

Kansliets noteringar Kod	Dnr
2009-3435-13495-18	

2009 Strategic Research

Announced grants

Marine environment

Total amount for which applied (kSEK)

2010	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
7000	10000	14000	14000	14000						

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HIGHER EDUCATION INSTITUTION (HEI)

Administering organisation

Stockholms universitet

DESCRIPTIVE DATA

Project title, English (max 200 char)

Ecosystem Approach to the Baltic Sea

Project title, Swedish (max 200 char)

En ekosystemansats för Östersjön

Project description, English (max 1500 char)

Stockholm University (SU) has the most active and highest ranked research on the Baltic Sea Environment, which is under severe stress from human activities. To improve the Baltic Sea, Sweden's worst marine problem area, requires ecosystem management, as widely agreed on internationally. This application proposes a leading-edge ecosystem research program, which builds on successful research on Baltic ecosystems, contaminants, natural resource management, and use of ecological modelling for environmental management. This interdisciplinary research program will use a holistic approach to Baltic ecosystem functioning and management. The research covers Ecosystem functioning (key mechanisms for management, cyanobacterial blooms, zooplankton production and feeding, sedimentation, benthic nutrient fluxes, monitoring methods), Nutrient Enrichment (eutrophication models, nutrient loads, phosphorus binding by sediments), Fisheries and Aquaculture (EU Fisheries Policy, pikeperch sea-ranching, genetic monitoring), Hazardous Substances (model of persistent organic pollutant distribution, natural toxins, radionuclides, monitoring dissolved organic contaminants, novel contaminants), Laws and Management (governance for Baltic Sea Management, regime shifts), Climate Change (3D modelling, climate change scenarios, effects of temperature & CO2 increases). This program could assist in making the Baltic Sea the first example of effective ecosystem management of a large marine ecosystem.

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Project description, Swedish (max 1500 char)

Stockholms universitet har den mest aktiva och högst rankade forskningen om Östersjöns av mänsklig aktivitet hotade havsmiljö. För att förbättra Östersjön, som har Sveriges värsta havsmiljöproblem, krävs enligt utbredd internationell enighet en ekosystemförvaltning. Denna ansökan föreslår en ekosystemforskning i fronten, baserad på framgångsrik forskning om Östersjöns ekosystem, föroreningar, naturresurshushållning, och ekologisk modellering som stöd för förvaltning. Detta tvärvetenskapliga program tar ett helhetsgrepp på Östersjöns ekosystemfunktion och förvaltning. Forskningen omfattar ekosystemfunktion (nyckelmekanismer för förvaltning, cyanobakterieblomningar, djurplanktons föda och produktion, sedimentation, bottenars näringsflöden, monitoringmetoder), näringsberikning (övergödningsmodeller, näringsbelastning, forsforbindning i sediment), fiske och vattenbruk (EUs fiskeripolitik, gösutsättning, genetisk monitoring), risksubstanser (modell för fördelning av svårnedbrytbara organiska föroreningar, naturliga toxiner, radionuklider, monitoring av lösta organiska föroreningar, nyupptäckta föroreningar), lagar och förvaltning (Östersjöns miljöförvaltning, regimskiften), klimatförändringar (3D-modellering, klimatscenarier för Östersjön, effekter av ökad temperatur och koldioxid). Programmet kan medverka till att göra Östersjöområdet till det första stora havsekosystem där ekosystemförvaltning fungerar.

Research areas

Strategic Research Area

Classification codes (SCB) in order of priority

152103, 153303, 120907

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COLLABORATING SWEDISH HEIs

Collaborating organisation
SMHI, Institute of Coastal Research

ENCLOSED APPENDICES

A, B, C, D, E, F

APPLIED FUNDING: THIS APPLICATION

Funding period (planned start and end date)

2010-01-01 -- 2014-12-31

Total amount for which applied kSEK

2010	2011	2012	2013	2014	2015
7000	10000	14000	14000	14000	

POPULAR SCIENCE DESCRIPTION

Popularscience heading and description (max 4500 char)

Östersjön har Sveriges värsta havsmiljöproblem, och förorenar dessutom via Baltiska ytströmmen södra delen av vår västkust. Östersjöns miljö har skadats svårt av mänskliga aktiviteter som överfiske, och utsläpp av näringsämnen och giftiga föroreningar. Fisk från Östersjön kan inte längre handlas fritt eller ätas med förtroende av människor och djur, och de ekonomiskt viktigaste bestånden är utarmade. Täta algbloomningar har minskat Östersjöns värde för turism och rekreation. Östersjöns ekosystem har förändrats radikalt under det senaste seklet, och erbjuder inte längre de ekologiska varor och tjänster vi varit vana vid. Dessa försämringar har bemötts med många nationella och internationella handlingsplaner, men framgångarna med att återställa Östersjöns ekosystem har varit begränsade och fläckvisa. Många anser att prognosen för framtiden är mörk, i en tid av snabba klimatförändringar och mänsklig befolkningstillväxt.

För att Östersjöns miljö skall återhämta sig krävs förvaltning både nationellt och internationellt som baseras på ekosystemens krav, eftersom miljöproblemen är så sammanvävda att de inte kan behandlas var för sig. Åtgärder mot övergödningen kommer att påverka fiskbestånden, överfiskningen påverkar halterna av miljögifter i fisken och kanske även frekvensen av algbloomningar. Behovet av ekosystemförvaltning uttrycks av Konventionen för biologisk mångfald, av FAO och Internationella havsforskningsrådet, av Östersjökonventionen och är grunden för EUs Vattendirektiv. Stockholms universitet kombinerar omfattande tvärvetenskaplig forskning med djuplodande specialforskning på många områden inom Östersjöns miljö, på ett sätt som saknar motsvarighet i landet eller regionen. Stockholms universitet föreslår här ett forskningsprogram som utnyttjar denna breda kompetens för att bidra till Östersjöns återhämtning. Genom att samordna befintlig forskning och förstärka vissa strategiska forskningsområden vid Stockholms universitet skapas ett forskningsprogram i frontlinjen, inriktat på Österjöområdet havsmiljö, som kommer att stärka Sveriges förmåga inom de områden som anslagsutlysningen angivit som strategiska.

Forskningsprogrammet bygger på Stockholms universitets tidigare framgångar inom Östersjöforskningen, särskilt inom ekosystemforskning, forskning om organiska miljögifter, om naturresurshushållning, och om användning av ekologiska modeller som stöd för miljöförvaltning. Det beslutsstödsystem för övergödningsfrågor om Östersjön, ?Baltic Nest?, som användes av Helsingforskommissionen för dess banbrytande beslut 2007 om kvoter för utsläppsminskningar för alla medlemsstater, skapades vid Stockholms universitet. Med stöd av framstående ekosystemforskning skall nu detta beslutsstödsystem utvecklas vidare, till fromma för Östersjöns miljö.

Forskningsprogrammet tar ett helhetsgrepp på Östersjöns ekosystem och förvaltning. Det prioriterar samarbeten mellan forskare inom olika områden och institutioner som skapar samordningsvinster, synergier. Programmet ger Stockholms universitets forskare en unik möjlighet att samarbeta över ämnesgränser, och kan förväntas ge resultat av stort samhällsvärde. Det stödjer specifikt flera viktiga områden inom ekosystemforskning där Stockholms universitet har landets främsta kompetens, som 3-dimensionella havsmodeller, marin fjärranalys och marin radioekologi.

Forskningen omfattar ekosystemfunktioner (nyckelmekanismer för förvaltning,

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cyanobakterieblomningar, djurplanktons föda och produktion, sedimentation, bottenars näringsflöden, övervakningsmetoder), näringsberikning (övergödningsmodeller, näringsbelastning, forsforbindning i sediment), fiske och vattenbruk (EUs fiskeripolitik, gösutsättning, genetisk monitoring), risksubstanser (modell för fördelning av svårnedbrytbara organiska föroreningar, naturliga toxiner, radionuklider, övervakning av lösta organiska föroreningar, nyupptäckta föroreningar), lagar och förvaltning (Österjöns miljöförvaltning, regimskiften), klimatförändringar (3D-modellering, klimatscenarier för Östersjön, effekter av ökad temperatur och koldioxid).

Programmets största fördel ligger i helhetsgreppet på Östersjön som ett sammankopplat socialt-ekologiskt system. Det kan medverka till att göra Östersjöområdet till det första stora havsekosystem som får en fungerande ekosystemförvaltning. Endast Stockholms universitet har förutsättningar att med begränsade resursförstärkningar skapa ett så brett, sammanhållet forskningsprogram om havsmiljön.

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Title of research programme
Ecosystem Approach to the Baltic Sea

Appendix A (Executive summary)

Ecosystem Approach to the Baltic Sea

1. Executive summary

Stockholm University combines the broadest interdisciplinary science with the most active, in-depth disciplinary research relevant to the Baltic marine environment of any university in the Baltic region. To support Sweden's role in the restoration of the Baltic Sea, this application brings together Stockholm University's strong marine environmental research capacity. It presents a plan to coordinate available competence and strengthen selected strategic areas, to give a leading-edge ecosystem research program focussed on the Baltic Sea Area. This program will enhance Sweden's research capability in the areas identified as strategic in the research call.

The Baltic marine environment is under severe stress from human activities such as overfishing, emissions of nutrients and man-made pollutants, and exploitation of coastlines. Fish from the Baltic cannot be used and traded freely and confidently as food for humans or domestic animals and most economically important fish stocks are depleted. Frequent phytoplankton blooms have reduced the value of the Baltic for tourism and recreation. Baltic ecosystems have changed, in many cases radically, from their natural state of a century or more ago, and no longer provide the ecological goods and services that we used to depend on. These negative developments have been met with many national and international action plans, but progress in restoring Baltic ecosystems has so far been modest and piecemeal, and many see the future prognosis as bleak, in an era of human population growth and rapid climate change.

Successful rehabilitation of the Baltic environment requires ecosystem management, both at national and international level, since its varied problems are not separate, but closely interwoven. Management of nutrients will affect fish stocks, the status of stocks will influence levels of toxic pollutants in the fish, and potentially also the frequency of phytoplankton blooms. The need for an ecosystem approach to management is agreed on by the Biodiversity Convention, by FAO and ICES, by the international marine environment conventions applicable to Swedish waters (HELCOM; OSPAR) and is implicit in the EU Water Framework Directive.

The program proposed here builds on previous success by Stockholm University, in Baltic ecosystem and contaminant research, in management of natural resources, and in using ecological modelling as a tool for environmental management. The environmental decision support system Baltic Nest, used by HELCOM as the basis for its 2007 agreement on country-specific nutrient reduction goals, can be developed further with the support of strong ecosystem research.

This interdisciplinary research program will concentrate on achieving a holistic approach to Baltic ecosystem functioning and management. It will give priority to collaborations that create synergy through interaction between scientists in different departments and faculties give marine scientists at Stockholm University a unique possibility to cooperate across disciplinary borders and can be expected to lead to novel scientific results of high

societal impact. It will give support to several areas important for ecosystem research, in which Stockholm University has the best competence in Sweden, e.g. 3-D physical modelling, marine remote sensing, and marine radioecology.

The proposed research, though broadly interacting, can be grouped in 6 areas:

In **Ecosystem functioning**, it will study key mechanisms for Baltic ecosystem functioning and management, concerning cyanobacterial blooms, zooplankton production and feeding, sedimentation, benthic nutrient fluxes, and methods to improve monitoring (satellite, acoustic and molecular), to underpin the ecosystem approach to management.

In **Nutrient Enrichment**, models of open sea and coastal eutrophication, of inflow of nutrients and organic carbon from land, and to estimate historical chlorophyll concentrations, and methods to enhance phosphorus binding in sediments will be covered, to support measures to reduce coastal and offshore eutrophication.

In **Fisheries and Aquaculture**, the revision of the EU Common Fisheries Policy, sea-ranching of pikeperch and genetic monitoring of effects of fishing and supportive breeding will be considered, to promote long-term use of Baltic fishery resources

In **Hazardous Substances**, basin-wide modelling of persistent organic pollutant distribution, naturally produced toxic compounds, radionuclide ecology, monitoring of dissolved organic contaminants in water, screening for novel contaminants will be investigated, to support the goal of a Baltic free of anthropogenic toxic substances.

In **Laws and Management**, governance structures and legal frameworks for Baltic Sea Management, including implications of regime shifts will be explored, to foster a resilient, multilevel management system

In **Climate Change**, it will focus on 3D physical-biogeochemical modelling, ensemble modelling of Baltic climate change scenarios, temperature and CO₂ effects on ecological processes, to assist in preparation for the likely drastic future changes.

The greatest gain from this program will not, however, be the sum of these parts, but in the added value this broadly integrative research on the Baltic Sea as a coupled social-ecological system will bring. Only at Stockholm University, with its wide basis in ongoing Baltic Sea research, and leading ecosystem expertise could such a program be created with the relatively modest means requested. The Baltic Sea is Sweden's foremost marine problem area, and by exporting its problems also pollutes the Swedish west coast. It is therefore essential that Sweden strengthens its research capacity on the Baltic Sea.

This program will assist in making the Baltic Sea the first example globally of how ecosystem management can be made operational in a large marine ecosystem.

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Title of research programme
Ecosystem Approach to the Baltic Sea

Appendix B (Research programme)

2. Research program

Preamble: Plans of the University for the further development of the prominent research within the area

A prime mission of Stockholm University is to conduct research of high international standard. The university has identified 15 areas of research that are at the forefront of research in Sweden and in addition enjoy high international status. Stockholm University believes in striving for international excellence in research in combination with a wider research approach to generate the potential to absorb new thoughts and ideas rapidly. The university thus believes in combining excellence with diversity in research, which also is required to maintain high-quality undergraduate programs.

The university encourages its researchers to cooperate not only within and between faculties but also with other institutions of higher education, especially in the Stockholm area. Stockholm University also maintains a broad and diverse dialogue with the surrounding community.

The Faculty of Science has in its Strategic Plan 2007-2011 defined the goals of the faculty as:

- to be internationally highly recognized for its research and education programs at all levels
- to emphasize and defend the importance of curiosity-driven research
- to base the education programs on results from and in close contact with research with high scientific standard

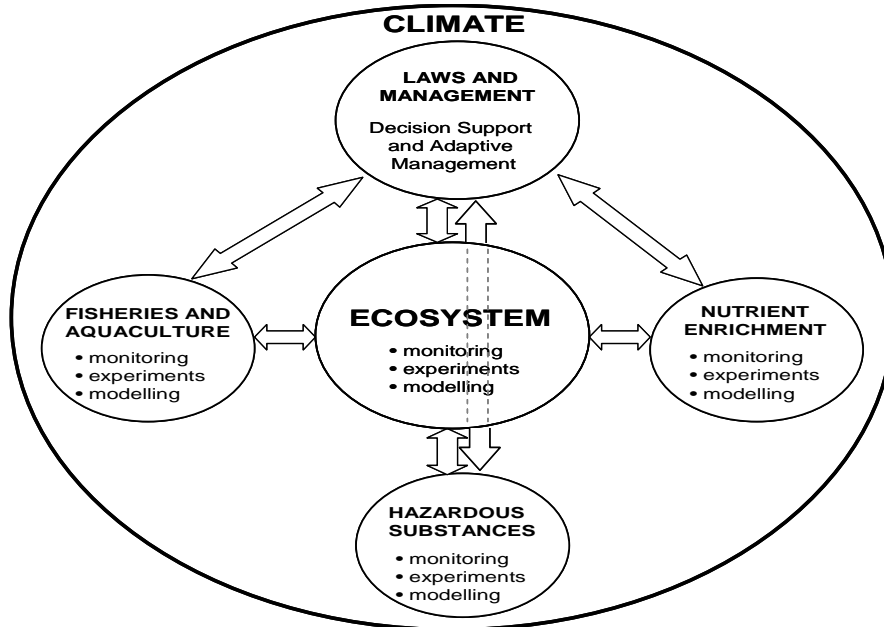
Furthermore the Faculty has defined five areas in which research is highly recognized and these extend across the four sections and the departments of the Faculty. In addition, each of the sections has defined areas of particular strength as well as areas with potential to develop excellence. Most of these areas are also part of the profile areas defined at the university level. The Faculty has a policy to provide start-up grants when new scientists are recruited, especially in the defined strong areas.

2a. Ecosystem approach to the Baltic Sea: Research Plan

The Baltic Sea, one of world's best studied marine areas, could become a global example showing how ecosystem management can be made operational in a large marine ecosystem. Stockholm University (SU) can be a key partner in realizing this vision, using its extensive in-house knowledge of marine ecosystem dynamics, environmental chemistry and governance frameworks. The Faculty of Science (SU) is a leader in Baltic Sea science, addressing ecosystem ecology, biogeochemical cycles, and chemical hazards. SU's Baltic Nest Institute and Stockholm Resilience Centre are regional and global players in marine ecosystem modelling and marine governance, respectively, while the SU Dept of Law is internationally recognized for its work on international and transnational environmental law. **A major aim of this proposal is to establish a common research platform for these players, creating synergy effects in research to support an ecosystem approach to management of the Baltic Sea.**

The ecosystem approach is the basis for a range of policy agreements. This means that ecosystem boundary conditions should shape management, in geographical terms, *i.e.* the

scale of the ecosystem should be matched by its institutions, as well as in process terms, *i.e.* human impacts should not jeopardize the capacity of ecosystems to deliver goods and services. The structure of the proposed program is visualized below:



An ecosystem approach to Baltic environmental management demands that we view the Baltic Sea as a coupled social-ecological system. We need to understand the internal workings of the Baltic ecosystem and its response to external driving forces, such as fisheries, climate change and input of nutrients and hazardous substances, and have predictions of how they are likely to change, and can be modified by human action. We must also know and question the governance systems and laws in place, and explore the potential of multilevel adaptive governance systems for Baltic ecosystem management, also taking the Baltic catchment into account (e.g. Folke et al. 1991)

The interaction between departments at SU in this program will generate synergy effects in the following projects in the six major research areas identified in the previous figure:

- A. Ecosystem Functioning:** Key regulatory mechanisms for Baltic ecosystem functioning and management, concerning cyanobacterial blooms, zooplankton production and feeding, sedimentation, benthic nutrient fluxes, and methods to improve monitoring (satellite, acoustic and molecular).
- B. Nutrient Enrichment:** Models of open sea and coastal eutrophication, of inflow from land of nutrients and organic carbon, and to estimate historical chlorophyll concentrations, and methods to enhance phosphorus binding in sediments.
- C. Fisheries and Aquaculture:** Revision of the EU Common Fisheries Policy, sea-ranching of pikeperch and genetic monitoring of effects of fishing and supportive breeding.
- D. Hazardous Substances:** Basin-wide modelling of persistent organic pollutant distribution, naturally produced toxic compounds, radionuclide ecology, monitoring of dissolved organic contaminants in water, screening for novel contaminants.

E. Laws and Management: Governance structures and legal frameworks for Baltic Sea Management, including implications of regime shifts.

F. Climate: 3D modelling, ensemble modelling of Baltic climate change scenarios, temperature and CO₂ effects on ecological processes.



This proposal covers the Baltic Sea Area, which includes the Kattegat and corresponds to the Helsinki convention area, representing 90% of Sweden's coastline and sea area, as shown on map at left.

The outer line shows the economic zone of Sweden, blue colouring its territorial waters. The area covered by the Water Framework Directive extends one nautical mile beyond the inner, violet baseline.

A. Ecosystem Functioning

The physical structure of the Baltic ecosystem is the framework for its biological and chemical functioning, and is preferably studied with 3-dimensional coupled physical-biogeochemical models (Meier 2007, Eilola et al. 2009), a specialty in which SU is leading in Sweden. Baltic currents carry both dissolved and particle-associated nutrients and contaminants. Lagrangian modelling of water and particle transport is required to predict the flux, distribution, mixing and ultimate fate of sediment, nutrients, and pollutants in the sea. This will permit analyses of spatial differences in contaminant and nutrient loading, and the cost-benefit of waste-water treatment. The transport of plankton determines their distribution and the spread of invasive species. The vertical movement patterns of plankton may differ from that of non-living particles, and are still poorly known. *Competence in 3D-modelling at SU will be strengthened.*

Cyanobacterial blooms: The relative importance of nitrogen or phosphorus in regulating phytoplankton growth, and hence phytoplankton blooms, in the Baltic Sea is crucial for management, and still under debate (O'Melia et al. 2006). Nitrogen-fixing cyanobacteria have a key role in Baltic eutrophication management, due to their unpleasant blooms, toxicity, and fixation of large quantities of nitrogen that sustains most of the primary production in summer (Larsson et al. 2001). In addition to filamentous forms (Capone et al. 1997), small unicellular cyanobacteria have recently been shown to be important nitrogen fixers in tropical oceans (Zehr et al. 2001; Falcon et al. 2004). Their genomes are partly known and can be searched for in the Baltic, where evidence for such

unicellular nitrogen-fixers is inconclusive. *Molecular markers of Baltic cyanobacterial nutrient status developed at SU will be combined with ecological methods to study what regulates diazotrophic cyanobacteria, their nitrogen fixation, and effects on food webs and as carbon and nitrogen exporters to bottom sediments.*

Metagenomics: Processes that return combined nitrogen to nitrogen gas are critical for the Baltic ecosystem. They take place mainly in the absence of oxygen and are more effective when anoxia is widespread. Recently several new such processes have been identified, in addition to classic denitrification, such as anammox (Kuypers et al. 2003) and oxidation of H₂S by nitrate, with the formation of N₂ (Lavik et al. 2009). The Baltic Metagenome Project, planned jointly by SU/KTH/KI in the Science for Life Laboratory a strategic application in Molecular Bioscience, will study the Baltic Sea microbial metagenome. *This new resource will be used to show the presence in the Baltic of the micro-organisms that carry out these important processes, to facilitate ecological studies.*

Zooplankton grazing can control phytoplankton biomass, and thus reduce eutrophication symptoms. Conversely, it has been proposed that high clupeid biomass can suppress zooplankton, and stimulate summer phytoplankton blooms in the Baltic. A single long-term zooplankton data set from the eastern Gotland basin has been used to support this important hypothesis (Casini et al. 2008). That cascading trophic interactions are as important as nutrients in causing Baltic phytoplankton blooms needs confirmation with other data, and verification of ecological mechanisms. When zooplankton is scarce, clupeids are food-limited, slow-growing, lean, and accumulate more lipophilic contaminants. This may explain the slow decline of some dioxins and PCBs in Baltic fish and fish-eaters. *Molecular tools for assessing growth and nutrition of zooplankton* (Gorokhova et al. 2007) *will be developed and used to study the coupling between zooplankton and fish growth* (Höök et al. 2008).

Biological pump: The carbon uptake by marine phytoplankton and its transfer to bacteria and zooplankton regulates the vertical flux of organic material in the sea. This biological pump determines the residence times of nutrient elements and pollutants. Knowing the processes that create vertical fluxes is a prerequisite for understanding the ecosystem. This motivated the focus on upper ocean export fluxes in the decade-long Joint Global Ocean Flux Study of the International Geosphere-Biosphere Program (Buesseler et al. 2007). *Carbon dynamics, export fluxes and budgets in the open Baltic proper will be assessed in relation to nutrients, using time series of sediment traps and the ²³⁴Th proxy.*

Sediment nutrient flux: In shallow seas such as the Baltic, the exchange of nutrients, oxygen, and carbon between the sediment and the water column is of critical importance to balance demands for nutrients in the photic zone and for oxygen in the sediment. The patchiness of sediments prevents accurate flux estimates, valid for large areas. *New, non-invasive measuring methods using large sediment areas to average out the small-scale patchiness will be developed.* Such estimates, based on high-frequency eddy correlation measurement of bottom water dissolved oxygen (Berg 2007) and bottom water profiling of nutrients and gases, will improve biogeochemical modelling.

Marine remote sensing: Remote sensing is an indispensable tool for modelling the ocean, but global algorithms fail in estuarine waters such as the Baltic, with high concentration of coloured dissolved organic matter (Siegel et al. 2005). *Algorithms specific for the Baltic will be developed, to make satellite remote sensing more accurate in the Baltic Sea.* The improved spatial resolution of newer satellites can make them important tools also for management of coastal waters (Kratzer et al. 2008). SU is the only Swedish university with a research group specialized in marine optics and remote sensing.

Acoustic monitoring: SU is the only Swedish university training ecologists in the acoustic techniques widely used in fish stock assessment. Acoustics can also be used to study fish behaviour, for monitoring jellyfish, zooplankton and even phytoplankton blooms, and to map bottom substrates, but this has been little used in the Baltic. *This potentially highly cost-effective method will be tested and adapted for use in the unique conditions of the Baltic Sea,* such as much smaller dominant zooplankton than normal in the world ocean.

Molecular plankton monitoring: Molecular methods can give rapid, sensitive and reliable tests for the presence of toxic or invasive species, and are powerful tools for ecological studies. SU is developing molecular assays to identify and quantify species difficult to analyze by microscope, and for assessing their growth and nutritional status, as well as trophic interactions. *Molecular analysis of 10 years of samples from plankton monitoring will reveal temporal dynamics of important organisms, linked to environmental factors.*

B. Nutrient enrichment

Baltic Nest Institute (<http://www.balticnest.org/>) at SU provides long-term eutrophication forecasts for the Baltic Sea Area. This is possible because the large-scale dynamics of nutrients in the Baltic appear to be driven by a few first-order biogeochemical and physical processes (Wulff et al. 2001) that can be described in fairly aggregated models (Savchuk et al. 2008). The current coupled physical-biogeochemical marine model in Nest has been used to evaluate management strategies and to develop the country-specific nutrient reduction schemes of the HELCOM Baltic Sea Action Plan. Future model work aims to improve large-scale coupled physical-biogeochemical models as tools for management, by testing impacts of different scenarios of nutrient input and climate change on Baltic water quality and mitigation costs. *The current model, with limited temporal and spatial resolution, will initially be complimented by a more developed model, with seasonal and high vertical resolution, and in the long run by 3D-models*

Coastal eutrophication research at SU since 1972 includes detailed studies of the effects of eutrophication and its mitigation in Himmerfjärden, south of Stockholm, including hypothesis testing using whole-system nutrient load changes. Most ecosystem elements, from nutrients and pelagic micro-organisms by way of benthic animals and plants to fish have been studied for up to >30 years, as have land use and nutrient loads from small watersheds. These data offer a unique opportunity to *develop, test and validate coastal zone decision-support systems for coastal zone management,* and support implementation of the EU Water Framework Directive. Results of several models of various complexity (simple box to full 3D model) will be compared and benchmarked.

High phosphorus concentrations in the Baltic proper can stimulate toxic summer blooms of nitrogen-fixing cyanobacteria. The binding of phosphorus in oxic sediments, and its release as they turn anoxic, are key processes influencing phosphate concentrations. It is often assumed that phosphorus in sediments is permanently bound in apatite, but it has recently been shown that the concentration of Mg^{2+} in the Baltic is high enough to inhibit apatite formation (Gunnars et al. 2004). Furthermore, much of the phosphate released in anoxia will remain dissolved when bottom waters are oxygenated, since the iron needed for precipitation has been removed by sulphide during the anoxia (Blomqvist et al. 2004). *Studies will be made of phosphorus binding in coastal sediments and means of enhancing this natural process* (Blomqvist & Rydin 2009).

Land run-off models: Uncertainties concerning the effects of measures to reduce nutrient loads from land are large, making it unclear if the Water Framework Directive can ensure that the nutrient reductions of the Baltic Sea Action Plan can be reached, or the national Swedish environmental goals for the sea achieved. How future climate change scenarios will influence nutrient loads from land to sea is unknown. Monitoring of nutrients in river and land runoff can probably be rearranged to better support management of the marine environment. A particular problem is estimating loads from small, near-coastal watersheds not in the national monitoring program, but likely to leak more than the average watershed, precisely because of their proximity to the sea (Destouni et al. 2008). SU has long-term data from unmonitored watercourses that can be used to test this. *Modelling of the nutrient (N, P, Si, organic C) content of land run-off will be supported, to evaluate how the land-based nutrient load to the sea can be reduced.*

Coloured dissolved organic matter (CDOM) inflow by rivers to the Baltic Sea has increased in recent years. This will affect ecology, since organic matter from land is used in Baltic food-webs (Rolff & Elmgren 2000). More CDOM will also reduce penetration of light into the sea, reducing compensation depth. Secchi depth records from the early 20th century are the oldest that can be used to estimate the long-term increase of Baltic phytoplankton biomass, but the CDOM inflow will complicate calculations. *Marine optic models* (Kratzer et al. 2003; Kratzer & Tett 2009) *will be used to estimate the relative contributions of CDOM and phytoplankton to decreased Baltic Secchi depths.* Such estimates are crucial for achieving the well defined reference conditions needed in the water quality classifications of the EU Water Framework Directive.

C. Fisheries and aquaculture

Fisheries management: The Baltic Nest Institute and Stockholm Resilience Centre currently collaborate with researchers and policy makers in Europe and beyond to provide a scientific basis for the revision between 2009 and 2012 of the EU Common Fisheries Policy. *The research will focus on governance structures for regional fisheries management (legal and institutional frameworks needed) and on understanding the importance of leaderships and adaptive co-management processes.*

Genetic effects of decades of intense fishing for herring are being investigated at SU. International conventions require monitoring of changes in biodiversity. There are methods to do this at the ecosystem and species levels, but not for the gene-level. SU scientists were among the first to propose protocols for identifying serious loss of genetic diversity, without which natural populations cannot adapt to change, lowering their chance of long-term survival (Laikre & Ryman 1996; Laikre et al. 2008). *Methods will be developed for genetic diversity monitoring in the Baltic Sea.*

Sea-ranching, the release of cultured fish which then feed and grow in the sea, and can be caught after reaching commercial size, is an aquaculture activity of interest for Baltic coastal areas. A pikeperch stocking experiment has been started by SU for testing the cascading trophic interaction hypothesis by massive releases of young pikeperch in a well-monitored restricted coastal area. This will also test sea-ranching for producing one of the highest priced fish caught commercially in Sweden. *Genetic analyses of pikeperch from the stocked and surrounding areas will be used to map the dispersal of the stocked fish, and their possible interbreeding with native pikeperch.*

D. Hazardous substances

Pollutant modelling: SU scientists are experts on transport and cycling of persistent organic pollutants (POPs) in marine ecosystems, using multimedia fate, transport, and bioaccumulation models (Czub and McLachlan 2004; Prevedouros et al. 2006). *This modelling expertise will be used to develop a decision support system for management POPs in the Baltic.* The current physical and biological Baltic Nest models will be adapted for this use by adding fugacity and food-chain modelling of POPs. The model will synthesise years of research at SU, from which parameter values can be estimated. It will aim to prognosticate future POP concentrations under different assumptions concerning POP input, and changes in eutrophication, fish stocks and climate.

Screening tools for new environmental contaminants: Discovery of novel environmental contaminants can be approached either through direct chemical analysis or through modelling. *SU will use new modelling approaches to develop tools to predict chemicals that are likely to become environmental pollutants, i.e. persistent chemicals with a high tendency to bioaccumulate.* This is essential in order to prevent such chemicals reaching the market, and to initiate study of those already in use, using modern analytical methods. Such tools could mean a major advance in our ability to find new contaminants.

Health problems of unknown origin persist in Baltic wildlife, even though levels of most of the well-known toxic contaminants have decreased. Deaths of sea birds, reduced fat content in herring, guillemot and grey seals, and poor recruitment in salmon and other fish in the Baltic are all suspected effects of ecosystem changes. The cause may be multifactorial, involving increased natural production of toxic substances, such as halogenated phenolic compounds, by macroalgae, phytoplankton or cyanobacteria (Malmvärn et al. 2008). *Research to test this hypothesis will require the interdisciplinary cooperation favoured in this program.* Baltic cyanobacteria also produce β -N-metylamino-L-alanine (BMAA), a bioaccumulating toxic amino acid associated with

neurological disease (Cox et al. 2005), which warrants further study. Studies will combine SU excellence in chemical analysis and synthesis, cyanobacteria, macroalgal ecology and ecotoxicology, chemical composition of plankton, and nutrition of planktonic and benthic secondary producers).

Radionuclides: Sweden needs expertise on radionuclide transport and accumulation in the environment since nuclear energy is used in the region (Bradshaw et al. 2006a). *By tracing radioactive isotopes, which can be monitored with high precision, we can improve understanding of the cycling of stable isotopes of the same elements, some of which are pollutants* (Bradshaw et al. 2006b). Earlier research on marine radionuclide accumulation focussed on human foods, with little attention to non-human biota. Internationally, this is now a key research area and is a focus of the marine radioecology group at SU, the only one in Sweden. This group is part of the new Centre for Radiation Protection Research (www.gmt.su.se/crpr) at SU.

