



Gulf of Finland Trilateral Co-operation Scientific Forum

17 – 18 November 2015
Tallinn

Programme and Abstract Book



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Gulf of Finland Trilateral Co-operation Scientific Forum, 17-18 November
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FORUM PROGRAMME

Venue: Hotel Euroopa, Paadi 5, Tallinn, Estonia

17 November 2015

Time	TITLE	Authors
Plenary session I – Hall: Lääne-Euroopa		
9:00	OPENING OF THE FORUM	Minister of the Environment, Estonia Marko Pomerants GOF2014 project co-ordinator Kai Myrberg
9:20	POPULATION STATUS AND HABITAT USE OF THE RINGED SEAL IN THE GULF OF FINLAND	Mart Jüssi*, Markus Ahola, Vyacheslav Alexeev, Elena Andrievskaya, Tero Härkönen, Ivar Jüssi, Martin Silts, Irina Trukhanova, Mikhail Verevkin
9:40	ASSESSMENT OF GEOLOGICAL ENVIRONMENT OF THE EASTERN GULF OF FINLAND BY RESULTS GEOECOLOGICAL MONITORING	A.Rybalko*, O.Korneev, N.Fedorova, N.Berezina, Z.Zhakovskaja
10:00	A LONG TERM EVOLUTION OF HARMFUL SUBSTANCES INPUT INTO THE GULF OF FINLAND	Aarno T. Kotilainen*, Outi Hyttinen, Daria Ryabchuk, Henry Vallius, Joonas J. Virtasalo, Natalia Deryugina , Andrey

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Grigoriev, Vladimir
Zhamoida

10:20 PELAGIC FISH STOCKS IN THE GULF OF FINLAND - LIFE ON THE EDGE OF THE SEA Heikki Peltonen*, Tiit Raid and Jukka Pönni

10:40-11:10 Coffee break

11:10 NUTRIENT LOADING INTO THE GULF OF FINLAND: TRENDS AND WATER PROTECTION TARGETS Seppo Knuuttila*, Petri Ekholm, Sergey Kondratyev, Antti Räike

11:30 LINKING DIVERSITY OF SHALLOW WATER BENTHIC INVERTEBRATE COMMUNITIES TO ENVIRONMENTAL GRADIENTS IN THE GULF OF FINLAND Jonne Kotta, Samuli Korpinen, Markku Viitasalo*

11:50 THE GULF OF FINLAND UNDERWATER SOUNDSCAPE ASSESSMENT Pajala, Jukka*, Klauson, Aleksander, Laanearu, Janek, Mustonen, Mirko, Peltonen, Heikki

12:10 AN ESTIMATION OF THE PHARMACEUTICALS RELEASE INTO THE GULF OF FINLAND (2011-2013) Ekaterina N. Chernova, Iana V. Russkikh, Zoya A. Zhakovskaya*, Vladimir A. Nikiforov, Niina Vieno

12:30-13:30 Lunch

Parallel session: Eutrophication – Hall: Põhja-Euroopa

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| 13:30 | NUTRIENT LOAD FROM THE RUSSIAN TERRITORY TO THE GULF OF FINLAND | Sergey Kondratyev*,
Petri Ekholm, Alexandra Ershova, Natalia Victorova |
| 13:45 | INPUT OF NUTRIENTS TO THE GULF OF FINLAND FROM RUSSIAN AND TRANSBOUNDARY RIVERS | Grigory Frumin |
| 14:00 | TROPHIC CHANGES IN THE COAST-OFFSHORE GRADIENT IN THE FINNISH COAST OF THE GULF OF FINLAND | Pirkko Kauppila* and
Mika Raateoja |
| 14:15 | INTERNAL DYNAMICS AND EXTERNAL LOADING AFFECT NUTRIENT STATUS IN THE GULF OF FINLAND | Jouni Lehtoranta*, Kim Dahlbo, Mika Raateoja, Pirkko Kauppila, Oleg Savchuk, Harri Kuosa, Antti Räike, Heikki Pitkänen |
| 14:30 | LONG TERM INVESTIGATION OF EUTROPHICATION PROCESS OF THE NEVA ESTUARY: DRIVING FORCES AND FUTURE PROGNOSIS | Mikhail Golubkov*,
Sergei Golubkov |
| 14:45 | ORIGIN AND CYCLING OF ORGANIC CARBON IN THE NEVA ESTUARY | Sergei Golubkov*,
Alexey Tiunov, Mikhail Golubkov |

Parallel session: Pollution and ecosystem health – Hall: Ida-Euroopa

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| 13:30 | APPLICATION OF NEW BIOMARKERS FOR ASSESSMENT ENVIRONMENTAL STATE IN THE NEVA ESTUARY | Nadezhda, Berezina, Andrey, Sharov*, Vasiliy, Lyubimtsev |
| 13:45 | ENZYMATIC ACTIVITIES AND PROKARYOTIC ABUNDANCE IN THE EASTERN GULF OF FINLAND SEDIMENT ENVIRONMENT | Yulia Polyak*, Tatyana Shigaeva, Ludmila Bakina, Valentina Kudryavtseva, Yulia Gubelit |
| 14:00 | POLLUTANTS IN FISH IN THE GULF OF FINLAND | Simm, Mart*, Järv, Leili, Kiviranta, Hannu, Kotta, Jonne, Roots, Ott, Ruokojärvi, Päivi |
| 14:15 | ORGANOHALOGEN CONCENTRATIONS IN FISH IN THE GULF OF FINLAND | Pekka J. Vuorinen*, Ott Roots, Marja Keinänen |
| 14:30 | DEVELOPMENT OF STUDIES IN THE ASSESSMENT OF BIOLOGICAL EFFECTS OF POLLUTION IN THE GULF OF FINLAND | Sergey Kholodkevich*, Tatiana Kuznetsova, Urmas Lips, Natalja Kolesova, Kari K. Lehtonen, Andrey Sharov, Anton Kurakin |
| 14:45 | TOXICITY ASSESSMENT OF EASTEN PART OF GUL OF FINLAND BY THE RESULTS OF BIOASSAY AND PATHOLOGICAL STUDY OF FISH | Lyashenko. O.A., Ekimova. S.B., Arshanitsa N.M., Sobolev K.D. |

15:00-15:30 Coffee break / Posters

Parallel session: Monitoring and assessment – Hall: Põhja-Euroopa

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| 15:30 | ASSESSMENT OF CHL-A ON GOF USING MULTISOURCE DATA | Jenni Attila*, Pirkko Kauppila, Vesa Keto, Stella-Theresa Stoicescu, Seppo Kaitala, Kari Kallio, Inga Lips |
| 15:45 | CHLOROPHYLL AND NUTRIENT DYNAMICS IN THE GULF OF FINLAND DURING THE LAST TWO DECADES | Harri Kuosa*, Saku Anttila, Jenni Attila, Jan-Erik Bruun, Tatjana Eremina, Alexandra Ershova, Andres Jaanus et al |
| 16:00 | LONG-TERM PHYTOPLANKTON MONITORING IN THE GULF OF FINLAND | Irina Andreeva, Andres Jaanus, Eugenia Lange, Sirpa Lehtinen, Andrey Sharov* |
| 16:15 | TOWARDS SPATIAL OPTIMIZATION OF PHYTOPLANKTON MONITORING IN THE BALTIC SEA | Andres Jaanus*, Ivan Kuprijanov, Kaire Kaljurand, Sirpa Lehtinen, Annely Enke |
| 16:30 | ASSESSMENT OF WATER QUALITY AND ECOSYSTEM STATE OF NEVA ESTUARY BY INTEGRATED INDEX IP . | Evgeniya Balushkina, Sergey Golubkov |
| 16:45 | MICROLITTER IN THE SURFACE WATERS OF THE GULF OF FINLAND – COMPARISON OF TWO METHODS | Outi Setälä*, Kerstin Magnusson, Fredrik Norén |

Parallel session: Pollution, ecosystem health and geology – Hall:
Ida-Euroopa

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| 15:30 | SELECTION OF BIOTESTS FOR THE ASSESSMENT OF CONTAMINATED SEDIMENTS: THE CONTEST PROJECT | Kari K. Lehtonen*,
Nadezhda Berezina, Brita Sundelin, and Jakob Strand |
| 15:45 | FERROMANGANESE CONCRETIONS OF THE EASTERN GULF OF FINLAND –ENVIRONMENTAL ROLE AND EFFECTS OF SUBMARINE MINING | Vladimir Zhamoida*,
Andrey Grigoriev, Daria Ryabchuk, Anton Evdokimenko, Aarno T. Kotilainen, Henry Vallius, Joonas J. Virtasalo , Anu M. Kaskela |
| 16:00 | CHANGES IN HEAVY METAL CHEMISTRY OF THE SEDIMENTS OF THE GULF OF FINLAND DURING THE LAST TWO DECADES | Henry Vallius*, Daria Ryabchuck, Vladimir Zhamoida, Andrey Grigoriev, Tiiu Alliksaar, and Sten Suuroja |
| 16:15 | POLYBROMINATED DIPHENYL ETHERS (PBDES) IN SEDIMENTS AND WATER FROM THE NEVA RIVER AND THE EASTERN GULF OF FINLAND (2011-2012) | Larissa O. Metelkova*,
Zoya A. Zhakovskaya,
Galina I. Kukhareva,
Alexander E. Rybalko,
Vladimir A. Nikiforov |
| 16:30 | CONCENTRATIONS OF PCDDs, PCDFs, SOME PCBs AND HEAVY METALS IN BAYS SURROUNDING TALLINN | Ants Erm*, Martin Voll,
Fred Buschmann |

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- 16:45 CHARACTERISTICS OF THE ABUNDANCE OF PCDD/PCDFS AND DIOXIN-LIKE PCBS IN SEDIMENTS FROM THE NEVA RIVER AND THE EASTERN GULF OF FINLAND (2011-2012) Larissa O. Metelkova, Zoya A. Zhakovskaya*, Galina I. Kukhareva, Alexander E. Rybalko, Vladimir A. Nikiforov

17:00-18:00 Poster session

19:30-22:30 Dinner (Estonian Maritime Museum - Seaplane Harbour)

18 November 2015

Time	TITLE	Authors
Parallel session: Maritime traffic and maritime spatial planning – Hall: Põhja-Euroopa		
9:00	OPERATIONAL ASSESSMENT OF TANKER GROUNDING AND RELATED ENVIRONMENTAL RISK MANAGEMENT	Kristjan Tabri *, Valeriy Agoshkov, Robert Aps, Mihhail Fetissov, Floris Goerlandt, Pentti Kujala, Vladimir Zalesny
9:15	THE RISK MANAGEMENT MODEL OF WINTER NAVIGATION OPERATIONS	Osiris A. Valdez Banda, Floris Goerlandt, Vladimir Kuzmin, Pentti Kujala, Jakub Montewka
9:30	ENVIRONMENTAL SAFETY MANAGEMENT OF ECO- SOCIO-TECHNICAL MARITIME TRANSPORT SYSTEM IN THE GULF OF FINLAND (BALTIC SEA)	Robert Aps*, Mihhail Fetissov, Floris Goerlandt, Ville Karvinen, Madli Kopti, Jonne Kotta, Oleg Korneev, Pentti Kujala
9:45	INDICATOR DEVELOPMENT FOR HUMAN IMPACT ASSESSMENT FOR COASTAL LOCAL MUNICIPALITIES IN THE GULF OF FINLAND	Gogoberidze, G.*, Lednova, J. , Kostamo, K. , Nurmi, M., Karjalainen, M
10:00	METADATA ANALYSIS IN THE GULF OF FINLAND FOR MSP – LESSON LEARNT	Hanna Luhtala, Anita Mäkinen*, Harri Tolvanen, Robert Aps, Risto Kalliola, Andrei Lappo

