



B I R E M E

Baltic Sea Research Programme

■ Nutrient inputs into the Gulf of Finland relative to its surface area are two to three times the average inputs of the whole of Baltic Sea. The two land-based sources of nutrients are of primary importance: the City of St. Petersburg and the River Neva drainage basin. However, the role of internal loading - the release of nutrients from the sediment - has become an increasingly important source of nutrients in Baltic coastal waters. Read more on _____ 3

■ The importance and effects of invader species are well recognized and under intense monitoring. However by conventional morphological criteria some species have been unnoticeable. The use of molecular tools have revealed the true story of colonization of Baltic Sea after deglaciation. Read more on ___ 7

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N E W S L E T T E R I / 2 0 0 4



EDITORIAL

The Baltic Sea is our common sea, the environmental threats our common problem – and dealing with them is our joint effort. International and national collaboration plays a key role in the assessment and efficient reduction of the impacts caused by human activities on the marine ecosystem.

Among the key goals of the BIREME programme are the national and international networking of scientists, and simultaneous enhancement of the development of creative research and training environments. The applicants were from the very start actively encouraged to seek co-operation in the form of joint projects or parallel comparative studies in other Baltic Sea countries. With the aim to further increase opportunities for networking, the coordinator organized a seminar for those applicants who were invited to submit a full proposal. At this seminar researchers were given information on various opportunities for international networking, and representatives from different funding organizations in the Baltic Sea countries told about their potential for research cooperation.

Some of the projects had already prior to BIREME established close collaboration between research groups and institutes in other Baltic Sea countries, and this collaboration has been further intensified by BIREME. Collaboration has been especially fruitful between BIREME projects and projects within the Swedish sister programme MARE (Marine Research on Eutrophication, www.mare.su.se). For more on collaboration in the field of eutrophication, see page 3.

The bilateral collaboration agreement between the Academy of Finland and the Russian Foundation for Basic Research made it possible to announce a special call for funding of Finnish-Russian collaborative projects on environmental problems in the Baltic Sea. Two projects were selected and incorporated into BIREME from the beginning of 2004. These projects, Dissecting cryptic invasions and Bioremediation of oil spills, are introduced on pages 7 and 10.

Intensified international and national collaboration also brings opportunities to versatile supervision of students. This possibility is comprehensively used by the project Governing a Common Sea. More on page 9.

In this Newsletter four out of the twenty-four BIREME projects present themselves. They illustrate a variety of collaborative actions being carried out within the programme and describe a few of the flourishing and dynamic training environments provided. At the end of the second year BIREME is in its prime. The projects are actively establishing research collaboration and networks within the programme, hence enhancing the successful outcome of the whole programme. I trust that the researchers involved in BIREME, now that we are entering the final year of the programme, share my full confidence that BIREME will have a major contribution to the work being done in favour of the Baltic Sea.

Helsinki, November 2004

Tuula Aarnio
Programme Manager



SEGUE¹⁾: A BIREME JOINT VENTURE BETWEEN FINLAND, ESTONIA, RUSSIA AND SWEDEN IN SEARCHING EFFICIENT PROTECTION STRATEGIES FOR THE EUTROPHIED GULF OF FINLAND

■ Anthropogenic nutrient flows from the catchment cause eutrophication and poses a major threat to coastal and marine ecosystems. The Baltic Sea receives nutrients from the catchment area of about four times the sea area itself and it belongs – together with the coastal North Sea and some other restricted coastal water areas – to the most eutrophied marine waters in Europe. The Baltic Sea is sensitive to eutrophication due to its outstanding external nutrient load compared to the water volume and long residence time of this enclosed sea. Density stratification subjects deep waters to anoxia, which is a common feature for coastal and marine waters with increased organic production and restricted deep water renewal.

The external nutrient loading into the Baltic Sea has decreased since the early 1990s. Despite the positive development, eutrophication of the sea area has continued, when estimated on the basis of summertime chlorophyll-a. The primary reason seems to be the poor capacity of the open sea sediments to retain nutrients. During recent years the role of internal loading – the release of nutrients, especially phosphate from the sediment - has become an increasingly important source of nutrients also in Baltic coastal waters, and received increasing attention both from

the scientific community, decision makers and the general public. In addition to causing coastal eutrophication, the worsened capacity of coastal sediments to retain nutrients eutrophies open waters via the weakened coastal retention and removal of nutrients.

The Gulf of Finland (GOF) forms an ideal case for testing and developing approaches for the abatement of eutrophication. It is the most eutrophied sub-basins of the Baltic Sea, receiving directly nutrient loading from the surrounding countries: Finland, Russia and Estonia. A comparable input of nutrients comes via the atmosphere and due to the water exchange with the Northern Baltic. These fluxes link the eutrophication of the Gulf of Finland to a larger European perspective. In the long run, the development of the nutrient load – and eutrophication – depends on the economic progress and environmental policy in the Baltic Sea catchment, and especially in the three countries surrounding the Gulf. The case of the Gulf of Finland is also interesting because it displays the problems of a jointly managed resource. A joint project focusing on the Gulf of Finland will thus provide insight that can also be applied elsewhere.