Monitoring of dissolved organic contaminants in water is not done in Sweden, making concentration data on Baltic seawater and river water scarce. Recently developed passive sampling techniques are more flexible and less costly than traditional ones. SU scientist are using these methods to study the transport of POPs in the Baltic (Cornelissen et al. 2008), but long sampling times limit their utility. *Rapid equilibrium samplers for monitoring of riverine inputs will therefore be developed.*

E. Laws and Management

Regime shifts: Today, the view that ecosystems gradually evolve towards a “climax”, predetermined by climatic and abiotic conditions, is seen as old-fashioned. Instead, ecosystems are constantly changing, and prone to dramatic shifts to new states of composition and function, so called regime shifts, from which return to previous states may be difficult or in practice even impossible (Scheffer et al.2001). This new view has important implications for management, which still tends to see ecosystems as balanced, expecting them to return harmoniously to previous states, once perturbations have passed or been reduced. *The research will identify early warning signals for regime shifts as well the need for changes in governance, including ways to use incentives to prevent overexploitation of marine resources.*

Governance of marine resources involves the management structures (informal and formal institutions) and the legal frameworks in which they operate. Researchers at the Stockholm Resilience Centre (SRC) have long experience in understanding governance structures, the role of informal networks, the role of local knowledge and monitoring for successful management, as well as the critical role of leaderships and flexible institutions for manoeuvring the transition to ecosystem-based management (Folke publication list). *The importance of congruence between ecosystem understanding (Baltic Nest) governance structures (SRC) and legal framework (Dept of Law) will be studied.*

Legal framework: An over-riding question for Baltic Sea management is whether current legal frameworks (e.g. 1982 UN Convention on the Law of the Sea, 1992 Baltic Sea

Convention and 2008 European Community Marine Strategy Framework Directive) are strong, flexible and consistent enough to fully support long-term ecosystem-based management, in the light of new ecosystems theories and the fact that all coastal states, but Russia, are now members of the EU. *This research will consider 1) the adequacy of existing legal frameworks e.g. with regard to the control of nutrients from land-based sources, hazardous substances, and fishery, 2) if the legal positions of non-state actors (individuals, corporations etc.) are defined in manners that sustain the marine environment, and 3) if improved legal platforms for long-term cooperation are needed.*

F. Climate

Regional climate models of the Baltic Sea region suggest that global warming will increase water temperatures, reduce sea ice, increase mean winter wind speeds and vertical mixing, and enhance river runoff, causing lower salinity. Such changes may greatly change the Baltic Sea ecosystem and its biodiversity, but future scenarios are still uncertain, and have not been extensively studied. The full, complex response of the ecosystem thus cannot yet be prognosticated, and the broad ecosystem competence this application builds at SU will be needed to improve future capacity for prediction. *Research on the ecological effects of climate change needs to be based on a three-dimensional ocean circulation model forced by the results of regional climate models.* The coupled physical-biogeochemical model presently run at SU (Meier 2007) needs to be further refined and validated using an observational system already installed between the Swedish mainland and Gotland, as well as satellite observations. The calculated velocity fields can be used for many purposes, such as tracer studies and quantification of transports by following Lagrangian trajectories (see above).

Climate scenarios: *Long-term simulations to study the impact of changing hydrological and atmospheric forcing on the biogeochemical cycles will be made for an ensemble of Baltic Sea climate scenarios.* The model responses will be analyzed and the importance of the studied processes for the overall sensitivity will be evaluated to improve process descriptions. The expected outcome is a deeper understanding of the interaction between physics and biogeochemistry, between sediments and water column, and of horizontal transport between coastal zones and the open sea, of the spreading juvenile freshwater and of up- and down-welling in Baltic ecosystem dynamics.

Increases in temperature and CO₂ concentration (and attendant lower pH) will affect ecosystems at all levels. Such effects on biogeochemical processes and natural ecological communities in sediment and water are little known and difficult to study in nature, because of the strong interactive environmental effects. *Experiments will be made to assess the sensitivity of key temperature- and CO₂-sensitive processes, e.g. primary production, zooplankton feeding and growth, organic matter mineralization and calcite dissolution.* The experiments will yield improved quantitative input parameters, such as Q₁₀ factors and calcite dissolution rates, which can be used in the numerical models.

2b. Current quality in an international comparison

SU combines the broadest interdisciplinary research with the most active, in-depth disciplinary research relevant to the Baltic Marine Environment of any university in Sweden, and the Baltic region. SU has long been a leader in research on Baltic ecosystems, eutrophication and hazardous substances, and has more recently developed world-leading research on climate change, management of natural resources and ecosystem services as well as multimedia fate, transport, and bioaccumulation models for persistent organic pollutants. Other marine research at SU, which interacts with its Baltic Sea studies, include high-quality research on geology and climate in the Arctic and North Atlantic, on coral reefs, mangroves, tropical cyanobacteria, and global aquaculture.

A few simple bibliographic searches indicate the quantity and quality of marine research at SU. Table 1 shows publications on marine topics in the two top science journals:

Table 1. Publications in *Nature* and *Science* 2000-2009 with topic Sea, Marine or Ocean. Source: ISI Web of Knowledge 20090314. Items may have authors from >1 address.

<u>Address</u>	<u>Number of items</u>	<u>Number of citations</u>
All Sweden	56	5126
Stockholm University	27	3159

SU had three times the marine items of the nearest Swedish university, and almost six times the citations, and SU items received 62% of citations to Swedish items. However, few of these Swedish articles deal explicitly with the Baltic or North seas.

Table 2 specifically covers publications from the Baltic Sea Area, the area encompassed by the Helsinki Convention and by this application.

Table 2. Publications 2000-2009 with topic Baltic Sea Area (Baltic Sea, Baltic proper, Southern, Northern, Eastern, Western, Southwestern or central Baltic, Bothnian, Gulfs of Bothnia, Riga and Finland, Kattegat, Oresund, Bornholm Basin, Arkona Basin.

Source: ISI Web of knowledge 20090314. Items may have authors from >1 address)

<u>Address</u>	<u>Number of items</u>	<u>Number of citations</u>
World	4 958	38 024
All Sweden	1 199	11 243
Stockholm University	457	4 935

SU contributed 9% of all items, received 13% of all citations, and had 38% of Swedish items, with 44% of citations to such items. Of 25 authors with over 20 items, 9 were from Sweden. The 6 from SU will all participate in this project. For all Swedish seas including the North Sea and Skagerrak, SU had 35% of Swedish items and 42% of their citations, in every case more than twice that of any other Swedish university. A similar Baltic Sea bibliographic study (Snoeijs et al. 2008) searching 12 more databases found this added 6% relevant publications to ISI Web of Knowledge.

Table 3 (next page) gives recent data for narrower fields relevant to this application. SU has generated about a fifth of the published items, but consistently receives a higher proportion of the citations. Other Swedish universities contribute much less.

Table 3. World publications 2000-2009 with Baltic topics, and the SU contribution. Source: ISI Web of Knowledge 20090314. Items may have authors from >1 address.

Topic (+Baltic)	# items	%SU	# citations	%SU citation	rate mean	SU citation rate mean	highest ranked SU item (≤ 10)
Ecosystem	105	19	848	23	8.1	9.9	3, 6
Phytoplankton +primary production +cyanobacteria +nitrogen fixation	203	19	2059	29	10.1	15.4	1, 2, 4, 6
zooplankton	43	23	389	32	9.1	12.4	2, 3, 4, 6
Eutrophication +nutrient(s) +nitrogen +phosphorus	367	17	3819	26	10.4	15.5	1, 2, 3, 6, 9
Fisheries	52	17	293	28	5.6	9.1	1, 6, 9
Management	74	20	433	43	5.9	12.4	1, 2, 3, 4, 7, 10

A. Ecosystem Functioning

Baltic ecosystem research started in 1970 at SU with the project "Dynamics and Energy flow in the Baltic ecosystem", led by Bengt-Owe Jansson, in which ecosystem modelling incorporating physical and ecological processes was initiated. SU has remained active in Baltic ecosystem research (Elmgren publication list) and modelling (Wulff & Stigebrandt 1989, Savchuk et al. 2008). SU scientists have advanced our understanding of particle export from the upper ocean (Gustafsson publication list), studied ecosystem effects of invasive species (Gorokhova publication list), and participated in discovering new bacterial processes coupling nutrient cycles to the cycles of Mn, Fe and S (Brüchert et al. 2003; Lavik et al. 2009). SU scientists have done leading research on cyanobacteria in the oceans (Bergman publication list) and the Baltic Sea. The ecosystem approach is important for the national Swedish environmental objectives "A balanced marine environment, flourishing coastal areas and archipelagos" and "A rich diversity of plant and animal life". SU scientists have produced many reviews of the interacting effects of human activity on the Baltic Sea (e.g. Elmgren 1989, 2001, Vahtera et al. 2007, Österblom et al. 2007). SU contributed to the design of the national Swedish marine environmental monitoring program, and since the 1970s has carried out much of this monitoring in the Baltic proper. Many publications have resulted, some highly cited (http://www.ecology.su.se/LTER/Publications_monitoring.pdf), and of great significance for managing Baltic environmental problems.

B. Nutrient enrichment

Eutrophication research: SU has long been at the forefront of Baltic eutrophication research. SU produced the first proof that the Baltic nutrient increase had a biological

effect, increased benthic biomass (Cederwall & Elmgren 1980). Further papers treated limiting nutrients in the Baltic (Granéli et al, 1990), coastal eutrophication (Cederwall & Elmgren 1990), management advice (Rosenberg et al. 1990), and the first influential coupled physical-biogeochemical models of the Baltic (Stigebrandt & Wulff 1987, Wulff & Stigebrandt 1989). This work continues at SU, both for the open sea and for the coastal zone, and is highly relevant to the National Swedish environmental objective “Zero eutrophication” (Elmgren & Humborg publication lists).

Nutrient loads: A paper from SU (Larsson et al. 1985) provided the first realistic basin-wide estimate of the Baltic nitrogen load. SU scientists have also studied eutrophication by land input in the Black Sea (Humborg et al. 1997) and the North Atlantic (Howarth et al. 1996), and today three SU department and Baltic Nest Institute are involved in such research on the Baltic (publication lists of Humborg, Elmgren).

Marine Research on Eutrophication (MARE): This Mistra-funded program has developed the Baltic Nest decision support system for management of eutrophication of the Baltic Sea Area. After an enthusiastic scientific evaluation in 2007, this research program now continues with permanent government funding as the Baltic Nest Institute within the Stockholm Resilience Centre at SU.

C. Fisheries and Aquaculture

Management options for Baltic fisheries have been studied at SU (Hjerne & Hansson 2001; Hansson et al. 2007), as have effects on fish stocks of Baltic different nutrient loads and seal stocks (Österblom et al. 2007). Ecosystem effects of Baltic fisheries studied at SU are removal of nutrients (Hjerne & Hansson 2002) and POPs (McKenzie et al. 2004) by fish landings, and their release from the trawled sediments (Bradshaw).

Aquaculture: The most cited articles in Web of Science on this topic show the industry’s main problems to be feed availability, nutrient emissions, genetically different or exotic escapees from farming and organic contaminants in feed and hence product. These are areas in which SU has very strong research pertaining to the Baltic Sea. The most and 5th most cited aquaculture articles have SU authors (Naylor et al. 2000, Hindar et al. 1991).

D. Hazardous substances

Baltic organic hazardous substances research at SU started after drastic declines in seal and eagle populations in the 1960s. This research discovered PCB, persistent metabolites of PCB and DDT, and other novel environmental contaminants, showed the importance of actively bioaccumulated metabolites, and found the main causes of reproductive failures, egg-shell thinning, malformations and other health effects. SU scientists are now leading in showing that halogenated phenolic compounds are produced by Baltic biota, not only by industries. Further, SU scientists working in the Baltic pioneered studies of key processes for the fate of POPs, such as sorption to black carbon and partitioning between seawater and suspended particulate organic matter, which affects bioavailable exposures and transport through volatilization and particle-bound settling. Recently, SU

demonstrated that the atmosphere is the main source of dioxins and PCBs, and predicted future levels in the Baltic Sea for different abatement scenarios. This research is highly relevant to the national Swedish environmental objective “A non-toxic environment” (Å Bergman, Gustafsson, McLachlan publication lists)

E. Laws and Management

Natural resource management: Stockholm Resilience Centre (SRC) is a world-leading environment for the integrated study of governance (laws and management structures) of natural resources and has produced some of the most cited papers in this field. Formas recently evaluated its Centre of Excellence project at SRC and concluded that it “has already laid a strong ground for creating a highly competitive, strategically important research environment concerning resilience and sustainability”.

Environmental law: SU is the leading Swedish university in international, EC and transnational environmental law, and has published numerous articles and reports on legal issues on management and protection of the Baltic marine environment.

F. Climate

Scenarios of climate changes: SU scientists have been leading in producing scenarios for the likely effect of climate change on the Baltic (Meier publication list), needed for predicting ecological effects. Of the small and recent literature on “Baltic Sea” and “climate change”, totally 34 items, 14 have a Swedish author, and 7 of those are by authors now at SU (HEM Meier, BG Gustafsson)

2c. Promoting the development of marine environmental research at SU

The funds applied for here are not large compared to those already used for Baltic Environment research at SU, but will make a huge difference when used to promote synergy and cooperation between departments and research groups, and initiate crucial new activities. By creating cooperative projects between departments in Science, Social Science and Law and taking full advantage of two new elements in SU’s research portfolio, the *Baltic Nest institute* and the *Stockholm Resilience Centre*, a coherent, leading-edge Baltic Environmental Research program of great strategic value to the nation and region will be established.

2d. Career opportunities for young researchers

We intend to use only the barest minimum of funds for equipment or infrastructure, and will focus on supporting doctoral students, postdoctoral fellows, and junior research fellows and to help competent scientists get their first tenured position. We calculate that up to 15-20 scientists can receive early career support in this program.

2e. Priority of the research area at SU

Stockholm University has a long-standing reputation as an international leader in *marine research* and this is clearly one of the defined Faculty areas. Furthermore, there are a number of interactions between scientists in this area and those in other high priority areas within the Faculty of Science. Marine research will have an increased importance in the future within the Faculty with focus on the understanding of the effects of environmental and climate change on the Baltic Sea. The long-term commitment to marine research at the Faculty of Science is manifested by the establishment of the *Stockholm University Marine Research Centre* from April 2009.

2f. Need for infrastructure

This initiative needs no major new infrastructure. Of the initiatives mentioned in the call, SU participates in EMSO, which plans no activity in the Baltic, “Life-watch” is under development, but may prove valuable for genomic approaches to Baltic biodiversity. As for SND-KM (Swedish National Database for Climate and Environmental Data) the crucial future need for this research is access to data on biology and toxic pollutant concentrations from the whole Baltic Sea area, not from Sweden only.

2g. Need for expensive equipment

Baltic Sea research depends on expensive equipment such as ships, satellites, analytical instruments, echo-sounders and high-speed computers for modelling. Ship and satellite access is costly, but national initiatives are in place to meet future needs. SU has well equipped laboratories, and access to modern computers for Baltic 3D-modeling. There will be a need to replace sampling and analytical equipment as it ages, and to buy new instruments, but the greatest need is to strengthen the human research capability.

2h. Linkage to advanced education and research training

Almost all the 79 recent Baltic Sea doctoral theses at SU were on environmental issues:

	PhD theses 2000-2009	Current doctoral students (2009)
Marine topics	122	96
Thereof Baltic	79	58

SU has recently started both a Candidate program and a Masters Programme in Marine Biology, and also a Candidate Program and a Masters Program in Environmental Science with a strong marine focus, all of which will benefit from the research proposed here. SU and Umeå University run a joint Masters Programme in Environmental Chemistry, which has strong relevance to the Baltic.

2i. Gender issues

SU values gender equality for the quality enhancement it provides, for its importance for the internal development of the University and for the good example it sets students. SU

actively promotes gender equality in all its activities, such as teaching, research, conditions for study and work, as well as in representation among employees and student and on boards and committees. The Vice-Chancellor has granted special funding to enable highly qualified female associate professors to qualify for promotion to professor, and for recruiting prominent female guest professors. The University has surpassed its goal of 30% women among professors recruited in 2005-2008. The Faculty of Science strives for gender balance when recruiting new staff, and has succeeded well, except in some traditionally male areas. The Faculty has therefore specifically recruited highly recognized female scientists in some such areas.

Of the scientists in this application, 40% are women. The budget has support for 3 female associate professors (Bradshaw, Gorokhova, Kratzer) to secure their services for SU.

Cited literature (For bracketed initial+numbers see research leader publication lists)

Berg et al 2007 *Limnol Oceanogr* 52:1672, **Blomqvist** et al 2004 *Limnol Oceanogr* 49:2236 [RE67], **Blomqvist & Rydin** 2009 Swedish EPA Report 5914, 111 pp., **Bradshaw** et al 2006a *Ambio* 35, 106pp., **Bradshaw** et al 2006b *Estuar Coast Shelf S* 66:123, **Brüchert** et al 2003 *Geochim Cosmochim Acta* 67:4505, **Buesseler** et al 2007 *J Mar Res* 65:345 [ÖG82], **Capone** et al 1997 *Science* 276:1221 [BB106], **Casini** et al 2008 *P Roy Soc Lon B Biol* 275:1793, **Cederwall & Elmgren** 1980 *Ophelia* 1:287 [RE16], **Cederwall & Elmgren** 1990 *Ambio* 19:109 [RE34], **Cornelissen** et al 2005 *Env Sci Technol* 39:6881 [ÖG62], **Cox** et al 2005 *Proc Natl Acad Sci USA* 102:5074 [BB154], **Czub & McLachlan** 2004 *Environ Sci Technol* 38:2406 [MML33], **Destouni** et al 2008 *Global Biogeochemical Cycles* 22:GB4003, **Eilola** et al 2009 *J Mar Systems* 75:163 [HEMM27], **Elmgren** 1989 *Ambio* 18:326 [RE30], **Elmgren** 2001 *Ambio* 30: 222 [RE59], **Falcón** et al 2004 *Appl Environ Microbiol* 70:765 [BB148], **Folke** et al 1991 *Ecological Economics* 3:123 [CF38], **Gorokhova** et al 2007 *Mar Ecol Prog Ser* 349:213 [EG24], **Granéli** et al 1990 *Ambio* 19:142 [RE33], **Green & Bergman** 2005 *Environ Sci Technol* 39:480 [ÅB21], **Gunnars** et al 2004 *Mar Chem* 91:15, **Hansson** et al 2007 *Ambio* 36:265, **Hindar** et al 1991 *Can J Fish Aquat Sci* 48:945, **Hjerne & Hansson** 2001 *Fish Res* 53:57, **Hjerne & Hansson** 2002 *Limnol Oceanogr* 47:1023, **Howarth** et al 1996 *Biogeochemistry* 35:75 [RE43], **Humborg** et al 1997 *Nature* 386:385 [CH43], **Höök** et al 2008 *Estuar Coast Shelf S* 76:29 [EG27], **Kratzer** et al 2003 *Ambio* 32:577, **Kratzer & Tett** 2009 *Hydrobiologia*, in press, **Kratzer** et al 2008 *Remote Sens Environ* 112: 2284, **Kuypers** et al 2003 *Nature* 422:608, **Laikre & Ryman** 1996 *Ambio* 25:504, **Laikre** et al 2008 *Biodivers Conserv* 17:893, **Larsson** et al 1985 *Ambio* 14:9 [RE23], **Larsson** et al 2001 *Limnol Oceanogr* 46:811 [RE58], **Lavik** et al 2009 *Nature* 457:581, **O'Melia** et al 2006 Swedish EPA Report 5509 67 pp, **MacKenzie** et al 2004 *Env Sci Technol* 38:1970, **Malmvärn** et al 2008 *Chemosphere* 72:910 [ÅB3], **Meier** 2007 *Estuar Coast Shelf S* 74:717 [HEMM25], **Naylor** et al 2000 *Nature* 405:1017 [CF2], **Prevedouros** et al 2006 *Env Sci Technol* 40:32, **Rolff & Elmgren** 2000 *Mar Ecol Prog Ser* 197:81 [RE50], **Rosenberg** et al 1990 *Ambio* 19:102 [RE35], **Savchuk** et al 2008 *J Mar Systems* 74:485 [CH6], **Scheffer** et al 2001 *Nature* 413:591 [CF1], **Siegel** et al. 2005 *Geophys Res Lett* 32: L20605, **Snoeijs** et al 2008 *Bonus publication* 9:1, **Stigebrandt & Wulff** 1987 *J Mar Res* 45:729, **Vahtera** et al 2007 *Ambio* 36:186, **Wulff** et al 2001 *Ambio* 30:254, **Wulff & Stigebrandt** 1989 *Global Biogeochemical Cycles* 3:63, **Zehr** et al 2001 *Nature* 412:635, **Österblom** et al 2007 *Ecosystems* 10:877 [RE 76] [CF48]

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Title of research programme
Ecosystem Approach to the Baltic Sea

Appendix C (Strategic importance for the business sector and so)

3. Strategic importance of the research to society and business

The future of the Baltic marine environment is in human hands. With a modern industrial society of 85 million people within its drainage basin, most of Europe in its airshed and the strong likelihood of accelerating climate change, it is no longer feasible to restore the Baltic Sea to some previous pristine state, no matter what measures are taken. This makes management of the Baltic Sea environment an even greater responsibility, as well as more difficult. The choices are ours; our descendants will inherit the consequences.

This application is of strategic importance to society in providing the ecosystem science to guide marine activities, through influencing national laws, regulation and political objectives and international laws, conventions, directives and agreements. Potentially, it could become globally important, if it can promote ecosystem-based management in the Baltic, as the first large marine ecosystem in the world. The concepts and methods of this project could then serve as models or inspirations for environmental research, monitoring and management in other marine areas strongly affected by human activities.

The proposed integrated research program will help educate a new generation of marine ecosystem scientists with the interdisciplinary knowledge required to make good suggestions for managing the problems ahead of us. This program will set up meeting places for all scientists involved and communicate with the Swedish national authorities responsible for proposals to the government and to international conventions for managing problems in the Baltic Sea.

3a. Strategic importance to business sector and society

Importance for international environmental agreements

Eutrophication is the greatest challenge for the HELCOM Baltic Sea Action Plan, and is also important for the EU Marine Strategy. Research at SU has historically had an marked influence on how Baltic eutrophication is perceived internationally, and the development of the Baltic Nest decision support system has given SU research an even more central position in the work to reduce nutrient loads to the Baltic, and hence the eutrophication of its coastal and open waters. The models of Baltic Nest have thus had enormous importance, but it is important that they be constantly re-evaluated in the light of improved knowledge of ecosystem dynamics and by comparison with monitoring results. It is also highly desirable that alternative models be developed and tried, as is the norm in global climate research, e.g. for nutrient run-off from land. Finally, the potential of the Water Framework Directive (WFD) for improving not only the coastal areas of the Baltic, but also the open Baltic, albeit at a slower pace, must not be overlooked, since almost all nutrients, except those coming from Russia, or by way of the atmosphere, reach the Baltic after passing through an EU coastal area, under WFD rule. The research proposed here strongly supports improvement of Baltic ecosystem knowledge, and also specifically of the Nest model system through its support for 3-D modelling and land run-off modelling at SU.

Management of Baltic fish stocks has widely been seen as a failure, and calculations indicate that catches of cod, the commercially most important species, could have been twice those of today, had the advice of ICES scientists been consistently heeded by politicians. Overfishing of cod may also have contributed to the high organic contaminant concentrations in fat fish species, and possibly even to an increased frequency of harmful cyanobacterial blooms. A first, large step towards better management would be to follow ICES recommendations, but in the longer perspective this advice should be based on multi-species or ecosystem models, which requires improved ecosystem knowledge. The possibility that change in governance structures could facilitate responsible management should also be investigated. The research proposed here supports a fuller integration of fish and fish stocks in the models of the Nest system, and hence in the longer run an ecosystem approach to the Baltic fishery.

Hazardous organic pollutants have high priority in a number of international environmental management programs, including the Water Framework Directive, The HELCOM Baltic Sea Action Plan, the Stockholm Convention, and the new chemicals legislation in the European Union, REACH. The research in this proposal will support all of these environmental management programs.

The research in this program will use accumulated knowledge of the behaviour of pollutants of concern in the environment to model their distributions and fluxes in the ecosystem. Such modelling can help develop a quantitative understanding of the relationships between sources/emissions of the pollutant and its levels in sensitive environments/organisms. This understanding is a prerequisite for the development of control strategies and is severely lacking for the Baltic environment today. Thus, HELCOM does not yet have a quantitative understanding of the source contributions of any of the organic pollutants on its priority list, and hence cannot develop a rational action plan to reduce levels in Baltic ecosystems. This research program will address this deficit.

Prevention of future pollutant problems is perhaps the most important service that research can provide to society. This program will make important contributions e.g. by developing new tools for predicting the potential of a chemical to become a marine pollutant based on its chemical structure. Such tools will in the future help guide society in deciding which chemicals it is going to produce and use.

Identifying new pollutants is an essential step towards preventing or mitigating harm to the ecosystem. The proposed program will develop novel model-based chemical screening and prioritization tools combining environmental chemistry, ecotoxicology, and biogeochemistry with advanced analytical techniques. This will contribute to the incorporation of new chemicals in the Stockholm Convention, to a science-based expansion of the HELCOM and WFD priority lists, to the identification of needs and priorities for working towards the Swedish environmental goals, and to the proper classification of industrial chemicals as e.g. PBTs or vPvBs under REACH. Earlier pollutant identification research at SU has had an international impact beyond the boundaries of the Baltic Sea watershed.

Importance for national environmental management

The ecosystem research proposed in this program will support management towards reaching the two Swedish national environmental objectives “A balanced marine environment, flourishing coastal areas and archipelagos” and “A rich diversity of plant and animal life” by providing advice to society on ecosystem-based management of the fishery, as well as of nutrients, hazardous substances and invasive species. Climate change may cause large changes by extirpating cold-water species and facilitating invasions of exotic warm-water species.

The EU Water Framework Directive (WFD) is the single most important management framework for improving water quality in the coastal zone as well as open waters of the Baltic Sea (Gipperth & Elmgren 2005). When fully implemented, it will provide a legally binding framework for achieving ‘good water quality’. It uses an ecosystem perspective to integrate handling of surface waters, ground waters and coastal waters within the natural boundaries of each watershed, and proscribes adaptive management as a way to fulfil its objective. Implemented wisely, the WFD provides the tools needed to improve surface, ground, and coastal water quality and eventually also the open Baltic, to the extent possible without dismantling modern society. SU is developing a coastal monitoring program for the Svealand region of Sweden, and a coastal decision support system for implementation of the WFD in this region.

Baltic influences Kattegat: Statistical analyses of marine monitoring data have shown that concentrations of total nitrogen and phosphorus in the surface water along the Swedish west coast of the Kattegat are significantly influenced by the generally somewhat higher concentrations in the southern Baltic Sea (Larsson et al. 2008), which explain about half the variation in total N and P in the southern Kattegat. This indicates that regional eutrophication along the Swedish Kattegat coastline is largely governed by the outflow of high nutrient, low salinity water in the Baltic current, rather than by local sources, and that marked improvement there first requires improvement in the whole Baltic Sea.

The nutrient enrichment research in this program supports management towards reaching the national environmental objective “Zero eutrophication”. The Baltic Nest model system is specifically built to provide decision support for eutrophication management for the Baltic Sea Area, and its further development is supported by this application. In addition, SU is providing coastal decision support for water quality management in the Svealand coastal region of the Baltic Sea, which could become a blueprint for other regions.

Swedish marine environmental monitoring: SU has carried out much of this program in the Baltic Sea and is accredited for most methods used in these programs, and repeated European QUASIMEME intercalibrations have proven the reliability of the measurements. Combining marine environmental monitoring with basic research has proven highly efficient and mutually beneficial. The long-term time series studies at the Landsort Deep, open Baltic proper, is one of the longest-running time series stations on

the continental shelf anywhere. Fundamental insights on the links between ecosystem dynamics and biogeochemistry have been reached by using monitoring data (Larsson et al., 2001; Gustafsson et al., 2004; Waite et al., 2005). For the monitoring program, this has meant that the quality of the data has been continuously evaluated as publications and doctoral theses using them have been scrutinized by the scientific community. Scientists at SU have been given the possibility to make other measurements during the regular expeditions on the Baltic, with little or no extra cost in ship time, and with the free availability of many important measurements of known high accuracy, on which they would otherwise have had to spend time and money. The long and diverse ecological time-series resulting have proven invaluable to scientist around the Baltic, and to society, e.g., when implementing the EU Water Framework Directive and formulating national policies on Baltic eutrophication.

Alien Species: SU has conducted research supporting the Swedish National Strategy and Action Plan for Alien Species for over 10 years. With intensified shipping and climate change, non-indigenous species (NIS) arrive more often in the Baltic Sea. Such invaders may potentially change marine ecosystems, hamper economic use of the sea and even constitute a risk to human health. SU has identified natural enemies of NIS that can suppress their populations in the Baltic and studied the effectiveness of prevention.

Hazardous compounds: The national environmental goal that “The environment must be free from man-made or extracted compounds and metals that represent a threat to human health or biological diversity” is strongly supported by research at SU. The program proposed here will serve as a centre for research to identify novel environmental contaminants in the Baltic Sea ecosystem, for assessing their effects and for guiding management towards achievement of the objective.

Improving monitoring methods: SU scientists analyze organic pollutants for the Swedish marine monitoring program, in close communication with the Swedish Environmental Protection Agency, which is responsible for the monitoring. This close link frequently results in rapid implementation of new research results in monitoring, in Sweden and beyond. The planned decision support system will strengthen this connection and give new impulses in defining monitoring program objectives.

Natural toxic compounds: The present program is addresses the important hypothesis that toxic natural compounds may now be present in un-natural concentrations in some Baltic areas. The possibility that natural halogenated phenolic compounds through an impact on inhibition of the oxidative phosphorylation can lead to acute reproductive effects or reduced fat content in wild animals. Interactions between these compounds, antioxidants and hormones are not yet understood. Further research is needed to unravel these interactions, and evaluate the potential for countermeasures, e.g., for reproductive failure in wild salmon and other fish. Production of the bioaccumulating neurotoxic amino acid BMAA by Baltic cyanobacteria is another example, which constitutes a potential health risk that needs further evaluation in a Baltic context. If BMAA can be implicated in causing neurological disease here, it becomes highly relevant for society to understand links between water quality and production and trophic transfer of BMAA.

Support for a national strategy to implement the Baltic Sea Action Plan: The Baltic Sea Action Plan (BSAP) has the goal of achieving good environmental status by 2021. This application supports implementation of the BSAP by strengthening SU research on all its main topics. Reducing the nutrient input is the greatest challenge of the BSAP. The link between land input, eutrophication and climate is central, as is uncertainty in estimates and scenarios of land-based nutrient loads. SU research has a central role here, since the models of BNI were the basis for 2007 land-mark decision by HELCOM on country-specific nutrient load reductions. SU is Sweden's leading university for climate change research, and has provided important knowledge on land-derived nutrient inputs. The SU project to enhance chemical phosphorus sequestration in Baltic sediments is also highly relevant. The BSAP stresses the need for better knowledge of the distribution of hazardous substances, and for tools to assess and map any damages, but completely lacks an integrated approach to managing POPs. The use of the mass balance models of BNI could revolutionize this work. In addition, SU work on identification and quantification of new contaminants is highly relevant. Several SU fisheries projects, such as acoustic monitoring, the fisheries modelling in BNI, and the pikeperch stocking experiment will also support the BSAP. The proposed research in support of revision of the Common Fisheries Policy also contribute to the BSAP by means of providing scientifically based recommendations for potentially successful fisheries management tools.

Further pollution reduction: The Swedish government has recently stressed the need to further reduce the pollution load to Swedish Seas, e.g. by proposing a new marine authority, responsible for co-ordination of all such activities. The government also recognized the great need for practical research to facilitate implementation of measures to reduce pollution of the sea. Research proposed in this application will further strengthen the capacity of SU to support decision-making at national, regional and local levels, and to provide businesses and NGOs with a scientific basis for their activities.

Supportive breeding in aquaculture: Part of Swedish aquaculture involves supportive breeding, where a minor portion of the population is artificially bred to produce large numbers of offspring, which are then released in the environment, to enhance the stock. Such activities may cause loss of genetic variability in the natural population through in-breeding effects, the so called Ryman-Laikre effect, first described at SU (Ryman & Laikre 1991). Methods for theoretically evaluating the risks of causing such effects by a specific management are available (Wang & Ryman 2001), but genetic monitoring is needed for empirical detection in individual cases (Laikre et al. 2006).

Strategic importance to the business sector

Water Framework Directive: Since it influences implementation of the WFD, this application is of importance to private business. The WFD requires EU member states to work to reach good water status in all its water areas by 2015, or 2021, if permission for later attainment is granted. It also requires that water areas that have reached good water status do not deteriorate in water quality, even if they still maintain good water status. If there is a risk of non-compliance with the requirements of the WFD, the competent local

authorities are required to close ongoing and ban new activities that may compromise water quality. It is therefore of utmost importance for business activities that decisions in these matters are based on the best possible scientific knowledge. This is particularly obvious for the coastal zone, since non-attainment of good water status locally may be due to pollutant emissions in remote areas of the sea, rather than the local catchment, but could still legally require drastic restrictions on local business activity.

Business opportunities will be created by the WFD requirements to protect the water status of the Baltic Sea and its coastal areas, in treating industrial and municipal sewage, in water treatment solutions for single households and small villages, in new solutions for minimizing nutrient runoff from agriculture, and in particular concentrated animal husbandry. Environmental consultant businesses can also be expected to see brisk trade ahead, when industries and local governments are required to evaluate the environmental effects of planned new activities in relation to the WFD.