Parallel session: Biodiversity – Hall: Ida-Euroopa

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| 9:00 | THE VALUE OF BIODIVERSITY MONITORING IN THE GULF OF FINLAND | Henrik Nygård*, Soile Oinonen, Heidi Hällfors, Maiju Lehtiniemi, Georg Martin, Eija Rantajärvi, Joonas Salojärvi, Laura Uusitalo |
| 9:15 | INTERLINKAGES BETWEEN ZOOBENTHIC ASSEMBLAGES AND ABIOTIC ENVIRONMENT IN A HETEROGENEOUS INLAND SEA AREA, THE EASTERN GULF OF FINLAND | Anu, Kaskela*, Heta, Rousi, Minna, Ronkainen, Marina, Orlova, Alexander, Babin, Kirsi, Kostamo, Aarno, Kotilainen, Igor, Neevin, Daria, Ryabchuk, Alexander, Sergeev, Vladimir, Zhamoida |
| 9:30 | LITTORAL COMMUNITIES OF THE NEVA RIVER ESTUARY: STRUCTURE AND DYNAMICS OF QUANTITATIVE ADJECTIVES UNDER ANTHROPOGENIC PRESSURE | Elizaveta Pankova1, Andrey Brodsky, Daria Safronova* |
| 9:45 | SEASONAL AND SPATIAL VARIABILITY OF FUCUS VESICULOSUS ASSOCIATED FAUNA IN ESTONIAN COASTAL WATERS | Natalja Kolesova*, Kaia-Liisa Siimon, Natalia Fateeva |
| 10:00 | CLIMATIC IMPACT AND BIOMASS OF OPPORTUNISTIC MACROALGAE IN THE NEVA ESTUARY (EASTERN BALTIC SEA) | Yulia I. Gubelit* |

10:15-11:00 Coffee break / Posters

Parallel session: Hydrography and modelling – Hall: Põhja-Euroopa

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| 11:00 | NEAR BOTTOM OXYGEN DEFICIENCY AND INTERNAL LOADING OF PHOSPHORUS IN THE COASTAL AREA OF HELSINKI | Emil Vahtera*,
Kaarina Lukkari |
| 11:15 | NEW APPROACH TO MODEL BENTHIC LAYER WITH IMPACT OF BIOIRRIGATION ACTIVITY OF MARENZELLERIA SPP. IN THE GULF OF FINLAND | Tatjana Eremina*,
Alexey Isaev,
Ekaterina
Voloshchuk, Vladimir
Ryabchenko |
| 11:30 | DANGEROUS SEA LEVEL RISES IN THE EASTERN PART OF GULF OF FINLAND: MECHANISMS, STATISTICAL STRUCTURE, INTERANNUAL VARIABILITY. | Vladimir Sukhachev*,
Evgenii Zakharchuk,
Urmas Lips, Natalia
Tikhonova, Irina
Suhhova |
| 11:45 | NUMERICAL STUDY OF SUBMESOSCALE FLOWS IN THE GULF OF FINLAND (GOF) | Roman Vankevich*,
Ekaterina Sofina, Jari
Haapala, Antti
Westerlund |
| 12:00 | ANATOMY AND STATISTICS OF SUBMESOSCALE STRUCTURES SIMULATED DURING AN UPWELLING EVENT IN THE GULF OF FINLAND, BALTIC SEA | Germo Väli*, Victor
Zhurbas, Urmas Lips,
Jaan Laanemets |
| 12:15 | THE SATELLITE-MEASURED SEA SURFACE TEMPERATURE CHANGE IN THE GULF OF FINLAND | Andrei Tronin |

Parallel session: Biodiversity, fish and fisheries – Hall: Ida-Euroopa

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| 11:00 | ALIEN SPECIES IN THE RUSSIAN PART OF THE GULF OF FINLAND | Alexander Antsulevich*, Nadja Berezina, Larissa Litvinchuk, Alexey Maximov and Marina Orlova |
| 11:15 | USING OF AQUATIC INVADER GMELINOIDES FASCIATUS FOR MONITORING OF WATER POLLUTIONS IN THE BALTIC SEA REGION. | Eugene Daev*, Anna Dukelskaya, Larisa Barabanova |
| 11:30 | CLIMATE CHANGE AND ANTHROPOGENIC IMPACT ON FISH STOCKS OF FINLAND GULF | Andrey Pedchenko* |
| 11:45 | STOCK DIVERSITY OF HERRING IN THE NORTHERN BALTIC: IS THE SEPARATE ASSESSMENT OF THE HERRING IN THE GULF OF FINLAND POSSIBLE? | Tiit Raid*, Jukka Pönni, Jari Raitaniemi |
| 12:00 | ATLAS OF TROUT (SALMO TRUTTA) AND SALMON (SALMO SALAR) POPULATIONS OF THE GULF OF FINLAND RIVERS | Markku Kaukoranta*, Martin Kesler, Sergey Titov, Aki Janatuinen and Marja-Liisa Koljonen |
| 12:15 | ENVIRONMENTAL AND TECHNOLOGICAL ASPECTS OF SUSTAINABLE AQUACULTURE DEVELOPMENT AT THE GULF OF FINLAND | Leonid Bugrov* |

12:30-13:30 Lunch

Plenary session II – Hall: Lääne-Euroopa

13:30	The Gulf of Finland Year 2014	Kai Myrberg
13:50	Presentation about load reduction from St Petersburg	Dmitry Trochenko
14:10	Assessment of the state of GoF	Mika Raateoja
14:30	Monitoring - steps made and future coordination	Urmas Lips
14:50	JMS special issue	Wolfgang Fennel
15:00-15:30		
15:30	Programme of measures / joint action	Heikki Pitkänen
15:50	Input from the Steering Group	Andres Talijärv
16:10	Declaration	Ismo Tiainen
16:30	Closing of the Forum	

Posters

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| 1 | HOW WINTER PH HAS CHANGED OVER THE LAST 40 YEARS IN THE GULF OF FINLAND | Anna-Karin Almén,
Jonna Engström-Öst,
Olivier Glippa,
Pekka Alenius, Heidi
Pettersson |
| 2 | ABUNDANCE AND FEEDING OF CYPRINID FISHES IN EASTERN GULF OF FINLAND | Anton A.
Uspenskiy*, Anna S.
Demchuk, Sergey M.
Golubkov |
| 3 | TOWARDS AN EVIDENCE-BASED PROBABILISTIC RISK MODEL FOR SHIP GROUNDING ACCIDENTS | Arsham Mazaheri*,
Jakub Montewka,
Pentti Kujala |
| 4 | THE RESULTS OF LONG-TERM MONITORING RESEARCH OF VASCULAR PLANT FLORA OF THE OUTER ISLANDS OF THE GULF OF FINLAND (LENINGRAD REGION) | Elena Glazkova |
| 5 | HEAVY METALS IN THE SEDIMENTS OF THE GULF OF FINLAND | Emelyan
Emelyanov, Henry
Vallius*, Victor
Kravtsov |
| 6 | ASSESSING NEAR-BOTTOM VELOCITY FIELD USING UNDERWATER CAMERA | Fred Buschmann*,
Ants Erm, Madis
Listak, Jaan Rebane |
| 7 | BIRD AND MAMMAL ARTIFICIAL HABITATS OF THE EASTERN PART OF THE GULF OF FINLAND | Julia Bublichenko,
Andrew
Bublichenko |
| 8 | GMELINOIDES FASCIATUS IS A NEW BIOINDICATOR OF GENETIC BIODIVERSITY IN FINNISH BAY AREA. | Larisa Barabanova*,
Anna Dukelskaya,
Eugene Daev |

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| 9 | SATELLITE MONITORING OF GULF OF FINLAND FOR ASSESSMENT IMPACT OF DREDGING ACTIVITY DURING «PORT BRONCA» CONSTRUCTION | Leontina
Sukhacheva, Marina
Orlova |
| 10 | REFLECTIONS OF PREY QUALITY AND ORGANIC TOXICANTS IN BIOCHEMISTRY OF SALMON IN THE GULF OF FINLAND COMPARED TO OTHER BALTIC FEEDING AREAS | Marja Keinänen*,
Soili Nikonen, Tiina
Putkonen, Pekka J.
Vuorinen |
| 11 | RELEASE OF TEXTILE MICROPLASTICS DURING MACHINE WASHING | Markus Sillanpää,
Pirjo Sainio* and
Minna Sepponen |
| 12 | FATE AND EFFECTS OF NONYLPHENOL IN A TERRIGENOUS FUNGUS PENICILLIUM EXPANSUM | Nadezda
Medvedeva, Irina
Kuzikova, Vera
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| 13 | CELLULAR RESPONSES AND BIOREMOVAL OF NONYLPHENOLS BY THE CYANOBACTERIA PLANKTOTHRIX AGARDHII 1113 | Nadezda
Medvedeva, Tatyana
Zaytseva |
| 14 | CHANGE OF THE GULF OF FINLAND AQUATIC BIOTA NEAR THE AREA OF CONSTRUCTION MMPK "BRONKA" | Olga Susloparova.,
Anatoly
Khozyaykin, Yury
Zuyev, Olga
Semenova |
| 15 | MONITORING OF PAH-METABOLITE CONCENTRATIONS OF PERCH BILE IN OPEN GULF OF FINLAND COMPARED TO COASTAL AREAS | Pekka J. Vuorinen*,
Kari Saulamo, Tiina
Lecklin, Mika
Rahikainen, Pertti
Koivisto, Marja
Keinänen |

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| 16 | FATE OF MICROPLASTICS IN
SOFT MARINE SEDIMENTS | Pinja Näkki*, Outi
Setälä, Maiju
Lehtiniemi |
| 17 | THE ROLE OF CYANOBACTERIA
IN THE NORTHERN BALTIC SEA –
GOOD, BAD OR ONLY UGLY? | Sanna Suikkanen*,
Pirkko Kauppila,
Harri Kuosa, Sirpa
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Lehtiniemi, Laura
Uusitalo |
| 18 | DINAOFLAGELLATE CYST
DYNAMICS IN THE NORTHERN
BALTIC SEA | Sirje Sildever, Anke
Kremp, Annely
Enke, Inga Lips |
| 19 | BALTIC HERRING (CLUPEA
HARENGUS MEMBRAS L.) OF
WEIGHT-AT-AGE-AT-LENGTH
ANALYZES FROM THE ESTONIAN
COASTAL WATERS AND FOOD
SAFETY | Tiit Lukki, Ott Roots |
| 20 | HIGH-RESOLUTION VIEW ON THE
HALOCLINE AND HYPOXIC
LAYER DYNAMICS IN THE GULF
OF FINLAND | Urmas Lips, Taavi
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Theresa Stoicescu |
| 21 | IMPORTANCE OF CORRECT
DISTRIBUTION CONTRACTING
PARTIES SHARES IN FORMATION
OF NUTRIENT LOAD WITH
NARVA RIVER FOR HELCOM
BALTIC SEA ACTION PLAN
IMPLEMENTATION | Valentina
Varlashina*, Leonid
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Oblomkova |
| 22 | ASSESSMENT OF MICROBIAL
AND VIRUS CONTAMINATION OF
WATER AREAS THE NEVA BAY
AND THE EASTERN PART OF THE
GULF OF FINLAND | Vladimir Malyshev
and Rosa
Mikhailenko |

POPULATION STATUS AND HABITAT USE OF THE RINGED SEAL IN THE GULF OF FINLAND

Mart Jüssi*¹, Markus Ahola², Vyacheslav Alexeev³, Elena Andrievskaya³, Tero Härkönen⁴, Ivar Jüssi¹, Martin Silts⁵, Irina Trukhanova⁶, Mikhail Verevkin⁷

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³St.Peterburg Marine Mammal Rehab Centre, Russia; ⁴Swedish Museum of Natural History, Sweden; ⁵University of Tartu, Estonia; ⁶Baltic Fund for Nature, Russia;
⁷St.Peterburg State University.

