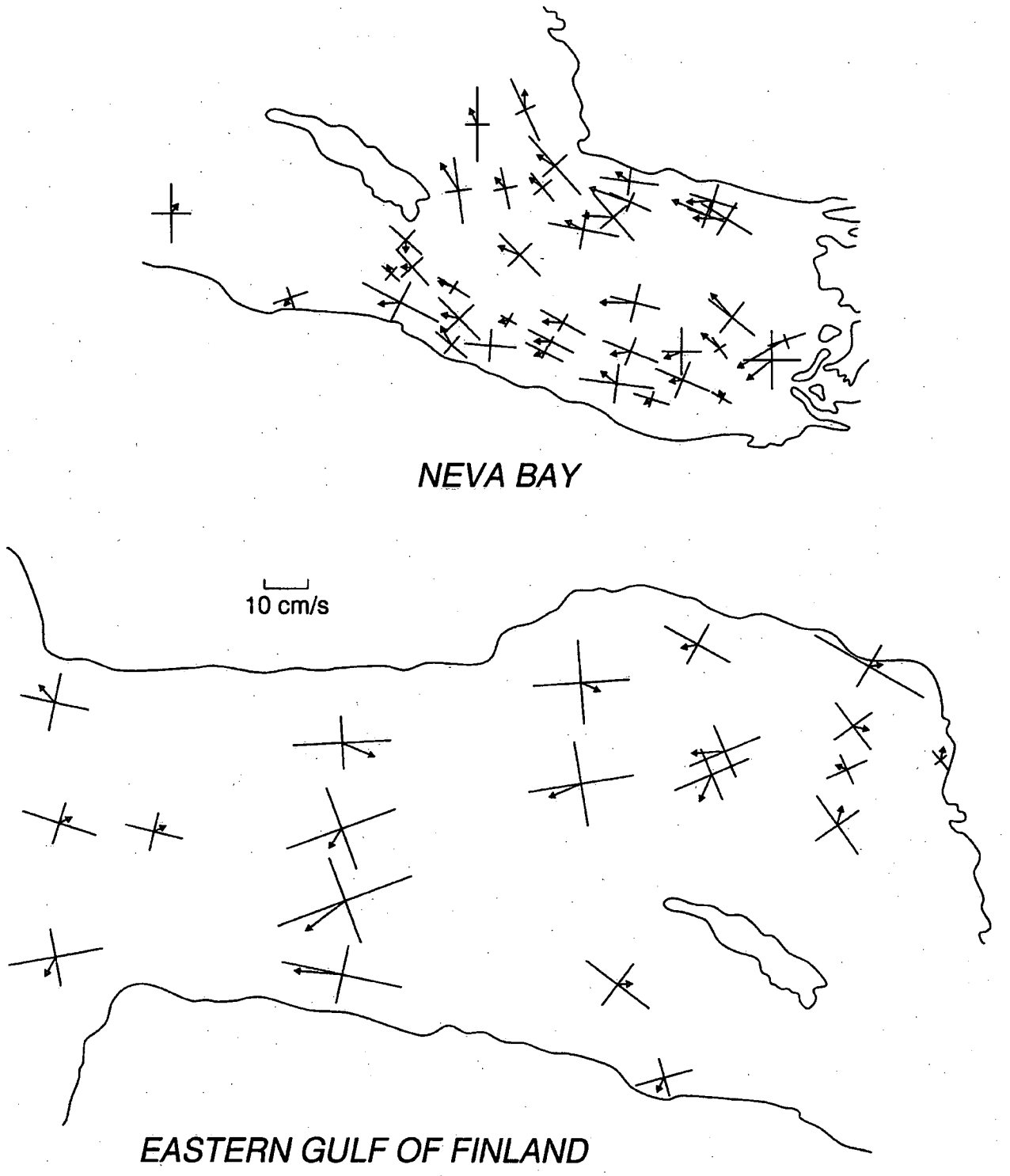


Fig. 3. Surface currents observed in Neva Bay and Eastern Gulf of Finland: main axes of dispersive ellipses, and mean vector averaged over periods from two weeks to six months. (from Belyshev and Preobrazhensky, 88)