Making Swedish industry more competitive: The active search for chemical pollutants have made Swedish industry more environmentally friendly. The development of new technology for bleaching of pulp is an example. The use of chlorine as the bleaching agent had severe effects on Baltic fish near the industries. Changing the pulp bleaching process largely eliminated the problem, and the Swedish paper and pulp industry gained an environmental marketing argument. Another industrial success story is the work on recycling of copper, silver and gold from printed circuit boards. Through changes in storage of the e-waste significant changes in Baltic Sea contamination have been achieved. These developments would not have been so rapid, unless SU researchers had first identified the problems. Universities with strong environmental research can thus be an advantage to Swedish industry, since environmental arguments are valid worldwide.

Invasions by non-indigenous species cause problems in aquatic ecosystems world-wide. Since eradication of aquatic invaders is seldom possible, preventive measures are crucially important. Ship's ballast water is a prime vector for aquatic invaders. SU has assisted in developing one of the first commercial ballast-water treatment systems for preventing the spread of invasive species, which was released on the global market by Alfa Laval in 2007.

Aquaculture in the Baltic is hampered by the low salinity, which makes shellfish farming impossible or uneconomic. The nutrient release from fish-farming has restricted the development of pen-raising in the Baltic, since the value added per unit of nutrient released is far below the cost of removing the same nutrients from sewage or industry emissions. There is, however, a potential to develop a Baltic fish-farming industry based entirely on feed from Baltic Sea fish. This will remove rather than add nutrients to the Baltic, but could still cause local eutrophication. Farms will therefore have to be located in areas with good water exchange, which probably requires large farms for economy, and the fish meal and oil used to produce the fodder will have to be treated to reduce the pollutant content. The research proposed here can assist the industry in realizing this vision and the authorities to advice and control it.

Demand for skilled personnel: Finally, we foresee an increased demand for scientists trained in marine environmental management both by public authorities and businesses. An important task for SU, which this programme will support, will be to supply society with qualified personnel at all academic levels, with the theoretical insights and practical experience society will need.

3b. Strategies and plans to generate benefits from the research

Importance for international environmental agreements

The decision support system for Baltic eutrophication management called Baltic Nest (<http://nest.su.se/nest/>) has been developed at SU in the MARE projects, financed by Mistra. Baltic Nest links information on environmental conditions and costs in the entire Baltic Sea Area through a series of models, where possible measures to achieve good environmental status in the Baltic Sea can be explored. The current models will be further developed to provide sound management advice for international negotiations between riparian countries, within HELCOM and the EU on priority environmental issues of the Baltic Sea. Four linked models describe the fluxes of matter and energy to and within the Baltic Sea Area and address issues of eutrophication, climate change and overfishing, using the ecosystem approach to management. Atmospheric, catchment and marine models are directly interlinked; the marine and the food web model will be linked through primary production and zooplankton, which are part of both models. Economic models linked with the catchment model will estimate the cost of various measures to achieve good environmental status within the basins of the Baltic Sea. Baltic Nest uses huge environmental databases for the Baltic Sea Area and its catchment, to give realism to the model results.

Changed land-sea fluxes? The Baltic Nest models will be used to investigate the effects of likely changes in the land-sea fluxes of biogenic elements (C, N, P, Si) in the catchment of the Baltic Sea Area. Possible future scenarios, with improved sewage treatment and agricultural practices and different degrees of climate change (temperature, hydrology), will be simulated. Not only will the total nutrient fluxes to the Baltic Sea change, but also their ratios (C:N:P:Si). A possibility is that N fluxes increase due to increased livestock densities in the new EU countries, whereas P and Si fluxes decrease due to better sewage treatment, a ban on P in detergents, and the building of new dams in the Baltic catchment. Such altered nutrient input could change the phytoplankton species composition, perhaps leading to fewer diatoms and cyanobacteria, but more dinoflagellates.

The research proposed here will support the further development of Baltic Nest by

- Development of 3D-models suitable for use in the Nest model system
- Testing and improving representation of cyanobacterial growth, nitrogen fixation, zooplankton production, organic matter sedimentation and sediment-water fluxes in the biogeochemical models
- Improving representation of the coupling of zooplankton and fish, and of fish recruitment in the fisheries modelling

- improving modelling of land run-off in the Nest models by use of several models tested against empirical runoff data
- Providing better scenarios for climate change simulations through 3D ensemble modelling
- Adding a module for organic contaminants to the Nest model system

Modelling organic pollutants: A major new initiative in this research program is to create a decision support tool for the environmental management of organic pollutants, based on the successful Baltic Nest decision support tool for nutrients. SU has excellent understanding of mathematical models of organic contaminant sources, fate, and bioaccumulation. This program will forge the last and key link in the knowledge transfer chain, from system understanding to decision support. The application of this system will be facilitated by the links of the Baltic Nest Institute to HELCOM and the Swedish agencies responsible for the Baltic environment. As the first decision support system for environmental management of organic pollutants that we are aware of, this work can be expected to have an impact well beyond the Baltic region.

Monitoring is required to assess the spatial distribution of chemicals, and aid in source identification. Not all contaminants decrease with time, showing that pollutant release continues and reduction strategies are ineffective, and indicating a need to act. Monitoring programs must evolve as new knowledge becomes available, and the contaminant situation changes. Building on SU's extensive marine monitoring, this research program will develop innovative new passive sampling methods of monitoring. International conventions such as HELCOM and the Stockholm Convention will benefit, as will the WFD (satisfactory monitoring methods are lacking for some organic pollutants on the priority list), and many national activities directed at pollutant reduction.

Importance for national environmental management

WFD Implementation: Sweden lags several of its Baltic EU-neighbours in implementing the WFD. Much effort remains before a consistent and scientifically sound Swedish classification of water quality has been established, and methods to evaluate cost-effective measures and monitor progress have been agreed on. As of now, Swedish classification systems are still lacking for EU priority pollutants, as well as for fish communities in transitional waters. At the national level, SU has led the work of developing several of the current Swedish marine classifications, and has unique competence for making significant contributions in the first round of revisions, recently initiated by the Swedish Environmental Protection Agency, as well as for developing the missing classification systems.

Adaptive management is used by SU to tackle difficult marine management issues, such as full scale experiments with varying nutrient reduction in a sewage treatment plant to observe water quality effects (since 1984), release of pikeperch in a coastal bay to test for cascading trophic interactions and fisheries enhancement (started 2008), and use of chemical capping to reduce the release of toxic pollutants or phosphorus from sediments (planned for 2009 on). Such experiments are directly relevant to coastal management

under the Water Framework Directive, and eliminate the need to deduce causation from correlation as well as the difficulty of predicting field effects from laboratory experiments. They also provide valuable data for model validation.

New screening tools: The development of new screening tools for identifying potential environmental contaminants is another important means of transforming research results into applications of value to both industry and government. Existing knowledge on the relationship between chemical structure/properties, production and use on the one hand and chemical emissions, transport, transformations, fate bioaccumulation, and toxicity on the other hand will be incorporated into a modelling tool that will predict the expected concentrations in Baltic Sea ecosystems. This tool will be used to screen lists of chemicals in use (e.g. the list of chemicals registered under REACH) to identify those most likely to be environmental pollutants. Another tool under development will assess persistency and bioaccumulativity from information on chemical structure (Green & Bergman 2005). Knowledge of the potential of a chemical to become a marine pollutant is important to assist in making wise business decisions that result in good products with a long-term sustainable market and a minimal risk of future environmental litigation.

Importance for the business sector

Serving business interests: The proposed model and screening tool will serve business interests by providing a foundation for science-based decision-making on measures to control and reduce Baltic Sea pollution. This is essential for cost-effective utilization of business resources, and hence important for national and international competitiveness. As a recent case in point, old sawmill sites contaminated with dioxins as well as certain suspected industrial dioxin emitters were studied by SU scientists and were found to be negligible dioxin sources compared to the atmospheric deposition of dioxins from diffuse combustion sources to the Baltic Sea. Hence costly investments that would have been of negligible benefit to the Baltic Sea environment were avoided, and the real main source of the problem was identified as the focus for future work. This illustrates how this research program can benefit business as well as environmental managers.

3c. Capacity and supportive activities to generate benefits

3d. Participation by community organisations in problem formulation and implementation of research results

Ecosystem-based management: BNI and SRC are involved in discussing the development of institutional structures for ecosystem-based management at national, regional and European levels, with national governments, HELCOM and the EU Commission.

Collaboration with HELCOM: The relevance of the research proposed here to the political process will benefit from the close collaboration developed by Baltic Nest Institute and the HELCOM secretariat and Heads of Delegation, as well as the ongoing strategic dialogue between Stockholm Resilience Centre and the Swedish government.

Simultaneously, the academic record of participating partners will safeguard the scientific integrity and excellence, and build on the extensive knowledge and experiences accumulated through international cooperation with research partners studying the ecosystem approach to management in other marine systems.

SU is also in a unique position to contribute with the new knowledge needed by the Water authorities for establishing effective management plans. County Boards, cities, town and communes, businesses and NGOs (e.g. water associations, WWF) all benefit from university research and competence. SU has a long standing co-operation with regional and local authorities and NGOs. SU has assisted the County Boards of Uppsala, Stockholm and Södermanland in classifying their coastal waters according to the WFD, and the Svealand Coastal Water Association (a voluntary union of county boards, communities, industry and NGOs) in developing a system for environmental impact assessment of its coastal waters and planning its extensive environmental control programme.

Cited literature (For bracketed initial+numbers see research leader publication lists)
Gipperth & Elmgren 2005 *Ambio* 34:157 [RE69], **Green & Bergman** 2005 *Environ Sci Technol* 39:480 [ÅB21], **Gustafsson** et al 2004, *Limnol Oceanogr Methods* 2:62 [ÖG37], **Laikre** et al 2006 *Ambio* 35:255, **Larsson** et al 2001 *Limnol Oceanogr* 46:811 [RE58], **Larsson** et al 2008 *In Havet 2008* Swedish EPA ISBN 978-91-620-1262-5: 53, **Ryman & Laikre** 1991 *Conservation Biology* 5:325, **Waite** et al 2005 *Limnol Oceanogr* 50:658 [ÖG54], **Wang & Ryman** 2001 *Conservation Biology* 15:1619

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Title of research programme
Ecosystem Approach to the Baltic Sea

Appendix D (Collaboration)

4. Collaborations

SU scientists have too many academic collaborators the world over to list them all. Many personal research collaborations are listed in the CVs of the 10 research leaders. We list here only a small selection of research collaborations that involve whole research groups or departments, and have relevance to this application.

The Baltic Nest institute has a sister institute of similar size at the Danish Environment Institute, now part of Aarhus University, and a wide net of collaborations at research contacts around the Baltic. It also has an unequalled contact net at the level of environmental agencies and governments all around the Baltic Sea, built up as a necessity for convincing HELCOM to adopt the Nest decision support system as a basis for its negotiations.

This initiative will establish and keep alive a permanent link between the scientists developing and applying the decision support system and the scientists working on basic research (pollutant discovery, novel monitoring methods and strategies, source identification and quantification, understanding transformation, fate and bioaccumulation processes) and building system understanding (modellers). Thus incorporation of new scientific advances will continue to improve the decision support system. It will also provide the users of the system with access to available measurements of pollutant emissions, levels in the environment and physical chemical properties, data which are necessary for using the decision support system. This link will also help users of the decision support system to communicate their data needs and perceived research priorities to the scientists conducting basic research and building system understanding. This will organize the broad organic pollutant research competence at SU to allow its effective application to improving the Baltic Sea environment.

Baltic Nest Institute also collaborates with the ICES integrated assessments working group for the Baltic Sea in order to model and understand regime shifts in the Baltic Sea, and to identify the driving forces for these shifts. Work in this program will be directed towards identifying early warning signals for regime shifts as well as how governance structures can be adapted to deal with regime shifts (what flexible legislation are needed, and how management structures can deal with the dynamics).

The Baltic Marine Biologists (BMB) is an international non-governmental scientific organisation and one of the major networking organisations for scientists working in the Baltic Sea area. Stockholm University has had a leading role in BMB since its start in 1968, and Pauline Snoeijs at SU is General Secretary of BMB since 1997. Stockholm University organized the 2nd BMB Symposium in 1971 (150 participants) and the first Baltic Sea Science Congress (450 participants) in 2001.

4a. National and international partners

International research collaborations:

The Resilience Alliance (RA; <http://www.resalliance.org>) on the dynamics of social-ecological systems. RA is a global research organization of scientists and practitioners from many disciplines, which developed the key concepts of resilience, adaptability and transformability and provides a foundation for sustainable development policy and practice. Carl Folke at SU is a founding member of the RA group.

The ARC Centre of Excellence for Coral Reef Studies, Australia, on ecosystem management. The ARC Centre had a leading role in the research that led to the present management of the Great Barrier Reef National Park. It is a partnership of James Cook University, the Australian Institute of Marine Science, The Australian National University, the Great Barrier Reef Marine Park Authority and The University of Queensland.

World Fish (a trans-disciplinary research centre), on policy economics and social sciences, natural resource management, and aquaculture

The Fisheries Centre, University of British Columbia, on food web modeling, network analysis for ecosystem based management and governance institutions for fisheries management

The Telfer School of Management at the University of Ottawa, on management policies for fisheries, oceans and aquaculture management policies.

Åbo Academy University, Åbo, Finland, on fisheries research, chemical pollution issues and in undergraduate marine ecology education.

Tvärminne Zoological Station, Helsinki University, on plankton ecology, and in undergraduate marine ecology education

Institute of Veterinary Medicine, University Amsterdam, on ecotoxicological health effects, especially fish reproduction.

The University of Toronto and the University of Oslo, on development of modelling tools for describing the fate and bioaccumulation of organic pollutants and for identifying chemicals that are potential pollutant threats.

The National Environmental Research Institute of Denmark, on the development of equilibrium passive sampling methods to sample organic pollutants in the marine environment.

The Helmholtz Centre for Environmental Research – UFZ, on investigating the environmental fate of perfluorinated chemicals.

Institut Für Ostseeforschung, Warnemünde, Germany, on Baltic Sea research and undergraduate education.

National research collaborations:

The two first are more deeply involved in this particular program and are also presented as part of the research constellation:

The Swedish Meteorological and Hydrological Institute, on climate change, through Markus Meier, who is affiliated to both SMHI and SU.

The Institute of Coastal Research of the Swedish Board of Fisheries, on fish ecology, fisheries and invasive species. Its Head, Magnus Appelberg is an SU guest professor

The Institute of Marine Research of the Swedish Board of Fisheries, on fisheries management and ecosystem effects of fisheries

Swedish Natural History Museum, on environmental pollutants and their monitoring and radionuclides in the Baltic Sea Area, and in undergraduate and graduate education

Umeå Marine Research Centre, on plankton ecology, and in undergraduate marine ecology education

Södertörn University College, on Baltic benthic ecology, ecotoxicology and risk assessment of hazardous substances.

Gothenburg University, on genetics of Baltic organisms, zooplankton ecology and benthic ecology. Tjärnö Marine Laboratory was started in 1965 as a joint venture of SU and Gothenburg University, and is still used for marine biology education at SU and joint research project.

The Departments of Chemistry at Umeå University, on ecotoxicology, including a joint Masters Programme in Environmental Chemistry.

Dept of Ecotoxicology, Uppsala University, on ecotoxicology

The Swedish Radiation Safety Authority funds SU new Marine Radioecology Group (C. Bradshaw), initially for the period 2008-2013.

The Swedish Nuclear Fuel and Waste Management Co has funded marine research at SU for many years, are expected to continue to do so for some time.

The Department of Chemical Engineering and Geosciences at Luleå University of Technology, on speciation of iron and molybdenum and their uptake by cyanobacteria

4b. Forms and conditions for collaboration.

4c. Desired distribution of funds: All to SU. The external collaborating institutes are interested in the research cooperation, but have not asked for funding.

4d. Effect on the development of the research environment.

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Appendix E (Budget)

5. Budget

Funds (Mkr) used for Marine Research at Stockholm University in 2008				
	Faculty funds	External Funds	Monitoring funds	Sum total
Non-Baltic marine	17	19	0	36
Baltic	41	63	14	118
Total marine	58	82	14	154

In 2008, SU used over 150 Million Swedish Crowns (Mkr) for marine research and environmental monitoring, of which almost 120 Mkr was for Baltic Sea activities. Very little of this money is, however, flexible in nature. The faculty funds are almost entirely bound up in salary for permanent personnel, field station and ship costs, and the external funds are tied to specific projects. The funds sought here could have a disproportionate importance in shaping the future of Baltic research at SU, by supplying the coordination and missing links for shaping a coherent program,

<u>Proposed budget in million Swedish kronor (Mkr)</u>					
Year	<u>2010</u>	<u>2011</u>	<u>2012</u>	<u>2013</u>	<u>2014</u>
PhD students	2	2	2.5	3	3
Postdoctoral students	1.5	2	2.5	2.1	2.1
Postdoc fellows/assistant lecturers	1	2	3.2	3.2	3.2
Senior lecturer support	0	1	1.5	2	2.5
Visiting scientists + Seminars, Workshops	0.5	0.5	0.9	0.9	0.9
Uncommitted funds	1.5	2	2.8	2.2	1.7
Management	0.5	0.5	0.6	0.6	0.6
Mkr/year	7	10	14	14	14

Most of the salary money will be used for doctoral students, post-doctoral students (see below), or positions as postdoctoral fellow, i.e. early-career positions, but some will also be used to provide support to create senior lecturer positions in areas where SU now has highly accomplished female scientists on soft money, to secure their services for SU. About 2 million per year will be used for workshops, mini-symposia, and guest lecturers and seminars designed to stimulate collaboration within the faculty.

Post-doc positions are underused in Sweden in an international comparison. Post-docs are important in this strategic program because they give flexibility in program resource distribution and avoid long-term financial commitment to any department or research group, and can serve to stimulate new collaborations, by giving priority to projects bridging between research groups. They can also make competence available to areas that are prioritized in different phases, aid internationalization, and infuse new competence and stimulus.

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Appendix F (Research constellation)

6. The Research Constellation

6a. Principal investigators and their CVs and publication lists (each CV 2 pp + max 50 publications)

The following research leaders are presented with their CVs and publication lists:

Professor Birgitta Bergman	Dept Botany
Professor Åke Bergman	Dept Environmental Chemistry
Professor Jonas Ebbesson	Dept Law
Professor Ragnar Elmgren	Dept Systems Ecology
Professor Carl Folke	Stockholm Resilience Centre & Dept Systems Ecology
Docent Elena Gorokhova	Dept Systems Ecology
Professor Örjan Gustafsson,	Dept Applied Environmental Science
Docent Christoph Humborg,	Baltic Nest Institute & Dept Applied Environmental Science
Professor Michael McLachlan,	Dept Applied Environmental Science
Adjunct Professor Markus Meier	Dept Meteorology & Swedish Meteorological and Hydrological Institute

The following 18 senior scientists will also be involved in the program (55% women):

Dr. Lillemor Asplund	Dept Applied Environmental Science
Professor Cynthia de Wit	Dept Applied Environmental Science
Docent Ian Cousins	Dept Applied Environmental Science
Professor Lena Kautsky	Dept Botany
Docent Ulla Rasmussen	Dept Botany
Dr. Helle Ploug	Dept Botany
Docent Volker Brüchert	Dept Geology and Geochemistry
Docent Kristoffer Döös	Dept Meteorology
Adjunct Professor Peter Sigray	Dept Meteorology
Professor Georgia Destouni,	Dept Physical Geography and Quaternary Geology
Docent Sven Blomqvist	Dept Systems Ecology
Professor Sture Hansson	Dept Systems Ecology
Docent Susanne Kratzer	Dept Systems Ecology
Docent Ulf Larsson	Dept Systems Ecology
Professor Pauli Snoeijs	Dept Systems Ecology
Docent Clare Bradshaw	Dept Systems Ecology
Professor Said Mahmoudi	Law Dept
Docent Linda Laikre	Zoology Dept

6b. Presentation of external collaborators

The Institute of Coastal Research, Swedish Board of Fisheries

The Swedish Meteorological and Hydrological Institute

6c. Management structure for the research initiative

During the first 5 years the funds for this strategic initiative will be managed under a lead group at the Stockholm University Marine Research Centre, chaired by a Baltic Sea scientist appointed by the Vice-Chancellor, and encompassing the Dean of the SU Science Faculty as well as 4-5 of the principal investigators listed above, selected so as to represent different research areas at SU. This arrangement will ensure a working coordination of research efforts, and that the funds which are not initially set aside for a specific purpose will be used where they are most needed to reach the goals of the application. As described above, highest priority should be given to projects of strategic value that also lead to synergy and cooperation between research areas and departments. The excellent contacts of SU scientists with HELCOM, ICES, and the Swedish Environment Protection Agency will ensure that the applicability of the research results are given due weight. Following the evaluation after five years, the money will be permanently redistributed by the University, taking progress achieved and future needs into account.

CURRICULUM VITAE for BIRGITTA BERGMAN (abbreviated)

Nationality: Swedish

Date of birth & Status: 26 Dec 1945

Civil status: Married (two children)

Present address: Department of Botany, University of Stockholm,
S-106 91 Stockholm, Sweden; phone: +46 8 16 37 51;
e-mail: bergmanb@botan.su.se; www.botan.su.se/fysiologi



Present position:

- Full professor in plant physiology,
- Head of Department of Botany, Stockholm University

Education:

- PhD in plant physiology, University of Uppsala, 1977
- Associate professor ("docent competence"), University of Uppsala, 1981

Academic appointments:

- Research Assistant, University of Uppsala, (The Swedish Research Council), 1978 - 1985
- Researcher ("Särskild forskare"), University of Uppsala, (The Swedish Research Council), 1985 - 1990
- Full Professor in plant physiology, Stockholm University, 1st July 1990 –

Memberships and other commissions (selected):

- Member of scientific evaluation committee, The Swedish Research Council, 1992 – 94
- Member of scientific evaluation committee, SIDA/SAREC-Sweden, 1997 – 2002
- Deputy Member of the Council of the Scandinavian Society for Plant Physiology, 1997 --
- Member of scientific evaluation committee, STINT-Sweden, 1998 - 2000
- Vice head of the Department of Botany, Stockholm University, 1999 – 2008
- Chair person of a European Science Foundation Scientific Programme (CYANOFIX; eight countries), 1998 – 2003
- Member of Washington Advisory Group, USA (evaluation of a university in Europe), 2004
- Member of int. evaluation team for Norwegian Research Council, 'Centers of Excellence', 2006
- Member of evaluation committee – post doc positions, Denmark, 2007
- Board member of a Research and Education Foundation (T. Swahn), 2007-2009
- Chair person for the board of T. Swahn's Foundation, 2009 --
- Head of the Department of Botany at Stockholm University (~90 persons), 2008 -

Commissions at the the Royal Swedish Academy of Sciences:

- Member & secretary of the National Committee for Biology, Royal Swedish Academy of Sciences, 1991 – 1998
- Elected Member of the Royal Swedish Academy of Sciences, Biology 1996 –
- Member of scientific evaluation committee (Sweden-Russia research program), Royal Swedish Academy of Sciences, 1998 – 2000; Chair person 2000 – 2003
- Member of Selection Committee for new Members at The Royal Swedish Academy of Sciences, 2003 –
- Vice chair person of Class VI, Biology, Royal Swedish Academy of Sciences, 2007 –
- The Royal Swedish Academy of Sciences: Chair person for Class VI in the 'Crafoord Foundation', 2007 -

Awards - Prizes:

- The "Linné Prize" for excellence, Academy of Sciences, University of Lund, Sweden, 1995
- The "Björkén Award" for excellence in science, Uppsala University, Sweden, 2002
- Evaluated as "Outstanding" scientist by the Swedish Research Council, 2003

Research profile:

Evolution and adaptations in cyanobacterial-plant symbioses; genome and proteome analyses of cyanobionts, molecular communication, cell division and differentiation; metagenomic analyses of marine cyanobacteria; molecular diversity and significance of marine cyanobacteria

Publications: ~180 in international journals/books

Doctoral Thesis Supervised : 22 in total; presently supervising 5 PhD students

Licentiat Thesis supervised: 8 in total

Post doctors supervised: 17 in total; presently supervising 4 post docs

External support: NFR/VR, SJFR/FORMAS, EU, MISTRA, STINT, SAREC, KVA, Swedish Energy Agency, Knut & Alice Wallenberg Foundation

Participation in International Programmes & Collaborations in recent years:

- STINT Research Programme, 3 groups in the US, 97/98 – 00/01;
- SIDA/SAREC funded programme (bilateral & Swedish) University of Dar-es-Salaam 1992 --
- SIDA/SAREC funded programme (Swedish) with North-Eastern Hill Univ., India 1997 - 2001
- ESF sponsored Scientific Programme, 8 countries involved 1998 – 2003
- FSTC-sponsored co-operation with FAAS in China, 1997 –
- STINT Research Programme with UNAM, Mexico, Spain, Tanzania, Venter Institute 2006 –

Collaboration outside SU & Visiting Scientists: Collaborations with research groups in USA, India, China, Tanzania, Europe, Mexico; 4-5 visiting scientists per year in my group (graduate students to full professors) from these groups.

Invited as speaker/chair person at international meetings: 2-3 times per year for oral presentations

International meetings organized: 5

External referee commissions: 'Opponent' (external examiner) at 7 PhD-dissertations and committee member about 30 times; Evaluator for professorships: 17 times (Sweden & Norway); Evaluator of research applications: 4-5 times per year from other countries (US, Israel & Europe)

Referee on publications: 8-10 per year, including some in Nature, Science and PNAS

PUBLICATIONS for B. BERGMAN, SU

Note – only refs within marine sciences included

- 103) Bergman, B., Fredriksson, C., Janson, S., Paerl, H., Carpenter, E.J. & Lugomela, C. 1997. *Trichodesmium* has nitrogenase in differentiated cells but lacks heterocysts. In: Proceedings of the 2nd European Nitrogen Fixation Meeting, Poznan, Polen
- 104) Fredriksson, C. & Bergman, B. 1997. Ultrastructural characterization of cells specialised for nitrogen fixation in a non-heterocystous cyanobacterium *Trichodesmium* spp. - **Protoplasma** 197: 76-85.
- 105) Bergman, B. Gallon, J.R., Rai A.N. & Stal, L.J. 1997. Nitrogen fixation by non- heterocystous cyanobacteria. - **FEMS Microbiol. Rev.** 19: 139-185.
- 106) Capone, D. G., Zehr, J.P., Paerl, H.W., Bergman, B. & Carpenter, E.J. 1997. *Trichodesmium*: a globally significant marine cyanobacterium. - **Science** (Article) 276: 1221-1229.
- 107) Jiang, F., Mannervik, B. & Bergman, B. 1997. Evidence for redox regulation of the transcription factor NtcA, acting both as an activator and a repressor, in the cyanobacterium *Anabaena* PCC 7120. - **Biochem. J.** 327: 513-517.
- 108) Lin, S., Henze, S., Lundgren, P., Bergman, B. & Carpenter, E.J. 1998. Whole-cell immunolocalization of nitrogenase in marine diazotrophic cyanobacteria, *Trichodesmium* spp. - **Appl. Environm. Microbiol.** 64: 3052-3058.
- 109) Fredriksson, C., Malin, G., Siddiqui, P.J.A. & Bergman, B. 1998. Aerobic nitrogen fixation is confined to a sub-set of cells in the non-heterocystous cyanobacterium *Symploca* PCC 8002. – **New Phytol.** 140: 531-538.
- 110) Janson, S., Matveyev, A. & Bergman, B. 1998. The presence and expression of *hetR* in the non-heterocystous cyanobacterium *Symploca* PCC 8002. - **FEMS Microbiol. Lett.** 168: 173-179.
- 112) Bergman, B. 1999. Distribution of nitrogenase in the marine non-heterocystous cyanobacterium *Trichodesmium*: a review. In: "*Marine Cyanobacteria*", Charpy, L. & Larkum, T. (eds.) - **Bull. Inst. Oceanograph.** 158-163.
- 116) Janson, S., Bergman, B., Carpenter, E.J., Giovannoni, S.J. & Vergin, K. 1999. Genetic analysis of natural populations of the marine diazotrophic cyanobacterium *Trichodesmium*. - **FEMS Microbiol. Ecol.** 30: 57-65.
- 117) Janson, S., Wouters, J., Bergman, B. & Carpenter, E.J. 1999. Host specificity in the *Richelia*-diatom symbiosis revealed by *hetR* gene sequencing analysis. - **Environm. Microbiol.** 1: 431-438.
- 119) Jiang, F., Wisèn, S., Widersten, M., Bergman, B. & Mannervik, B. 2000. Examination of the transcription factor NtcA binding motif by *in vitro* selection of DNA sequences from a random library. - **J. Mol. Biol.** 301:783-793.
- 122) Lundgren, P., Söderbäck, E., Carpenter, E.J. & Bergman, B. 2001. *Katagnymene*: characterization of a novel marine diazotroph. - **J. Phycol.** 37: 1052-1062.
- 123) Lugomela, C., Bergman, B. & Waterbury, J. 2001. Cyanobacterial diversity and nitrogen fixation potential in coastal areas of Zanzibar, Tanzania. - **Algological Studies** 140:95-115.
- 124) Bergman, B. 2001. Nitrogen-fixing cyanobacteria in tropical oceans, with emphasis on Western Indian Ocean. - **South African J. Bot.** 67: 426-432.
- 126) Berman-Frank, I., Lundgren, P., Chen, Y-B., Küpper, H., Kolber, Z., Bergman, B. & Falkowski, P. 2001. Segregation of nitrogen fixation and oxygenic photosynthesis in the marine cyanobacterium *Trichodesmium*. – **Science** 294: 1435-1537.
- 127) Karl, D., Michaels, A., Bergman, B., Capone, D., Carpenter, E., Letelier, R., Lipschultz, F., Paerl, H., Sigman, D. & Stal, L. 2002. Nitrogen Fixation in the world's oceans. – **Biogeochemistry** 57/58: 47-98.

- 128) Orcutt, K.M., Rasmussen, U., Webb, E.A., Waterbury, J., Gundersen, K. & Bergman, B. 2002. Characterization of *Trichodesmium* spp. by genetic techniques. - **Appl. Environ. Microbiol.** 68: 2236-2245.
- 129) Lugomela, C., Lyimo, T., Bryceson, I., Semesi, A.K. & Bergman, B. 2002. *Trichodesmium* in coastal waters of Tanzania: diversity, seasonality, nitrogen and carbon fixation. - **Hydrobiologia** 477: 1-13 .
- 132) Gallon JR, Albertano P, Bergman B., von Bröckel K, Canini A, Congresti R, Evans AM, Fritsche P, Gundersen K, te Lintel Hekkert S, Jones DA, Meyerhöfer M, Nachtigall K, Ohlendieck U, Orcutt KM, Repka S, Sivonen K, Staal M & Stal LJ. 2002. N₂ fixation and primary production are uncoupled in a developing cyanobacterial bloom in the Baltic Sea. - **Limnol. & Oceanogr.** 47: 1514-1521.
- 137) Lugomela, C. & Bergman, B. 2002. Biological N₂-fixation on mangrove pneumatophores: preliminary observations and perspectives. - **Ambio** 31: 612-613.
- 141) Stal, L.J., Albertano, P., Bergman, B., von Bröckel, K., Gallon, J.R., Hayes, P.K., Sivonen, K. & Walsby, A.E. 2003. BASIC: Baltic Sea cyanobacteria. An investigation of the structure and dynamics of water blooms of cyanobacteria in the Baltic Sea – responses to a changing environment. – **Cont. Shelf Res.** 23: 1695-1714.
- 142) El-Shehawy, R. & Bergman B. 2003. Inhibition of cell division blocks the synthesis of the second nitrogenase (Nif2) in the cyanobacterium *Anabaena variabilis*. - **FEMS Microbiol. Lett.** 219: 23-25.
- 143) Lundgren, P., Lugomela, C., Bauer, K., Söderbäck, E. & Bergman B. 2003. Re-evaluation of the nitrogen fixation behaviour in the marine non-heterocystous cyanobacterium *Lyngbya majuscula*. - **J. Phycol.** 39: 310-314.
- 145) El-Shehawy, R., Lugomela, C., Ernst, A. & Bergman, B. 2003. Diurnal expression of *ntcA* and *hetR* and diazocyte formation in the filamentous non-heterocystous cyanobacterium *Trichodesmium erythraeum*. – **Microbiology** 149: 1139-1146.
- 148) Falcón, L.I., Carpenter E.J., Cipriano, F., Bergman, B. & Capone, D.G. 2004. N₂-fixation by unicellular bacterioplankton in the Atlantic and Pacific Oceans: phylogeny and *in situ* rates. - **Appl. Environ. Microbiol.** 70: 765-770.
- 149) Wisén, S., Bergman, B. & Mannervik, B. 2004. Mutagenesis of the cysteine residues in the transcription factor NtcA from *Anabaena* PCC 7120 and its effects on DNA-binding *in vitro*. - **Biochem. Biophys. Acta** 1679: 156-163.
- 151) Falcón, L.I., Lindvall, S., Bauer, K., Bergman, B. & Carpenter, E.J. 2004. Ultrastructure of unicellular N₂ fixing cyanobacteria from the tropical North Atlantic and the subtropical North Pacific Oceans. - **J. Phycol.** 40: 1074-1078.
- 152) Lundgren, P., Janson, S., Singer, A., Jonasson, S. & Bergman, B. 2005. Unveiling of novel radiations within the *Trichodesmium* cluster by *hetR* gene sequence analysis. - **Appl. Environ. Microbiol.** 71: 190-196.
- 154) Cox, P.A., Banack, S.A., Murch, S.J., Rasmussen, U., Tien, G., Bidigare, R.R., Metcalf, J.S., Morrison, L.F., Codd, G.A., & Bergman, B. 2005. Diverse taxa of cyanobacteria produce BMAA, a neurotoxic amino acid. – **Proc. Natl. Acad. Sci. (USA)** 102:5074-5078.
- 157) Foster, R., Bergman, B. & Carpenter, E.J. 2006. Unicellular cyanobionts in open ocean dinoflagellates, radiolarians, and tintinnides: ultrastructural characterization and immuno-localization of phycoerythrin and nitrogenase. - **J. Phycol.** 42: 453–463.
- 158) Degerholm, J., Gundersen, K., Bergman, B. & Söderbäck, E. 2006. Phosphorus-limited growth dynamics in two Baltic Sea cyanobacteria, *Nodularia* sp. and *Aphanizomenon* sp. – **FEMS Microbiol. Ecol.** 58: 323-332.
- 161) Ohlendieck, U., Gundersen, K., Meyerhöfer, M., Fritsche, P. Nachtigall, K. & Bergman, B. 2006. The significance of nitrogen fixation to new production during early summer in the Baltic Sea. - **Biogeosciences Discuss.** 3:1279-1311.
- 166) Diez, B., Bauer, K. & Bergman, B. 2007. Epilithic cyanobacterial communities of a marine tropical beach rock (Heron Island, Great Barrier Reef): diversity and diazotrophy. – **Appl. Environ. Microbiol.** 73:3656-3668.