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Keywords: biodiversity, ringed seal, habitat selection, climate change, Gulf of Finland

The Gulf of Finland is geographically close to the southern limit of the main distribution range of the ringed seal (*Phoca hispida*) in the Baltic Sea. During the 20th century dramatic drop in abundance of the species in the whole Baltic Sea was observed. In the Gulf of Finland an estimate of about 3500 in the 1970ies has been reduced to only some hundred seals during the last decade. The species was before observed along the whole length of the coast of the gulf. Possibly caused by the population decline, the modern core distribution range extends only in the easternmost part of the gulf. We used telemetric data recorders on the ringed seals to study movements and activity patterns of 4 (2 male, 2 female) ringed seals in 1998-1999 and 5 (4 male, 1 female) ringed seals in 2014-2015. The studied seals demonstrated regular movements around haul out areas with active feeding at the average depths of 16 ± 11.1 metres during the autumn-early winter period. The moving patterns changed to more diverse, long distance trips with the onset of breeding season. Comparison of the data from 1998-1999 and 2014-2015 indicate a further shift of distribution to the east. Use of artificial islands as a haul-out platform by one individual was registered. Given the geography of the Eastern part of the Gulf of Finland and reduced duration and extent of sea ice as obligatory breeding platform for the species, this marine top predator is exposed to substantial biological and anthropogenic pressure factors.

**ASSESSMENT OF GEOLOGICAL ENVIRONMENT OF THE
EASTERN GULF OF FINLAND BY RESULTS
GEOECOLOGICAL MONITORING**

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Zhakovskaja³

¹*Sevmorgeo, St-Petersburg, Russia*, ²*ZIN RAC, St-Petersburg, Russia*, ³*SRCES RAS, St-Petersburg*, ⁴*St-Petersburg state University*

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Keywords: assessment, the Eastern Gulf of Finland, monitoring, hydrogeochemistry, GOF 2014

Geo-environmental monitoring in the Eastern Gulf of Finland is performed regularly since 2001. The scope of work included the study of the geochemistry of bottom sediment and bottom and pore waters.

Monitoring in 2014 were completed in cycle studies (2011-2014). It showed that, geo-hydrochemical indicators became to the situation of 2008-2010. Activity of radionuclide ¹³⁷Cs decreased significantly because of the half-life of elements. The clearly local anomalies of hydrocarbons along major transport routes appeared at the same time. This is connected with significantly increase of parking of vessels. Specialized sampling for rare toxic substances from the HELCOM list (PCDD/PCDR, PBDEs, PCBs, TBTs etc.) was conducted with SRCES RAS. With ZIN RAS was carried out an experiment comparing geochemical and bio-indicator methods. The first results allow relatively high level of correlation between these two parameters.

Geo-environmental monitoring of GOF2014 allowed to assess the state of the environment of the Gulf of Finland, which can be characterized as stable.

A LONG TERM EVOLUTION OF HARMFUL SUBSTANCES INPUT INTO THE GULF OF FINLAND

Aarno T. Kotilainen*¹, Outi Hyttinen², Daria Ryabchuk³, Henry Vallius¹, Joonas J. Virtasalo¹, Natalia Deryugina⁴, Andrey Grigoriev³, Vladimir Zhamoida³

¹*Geological Survey of Finland, Finland;* ²*Department of Geosciences and Geography, University of Helsinki, Finland;* ³*A.P. Karpinsky Russian Geological Research Institute (VSEGEI), Russia;* ⁴*St. Petersburg State University; Russia*

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Keywords: sediment, marine geology, heavy metal, nutrient, anthropogenic input

The environmental problems of the Gulf of Finland (GoF) include e.g. eutrophication and input of hazardous substances. In this work we have used geological records, seabed sediments, to study environmental history and trends in heavy metal input (e.g. lead, cadmium and zinc) and sedimentary phosphorus in the GoF, the Baltic Sea, over the past 6000 years.

We have studied sediment cores from three sites, from the western (JML), central (GF2) and eastern GoF (F40). These sites are located in the water depths of 80, 84 and 38 meters, respectively. The short sediment cores were recovered using a GEMAX gravity corer, and long sediment cores using a piston and a gravity corer. Detailed analyses of sediments include e.g. ICP-MS geochemical, total carbon and LOI. The age model for these sediment cores is based on AMS¹⁴C-, palaeomagnetic-, ²¹⁰Pb- and ¹³⁷Cs dating, and Pb-content records.

Results from sediment studies indicate an anthropogenic input of harmful substances (e.g. Pb) already during the Medieval Climate Anomaly (around 950-1250 AD). Increase in heavy metal input, since 1950's until 1970's/1980's, is also clearly visible in sedimentary records. Over the last decade(s) the concentrations of heavy metals have generally declined. However, seabed sediments of the GoF still contain high concentrations of nutrients and heavy metals.

This work is a part of an ongoing CISU project that is funded by Academy of Finland and Russian Foundation for Basic Research (project 14-05-91763).

PELAGIC FISH STOCKS IN THE GULF OF FINLAND - LIFE ON THE EDGE OF THE SEA

Heikki Peltonen*¹, Tiit Raid² and Jukka Pönni³

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Keywords: Herring, sprat, Gulf of Finland, Baltic Sea, ecology, environmental impacts

In the Gulf of Finland, herring and sprat are marine fish species which provide the principal resources for fisheries and can also be regarded to belong among the key species in the ecosystem. Steep gradients and variations in natural environmental factors and anthropogenic pressures consistently restructure the food-web and the fish community in this marginal marine ecosystem. As both herring and sprat live here on the edge of their distribution, even minor environmental variations can have substantial impacts on the productivity of the populations.

This presentation aims to highlight how a complex interaction of anthropogenic influences and variations in natural forcing shape the marine fish stocks in the Gulf of Finland. Due to the continuous change and the wide variability in environment forcing, Gulf of Finland provides an interesting area to learn about the dynamics of the fish stocks and about the ecosystem function in multiple stressed coastal sea. The factors contributing to the extreme variations in the growth rates and in the feeding of different species, as well as in the spatial distribution of pelagic fish are discussed in this presentation.

NUTRIENT LOADING INTO THE GULF OF FINLAND: TRENDS AND WATER PROTECTION TARGETS

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Keywords: nutrients, loading, trends, reduction targets

The catchment area of the Gulf of Finland (GOF) is nearly 14 times bigger than the sea area and it is a home to a population of more than 12 million people, the population density being 29 people per square kilometer (HELCOM 2013). As a consequence the GOF is heavily polluted by nutrients and eutrophication is one of the major environmental concerns. The average annual NTOT input to the GOF in 2009-2013 was 110 229 t. Rivers exported 79% of the input, point sources accounted for 10% and 11% originated from deposition. The corresponding PTOT input was 4090 t, of which rivers exported 88% and point sources accounted for 12%. The largest share (61% NTOT and 73% PTOT) of the inputs came from Russia, even if the specific areal inputs (input divided by land area) were smaller than in Estonia or Finland. The aim of this study was to estimate trends in nutrient loading into the GOF and to evaluate if present water protection targets (national EU and HELCOM) will be achieved and which are the most significant objects to reach this goal. We used both national and HELCOM pollution load database as our data source.

LINKING DIVERSITY OF SHALLOW WATER BENTHIC INVERTEBRATE COMMUNITIES TO ENVIRONMENTAL GRADIENTS IN THE GULF OF FINLAND

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Keywords: Benthic communities, Macroalgae, Invertebrates, Gulf of Finland, Environmental gradients

We used Estonian and Finnish monitoring and inventory data from 2009-2014 to analyse the patterns of shallow water benthic soft and hard bottom communities in the Gulf of Finland. Boosted Regression Trees modelling was used to determine relative contribution of natural and human induced drivers to the abundance, richness and diversity of the communities. The studied environmental gradients had scale-specific effects on the benthic invertebrate communities. At the gulf scale, the variability in the taxonomic richness was primarily due to salinity and inshore-offshore gradient in archipelago areas, with number of taxa diminishing towards the inner archipelagoes and towards the eastern parts of the Gulf. At smaller spatial scales, depth and seafloor seawater temperature were also important, with highest species richness in the shallower areas and at moderate temperatures. Habitat diversity also affected the functional groups: suspension feeders, herbivores and carnivores benefited of an increase of rocky substrates, while deposit feeders were favoured by an elevated share of sand and gravel. Water transparency (as a proxy of eutrophication) was not negatively correlated with the diversity of shallow water benthic invertebrates. Elevated primary productivity generally increases benthic species richness, diversity and abundances, but when zooming in to smaller spatial scales and longer time scales, prolonged eutrophication may - also at shallower depths - induce strong negative effects to benthic biota.

THE GULF OF FINLAND UNDERWATER SOUNDSCAPE ASSESSMENT

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Keywords: anthropogenic underwater noise, ship traffic, soundscape

Underwater soundscapes in seas consist of natural sounds and noise caused by human activities. The noise from human activities may propagate long distances from the sources and, depending on sound exposure level and frequency, may disturb marine mammals and fish.

Within the Life+ BIAS project, hydroacoustic loggers were deployed in the Baltic Sea for one year with the aim to establish an underwater soundscape for the sea. Hydroacoustic loggers were also deployed in the Gulf of Finland which is one of the dense ship traffic areas with about 12 000 ship passages annually along the main fairways. The collected material together with modelling will give a detailed view of seasonal changes of the underwater sound pressure levels in the Baltic Sea.

The sound pressure analyses are focusing especially on the third-octave bands of 63 and 125 Hz in accordance with the MSFD Indicator 11.2.1. because these are considered as the most representative for the noise from shipping. However, these frequencies do not overlap with those vital for sea mammal's communication. To study the impact of the underwater noise to the marine mammals, harbour porpoises in particular, higher frequency bands should be analysed, where the auditory perception of mammals is maximal.

The analyses of the loggers' recordings reveal that the sound pressure percentiles can be used in identification of the presence of the shipping noise. In the absence of the shipping noise the recorded sound pressure levels correlate well with the significant wave height.