1) Searching efficient protection strategies for the eutrophied Gulf of Finland (GOF): the integrated use of experimental and modeling tools



Searching realistic state alternatives

To improve the state of GOF and its coastal waters, targeted measures to reduce nutrient loading from the surrounding countries are needed. Finding cost-effective solutions for eutrophication control is thus one of the key policy tasks in this region. However, the choice of cost-effective load reduction measures is far from being straightforward; the measures have to be not only correct from the ecological point of view but socio-economically feasible. First, the potential impact of a unit nutrient load from different sources is not constant. In contrast, it varies widely according to the source-dependent availability of nutrients to aquatic primary producers and, with regard to inland sources, as a function of the retention of nutrients in river networks and lakes. As a result, the cost-effectiveness of different policy measures in reducing nutrient load also varies substantially.

Second, cost-effectiveness is crucially affected by implementation and monitoring costs and other social costs. Therefore, a comprehensive study requires an analysis of incentives (including prices, taxes, subsidies), institutions and regulation affecting economic choices. In conclusion, the reduction of nutrient losses should be directed towards sources contributing most to the actual loading (total loading minus retention) of algal-available nutrients using measures which can be implemented in a cost-efficient way. Such measures are likely to vary from case to case, but can be determined using common approaches.

The catchment of the Gulf of Finland (412 900 km²) inhabits 12.7 million people. The annual nutrient load into the Gulf from the three surrounding countries totals about 6 400 tons of phosphorus and 120 000 tons of nitrogen. This nutrient load partly enters the Gulf via a relatively complex hydrological route. For example, the nutrients released in large parts of eastern Finland are first selectively retained in the large Saimaa lake system, then transported to Russia via the River Vuoksi where they discharge into the vast Lake Ladoga (17 891 km²), and what remains is transported to the eastern Gulf of Finland by the River Neva. Within the catchment of the River Neva the most important nutrient source is, however, the densely populated St. Petersburg region with a relatively poor processing of urban wastewaters. The Finnish area from which water is directly discharged to



Photo by Seppo Knuutila, SYKE

BOX I

WHY NUTRIENT CONCENTRATIONS ARE HIGH IN THE GULF OF FINLAND

Nutrient inputs into the Gulf of Finland relative to its surface area are two to three times the average inputs of the whole Baltic Sea. Additionally, due to the estuarine nature of the Gulf, the input of nutrients from the Baltic Proper together with prevailing stratification conditions strongly regulates the state of the Gulf of Finland. Two land-based sources of nutrients are of primary importance: the City of St. Petersburg having 4.5 million inhabitants and the River Neva drainage basin, covering about 80 per cent of the whole Gulf of Finland catchment.

The high phosphate values of the Gulf (Fig. 3) cannot be explained by external loading alone. A special feature affecting nutrient balance of the sea area is so-called internal loading. Owing to density stratification and increased organic sedimentation, poor near-bottom oxygen conditions have developed which decrease the burial of nutrients in bottom sediments, and even augment phosphate and ammonium release back to the water. It has been estimated that under poor oxygen conditions the release of phosphorus can annually be of the same order of magnitude as the annual input to the Gulf of Finland from the Baltic Proper. Both these fluxes far exceed the annual land-derived phosphorus loading.

In order to improve the state of the bottoms, the presently high primary production and organic sedimentation should be decreased via cutting the nutrient fluxes entering the Baltic Sea and the Gulf of Finland.

the Gulf of Finland accounts for 13 per cent of the total catchment. With regard to the Finnish coastal waters of the Gulf of Finland, the largest anthropogenic nutrient source is agriculture being responsible for about 60% of phosphorus and 45% of nitrogen load.

The catchment modelling approach

In the SEGUE project an effort is made to evaluate the effects of different policy measures in order to produce state forecasts for the Gulf of Finland. By combining biological-chemical and socio-economic expertise the project aims at providing scientifically sound and economically realistic methodology and measures for the assessment and reduction of the anthropogenic nutrient load to the Baltic Sea.

The more specific goal is to estimate the fluxes of nutrients entering the Gulf of Finland from its catchment and to divide this loading into original sources (crop production, animal husbandry, forestry, municipalities, sparse population, industries, natural background). The load assessment will be made for the present situation, for the period before the break-up of the Soviet Union and for future socio-economic alternatives. Special emphasis will be paid on the load from agriculture, which is expected to change in the future. Catchment studies will be based on a comprehensive examination of pressures and driving forces. With the aid of a catchment modelling work in the Tallinn Technical University (the PolFlow model) it is possible to manage this information in a systematic way and to estimate the effect of socio-economic development on the nutrient load to the Gulf of Finland. Active collaboration and model comparison with the research

BOX 2

The SEGUE joint project develops nutrient reduction alternatives to combat eutrophication in coastal and open waters of the Baltic Sea, the Gulf of Finland as a case area. By producing and combining information on the (1) external nutrient fluxes of phosphorus, nitrogen and silica, (2) principal internal nutrient processes and (3) socio-economic controls, the relevant protection measures needed to reach the realistically targeted trophic state of the open and coastal GOF can be defined.