- 167) Uku, J., Björk, M., Bergman, B. & Díez, B. 2007. Characterization and comparison of prokaryotic epiphytes associated with three east African seagrasses. - **J. Phycol.** 43:768-779.
- 168) Usher K., Bergman B. and Raven J. 2007. Exploring cyanobacterial mutualisms. – **Ann. Rev. Ecol. Evol. Syst.** 38:255-273. (Invited review)
- 169) Degerholm, J., Gundersen, K., Hajdu, S., Bergman, B. & Söderbäck, E. 2008. Seasonal significance of N₂ fixation in coastal and offshore waters of the north-western Baltic Sea. – **Marine Ecol. Prog. Series** 360:73-84.
- 171) Eriksson, J., Jonasson, S., Rasmussen, U., Berntzon, L. & Bergman, B. 2008. Improving derivatization efficiency of BMAA utilizing AccQ-Tag® in a complex cyanobacterial matrix. – **Amino Acids** Jan (Epub ahead of print)
- 172) Bauer, K., Díez, B., Lugomela, C., Seppälä, S., Borg, A.J. & Bergman, B. 2008. Variability in diazotrophy and cyanobacterial diversity in a tropical intertidal lagoon. - **FEMS Microbiol. Ecol.** 63:205-221.
- 175) Díez, B., Bergman, B. & El-Shehawy, R. 2008. Marine nitrogen-fixing cyanobacteria: out of the blue. - **Plant Biotechnol.** 25:221-225.
- 176) Jonasson, S., Eriksson, J., Berntzon, L., Rasmussen, U. & Bergman, B. 2008. A novel cyanobacterial toxin (BMAA) with potential neurodegenerative effects. - **Plant Biotechnol.** 25: 227-232.
- 178) Lin, S., Sandh, G., Zhang, H., Cheng, J., Perkins, K., Carpenter, EJ & Bergman, B. 2009. - Two flavodoxin genes in *Trichodesmium* (Oscillatoriales, Cyanophyceae): remarkable sequence divergence and possible functional diversification. – **J. Exp. Marine Biol. Ecol.** (in press)
- 181) Hamisi, M.I., Lyimo, T.J., Muruke, M.H.S. & Bergman, B. 2008. Nitrogen fixation (nitrogenase activity) by epiphytic and epibenthic diazotrophs associated with seagrass meadows in Western Indian Ocean. – **Aquatic Microbiol. Ecol.** (accepted)

Åke Bergman

Born March 30, 1950; Married

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Stockholm University

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E-mail: ake.bergman@mk.su.se

Web: <http://www.mk.su.se/personal/personligt?id=2&lang=sv>



Doctoral degree: Ph.D. in Organic Chemistry; 27th of May, 1980.

Postdoctoral visit: 1981-82. Dept of Biochemistry, North Dakota, State University, Fargo, ND, USA, active at Biosciences Research Laboratory, USDA

Senior lecturer (Docent): in 1983 at the Department of Organic Chemistry, Stockholm University.

Current position: Professor in Environmental Chemistry (recruited in 1993; date of appointment: 931101), Stockholm University; permanent position.

Previous employment and length of employment: Researcher assistant at the Organic Chemistry division, Wallenberg laboratory, Stockholm University, 750101-830930.

Researcher at the Organic Chemistry division, Wallenberg laboratory, Stockholm University, (40%) 831001-860630. Researcher at the Special Analytical Laboratory, Swedish Environmental Protection Agency (60%) 860701-870630. University lecturer in Environmental Chemistry Synthesis at the Division of Environmental Chemistry, Stockholm University, 870701-931031. Head of the Division of Environmental Chemistry "Prefekt", from July 1, 1990, and thereafter for the Department of Environmental Chemistry, i.e. from September 1994 and onwards.

Awards: Swedish Union of Clerical and Technical Employees in Industry (SIF) award 1997. Research award from King Carl XVI Gustaf's jubilee foundation, 1998. Travelling scholarship from Stockholm University, 1999. Awarded Honoris causa degree at the University of Latvia, 2002. The award "The Åke Bergman & Bo Jansson BFR Student Presentation Award" ("Award recognizing the contribution of Å. Bergman and B. Jansson in the field of BFR research") was established at the International BFR workshop 2004 in Toronto. Travelling scholarship from Stockholm University, 2007.

Excellence in Review Award 2008, ACS, Environmental Science and Technology

Main supervisor for 18 Ph.D. degrees: Eva Jakobsson (1994); Anders Olsson (1999); Andreas Sjödin (2000); Karlis Valters (2001); Maria Söderström (2002); Christina Larsson (2002); Göran Marsh (2003); Maria Athanasiadou (2003); Johan Eriksson (2004); Sara Rahm (2004); Tina Malmberg (2004); Kaj Thuresson (2005); Britta Fängström (2005); Lotta Hofvander (2006); Karin Norström (2006); Jana Weiss (2006), Anna Christiansson (2008); Hrönn Jörundsdottir (2009).

Deputy supervisor for six Ph.D. degrees: Eva Klasson Wehler (1989); Lillemor Asplund (1994), Henrik Kylin (1994), Daiva Guvenius-Meironyté (2002), Anna Malmvörn (2007), Daniel Teclechiel (2008)

Post doctoral collaborators: Koichi Haraguchi, Japan (1990/91); Hiroaki Kuroki, Japan (1991/92); Nicholas Green, UK (2003/04); Kerri Hornbuckle, USA (2007); Belen Gomara, Spain (2007); Yanling Qiu, China (2007/08); Mohammad Shoeb, Bangladesh (2008)

Sustained collaboration outside Sweden: Several scientists at IVM, Faculty of Earth and Life Science (FALW), VU University Amsterdam, The Netherlands; Prof. Martin van den Berg, Dept. of Toxicology, Univ. of Utrecht, The Netherlands; Prof. Irva Hertz-Picciotto, Department of Public Health Sciences, UC at Davis, Calif. USA; Prof. Koichi Haraguchi, Daiichi College of Pharmaceutical Sciences, Fukuoka, Japan; Dr Yanling Qiu, UNEP-Tongji Institute for Environment and Sustainable Development, Tongji University, Shanghai, China, among several others (cf. publications please).

National commissions (a selection):

Member of the Environmental Committee at the Royal Swedish Academy of Science, 2000-05. Board member of The Foundation for Strategic Environmental Research – MISTRA, 2000-05. Member of the Advisory Board for the Swedish Society for Risk Sciences, 2000- . Chairman at the Swedish Research Council Formas drafting committee, KMRT, 2001-2003. Member of the Swedish Governmental Environmental Advisory Council, 2002-2006. Member of the Swedish Chemical Inspectorate's board, 2005-2007.

International commissions:

International Advisory Committee for the dioxin series of symposia, from 1996 – 2002
Editorial board of "Impact of Endocrine Disrupters on Human Health and Wildlife, 1996/1997, (EU, EEA, WHO, OECD and three national EPA, CEFIC/EMSG).
Steering group on Endocrine disrupters, IPCS/OECD, WHO, Pan American Health Organisation/AMRO 1998- . National representative in European Association of chemical and Molecular Sciences, Division on Chemistry and the Environment, 1998 – ; Vice chair 2009 - . International Advisory Committee for BFR workshops 2003-
Member of the International Panel on Chemical Pollution (IPCP), Steering committee 2007-2008; Founding and IPCP board member 2008-11-24 - . Member of Albemarle Advisory Council 2008 – . Chairman of the International Conference on Chemicals and the Environment 2009 (ICCE-2009) Stockholm June 14-17, 2009. Founding member of International Panel on Chemical Pollution (IPCP), 2008

Reviewer for scientific journals: Ambio; Analytical Chemistry; Chemosphere; Environment and Health Perspectives; Environmental Science and Technology; Journal of Chromatography; Rapid Communications in Mass Spectrometry; Toxicological and Environmental Research; Environmental Pollution, among others.

Research interests: Organic environmental chemistry in a interdisciplinary context, particularly related to exposure to organic pollutants and biological effects. (H-factor: 46)

External funding: Approximately 3-5 MSEK per year over the last 15 years from national funding agencies (e.g. Formas, MISTRA, the Swedish EPA) and EU.

Åke Bergman, List of 50 selected publications out of a total of 232.

- 1 (6/232) Fångström, B.; Athanassiadis, I.; Odsjö, T.; Noren, K.; Bergman, Å. Temporal trends of polybrominated diphenyl ethers and hexabromocyclododecane in milk from Stockholm mothers, 1980-2004. *Mol Nutr Food Res* **2008**, *52*, 187-193.
- 2 (12/232) Lofstrand, K.; Jörundsdóttir, H.; Tomy, G.; Svavarsson, J.; Weihe, P.; Nygard, T.; Bergman, Å. Spatial trends of polyfluorinated compounds in guillemot (*Uria aalge*) eggs from North-Western Europe. *Chemosphere* **2008**, *72*, 1475-1480.
- 3 (13/232) Malmvärn, A.; Zebuhr, Y.; Kautsky, L.; Bergman, Å.; Asplund, L. Hydroxylated and methoxylated polybrominated diphenyl ethers and polybrominated dibenzo-p-dioxins in red alga and cyanobacteria living in the Baltic Sea. *Chemosphere* **2008**, *72*, 910-916.
- 4 (16/232) Moreira Bastos, P.; Eriksson, J.; Green, N.; Bergman, Å. A standardized method for assessment of oxidative transformations of brominated phenols in water. *Chemosphere* **2008**, *70*, 1196-1202.
- 5 (18/232) Ueno, D.; Darling, C.; Alae, M.; Pacepavicius, G.; Teixeira, C.; Campbell, L.; Letcher, R. J.; Bergman, Å.; Marsh, G.; Muir, D. Hydroxylated Polybrominated Diphenyl Ethers (OH-PBDEs) in the Abiotic Environment: Surface Water and Precipitation from Ontario, Canada. *Environmental science & technology* **2008**, *42*, 1657-1664.
- 6 (26/232) Strid, A.; Jörundsdóttir, H.; Pöpke, O.; Svavarsson, J.; Bergman, Å. Dioxins and PCBs in Greenland shark (*Somniosus microcephalus*) from the North-East Atlantic. *Marine Pollution Bulletin* **2007**, *54*, 1514-1522.
- 7 (27/232) Teclechiel, D.; Christiansson, A.; Bergman, Å.; Marsh, G. Synthesis of octabrominated diphenyl ethers from aminodiphenyl ethers. *Environ. Sci. Technol.* **2007**, *41*, 7459-7463.
- 8 (28/232) Athanasiadou, M.; Marsh, G.; Athanassiadis, I.; Asplund, L.; Bergman, Å. Gas chromatography and mass spectrometry of methoxylated polybrominated diphenyl ethers (MeO-PBDEs). *J. Mass Spectrom.* **2006**, *41*, 791-801.
- 9 (30/232) Christiansson, A.; Teclechiel, D.; Eriksson, J.; Bergman, Å.; Marsh, G. Methods for synthesis of nonabromodiphenyl ethers and a chloro-nonabromodiphenyl ether. *Chemosphere* **2006**, *63*, 562-569.
- 10 (32/232) Hagmar, L.; Wallin, E.; Vessby, B.; Jönsson, B. A. G.; Bergman, Å.; Rylander, L. Intra-individual variations and time trends 1991-2001 in human serum levels of PCB, DDE and hexachlorobenzene. *Chemosphere* **2006**, *64*, 1507-1513.
- 11 (34/232) Jörundsdóttir, H.; Norström, K.; Olsson, M.; Pham-Tuan, H.; Hühnerfuss, H.; Bignert, A.; Bergman, Å. Temporal trend of bis(4-chlorophenyl) sulfone, methylsulfonyl-DDE and -PCBs in Baltic guillemot (*Uria aalge*) egg 1971-2001 - A comparison to 4,4'-DDE and PCB trends. *Environ. Pollut.* **2006**, *141*, 226-237.
- 12 (38/232) Peters, A. K.; Nijmeijer, S.; Gradin, K.; Backlund, M.; Bergman, Å.; Poellinger, L.; Denison, M. S.; van den Berg, M. Interactions of Polybrominated Diphenyl Ethers with the Aryl Hydrocarbon Receptor Pathway. *Toxicol. Sci.* **2006**, *92*, 133-142.
- 13 (39/232) Peters, A. K.; Leonards, P. E.; Zhao, B.; Bergman, Å.; Denison, M. S.; van den Berg, M. Determination of in vitro relative potency (REP) values for mono-ortho polychlorinated biphenyls after purification with active charcoal. *Toxicol. Lett.* **2006**, *165*, 230-241.
- 14 (40/232) Peters, A. K.; Sanderson, J. T.; Bergman, Å.; van den Berg, M. Antagonism of TCDD-induced ethoxyresorufin-O-deethylation activity by polybrominated diphenyl

- ethers (PBDEs) in primary cynomolgus monkey (*Macaca fascicularis*) hepatocytes. *Toxicol. Lett.* **2006**, *164*, 123-132.
- 15 (43/232) Weiss, J.; Wallin, E.; Axmon, A.; Jönsson, B. A. G.; Åkesson, H.; Janak, K.; Hagmar, L.; Bergman, Å. Hydroxy-PCBs, PBDE and HBCDD in serum from an elderly population of Swedish fishermen's wives and associations to bone density. *Environ. Sci. Technol.* **2006**, *40*, 6282-6289.
- 16 (44/232) Canton, R. F.; Sanderson, J. T.; Letcher, R. J.; Bergman, Å.; van den Berg, M. Inhibition and induction of aromatase (CYP19) activity by brominated flame retardants in H295R human adrenocortical carcinoma cells. *Toxicol. Sci.* **2005**, *88*, 447-455.
- 17 (46/232) Fångström, B.; Strid, A.; Grandjean, P.; Weihe, P.; Bergman, Å. A retrospective study of PBDEs and PCBs in human milk from the Faroe Islands. *Environmental Health* **2005**, *4*, 12-16.
- 18 (47/232) Fångström, B.; Hovander, L.; Bignert, A.; Athanassiadis, I.; Linderholm, L.; Grandjean, P.; Weihe, P.; Bergman, Å. Concentrations of polybrominated diphenyl ethers, polychlorinated biphenyls, and polychlorobiphenyls in serum from pregnant Faroese women and their children 7 years later. *Environ. Sci. Technol.* **2005**, *39*, 9457-9463.
- 19 (48/232) Fångström, B.; Athanasiadou, M.; Athanassiadis, I.; Weihe, P.; Bergman, Å. Hydroxylated PCB metabolites in nonhatched fulmar eggs from the Faroe Islands. *Ambio* **2005**, *34*, 184-187.
- 20 (49/232) Fångström, B.; Athanasiadou, M.; Athanassiadis, I.; Bignert, A.; Grandjean, P.; Weihe, P.; Bergman, Å. Polybrominated diphenyl ethers and traditional organochlorine pollutants in fulmars (*Fulmarus glacialis*) from the Faroe Islands. *Chemosphere* **2005**, *60*, 836-843.
- 21 (50/232) Green, N.; Bergman, Å. Chemical reactivity as a tool for estimating persistence. *Environ. Sci. Technol.* **2005**, *39*, 480A-486A.
- 22 (56/232) Malmvärn, A.; Marsh, G.; Kautsky, L.; Athanasiadou, M.; Bergman, Å.; Asplund, L. Hydroxylated and methoxylated brominated diphenyl ethers in the red algae *Ceramium tenuicorne* and blue mussels from the Baltic Sea. *Environmental science & technology* **2005**, *39*, 2990-2997.
- 23 (57/232) Marsh, G.; Athanasiadou, M.; Athanassiadis, I.; Bergman, Å.; Endo, T.; Haraguchi, K. Identification, Quantification, and Synthesis of a Novel Dimethoxylated Polybrominated Biphenyl in Marine Mammals Caught Off the Coast of Japan. *Environ. Sci. Technol.* **2005**, *39*, 8684-8690.
- 24 (63/232) Weiss, J.; Pöpke, O.; Bergman, Å. A worldwide survey of polychlorinated dibenzo-*p*-dioxins, dibenzofurans, and related contaminants in butter. *Ambio* **2005**, *34*, 589-597.
- 25 (68/232) Larsson, C.; Norström, K.; Athanassiadis, I.; Bignert, A.; König, W. A.; Bergman, Å. Enantiomeric specificity of methylsulfonyl-PCBs and distribution of bis(4-chlorophenyl) sulfone, PCB, and DDE methyl sulfones in grey seal tissues. *Environ. Sci. Technol.* **2004**, *38*, 4950-4955.
- 26 (70/232) Marsh, G.; Athanasiadou, M.; Bergman, Å.; Asplund, L. Identification of hydroxylated and methoxylated polybrominated diphenyl ethers in Baltic Sea salmon (*Salmo salar*) blood. *Environ. Sci. Technol.* **2004**, *38*, 10-18.
- 27 (71/232) Norström, K.; Olsson, A.; Olsson, M.; Bergman, Å. Bis(4-chlorophenyl) sulfone (BCPS) in Swedish marine and fresh water wildlife-a screening study. *Environment International* **2004**, *30*, 667-674.

- 28 (72/232) Sandin, P.; Bengtsson, B.-E.; Bergman, Å.; Brandt, I.; Dencker, L.; Eriksson, P.; Förlin, L.; Larsson, P.; Oskarsson, A.; Rudén, C.; Södergren, A.; Woin, P.; Hansson, S. O. Precautionary defaults - A new strategy for chemical risk management. *Human and Ecological Risk Assessment* **2004**, *10*, 1-18.
- 29 (74/232) Alaee, M.; Arias, P.; Sjödin, A.; Bergman, Å. An overview of commercially used brominated flame retardants (BFRs) and their applications, changes in their use pattern in different countries/regions over time and possible modes of release. *Environmental International* **2003**, *29*, 683-689.
- 30 (75/232) Marsh, G.; Stenutz, R.; Bergman, Å. Synthesis of hydroxylated and methoxylated polybrominated diphenyl ethers - Natural products and potential polybrominated diphenyl ether metabolites. *Eur. J. Org. Chem.* **2003**, *2003*, 2566-2576.
- 31 (78/232) Fångström, B.; Athanasiadou, M.; Grandjean, P.; Weihe, P.; Bergman, Å. Hydroxylated PCB metabolites and PCBs in serum from pregnant Faroese women. *Environ. Health Perspect.* **2002**, *110*, 895-899.
- 32 (80/232) Hovander, L.; Malmberg, T.; Athanasiadou, M.; Athanassiadis, I.; Rahm, S.; Bergman, Å.; Klasson Wehler, E. Identification of hydroxylated PCB metabolites and other phenolic halogenated pollutants in human blood plasma. *Arch. Environ. Contam. Toxicol.* **2002**, *42*, 105-117.
- 33 (83/232) Letcher, R. J.; Lemmen, J. G.; van der Burg, B.; Brouwer, A.; Bergman, Å.; Giesy, J. P.; van den Berg, M. In vitro antiestrogenic effects of aryl methyl sulfone metabolites of polychlorinated biphenyls and 2,2-bis(4-chlorophenyl)-1,1-dichloroethene on 17 β -estradiol-induced gene expression in several bioassay systems. *Toxicol. Sci.* **2002**, *69*, 362-372.
- 34 (84/232) Meerts, I. A. T. M.; Assink, Y.; Ceniijn, P. H.; van den Berg, J. H. J.; Weijers, B. M.; Bergman, Å.; Koeman, J. H.; Brouwer, A. Placental transfer of a hydroxylated polychlorinated biphenyl and effects on fetal and maternal thyroid hormone homeostasis in the rat. *Toxicol. Sci.* **2002**, *68*, 361-371.
- 35 (86/232) Bergman, Å.; Brouwer, A.; Hagmar, L.; Meerts, I.; Sjödin, A. Hydroxylated PCBs (OH-PCBs) as potential endocrine disrupters - exposures and toxic effects. *APMIS* **2001**, *109*, Supl. 103, 505.
- 36 (88/232) Hagmar, L.; Björk, J.; Sjödin, A.; Bergman, Å.; Erfurth, E. M. Plasma levels of persistent organohalogenes and hormone levels in adult male humans. *Arch. Environ. Health* **2001**, *56*, 138-143.
- 37 (89/232) Halldin, K.; Berg, C.; Bergman, Å.; Brandt, I.; Brunström, B. Distribution of bisphenol A and tetrabromobisphenol A in quail eggs, embryos and laying birds and studies on reproduction variables in adults following in ovo exposure. *Arch. Toxicol.* **2001**, *75*, 597-603.
- 38 (92/232) Meerts, I. A. T. M.; Letcher, R. J.; Hoving, S.; Marsh, G.; Bergman, Å.; Lemmen, J. G.; van der Burg, B.; Brouwer, A. In vitro estrogenicity of polybrominated diphenyl ethers, hydroxylated PBDEs, and polybrominated bisphenol A compounds. *Environ. Health Perspect.* **2001**, *109*, 399-407.
- 39 (101/232) Olsson, A.; Ceder, K.; Bergman, Å.; Helander, B. Nestling blood of the white-tailed Sea Eagle (*Haliaeetus albicilla*) as an indicator of territorial exposure to organohalogen compounds - An evaluation. *Environ. Sci. Technol.* **2000**, *34*, 2733-2740.

- 40 (110/232) Marsh, G.; Hu, J.; Jakobsson, E.; Rahm, S.; Bergman, Å. Synthesis and characterization of 32 polybrominated diphenyl ethers. *Environ. Sci. Technol.* **1999**, *33*, 3033-3037.
- 41 (116/232) Valters, K.; Olsson, A.; Vitinsh, M.; Bergman, Å. Contamination sources in Latvia: Levels of organochlorines in perch (*Perca fluviatilis*) from rivers Daugava and Lielupe. *Ambio* **1999**, *28*, 335-340.
- 42 (117/232) Valters, K.; Olsson, A.; Asplund, L.; Bergman, Å. Polychlorinated biphenyls and some pesticides in perch (*Perca fluviatilis*) from inland waters of Latvia. *Chemosphere* **1999**, *38*, 2053-2064.
- 43 (127/232) Valters, K.; Olsson, A.; Asplund, L.; Bergman, Å. Analysis of organohalogen substances in Latvian freshwater fish - concentrations of PCB and DDE in Perch (*Perca Fluviatilis*). *Crit. Rev. Anal. Chem.* **1998**, *28*, 123-128.
- 44 (144/232) Olsson, A.; Bergman, Å. A new persistent contaminant detected in Baltic wildlife: Bis (4-chlorophenyl) sulfone. *Ambio* **1995**, *24*, 119-123.
- 45 (145/232) Asplund, L.; Jakobsson, E.; Haglund, P.; Bergman, Å. 1,2,3,5,6,7-hexachloronaphthalene and 1,2,3,4,6,7-hexachloronaphthalene - Selective retention in rat liver and appearance in wildlife. *Chemosphere* **1994**, *28*, 2075-2086.
- 46 (146/232) Bergman, Å.; Norstrom, R. J.; Haraguchi, K.; Kuroki, H.; Béland, P. PCB and DDE methyl sulfones in mammals from Canada and Sweden. *Environ. Toxicol. Chem.* **1994**, *13*, 121-128.
- 47 (147/232) Bergman, Å.; Klasson Wehler, E.; Kuroki, H. Selective retention of hydroxylated PCB metabolites in Blood. *Environ. Health Perspect.* **1994**, *102*, 464-469.
- 48 (161/232) Bergman, Å.; Athanasiadou, M.; Bergek, S.; Haraguchi, K.; Jensen, S.; Klasson Wehler, E. PCB and PCB methyl sulfones in mink treated with PCB and various PCB fractions. *Ambio* **1992**, *21*, 570-576.
- 49 (162/232) Haraguchi, K.; Athanasiadou, M.; Bergman, Å.; Hovander, L.; Jensen, S. PCB and PCB methyl sulfones in selected groups of seals from Swedish waters. *Ambio* **1992**, *21*, 546-549.
- 50 (165/232) Jönsson, C. J.; Lund, B.-O.; Bergman, Å.; Brandt, I. Adrenocortical toxicity of 3-methylsulphonyl-DDE; 3: studies in fetal and suckling mice. *Reproductive Toxicology* **1992**, *6*, 233-240.

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Positions:

- Professor (2003-)
- Vice-dean, Faculty of Law (2006-2008)
- Director of the Centre for Transdisciplinary Environmental Research (CTM) at Stockholm University, (2007)
- Director of Stockholm Environmental Law and Policy Centre (2004-)
- Member of the Stockholm Resilience Centre Advisory Group (2007-)
- Lecturer (1996-2003)

Academic Degrees:

LL.M., Stockholm, 1988

LL.D., Uppsala, 1995

Docent, Stockholm, 1997

Postdoctoral visits:

- Georgetown University Law Center, Washington DC, autumn 1997
- Robert Schuman University, Strasbourg, France, spring and summer 2000

Editorial Boards:

- Yearbook of International Environmental Law, Book Rev. Ed. (2001-6)
- European Environmental Law Review (-2007)
- Journal of European Environmental & Planning Law

Academic Work: Research and Teaching

Jonas Ebbesson is Professor of environmental law at the Faculty of Law, Stockholm University. He is also researcher at Stockholm Resilience Centre, at Stockholm University. He teaches international, European Community and Swedish environmental law.

In his research, Jonas Ebbesson essentially focuses on international, European Community and transnational dimensions of environmental law. His research covers a broad range of issues. One issue of particular interest is legal aspects on public interests, public participation and access to justice in environmental law. This includes comparative work on access to justice in environmental

matters in the EU, and also studies on the notions of public participation and environmental impact assessments in international law. He is also devoted to the study of liability for transnational corporations for harm to health and the environment, as well as to the study of justice aspects of environmental law. Previously, Jonas Ebbesson has carried out a comprehensive research programme on the linkage between and compatibility of international and national environmental law. Other issues researched are the Baltic Sea regimes for the protection of the environment, and North-South tension in environmental matters, the implementation of international environmental agreements, and legal clashes between foreign direct investments and environmental protection.

Jonas Ebbesson is the Director of the Stockholm Environmental Law and Policy Centre.

For a list of published books and articles, see below.

Consultancy and Legal Practice

Jonas Ebbesson has been a legal consultant for various governmental and intergovernmental bodies, such as the Swedish Ministry of the Environment, the Swedish Ministry for Foreign Affairs, the Swedish Environment Protection Agency (SEPA), the Swedish Council of Nuclear Waste (Kasam), the Nordic Council of Ministers, and the Organization for Security and Cooperation in Europe (OSCE). Jonas Ebbesson has participated and presented papers at several UNEP meetings.

In addition he has acted as a consultant for various environmental and development assistance NGOs, law firms, and environmental consultants.

Jonas Ebbesson has for many years been involved in the UN Economic Commission for Europe (UNECE) arrangements under the 1998 Aarhus Convention concerning public participation in environmental matters, and he serves since 2005 as a member of the Compliance Committee of the Aarhus Convention.

He has also been a legal expert in the preparation of environmental legislation in Serbia and Vietnam. These activities include drafting of legislation, legal analyses, organisational matters and litigation. In substance, among the issues dealt with are foreign direct investment and environment protection; trade and the environment; environmental protection in the marine areas (oil pollution and nature conservation); procedures for environmental impact assessment, public participation; transboundary litigation; and compliance control in environmental law.

List of Selected Publications by Jonas Ebbesson

Works focusing specifically on the Baltic Sea Area:

1. **"Implementing and Enforcing the Baltic Sea Convention Through European Community Law"**
in the book *Umweltrecht und Umweltwissenschaft: Festschrift für Eckard Rehbinder* (Erich Schmidt Verlag, Berlin, 2007), p 693-704.
 2. **"EU är Östersjöns chans" ["EU: and opportunity for the Baltic Sea"]**
in the book *Östersjön – hot och hopp* (Formas, Stockholm, 2006), p 189-201
 3. **"Protection of the Marine Environment of the Baltic Sea Area – the Impact of the Stockholm Declaration"**
in the book *Stockholm Declaration and Law of Marine Environment* (Kluwer, 2003) p 155-164.
 4. **"A Critical Assessment of the 1992 Baltic Sea Convention"**
in 43 *German Yearbook of International Law* (2000), s 38-64.
 - **"1992 Baltic Convention; Transition or Stand-still?"**
in the book *Baltic Environmental Co-operation* (Tema Vatten, Linköping, 1996), p 39-53.
 5. **Oil Pollution Control in the Baltic Sea Area – A Survey of Approaches in International and European Community Law**
Report, 68 p (WWF Sweden Report, Solna, 1999).
 6. **Nature Conservation in the Baltic Sea Area – Rules and Procedures of International Law for Protecting Off-shore Areas**
Report, 32 p (WWF Sweden Report, Solna, 1997).
- General works also covering the Baltic Sea Area:**
7. **Miljö rätt [Environmental Law]**
Textbook, 221 p (Iustus, Uppsala, 2. uppl., 2008)
 8. **Internationell Miljö rätt [International Environmental law]**
Textbook 282 s (Iustus, Uppsala, 2. uppl., 2000).
 9. **Compatibility of International and National Environmental Law**
Monography, 328 p, (Kluwer, Haag/London/Boston, 1996).
 10. **Den nordiska miljöskyddskonventionens relevans och framtid [The Relevance and Future of the Nordic Environment Protection Convention]**
Report, 179 p (Nordic Council of Ministers, Copenhagen, 2003).

Other works of relevance for the Baltic Sea Area:

11. **Environmental Law and Justice in Context**
Anthology (co-ed.), 483 p (Cambridge University Press, Cambridge, 2009)
12. **Access to Justice in Environmental Matters in the EU/Accès à la justice en matière d'environnement dans l'UE**
Anthology (ed.), 521 p (Kluwer, Haag /London/Boston, 2002).
13. **"The Notion of Public Participation in International Environmental Law"**
in 8 *Yearbook of International Environmental Law* 1997 (1998), p 51-97.
14. **"Tentativt om rätt och social-ekologisk resiliens" ["Tentatively on Law and Socio-ecological Resilience"]**
in the book *Miljörättsliga emner, Festschrift til Ellen Margrethe Basse* (Jurist- og

økonomförbundets forlag, Köpenhamn, 2008), p 33-46.

15. "European Legal Strategies to Global Environmental Cooperation"

in 2 Swedish Studies in European Law (2007), p 17-38

16. "Public Participation"

in the book The Oxford Handbook of International Environmental Law (Oxford University Press, Oxford, 2007) p 681-703.

17. "Transboundary Corporate Responsibility in Environmental Matters: Fragments and Foundations for a Future Framework"

in the book Multilevel Governance of Global Environmental Change: Perspectives from Science, Sociology and the Law (Cambridge University Press, Cambridge, 2006), p 200-224.

18. "Lex pernis apivorus – an Experiment of Environmental Law Methodology"

in 15 Journal of Environmental Law (2003), p 153-174.

19. "Comparative Introduction – Introduction comparative"

in the book Access to Justice in Environmental Matters in the EU, p 1-47.

20. "European Community – Communauté européenne"

in the book Access to Justice in Environmental Matters in the EU, p 49-100.

21. "Ansvar i Sverige för miljöskadlig verksamhet utomlands" ["Liability in Sweden for Environmentally Harmful Activities Abroad"]

in Juridisk tidskrift [2006/2007], p 279-310.

22. "Transbordering Democracy? The Case of Environment Protection"

with M. Zamboni, in Human Rights and Ethics/Derechos humanos y Ética, Proceedings from the 22nd IVR World Congress, Granada 2005, Volume III (red. Andrés Ollero, Franz Steiner verlag, Stuttgart, 2007), p 275-280.)

23. "Miljöskydd och rättvisa - idag och i övermorgon" ["Environment Protection and Justice – Today and the Day After Tomorrow"]

i boken Världens eko (Atlas, Stockholm, 2005), p 157-172.

24. "Law and Sociology in 'The Information Age'"

in 48 Scandinavian Studies in Law (2005), p 65-74

25. "Rättigheter i den juridiska praktiken – fokus på miljöfrågor" ["Rights in Legal Practice with a Focus on Environmental Matters"]

in the book Svenska värderingar? (Carlssons, Stockholm 2002), p 113-134.