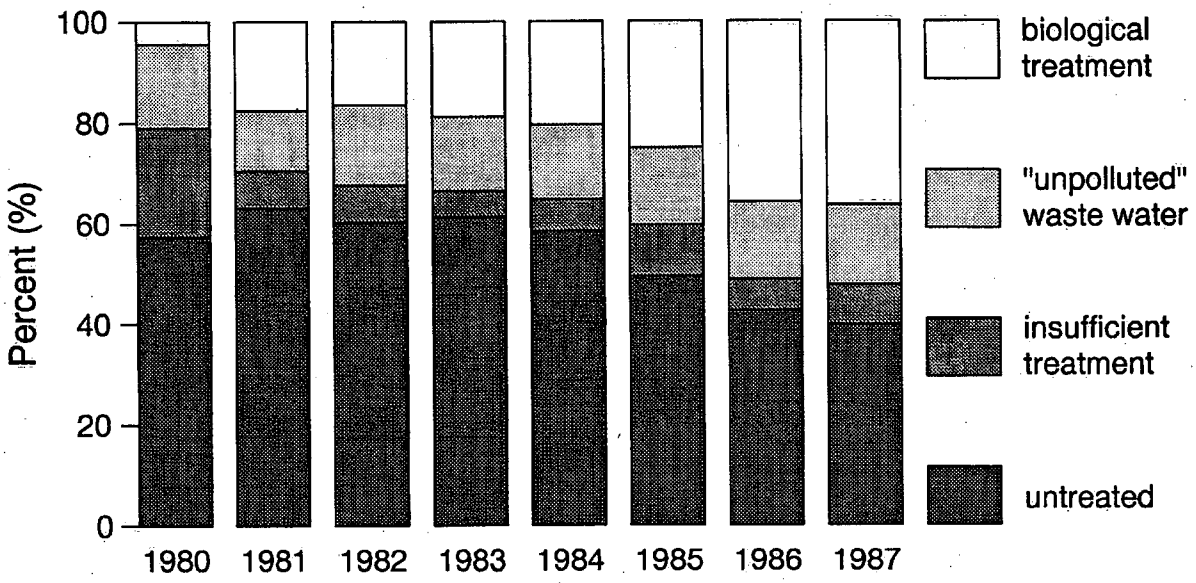


Fig. 4. Treatment of waste water in St. Petersburg (1980-1987) (from Rodenhuis, 1992)