The project is performed as a joint venture between Finnish (SYKE, FIMR, Helsinki University, Agrifood Research Finland), Russian (Institute of Limnology, Russian Academy of Sciences, NV Hydromet), Swedish (Stockholm University, Linköping University) and Estonian (Tallinn Technical University) Institutes. Additionally the project has close cooperation with several other institutes and projects studying eutrophication of coastal and marine waters.

group at the Linköping University under the Swedish MARE Project (<http://www.mare.su.se>) and studying the linking of drainage basin modeling to cost-effective measures is underway.

The work presumes active and consistent collaboration between Finnish, Estonian, Russian and Swedish institutes. In addition to the surveys and experimental data produced in SEGUE, the project very much relies on data produced and knowledge gained by several different organisations. The participation of all surrounding countries in the project also helps the dissemination of the results to those concerned. The Institute of Limnology of the Russian Academy of Science is focusing on the external nutrient load in the Neva basin and assesses the nutrient budget of the lake Ladoga including external and internal fluxes, retention and outflow with the River Neva. The data obtained by the institute will be incorporated in

the catchment model to account for the Russian part of the catchment.

Socio-economic analyses and scenarios will be provided by the Finnish Environment Institute (SYKE) together with MTT Economic Research. The scenarios will be partly based on the findings of other projects (e.g. SUSAGFU – Sustainable Futures of Finnish Agriculture). MTT Economic Research is also responsible for the more sophisticated economical assessments on e.g. economic uncertainty related to different policy measures. So far a theoretical model for studying how public funds should be allocated between nutrient load reduction in agriculture and investments in large scale waste water treatment facilities has been developed. At present the empirical data that is necessary for applying the model to nutrient control in the Gulf of Finland is being compiled.

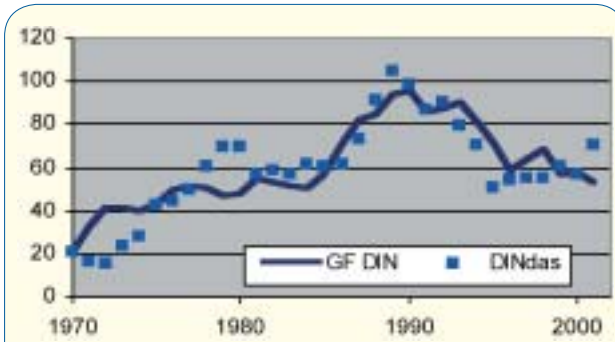


Fig. 2. Long-term dynamics of annually averaged concentration of inorganic nitrogen (mg N/m³) in the Gulf of Finland simulated by SANBalts (curves, GF DIN) and calculated with Data Analysis System (DINdas) from the marine monitoring data in the Baltic Environment Database (BED). (Oleg Savchuck / Stockholm University).