AN ESTIMATION OF THE PHARMACEUTICALS RELEASE INTO THE GULF OF FINLAND (2011-2013)

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Keywords: pharmaceuticals, natural and sewage waters, mass-spectrometry

St. Petersburg is the largest megapolis on the Baltic Sea. It is also the largest single point of consumption, excretion and, presumably, release of pharmaceutical substances into the Baltic Sea environment. The study whose purpose was to analyse the load of pharmaceuticals entering, passing through the city's sewage system and releasing to Gulf of Finland has been done in the frame of HELCOM projects BALTHAZAR Phase II and BASE. More than 100 water samples (natural, influent and effluent sewage water) taken during different seasons were analysed by the method of liquid chromatography high-resolution mass-spectrometry to obtain pharmaceuticals concentrations. This study was the first of its kind done in St Petersburg. Diclofenac (DCF, being developed by HELCOM as pre-core indicator) and 18 other pharmaceutical substances of different classes and chemical nature were found in natural raw sewage and effluent water samples. Their levels ranged from tens to hundreds of ngL^{-1} . Detected DCF concentrations in the influent and the effluent water samples were 150-740 ngL^{-1} and 150-490 ngL^{-1} accordingly. Similar observations have been made at a number of WWTPs elsewhere in the world. Diclofenac were detected in some natural water samples (in the range of 4-270 ngL^{-1}). The data obtained in the project can be used to assess the overall load of pharmaceuticals on the gulf-basin scale and also to evaluate the existing water treatment technology in St. Petersburg.

NUTRIENT LOAD FROM THE RUSSIAN TERRITORY TO THE GULF OF FINLAND

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Keywords: Gulf of Finland, catchment, total nitrogen, total phosphorus, nutrient load, monitoring

The present level of nutrient load to the Gulf of Finland (the Baltic Sea) from the Russian territory is estimated. The results of a long term joint research work of RSHU and IL RAS (including field measurements of nutrient load at some rivers, as well as model experiments by means of the ILLM model) show that at present the Russian territory (accounting for about 80% of the Gulf of Finland catchment area) forms 64-65% of the admissible values of loading of total phosphorus and total nitrogen recommended by the HELCOM Baltic Sea Action Plan (2013). The value of nutrient loading in this area can be reduced as a result of improvement of manure storage and processing systems and optimisation of fertilizer use in agriculture of the Leningrad region. At the same time, the suggestions for improvement of monitoring system of small tributaries of the Gulf of Finland are formulated aiming at a more correct assessment of nutrient loading

INPUT OF NUTRIENTS TO THE GULF OF FINLAND FROM RUSSIAN AND TRANSBOUNDARY RIVERS

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On November 15, 2007 in Krakow (Poland) HELCOM member countries (Finland, Sweden, Denmark, Russia, Germany, Poland, Latvia, Lithuania and Estonia) adopted the Baltic Sea Action Plan (BSAP), which is a long-term strategic document. Its aim is to reduce marine pollution and to restore the safe ecological status of the Baltic Sea to the year 2021. BSAP provides for pollutant reduction of nitrogen and phosphorus compounds into the Baltic Sea to 135 000 t and 15 250 t respectively to the year 2016 (Helcom, 2007). This data set has then been used for calculating the revised nutrient reduction scheme which was adopted by the 2013 HELCOM Copenhagen Ministerial Meeting (HELCOM 2013a) (Table 1).

Table 1. Allowable inputs and needed reduction of nutrients to the Gulf of Finland

Maximum allowable inputs		Needed reduction	
Total nitrogen (TN), tons	Total phosphorus (TP), tons	Total nitrogen (TN), tons	Total phosphorus (TP), tons
101 800	3 600	14 452	3 909

Nitrogen and phosphorus are the main growth limiting nutrients - high nutrient concentrations in the aquatic environment stimulate the growth of algae, which leads to an imbalanced functioning of the ecosystem.

The aim of this research was to assess dynamic of input of nutrients to the Gulf of Finland from some Russian (the Neva River, the Luga River) and transboundary rivers (the Narva River, the Seleznevka River). Fluxes of total phosphorus and total nitrogen are calculated on annual basis concentrations by multiplying annual mean discharge:

$$Q = 0.031536 \cdot C_i \cdot R_i$$

where Q is input of TN or TP, tons; C_i is average annual concentration, $\mu\text{g L}^{-1}$; R_i is annual mean discharge of water, $\text{m}^3 \cdot \text{s}^{-1}$. Results of calculations are given in Table 2.

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Table 2. Mid-annual input of nutrients to the Gulf of Finland. tons

River	Period covered	Average input	
		Q(TN)	Q(TP)
The Neva River and its branches	2004-2014	57 456	2 847
The Narva River	2004-2014	14 357	511
The Luga River	2004-2014	5 499	707
The Seleznevka River	2011-2014	531	16
Total		77 843	4 081

The results show that the input of total phosphorus to the Gulf of Finland (4 081 tons) higher than the maximum allowable input (3 600 tons).

TROPHIC CHANGES IN THE COAST-OFFSHORE GRADIENT IN THE FINNISH COAST OF THE GULF OF FINLAND

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Keywords: Eutrophication, chlorophyll a, inorganic nutrients, offshore waters, coastal waters, Gulf of Finland, Baltic Sea

Managing eutrophication is a challenge in the coastal marine waters of the GOF where complex morphometry and specific hydrographical features restrict water exchange. We chose the Finnish estuaries of the rivers Mustio, Vantaa and Kymi to study trophic changes along the coast-offshore gradient. The estuaries differ from each other in terms of catchment properties and sizes as well as in terms of the extent of riverine impact and openness to the offshore waters.

The dataset was compiled to detect how far off the coast the trophic development was predominantly dictated by the catchment processes and where the sea starts to play a role - the kind of information which is increasingly required to be able to implement EU directives appropriately. The trend data on wintertime inorganic nutrients and summertime chlorophyll-a were normalized to exclude the impact of quantitative inter-station differences. We also made effort to minimize errors arising e.g. from analytical differences.

Nutrient and trophic dynamics differed profoundly in the coast-offshore continuum. In the River Mustio, nutrient dynamics was shaped by the semi-enclosedness of the recipient water body. In the River Vantaa, the temporal nutrient patterns were dictated by the drastic changes in the anthropogenic load onto the recipient water body. The River Kymi was the only estuary where the land-based and marine nutrient reserves mixed effectively close to the coast.

INTERNAL DYNAMICS AND EXTERNAL LOADING AFFECT NUTRIENT STATUS IN THE GULF OF FINLAND

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Keywords: sediment, nutrients, phosphorus, nitrogen, silicate, salinity

The concentrations of inorganic nutrients vary greatly in the Gulf of Finland. The Gulf has large nutrient loading and the lack of a sill between the Baltic Proper and the Gulf creates a dynamic boundary-system having an ability to exchange large volumes water and high amounts of substances. Additionally, the sediments of the Gulf have a good capacity to capture large amounts of phosphorus that maybe released back to water during poor oxygen conditions. These factors are likely to explain the concentration variation, but a comprehensive study pointing out the drivers behind the dynamics in the nutrient variation is yet lacking on the scale of whole Gulf. The objective of this study is to highlight how the internal factors affect the abundance of nutrients and their ratios in different water layers and their storages in the entire water volume in relation to the external loading. We find that the nutrients imported from the Baltic Proper and released and processed by the sediment system accumulate into the near-bottom water during the saline water inflows from the Baltic Proper to the Gulf. These episodes enrich bottom water especially with phosphorus compared to silicate and nitrogen. The nutrients accumulated into the deep water layers have the capacity to decrease the ratios of N:P and Si:P to low levels in the entire water column during the events of vertical mixing. Therefore, the extent of the saline water inflows from the Baltic Proper and the timing of mixing events and the spreading of mixed water create highly variable nutrient content premises for the spring bloom community between the years. The observed large inter-annual variation in the concentrations and storages of phosphorus in the open Gulf are mainly driven by the internal factors which are able mask the effect of the implemented phosphorus reductions significantly.

**LONG TERM INVESTIGATION OF EUTROPHICATION
PROCESS OF THE NEVA ESTUARY: DRIVING FORCES
AND FUTURE PROGNOSIS**

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Keywords: eutrophication, primary production, phytoplankton, Neva Estuary

Integrated water samples were taken at 27 sampling stations in the Neva Estuary in July-August of 2003 - 2015. Concentration of chlorophyll "a" (Chl), plankton primary production (PP), concentration of total phosphorus in unfiltered water (TP), concentration of suspended matters were measured. In the Neva Estuary PP was fluctuated from 0.3 up to 2.2 gC m⁻² day⁻¹ in 2003-2015, concentration of Chl from 1.52 up to 21.9 mg m⁻³. Dredging activity in upper part of the estuary in 2006-2007 leads to high concentration of mineral particulate matter in water (up to 103 g m⁻³). As a result minimum values of PP were measured in 2006. Positive relationship between concentration of mineral particulate matter and concentration of TP was found in the Neva Bay in 2006, but increase of primary production was not observed, due to low transparency of the water, at some stations about 5 cm. In the middle part of estuary, where salinity of surface water increased from 0.06 to 3 ‰ formed geochemical barriers, which characterized the highest PP in comparison with other parts of the Neva Estuary. In the most marine part the highest PP was observed in 2004. It probably may be connected with the massive intrusion of salt waters from the North Sea into the Baltic Sea, which happened in 2003. Present investigation shows that change of trophic status of the Neva Estuary induced by the complex of natural and anthropogenic factors, but importance of each one in all parts of estuary were quite different.

ORIGIN AND CYCLING OF ORGANIC CARBON IN THE NEVA ESTUARY

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Keywords: carbon cycling, estuary, stable isotopes

We ascertained the origin and utilization of organic carbon in benthic and pelagic habitats in the Neva Estuary by analysing the metabolism and the stable isotopic (C, N) composition of zoobenthos and seston. Isotopic signatures ($\delta^{13}\text{C}$) of seston and most of the dominant species of zoobenthos in Neva Bay (upper part of the estuary) were similar to the signature of terrestrial carbon (-27 ‰) coming from watershed. Decomposition of allochthonous organic matter (OM) in Neva Bay was higher than autochthonous OM production. Important role in decomposition of OM had zoobenthos. In the lower part of the Neva Estuary, Inner Estuary, $\delta^{13}\text{C}$ signature of seston was distinctly higher than in Neva Bay. Especially high $\delta^{13}\text{C}$ signature (-21 ‰) was determined in the local blooms of cyanobacteria. However, primary production in the Inner Estuary was lower than the rate of decomposition of OM indicating considerable income of allochthonous OM to this part of the estuary. Most species of zoobenthos had $\delta^{13}\text{C}$ signature similar to the signature of seston in hypolimnion that was notably lower than isotopic signature of cyanobacteria. Therefore, OM creating during their blooms was not important as a source of food for zoobenthos. The study shows the importance of allochthonous OM in carbon cycling of the Neva Estuary. Detail investigations of different forms of OM coming from the watershed are required to realize the ecosystem function of the estuary and to development of effective remedial measures.

APPLICATION OF NEW BIOMARKERS FOR ASSESSMENT ENVIRONMENTAL STATE IN THE NEVA ESTUARY

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Keywords: malformed embryos rate, gammaridean amphipods, heart rate recovery time, bivalve molluscs, toxicity, coastal area

This study is based on comparison of results after using different well-known assessment methods such as structural characteristics of indices in the Neva Bay and eastern Gulf of Finland (summer of 2014 and 2015) and new methods: embryo malformation in amphipod crustaceans and heart rate (HR) recovery time after loading in the bivalve mollusc. The methods cover responses at the organism level and bridge the contamination level of the environment to the health state of local biota.