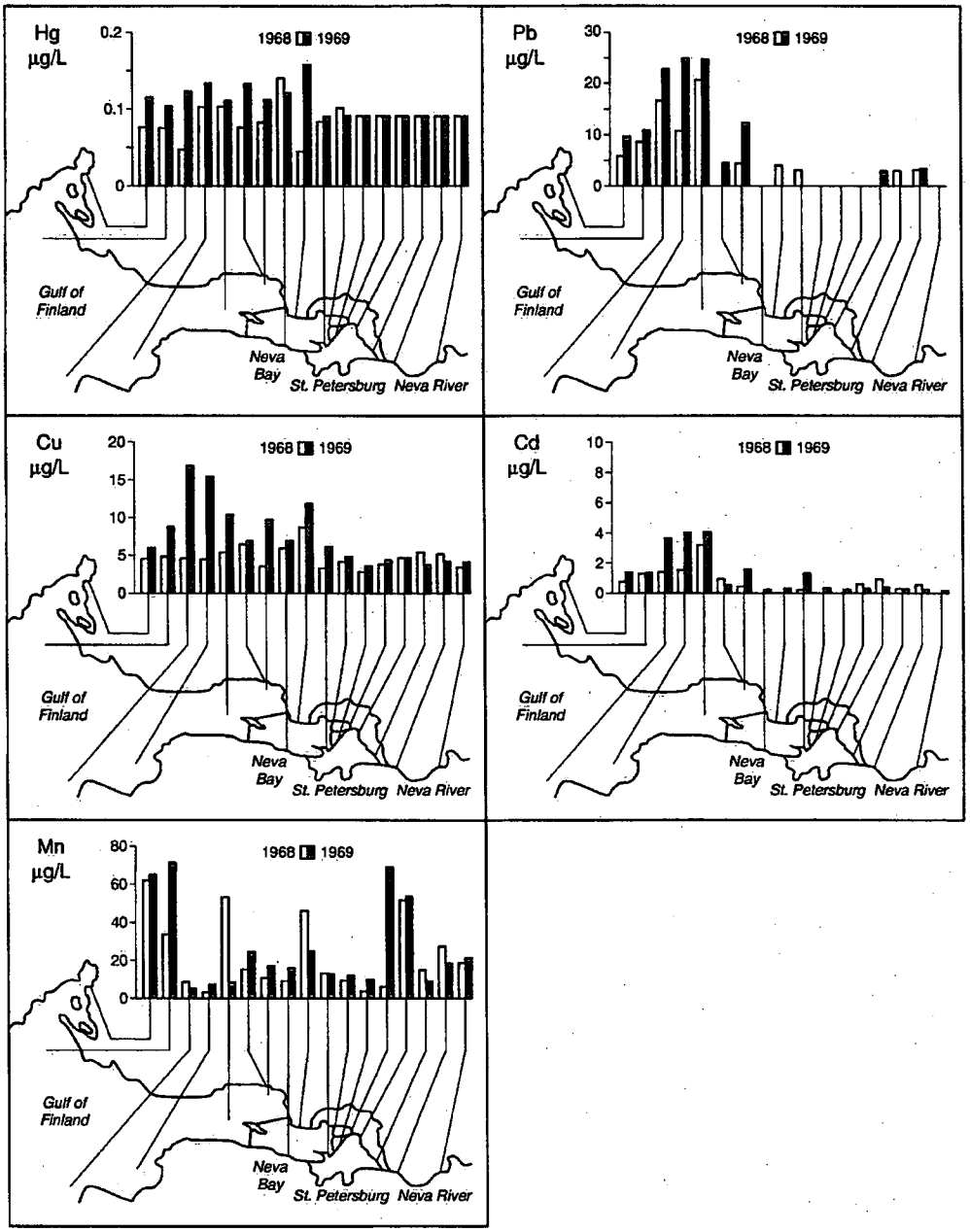


Fig. 5. Yearly averaged concentrations (1988 and 1989) of metals: total concentration of mercury, lead, copper, cadmium and manganese along a transect including the Neva River, Neva Delta (St. Petersburg), Neva Bay and the eastern