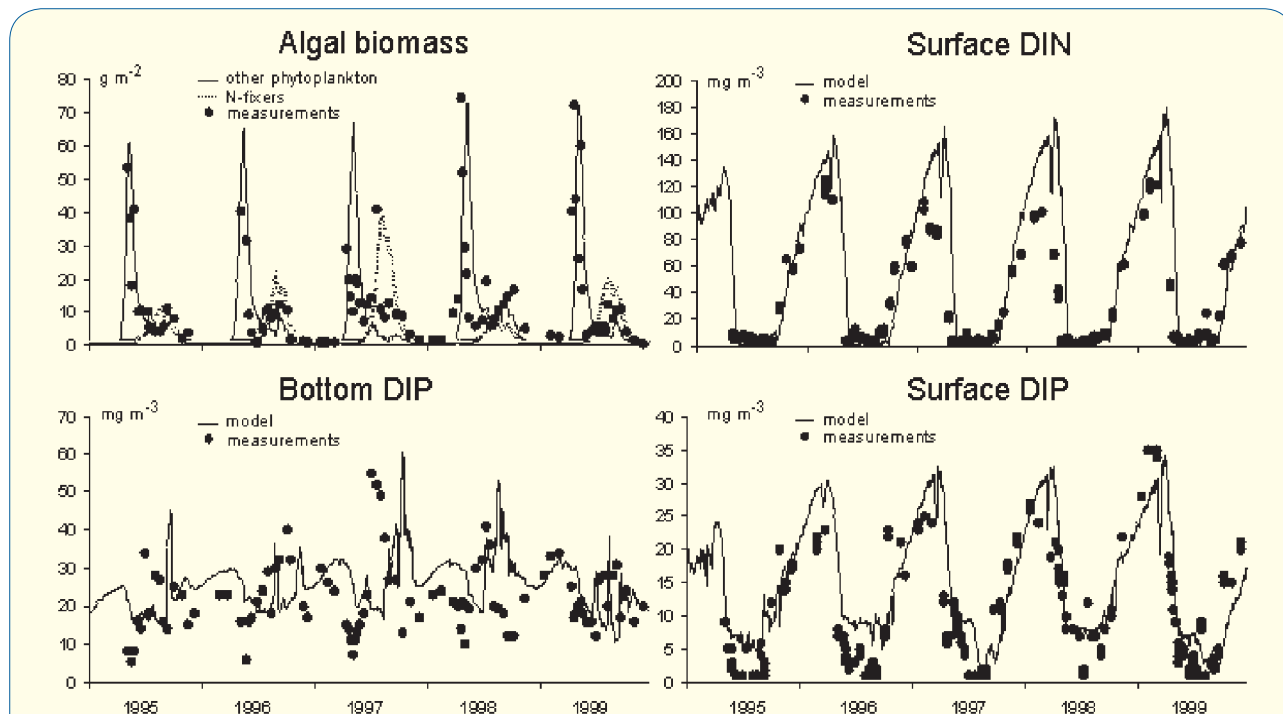


Fig. 1. Validation results of the 3 D ecosystem modelling in the Längden monitoring station, western Gulf of Finland. (DIP dissolved inorganic phosphorus, DIN dissolved inorganic nitrogen). (Mikko Kiivikki / Syke).

In addition, the current work focuses on estimating the cost of reducing agricultural loads, measured in terms of agricultural income lost due to stricter environmental regulations. We are also deriving a monetary measure of the damages caused by eutrophication.

State scenarios: the role of marine processes

In order to evaluate the effect of different loading scenarios on the trophic state, the 3D SYKE-EIA ecosystem model is applied for 5-year high-resolution forecasts. Long-term forecasts will be produced in constant interaction with Stockholm University (the MARE Project) by combining the use of the 3 D ecosystem model with the MARE's 1 D ecosystem model BALTSEM (BALTic Sea Long-Term Large-Scale Eutrophication Model) and its simplified version SANBalt (Simple As Necessary Baltic).

In SEGUE (see Box 2) new information is produced on the sediment-water exchange of N, P and Si, the factors controlling this exchange and the role of the exchange in the nutrient balance of GOF. The use of these results together with available monitoring data from Finland, Russia and Estonia will make the results of ecosystem modelling and state forecasts more reliable and applicable for GOF, as a case area for the whole Baltic Sea.

Existing data on external nutrient loading and marine state variables have been compiled in co-operation by SYKE, the Finnish Institute of Marine Research (FIMR), the Estonian Environment Information Centre (EEIC) and the North-West Administration of Federal Service of Russia for Hydrometeorology and Environmental Monitoring (NW Hydromet). The information on natural and socio-economic controls in the GOF catchment together with the results on coastal retention and the results on the main internal nutrient fluxes produced in SEGUE-Load, SEGUE-P and SEGUE-N are used in ecosystem modelling (see Fig. 4). The modelling results are then used for the analyses of ecological and economic effects of different protection alternatives. Future developments in Russia and Estonia will be taken into account as external uncertainties, which can mitigate or enforce the impact of water protection measures in the scale of GOF.

In the model calibration and validation work good correspondence has been found between modelled and measured values (Figs. 1 and 2). The results indicate the very strong role of sediments and benthic nutrient inputs (compared to external loading) in the control of eutrophication of the Gulf of Finland, and on the other hand the important role of trans-boundary and longrange transport especially in the case of nitrogen.

The SEGUE project has been going on for 2 years now and the work continues till the end of 2005, and regarding the catchment coupling of ecology and economy till the end of 2006. We expect that the project will produce information that is useful for general policy assessments both in the Baltic Sea area and in EU's water protection

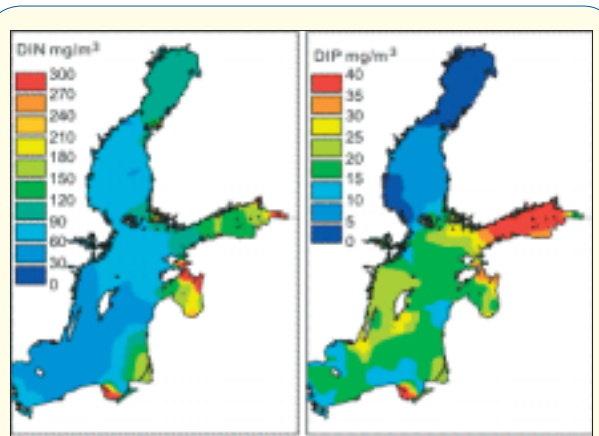


Fig. 3. Surface DIN and DIP distributions of the Baltic Sea in winter 2002 according to data from 362 stations collected by the Finnish Institute of Marine Research, Finnish Environment Administration, Swedish Meteorological and Hydrological Institute and the City of Helsinki. Interpolation has been carried out by using DAS-program developed in the Stockholm University (Mikko Kiirikki/SYKE).