Embryo malformation endpoints in amphipods (*Gmelinoides fasciatus*, *Pontogammarus robustoides*, *Gammarus tigninus*) such as the mean frequency (%) of malformed, enlarged, undifferentiated and dead embryos per female or frequency of females with >1 of malformed embryos have been recommended as a general bio indicators of contaminant effects.

The HR recovery to norm after exclusion of the load was calculated as the time (in min) needed for recovery of HR to individual background HR specific patterns. Method is based on the assessment of the compensatory response of test organisms (mollusc *Anodonta anatina*) to functional load as rapid changes in water salinity by addition of 6 g/L NaCl for 1 h (hyper-osmotic stress).

Comparison of results after using different assessment methods in the Neva Bay and eastern GoF showed the similar environmental state (Good - Moderate) at studied sites. The applied new methods might be recommended to using in monitoring programs and help to authorities in taking of decisions to prevent unfavourable impacts on human health and environmental quality.

**ENZYMATIC ACTIVITIES AND PROKARYOTIC
ABUNDANCE IN THE EASTERN GULF OF FINLAND
SEDIMENT ENVIRONMENT**

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Keywords: coastal sediments, environmental variability, dehydrogenase activity, catalase activity, heterotrophic bacteria

The dehydrogenase and catalase activity as well as the abundances of cultural heterotrophic bacteria were measured in coastal sediments of the eastern Gulf of Finland during two year surveys (2014-2015) together with mineralization, sediment particle size, pH, Eh, heavy metals, PAH, organic carbon, and macroalgal biomass determinations. Dehydrogenase and catalase are the two common oxidoreductase enzymes indicating the oxidative microbial activity and antioxidant potential under pollutant stress, respectively. Dehydrogenase, a very sensitive enzyme to pollutants, showed significant variation between stations. Dehydrogenase activity was strongly inhibited by labile copper concentrations, whereas the correlation of this component to the level of total Cu was poor, suggesting that the variation in dehydrogenase profiles was more correlated with labile than total heavy metals. Changes in catalase activity were more correlated to the variations in Fe than other metals. The abundances of culturable heterotrophic bacteria (CHB), varied significantly among the stations, reflecting their environmental variability. Biological parameters were shown to be positively correlated with each other, excepting algal biomass which was independent of both microbial activities and CHB. This study suggests that microbial activities are directly related to anthropogenic factors, and may be sensitive indicators of sediment contamination in coastal ecosystems.

POLLUTANTS IN FISH IN THE GULF OF FINLAND

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Keywords: pollutants, fish, Gulf of Finland

In this study fish samples were collected from the Gulf of Finland in 2013 and 2014 with the aim to get an overview about the content of pollutants in fish caught in Estonian waters. Baltic herring, sprat, plaice, perch, salmon and river lamprey samples were collected. The content of following chemical elements were examined: dioxins (PCDD/PCDFs), dioxin like polychlorinated biphenyls (dl-PCBs) and other polychlorinated biphenyls (PCBs), polybrominated diphenyl ethers (PBDEs), organic tin (OT), perfluorocompounds (PFAS) and heavy metals (lead, cadmium, mercury, arsenic). It can be concluded that problems arise with pollutants such as dioxins, organotin compounds, perfluorocompounds and polybrominated diphenyl ethers in Baltic herring, salmon and river lamprey. However, in Estonia, where fish is eaten very little, care should be taken when spreading news on the content of toxins in fish. On the other hand, it cannot be ruled out that some species in vicinity of industrial areas and harbours will not exceed allowed concentration of pollutants. It is important to link pollutant content to lipid content of fish and follow their seasonal variation in different age classes of fish. It should be discussed whether Estonia may want to negotiate some specific clauses for the maximum allowable EU concentration values. Such specific values are already adopted for Finland, Sweden and Latvia. Nevertheless, it is important to monitor and control dioxins and other pollutants found in fish that were discussed in this outline.

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ORGANOHALOGEN CONCENTRATIONS IN FISH IN THE GULF OF FINLAND

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Keywords: dioxins, PCB, POPs, environmental toxicant

A compilation of publications reporting organohalogen concentrations in fish sampled in the Gulf of Finland was performed. Reporting covered time span from the year 1976 to present and concentrations of 12 toxicants in 13 fish species. More than half of the reporting was for herring (*Clupea harengus*) with the second species being sprat (*Sprattus sprattus*) and third salmon (*Salmo salar*). Recent results were mostly for toxic equivalent concentrations of polychlorinated dibenzo-p-dioxins and dibenzofurans (PCDD/Fs) and older ones for DDTs and PCBs. Drawing of time trends is hampered due to differences in analytical methods and size or age of sampled fish and deficiencies in describing samples. Some time trends could be compiled and spatial differences were also detected, i.e., concentrations of certain organohalogenes were higher in eastern than western samples.

DEVELOPMENT OF STUDIES IN THE ASSESSMENT OF BIOLOGICAL EFFECTS OF POLLUTION IN THE GULF OF FINLAND

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Keywords: bioindication, water pollution, heart rate recovery time, mollusks

The Gulf of Finland is characterized by a significant gradient of water salinity with the majority of its areas being in the so-called critical salinity zone. This may cause the deterioration of the physiological status of local biota that lives under unfavourable environmental conditions. When using the caging approach (i.e. transplantation of organisms to the target areas of concern) native organisms from the reference location of the study region should be used as the reference; knowledge of background values of the measured health characteristics is a basic requirement in the monitoring of biological effects of pollution.

In the present study the heart rate recovery times of bivalve mollusks collected in different areas of the Gulf of Finland (*Anodonta anatina* from the estuary of the Neva Bay, *Mytilus trossulus* from the Lahepera Bay and *Macoma balthica* close to the Naissaar Island) were measured after standardized functional loading. The recovery time is used as an example of a basic index for indication of biological effects of a mixture of contaminants present in the aquatic environment. A recovery time less than 60 minutes signifies a good ecological status of site, corresponding to a reference site value. Conclusively, the applied bioelectronic method can be used in the bioindication of pollution in the Gulf of Finland.

**TOXICITY ASSESSMENT OF EASTERN PART OF GULF OF
FINLAND BY THE RESULTS OF BIOASSAY AND
PATHOLOGICAL STUDY OF FISH**

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Keywords: toxicity, bioassay, water, sediments, fish, pathoanatomical investigation

For the results of bioassay of water and sediments (by using the *Daphnia magna* as test object) the most part of samples were non-toxic in 96 - hour essay (acute experiment). Toxic impact was revealed for more than half of water and sediments samples during chronic experience by the test-function as “survivance” and “fertility”. Studies of seasonal changes of chronic toxicity according to the experiments with water and bottom sediments from the Neva and Luga Bay were revealed the increase of toxicity in autumn.

The toxicity of Neva Bay water (76% of samples) was significantly higher than the water of Luga Bay (38%). The toxicity of sediment amount to 59% of samples from the Neva Bay and 46% - from the Luga Bay.

By the results of pathoanatomical investigation of different species of fish from the eastern part of the Gulf of Finland chronic toxicosis were regular registered for most examples, predominantly in mild or moderate case. The maximum proportion of affected individuals was marked in the Neva Bay.

Symptoms of chronic toxicosis, as a rule, were marked for all systems of fish organism that showed the complex impact of harmful substances. Toxicoses predominantly was appeared as damages of tegument, gill tissue, and parenchymatous organs. Hemodynamics damage was typical for most fish.

The bulk of affected individuals was observed in samples of bream, smelt, herring and roach.

ASSESSMENT OF CHL-A ON GOF USING MULTISOURCE DATA

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Keywords: chlorophyll-a, satellite, Earth Observation, Alg@line, Gulf of Finland

To assess reliably and comprehensively eutrophication status of marine waters compel to develop and implement joint use of data from several monitoring methods. The data of this study consisted of chlorophyll-a results derived from three sources of the multi-faced Gulf of Finland (GOF) since the early 2000s: (i) conventional monitoring data originated from the trilateral dataset collected in the framework of GOF2014-year and ICES, (ii) Earth Observation (EO) data from satellite instrument MERIS (MEdium Resolution Imaging Spectrometer) and (iii) the Alg@line ferrybox system, which provides real-time information on the water quality with high-frequency automated sampling onboard several merchant ships on the GOF. This study evaluated chlorophyll-a results produced through EO, Alg@line and conventional water quality monitoring in different parts of the GOF. The comparisons were carried out by analysing areal distributions, time series and histograms. We also tested the ability of different measures of central tendency in EO and compared it to the conventional monitoring data to describe eutrophication status in the open GOF. We were able to yield spatially and temporally reliable results for the status assessments of the GOF.

CHLOROPHYLL AND NUTRIENT DYNAMICS IN THE GULF OF FINLAND DURING THE LAST TWO DECADES

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Keywords: chlorophyll, nutrients, eutrophication trends, GES

At present, phytoplankton chlorophyll a (Chl) is the most commonly used indicator of algal biomass in surface waters. It is often considered to reflect directly eutrophication status. We analysed the status and trends of Chl, as well as phosphorus and nitrogen concentrations in the Gulf of Finland (GOF) with available data sets from Estonia, Finland and Russia. The results showed, as expected, strong spatial and temporal variability for the whole study period 1996-2014. For the period after the early 2000s statistically significant decreasing trends of Chl were found for several areas of the GOF, including the easternmost parts. This development is probably connected to on average improved deep water oxygen conditions of the GOF in recent years, and also to a decrease in nutrient loading in the eastern Gulf. Regarding eutrophication, the decrease has not generally been strong enough for reaching GES (good environmental status). The nutrient dynamics for the entire GOF was closely related to episodic deep water intrusions from the Baltic Proper. Additionally, the River Neva flow pattern in the eastern Gulf strongly controls nutrient dynamics. The resulted year-to-year fluctuation in the concentrations of nutrients obscured the detection of clear temporal trends. Interestingly, in the eastern GOF, nitrogen level jumped up in 2008 with the concurrent invasion of the non-indigenous species *Marezzelleria arctica*. Phosphorus trends have increased lately in the western and middle offshore waters, while in the easternmost GOF and in the Finnish coastal waters some hints of decreasing trends since the early 2000s exist. The results emphasize the value of integrated monitoring and the further harmonization between national monitoring programmes.

LONG-TERM PHYTOPLANKTON MONITORING IN THE GULF OF FINLAND

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Keywords: monitoring and assessment, phytoplankton dataset, Golf of Finland

Finland, Estonia and Russia have combined for the first time (in 2014) their phytoplankton monitoring data of the Gulf of Finland (GoF). Combined dataset is now available and contains data from 1993 onwards. The dataset is a compilation of several datasets collected from around the Gulf of Finland as parts of national monitoring programs committed by the North-West Administration Hydrometeorology and Environmental Monitoring, Russia; Marine Research Centre, Finnish Environment Institute; University of Tartu, Estonian Marine Institute.

Finland has monitored phytoplankton quantitatively on 3 HELCOM COMBINE monitoring stations situated in the open GoF yearly in August since year 1979, and on two coastal stations once or twice per month during open water season since year 1993.

Estonian dataset comprises samples from 18 stations (6 of them sampled 10-12 times a year). Ferrybox samples 15-20 times per year from 3 stations in the western GoF.

In Russia, NW Roshydromet has collected samples usually three times per year (spring, summer, autumn) on 22 monitoring stations in the Neva Bay and on 15 monitoring stations in the GoF since 1978.