26. "Innovative Elements and Expected Effectiveness of the 1991 EIA Convention"

in 19 Environmental Impact Assessment Review (1999), p 47-55.

27. "Igualdade de gêneros e poder às mulheres no desenvolvimento e implementação do direito ambiental" ["Gender Equality and Women Empowerment in the Development and Implementation of Environmental Law"]

UNEP Paper published in the book Direito ambiental em evolução 4 (red: V. Passos de Freitas) (Juruá editora, Curitiba, 2005), s 163-175

28. "Svenska miljöbeslutsprocesser i ljuset av internationell rätt – Del 1 och 2" ["Swedish Environmental Decision-making in Light of International Law – Parts I and II"]

in Juridisk tidskrift [1999-2000], p 3-24 and 823-845.

29. "Nordiskt genomförande av gränsöverskridande miljökonsekvensbedömningar" ["Nordic Implementation of

Transboundary Environmental Impact assessments”]

in the report Grenseoverskridende miljøvirkninger i lys av Espoo-konvensjon (Nordiska ministerrådets publikation, Köpenhamn, 1999), p 101-115.

30. ”Individuals and Transboundary Pollution; Two Decades with the 1974 Nordic Convention”

in the book North European Environmental Law (Helsinki, 1995), s 39-62.

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Positions:

Teaching assistant, Dept Zoology, Stockholm University, 1965/66, March-June, 1970.

Antiquarian, Swedish Museum of National Antiquities, Stockholm, Jan-March, 1970.

Research assistant (forskningsassistent), Askö Laboratory, SU, 1970-1976.

Postdoctoral fellow (forskarassistent), Dept Zoology, SU, 1976-1981 (on leave 1977-78).

Research Associate, Marine Ecosystems Research Laboratory, Graduate School of Oceanography, University of Rhode Island, Narragansett, RI, USA, 1977-78

Senior lecturer (docent) in Ecological Zoology, Dept Zoology, SU, 1981-1983.

Special Research Position in Aquatic Ecology funded by The Swedish Natural Science Research Council (NFR), Dept Zoology, SU, 1984-1989.

Professor of Brackish Water Ecology (NFR), 1990-1992

Professor of Brackish Water Ecology, Department of Systems Ecology, SU, 1992-.

Selected special assignments and university service:

Dean of the Sub-faculty of Biology, Stockholm University, 1993-1995

Head of Department, Zoology Department, SU 1980/1981, Deputy Head 1982-1984

Head of Department, Dept Systems Ecology, SU 2003-2008, Deputy 1993-2002, 2009

Member of the Board of the Faculty of Science, SU, for over 20 years.

Member of Departmental Boards of Dept Zoology, Askö Laboratory and Dept Systems Ecology, for over 30 years.

Chairman, Teacher Appointments Board, Sub-faculty of Biology, SU, 1993-1997

Member, Programme Committee for Biology, Swedish Natural Science Research Council, 1986-92.

Member, Marine Advisory Committee of the Swedish Environment Protection Agency 1981-1984, Chairman 1983-84.

Member, Research Committee of the Swedish Environment Protection Agency, 1983-84.

Member, Swedish Committee, International Oceanographic Commission, 1986-1994.

Member, Boards of Kristineberg Marine Biological Station, Royal Swedish Academy of Science, 1990-1993, Tjärnö Marine Biological Station, 1998-2001 and Stockholm Marine Research Centre, 2000-2008

Elected Member, Royal Swedish Academy of Agriculture and Forestry, 2005-

Academic Degrees and honorary titles

B.Sc. Stockholm University, 1966 (Chemistry, Zoology, Philosophy)

Ph.D. in Zoology, Stockholm University, 1976. Supervisor: Bengt-Owe Jansson. Thesis: Baltic benthos communities and the role of the meiofauna.

Docent (Research fellow, unsalaried), Faculty of Science, SU, 1979.

Adjunct Professor of Oceanography (unsalaried), Graduate School of Oceanography, University of Rhode Island, USA, 1978-1985 and 1987-1993.

Awards and distinctions

Awarded the Demel Medal of the Polish Sea Fisheries Institute in 2006, for “Outstanding contributions to Baltic Ecosystem Ecology and Integrated Coastal Zone Management”

Main supervisor of 20 doctoral students at SU (PhD completion year in brackets):

Dept Zoology (12): Hans Cederwall (1979), Annikki Lappalainen (1980), Stig Sjöberg (1980), Bertil Widbom (1988), Lars Rudstam (1988), Ulf Larsson (1989), Sture Hansson (1989), Catherine Hill (1991), Brita Sundelin (1994),

10. Birgitta Johansson (1997), 11. Carl Rolff (1998), 12. Gunilla Ejdung 1998;

Dept Systems Ecology (8): Daniel E. Duplisea (1998), Peter Landergren (2001), Candida Savage (2003), Lars Byrén (2004), Lisa Almesjö (2007), Sigrid Z. Ehrenberg (2008). Current students: Francisco J. A. Nascimento 2005-, Agnes L. M. Karlson 2005-.

Postdoctoral collaborators:

Emil Ólafsson 1989-1990; Wouter van de Bund 1995-1998; Clare Bradshaw 2003-2005.

Sustained collaboration outside SU

Professor Thomas S. Bianchi, Texas A& M University, USA

Professor Robert W. Howarth, Cornell University, USA

Professor Maren Voss, Institut für Ostseeforschung, Warnemünde, Germany

Professor Peter R. Leavitt, Regina University, Canada

Dr. Mati Kahru, Scripps Institution of Oceanography, USA

Served as a referee, often repeatedly, for more than 35 scientific journals.

Served as an external grant evaluator for: Canadian Natural Sciences Research Council, U.S. National Science Foundation, International Foundation for Science, Swedish Board for Technical Development, Swedish International Development Cooperation Agency, Swedish National Bank Tercenary Jubilee Fund, Swedish Royal Academy of Science, The Knut and Alice Wallenberg Foundation and many others.

Research interests: Baltic benthic and ecosystem ecology, eutrophication, coastal management.

External funding: Has received over 50 MSEK in external funding since 1979 from Swedish Research Councils (NFR, VR, SJFR, FRN, Formas), The Swedish Environment Protection Agency, Swedish Foundation for Strategic Environmental Research, and the European Union (BASYS, SIGNAL, SPICOSA), The Andrew Mellon Foundation and others. Current grants from Formas and EU.

Ragnar Elmgren, List of Publications

Citation counts from ISI Web of knowledge 20090216

5. Ankar, S. & R. Elmgren. 1976. The benthic macro- and meiofauna of the Askö-Landsort area (northern Baltic proper). A stratified random sampling survey. – Contributions from the Askö Laboratory, University of Stockholm 11: 1-115. Cited 140 times.
7. Dybern, B.I., H. Ackefors & R. Elmgren (Eds.). 1976. Recommendations on methods for marine biological studies in the Baltic Sea. – The Baltic Marine Biologists Publication 1: 1-98. Cited 99 times.
10. Elmgren, R. 1978. Structure and dynamics of Baltic benthos communities, with particular reference to the relationship between macro- and meiofauna. – Kieler Meeresforschungen, Sonderheft 4: 1-22. Cited 108 times.
12. Lindén, O., R. Elmgren & P. Boehm. 1979. The Tsesis oil spill — its impact on the coastal ecosystem of the Baltic Sea. – *Ambio* 8: 244-253. Cited 31 times.
16. Cederwall, H. & R. Elmgren. 1980. Biomass increase of benthic macrofauna demonstrates eutrophication of the Baltic Sea. – *Ophelia*, Suppl. 1: 287-304. Cited 117 times.
19. Elmgren, R., S. Hansson, U. Larsson, B. Sundelin & P.D. Boehm. 1983. The Tsesis oil spill; Acute and long term effects on the benthos. – *Marine Biology* 73: 51-65. <http://tinyurl.com/yv9dgd> . Cited 95 times.
21. Elmgren, R. 1984. Trophic dynamics in the enclosed, brackish Baltic Sea. – *Rapports et Procès-verbaux des Reunions. Conseil International pour l'Exploration de la Mer* 183: 152-169. Cited 138 times.
22. Elmgren, R., R. Rosenberg, A.-B. Andersin, S. Evans, P. Kangas, J. Lassig, E. Leppäkoski & R. Varmo. 1984. Benthic macro- and meiofauna in the Gulf of Bothnia (northern Baltic). – *Finnish Marine Research* 250: 3-18. Cited 31 times.
23. Larsson, U., R. Elmgren & F. Wulff. 1985. Eutrophication and the Baltic Sea - Causes and consequences. – *Ambio* 14: 9-14. Cited 249 times.
26. Elmgren, R., S. Ankar, B. Marteleur & G. Ejdung. 1986 Adult interference with postlarvae in soft sediments – the *Pontoporeia-Macoma* example. – *Ecology* 67: 827-836. Cited 99 times.
27. Hill, C. & R. Elmgren. 1987. Vertical distribution in the sediment in the co-occurring benthic amphipods *Pontoporeia affinis* and *P. femorata*. – *Oikos* 49: 221-229. Cited 56 times.
29. Lopez, G. & R. Elmgren. 1989. Feeding depths and organic absorption for the deposit-feeding benthic amphipods *Pontoporeia affinis* and *P. femorata*. – *Limnology and Oceanography* 34: 982-991. <http://tinyurl.com/2e8mmv> Cited 73 times.

30. Elmgren, R. 1989. Man's impact on the ecosystem of the Baltic Sea: Energy flows today and at the turn of the century. – *Ambio* 18: 326-332. Cited 162 times.
33. Granéli, E., K. Wallström, U. Larsson, W. Granéli & R. Elmgren. 1990. Nutrient limitation of primary production in the Baltic Sea area. – *Ambio* 19: 142-151. Cited 212 times.
34. Cederwall, H. & R. Elmgren. 1990. Biological effects of eutrophication of the Baltic Sea, particularly the coastal zone. – *Ambio* 19: 109-112. Cited 116 times.
35. Rosenberg, R., R. Elmgren, S. Fleischer, P. Jonsson, G. Persson & H. Dahlin. 1990. Marine eutrophication case studies in Sweden — a synopsis. – *Ambio* 19: 102-108. Cited 186 times.
36. Abrams, P. A., C. Hill & R. Elmgren. 1990. The functional response of the predatory polychaete, *Harmothoe sarsi* to the amphipod, *Pontoporeia affinis*. – *Oikos* 59: 261-269. Cited 30 times.
42. de Jonge, V.N., W. Boynton, C.F. D'Elia, R. Elmgren & B.L. Welsh. 1994. Responses to developments in eutrophication in four different North Atlantic estuarine systems. – In: Dyer, K. R & R. J. Orth (Eds). *Changes in Fluxes in Estuaries*. ECSA22/ERF Symposium Plymouth, September 1992, pp. 179-196. Cited 37 times.
43. Howarth, R.W., G. Billen, D. Swaney, A. Townsend, N. Jaworski, K. Lajtha, J.A. Downing, R. Elmgren, N. Caraco, T. Jordan, F. Berendse, J. Freney, V. Kudryarov, P. Murdoch, & Z. Zhao-liang. 1996. Regional nitrogen budgets and riverine N & P fluxes for the drainages to the North Atlantic Ocean: Natural and Human influences. – *Biogeochemistry* 35: 75-139. Cited 490 times.
44. Nixon, S.W., J.W. Ammerman, L.P. Atkinson, V.M. Berounsky, G. Billen, W.C. Boicourt, W.R. Boynton, T.M. Church, D.M. DiToro, R. Elmgren, J.H. Garber, A.E. Giblin, R. A. Jahnke, N.J.P. Owens, M.E.Q. Pilson & S.P. Seitzinger. 1996. The fate of nitrogen and phosphorus at the land-sea margin of the North Atlantic Ocean. – *Biogeochemistry* 35: 141-180. Cited 264 times.
45. Ólafsson, E. & R. Elmgren. 1997. Seasonal dynamics of sublittoral meiobenthos in relation to phytoplankton sedimentation in the Baltic Sea. – *Estuarine, Coastal and Shelf Science* 45: 149-164. Cited 47 times.
46. Elmgren, R. & C. Hill. 1997. Ecosystem Function at Low Biodiversity - The Baltic Example. – In: Ormond, R.F.G., J. Gage & M. Angel (Eds). *Marine Biodiversity: Patterns and Processes*. Cambridge University Press, pp. 319-336. Cited 32 times.
47. Hansson, S., J. E. Hobbie, R. Elmgren, U. Larsson, B. Fry & S. Johansson. 1997. The stable nitrogen isotope ratio as a marker of food web interactions and fish migration - a comparison of three coastal Baltic Sea stations. – *Ecology* 78: 2249-2257. Cited 105 times.

49. Sandberg, J., R. Elmgren & F. Wulff. 2000. Carbon flows in Baltic Sea food webs. A re-evaluation using a mass balance approach. – *Journal of Marine Systems* 25: 249-260. Cited 23 times.
50. Rolff, C. & R. Elmgren. 2000. Use of riverine organic matter in plankton food webs of the Baltic Sea. – *Marine Ecology Progress Series* 197: 81-101. <http://tinyurl.com/2xfjxy> Cited 24 times.
51. Bianchi, T.S., P. Westman, C. Rolff, E. Engelhaupt, T. Andrén & R. Elmgren. 2000. Cyanobacterial blooms in the Baltic Sea: Natural or human-induced? – *Limnology and Oceanography* 45: 716-726. <http://tinyurl.com/2a73gt> Cited 96 times.
52. Bianchi, T. S., B. Johansson & R. Elmgren. 2000. Breakdown of phytoplankton pigments in Baltic sediments: effects of anoxia and loss of deposit-feeding macrofauna. – *Journal of Experimental Marine Biology and Ecology* 251: 161-183. Cited 29 times.
54. Elmgren, R. & U. Larsson. 2001. Eutrophication in the Baltic Sea Area: Integrated Coastal Management Issues. – In: von Bodungen, B. & R.K. Turner, Eds. *Science and Integrated Coastal Management*. Berlin: Dahlem University Press, pp. 15-35. Cited 33 times.
56. Elmgren, R., G. Ejdung & S. Ankar. 2001. Intraspecific food competition in the deposit-feeding benthic amphipod *Monoporeia affinis* — a laboratory study. – *Marine Ecology Progress Series* 210: 185-193. <http://tinyurl.com/24mkor> Cited 11 times.
57. van de Bund, W. J., E. Ólafsson, H. Modig & R. Elmgren. 2001. Effects of a simulated spring diatom bloom on the coexisting benthic amphipods *Monoporeia affinis* and *Pontoporeia femorata*. – *Marine Ecology Progress Series* 212: 107-115. <http://tinyurl.com/yov98q> Cited 19 times.
58. Larsson, U., S. Hajdu, J. Walve & R. Elmgren. 2001. Estimating Baltic nitrogen fixation from the summer increase in upper mixed layer total nitrogen. – *Limnology and Oceanography* 46: 811-820. <http://tinyurl.com/2fus4k> . Cited 81 times.
59. Elmgren, R. 2001. Understanding human impact on the Baltic ecosystem: Changing views in recent decades. – *Ambio* 30: 222-231. Cited 49 times.
61. Elmgren R. & U. Larsson. 2001. Nitrogen and the Baltic Sea: Managing nitrogen in relation to phosphorus. In: *Optimizing Nitrogen Management in Food and Energy Production and Environmental Protection: Proceedings of the 2nd International Nitrogen Conference on Science and Policy*. – *TheScientificWorld* 1 (S2): 371-377. Cited 24 times.
62. Bianchi, T.S., C. Rolff, B. Widbom & R. Elmgren. 2002. Phytoplankton pigments in Baltic seston and sediments: Seasonal variability, fluxes and transformations. – *Estuarine, Coastal and Shelf Science* 55: 369-383. <http://tinyurl.com/2afaak> Cited 21 times.

63. Bianchi, T.S., E. Engelhaupt, B.A. McKee, S. Miles, R. Elmgren, S. Hajdu, C. Savage & M. Baskaran 2002. Do sediments from coastal sites accurately reflect time trends in water column phytoplankton? A test from Himmerfjärden Bay (Baltic Sea proper). – *Limnology and Oceanography* 47: 1537-1544. <http://tinyurl.com/2afaak> Cited 11 times.
64. Savage, C, R. Elmgren & U Larsson. 2002. Effects of sewage-derived nutrients on an estuarine macrobenthic community. – *Marine Ecology Progress Series* 243: 67-82. <http://tinyurl.com/24s39l> Cited 11 times.
66. Savage, C & R. Elmgren. 2004. Macroalgal (*Fucus vesiculosus*) $\delta^{15}\text{N}$ values trace decrease in sewage influence. – *Ecological Applications* 14: 517-526. Cited 28 times.
67. Blomqvist, S., A. Gunnars & R. Elmgren. 2004. Why the limiting nutrient differs between temperate coastal seas and freshwater lakes: A matter of salt. – *Limnology & Oceanography* 49: 2236-2241. <http://tinyurl.com/ynv7gl> Cited 23 times.
68. Savage, C., Leavitt, P. R. & R. Elmgren. 2004. Distribution and retention of effluent nitrogen in surface sediments of a coastal bay. – *Limnology & Oceanography* 49: 1503-1511. http://aslo.org/lo/toc/vol_49/issue_5/1503.pdf Cited 19 times.
69. Gipperth, L. & R. Elmgren. 2005. Adaptive coastal planning and the European Union's Water Framework Directive: A Swedish perspective. – *Ambio* 34: 157-162. Cited 2 times.
70. Howarth, R.W., K. Ramakrishna, E. Choi, R. Elmgren, L. Martinelli, A. Mendoza, W. Moomaw, C. Palm, R. Roy, M. Scholes and Z. Zhao-Liang. 2005. Chapter 9. Nutrient Management. – In: Chopra, K, R. Leemans, P. Kumar & H. Simons (Eds.). *Ecosystems and Human Well-Being, Volume 3 Policy Responses*: 295-311. <http://tinyurl.com/yrum39> Cited 6 times.
71. Ehrenberg, S.Z., S. Hansson & R. Elmgren. 2005. Sublittoral abundance and food consumption of Baltic gobies. – *Journal of Fish Biology* 67: 1083-1093. <http://tinyurl.com/2ge23n> Cited 4 times.
72. Byrén, L., G. Ejdung & R. Elmgren. 2006. Uptake of sedimentary organic matter by the deposit-feeding Baltic amphipods *Monoporeia affinis* (Lindström) and *Pontoporeia femorata* Kröyer. – *Marine Ecology Progress Series* 313: 135-143. <http://tinyurl.com/yvs4sw> Cited 3 times.
73. Voss, M., B. Deutsch, R. Elmgren, C. Humborg, P. Kuuppo, M. Pastuszak, C. Rolff & U. Schulte. 2006. Source identification of nitrate by means of isotopic tracers in the Baltic Sea catchments. – *Biogeosciences* 3: 663-676. <http://tinyurl.com/2drblz> Cited 5 times.

74. Rolff, C, L. Almesjö, & R. Elmgren. 2007. Nitrogen fixation and the abundance of the diazotrophic cyanobacterium *Aphanizomenon* sp. in the Baltic Proper. – *Marine Ecology Progress Series* 332: 107-118. <http://tinyurl.com/2z4jmr> Cited 4 times.
75. Kahru, M., O.P. Savchuk, & R. Elmgren. 2007. Satellite measurements of cyanobacterial bloom frequency in the Baltic Sea: Interannual and spatial variability. – *Marine Ecology Progress Series* 343: 15-23. <http://tinyurl.com/yw4zo7> Cited 5 times.
76. Österblom, H., S. Hansson, U. Larsson, O. Hjerne, F. Wulff, R. Elmgren, & C. Folke. 2007. Human-induced trophic cascades and ecological regime shifts in the Baltic Sea. – *Ecosystems* 10: 877-889. <http://tinyurl.com/2z39z3> Cited 3 times.
77. Nascimento, FJA, Karlson, AML and Elmgren, R. 2008. Settling blooms of filamentous cyanobacteria as food for meiofauna assemblages. – *Limnology & Oceanography* 53: 2636-2643. http://aslo.org/lo/toc/vol_53/issue_6/2636.pdf Cited once.
78. Karlson, AML, Nascimento, FJA and Elmgren, R. 2008. Incorporation and burial of carbon from settling cyanobacterial blooms by deposit-feeding macrofauna. – *Limnology & Oceanography* 53: 2754-2758. http://aslo.org/lo/toc/vol_53/issue_6/2754.pdf Cited once.
79. Rolff, C, Elmgren, R. and Voss, M. 2008. Deposition of nitrogen and phosphorus on the Baltic Sea: Seasonal patterns and nitrogen isotope composition. – *Biogeosciences* 5: 1657-1667. <http://tinyurl.com/6eoncX>

CARL FOLKE (born 1955), Abbreviated CV

SELECTED POSITIONS

2007 Director, Beijer Institute, Royal Swedish Academy of Sciences (50%).

2007 Science Director, Stockholm Resilience Centre, a joint of Stockholm University, Beijer Institute, Stockholm Environment Institute (50%)

1997-2007 Full Professor and Chair, Natural Resource Management, Department of Systems Ecology, Stockholm University. On leave since Feb. 2007.

1999-2006 Director, Centre for Transdisciplinary Environmental Research (CTM), SU.

1991-1996 Deputy Director, Beijer International Institute of Ecological Economics, Royal Swedish Academy of Sciences, Stockholm, Sweden.

SELECTED AWARDS AND SCIENTIFIC COMMISSIONS

Science Director of a major grant (>25 million US\$) to develop the new *Stockholm Resilience Centre* focusing on *sustainable governance and management of linked social-ecological systems*, with core support from the Swedish Research Foundation MISTRA. *Formas Centre of Excellence (Formel-Exc)*, Project leader “Resilience and sustainability – integrating research on social-ecological systems”, SU, Beijer Institute and SEI. *The 2004 Sustainability Science Award of the Ecological Society of America* for the paper Scheffer, M., S. Carpenter, J. Foley, C. Folke, and B. Walker. 2001. Catastrophic shifts in ecosystems. *Nature*, vol. 413: 591-596. The award is given annually to the authors of the peer reviewed paper published in the past five years that makes the greatest contribution to the emerging science of ecosystem and regional sustainability through the integration of ecological and social sciences.

Pew Scholar in Conservation and the Environment 1995. The Pew Scholars Program is run by the Pew Charitable Trusts, USA. A 3-year award of US\$150 000 each is given to 10 selected scholars annually.

Selected scientific commissions

Founding member and Chair of the Executive Committee of the Resilience Alliance

Member of the Royal Swedish Academy of Sciences 2002

Member of the Environmental Research Committee of the Royal Swedish Academy of Sciences 2003-

Board member Stockholm Environment Institute 2004-

Scientific Advisory Board, SARAS (South American Institute for Resilience and Sustainability Studies) 2007-

Science Advisory Committee, International Institute for Applied Systems Analysis, 2009-

Steering Committee of the Centre for Climate Change Economics and Policy, Leeds

University/London School of Economics 2009-

Associate Faculty of the Earth System Governance Project, IHDP, 2009-

Advisory Board to The International Network of Research on Coupled Human and Natural Systems (CHANS-Net) 2009- www.chans-net.org

Board member Beijer International Institute of Ecological Economics 2005-2006

Member of the Science Council of the International Human Dimensions Programme on Global Environmental Change (IHDP) 2002-2007

Member of the Scientific Advisory Board of the National Center for Ecological Analysis and Synthesis (NCEAS), Santa Barbara, California 2000-2003



Sciences
initiative

Officer/Secretary, International Society for Ecological Economics. 1993-1996
Secretary/Treasurer, International Society for Ecological Economics. 1998-1999
Editor, Editorial and Advisory Board of scientific journals. Editor-in-chief *Ecology and Society* (www.ecologyandsociety.org) 2002-present. Book Review Editor of Ecological Economics 1989-2002. Advisory Board and Editorial Boards of 13 scientific journals including *Ambio*, *Conservation Biology*, *Ecological Economics*, *Environment*, *Environmental Conservation*, *Environment and Development Economics*, *Frontiers in Ecology and the Environment*, *Global Environmental Change*.

SELECTED PUBLIC COMMISSIONS

Scientific Committee, Volvo Environment Prize, 2008-
Member, Environmental Advisory Council to the Swedish Government, 1991-1994
Swedish Scientific Committee on Biological Diversity, appointed by the Swedish Government, 1994-1996 and United Nations Environmental Program (UNEP), several functions in relation to the Convention on Biological Diversity
Founder and Board member of Albaeco, an Institute devoted to communicate to the general public information on interactions of ecosystems, institutions and the economy, www.albaeco.com 1998-2004.

SCIENTIFIC PUBLICATIONS ETC

CF has published 10 books and more than 135 scientific articles and over 55 book chapter, including 13 articles in *Nature* and *Science* and in journals like *Annual Review in Ecology, Evolution and Systematics*, *Annual Review of Environment and Resources*, *Proceedings National Academy of Sciences, USA*, *Trends in Ecology and Evolution*, *Bioscience*, *Ecological Economics*, *Environmental and Resource Economics*, *Environment and Development Economics*, *Ecology and Society*, *Ecological Applications*, *Ecosystems*, *Global Environmental Change*, *Ambio*, *Philosophical Transactions of the Royal Society, London*, *Current Anthropology*, *Georgetown International Environmental Law Review* etc.

CF is among the 20 most cited scientists worldwide for journal articles in the area of Environment/Ecology among 3000 ranked scientists (Essential Science Indicators March 2009). Sixteen of CFs articles have been listed among the 1% most cited in their respective fields and seven of those have been listed among the top 0.1% (Essential Science Indicators). Currently CF has 19 publications >100 citations each (714-100), h-index 35, and >20 of his publications have been reprinted in books and journals.

CF currently supervises 2 and is associate supervisor for 4 PhD-students; has supervised 9 and been associated supervisor for 10 PhD-students; CF has organized several major international scientific conferences and workshops, the most recent in April 2008 - Resilience 2008; Resilience, Adaptations and Transformations in Turbulent Times; has given numerous invited speaker presentations world wide; numerous public lectures, policy seminars and interviews in media. His research has been reported in many newspapers, radio and television, both in Sweden and internationally. Information on grants is available on request. A complete CV is available upon request. See also www.beijer.kva.se; www.stockholmresilience.su.se; www.resalliance.org; www.ecology.su.se/staff/personal.asp?id=17

Carl Folke

March 2009, 50 selected publications

30 most cited publications

1. Scheffer, M., Carpenter, S., Foley, J., Folke, C. and Walker, B. 2001. Catastrophic Shifts in Ecosystems. *Nature* 413:591-596. >710 citations
2. Naylor, R., R. Goldburg, J. Primavera, N. Kautsky, M. Beveridge, J. Clay, C. Folke, J. Lubchenco, H. Mooney, and M. Troell. 2000. Effect of Aquaculture on World Fish Supplies. *Nature* 405:1017-1024. >460 citations
3. Hughes, T.P., A.H. Baird, D.R. Bellwood, M. Card, S.R. Connolly, C. Folke, R. Grosberg, O. Hoegh-Guldberg, J.B.C. Jackson, J. Kleypas, J.M. Lough, P. Marshall, M. Nyström, S.R. Palumbi, J.M. Pandolfi, B. Rosen and J. Roughgarden. 2003. Climate Change, Human Impacts, and the Resilience of Coral Reefs. *Science* 301:929-933. >400 citations
4. Berkes, F. and C. Folke (eds.). 1998. *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*. Cambridge University Press, Cambridge UK. 459 pp. Paperback edition in 2000. >400 cit.
5. Arrow, K., B. Bolin, R. Costanza, P. Dasgupta, C. Folke, C.S. Holling, B.-O. Jansson, S. Levin, K.-G. Mäler, C. Perrings, and D. Pimentel. 1995. Economic Growth, Carrying Capacity, and the Environment. *Science* 268:520-521. >330 citations
6. Bellwood, D., T.P. Hughes, C. Folke and M. Nyström. 2004. Confronting the Coral Reef Crisis. *Nature* 429:827-833. >270 citations
7. Berkes, F., J. Colding and C. Folke. 2003. *Navigating Social-Ecological Systems: Building Resilience for Complexity and Change*. Cambridge University Press, Cambridge UK. 393 pp. Paperback edition in 2008. >230 citations
8. Lambin, E.F, B.L. Turner II, H.J. Geist, S.B. Agbola, A. Angelsen, J.W. Bruce, O.T. Coomes, R. Dirzo, G. Fischer, C. Folke, P.S. George, K. Homewood, J. Imbernon, R. Leemans, X. Li, E.F. Moran, M. Mortimore, P.S. Ramakrishnan, J.F. Richards, H. Skånes, W. Steffen, G.D. Stone, U. Svedin, T.A. Veldkamp, C. Vogel, J. Xu. 2001. The Causes of Land-Use and Land-Cover Change: Moving Beyond the Myths. *Global Environmental Change* 11: 261-269. >210 citations
9. Worm, B., E.B. Barbier, N. Beaumont, J.E. Duffy, C. Folke, B.S. Halpern, J.B.C. Jackson, H.K. Lotze, F. Micheli, S.R. Palumbi, E. Sala, K.A. Selkoe, J.J. Stachowicz and R. Watson. 2006. Impacts of Biodiversity Loss on Ocean Ecosystem Services. *Science* 314:787-790. >190 citations

10. Berkes, F., C. Folke and J. Colding. 2000. Rediscovery of Traditional Ecological Knowledge as Adaptive Management. *Ecological Applications* 10:1251-1262. >185 citations
11. Folke, C., S.R. Carpenter, B. Walker, M. Scheffer, T. Elmqvist, L. Gunderson and C.S. Holling. 2004. Regime Shifts, Resilience and Biodiversity in Ecosystem Management. *Annual Review of Ecology, Evolution and Systematics* 35:557-581. >150 citations
12. Gadgil, M., F. Berkes, and C. Folke. 1993. Indigenous Knowledge for Biodiversity Conservation. *Ambio* 22:151-156. >145 citations
13. Costanza, R., L. Waigner, C. Folke and K.-G. Mäler. 1993. Modeling Complex Ecological Economic Systems: Toward an Evolutionary Dynamic Understanding of People and Nature. *BioScience* 43:545-555. >130 citations
14. Nyström, M., C. Folke and F. Moberg. 2000. Coral Reef Disturbance and Resilience in a Human Dominated Environment. *Trends in Ecology and Evolution* 15:413-417. >125 citations
15. Naylor, R., R. Goldburg, H. Mooney, M. Beveridge, J. Clay, C. Folke, N. Kautsky, J. Lubchenco, J. Primavera and M. Williams. 1998. Nature's Subsidies to Shrimp and Salmon Farming. *Science* 282:883-884. >120 citations
16. Hughes, T., D. Bellwood, C. Folke, R. Steneck and J. Wilson. 2005. New Paradigms for Supporting the Resilience of Marine Ecosystems. *Trends in Ecology and Evolution* 20:380-386. >110 citations
17. Daily, G., T. Söderqvist, S. Aniyar, K. Arrow, P. Dasgupta, P.R. Ehrlich, C. Folke, A.M. Jansson, B.-O. Jansson, N. Kautsky, S. Levin, J. Lubchenco, K.-G. Mäler, D. Simpson, D. Starrett, D. Tilman and B. Walker. 2000. The Value of Nature and the Nature of Value? *Science* 289:395-396. >105 citations
18. Perrings, C.A., K.-G. Mäler, C. Folke, C.S. Holling and B.-O. Jansson (eds.). 1995. *Biodiversity Loss: Ecological and Economic Issues*. Cambridge University Press, Cambridge, UK. 332 pp. Paperback edition in 1997. >105 citations
19. Folke, C., C.S. Holling and C.A. Perrings. 1996. Biological Diversity, Ecosystems and the Human Scale. *Ecological Applications* 6:1018-1024. >100
20. Elmqvist, T., C. Folke, M. Nyström, G. Peterson, J. Bengtsson, B. Walker and J. Norberg. 2003. Response Diversity and Ecosystem Resilience. *Frontiers in Ecology and the Environment* 1:488-494. >95 citations
21. Folke, C., Å. Jansson, J. Larsson and R. Costanza. 1997. Ecosystem Appropriation by Cities. *Ambio* 26:167-172.