part of the the Gulf of Finland up to Vyborg.

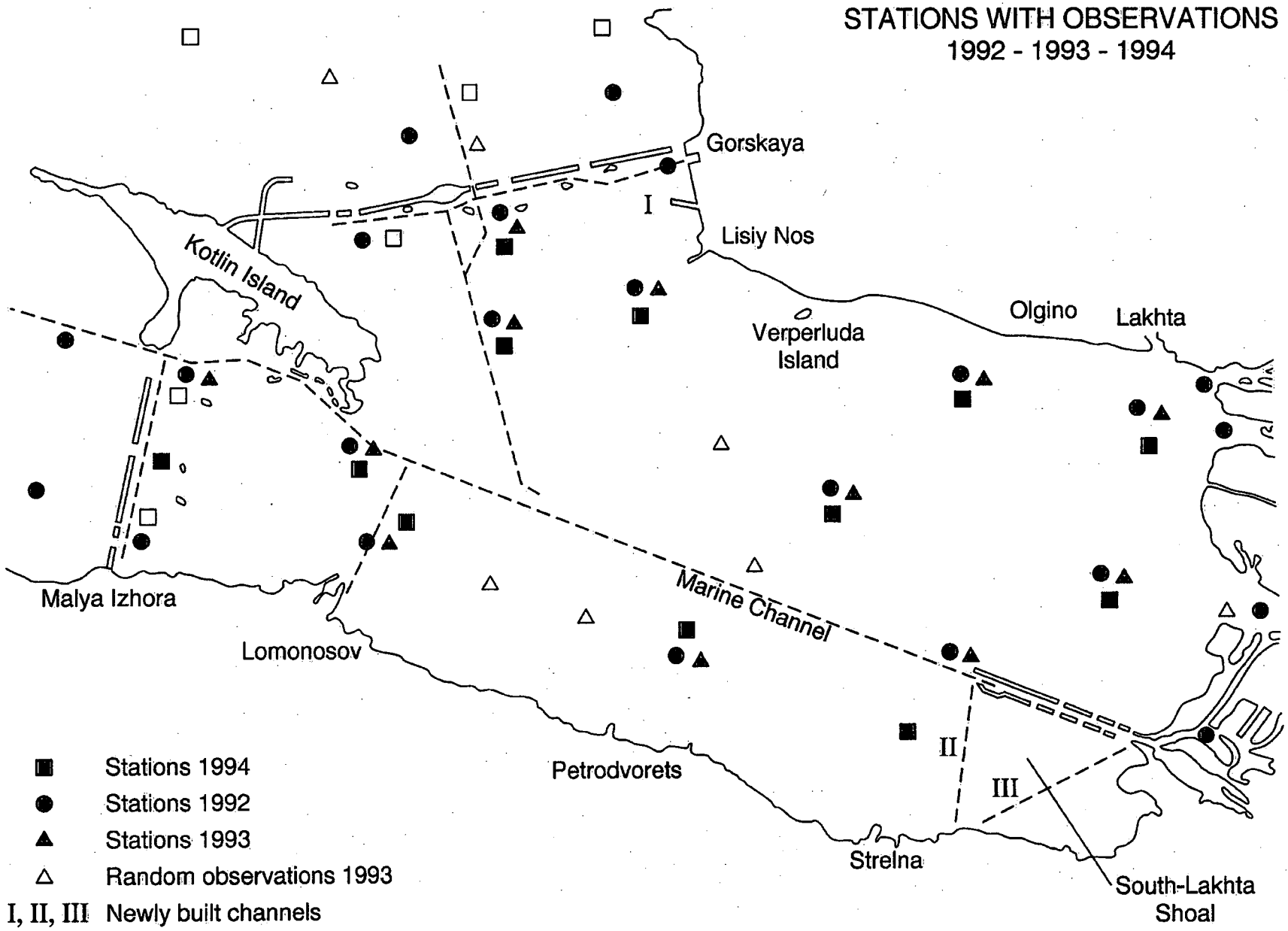


Fig. 6. Stations in Neva Bay and Eastern Gulf of Finland at which the observations have been made by the Research Institute of Ecological Safety, St. Petersburg in 1992 - 1994