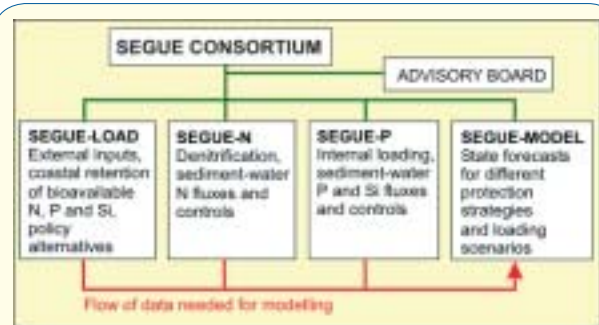


Fig. 4. Structure and tasks of the SEGUE Consortium.

work. For more precise planning of water protection the results will be applicable within the Gulf of Finland and its catchment.

The SEGUE Consortium consists of four projects:

- SEGUE-LOAD, project leader Dr. Petri Ekholm, Finnish Environment Institute (SYKE).
- SEGUE-P, project leader Dr. Mirja Leivuori, Finnish Institute of Marine Research (FIMR).
- SEGUE-N, project leader Prof. Jorma Kuparinen, Helsinki University.
- SEGUE-MODEL, project leader Dr. Heikki Pitkänen, SYKE

www.environment.fi/syke/segve

Heikki Pitkänen, Petri Ekholm and Mikko Kiirikki,

Finnish Environment Institute

Oleg Savchuk, Stockholm University, Sweden

Sergey Kondratyev, Institute of Limnology, St. Petersburg, Russia

Susanna Hietanen, University of Helsinki

Mirja Leivuori, Finnish Institute of Marine Research



DISSECTING CRYPTIC INVASIONS – TOWARDS BETTER UNDERSTANDING OF DIVERSITY AND HISTORY OF LIFE IN MARGINAL SEAS



Photo by Risto Vainölä

■ The numbers of non-indigenous species and their significance to the Baltic ecosystem are continuously increasing. The invading aliens represent an ongoing wave of globalization, with twofold effects on the distribution of biodiversity. On the one hand, they may cause an increase in the regional or local diversity, in terms of species numbers at least. On the other hand, their appearance means erosion of the unique features of the local ecosystem – a degradation of the post-glacial biotic heritage that we may consider as the ‘original Baltic’.

The importance and effects of invaders are by now well appreciated and under intense monitoring as regards species that are clearly distinct from the indigenous fauna. In fact, many of the aliens represent lifeforms originally absent from the Baltic communities, and they now occupy niches that were left vacant during natural post-glacial colonization. Some of the early invaders became established and conspicuous members of Baltic bottom communities even before the start of intensive marine research, and are therefore not easily conceived as aliens. Notably this applies to the soft-shelled clam *Mya* and

the barnacle *Balanus*, both of North American origin. Similarly, dominant roles have been taken by some recent invaders, such as the polychaete worm *Marenzelleria* and the Ponto-Caspian fishhook water flea *Cercopagis*.

Biodiversity is a multi-level concept, encompassing units from ecosystems through all levels of the systematic hierarchy to genes within populations. Globalization caused by biotic invasions is also a phenomenon concerning all levels. Yet the lower parts of the diversity scale, below the easily distinguished taxa discussed above, are still poorly explored, while they form an essential part of the true diversity. Particularly, the extent and importance of invasions at these cryptic levels are generally not appreciated and understood. By using molecular tools to study the distinguishing characters at the genomic level, in the structure of DNA and enzyme proteins, cryptic species not recognizable by traditional gross morphology can, however, be now identified. Similarly, molecular characters enable analysis of mixing intraspecific stocks or lineages of different geographical origins, as well as monitoring the erosion of their original identities to give way to a new kind of synthetic diversity.

A Finnish-Russian joint effort is addressing the role and importance of cryptic invasions and of amalgamation of closely related taxa in a number of North European marginal seas. Our model system comprises two of the most important benthic organisms in the boreal-subarctic seas. The common mussel *Mytilus* is a dominant taxon of Baltic hard bottom communities and in the intertidal zone of the North Atlantic and that of the White Sea. The Baltic clam *Macoma balthica* in turn dominates on soft bottom habitats. By conventional morphological criteria, each of these taxa used to be treated as a single, homogeneous species in all northern sea areas. Yet a molecular systematic scrutiny indicated that both taxa actually represent circumpolar taxonomic complexes of a number of species and subspecies that have evolved in partial isolation during the Plio-Pleistocene glacial biogeographic history. A principal systematic division in each case can be made between North Atlantic and North Pacific lineages.



Photo by Risto Vainölä





Photo by Risto Väinölä

A mixture of Pacific and Atlantic elements

From the viewpoint of marginal North European seas – the Baltic, Barents and White Seas – a most intriguing observation is that both the originally Atlantic and Pacific mollusk lineages are currently present in these regions. Particularly, the bivalves of the Baltic and the White Sea have a predominantly Pacific ancestry; they are clearly systematically distinct from the neighbouring North Sea and North Atlantic populations. The inferred Pacific roots of our dominant ‘native’ invertebrates add a peculiar, unanticipated biogeographical flavour to the composite mixture of the indigenous and invading elements that make up the Baltic communities.