Dominant taxa: *Aphanizomenon flos-aquae*, *Planktothrix agardhii*, *Dolichospermum spp.*, *Skeletonema sp.*, *Cryptomonadales*, *Mesodinium rubrum*, *Pseudanabaena limnetica*, *Nodularia spumigena*, *Pseudanabaena spp.*, *Woronichinia spp.*, *Dinophysis acuminata*, *Protoperedinium spp.*, *Pyramimonas spp.*, *Heterocapsa triquetra*, *Chysochromulina sensu lato.*, *Coscinodiscus granii*.

TOWARDS SPATIAL OPTIMIZATION OF PHYTOPLANKTON MONITORING IN THE BALTIC SEA

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Keywords: monitoring, phytoplankton, Baltic Sea

Since water quality monitoring can be quite costly, it is important to properly design the monitoring network so that maximum information extraction can be achieved. One component of monitoring is measuring community composition of an area and detecting whether that has changed. Phytoplankton communities are associated with several sources of variations. In the Baltic Sea area, seasonality is the main factor shaping community structure. From April to October 2012, we collected samples simultaneously from 15 offshore stations in the western Gulf of Finland and northern Baltic Proper to find out spatial variability in phytoplankton species composition and biomass. The environmental conditions between those two basins were similar with slight but significant differences in salinity only. The area covered with sampling was 8400 km² and the distances between the stations varied from 10 to 200 kilometres. The analysis was performed with 10 dominant taxa selected on monthly basis and constituting >90 % of total phytoplankton biomass. The results revealed high variability and no clear changes in dissimilarities in the community structure with increasing spatial sampling distances. This allows us to conclude that the number of phytoplankton monitoring stations in open sea areas can be reduced without considerable loss of information on species composition. On the other hand, temporal resolution of sampling has to be kept high, especially during the bloom periods.

Gulf of Finland Trilateral Co-operation Scientific Forum, 17-18 November
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ASSESSMENT OF WATER QUALITY AND ECOSYSTEM STATE OF NEVA ESTUARY BY INTEGRATED INDEX *IP'*

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Keywords: anthropogenic stress, biodiversity, zoobenthos, water quality

Integrated indexes *IP* and *IP'* was elaborated for water quality and state of Neva River estuary assessment. It is based on structural parameters of zoobenthic communities and it allows to estimate both organic pollution and toxic contamination. Substantial differences in benthic communities structural parameters like number of species, abundance, biomass, biodiversity indices and *IP'* were registered on various sites of the Neva River estuary during the research period 1994-2014 years. On average the water quality of the Neva Bay judging from *IP'* values was relatively stable during 1994-2014 years period. It was assessed as «polluted» with exception for abnormality in 2006 («dirty») caused by large-scale dredging work. Average values of *IP'* in the Resort District of the eastern Gulf of Finland varied from 67.4 to 72.6% during 1994-2014 years period, what characterizes local waters as «polluted - dirty», i.e. one class lower in compare with water of the Neva Bay (except 2012-2013, where waters assessed like in the Neva Bay - «polluted»). As a consequence of pollution species diversity of benthic animals in the Resort District of the eastern Gulf of Finland is notably lower than in the Neva Bay.

MICROLITTER IN THE SURFACE WATERS OF THE GULF OF FINLAND- COMPARISON OF TWO METHODS

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Keywords: Marine litter, microplastics, methods

Two sampling methods for collecting surface water microlitter were compared during a monitoring cruise in the Gulf of Finland in August 2013:

1) Manta trawl, that samples the surface water with a 333 μm nylon mesh and
2) a submersible pump, that sucks water through a filter (nylon mesh; 300 μm and 100 μm in this study). The use of 100 μm mesh size (pump) gave in overall the highest microlitter concentrations. Using the submerged pump with 300 mesh size net gave higher total microlitter concentrations than Manta trawl. The maximum concentration of plastic fibres collected with Manta trawl was 0.72 particles m^{-3} , and with the pump 0.98 particles m^{-3} . Maximum concentration of other plastic particles collected with the Manta was 0.28 m^{-3} , and with the pump 0.5 particles m^{-3} . The same was observed also for non-synthetic fibres (Manta: max. 1.46 fibres m^{-3} ; pump: max 3.16 fibres m^{-3}) and combustion particles (Manta: max. 0.13 particles m^{-3} ; pump: max. 0.48 particles m^{-3}). Operating Manta for monitoring purposes is practical and less time consuming, while the use of the submerged pump minimizes contamination from air, and gives exact volumetric measures, and also allows the use of different filter sizes.

SELECTION OF BIOTESTS FOR THE ASSESSMENT OF CONTAMINATED SEDIMENTS: THE CONTEST PROJECT

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Keywords: contaminated sediments, sediment toxicity, biotests, Baltic Sea

There is a lack of a harmonised assessment methodology for contaminated marine sediments in the Baltic Sea countries. This is urgently needed for the ecosystem-based management of marine environments impacted by various anthropogenic activities such as dredging and dumping of sediment materials, industrial areas, contamination by riverine run-off municipal wastewaters, harbours, maritime traffic, and also in association to marine spatial planning in general, including energy constructions, sand extraction, fillings and artificial reefs. The CONTEST project (2014-15), funded by the Nordic Council of Ministers (the Finnish partner co-funded by the Finnish Ministry of the Environment) and consisting of major research institutions from Finland, Russian Federation, Sweden and Finland, is targeted at developing and harmonising methodologies for the assessment of contaminated sediments in the Baltic Sea. New information on the applicability and sensitivity of various biotest methods is provided. CONTEST presents recommendations on the selection of biotests to be used in the assessment of contaminated sediments based on an objective evaluation of the results obtained using an assemblage of scientific and practical assessment criteria. General guidelines on the use of biotests for the assessment of contaminated sediments in the Baltic Sea will be made available for all relevant national stakeholders from the public and private sectors in the partner countries.

FERROMANGANESE CONCRETIONS OF THE EASTERN GULF OF FINLAND -ENVIRONMENTAL ROLE AND EFFECTS OF SUBMARINE MINING

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Keywords: Fe-Mn concretions, marine geology, sediment, environment

Fe-Mn concretions in the Gulf of Finland may be considered to be important for environment because of their role in active concentrating heavy metals, radionuclides and phosphorus and their possible influence on the redox potential of the bottom waters.

In frame of TOPCONs project of ENPI Program (2012-2014) and national Russian project “Monitoring of geological environment” an area of Fe-Mn concretion underwater mining in the Vyborg Bay in 2006-2008 was studied. The main goal was to investigate the transformation process of ferromanganese concretions. Full coverage of study area by multibeam and side scan sonar survey, and careful choosing of sampling and video-observations sites allowed developing detailed map and receiving important results concerning Fe-Mn concretion growing/dissolving processes. Contrary to the hypothesis of possible concretion regeneration, it was found that within the trenches (up to 1 m of relative depth) left by mining vessel the natural conditions of sedimentation were markedly changed. Former slow sedimentation within these areas was replaced by active silty-clayey mud accumulation; observation and sampling of 2013-2015 indicated expanding of anoxic conditions and dissolving of spheroidal concretions, which nowadays are rare and mainly found buried in the sediments at a depth of 5-10 cm

Comparison of the geochemical structure of concretions sampled within areas of under-water mining and outside this zone, allowed to establish their noticeable difference, as a result of selective removal of elements from dissolving concretions. Thus, the concretions become a secondary source of contamination. Absolute age determination of concretions inside and outside under-water mining area using ²¹⁰Pb and ²²⁶Ra showed controversial results.

CHANGES IN HEAVY METAL CHEMISTRY OF THE SEDIMENTS OF THE GULF OF FINLAND DURING THE LAST TWO DECADES

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keywords: heavy metals, sediment toxicity, sediment quality, environment, improvement

During the Gulf of Finland Year 2014 old sediment sampling stations were visited with an aim of sampling muddy clays from the same positions as during the field work in the mid 1990'ies. 5 stations with old sediment heavy metal chemistry were visited in Finland, Russia, as well as Estonia. Examination of the obtained new sediment chemistry data revealed that sediment chemistry has partly improved but not in the same pace for all metals. Mercury concentrations have on average halved over the whole Gulf of Finland, with an average decrease of 51.7%, varying between 44 and 57.5% depending on station. Also cadmium concentrations have decreased considerably over the whole Gulf of Finland, with an average decrease of 39.4%, varying between 22.7 and 65.7% depending on station. Copper and zinc show some local increase of between 10 and 24% mainly at the western stations, but both metals show decrease at the easternmost station. Lead shows an average decrease of 17%, varying between 2.3 and 33.9%, such that the highest decrease is recorded at the easternmost station. Arsenic shows an average decrease of 25.4%, varying between almost none and 37.9%. Cobalt and chromium have remained at almost same levels as in the mid 1990'ies. On the other hand they have never been considered as being on alarmingly high levels in the Gulf of Finland. When comparing the data with sediment quality guidelines in practice much of the heavy metals data from 2014 still plot over the threshold levels. Interestingly mercury has decreased in such a degree in the topmost sediments that it now plots below or very close to its threshold level. None of the samples reach the probable effects level (PEL) in the surface, but zinc exceeds the PEL at depths of 5 to 10 centimetres at one site in the Eastern Gulf of Finland.

**POLYBROMINATED DIPHENYL ETHERS (PBDE_s) IN
SEDIMENTS AND WATER FROM THE NEVA RIVER AND
THE EASTERN GULF OF FINLAND (2011-2012)**

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Keywords: Gulf of Finland, Neva river, bottom sediments, natural water, PBDEs.

A total of 23 surface sediments and 5 water samples were collected in the Neva river (including Saint-Petersburg city area) and in the Russian part of the Gulf of Finland during 2011-2012. The samples were analysed for major PBDE congeners (in range of tri- to hexa-BDEs) entering into penta-BDE commercial mixture. ΣPBDE₁₀ concentrations in sediments of the Gulf of Finland and the Neva river ranged from 0.004 to 1.75 ng g⁻¹ dw and from 0.22 to 1.75 ng g⁻¹ dw respectively. The total concentrations of 6 PBDEs in natural water are ranged from 0.05 to 0.27 ng L⁻¹. The highest concentrations were found at Saint-Petersburg locations and in samples collected in fairway zone, suggesting that human activities contribute to PBDE contamination in environment. The congener profile results are showing that BDE-47 (tetra-BDE) is the dominant congener in sediment samples, but the congeners BDE-99 and BDE-100 (penta-BDEs) are predominant in the water samples. According to sediment and water quality guidelines established in EU (PNEC) and in Canada (FEQG), all samples can be classified as lowly contaminated with probable ecotoxicological impact to water organisms. The PBDE sediment concentrations measured in this study are comparable or lower than those reported for other areas of the Baltic Sea.

CONCENTRATIONS OF PCDDs, PCDFs, SOME PCBs AND HEAVY METALS IN BAYS SURROUNDING TALLINN

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Keywords: Gulf of Finland, Voll's sampler, sediment profile, dioxin, furan, PCDD, PCDD/F, PCB, TEQ, Hg, Cd, Cu, Pb, Zn, HELCOM metals

During years 2012 and 2013 a complex study was made in different bays surround Tallinn to investigate harmful substances in sediments and water column. A unique device was used for sampling water and soft sediment profiles. Samples were analysed against 7 polychlorinated dibenzo-p-dioxins (PCDD), 10 polychlorinated dibenzofurans (PCDF), 12 dioxin-like polychlorinated biphenyls (dl-PCBs), 13 WHO PCBs, 11 other PCB-s, Hg, Cd, Cu, Pb and Zn. Analyses indicated that the content of the most toxic HELCOM metals - Hg, Cd and Pb was very low at most stations, but considerable amounts of Zn and Cu were found at some stations. The highest concentrations of PCDD/Fs (WHO-TEQ 2005 value up to 6 ng/kg d.m.) and dl-PCBs were found in some deeper areas of Tallinn Bay and Muuga Bay. Based on the circumstance that the maximum concentrations of all investigated metals and compounds were found in lower layers of sediments (6 - 15 cm), it may be concluded that the environmental status of the catchments and also of the sea has improved considerably during the last decades.