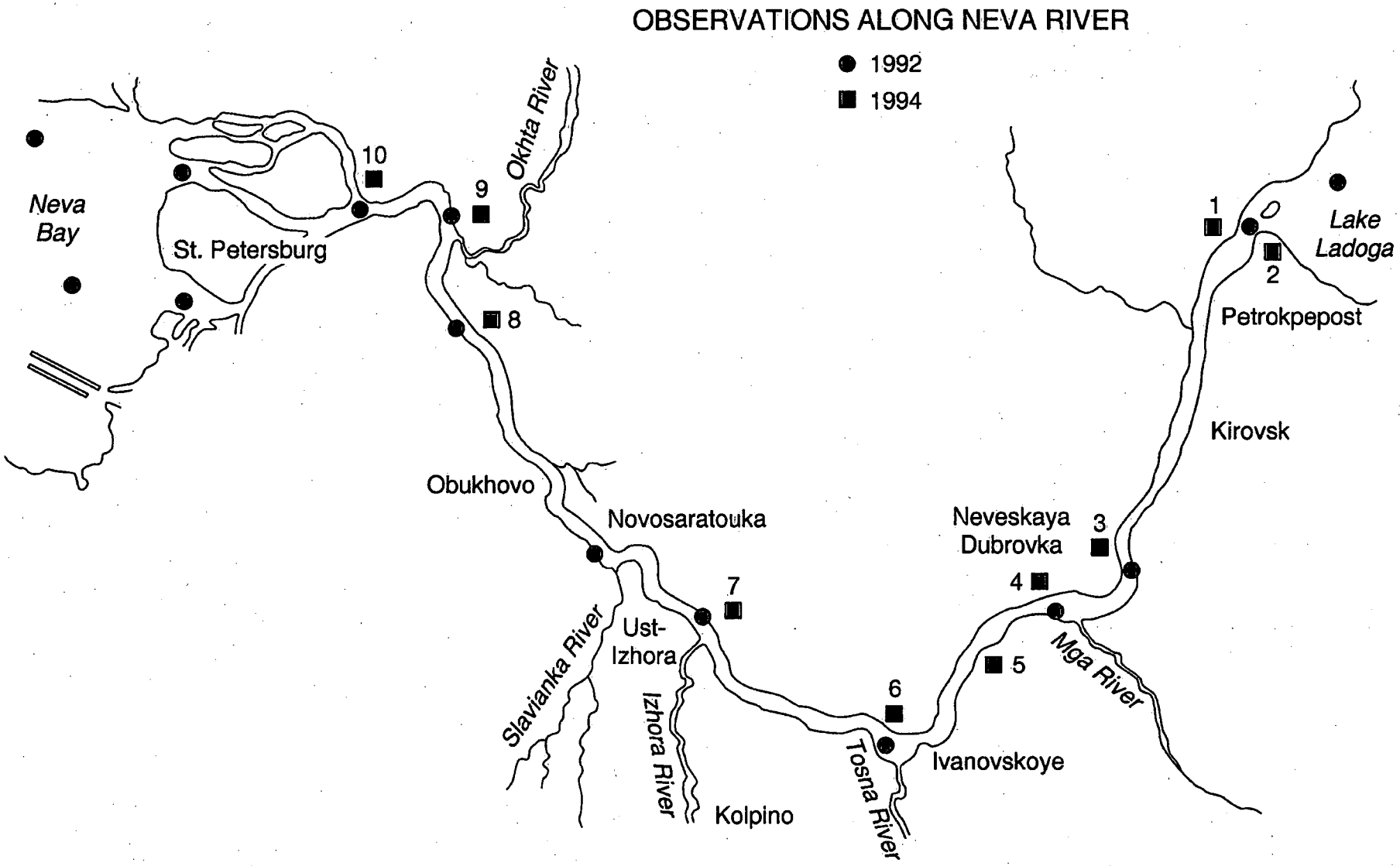


Fig. 7. Stations along the Neva River at which the observations have been made by the Research Institute of Ecological Safety in 1992 and 1994