22. Folke, C., T. Hahn, P. Olsson and J. Norberg. 2005. Adaptive Governance of Social-Ecological Systems. *Annual Review of Environment and Resources* 30:441-473.
23. Folke, C., and N. Kautsky. 1989. The Role of Ecosystems for a Sustainable Development of Aquaculture. *Ambio* 18:234-243.
24. Olsson, P., C. Folke and F. Berkes. 2004. Adaptive Co-Management for Building Resilience in Social-Ecological Systems. *Environmental Management* 34:75-90.
25. Jansson, A.M., M. Hammer, C. Folke, and R. Costanza (eds.). 1994. *Investing in Natural Capital: The Ecological Economics Approach to Sustainability*. Island Press, Washington. 450 pp.
26. Hanna, S., C. Folke and K.-G. Mäler (eds.). 1996. *Rights to Nature: Ecological, Economic, Cultural, and Political Principles of Institutions for the Environment*. Island Press, Washington. 298 pp.
27. Folke, C., S. Carpenter, T. Elmqvist, L. Gunderson, C.S. Holling, B. Walker, J. Bengtsson, F. Berkes, J. Colding, K. Danell, M. Falkenmark, L. Gordon, R. Kaspersson, N. Kautsky, A. Kinzig, S.A. Levin, K.-G. Mäler, F. Moberg, L. Ohlsson, P. Olsson, E. Ostrom, W. Reid, J. Rockström, S. Savenije and U. Svedin. 2002. Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations. *Report for the Swedish Environmental Advisory Council 2002:1*. Ministry of the Environment, Stockholm, www.mvb.gov.se also published for the World Summit on Sustainable Development. *ICSU Series on Science for Sustainable Development* No. 3, 2002. International Council for Science, Paris.
28. Folke, C., S. Carpenter, T. Elmqvist, L. Gunderson, C.S. Holling and B. Walker. 2002. Resilience and Sustainable Development: Building Adaptive Capacity in a World of Transformations. *Ambio* 31:437-440.
29. Barbier, E.B., J. Burgess and C. Folke. 1994. *Paradise Lost? The Ecological Economics of Biodiversity*. Earthscan, London. 267 pp.
30. Holling, C.S., F. Berkes and C. Folke. 1998. Science, Sustainability, and Resource Management. In: Berkes, F. and C. Folke (eds.). *Linking Social and Ecological Systems: Management Practices and Social Mechanisms for Building Resilience*. Cambridge University Press, Cambridge, UK. pp 342-362.

Another 20 relevant publications

31. Adger, W.N., T. Hughes, C. Folke, S.R. Carpenter and J. Rockström. 2005. Social-Ecological Resilience to Coastal Disasters. *Science* 309:1036-1039.

32. Bengtsson, J., P. Angelstam, T. Elmqvist, U. Emanuelsson, C. Folke, M. Ihse, F. Moberg and M. Nyström. 2003. Reserves, Resilience, and Dynamic Landscapes. *Ambio* 32:389-396.
33. Berkes, F., T.P. Hughes, R.S. Steneck, J.A. Wilson, D.R. Bellwood, B. Crona, C. Folke, L.H. Gunderson, H.M. Leslie, J. Norberg, M. Nystrom, P. Olsson, H. Österblom, M. Scheffer, B. Worm. 2006. Globalization, Roving Bandits, and Marine Resources. *Science* 311:1557-1558.
34. Carpenter, S.R. and C. Folke. 2006. Ecology for Transformation. *Trends in Ecology and Evolution* 21: 309-315.
35. Chapin, F.S, III, G.P. Kofinas and C. Folke (eds.). 2009. *Principles of Ecosystem Stewardship: Resilience-Based Natural Resource Management in a Changing World*. Springer Verlag, New York. Forthcoming.
36. Deutsch, L., S. Gräslund, C. Folke, M. Huitric, N. Kautsky, M. Troell and L. Lebel. 2007. Feeding Aquaculture Growth through Globalization; Exploitation of Marine Ecosystems for Fishmeal. *Global Environmental Change* 17:238-249.
37. Folke, C. 2006. Resilience: The Emergence of a Perspective for Social-Ecological Systems Analyses. *Global Environmental Change* 16: 253-267.
38. Folke, C., M. Hammer and A.M. Jansson. 1991. The Life-Support Value of Ecosystems: A Case Study of the Baltic Sea Region. *Ecological Economics* 3:123-137.
39. Folke, C., N. Kautsky and M. Troell. 1994. The Costs of Eutrophication from Salmon Farming: Implications for Management. *Journal of Environmental Management* 40:173-182.
40. Folke, C., N. Kautsky, H. Berg, Å. Jansson, and M. Troell. 1998. The Ecological Footprint Concept for Sustainable Seafood Production: A Review. *Ecological Applications* 8:63-71.
41. Jansson, Å., C. Folke and S. Langaas. 1998. Quantifying the Nitrogen Retention Capacity of Natural Wetlands in the Large-Scale Drainage Basin of the Baltic Sea. *Landscape Ecology* 13: 249-261.
42. Jansson, Å., C. Folke, J. Rockström, and L. Gordon. 1999. Linking Freshwater and Ecosystem Appropriation by People: The Case of the Baltic Sea Drainage Basin. *Ecosystems* 2:351-366.
43. Liu, J., T. Dietz, S.R. Carpenter, M. Alberti, C. Folke, E. Moran, A.C. Pell, P. Deadman, T. Kratz, J. Lubchenco, E. Ostrom, Z. Ouyang, W. Provencher, C.L. Redman, S.H. Schneider, W.W. Taylor. 2007. Complexity of Coupled Human and Natural Systems. *Science* 317:1513-1516.
44. McMichael, A.J., C.D. Butler and C. Folke. 2003. New Visions for Addressing Sustainability. *Science* 302:1919-1920.

45. Moberg, F. and C. Folke. 1999. Ecological Services of Coral Reef Ecosystems. *Ecological Economics* 29:215-233.
46. Norström, A, M. Nyström, J. Lokrantz and C. Folke. 2009. Alternative States on Coral Reefs: Beyond Coral–Macroalgal Phase Shifts. *Marine Ecology Progress Series* 376: 295–306.
47. Olsson, P., C. Folke and T.P. Hughes. 2008. Navigating the Transition to Ecosystem-Based Management of the Great Barrier Reef, Australia. *Proceedings National Academy of Sciences, USA* 105:9489-9494.
48. Österblom, H., S. Hansson, U. Larsson, O. Hjerne, F. Wulff, R. Elmgren and C. Folke. 2007. Human-induced Trophic Cascades and Ecological Regime Shifts in the Baltic Sea. *Ecosystems* 10:877-889.
49. Sweitzer, J., S. Langaas and C. Folke. 1996. Land Cover and Population Density in the Baltic Sea Drainage Basin: A GIS Database. *Ambio* 25:191-198.
50. Turner, R.K., S. Georgiou, I.-M. Gren, F. Wulff, S. Barrett, T. Söderqvist, I.J. Bateman, C. Folke, S. Langaas, T. Zylicz and A Markowska. 1999. Managing Nutrient Fluxes and Pollution in the Baltic Sea: An Interdisciplinary Simulation Study. *Ecological Economics* 30:333-352.

Elena Gorokhova

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University (SU)
SE-10691 Stockholm, Sweden
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E-mail: elenag@ecology.su.se
Web-page: <http://www.ecology.su.se/staff/personal.asp?id=33>



Positions

Laboratory Engineer, Dept. of Zoology, Voronezh State University, Russia; 1988-1989.
Researcher, Dept. of Invertebrate Zoology, Voronezh State University; 1990-1995.
Research fellow, Fellowship awarded by CIMO (Ministry of Education of Finland), Lammi
Biological Station, University of Helsinki, Finland; 1995-1996.
PhD student, Dept. of Systems Ecology, Stockholm University (SU); 1995-1999.
Postdoctoral Research Associate, joint appointment at Division of Evolutionary and Conservation
Genetics & Division of Aquatic Ecology, Arizona State University, USA; 1999-2001.
Assistant Professor (forskarassistent). Dept. of Systems Ecology, SU; 2002-2006.
Associate Professor, Dept. of Systems Ecology, SU; 2008-.

Other appointments

Member of the HELCOM Monas Zooplankton Expert Group; 2002-
Swedish representative in 'ICES Study Group on Baltic Sea Productivity Issues' (SG PROD),
appointed by the National Board of Fisheries; 2003-
Convener of Zooplankton Section, appointed by Baltic Marine Biologists (BMB); 2003-
Responsible for zooplankton monitoring at SU (Swedish National Monitoring Programme);
2007-

Academic Degrees

B.Sc. Voronezh State University, Russia, 1988. (Biology, Chemistry)
Ph.D. in Systems Ecology, Stockholm University, Sweden, 1999. Supervisor: Sture Hansson.
Thesis: *Mysid growth, stable isotope fractionation, and energetics: implications for food web
studies.*
Docent (Research fellow, unsalaried), Faculty of Science, SU, 2008.

Research interests

Plankton ecology and evolution, Baltic Sea zooplankton, ecological stoichiometry and trophic
interactions.

Students supervised (completion year in brackets)

PhD students: T. Holmborn – started April 2005. I am (was) also an assistant supervisor for 9
PhD students – A. Sundström, H. Hogfors, M. Ogonowski, A. Zakrisson, P. Sylvander (Systems
Ecology, SU); U. Dahl (2008), T. Björneson, E. Lundström (ITM, SU), and J. Lesituene

(Klaipeda University, Lithuania). *Degree project students* (main supervisor): S. Alutoin (1999); T. Fagerberg (2003); K. Carlsson and S. Svensson (2006), P. Holliland (2008), J. Seftom (2009).

Postdoctoral collaborators

Marina Orlova 2006-2007.

Sustained collaboration outside SU

Drs. Maiju Lehtiniemi and Juha Flinkman (FIMR/SYKE, Finland)

Dr. Jonna Engström-Öst (Åbo Akademi, Finland)

Dr. Jens Nejstgaard (University of Bergen, Norway)

Dr. Lutz Postel (Baltic Sea Research Institute, Rostock-Warnemünde, Germany)

Professor James J. Elser (Arisona State University, USA)

Peer-reviews and grant review panels

Scientific Journals	Expert Panels
<p>6-9 reviews/year: Archiv für Hydrobiologie, Aquatic Biology, Aquatic Ecology, Aquatic Invasions, Aquatic Microbial Ecology, Canadian Journal of Fisheries and Aquatic Science, Comparative Biochemistry and Physiology, Deep Sea Research, Ecological Modelling, Ecotoxicology and Environmental Safety, Freshwater Biology, Fundamental and Applied Limnology, Hydrobiologia, Journal of Experimental Marine Biology and Ecology, Journal of Plankton Research, Limnology and Oceanography, Limnology and Oceanography: Methods, Marine Biology, Marine Ecology Progress Series, Science of the Total Environment.</p>	<p>2-3 expert evaluations/year:</p> <p>International: EU Comission (FP7, FP6, INCO, Global Changes and Ecosystems), INTAS, NSF (USA), Australian Antarctic Science Program (AAS), Russian Fond for Fundamental Research, National Academy of Sciences of Armenia; National Science Foundation of USA (NSF), Darwin Center for Biogeology (The Netherlands).</p> <p>Swedish: Sida, Formas.</p>

External funding – main holder of the following research grants for the last 5 years; ca 11 MSEK in total

Impact of zooplankton grazing on development and persistence of *Nodularia spumigena* in the Baltic Sea. Formas, 2007-2010;

Zooplankton abundance and productivity in the northern Baltic proper: implications for fish feeding conditions. Formas, 2006-2008;

Cercopagis pengoi – an invader threatening the biodiversity of the Baltic Sea and inland waters. Formas; 2002-2006;

Life on the edge – reproductive strategies of *Cercopagis pegoi* in the Bothnian Bay. Small field study grant, UMF, 2006;

Development of test methods for evaluating ballast water treatment efficacy. Alfa Laval Tumba AB & Wallenius Water AB (Sweden); Principal Investigator; 2005-present;

AquAliens, WorkPackage *Invertebrates*; SEPA, 2002-2007;

Biochemical method for growth assessment of dominant Baltic copepods. Formas; 2003-2004.

Elena Gorokhova

Citation counts from ISI Web of knowledge, 2009-02-28

1. Gorokhova E, Hansson S (1997). Effects of experimental conditions on the feeding rate of *Mysis mixta*. *Hydrobiologia* 355: 167-172. Cited 18 times.
2. Gorokhova E (1998). Exploring and modelling the growth dynamics of *Mysis mixta*. *Ecological Modelling* 110: 45-54. Cited 12 times.
3. Gorokhova E, Hansson S (1999). An experimental study on variations in stable carbon and nitrogen isotopes fractionation during growth of *Mysis mixta* and *Neomysis integer* (Crustacea, Mysidacea). *Canadian Journal of Fisheries and Aquatic Science* 56: 2203-2210. Cited 50 times.
4. Uitto A, Gorokhova E, Välipakka P (1999). Distribution of the newcomer cladoceran species of *Cercopagis pengoi* in the Finnish coastal waters of the Eastern Gulf of Finland. *ICES Journal of Marine Science* 56a: 49-57. Cited 20 times.
5. Gorokhova E, Hansson S (2000). Elemental composition of *Mysis mixta* (Crustacea, Mysidacea) and energy costs of reproduction and embryogenesis under laboratory conditions. *Journal of Experimental Marine Biology and Ecology* 246: 103-123. Cited 11 times.
6. Elser J, Sterner R, Gorokhova E, Fagan W, Markow T, Cotner J, Harrison J, Hobbie S, Odell G, Weider L (2000). Biological stoichiometry from genes to ecosystems. *Ecology Letters* 3: 540-550. Cited 155 times.
7. Gorokhova E, Aladin N, Dumont H (2000) Further range extensions of *Cercopagis* genus (Crustacea, Branchiopoda, Onychopoda) with notes on taxonomic composition and ecology. *Hydrobiologia* 429: 207-218. Cited 21 times.
8. Hansson S, De Stasio BT, Gorokhova E, Mohammadian MA (2001). Ratio-dependent functional responses – tests with the zooplanktivore *Mysis mixta*. *Marine Ecology Progress Series* 216: 181-189. Cited 12 times.
9. Gorokhova E, Kyle M (2002). Analysis of nucleic acids in *Daphnia*: development of methods and ontogenetic variations in RNA-DNA content. *Journal of Plankton Research* 24: 511-522. Cited 37 times.
10. Gorokhova E (2002). Moults cycle and its chronology in *Mysis mixta* and *Neomysis integer* (Crustacea, Mysidacea): implications for growth assessment. *Journal of Experimental Marine Biology and Ecology* 278: 179-194. Cited 9 times.
11. Gorokhova E, Dowling TE, Weider LJ, Crease TJ, Elser JJ (2002). Functional and ecological significance of rDNA IGS variation in a clonal organism under divergent selection for production rate. *Proceedings of Royal Society of London, Biological Science* 269(1507): 2373-2379. Cited 28 times.
12. Gorokhova E (2003). Relationships between nucleic acid levels and egg production rates in *Acartia bifilosa*: implications for growth assessment of copepods in the northern Baltic proper. *Marine Ecology Progress Series* 262: 163-172. Cited 13 times.

13. Johansson M, Gorokhova E, Larsson U (2004). Annual variability in ciliate community structure, potential prey and predators in the open northern Baltic Sea proper. *Journal of Plankton Research* 26: 67-80. Cited 19 times.
14. Gorokhova E, Fagerberg T, Hansson S (2004). Predation by herring (*Clupea harengus*) and sprat (*Sprattus sprattus*) on *Cercopagis pengoi* in a western Baltic Sea bay. *ICES Journal of Marine Science* 61: 959-965. Cited 12 times.
15. Kay AD, Ashton I, Gorokhova E, Kerkhoff AJ, Liess A, Litchman E (2005). Toward a stoichiometric framework for evolutionary biology. *Oikos* 109: 6-17. Cited 13 times.
16. Gorokhova E, Hansson S, Högländer H, Andersen CM. (2005). Stable isotopes show food web changes after invasion by the predatory cladoceran *Cercopagis pengoi* in a Baltic Sea bay. *Oecologia* 143(2): 251-259. Cited 18 times.
17. Gorokhova E (2005). Effects of preservation and storage of microcrustaceans in RNA later on RNA and DNA degradation. *Limnology and Oceanography: Methods* 3: 143-148. Cited 13 times.
18. Gorokhova E (2006). Molecular identification of *Cercopagis pengoi* in stomachs of predators. *Limnology and Oceanography: Methods* 4: 1-6. Cited 6 times.
19. Calliari D, Andersen CMA, Thor P, Gorokhova E, Tiselius P (2006). Salinity modulates the energy balance and reproductive success of co-occurring copepods *Acartia tonsa* and *A. clausi* in different ways. *Marine Ecology Progress Series* 312: 177-188. Cited 6 times.
20. Dahl U, Gorokhova E, Breitholtz M (2006). Application of growth-related sublethal endpoints in ecotoxicological assessments using a harpacticoid copepod. *Aquatic Toxicology* 77: 433-438. Cited 13 times.
21. Gardeström J, Gorokhova E, Gilek M, Grahn M, Bengtsson B-E, Breitholtz M (2006). A multilevel approach to predict toxicity in copepod populations: Assessment of growth, genetics, and population structure. *Aquatic Toxicology* 79: 41-48. Cited 5 times.
22. Lesutienė J, Gorokhova E, Gasiūnaitė ZR, Razinkovas A (2007). Isotopic evidence for zooplankton as an important food source for a coastal mysid *Paramysis lacustris* in the Curonian Lagoon, south-eastern Baltic Sea. *Estuarine, Coastal and Shelf Science* 71 (5): 73-80. Cited once.
23. Gorokhova E, Lehtiniemi M (2007). A combined approach to understand trophic interactions between *Cercopagis pengoi* (Cladocera: Onychopoda) and mysids in the Gulf of Finland. *Limnology and Oceanography* 52 (2): 685-695. Cited 4 times.
24. Gorokhova E, Edlund A, Hajdu S, Zhivotova EN (2007). Nucleic acid levels in copepods: dynamic response to the phytoplankton bloom in the northern Baltic proper. *Marine Ecology Progress Series* 349: 213-225. Cited once.
25. Lehtiniemi M, Pääkkönen JP, Flinkman J, Katajisto T, Gorokhova E, Karjalainen M, Viitasalo S, Björk H (2007). Distribution and abundance of the American comb jelly (*Mnemiopsis leidyi*) – A rapid invasion to the northern Baltic Sea during 2007. *Aquatic Invasions* 2 (4): 445-449

26. Svensson S, Gorokhova E (2007). Embryonic development time of parthenogenically reproducing *Cercopagis pengoi* (Cladocera, Onychopoda) in the northern Baltic proper. *Fundamental and Applied Limnology* 170 (3): 257-261.
27. Höök T, Gorokhova E, Hansson S (2008). RNA:DNA ratios of Baltic herring larvae and copepods in embayment and open sea habitats. *Estuarine, Coastal and Shelf Science* 76 (1): 29-35
28. Holmborn T, Gorokhova E (2008). Relationships between RNA content and egg production rate in *Acartia bifilosa* (Copepoda, Calanoida) of different spatial and temporal origin. *Marine Biology* 153 (3): 483 – 491. Cited 2 times.
29. Lehtiniemi M, Gorokhova E (2008). Predation of the introduced cladoceran *Cercopagis pengoi* on the calanoid copepod *Eurytemora affinis* in the Gulf of Finland, Baltic Sea. *Marine Ecology Progress Series* 362: 193-200.
30. Calliari D, Andersen Borg CM, Thor P, Gorokhova E, Tiselius P (2008) Instantaneous salinity reductions affect the survival and clearance rates of the co-occurring copepods *Acartia tonsa* Dana and *A. clausi* Giesbrecht differently. *Journal of Experimental Marine Biology and Ecology* 362 (1): 18-25.
31. Lesutienė J, Gorokhova E, Gasiūnaitė ZR, Razinkovas A (2008) Role of mysid seasonal migrations in the organic matter transfer in the Curonian Lagoon, south-eastern Baltic Sea. *Estuarine, Coastal and Shelf Science* 80 (2): 225-234.
32. Gorokhova E (2009) Toxic cyanobacteria *Nodularia spumigena* in the diet of Baltic mysids: evidence from molecular diet analysis. *Harmful Algae* 8: 264-272.
33. Dahl U, Rubio Lind C, Gorokhova E, Eklund B, Breitholtz M. (2009) Food quality effects on copepod growth and development: implications for bioassays in ecotoxicological testing. *Ecotoxicology and Environmental Safety* 72 (2): 351-357.
34. Nascimento FJA, Karlson AML, Näslund J, Gorokhova E (2009) Settling cyanobacterial blooms do not improve growth conditions for soft bottom meiofauna. *Journal of Experimental Marine Biology and Ecology* 368: 138-146.
35. Holeton C, Lindell K, Holmborn T, Hogfors H, Gorokhova E. (In press) Decreased astaxanthin levels at high feeding rates in the calanoid copepod *Acartia bifilosa*. *Journal of Plankton Research*.

CURRICULUM VITAE

Örjan Mikael GUSTAFSSON

Born 4 January 1968, married to Maria Gustafsson, three children (Elsa Feb. 2004, Erik Sept. 2005, Anna Dec. 2008)

Present Address: Stockholm University
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EDUCATION AND DEGREES:

2001	Docent (Associate Professor) , Stockholm University.
1997	Ph.D. , <i>Chemical Oceanography</i> , Massachusetts Institute of Technology (MIT) and Woods Hole Oceanographic Institution (WHOI).

PROFESSIONAL POSITIONS:

2008 - permanent	Professor , Biogeochemistry, ITM, Stockholm University
2002 – 2008	Tenured Associate Professor, ITM, Stockholm University
1998 - 2002	Assistant Professor, ITM, Stockholm University
1997-1998 Aug.	Postdoc, Lab. for Isotope Geology, Swe. Museum Nat. Hist.
1997, Jan-May	Postdoctoral Researcher, MIT

STUDENTS/POST-DOCS AND RESEARCH GROUP MANAGEMENT

Leader of a 12 person research group: responsible for financing and advising at present five international post-doc researchers, five Ph.D. students, and two research technicians.

Advisor to four completed Ph.D.s:

Anders Jönsson (2004), Anna Sobek (2005), Henry Holmstrand (2006), Marie Elmquist (2007)

Host to international post-docs:

Dr. Thomas Bucheli (ETH-Zürich, Switzerland) 1999 –2001; Dr. Manolis Mandalakis (Univ. Crete, Greece) 2002 – 2004; Dr. Gerard Cornelissen (Univ. Amsterdam, The Netherlands) 2002 – 2004; Dr. Laurent Coppola (U. Toulouse, France) 2002 – 2004; Dr. Hidetoshi Kumata (Tokyo University of Pharm. and Life Sciences, Japan) 2003-2004; Dr. Zdenek Zencak (Univ. Basel, Switzerland) 2005-2007; Dr. Bart van Dongen (NIOZ; Univ. Utrecht, The Netherlands) 2005-2008; Dr. Rebecca Sheesley (Univ. Wisconsin, USA) 2007-2009; Dr. Laura Sanchez-Garcia (Univ. Madrid, Spain) 2008-, Dr. Daniel Carrizo (CID-CSIC, Univ. Barcelona, Spain) 2008-; Dr. Brett Thornton (Univ. Colorado, USA) 2009-; Dr. Christoph Aeppli (ETH, Switzerland), 2009-.

SCIENTIFIC MERITS

- **Author of 100 papers (21 as first author) since 1996 in international peer-reviewed journals**
- Best Geochemistry Paper 1997, American Chemical Society, Division of Geochemistry
- Frequently cited: several of my papers are cited > 100 times.
- Attracted 35 external research grants for a total of about 80 Mill. SEK (ca. 7.5 Mill. €, US\$ 10 Mill)
- Selected Senior Research Fellow of the Swedish Research Council (2002-2008) and Academy Researcher to the Swedish Royal Academy of Sciences (2008-2012).

SCIENTIFIC/ADMINISTRATIVE COMMISSIONS

- Proposal referee for e.g. the Swedish Research Council (VR), EU Commission, US National Science Foundation (NSF), Swiss National Research Council, and European Science Foundation (ESF)
- The Swedish Research Council (VR) Evaluation Committee “Processes in Soil, Air, and Water” (NT-B), member 2005-2006
- Invited member, UNESCO-ICSU-SCOR (Scientific Committee of Oceanic Research) Working Group on “Sediment trap and ²³⁴Th methods for carbon export in the upper ocean: current status” 2002-2005
- Invited member, Arctic Monitoring and Assessment Programme (AMAP) Expert Group on Persistent Organic Pollutants (POPs), 2006-
- Invited as “Institution Visiting Scholar” (prestigious level) to the Woods Hole Oceanographic Institution (WHOI), Sept-Dec 2006.
- Co-chief scientist of the International Siberian Shelf Study 2008 (ISSS-08), 30 scientists, 45 days onboard R/V Smirnitskyi.
- Member, 3-person Working Group drafting Scientific Framework Plan for Arctic Ocean ODEN Expedition 2001, Swedish Royal Academy of Sciences (1999-2001) and Chief Scientist, 65-day AO-01 expedition to the high Arctic for “Biogeochemical Fluxes” (20 international participants) July - Sept. 2001
- Member, steering committee of the Bert Bolin Centre for Climate Research at Stockholm University
- Coordinator of several EU Framework Program research projects, at present for Iso-Soil (11 Partner groups) 2009-2011.

Publications in International Peer-Reviewed Journals/Books with High Impact Factors

- P1. Gustafsson, Ö.,** K. O. Buesseler and P. M. Gschwend (1996) On the integrity of cross-flow filtration for collecting marine organic colloids. *Marine Chemistry*, 55, 93-111.
- P3. Gustafsson, Ö.,** F. Haghseta, C. Chan, J. MacFarlane and P. M. Gschwend (1997) Quantification of the dilute sedimentary "soot-phase": Implications for PAH speciation and bioavailability. *Environmental Science and Technology*, 31, 203-209.
- P5. Gustafsson, Ö.** and P. M. Gschwend (1997) Aquatic Colloids: Concepts, definitions, and current challenges. *Limnology and Oceanography*, solicited review, 42, 519-528.
- P6. Gustafsson, Ö.,** K. O. Buesseler and P. M. Gschwend (1997) Using ²³⁴Th disequilibria to estimate the vertical removal rates of polycyclic aromatic hydrocarbons from the surface ocean. *Marine Chemistry*, 57, 11-23.
- P8. Gustafsson, Ö.** and P. M. Gschwend (1998) The flux of black carbon in surface sediments on the New England continental shelf. *Geochimica Cosmochimica Acta*, 62, 465-472.
- P9. Gustafsson, Ö.,** K. O. Buesseler, W. R. Geyer, S. B. Moran and P. M. Gschwend (1998) An assessment of the relative importance of horizontal and vertical transport of particle-reactive chemicals in the coastal ocean. *Continental Shelf Research*, 18, 805-829.
- P14. Gustafsson, Ö.,** A. Widerlund, P. Andersson, J. Ingri, and P. Roos (2000) Colloid dynamics and transport of major elements through a boreal river – brackish bay mixing zone. *Marine Chemistry*, 71, 1-21.
- P16. Gustafsson, Ö.,** A. Duker, J. Larsson, P. Andersson, J. Ingri (2000) Functional separation of colloids and gravitoids in surface waters based on differential settling velocity: Coupled cross-flow filtration – split flow thin cell fractionation (CFF-SPLITT). *Limnology and Oceanography*, 45, 1731-1742.
- P19. Gustafsson Ö.,** C. Long, J. MacFarlane and P. M. Gschwend (2001) Fate of linear alkylbenzenes (LABs) released to the coastal environment near Boston Harbor. *Environmental Science and Technology*, 35, 2040-2048.
- P22. Gustafsson Ö.,** T. D. Bucheli, Z. Kukulska, M. Andersson, C. Largeau, J.-N. Rouzaud, C. Reddy and T. Eglinton (2001) Evaluation of a protocol for the quantification of black carbon in sediments. *Global Biogeochemical Cycles*, 15, 881-890.
- P23. Gustafsson Ö.,** N. Nilsson and T. D. Bucheli (2001) Dynamic colloid-water partitioning of pyrene through a coastal Baltic spring bloom. *Environmental Science and Technology*, 35, 4001-4006.

- P25.** Larsson, J., **Ö. Gustafsson** and J. Ingri (2002) Optimization of two cross-flow ultrafiltration systems toward isolation of surface water colloids. *Environmental Science and Technology*, 36, 2236-2241.
- P28.** Axelman, J. and **Ö. Gustafsson** (2002) The global sinks of PCBs: a critical assessment of the vapor-phase hydroxy radical sink emphasizing field diagnostics and model assumptions. *Global Biogeochemical Cycles*, 16 (4), 1111, doi:10.1029/2002GB001904.
- P30.** Jönsson, A., **Ö. Gustafsson**, J. Axelman, and H. Sundberg (2003) Global accounting of PCBs in the continental shelf sediments. *Environmental Science and Technology*, 37, 245-255.
- P36.** Sobek, A., **Ö. Gustafsson**, S. Hajdu, and U. Larsson (2004) Particle-water partitioning of PCBs in the photic zone: A 25-month study in the open Baltic Sea. *Environmental Science and Technology*, 38, 1375-1382.
- P37.** **Gustafsson, Ö.**, P. Andersson, P. Roos, Z. Kukulska, D. Broman, U. Larsson, S. Hajdu, and J. Ingri (2004) Evaluation of the collection efficiency of upper ocean sub-photoc-layer sediment traps: A 24-month in situ calibration in the open Baltic Sea using ²³⁴Th. *Limnology and Oceanography: Methods*, 2, 62-74.
- P41.** Sobek, A., and **Ö. Gustafsson** (2004) Latitudinal fractionation of polychlorinated biphenyls in surface seawater along a 62N- 89N transect from the southern Norwegian Sea to the North Pole area. *Environmental Science and Technology*, 38, 2746-2751. doi: 10.1021/es0353816
- P43.** Sundelin, B., A.-K. Eriksson-Wiklund, G. Lithner, and **Ö. Gustafsson** (2004) Evaluation of the role of black carbon in attenuating bioaccumulation of PAHs from field-contaminated sediments. *Environmental Toxicology and Chemistry*, 23, 2611-2617.
- P48.** Mandalakis, M., **Ö. Gustafsson**, C. Reddy, and L. Xu (2004) Radiocarbon apportionment of fossil versus biofuel combustion sources of polycyclic aromatic hydrocarbons in the Stockholm metropolitan area. *Environmental Science and Technology*, 38, 5344-5349.
- P50.** Ingri, J., S. Nordling, J. Larsson, J. Rönnegård, N. Nilsson, I. Rodushkin, R. Dahlgvist, P. Andersson, **Ö. Gustafsson** (2004) Size distribution of colloidal trace metals and organic carbon during a coastal bloom in the Baltic Sea. *Marine Chemistry*, 91, 117-130.
- P52.** Cornelissen, G., and **Ö. Gustafsson** (2005) Prediction of large variation in BSAFs due to concentration-dependent black carbon adsorption of planar hydrophobic organic compounds. *Environmental Toxicology and Chemistry*, 24, 495-498.
- P54.** Waite, A.M., **Ö. Gustafsson**, O. Lindahl, P. Tiselius (2005) Linking ecosystem dynamics and biogeochemistry: Sinking fractionation of organic carbon in a Swedish fjord. *Limnology and Oceanography*, 50, 658-671.
- P55.** Mandalakis, M., **Ö. Gustafsson**, T. Alsberg, A.-L. Egebäck, C. Reddy, L. Xu, J. Klanova, I. Holoubek, E.G. Stephanou (2005) Contribution of biomass burning to atmospheric polycyclic

aromatic hydrocarbons at three European background sites. *Environmental Science and Technology*, 39, 2976-2982.

- P56.** Ö. Gustafsson, P. Andersson, J. Axelman, T.D. Bucheli, P. Kömp, M. McLachlan, A. Sobek, and J.-O. Thörngren (2005) Observations of the PCB distribution within and in-between ice, snow, ice-rafted debris, ice-interstitial water, and seawater in the Barents Sea marginal ice zone and the North Pole area. *Science of the Total Environment*, 342, 261-279.
- P59.** Jönsson, A., M. Lindström, R. Carman, C.-M. Mörth, M. Meili, and Ö. Gustafsson, (2005) Evaluation of the Stockholm archipelago sediments, northwestern Baltic Sea Proper, as a trap for freshwater-runoff organic carbon. *Journal of Marine Systems*, 56, 167-178.
- P62.** Cornelissen, G., Ö. Gustafsson, T.D. Bucheli, M.T.O. Jonker, A.A. Koelmans, and P.C.M. vanNoort (2005) Critical Review: Extensive sorption of organic compounds to black carbon, coal, and kerogen in sediments and soils: mechanisms and consequences for distribution, bioaccumulation, and biodegradation. *Environmental Science and Technology*, 39, 6881-6895 (doi: 10.1021/es050191b).
- P63.** Holmstrand, H., M. Mandalakis, Z. Zencak, Ö. Gustafsson, and P. Andersson (2006) Chlorine isotope fractionation of a semi-volatile organochlorine compound during preparative megabore-column capillary gas chromatography. *Journal of Chromatography A*, 1103, 133-138 (doi:10.1016/j.chroma.2005.11.009).
- P67.** J. Waples, C. R. Benitez-Nelson, N. Savoye, M. Rutgers van der Loeff, M. Baskaran, and Ö. Gustafsson (2006) An introduction to the application and future use of ^{234}Th in aquatic systems. *Marine Chemistry*, 100, 166-189. (doi: 10.1016/j.marchem.2005.10.011).
- P68.** Ö. Gustafsson, J. Larsson, P. Andersson, and J. Ingri (2006) The POC/ ^{234}Th ratio of settling particles isolated using split flow-thin cell fractionation (SPLITT). *Marine Chemistry*, 100, 314-322. (doi: 10.1016/j.marchem.2005.10.018).
- P69.** M. Rutgers van der Loeff, M.M. Sarin, M. Baskaran, C. R. Benitez-Nelson, K. O. Buesseler, M. Charette, M. Dai, Ö. Gustafsson, P. Masque, P. Morris, K. Orlandini, A. Rodriguez y Baena, N. Savoye, S. Schmidt, R. Turnewitsch, I. Vöge, and J. Waples (2006) ^{234}Th analysis review: State of the art and new methodologies and techniques. *Marine Chemistry*, 100, 190-212. (doi: 10.1016/j.marchem.2005.10.012).
- P70.** K. O. Buesseler, C. R. Benitez-Nelson, S. B. Moran, A. Burd, M. Charette, J. K. Cochran, L. Coppola, N. S. Fisher, S. W. Fowler, W. D. Gardner, L. D. Guo, Ö. Gustafsson, C. Lamborg, P. Masque, J. C. Miquel, U. Passow, P. H. Santschi, N. Savoye, G. Stewart, and T. Trull (2006) An assessment of particulate organic carbon to thorium-234 ratios in the ocean and their impact on the application of ^{234}Th as a POC flux proxy. *Marine Chemistry*, 100, 213-233. (doi: 10.1016/j.marchem.2005.10.013).
- P71.** Sobek, A., K. Olli, and Ö. Gustafsson (2006) On the relative significance of bacteria for the distribution of polychlorinated biphenyls in Arctic Ocean surface waters. *Environmental Science and Technology*, 38, 2746-2751. (doi: 10.1021/es0524907).