The background of this newly revealed diversity, and of the meeting and mixing of diverged bivalve lineages, is thought to be in a complex series of waves of invasion. The first wave was natural and took place with the onset of marine conditions in the marginal basins soon after deglaciation (e.g., to the early *Litorina* Sea c. 9000 years ago). More recent colonizations may be associated with the human-mediated invasion wave, but have so far remained unnoticed due to the deceitful external similarity of the species or lineages. The secondary contacts of the lineages are now accompanied by interbreeding and amalgamation

of the diverged genomes in hybrid populations. For instance, the nuclear genomes of both the Baltic and White Sea *Macomas* are estimated to carry genes 70 per cent of Pacific and 30 per cent of Atlantic ancestry. These stocks represent a new kind of synthetic product brought along by the biotic globalisation process.

In the joint project a variety of molecular characters are used to explore the history and fate of the different genetic and genomic origins of the bivalves within the Baltic and the White and Barents Seas: the sequence and timing of colonization events, the dynamics of genomic mixing and the rate of the genetic change that has taken or is taking place. The next questions concern the ecological effects or importance of the cryptic diversity and of the changes that take place in the genetic composition: is a population of an alien or an amalgamated genetic composition functionally equivalent to the indigenous one, or do the so far cryptic changes in the identity still carry along changes in community and ecosystem functioning?

Author information:

The Finnish–Russian project on the importance of cryptic invasions and low-level systematic diversity has its roots in long-term mutual interests in mollusk population structure of the Baltic and White Seas. It is based on insights obtained from the previous pilot-level collaboration carried out during short-term visits by the Russian partner to Helsinki, while he was still studying for his PhD in St. Petersburg. The results prompted to revise the views on the systematic diversity and invasion history of bivalves in both areas. They also pointed out a chance to use the similarly isolated but environmentally different basins as parallel experiments to better investigate the processes associated with secondary contacts of invading lineages.

Risto Väinölä, Finnish Museum of Natural History, University of Helsinki, Finland
Petr Strelkov, St. Petersburg State University, Russia



Photo by Risto Väinölä



GOVCOM WITHIN BIREME: AN INTERNATIONAL APPROACH TO RESEARCHER TRAINING



Photo by Paula Väinänen, SYKE

■ The Baltic Sea Region (BSR) is a political and administrative area of special research interest in social sciences. There have been rapid political changes within the region through-out history. The deepness and profoundness of these political changes and the environmental vulnerability of the sea itself makes the need for research into the interface of policy-change and environment evident within the region. The BSR is an ideal setting for our research project as it has introduced several new fora for sustainable decision making. At the same time, however, a large number of surrounding states and sub-national units have been showing considerable strength in existing administrative and political structures.

The main theoretical and empirical objectives for GOVCOM–project (full title: Governing a Common Sea – Changing Modes of Governance in the Baltic Sea Region) were thus defined at the beginning of the project: 1) To deepen the understanding of the origins, development and operation of traditional environmental governance in the BSR; 2) To examine newly introduced methods of governance in the BSR; 3) To analyse the effects of some of the changing patterns of governance on local actors, local communities and the state of the local environment, and 4) To provide a synthesis of the patterns of change we discover in governance modes in the BSR.

The theoretical and empirical approach in GOVCOM is thus comparative and international as a starting point. The comparative knowledge regarding the independent studies in the project is in the hands of the individual researchers. The international know-how and knowledge – the possibility to receive other than national feedback – is normally expected to come with the international networks that individual researchers are involved in. Also active participation in international scientific conferences is naturally a part of this networking. In many cases this

is a fully functional method and international input is secured without institutionalised structures. All these activities are encouraged within GOVCOM as well, with earmarked travel funding for conferences, for example.

Oriented to promote research training

GOVCOM is almost entirely oriented to fund and promote research training. A clear majority of both salary and travel costs are devoted to doctoral students. Even if the doctoral students involved in GOVCOM are all rather experienced in the field of international cooperation the project team could not expect them to have the knowledge and possibilities to international input and criticism as senior researchers. Therefore, the project team was from the very beginning expanded with international senior members to function as advisors within their core research areas.

GOVCOM includes four partner institutions in Finland (Åbo Akademi University, Dr. Marko Joas as senior partner, and doctoral students Ann-Sofie Hermanson, Tea Nömmann and Björn Grönholm; University of Tampere, Professor Yrjö Haila; Finnish Environment Institute with doctoral students Riku Varjopuro and Panu Kontio; and Diaconia Polytechnic, Dr. Aija Kettunen). These national institutes provide doctoral students or senior researchers as advisors into the research process.

The international research units involved in this cooperation are both German: University of Greifswald (Professor Detlef Jahn) and the Social Science Research Center Berlin (Dr. Kristine Kern). Both of these institutes provide senior expertise into the project within their research areas. Detlef Jahn is responsible for the senior input in the first research module, analysing the institutionalisation of environmental concerns into the region – a basis for the analysis of change, and Kristine



Kern is senior adviser in the second module analysing the processes of change in governance patterns within the region.