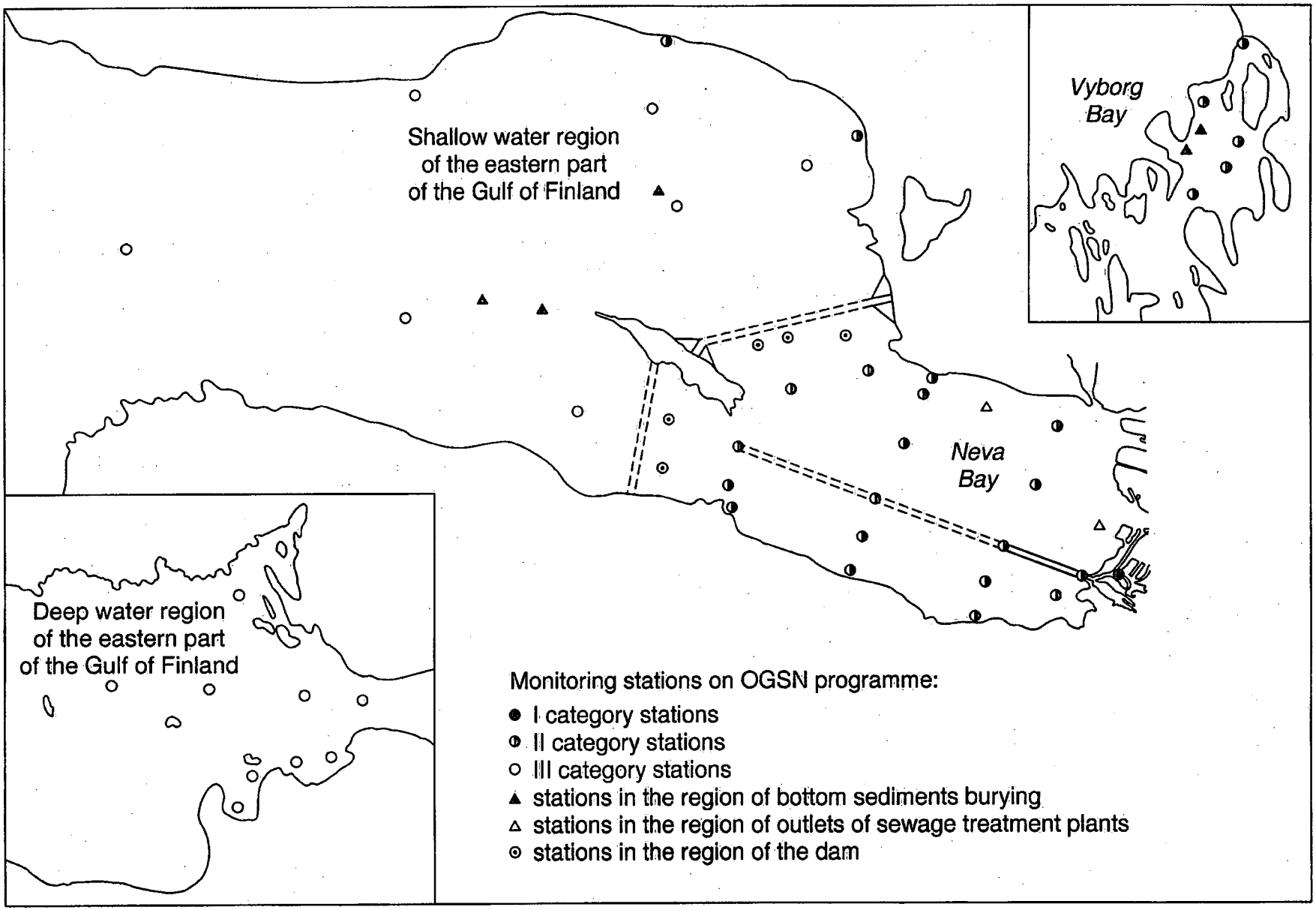
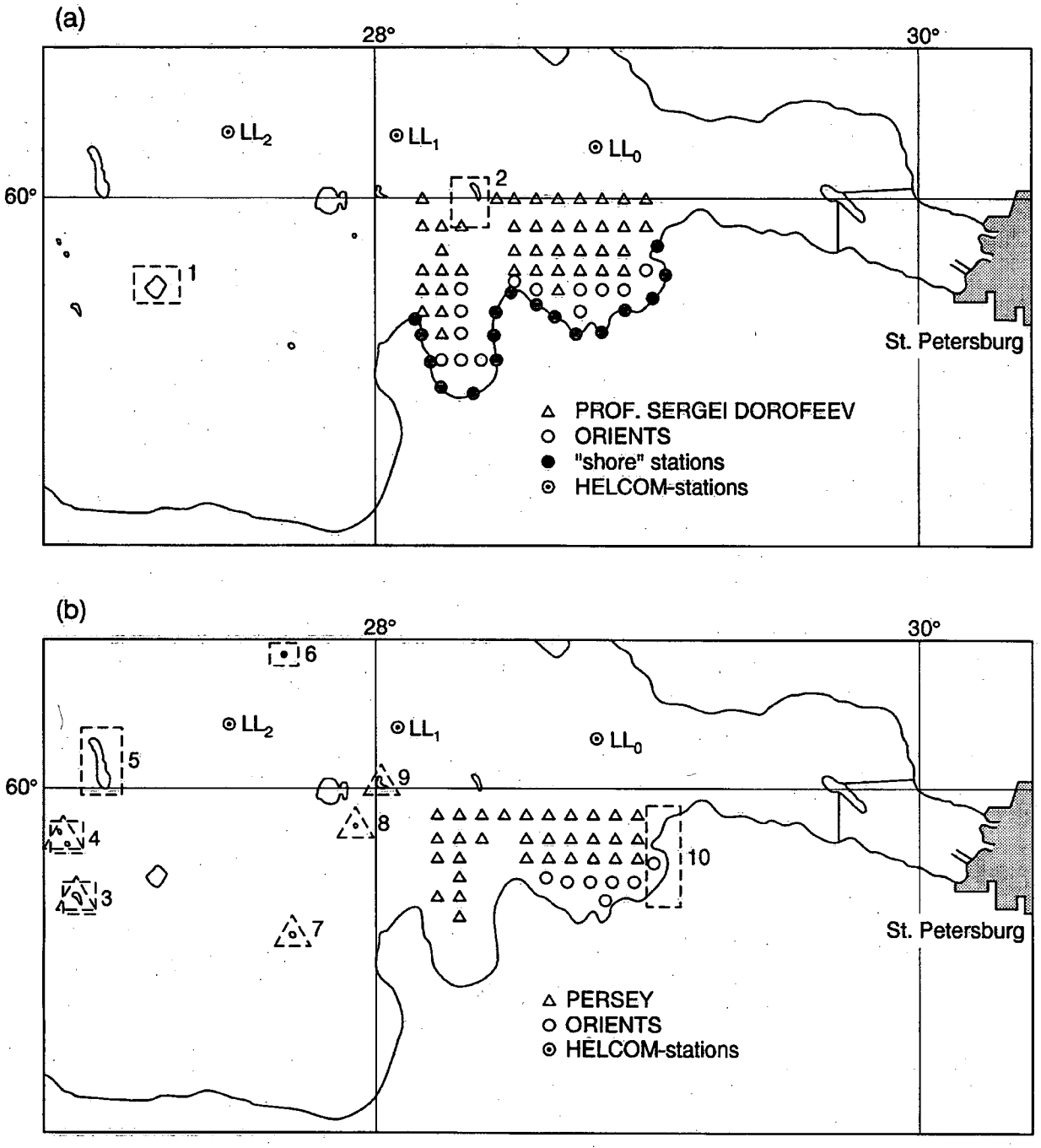