- P72.** Elmquist, M., G. Cornelissen, Z. Kukulska, and **Ö. Gustafsson** (2006) Distinct oxidative stabilities of char versus soot black carbon: Implications for quantification and environmental recalcitrance. *Global Biogeochemical Cycles*, doi: 10.1029/2005GB002629.
- P73.** Sobek, A., M. Reigstad, and **Ö. Gustafsson** (2006) Partitioning of polychlorinated biphenyls between Arctic seawater and size-fractionated zooplankton. *Environmental Toxicology and Chemistry*, 25, 1720-1728.
- P77.** Sobek, A., G. Cornelissen, P. Tiselius and **Ö. Gustafsson** (2006) Passive partitioning of polychlorinated biphenyls between seawater and zooplankton, a study comparing observed field distributions to equilibrium sorption experiments. *Environmental Science and Technology*, 40, 6703-6708. (doi: 10.1021/es061248c).
- P82.** Buesseler, K.O., A.N. Antia, C. Min, S. W. Fowler, W. D. Gardner, **Ö. Gustafsson**, K. Harada, A.F. Michaels, M. Rutgers van der Loeff, M. Sarin, D.K. Steinberg and T. Trull (2007) Estimating upper ocean particle fluxes using sediment traps. *J. Mar. Res.*, 65, 345-416.
- P83.** Coppola, L., **Ö. Gustafsson**, P. Andersson, T.I. Eglinton, M. Uchida and A.F. Dickens (2007) The importance of ultrafine particles as a control on the distribution and burial of organic carbon in Washington margin and Cascadia Basin sediments. *Chem. Geol.*, 243, 142-156.
- P86.** Elmquist, M., Z. Zencak and **Ö. Gustafsson** (2007) A 700 year sediment record of black carbon and polycyclic aromatic hydrocarbons near the EMEP air monitoring station in Aspöreten, Sweden. *Environmental Science and Technology*, 41, 6926-6932. (doi:10.1021/es070546m).
- P87.** Holmstrand, H., M. Mandalakis, Z. Zencak, P. Andersson, and **Ö. Gustafsson** (2007) First compound-specific chlorine isotope analysis of environmentally-bioaccumulated organochlorines indicates a degradation-related kinetic isotope effect for DDT. *Chemosphere*, 69, 1533-1539. (doi:10.1016/j.chemosphere.2007.05.067)
- P90.** van Dongen, B.E., I. Semiletov, J.W.H. Weijers and **Ö. Gustafsson** (2008) Contrasting lipid biomarker composition of terrestrial organic matter exported from across the Eurasian Arctic by the five Great Russian Arctic Rivers. *Global Biogeochem. Cycles*, 22, GB1011, doi:10.1029/2007GB002974.
- P92.** Armitage, J., I.T. Cousins, N. J. Persson, **Ö. Gustafsson**, G. Cornelissen, T. Saloranta, D. Broman and K. Naes (2008) Black carbon-inclusive modeling approaches for estimating the aquatic fate of dibenzo-p-dioxins and dibenzofurans. *Environmental Science and Technology*, 42, 3697-3703 (doi:10.1021/es702638g).
- P93.** Elmquist, M., I. Semiletov, L. Guo and **Ö. Gustafsson** (2008) Pan-Arctic patterns in black carbon sources and fluvial discharges deduced from radiocarbon and molecular markers in

estuarine surface sediments. *Global Biogeochem. Cycles*, 22, GB2018, doi:10.1029/2007GB002994.

- P96.** Vonk, J., B.E. van Dongen and **Ö. Gustafsson** (2008) Lipid biomarker investigation of terrestrial organic matter presently exported into the northern Bothnian Bay. *Mar. Chem.*, 112, 1-10 (doi: 10.1016/j.marchem.2008.07.001.)
- P98.** Huguet, C., G.J. de Lange, **Ö. Gustafsson**, J.J. Middelburg, J.S. Sininghe Damste and S. Schouten (2008) Selective preservation of soil organic matter in oxidized marine sediments (Madeira Abyssal Plain). *Geochim. Cosmochim. Acta*, 72, 6061-6068. (doi: 10.1016/j.gca.2008.09.021)
- P99.** van Dongen, B.E., Z. Zencak and **Ö. Gustafsson** (2008) Differential transport and degradation of bulk organic carbon and specific terrestrial biomarkers in the surface waters of a sub-arctic brackish bay mixing zone. *Mar. Chem.*, 112, 203-214 (doi: 10.1016/j.marchem.2008.08.002.)
- P100.** **Ö. Gustafsson**, M. Kruså, Z. Zencak, R.J. Sheesley, L. Granat, E. Engström, p.S. Praveen, P.S.P. Rao, C. Leck and H. Rodhe (2009) Brown clouds over South Asia: Biomass or fossil fuel combustion? *Science*, 323, 495-498.

Christoph Humborg

Date of Birth: 16.11.1963 in Münster, Germany

Marital Status: married to Heike Siegmund,

three children (Paula, Charlotte and Carl),

Nationality: German

Professional positions:

2007-present: Baltic Nest Institute at Stockholm Resilience Center (Director 75%)

2004-present: Department of Applied Environmental Science (Associate Professor 25%)

Stockholm University

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1995-1998: Post Baltic Sea Research Institute

Education

Stockholm University 2004 Associate Professor (Docent) in Biogeochemistry

Christian-Albrechts University Kiel, 1987-1995

1995 Ph.D. in Biological Oceanography



Scientific/administrative commissions

- Board member, Department of System Ecology, Stockholm University-1999-2002
- Member of the FORMAS evaluation committee “Marin Miljö”-2005-2007
- Board member Stockholm Marine Research Center-2006-2008
- Board member Baltic Nest Institute-2008-
- Board member Stockholm Resilience Center Advisory Board 2008-
- International expert on EU Marine Strategy Framework Directive (eutrophication)

Editorial work

Associate editor Journal of Marine Systems-2005-

Co-editor In: Ittekkot, V.; Unger, D.; Humborg, C.; Tac An, N. The Silicon Cycle_Human perturbations and impacts on aquatic systems. SCOPE 66 (Island Press, Washington D.C.), pp 252.

Guest Editor: Silicon and the Baltic Sea, Journal of Marine Systems Special Issue Vol. 73, 2008

List of projects and funds since 2000 divided by research interests (in total some 15 Mkr as main applicant)

Silicon biogeochemistry:

- EU project SIBER (2003-2005; EVK3-CT-2002-00069; Scientific and administrative coordinator CH) (<http://siber.ecology.su.se>), with 9 European institutes involved, 1.4 M €- of which 160 000 € for CH
- VR 2.1 Mkr financed study “Silicon Isotope-Based reconstruction of the silicon cycle and diatom production in the Baltic Sea; Implications for climate change and eutrophication” with Carl-Magus Mörth (main applicant), Per Andersson and Daniel J. Conley as co-applicants
- VR (Swedish Research Council) financed study on “Recent weathering of silicon in Northern Sweden – Implications for dissolved silicate runoff and ocean productivity”, 600 000 SEK--2002-2003
- NFR (Swedish Natural Science Research Council) financed study on “Nutrient retention in Reservoirs of Swedish rivers” in Kalixälven and Luleälven, 900 000 SEK--2000-2001

- Redistribution and soil carbon from high latitude watersheds:
- **VR** (2008-2010) 2.0 Mkr financed study on “THE AQUATIC CONDUIT IN TAIGA AND TUNDRA ECOREGIONS – A SINK OR SOURCE FOR ATMOSPHERIC CARBON?”, Carl Magnus Mörth and Gia Destuoni as co-applicants
- **Formas** (2008-2010) 1.6 Mkr financed study on “THE AQUATIC CONDUIT IN TAIGA AND TUNDRA ECOREGIONS – A SINK OR SOURCE FOR ATMOSPHERIC CARBON?”, Carl Magnus Mörth, Gia Destuoni and Reiner Giessler as co-applicants

Tracing terrestrial organic matter by multiple isotope signatures in estuaries:

- **VR** (2005-2007) 1.2 Mkr financed study on “Export and sequestration patterns of terrestrial organic carbon in coastal boreal environments of Northern Sweden – implications for the redistribution of soil carbon and oceanic carbon storage”; Carl-Magnus Mörth and Lars Rahm as co-applicants

Modelling of the Baltic Sea watersheds:

- **EU- Bonus+** project RECOCA (Reduction of Baltic Sea Nutrient Inputs and Cost Allocation within the Baltic Sea Catchment 2008-2011), 150 000 €-; 9 EU countries as co-applicants
- **EU- Bonus+** project AMBER (Assessment and Modelling Baltic Ecosystem Response 2008-2011), 140 000 €-, 12 EU countries as co-applicants
- **EU- Bonus+** project Baltic C (Building predictive capability regarding the Baltic Sea organic/inorganic carbon and oxygen systems 2008-2011), 140 000 €-, 6 EU countries as co-applicants
- **EU** project ELME (2004-2006 European Lifestyle and Marine Ecology) (<http://www.elme-eu.org>), 110 000 €.; Fred Wulff as main applicant
- **MISTRA** (2006-2007) 1.2 Mkr financed study on “Drainage basin models linked to cost-effective measures” (<http://mare.su.se>); Lars Rahm and Carl-Magnus Mörth as co-applicants
- **MISTRA** (2004-2005) 1.2 Mkr financed study on “Drainage basin models linked to cost-effective measures” (<http://mare.su.se>) with Carl-Magnus Mörth and Lars Rahm as co-applicants

List of PhD and licentiate exams

- Mona Johansson, PhD exam October 2002, CH main advisor
- Erik Smedberg, PhD exam June 2008, CH main advisor
- Vanja Alling: start 2006, licentiate 2008, CH main advisor
- Hanna Eriksson, start 2004, licentiate 2006, CH main advisor
- Louse Björkvald, PhD exam Sept. 2008, co-supervisor
- Jenni Brink. Licentiate exam 2003
- Helena Högländer, PhD exam 2005

List of Post Docs

- Barbara Deutsch, 2009-
- Theresia Wellstedt, 2009-

Christoph Humborg, List of Publications

1. McQuatters-Gollop, A., Gilbert, A., Mee, L., Vermaat, J., Artioli, Y., Daunys, D., **Humborg, C.**, Wulff, F. How well do ecosystem indicators communicate the effects of anthropogenic eutrophication? **Estuarine Coastal and Shelf Science**, in press.
2. Lyon, S.W., Destouni, G., Giesler, R., **Humborg, C.**, Mörth, M., E., Humborg, Seibert, J., Karlson, J., Torch, P.A. 2009. Estimation of permafrost thawing rates in a sub-arctic catchment using recession flow analysis. **Hydrol. Earth Syst. Sci. Discuss.** ·vol:6 ·pages: 63-83.
3. Smedberg, E., **Humborg, C.**, Jacobsson, M., Mörth, C.-M. 2008. Landscape elements and river chemistry as affected by river regulation – a 3-D perspective. **Hydrol. Earth Syst. Sci. Discuss.** ·vol:5 ·pages: 3355-3382.
4. Alling, V., **Humborg, C.**, Mörth, C.-M., Rahm, L. and Pollehne, F. 2008. *Tracing terrestrial organic matter by $d34S$ and $d13C$ signatures in a subarctic estuary.* **Limnology and Oceanography** ·vol:53 ·pages:2594-2602 .
5. Artioli, Y., Friedrich, J., Gilbert, A.J., McQuatters-Gollop, A., Mee, L.D., Vermaat, J.E., Wulff, F., **Humborg, C.** , Palmeri, L., Pollehne, F. 2008. *Nutrient budgets for European seas: a measure of the effectiveness of nutrient reduction policies.* **Mar. Pol. Bull.** ·vol:56 ·pages:1609-1617 ·i:10.1016/j.marpolbul.2008.05.027
6. Savchuk, O.P., Wulff, F., Hille, S., **Humborg, C.**, Pollehne, F. *The Baltic Sea a century ago — A reconstruction from model simulations, verified by observations* ·2008 ·**J. Mar. Syst.** ·vol:74 ·pages:485-495 ·DOI:doi:10.1016/j.jmarsys.2008.03.008
7. Sferratore, A., Billen, G., Garnier, J., Smedberg, E., **Humborg, C.**, Rahm, L. *Modelling nutrient fluxes from sub-arctic basins: Comparison of pristine vs. dammed rivers*·2008 ·**J. Mar. Syst.** ·vol:73 ·pages:236-249 ·DOI:10.1016/j.marsys.2007.10.012
8. **Humborg, C.**, Rahm, L., Conley, D.J., Tamminen, T., von Bodungen, B. *Long-term Si decrease in the Baltic Sea - A conceivable ecological risk?* ·2008 ·**J. Mar. Syst.** ·vol:73 ·pages:221-222 ·DOI:10.1016/j.jmarsys.2007.10.014
9. Pastuszak, M., Conley, D.J., **Humborg, C.**, Witek, Z., Sitek, S. *Silicon dynamics in the Oder estuary, Baltic Sea* ·2008 ·**J. Mar. Syst.** ·vol:73 ·pages:250-262 ·DOI:10.1016/j.jmarsys.2007.10.013
10. **Humborg, C.**, Smedberg, E., Rodriguez Medina, M., Mörth, C.-M. *Changes in dissolved silicate loads to the Baltic Sea - The effects of lakes and reservoirs* ·2008 ·**J. Mar. Syst.** ·vol:73 ·pages:223-235 ·DOI:10.1016/j.jmarsys.2007.10.014
11. Conley, D. J., **Humborg, C.**, Smedberg, E., Rahm, L., Papush, L., Danielsson, Å., Clarke, A., Pastuszak, M., Aigars, J., Ciuffa, D., Mörth, C.-M. *Past, present and future state of*

the biogeochemical Si cycle in the Baltic Sea ·2008 ·**J. Mar. Syst.** ·vol:73 ·pages:338-346
·DOI:10.1016/j.jmarsys.2007.10.016

12. Smith, B., Aasa, A., Ahas, R., Blenckner, T., Callaghan, T., de Chazal, J., **Humborg, C.**, Jönsson, A.M., Kellomäki, S., Kull, A., Lehtikoinen, E., Mander, Ü., Nöges, P., Nöges, T., Rounsevell, M., Sofiev, M., Tryjanowski, P., Wolf, A. *Climate-related change in terrestrial and freshwater ecosystems*. in: BACC Author Group, Assessment of Climate Change for the Baltic Sea Basin ·2008 ·**Springer-Verlag**, Germany ·pages:474 pp. ·ISBN:978-3-540-72785-9

13. Brink, J., **Humborg, C.**, Sahlberg, J., Rahm, L., Mörtz, C.-M. *Weathering rates and origin of inorganic carbon as influenced by river regulation in the boreal-arctic region of Sweden* ·2007 ·**Hydrol. Earth Syst. Sci. Discuss.** ·vol:4 ·pages:555-588 ·DOI:www.hydrol-earth-syst-sci-discuss.net/4/555/2007

14. Mörtz, C.-M., **Humborg, C.**, Eriksson, H., Danielsson, Å, Rodriguez Medina, M., Löfgren, S., Swaney, D.P., Rahm, L. *Modelling riverine nutrient transport to the Baltic Sea – A large scale approach* ·2007 ·**Ambio** ·vol:36 ·pages:124-133

15. Wulff, F., Savchuk, P., Sokolov, A., **Humborg, C.**, Mörtz, C.-M. *Management options and effects on a marine ecosystem: Assessing the future of the Baltic* ·2007 ·**Ambio** ·vol:36 ·pages:243-249

16. Eriksson, H., Pastuzak, M., Löfgren, S., Mörtz, C.-M., **Humborg, C.** *Nitrogen budgets of the Polish agriculture 1960 - 2000: implications for riverine nitrogen loads to the Baltic Sea from transitional countries* ·2007 ·**Biogeochemistry** ·vol:85 ·pages:185-168 ·DOI:10.1007/s10533-007-9126-y

17. **Humborg, C.**, Mörtz, C.-M., Sundbom, M., Wulff, F. *Riverine transport of biogenic elements to the Baltic Sea-past and possible future perspectives* ·2007 ·**Hydrol. Earth Syst. Sci.** ·vol:11 ·pages:1593-1607 ·DOI:www.hydrol-earth-syst-sci.net/11/1593/2007/

18. **Humborg, C.**, Pastuszak, M., Aigars, J., Siegmund, H., Mörtz, C.-M., Ittekkot, V. *Decreased silica land-sea fluxes through damming in the Baltic Sea catchment - significance of particle trapping and hydrological alterations.* ·2006 ·**Biogeochemistry** ·vol:77 ·pages:265-281 ·DOI:10.1007/s10533-005-1533-3

19. Smedberg, E., C. Mörtz, D. P. Swaney, **Humborg, C.** *Modeling hydrology and silicon-carbon interactions in taiga and tundra biomes from a landscape perspective: Implications for global warming feedbacks* ·2006 ·**Global Biogeochem. Cycles** ·vol:20 ·pages:GB2014, 1-15 ·DOI:10.1029/2005GB002567

20. Voss, M., Deutsch, B., Elmgren, R., **Humborg, C.**, Kuuppo, P., Pastuszak, M., Rolff, C., Schulte, U. *River biogeochemistry and source identification of nitrate by means of isotopic tracers in the Baltic Sea catchment* ·2006 ·**Biogeosciences** ·vol:3 ·pages:663-676 ·DOI:www.biogeosciences.net/3/663/2006/

21. **Humborg, C.**, Rahm, L., Smedberg, E., Mörth, C.-M., Danielsson, Å. *Dissolved silica dynamics in boreal and arctic rivers: vegetation control over temperature?* in: **SCOPE 66: The Silicon Cycle-Human Perturbations and Impacts on Aquatic Systems** (Ittekkot, V., Unger, D., Humborg, C., Tac An, eds.) --2006 ·**Island Press**, Washington ·pages:53-69 ·ISBN:1-59726-114-9
22. Ittekkot, V., Unger, D., **Humborg, C.**, Tac An, N. (Eds.) **SCOPE 66: The Silicon Cycle-Human Perturbations and Impacts on Aquatic Systems** --2006 ·**Island Press**, Washington ·pages:261 pp ·ISBN:1-59726-114-9
23. Ittekkot, V., Unger, U., **Humborg, C.**, Tac An, N. *The perturbed silicon cycle*. In: **SCOPE 66: The Silicon Cycle-Human Perturbations and Impacts on Aquatic Systems** (Ittekkot, V., Unger, D., Humborg, C., Tac An, eds.) --2006 ·**Island Press**, Washington ·pages:245-252 ·ISBN:1-59726-114-9
24. Ittekkot, V., Unger, D., **Humborg, C.**, Tac An, N. Introduction. In: **SCOPE 66: The Silicon Cycle-Human Perturbations and Impacts on Aquatic Systems** (Ittekkot, V., Unger, D., Humborg, C., Tac An, eds.) --2006 ·**Island Press**, Washington ·pages:1-2 ·ISBN:1-59726-114-9
25. Smith, S.V., Swaney, D.P., Buddemeier, R.W., Scarsbrook, M.R., Weatherhead, M.A., **Humborg, C.**, Eriksson, H., Hannerz, F. *River nutrient loads and catchment size*. 2005 ·**Biogeochemistry** ·vol:75 ·pages:83-107 ·DOI:10.1007/s10533-004-6320-z
26. **Humborg, C.**, Smedberg, E., Blomqvist, S., Mörth, C.-M., Brink, J., Rahm, L., Danielsson, Å., Sahlberg, J. *Nutrient variations in boreal and subarctic Swedish rivers: Landscape control on land-sea fluxes*. --2004 ·**Limnol. Oceanogr.** ·vol:49 ·pages:1871-1883
27. **Humborg, C.** *Dissolved silicate dynamics in subarctic Swedish rivers: a comparison between an nearly pristine and a regulated river*. --2004 ·**Oceanis** ·vol:29 ·pages:123-138
28. **Humborg, C.**, Å. Danielsson, B. Sjöberg, Green, M. *Nutrient land-sea fluxes in oligotrophic and pristine estuaries of the Gulf of Bothnia, Baltic Sea*. --2003 ·**Estuar. Coast. Shelf Sci.** ·vol:56 ·pages:781-793
29. Witek, Z., **Humborg, C.**, Savchuck, O., Lysiak-Pastuszack, E., Grelowski, A. *Nitrogen and phosphorus budgets of the Gulf of Gdansk*. --2003 ·**Estuar. Coast. Shelf Sci.** ·vol:57 ·pages:239-248
30. Ittekkot, V., **Humborg, C.**, Rahm, L., TacAn, N. *Carbon Silicon Interactions*. In: **SCOPE 61: Interactions of Major Biogeochemical Cycles: Global Change and Human Impacts** (Melillo, J.M., Field C.B., Moldan B.) eds.) --2003 ·**Island Press**, Washington ·pages:311-322
31. Conley, D.J., **Humborg, C.**, Savchuk, O., Rahm, L., Wulff, F. *Hypoxia in the Baltic Sea and basin-scale changes in phosphorus biogeochemistry*. --2002 ·**Environ. Sci. Technol.** ·vol:36 ·pages:5315-5320

32. **Humborg, C.**, Blomqvist, S., Avsan, E., Bergensund, Y., Smedberg, E., Brink, J., Mörth, C.-M. *Hydrological alterations with river damming in northern Sweden: Implications for weathering and river biogeochemistry.* ..2002 **Global Biogeochem. Cycles** ·vol:16 ·pages:doi:10.1029/2000GB001369
33. **Humborg, C.** *Luleälven estuary: a well monitored subarctic estuary importing nitrogen from the Bothnian Bay.* ..2002 **LOICZ Reports & Studies** ·vol:23 ·pages:66-71
34. Ittekkot, V., **Humborg, C.**, Schäfer, P. *Hydrological alterations and marine biogeochemistry: A silicate issue?* ..2000 **BioScience** ·vol:50 ·pages:776-782
35. **Humborg, C.**, Fennel, K., Pastuszak, M., Fennel, W. *A box model approach for a long-term assessment of estuarine eutrophication, Szczecin Lagoon, southern Baltic.* ..2000 **J. Mar. Syst.** ·vol:25 ·pages:387-403
36. Ittekkot, V., Rahm, L., Swaney, D., **Humborg, C.** *The perturbed silicon cycle.* ..2000 **EOS** ·vol:81 ·pages:198-200
37. **Humborg, C.**, Conley, D.J., Rahm, L., Wulff, F., Cociasu, A., Ittekkot, V. *Silicon retention in river basins: Far-reaching effects on biogeochemistry and aquatic food webs in coastal marine environments.* ..2000 **Ambio** ·vol:29 ·pages:45-50
38. Schernewski, G., Dannowski, R., **Humborg, C.**, Mahlburg, S., Mueller, C., Pollehne, F., Steidl, J., Wallbaum, V. *Intergriertes Kuestenmanagement am Beispiel von Oder/Stettiner Haff: Erfahrungen und Perspektiven.* ..2000 **Bodden** ·vol:9 ·pages:73-85
39. **Humborg, C.**, Schernewski, G., von Bodungen, B., Dannowski, R., Steidl, J., Quast, J., Walbaum, V., Rudolph, K.-U., Mueller, C., Mahlburg, S., Erbguth *Oder Basin - Baltic Sea Interactions.* ..2000 **Meereswissenschaftliche Berichte, Warnemünde** ·vol:41 ·pages:84 pp.
40. **Humborg, C.**, Kölle, C. *Integrated Coastal Management from the perspective of nutrient control.* 1999 **J. Coast. Conserv.** ·vol:5 ·pages:135-144
41. **Humborg, C.**, Nausch, G., Neumann, T., Pollehne, F., Wasmund, N. *The Exceptional Oder Flood in Summer 1997 - The Fate of Nutrients and Particulate Organic Matter in the Baltic Sea.* ..1998 **German J. Hydrogr.** ·vol:50 ·pages:169-181
42. Capone, D.G., Subramaniam, A., Montoya, J.P., Voss, M., **Humborg, C.**, Johansen, A.M., Siefert, R.L., Carpenter, E.J. *An extensive bloom of the N-2-fixing cyanobacterium Trichodesmium erythraeum in the central Arabian Sea.* ..1998 **Mar. Ecol. Progr. Ser.** ·vol:172 ·pages:281-292
43. **Humborg, C.**, Ittekkot, V., Cociasu, A., von Bodungen, B. *Effect of Danube River dam on Black Sea biogeochemistry and ecosystem structure.* ..1997 **Nature** ·vol:386 ·pages:385-388

44. Geernaert, G., **Humborg, C.**, Jordao, L., Köhn, J., Langenberg, H., Meire, P., Otter, H.S., Rahm, L., Salomons, W., Vidal, M., Wallbaum, V. *System dynamics of the continuum river catchment to the coastal region.* ·1997 ·**European Marine and Polar Science Secretariat** ·pages:51-61
45. **Humborg, C.** *Primary productivity regime and nutrient removal in the Danube estuary.* 1997 ·**Estuar. Coast. Shelf Sci.** ·vol:45 ·pages:579-589
46. Cociasu, A., Dorogan, L., **Humborg, C.**, Popa, L. *Long-term ecological changes in Romanian coastal waters of the Black Sea.* ·1996 ·**Mar. Pollut. Bull.** ·vol:32 ·pages:32-38

Michael McLachlan

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Positions

- 1983 - 1984 Development Engineer, Fuel Controllers
Pratt & Whitney Canada, Montreal, Canada
- 1984 - 1985 Scholarship of the German Academic Exchange
Institute for Radiation and Environmental Research, Munich
Research into the fluid mechanics of blood flow
- 1991 - 1998 Head of Laboratory Research
Chair of Ecological Chemistry and Geochemistry
University of Bayreuth
- 1998 - 2003 Professor of Marine Chemistry
Baltic Sea Research Institute, University of Rostock, Germany
- 2003 - Professor of Analytical Organic Environmental Chemistry
Department of Applied Environmental Science, Stockholm University

Educational Qualifications

- 1977 - 1982 B.A.Sc. Mechanical Engineering, University of Waterloo, Canada
University scholarships, graduated 1st in class
- 1986 - 1987 M.A.Sc. Civil Engineering (Environmental), University of Toronto
NSERC Scholarship, University Scholarship
- 1987 - 1992 Ph.D. Ecological Chemistry, University of Bayreuth, FRG
NSERC Scholarship
- 1996 Habilitation in Ecological Chemistry, University of Bayreuth
- 1997 Privatdozent in Ecological Chemistry, University of Bayreuth

University Leadership Responsibilities

- 1998 - 2001 Acting Department Head, Dept. of Marine Chemistry
Baltic Sea Research Institute, University of Rostock
- 2001 - 2003 Deputy Department Head, Dept. of Marine Chemistry
Baltic Sea Research Institute, University of Rostock
- 2003 - Unit Head, Unit for Analytical Environmental Chemistry
Department of Applied Environmental Science, Stockholm University
- 2008 - Deputy Department Head
Department of Applied Environmental Science, Stockholm University

Main supervisor of 12 PhD graduates (PhD completion year in brackets):

University of Bayreuth: Michael Horstmann (1994), Martin Hippelein (1996), Heike Kaupp (1996), Andreas Moser (1998), Peter Kömp (1998), Jürgen Towara (1999), Kerstin Welsch-Pausch (1999)

University of Rostock: Kristina Thron (2003), Gertje Czub (2004), Stephanie Bopp (2004), Antje Gerofke (2005)

Stockholm University: Margaretha Adolfsson-Erici (2005)

Supervisor of 22 Diploma Thesis (Germany)

Postdoctoral collaborators (excluding guests, collaborators):

Michael Horstmann (1994-1996), Gunther Umlauf (1996), Kilian Petrick (1994-1996), Jörg Klasmeier (1996-1998), Gisela Dörr (1993-1997), Sönke Lakaschus (1998-1999), Regina Bruhn (1998-2002), Peter Kömp (1998-2003), Gesine Witt (1998-2003), Kilian Smith (2001-2004), Gertje Czub (2005-2009), Margot Reth (2006-2007)

Research interests: Environmental behaviour of organic pollutants in terrestrial and marine ecosystems, including fate, bioaccumulation, and risk assessment.

External funding: Principle investigator on over 20 research grants with a value in excess of 50 kEuro from the European Union (FAMIZ, NOMIRACLE, NORMAN, OSIRIS, PERFFOOD), The Swedish Research Council for Environment, Agricultural Science and Spatial Planning, the German Research Council (DFG), INTAS, CEFIC – European Chemical Industry Council, the Swedish Environment Protection Agency, the German Environmental Protection Agency, the German Federal Ministry of Research and Technology, Unilever.

Selected Publications – Michael McLachlan

1. Horstmann, Michael; McLachlan, Michael S. (1992): Initial Development of a Solid-Phase Fugacity Meter for Semivolatile Organic Compounds. *Environ. Sci. Technol.* 26, 1643-1648.
2. McLachlan, Michael S. (1993): Mass Balance of Polychlorinated Biphenyls and Other Organochlorine Compounds in a Lactating Cow. *J. Agric. Food Chem.* 41, 474-480.
3. McLachlan, Michael S. (1993): Digestive Tract Absorption of Polychlorinated Dibenzo-p-dioxins, Dibenzofurans, and Biphenyls in a Nursing Infant. *Toxicology and Applied Pharmacology* 123, 68-72.
4. Tolls, Johannes; McLachlan, Michael S. (1994): Partitioning of Semivolatile Organic Compounds between Air and *Lolium multiflorum* (Welsh Ray Grass). *Environ. Sci. Technol.* 28, 159-166.
5. Kaupp, H.; Towara, J.; McLachlan, M.S. (1994): Distribution of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans in Atmospheric Particulate Matter with Respect to Particle Size. *Atmos. Environ.* 28, 585-593.
6. Hauk, Heike; Umlauf, Gunther; McLachlan, Michael S. (1994): Uptake of Gaseous DDE in Spruce Needles. *Environ. Sci. Technol.* 28, 2372-2379.
7. McLachlan, Michael S. (1994): Model of the Fate of Hydrophobic Contaminants in Cows. *Environ. Sci. Technol.* 28, 2407-2414.
8. Welsch-Pausch, Kerstin; McLachlan, Michael S.; Umlauf, Gunther (1995): Determination of the Principal Pathways of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans to *Lolium multiflorum* (Welsh Ray Grass). *Environ. Sci. Technol.* 29, 1090-1098.
9. McLachlan, Michael S.; Welsch-Pausch, Kerstin; Tolls, Johannes (1995): A Field Validation of a Model of the Uptake of Gaseous SOC in *Lolium multiflorum* (Welsh Ray Grass). *Environ. Sci. Technol.* 29, 1998-2004.
10. McLachlan, Michael S. (1996): Bioaccumulation of Hydrophobic Chemicals in Agricultural Food Chains. *Environ. Sci. Technol.* 30, 252-259.
11. Kömp, Peter; McLachlan, Michael (1997): The Influence of Temperature on the Plant/Air Partitioning of Semivolatile Organic Compounds. *Environ. Sci. Technol.*, 31, 886-890.
12. Tarasova, E.N.; Mamontov, A.A.; Mamontov, A.E.; Klasmeier, J.; McLachlan, M.S. (1997): Polychlorinated Dibenzo-p-dioxins (PCDDs) and Dibenzofurans (PCDFs) in Baikal Seal. *Chemosphere*, 34, 2419-2427.