In addition, to get further transdisciplinary and international knowledge in to the research process an international advisory panel was set up to be available at certain specific occasions to comment on the progress of the work. This panel includes input from Lithuania (Professor Leonardas Rinkevicius) as well as input from the political level (Matti Wuori, former MEP) and natural sciences (Professor Erik Bonsdorff).

Both of our international advisors are directly working with doctoral students in GOVCOM, i.e. four doctoral students in the project has direct guidance from international experts in their area of research. The whole research group has, however, the benefit of having our German colleagues present in our project team meetings where the floor is open to comments regarding the whole project. So far we have had three major project team meetings; the first in Helsinki (May 2003), the second in Greifswald (October 2003) and the third meeting together with the advisory board in Turku (September 2004). This year individual meetings have also been held within the research modules.

Even if the core funding in the project is devoted to doctoral students in the Finnish universities involved in the project, we have also opened a possibility of doctoral students from other participating units to be involved to some extent.

Collaboration provides new insights

As Kristine Kern tells us, 'being a 'foreign advisor' in the

GOVCOM project is not only a challenge but also provides new insights'. Today, doing research in an EU Member State and within the European Research Area requires international cooperation and the ability to communicate with researchers from foreign countries on a daily basis. However, this kind of cooperation is often restricted to the presentation of conference papers or preparation of a country report on one's own country. It is often carried out primarily by senior researchers, while a doctoral thesis is rarely integrated into such research projects. Contrary to this approach, GOVCOM provides comprehensive insights into the training of doctoral students in Finland. The implicit comparison between Finnish and German practices facilitates mutual learning. Besides, it is also a challenge to advise Finnish doctoral students because the starting point of their work is mostly the situation in Finland and a research question related to Finland. This situation has effects on both sides: While foreign advisors have to gain experience and acquire knowledge regarding the relevant developments in Finland, the doctoral students get strong incentives to extend their research design to other parts of the Baltic Sea Region. This is facilitated by the fact that GOVCOM starts from a comparative and international perspective and aims at research findings that are relevant for the whole Baltic Sea Region. Therefore, the institutionalized cooperation between a foreign advisor, who also deals with research questions related to the whole region, and Finnish doctoral students is a very fruitful approach.

Marko Joas, Åbo Akademi University, Finland

Kristine Kern, Social Science Research Centre Berlin, Germany

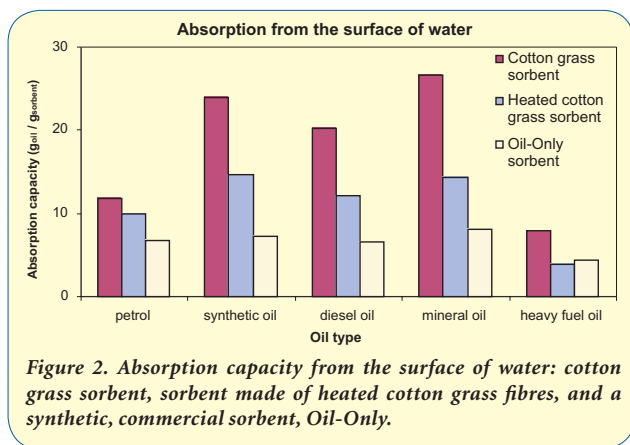
BIOREMEDIATION OF OIL SPILLS IN THE BALTIC SEA REGION: A SHARED PROBLEM – A SHARED EFFORT



Photo by FutureImagebank

■ The Baltic Sea is a natural resource for all the countries surrounding it, and its preservation is – and should be – a joint effort. A uniform and clear set of rules and objectives is a necessity when aiming towards a cleaner and safer environment in the Baltic Sea region. This can be achieved only through tight collaboration between the countries concerned. Scientific research aiming at the preservation of the ecosystem in the area should especially be a joint effort with shared goals.

Our project, which is part of the BIREME research programme, is realized as a collaboration project between our group at the Department of Ecological and Environmental Sciences (University of Helsinki), and the Russian research team led by Professor Alexander Boronin at the Russian Academy of Sciences (The Institute of Biochemistry and Physiology of Microorganisms, Russian Academy of Sciences, Pushchino, Russia.) Contacts between Martin Romantschuk and Alexander Boronin were established several years ago as part of a European consortium aiming at establishing research collaboration around oil degrading microbes and their use in decontamination of oil contaminated soil.



Although joint funding was not obtained at that point, collaboration and exchange of information was initiated.

In the current BIREME project, we saw an excellent opportunity to join our forces to study our common interest: The possibility of using bioremediation – cleaning the environment biologically – to clean spilled oil in the Baltic Sea region. Oil transportation has increased massively in the Baltic Sea during the last decade and will continue increasing in the near future: The amount of oil transported in the Baltic Sea is estimated to reach 100 million tons in 2005. The number of accidents will increase, but so will the intentional practice of emptying oily bilge water into the sea. It is estimated that 20,000 – 70,000 tons of oil enter the Baltic Sea each year. This creates a continuous threat to the vulnerable ecosystem of the area and an urgent need to develop better cleaning techniques applicable to the region. The Baltic Sea region has unique characteristics that have to be taken into account when designing cleaning techniques. One of the major ones affecting especially bioremediation is the cold climate of the whole area. Some experience about bioremediation of oil products does exist, but it is usually from areas with a warmer climate. Our project strives towards better understanding of the cold-adapted microbes in the area as well as utilising them for bioremediating the coastal regions of the Baltic Sea. Major accidents are beyond our scope, but the small-scale oil spills – that build up the vast majority of oil entering the Baltic Sea each year – form our target.