Fig. 8. Monitoring stations in Neva Bay and Eastern Gulf of Finland



underwater research near islands:
1 - Bolshoi Tuters; 2 - Seskar; 3 - Malyi Tuters; 4 - Virgins; 5 - Gogland; 6 - Sommers

seals observations near islands:
3 - Malyi Tuters; 4 - Virgins; 7 - Vigrund; 8 - Ostrovnoy; 9 - Malyi

10 - region of near-shore geological research

Fig. 9. General sketch of the (a) 1993, and (b) 1994 RSHI field research in the eastern Gulf of Finland

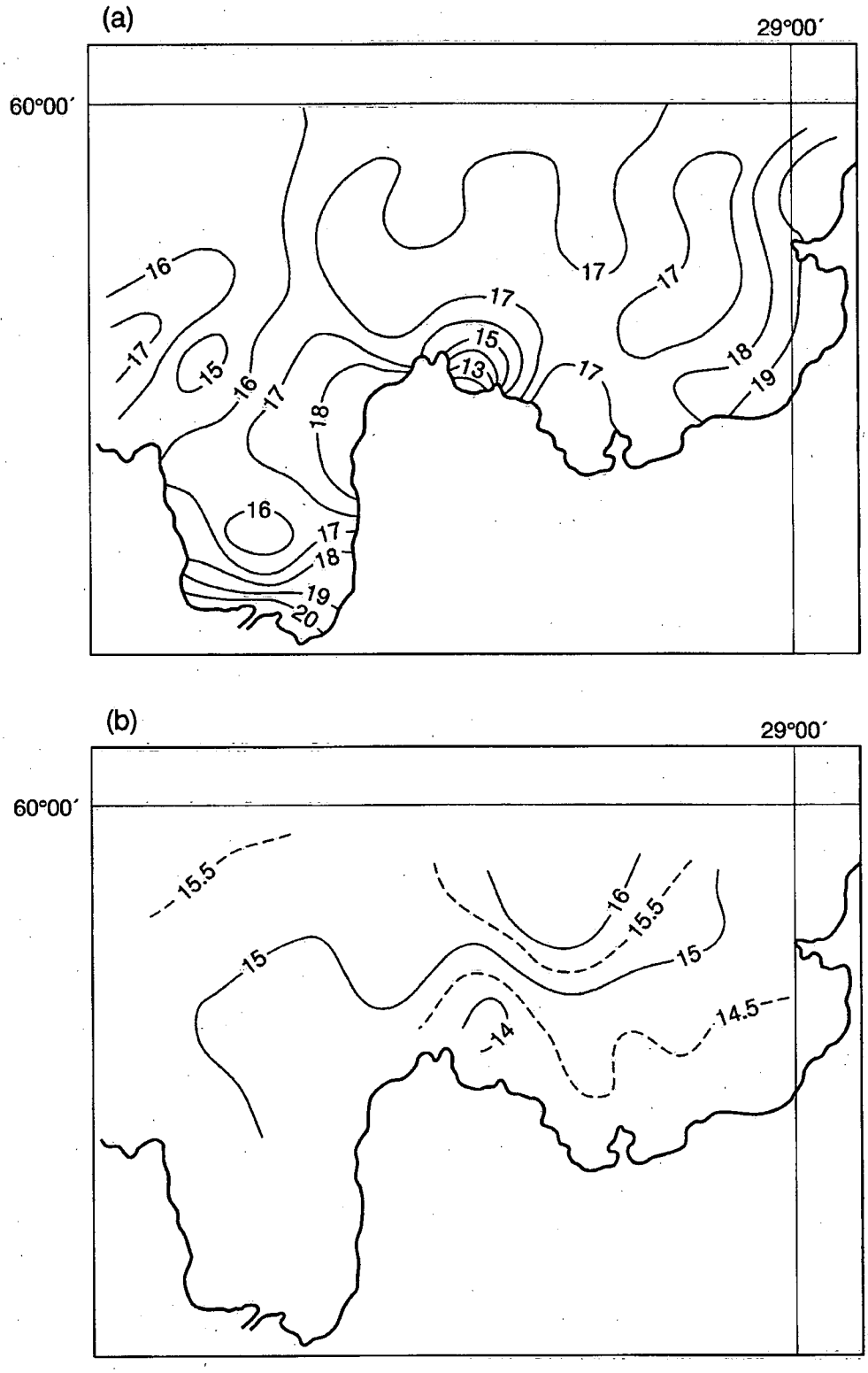


Fig. 10. Surface temperature distribution in the Luga-Koporye region: (a) July 18-21, 1993; (b) August 17-18, 1994