13. Kömp, Peter; McLachlan, Michael S. (1997): Interspecies Variability of the Plant/Air Partitioning of Polychlorinated Biphenyls. *Environ. Sci. Technol.* 31, 2944-2948.
14. Hippelein, Martin; McLachlan, Michael S. (1998): Soil/Air Partitioning of Semivolatile Organic Compounds. Part 1: Method Development and Influence of Physical-Chemical Properties. *Environ. Sci. Technol.* 32, 310-316.
15. McLachlan, Michael S.; Horstmann, Michael (1998): Forests as Filters of Airborne Organic Pollutants - A Model. *Environ. Sci. Technol.* 32, 413-420.
16. Horstmann, Michael; McLachlan, Michael S. (1998): Atmospheric Deposition of Semivolatile Organic Compounds to two Forest Canopies. *Atmos. Environ.* 32, 1799-1809.
17. Schlummer, Martin; Moser, G. Andreas; McLachlan, Michael S. (1998): Digestive Tract Absorption of PCDD/Fs, PCBs, and HCB in Humans: Mass Balances and Mechanistic Considerations. *Toxicology and Applied Pharmacology* 152, 128-137.
18. Kaupp, Heike; McLachlan, Michael S. (1999): Atmospheric Particle Size Distributions of Polychlorinated Dibenzo-p-dioxins and Dibenzofurans (PCDD/Fs) and Polycyclic Aromatic Hydrocarbons (PAHs) and their Implications for Wet and Dry Deposition. *Atmos. Environ.* 33, 85-95.
19. McLachlan, Michael S. (1999): A Framework for the Interpretation of Measurements of SOCs in Plants. *Environ. Sci. Technol.* 33, 1799-1804.
20. Böhme, Frieder; Welsch-Pausch, Kerstin; McLachlan, Michael S. (1999): Uptake of Airborne SOCs in Agricultural Plants: Field Measurements of Interspecies Variability. *Environ. Sci. Technol.* 33, 1805-1813.
21. Müller, Jochen F.; Haynes, David; McLachlan, Michael S.; Böhme, Frieder; Will, Stefan; Shaw, Glen R.; Mortimer, Munro; Sadler, Ross; Connell, Des W. (1999): PCDDs, PCDFs, PCBs and HCB in Marine and Estuarine Sediments from Queensland, Australia. *Chemosphere* 39, 1707-1721.
22. Geusau, Alexandra; Tschachler, Erwin; Meixner, Michael; Sandermann, Steffen; Pöpke, Olaf; Wolf, Christian; Valic, Eva; Stingl, Georg; McLachlan, Michael (1999): Olestra Increases Faecal Excretion of 2,3,7,8-Tetrachlorodibenzo-p-dioxin. *The Lancet* 354, 1266-1267.
23. Mamontov, Alexander A.; Mamontova, Elena A.; Tarasova, Evgenia N.; McLachlan, Michael S. (2000): Tracing the Sources of PCDD/Fs and PCBs to Lake Baikal. *Environ. Sci. Technol.* 34, 741-747.

24. Wania, Frank; McLachlan, Michael S. (2001): Estimating the Influence of Forests on the Overall Fate of Semivolatile Organic Compounds Using a Multimedia Fate Model. *Environ. Sci. Technol.* 35, 582-590.
25. McLachlan, M.S.; Haynes, D.; Müller, J.F. (2001): PCDDs in the Water/Sediment – Seagrass – Dugong (*Dugong dugon*) Food Chain on the Great Barrier Reef (Australia). *Environ. Pollut.* 113, 129-134.
26. Müller, Jochen F.; Manomanii, K.; Mortimer, Munro; McLachlan, Michael S. (2001): Partitioning of polycyclic aromatic hydrocarbons in the polyethylene/water system. *Fresenius' Journal of Analytical Chemistry* 371, 806-815.
27. Bruhn, Regina; McLachlan, Michael S. (2002): Seasonal Variation of Polychlorinated Biphenyl Concentrations in the Southern Baltic Sea. *Mar. Poll. Bull.* 44, 154-161.
28. Moser, G. Andreas; McLachlan, Michael S. (2002): Modeling Digestive Tract Absorption and Desorption of Lipophilic Organic Contaminants in Humans. *Environ. Sci. Technol.* 36, 3318-3325.
29. McLachlan, Michael S.; Czub, Gertje; Wania, Frank (2002): The Influence of Vertical Sorbed Phase Transport on the Fate of Organic Chemicals in Surface Soils. *Environ. Sci. Technol.* 36, 4860-4867.
30. Bruhn, Regina; Lakaschus, Soenke; McLachlan, Michael S. (2003): Air/Sea Gas Exchange of PCBs in the Southern Baltic Sea. *Atmos. Environ.* 37, 3445-3454.
31. Thron, Kristina U.; Bruhn, Regina; McLachlan, Michael S. (2004): The Influence of Age, Sex, Body-Condition, and Region on the Levels of PBDEs and Toxaphene in Harbour Porpoises from European Waters. *Fresenius Environmental Bulletin* 13, 146-155.
32. Wodarg, Dirk; Kömp, Peter; McLachlan, Michael S. (2004): A Baseline Study of Polychlorinated Biphenyl (PCB) and Hexachlorobenzene Contamination in the Western Baltic Sea and the Baltic Proper. *Marine Chemistry* 87, 23-36.
33. Czub, Gertje; McLachlan, Michael S. (2004): Bioaccumulation Potential of Persistent Organic Chemicals in Humans. *Environ. Sci. Technol.* 38, 2406-2412.
34. Gerofke, Antje; Kömp, Peter; McLachlan, Michael S. (2004): Stir Bar Contamination: A Method to Establish and Maintain Constant Water Concentrations of Poorly Water-Soluble Chemicals in Bioconcentration Experiments. *Water Research* 38, 3411-3419.
35. Kelly, Barry C.; Gobas, Frank A.P.C.; McLachlan, Michael S. (2004): Intestinal Absorption and Biomagnification of Organic Contaminants in Fish, Wildlife, and Humans. *Environ. Toxicol. Chem.* 23, 2324-2336.

36. Czub, Gertje; McLachlan, Michael S. (2004): A Food Chain Model to Predict the Levels of Lipophilic Organic Contaminants in Humans. *Environ. Toxicol. Chem.* 23, 2356-2366.
37. Gustafsson, Ö.; Andersson, P.; Axelman, J.; Bucheli, T.D.; Kömp, P.; McLachlan, M.S.; Sobek, A.; Thörngren, J.-O. (2005): Observations of the PCB Distribution within and in-between Ice, Snow, Ice-Rafted Debris, Ice-Interstitial Water, and Seawater in the Barents Sea Marginal Ice Zone and the North Pole Area. *Sci. Total Environ.* 342, 261-279.
38. Beineke, Andreas; Siebert, Ursula; McLachlan, Michael; Bruhn, Regina; Thron, Kristina; Failing, Klaus; Müller, Gundi; Baumgärtner, Wolfgang (2005): Investigation of the Potential Influence of Environmental Contaminants on the Thymus and Spleen of Harbor Porpoises (*Phocoena phocoena*). *Environ. Sci. Technol.* 39, 3933-3938.
39. Gerofke, Antje; Kömp, Peter; McLachlan, Michael S. (2005): Bioconcentration of Persistent Organic Pollutants in Four Species of Marine Phytoplankton. *Environ. Toxicol. Chem.* 24, 2908-2917.
40. Wania, Frank; Breivik, Knut; Persson, Johan; McLachlan, Michael S. (2006): CoZMo-POP2 - a Fugacity-Based Dynamic Multi-Compartmental Mass Balance Model of the Fate of Persistent Organic Pollutants. *Environment Modelling and Software* 21, 868-884.
41. Smith, Kilian E.C.; McLachlan, Michael S. (2006): Concentrations and Partitioning of PCBs in the Surface Waters of the Southern Baltic Sea – Seasonal Effects. *Environ. Toxicol. Chem.* 25, 2569-2575.
42. Czub, Gertje; McLachlan, Michael S. (2007): Influence of the temperature gradient in blubber on the bioaccumulation of persistent, lipophilic organic chemicals in seals. *Environ. Toxicol. Chem.* 26, 1600-1605.
43. Bopp, Stephanie K.; McLachlan, Michael S.; Schirmer, Kristin (2007): Passive sampler for combined chemical and toxicological long-term monitoring of groundwater: the Ceramic Toximeter. *Environ. Sci. Technol.* 41, 6868-6876.
44. McLachlan, Michael S.; Holmström, Katrin E.; Reth, Margot; Berger, Urs (2007): Riverine discharge of perfluorinated carboxylates from the European continent. *Environ. Sci. Technol.* 41, 7260-7265.
45. Ossiander, Lia; Reichenberg, Fredrik; McLachlan, Michael S.; Mayer, Philipp (2008): Immersed solid phase micro extraction to measure chemical activity of lipophilic organic contaminants in fatty tissue samples. *Chemosphere* 71, 1502-1510.

46. Czub, Gertje; Wania, Frank; McLachlan, Michael S. (2008): Combining long range transport and bioaccumulation considerations to identify potential Arctic contaminants. *Environ. Sci. Technol.* 42, 3704-3709.
47. Ricklund, Niklas; Kierkegaard, Amelie; McLachlan, Michael S. (2008): An international survey of decabromodiphenyl ethane (deBDethane) and decabromodiphenyl ether (decaBDE) in sewage sludge samples. *Chemosphere* 73, 1799-1804.
48. Jahnke, Annika; McLachlan, Michael S., Mayer, Philipp (2008): Equilibrium sampling: Partitioning of polychlorinated biphenyls (PCBs) and selected organochlorine pesticides (OCPs) from lipids into polydimethylsiloxane (PDMS). *Chemosphere* 73, 1575-1581.
49. Sellström, Ulla; Egebäck, Anna-Lena; McLachlan, Michael S. (2009): Identifying source regions for the atmospheric input of PCDD/Fs to the Baltic Sea. *Atmos. Environ.* (in press).
50. Armitage, James; McLachlan, Michael S.; Wiberg, Karin; Jonsson, Per (2009): A model assessment of dibenzo-p-dioxin and dibenzofuran sources and fate in the Baltic Sea. *Sci. Total Environ.* (in press).

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Positions:

1986-1989: Teaching assistant, Institute of Fundamental and Applied Nuclear Physics, University of Kiel

1989: Scientific employee, Institute of Fundamental and Applied Nuclear Physics, University of Kiel

1991-1996: Ph.D. student, Department of Theoretical Oceanography, Institute of Marine Research, Kiel

1996-1997: Postdoctoral fellow, Department of Theoretical Oceanography, Institute of Marine Research, Kiel

1997: Lecturer, University of Kiel

1997-2006: Senior scientist, Rossby Centre, SMHI since July 2006: Head of the Division of Oceanography, Research Department, SMHI (scientifically and economically responsible for 11

senior scientists comprising six postdoctoral researchers, one docent and one adjunct professor) since August 2006: 20% teaching and supervising as adjoint lecturer (adjungerad lector in meteorologi and oceanography), Depart. of Meteorology, SU (today main supervisor of one PhD student and one master thesis student)

Selected special assignments:

Member of two ocean modelling evaluation assessments, SMHI, 2000-2001

External expert and advisor of the EU funded Centre of Excellence for Baltic

Development, Education and Research (BALTDER), Institute of Oceanology, University of Gdansk, Gdynia, Poland, 2002-2005

Member of the writing team of chapter 2 (Past and current climate change, detection and attribution) and chapter 3 (Projections of future climate change) of the BALTEX Assessment of Climate Change for the Baltic Sea Basin (BACC), 2005

Chairman of the BALTEX Working Group on “Utility of Regional Climate Models” (http://www.baltex-research.eu/organisation/bwg_rcm.html), 2007-2010

Coordinator of the international BONUS+ project “ECOSUPPORT” with 11 involved partner institutes, about 1,6 mio Euro, 2009-2011

Coordinator of 6 international workshops, convener of 4 sessions at international conferences, scientific committee member of 4 international conferences, workpackage leader in 5 large international projects

Academic Degrees and honorary titles:

- Diploma in Physics (Experimental, Theoretical and Applied Physics, Astronomy, thesis at the Institute of Fundamental and Applied Nuclear Physics: “Nonlineare, plane plasma waves in Pulsar magnetospheres – an approach to take radiation reaction into account”), University of Kiel, Germany, September 1989
- Doctor of natural science (Physical Oceanography, Physics and Theoretical Physics, thesis at the Department of Theoretical Oceanography: “A regional model of the western Baltic Sea with open boundary conditions and data assimilation”), Institute of Marine Research, University of Kiel, July 1996
- Docent (associate professor) in phys. oceanography, Univ. of Göteborg, Jan. 2005

Teaching and supervising: Exercises for undergraduate students, Kiel University, 1986-1989, 1997; Lectures for undergraduate and graduate students, SU, since 2005; supervisor of 5 honours/master thesis students

Served as a referee, often repeatedly, for: *Science, Geophysical Research Letters, Journal of Geophysical Research – Oceans, Tellus, Climate Dynamics, Continental Shelf Research, Monthly Weather Review, International Journal of Climatology, Ocean Sciences, Journal of Marine Research, Journal of Marine Systems, Boreal Environmental Research, Ocean Dynamics, Climate Research, Journal of Sea Research, Ambio, Nordic Hydrology, Estuarine, coastal and shelf science, Oceanologia, Geophysica, Marine Ecology Progress Series, Global and Planetary Change, International Review of Hydrobiology, International Journal of Earth Sciences, Environmental Modeling and Assessment, Climate of the Past, Ocean Engineering, History of Oceanography Yearbook, Climate report for the Hamburg region, Germany*

Served as an external grant evaluator for: *Natural Sciences and Engineering Research Council of Canada (NSERC), Helmholtz Association of National Research Centres, Germany, The Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (FORMAS), The Netherlands Organisation for Scientific Research (NWO, the Dutch Research Council), Estonian Science Foundation, Intergovernmental Panel on Climate Change (IPCC),*

Canadian Foundation for Climate and Atmospheric Sciences (CFCAS), University of Alaska Coastal Marine Institute (CMI)

External funding: Has received about 49 MSEK in external funding since 2002:
INTERREG IIB program, SEAREG, 2002-2005, Co-PI for SMHI and the sub-contractor INREGIA AB Stockholm, 475 000 Euro
Swedish National infrastructure for computing (SNIC), PI, large computational resources from SWEGRID, 2004-2007
Swedish Research Council (VR), PI, 2007-2009, 1 822 500 SEK
Swedish Gov. Agency for Innov. Syst. (Vinnova), Subcontractor, 2007-2009, 1,5 MSEK
Swedish Research Council for Environment, Agricultural Sciences and Spatial Planning (Formas), PI, 2007-2008, 1 659 450 SEK
Knut and Alice Wallenberg foundation and SNIC, Co-PI, 2008-2011, 25.4 MSEK totally for the climate computing resource Ekman/Vagn
Baltic Sea 2020 foundation, Co-PI, 2007, 420 000 SEK
Nordic Council of Ministers, Co-PI, 2007, 77 000 SEK
NordForsk, Co-PI, 2008-2010, 900 000 NOK for the whole network
BONUS Era-Net program, 4 projects (ECOSUPPORT, AMBER, INFLOW, BalticWay), PI and 3 x Co-PI, 2009-2011, 9 678 296 SEK
EU/FP7, SAFEWIN, 2009-2012, 409 000 Euro (under negotiation) and other projects

Publications HEM Meier

Ph.D. Thesis

Meier, H.E.M., 1996: A regional model of the western Baltic Sea with open boundary conditions and data assimilation (in German). PhD thesis, University of Kiel, in: Ber. Inst. f. Meereskunde No.284, D-24105 Kiel, Germany, 117 pp.

Articles in international scientific journals with referee practice

1. Haapala, J., **H.E.M. Meier**, and J. Rinne, 2001: Numerical investigations of future ice conditions in the Baltic Sea. *Ambio*, 30, 237-244.
2. **Meier, H.E.M.**, 2001: On the parameterization of mixing in three-dimensional Baltic Sea models. *J. Geophys. Res.*, 106, 30,997 - 31,016.
3. Döscher, R., U. Willén, C. Jones, A. Rutgersson, **H.E.M. Meier**, U. Hansson, and L.P. Graham, 2002: The development of the regional coupled oceanatmosphere model RCAO. *Boreal Env. Res.*, 7, 183-192.
4. **Meier, H.E.M.**, 2002: Regional ocean climate simulations with a 3D ice ocean model for the Baltic Sea. Part 1: Model experiments and results for temperature and salinity. *Clim. Dyn.*, 19, 237-253.
5. **Meier, H.E.M.**, 2002: Regional ocean climate simulations with a 3D iceocean model for the Baltic Sea. Part 2: Results for sea ice. *Clim. Dyn.*, 19, 255-266.
6. **Meier, H.E.M.**, and R. Döscher, 2002: Simulated water and heat cycles of the Baltic Sea using a 3D coupled atmosphere-ice-ocean model. *Boreal Env. Res.*, 7, 327-334
7. **Meier, H.E.M.**, and T. Faxén, 2002: Performance analysis of a multiprocessor coupled ice ocean model for the Baltic Sea. *J. Atmos. Oceanic Technol.*, 19, 114-124.
8. Kauker, F., and **H.E.M. Meier**, 2003: Modeling decadal variability of the Baltic Sea: 1. Reconstructing atmospheric surface data for the period 1902-1998. *J. Geophys. Res.*, 108(C8), 3267, doi:10.1029/ 2003JC001797.
9. **Meier, H.E.M.**, and F. Kauker, 2003: Modeling decadal variability of the Baltic Sea: 2. Role of freshwater inflow and large-scale atmospheric circulation for salinity. *J. Geophys. Res.*, 108(C11), 3368, doi:10.1029/2003JC001799.
10. **Meier, H.E.M.**, and F. Kauker, 2003: Sensitivity of the Baltic Sea salinity to the freshwater supply. *Clim. Res.*, 24, 231-242.

11. **Meier, H.E.M.**, R. Döscher, and T. Faxén, 2003: A multiprocessor coupled ice-ocean model for the Baltic Sea: Application to salt inflow. *J. Geophys. Res.*, 108(C8), 3273, doi:10.1029/2000JC000521.
12. Wang, J., R. Kwok, F.J. Saucier, J. Hutchings, M. Ikeda, W. Hibler III, J. Haapala, M.D. Coon, **H.E.M. Meier**, H. Eicken, N. Tanaka, D. Prentki, and W. Johnson, 2003: Working toward improved small-scale sea ice-ocean modeling in the Arctic seas. *EOS, Trans. AGU*, 84(34), 325, 329-330.
13. Räisänen, J., U. Hansson, A. Ullerstig, R. Döscher, L.P. Graham, C. Jones, **H.E.M. Meier**, P. Samuelsson, and U. Willén, 2004: European climate in the late twenty-first century: regional simulations with two driving global models and two forcing scenarios. *Clim. Dyn.*, 22, 13-31.
14. Döös, K., **H.E.M. Meier**, and R. Döscher, 2004: The Baltic haline conveyor belt or the overturning circulation and mixing in the Baltic. *Ambio*, 33, 261-266.
15. Döscher, R., and **H.E.M. Meier**, 2004: Simulated sea surface temperature and heat fluxes in different climates of the Baltic Sea. *Ambio*, 33, 242-248.
16. **Meier, H.E.M.**, R. Döscher, and A. Halkka, 2004: Simulated distributions of Baltic sea-ice in warming climate and consequences for the winter habitat of the Baltic ringed seal. *Ambio*, 33, 249-256.
17. **Meier, H.E.M.**, B. Broman, and E. Kjellström, 2004: Simulated sea level in past and future climates of the Baltic Sea. *Clim. Res.*, 27, 59-75.
18. **Meier, H.E.M.**, R. Döscher, B. Broman, and J. Piechura, 2004: The major Baltic inflow in January 2003 and preconditioning by smaller inflows in summer/autumn 2002: a model study. *Oceanologia*, 46, 557-579.
19. **Meier, H.E.M.**, 2005: Modeling the age of Baltic Sea water masses: Quantification and steady state sensitivity experiments. *J. Geophys. Res.*, 110, C02006, doi:10.1029/2004JC002607.
20. Kjellström, E., R. Döscher, and **Meier, H.E.M.**, 2005: Atmospheric response to different sea surface temperatures in the Baltic Sea: Coupled versus uncoupled regional climate model experiments. *Nordic Hydrology*, 36 (4-5), 397-409.
21. **Meier, H.E.M.**, B. Broman, H. Kallio, and E. Kjellström, 2006: Projections of future surface winds, sea levels, and wind waves in the late 21st century and their application for impact studies of flood prone areas in the Baltic Sea region. In: Schmidt-Thomé, P. (ed.), *Sea level changes affecting the spatial development of the Baltic Sea region*, Geological Survey of Finland, Special Paper 41, Espoo, 23-43.
22. **Meier, H.E.M.**, 2006: Baltic Sea climate in the late twenty-first century: a dynamical downscaling approach using two global models and two emission scenarios. *Clim. Dyn.*, 27(1), 39-68, doi: 10.1007 / s00382-006-0124-x.

23. **Meier, H.E.M.**, R. Feistel, J. Piechura, L. Arneborg, H. Burchard, V. Fiekas, N. Golenko, N. Kuzmina, V. Mohrholz, C. Nohr, V.T. Paka, J. Sellschopp, A. Stips, and V. Zhurbas, 2006: Ventilation of the Baltic Sea deep water: A brief review of present knowledge from observations and models. *Oceanologia*, 48(S), 133-164.
24. **Meier, H.E.M.**, E. Kjellström, and L.P. Graham, 2006: Estimating uncertainties of projected Baltic Sea salinity in the late 21st century. *Geophys. Res. Lett.*, Vol. 33, No. 15, L15705, doi: 10.1029/2006GL026488.
25. **Meier, H.E.M.**, 2007: Modeling the pathways and ages of inflowing salt- and freshwater in the Baltic Sea. *Estuarine, Coastal and Shelf Science*, Vol. 74/4, 717-734.
26. Burchard, H., P. D. Craig, J. R. Gemmrich, H. van Haren, P.-P. Mathieu, **H. E. M. Meier**, W. A. M. N. Smith, H. Prandke, T. P. Rippeth, E. D. Skyllingstad, W. D. Smyth, D. J. S. Welsh, and H. W. Wijesekera, 2007: Observational and numerical modeling methods for quantifying coastal ocean turbulence and mixing. *Prog. Oceanogr.*, 76, 399-442.
27. Eilola, K., **H.E.M. Meier**, and E. Almroth, 2009: Modelling phosphorus biogeochemistry in the Baltic Sea. *J. Marine Systems.*, 75, 163-184.
28. Conley, D. J., S. Björk, E. Bonsdorff, J. Carstensen, G. Destouni, B. G. Gustafsson, S. Hietanen, M. Kortekaas, H. Kuosa, **H. E. M. Meier**, B. Müller-Karulis, K. Nordberg, G. Nürnberg, A. Norkko, H. Pitkänen, N. Rabalais, R. Rosenberg, O. Savchuk, C. P. Slomp, M. Voss, F. Wulff, and L. Zillén, 2009: Critical Review: Hypoxia in the Baltic Sea. *Environmental Science and Technology*, in press.
29. Döscher, R., K. Wyser, **H. E. M. Meier**, and M. Qian, 2009: Climate predictability of the Arctic in a regional coupled ocean-ice-atmosphere model. *Clim. Dyn.*, submitted.
30. Hordoir, R., and **H. E. M. Meier**, 2009: Freshwater fluxes in the Baltic Sea - a model study. *J. Geophys. Res.*, submitted.
31. **Meier, H.E.M.**, K. Eilola, and E. Almroth, 2009: Climate-related changes in marine ecosystems simulated with a three-dimensional coupled biogeochemical-physical model of the Baltic Sea. Submitted.

Monographs (Scientific reports)

1. **Meier, H.E.M.**, 1999: First results of multi-year simulations using a 3D Baltic Sea model. Reports Oceanography No. 27, SMHI, Norrköping, Sweden, 48 pp.
2. **Meier, H.E.M.**, R. Döscher, A.C. Coward, J. Nycander and K. Döös, 1999: RCO - Rossby Centre regional Ocean climate model: model description (version 1.0) and first results from the hindcast period 1992/93. Reports Oceanography No. 26, SMHI, Norrköping, Sweden, 102 pp.

3. **Meier, H.E.M.**, 2000: The use of the $k - \epsilon$ turbulence model within the Rossby Centre regional ocean climate model: parameterization development and results. Reports Oceanography No. 28, SMHI, Norrköping, Sweden, 81 pp.
4. **Meier, H.E.M.**, 2001: The first Rossby Centre regional climate scenario for the Baltic Sea using a 3D coupled ice-ocean model. Reports Meteorology and Climatology No. 95, SMHI, Norrköping, Sweden, 63 pp.
5. Kauker, F., and **H.E.M. Meier**, 2002: Reconstructing atmospheric surface data for the period 1902-1998 to force a coupled ocean-sea ice model of the Baltic Sea. Reports Meteorology and Climatology No. 99, SMHI, Norrköping, Sweden, 30 pp.
6. **Meier, H.E.M.** and F. Kauker, 2002: Simulating Baltic Sea climate for the period 1902-1998 with the Rossby Centre coupled ice-ocean model. Reports Oceanography No. 30, SMHI, Norrköping, Sweden, 111 pp.
7. Räisänen, J., U. Hansson, A. Ullerstig, R. Döscher, L.P. Graham, C. Jones, **M. Meier**, P. Samuelsson and U. Willén, 2003: GCM driven simulations of recent and future climate with the Rossby Centre coupled atmosphere - Baltic Sea regional climate model RCAO. Reports Meteorology and Climatology No. 101, SMHI, Norrköping, Sweden, 61 pp.
8. **Meier, H.E.M.**, J. Andréasson, B. Broman, L.P. Graham, E. Kjellström, G. Persson, and M. Viehhauser, 2006: Climate change scenario simulations of wind, sea level, and river discharge in the Baltic Sea and Lake Mälaren region - a dynamical downscaling approach from global to local scales. Reports Meteorology and Climatology No. 109, SMHI, Norrköping, Sweden, 52 pp.
9. Gustafsson, B.G., **H.E.M. Meier**, O.P. Savchuk, K. Eilola, L. Axell, and E. Almroth: Simulation of some engineering measures aiming at reducing effects from eutrophication of the Baltic Sea. Earth Sciences Report Series, Göteborg University, Sweden, Report Series C82, Earth Sciences Centre, Göteborg University, Sweden, 59 pp.
10. Eilola, K., **H.E.M. Meier**, E. Almroth, and A. Höglund, 2008: Transports and budgets of oxygen and phosphorus in the Baltic Sea. Rapport Oceanografi No. 96, SMHI, Norrköping, Sweden, 39 pp.
11. Höglund, A., **H.E. M. Meier**, B. Broman and E. Kriezi, 2009: Validation and correction of regionalised ERA-40 wind fields over the Baltic Sea using the Rossby Centre Atmosphere model RCA3.0. Rapport Oceanografi, SMHI, Norrköping, Sweden, 29 pp.

Book chapters

1. **Meier, H.E.M.**, 2005: The doubly stratified regime: turbulence closures for an OGCM of the Baltic Sea. In: H.Z. Baumert, J. Simpson, and J. Sündermann (eds.), Marine Turbulence: Theories, Observations, and Models. Results of the CARTUM Project., chapter 47, Cambridge University Press, Cambridge, 376-382

2. Rippeth, T. and **H.E.M. Meier**, 2005: The four shelf-sea regimes. In: H. Baumert, J. Simpson, and J. Sündermann (eds.), *Marine Turbulence: Theories, Observations, and Models. Results of the CARTUM Project.*, chapter 46, Cambridge University Press, Cambridge, 369-375

3. Heino, R., H. Tuomenvirta, V.S. Vuglinsky, B.G. Gustafsson, H. Alexandersson, L. Bärring, A. Briede, J. Cappelen, D. Chen, M. Falarz, M. Falarz, E. Førland, J. Haapala, J. Jaagus, L. Kitaev, A. Kont, E. Kuusisto, G. Lindström, **H.E.M. Meier**, M. Mietus, A. Moberg, K. Myrberg, T. Niedzwiedz, Ø. Nordli, A. Omstedt, K. Orviku, Z. Pruszek, E. Rimkus, V. Russak, C. Schrum, Ü. Suursaar, T. Vihma, R. Weisse, and J. Wibig, 2008: Past and current climate change. In: *BALTEX Assessment of climate change (BACC)*, chap. 2, pp. 35--131, Springer Verlag, Berlin, Heidelberg.

4. Graham, L.P., D. Chen, O.B. Christensen, E. Kjellström, V. Krysanova, **H.E.M. Meier**, M. Radziejewski, J. Räisänen, B. Rockel, and K. Ruosteenoja, 2006: Projections of future climate change. In: *BALTEX Assessment of climate change (BACC)*, chap. 3, pp. 133-219., Springer Verlag, Berlin, Heidelberg.

5. **Meier, H.E.M.**, and A. Andersson, 2009: Hur påverkas haven runt Sveriges kust av klimatförändringar? (How does climate change affect the seas around the Swedish coasts?) In: *Formas fokuserar: Sverige i nytt klimat*, Ed.: B. Johansson. Forskningsrådet Formas, Stockholm, Sweden, in press.

About 74 other scientific publications (Newsletter articles, conference proceedings, extended abstracts, etc.)

Institute of Coastal Research, Swedish Board of Fisheries. Öregrund 2009-03-08

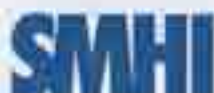
The Swedish Board of Fisheries (SBF) is the government authority responsible for the conservation and exploitation of Sweden's fish resources. On commission of the government SBF shall work for prosperous and varied fish populations, ecological and sustainable management of the fish resources, fisheries and aquaculture. SBF shall inform the government of state and development of the fish resources, as well as promote and conduct research and development in relation to fish and fisheries. Institute of Coastal Research (ICR) is one out of SBF's three research institutes. It is situated at the Baltic coast in Öregrund, 150 km NE Stockholm, with two field stations in southern Sweden, one in Oskarshamn, and one in Väröbacka. The staff consists of 40 employees, of which 12 are scientists with PhD exam, one appointed as guest professor at Stockholm university. In 2009 three additional post docs focussing on ecological modelling will be appointed to the institute. ICR collaborate with several Swedish and European universities and fisheries institutes, and the scientists participate in the ICES (International Council for the Exploration of the Sea) working groups and in HELCOM.

The research of SBF is divided in six programmes of which ICR have the main responsibility for the Baltic Sea programme and participate in several of the others. The research of ICR is funded by the government, by national and international research councils and the EU, and to a smaller extent also by the industry.

The main tasks of SBF's research institutes are data collection, fish monitoring and fish stock assessments. At ICR, coastal fish are monitored and sampled at a regular basis along the Baltic coast and in Kattegat/Skagerrack. Together with Institute of Marine Research, monitoring of pelagic and demersal fish species is performed in Gulf of Bothnia and Baltic Proper. In addition, the institute perform inventories of fish at open sea fishing grounds and in other areas. Data are used for analytical assessments in ICES working groups and for assessments of coastal fish species at a national level as well as for specific research projects. Data are also used for developing alternative assessment models and state indicators for fish species that are not assessed internationally. On commission from the Swedish EPA, SBF is host for fish data from national and regional monitoring programmes.

The research of ICR is focused on implementing the ecosystem approach in the commercial and recreational fisheries management. The newly launched project "Ecosystem based management of planktivorous fish" (PLAN FISH) has the main goal to reinstate the large predatory fish in the Baltic Sea. By use of structured food web modelling together with field and laboratory experiments, an ecosystem based approach to fishery management are being developed. With similar objectives research on habitat restoration in the coastal zone are conducted. Other major research topics are the effects of no-fishing areas and zonation of fishing activities, a research based on spatial modelling of fish populations using GIS. ICR participates in a variety of international research projects such as a Marie Curie project on evolutionary effects of fishing and two new BONUS+ projects of which one focuses on spatial fish modelling, and the other on ecotoxicogenomics. The institute is also involved in the ICES/HELCOM project on integrated assessment of the Baltic Sea ecosystem. A significant part of the research is focussed on developing environmental friendly fishing gears in order to monitor and to reduce by-catch of mammals and birds and to minimize the conflict between fishers and mammals.

2009-03-16



Our ref: 2009/480/140

Stockholms universitet

106 91 STOCKHOLM

Letter of support for Stockholm University application for strategic Marine Environmental Research 2009

SMHI's mission is to manage and develop information on weather, water and climate that provides knowledge and supports advanced decision-making for public services, the private sector and the general public. SMHI aims at contributing to increased social benefit, safety and a sustainable society.

In support of the different services of SMHI the Research Department conducts applied and basic research into weather, water, climate and environmental issues. The research department currently has a staff of about 70 researchers divided into six research groups. National and international research collaboration is extensive and external funding amounts to more than half of the total budget.

Environment, energy and climate are three main strategic areas for future development of SMHI services. In the marine sector SMHI focuses on a strengthened role as a provider of data and decision support regarding the environment and climate of the Baltic Sea.

The research in the field of oceanography covers a range of topics including short- and medium range ice-ocean forecasts in the Baltic Sea, North Sea and Arctic Ocean, short-range wave forecasts, seasonal forecasts, data assimilation, process studies, climate modelling and climate analysis (detection and attribution), coupled physical-biogeochemical modelling and marine remote sensing.

SMHI supports the application of Stockholm University for strategic research funds in the marine sector. In particular we see links between our research and the proposed research on the development of a true ecosystem approach to Baltic Sea management under anthropogenic stress including the development of decision support based on advanced models of the regional Earth System of the Baltic Sea basin including climate, nutrient and biological interactions.

Yours sincerely,

Torbjörn Kvick

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Dnr

Name of Applicant

Bremer, Kåre

Date of birth

480117-1192

Registration date

2009-03-16

Announced grants

Marine environment

Title of research programme

Ecosystem Approach to the Baltic Sea

Appendix S (Signatures)

A signature on the application is required not only from the applicant but also from the authorised representative of the host university/institution or equivalent (normally the head of the department or establishment where the research is to be conducted). The signature confirms that the department can accommodate the project (or equipment or network); that the costing in the application is approved for the department's part, and that any proposed experimentation on human or animal subjects has been reported, and that the applicant has reported any secondary occupations and commercial ties (s)he may have, and nothing inconsistent with good research practice has thereby emerged. The applicant must have discussed these conditions with the representative of the host university/institution or equivalent before the latter approves and signs the application.

Main applicant

Date

Head of department/corresponding

Clarification of signature

Phone