Using cotton grass fibre as first aid

One approach in this project is to clean up the environment from oil by absorbing it into a biodegradable fabric. The fabric is made out of cotton grass, a common plant found in boreal peat bogs. When peat is excavated from a bog, it has to be purified by separating it from other components, the major unwanted component being cotton grass fibre. This fibre forms when the plant dies and partly deteriorates; it does not decompose totally due to the acidic and anaerobic nature of the bog. The fibres are several hundreds of years old or more; they have some use in the textile industry, but most of them go to waste. Cotton grass fibre has proved to be an excellent absorbent of oil products, especially from the surface of water, as it does not absorb water itself (Figure 1). The fibre is totally biodegradable in appropriate conditions, which helps in disposal of the used, oily fabrics. One alternative for the disposal is burning them, but our aim in this project is to study the possibilities of its biodegradation, mainly by composting.

The fabric is water-repellent, which can be problematic; to resolve the problem, we are studying the use of cold-adapted, oil-degrading bacteria forming biosurfactants – compounds that lower the surface tension between oil and water. They can help the biodegradation of oil from the hydrophobic fabric. Most likely the fabric will be composted together with oily soil, which will also assist the composting process.

The cotton grass fabric is aimed as a first aid in cleaning spilled oil. It is, however, important to create a comprehensive cleaning strategy for the whole region of the Baltic Sea, not only for the water phase, because oil spills at land nearby will eventually contaminate the sea as well. If the oil has already reached the shore, or the spill has occurred on ground, the oil may have already been absorbed into the soil. In these cases, the capacity of microorganisms can be taken advantage of to degrade the oil. Many natural environments contain indigenous microbes that have the ability to mineralize oil products, and to use them as growth substrates. In the case of a recent oil spill, the number of these microbes may not be sufficient or the conditions not ideal for the activity of the microbes; the natural biodegradation of oil may take a long time. In order to start effective biodegradation immediately, we may introduce microbes known to be good degraders to the site. We have isolated microbes from the Baltic Sea area that are able to degrade oil products well, while also being well adapted to the local environment. With good dissemination methods, maintaining a strong viable degradative population will not be a problem. In addition, microbes have been observed to be able to transfer their degradative capacity to the indigenous microbes already in the site, thus reassuring the survival of an active degradation. We can also heat the soil with electricity to keep the soil temperature high enough for effective biodegradation even in the wintertime. When necessary, methods based on electricity can also be used to introduce suitable microbes into soil, a difficult task especially in the case of dense soil types such as clay.

Development of collaboration

This research project is still at the beginning and the forms of collaboration between the two groups are still developing. We have roughly divided the tasks of the project: In Finland, we will mostly concentrate on studying the absorption properties and biodegradation possibilities of the cotton grass fibres, while the Russian group's main focus is on the characterisation of the oil-degrading microflora of the Baltic Sea region. Still, there exists, naturally, collaboration within these tasks as well; for example, two researchers from the Russian group visited us this summer. The Russian partner group supplied us with strains isolated from oil-contaminated areas. The microbes had earlier been characterised by the Russian partner group, and they were identified during the visit to our laboratory by sequencing indicator regions of their genome. In the immediate future, both groups will explore the possibilities of the use of the cotton grass fibres and continue studying the various isolated strains. This collaboration and joining the special expertise of both groups gives us a great advantage in gaining a better understanding of the microbes in the area and in designing cleaning techniques especially applicable to the Baltic Sea region.

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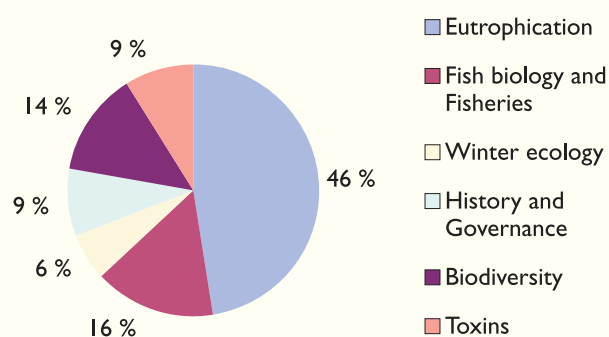


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Breakdown of funding by theme



Institutes and universities involved

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- Finnish Game and Fisheries Research Institute
- Finnish Institute of Marine Research
- Fish Biology and Fisheries Research
- Institute of Limnology RAS, Russia
- Kemira Chemicals Oy Kemwater
- National Institute of Nutrition and Seafood Research, Norway
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The Programme will be available shortly. Information and instructions on registration are already available in www.aka.fi/bireme. Registration **no later than 21 January**.

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