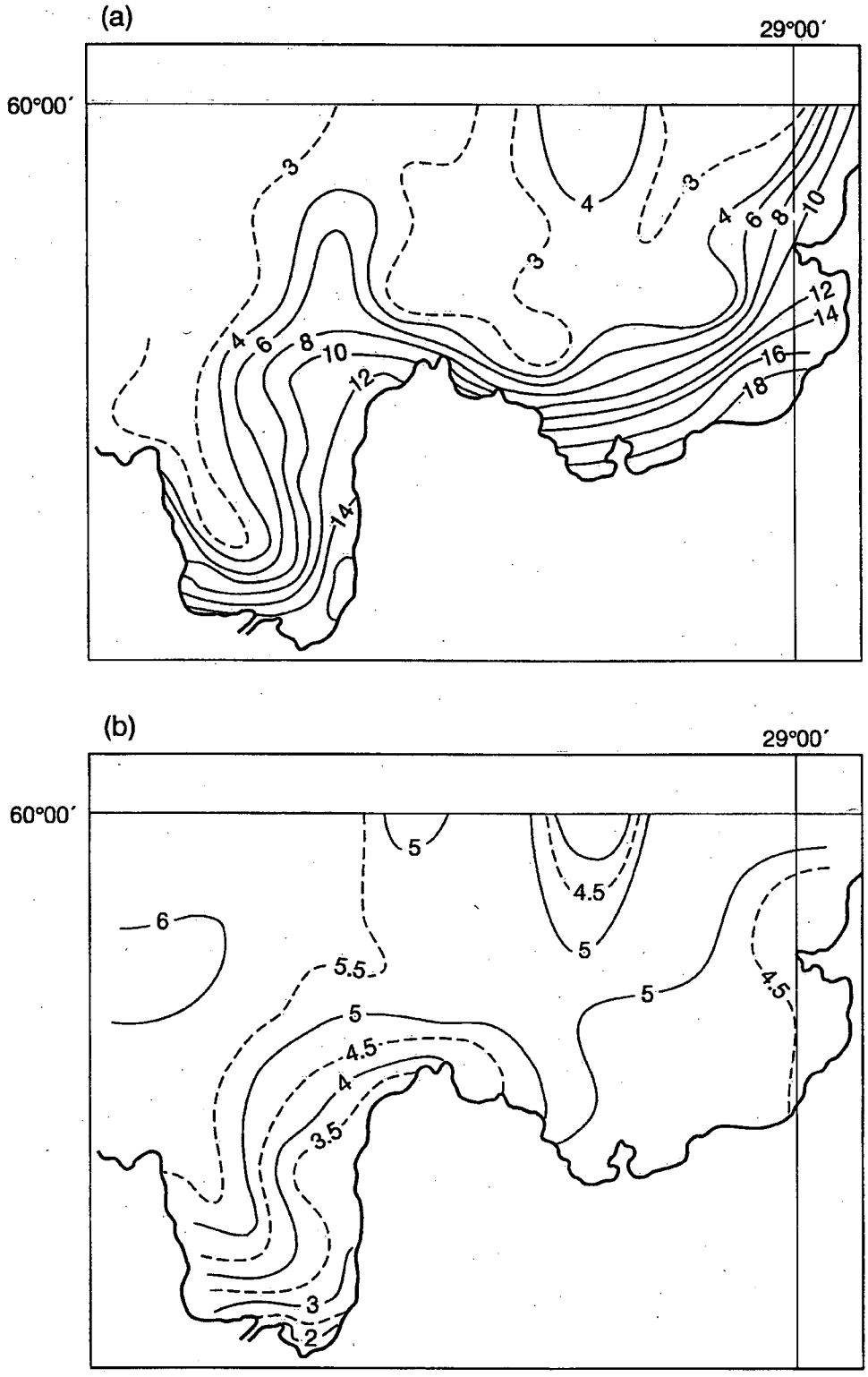


Fig. 11. Bottom characteristics distribution in the Luga-Koporye region (July 18-21, 1993): (a) temperature (^{O}C); (b) salinity (%)

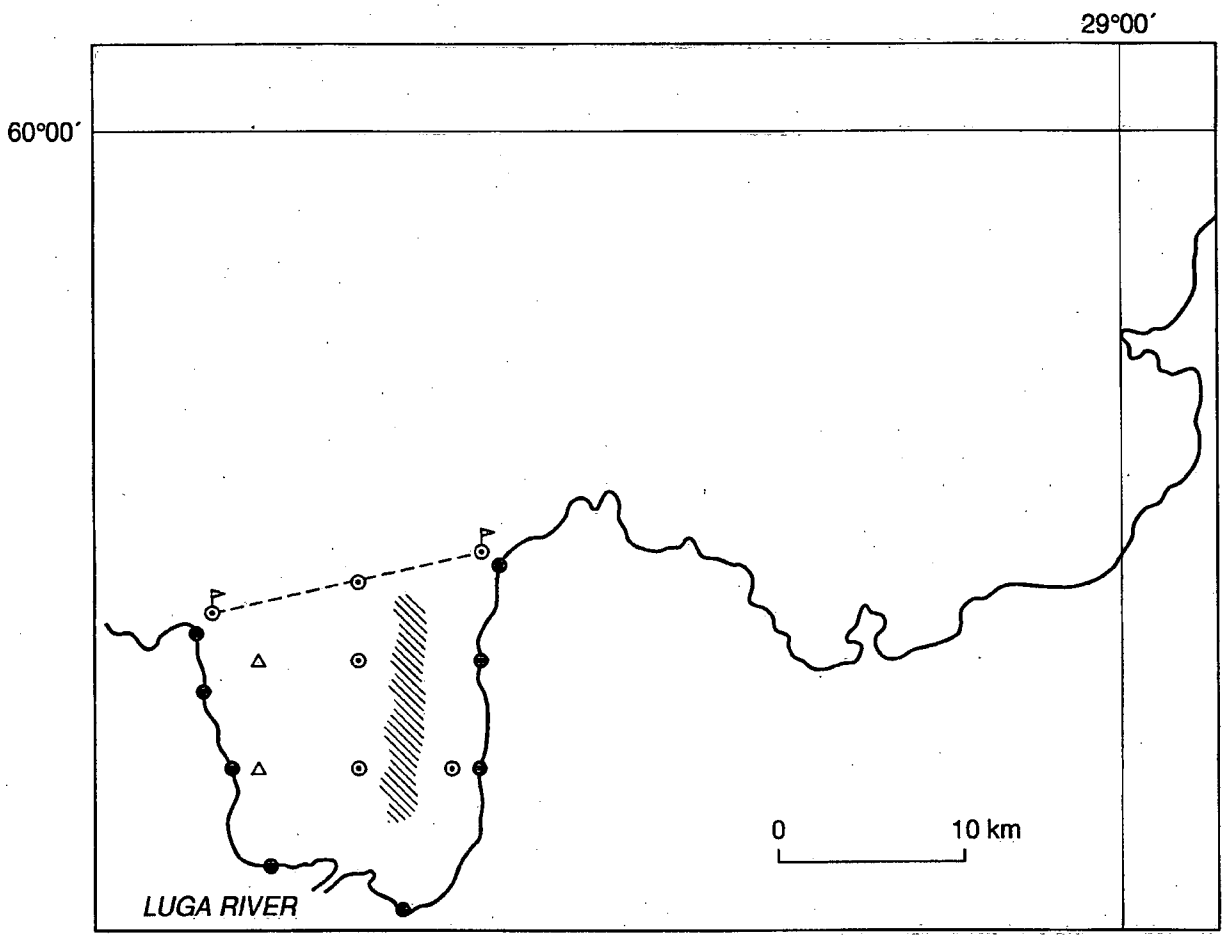


Fig. 12. Possible area of joint field experiment

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