Compared to sediment samplers used earlier, the new device (Voll's sampler) enabled simultaneous taking profiles with their composition and stratification representing the actual condition at the site.

The study was funded by the Estonian Science Foundation (Proj. 657).

CHARACTERISTICS OF THE ABUNDANCE OF PCDD/PCDF_S AND DIOXIN-LIKE PCB_S IN SEDIMENTS FROM THE NEVA RIVER AND THE EASTERN GULF OF FINLAND (2011-2012)

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Keywords: Gulf of Finland, Neva river, bottom sediments, PCDD/Fs, PCBs

A total of 24 surface sediments collected in the Neva river (including Saint-Petersburg city area) and in the Russian part of the Gulf of Finland were analysed for 17 polychlorinated dibenzo-p-dioxins, polychlorinated dibenzofurans (PCDD/Fs) and 12 dioxine-like polychlorinated biphenyls (dl-PCBs) congeners. The concentration levels of total PCDD/Fs and dl-PCBs in sediments ranged from analytical method detection limit to 219 pg g⁻¹ dw and 44.2 to 246 600 pg g⁻¹ dw respectively. The total WHO-TEQ value ranged between 0.01 and 59.0 pg g⁻¹. The results suggested that pollution levels of PCDD/Fs in sediments are considerable lower in comparison with the reported data of other areas of the Baltic Sea. For the Gulf of Finland overwhelming majority of the samples analysed do not exceed the threshold effect level (TEL) 0.85 pg TEQ g⁻¹ recommended by Helcom as quantitative targets for PCDD/Fs and dioxin-like PCBs. The congener profile analysis showed that, PCDD contamination in sediments should mainly originated from various combustion sources in association with human activities. As for the PCBs, the major source was identified as the usage of technical PCB products.

OPERATIONAL ASSESSMENT OF TANKER GROUNDING AND RELATED ENVIRONMENTAL RISK MANAGEMENT

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Keywords: tanker grounding, accidental structural damage, oil spill environmental risk
management, risk based optimization of vessel route, sensitivity function

Paper presents simulation environment in support of operational assessment of tanker grounding and related environmental risk management that consists of (i) accidental damage and oil spill assessment module and (ii) SmartResponse Web based environmental risk management module. The damage evaluation module defines the size and the position of the structural damage that is input for the oil spill operational assessment. Both the minor damage where only the outer hull is damaged and the major damage, where the whole double hull is breached are included. The influence of ice interaction is taken into account in the damage and following oil spill calculations. The amount and duration of oil spill is simulated using a model based on internal hydraulics theory. The coupled Seatrack Web - Smart Response Web simulation tool is used to assess the environmental consequences of the accidental oil spill. Performance of integrated simulation environment is exemplified by simulating the grounding accidents in the Gulf of Finland. Focusing on the maritime transport safety the risk theory based solution to the problem of optimal vessel route is presented and discussed. In addition, with aim to contribute to protection of sensitive environment the sensitivity function is formulated and used to specify the contribution of each marine basin point to the total pollution of the selected 'protected area'.

THE RISK MANAGEMENT MODEL OF WINTER NAVIGATION OPERATIONS

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The maritime traffic operations in the Gulf of Finland during wintertime are managed by the safety guidance and support provided through the Finnish-Swedish Winter Navigation System (FSWNS). This guidance establishes the requirements and limitations for the vessels which attempt to navigate when ice totally or partially covers this nautical area. This article presents a model for managing the risk of winter navigation operations. The model analyses the four most common winter navigation operations performed by merchant vessels and icebreakers. The aim is to identify different parameters for ensuring the safety during the development of these operations and to provide decision support concerning appropriate risk reducing measures for the assessed navigational operations. The model analyses the probability of having potential oil spills derived from collisions involving oil tanker vessels and other type of vessels. The model structure is based on the steps provided in the Formal Safety Assessment (FSA) by the International Maritime Organization (IMO). Thus, the steps of the FSA and the analysis of different technical aspects such as traffic conditions, vessels characteristics, ice conditions and damage estimation are integrated within a Bayesian Network model. The functioning of the model enables the identification of the correct and incorrect patterns for the development of winter operations. The results of this study present ship independent navigation and convoy operations as the types of operation with the higher probability of potential oil spills. However, the model is also able to represent a set of recommended actions and risk control options for the prevention of collisions during wintertime navigation.

ENVIRONMENTAL SAFETY MANAGEMENT OF ECO-SOCIO-TECHNICAL MARITIME TRANSPORT SYSTEM IN THE GULF OF FINLAND (BALTIC SEA)

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Keywords: System Theoretic Accident Model and Processes, System Theoretic Process Analysis, Maritime Spatial Planning, Marine Strategy Framework Directive, good environmental status

With increasing oil maritime transport in the Baltic Sea, and especially in the Gulf of Finland, the possibility of environmental harm due to shipping accidents is growing. The System Theoretic Accident Model and Processes (STAMP) approach is used to extend the Gulf of Finland Reporting System (GOFREP) beyond the area of socio-technical maritime transport safety into realm of environmental safety and toward even more complex eco-socio-technical system. The EU Marine Strategy Framework Directive (MSFD) good environmental status (GES) criteria are used as a comprehensive set of environmental risk management outcomes that are based on 11 interlinked integrative descriptors covering the functioning of the marine ecosystem in the Gulf of Finland. Relevant GES indicators are linked to the maritime transport environmental effects risk criteria and are used primarily to determine the effectiveness of the environmental safety management measures. Proactive resilience engineering and the System Theoretic Process Analysis (STPA) based safety-guided design is integrated into the Maritime Spatial Planning (MSP) methodology with aim to enhance the overall safety and efficiency of the planning solutions and to enable multiple users of marine areas, including government, shipping, offshore energy, aquaculture, fishing, conservation and recreation, to make informed, coordinated decisions about how to use marine resources / ecosystem services sustainably and reduce conflict between users.

**INDICATOR DEVELOPMENT FOR HUMAN IMPACT
ASSESSMENT FOR COASTAL LOCAL MUNICIPALITIES IN
THE GULF OF FINLAND**

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Keywords: human impact assessment, marine environment, maritime spatial planning, Baltic Sea

Human activities strongly affect marine environment in the whole Baltic Sea area. Furthermore, the Gulf of Finland is one of the most impacted areas due to riverine input of nutrients, active maritime traffic and tourism. However, also the coastal territories affect the environmental state of the marine areas. In this study the Human Impact Assessment (HIA) estimation for coastal local municipalities is developed to assess their impacts on the marine environment. Data on common enterprise impacts, atmospheric emissions, protection costs, protected areas and coastal population density were collated and used to calculate indicator values for each coastal municipality and region. The method is representative, nonmetric and independent to the geographic region and thus provides an opportunity to compare areas and regions. The results indicate great differences among areas with different economical activities and population densities. The study was financed by the South-East Finland - Russia ENPI CBC programme project TOPCONS - Transboundary tool for spatial planning and conservation of the Gulf of Finland.

METADATA ANALYSIS IN THE GULF OF FINLAND FOR MSP - LESSON LEARNT

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Keywords: maritime spatial planning, maritime spatial data, Gulf of Finland

Maritime spatial data comprise the backbone of the information needed in spatial planning. Collecting comprehensive, representative and high-quality data to cover a large sea area is a challenging task; and it is even more complicated if the area is shared by several countries.

Data inventory and metadata analyses were conducted to get an overview of the availability of maritime spatial data in the territorial waters of Estonia, Finland and the Russian Federation. The data coverage was assessed both thematically and spatially, and the main gaps in knowledge were identified. The 247 datasets identified include plenty of useful information for the Gulf of Finland MSP. Although it is not straightforward to assess the sufficiency of the information, the current data selection serves as a good starting point for the spatial analysis. The numerous technical, semantic, and thematic issues nevertheless hinder the interoperability of spatial data.

The future MSP work in the Gulf of Finland should follow these recommendations: 1) The identified data gaps should be acknowledged and verified, and new data production should be focused on the high-priority themes with lacking information. 2) Data should be collected in a harmonised manner to ensure technical and semantic interoperability in an international cooperation. 3) Communication among the planners in different countries is encouraged to establish a common understanding of the planning practices and data management principles.

THE VALUE OF BIODIVERSITY MONITORING IN THE GULF OF FINLAND

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Keywords: Biodiversity, Cost-effectiveness, Indicator-based assessments, Management, Marine Strategy Framework Directive, Monitoring

Monitoring of the environment provides the basis for understanding natural fluctuations and anthropogenic changes in ecosystems and the processes behind these. The collected monitoring data are fed into indicators, which respond to specific pressures and are able to detect changes in the ecosystem. These indicators advise management actions. Appropriate sampling frequency is needed to catch the magnitude of natural variability and diverging trends. The value of monitoring can be assessed as gains in detecting changes at an early phase and proper choice and scaling of measures. Monitoring thus assists in maintaining a healthy environment producing ecosystem services and advising on their sustainable use. In the MARMONI and DEVOTES projects the cost-effectiveness of marine biodiversity monitoring was assessed. To estimate the costs for the biodiversity monitoring programs, all expenses (field work, equipment, analyses, man-years etc.) were collected and evaluated based on the confidence of data and compliance of indicators fulfilling the criteria of the Marine Strategy Framework Directive. Lessons learned show that to evaluate the costs of monitoring programs it is important to account for the added value of combining sampling efforts and efficient use of collected data. Here, we focus on the Gulf of Finland and assess the value of information brought by biodiversity monitoring programs in context of management actions and sustainable use of ecosystem services.

**INTERLINKAGES BETWEEN ZOOBENTHIC
ASSEMBLAGES AND ABIOTIC ENVIRONMENT IN A
HETEROGENEOUS INLAND SEA AREA, THE EASTERN
GULF OF FINLAND**

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Keywords: Gulf of Finland, Ecosystem based management, Biodiversity, Geodiversity

In order to define broad scale habitat distribution patterns in a geologically heterogeneous inland sea with a vast archipelago in the Gulf of Finland, we have combined spatial datasets of hydrographic and geologic information to species abundance. Several datasets describing coastal influence and seabed heterogeneity at multiple scales were included in the analysis. Multivariate statistical analysis tools were used to identify links between the datasets. Salinity and broad scale variables describing physical complexity of the seabed had individual ρ -values above 0.7 and the combination of Secchi depth, stones, substrate variability in 20 km radius and slope with 20 km radius mostly accounted for the variation in the zoobenthic assemblages (ρ — value 0.80). Statistical analysis of specific zoobenthic assemblages allowed us to designate 11 broad scale marine habitats that resembled each other by their geological and hydrographical characteristics. The study demonstrates that physical heterogeneity of the seafloor should be considered in broad scale habitat mapping and marine spatial planning. The study is a part of ENPI CBC funded Finnish-Russian co-operation project the TOPCONS.

**LITTORAL COMMUNITIES OF THE NEVA RIVER
ESTUARY: STRUCTURE AND DYNAMICS OF
QUANTITATIVE ADJECTIVES UNDER ANTHROPOGENIC
PRESSURE**

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Keywords: littoral communities, Neva river estuary, amphipods

Habitats heterogeneity of the Neva river estuary littoral creates conditions for communities formation, which keep generalities in spite of the difference of conditions. Research showed that during many years in the littoral communities of the northern shore of the Neva bay amphipods, chironomids and oligochaetes dominate by abundance as well as by biomass. Amphipods at all sampling sites are represented by 2 alien species. One species (*Gmelinoides fasciatus*) has presence in the communities of 2 sites nearest to Saint-Petersburg, at the open part of the estuary lives another species (*Pontogammarus robustoides*). Ephemerals are numerous, grandly functioning in the food chains by energy transfer from detritus to the second-order consumers (amphipods, fishes). Typical representatives of the freshwater fauna are not numerous and don't play a significant role in communities functioning. So, leeches are extremely rare, dragonflies, water-slaters and indigenous amphipods species are absent, what affirms the significant influence of alien amphipods species on the littoral communities. Comparison of the research results with the data published before allowed to ascertain, that from the start of hydroengineering work in the Neva river mouth the substantial changes occurred in the littoral communities structure. So, from 2009 to 2011 quantitative characteristics of macrozoobenthos communities declined drastically.

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**SEASONAL AND SPATIAL VARIABILITY OF *FUCUS*
VESICULOSUS ASSOCIATED FAUNA IN ESTONIAN
COASTAL WATERS**

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Keywords: *Fucus vesiculosus*, associated fauna, Estonian coastal waters, seasonal variability

Fucus vesiculosus is an important canopy-forming alga on the rocky shores in Estonian coastal sea. It provides food and shelter for associated fauna and contributes to the biodiversity of an area. The aim of this study is to assess spatial and seasonal distribution of *F. vesiculosus* associated fauna in relation to environmental conditions. Samples of *F. vesiculosus* with associated fauna were collected in summer and autumn in 2013 by SCUBA diving from four study sites in Estonian coastal waters along the salinity gradient in the North-Eastern Baltic Sea. Our findings make a contribution to the field of sea ecology in Estonia as well as in the Baltic Sea on the whole. Abundance and diversity of *F. vesiculosus* associated fauna varies between study sites and seasons. The abiotic factors were crucial in determining the structure of associated fauna.

**CLIMATIC IMPACT AND BIOMASS OF OPPORTUNISTIC
MACROALGAE IN THE NEVA ESTUARY (EASTERN
BALTIC SEA)**

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Keywords: Cladophora, Climatic impact, North Atlantic Oscillation, Green tides

During last decades so-called ^{fc} 'green tides', caused by increasing nutrient loading in coastal areas, have become widespread. Besides of anthropogenic impact, the natural factors (e.g. climatic) can influence on macroalgal communities, regulating its development in different years. Understanding of this influence can help us to foreseen consequences of climate change and develop measures on management of coastal areas. In presented study the impact of climatic factors and North Atlantic Oscillation (NAO) on macroalgal community was analysed. It was found that climatic impact may depend on habitat features and that on different sites biomass of macroalgae correlated with different weather factors. Also seasonal biomass inversely significantly correlated with average seasonal wind speed and annual NAO-index. It is known that positive NAO causes increase of temperature in surface water layers, increasing sedimentation and accumulation of nutrients that can cause mass occurring of opportunistic algae. On the other hand increased impact of Atlantic cyclones causes frequent storms that adversely affects macroalgae. In presented study, calculated correlations demonstrated this negative influence. Studies of climate impact and other associated factors should be continued for prediction of mass occurrence of macroalgae on coasts. Detection of sites with accumulation of biomass due to transfer form neighbour areas or stagnant events may be useful for effective coastal management.

NEAR BOTTOM OXYGEN DEFICIENCY AND INTERNAL LOADING OF PHOSPHORUS IN THE COASTAL AREA OF HELSINKI

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Keywords: Phosphorus, Oxygen, Hypoxia, Anoxia, Internal phosphorus load, Eutrophication

We set out to elucidate the current state of the near bottom waters and bottoms of the coastal area outside Helsinki. There are several smaller areas where seasonally hypoxic near bottom waters occur close to the coast, and one larger hypoxic area, which is connected to the deep areas of the Gulf of Finland. Based on the results of our study, the areal extent of the hypoxic near bottom waters was estimated to be approximately 141 km². This area covers approximately 12 % of the studied bottom area.

In general, the flux of phosphorus from the sediments is largest when the water is vertically stratified, during late summer. This is also the time of the largest extent of hypoxic and anoxic near bottom waters. During this time, based on results from our incubation studies, the internal load of phosphorus was estimated to be approximately 10 times larger than the calculated external load. This estimate is most likely the upper limit of the potential internal phosphorus loading in the area, due to the methods used and timing of the study. When the oxygenated surface water is mixed down to the bottom during autumn the flux of phosphorus is most likely reversed, and the sediments start binding phosphorus instead of releasing it. To what extent the sediments can retain phosphorus depends on the labile organic matter content and the availability of iron compounds capable of binding phosphorus.

**NEW APPROACH TO MODEL BENTHIC LAYER WITH
IMPACT OF BIOIRRIGATION ACTIVITY OF
MARENZELLERIA SPP. IN THE GULF OF FINLAND**

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Keywords: modeling, benthic layer, invasive species, Gulf of Finland

The new approach to model benthic nitrogen and phosphorus fluxes changes with impact of invasive polychaetes *Marenzelleria spp.* activity in the pore water and sediments in the Eastern Gulf of Finland was developed. Given parametrization of bioirrigation activity was implemented in the model of benthic layer in Sankt-Petersburg eutrophication model of the Baltic Sea (SPBEM).

Since the end of 2000s biogeochemical processes in the sediments in the Eastern GoF have been affected by *Marenzelleria spp.* For quantitative assessment of bioirrigation activity impact on benthic layer diagenetic model CANDI (carbon and nutrient diagenesis) was applied. For model validation field data were collected from the Gulf of Finland in the years 2013 and 2015. Comparative analysis of model results for those years was carried out. The phosphorus and nitrogen dynamics are studied for the period 2010-2040 using new modification in the model of benthic layer with impact of bioirrigation activity of *Marenzelleria spp.* Preliminary results of simulations will be discussed.

DANGEROUS SEA LEVEL RISES IN THE EASTERN PART OF GULF OF FINLAND: MECHANISMS, STATISTICAL STRUCTURE, INTERANNUAL VARIABILITY

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Keywords: Gulf of Finland, floods, ADCP, currents, dangerous sea level rises, baroclinic conditions, atmospheric cyclones, interannual variability

Based on the results of Fourier analysis of hourly tide gauge sea level measurements at coastal and island stations in the eastern Gulf of Finland, characteristics of the Neva flood waves are estimated. These characteristics are compared with the theoretical dispersion relations of different types of low-frequency waves. This comparison shows that the Neva flood waves can be identified as baroclinic topographic waves. To confirm theoretical interpretation, the ADCP measurements of currents at various points in the Gulf of Finland during the floods in December 2011 are used. Statistical analysis of these data revealed a baroclinic nature of the low-frequency waves, which form dangerous sea level rise in the eastern Gulf of Finland. The results of the cross-correlation analysis show the strong connection between sea level and baroclinic currents during the formation of flood. The results of the statistical analysis of meteorological data do not support the hypothesis that the interannual variability of various characteristics of atmospheric cyclones is the main cause for the increased frequency of Neva floods in the recent decades. In contrast to absence of correlation between the flood events and characteristics of atmospheric cyclones, a high correlation between the number of dangerous sea level rise events in the eastern Gulf of Finland and the interannual changes of baroclinic conditions of the some areas Baltic Sea was found.

NUMERICAL STUDY OF SUBMESOSCALE FLOWS IN THE GULF OF FINLAND (GOF)

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Keywords: submesoscale eddies, numerical model, diapycnal mixing

Despite the importance of structures and processes on lateral scales of a kilometre (submesoscale) on certain hydrophysical processes – upwelling/downwelling, relaxation of the upwelling, estuarine circulation, density intrusions from the open Baltic, the understanding of submesoscale flows is still limited.

FMI and RSHU cooperation aim to improve understanding of the submesoscale, its dynamics and its associated effects on the lateral mixing of tracers by introducing a state-of-the art eddy resolving NEMO-based 3-D community model of the Gulf of Finland (GOF). We have developed tools that allow us to design and compute a flexible set of nested computational domains. This will enhance the interpretation of high resolution in situ and remotely sensed data and help predict mixing rates at small scales.

Submesoscale eddies and filaments generated by baroclinic instability of fronts recently recorded and modelled at the entrance to GOF (intrusions). In addition to lateral mixing of tracers, the small scale flows can also lead to significantly enhanced diapycnal mixing rates. The layered flow structures as well as sub-mesoscale intrusions of waters with different temperature and salinity along the isopycnals interact with vertical displacement of isopycnals (upwelling or downwelling). According to the modeling results these processes could also substantially contribute to the vertical material exchange (create episodic nutrient pulses or sub duct organic carbon) and re-stratification of the water column.

**ANATOMY AND STATISTICS OF SUBMESOSCALE
STRUCTURES SIMULATED DURING AN UPWELLING
EVENT IN THE GULF OF FINLAND, BALTIC SEA**

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Keywords: numerical modeling, submesoscale processes, upwelling

The aim of the present study is to estimate the role of submesoscale processes in the Gulf of Finland using model simulations for the real case scenario in summer 2006 when series of upwelling events occurred along the northern and southern coasts of the gulf. These upwelling events were widely documented by in situ observations and satellite sea surface temperature (SST) maps. We apply the Princeton Ocean Model (POM) with a domain comprising the Baltic Sea in orthogonal grid. Simulations with different horizontal resolution in the Gulf of Finland have been carried out to detect and emphasize the role of submesoscale processes. The initial conditions of the thermohaline fields are taken from the High Resolution Operational Model of the Baltic Sea (HIROMB) and atmospheric forcing from the High Resolution Limited Area Model (HIRLAM). The time-series of spatially averaged parameters (e.g. upwelling index, vertical velocity) show significant changes due to increase in horizontal resolution. The role of submesoscale processes in calculations and importance of the high resolution in simulations compared to the low resolution will be discussed.

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THE SATELLITE-MEASURED SEA SURFACE TEMPERATURE CHANGE IN THE GULF OF FINLAND

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Keywords: sea surface temperature, climate change, satellite

Climate change in Baltic region and in the Gulf of Finland is accomplished fact in human brains and in science. The purpose of this research is to retrieve quantitative level of changes for sea surface temperature (SST) of the Gulf of Finland. Two space systems NOAA/AVHRR and AQUA/MODIS provided satellite data about temperature of the sea surface. SST data cover period 1981-2014 and include 444 monthly data scenes with spatial resolution about 10 km. Data quality analysis display high reliability of NOAA/ AVHRR and AQUA/MODIS satellite information. The Gulf of Finland average annual SST changed from 6.8 °C in 1982 up to 8.2 °C in 2014. It means the speed of warming about 0.04 °C per year. The growth of the temperature was irregular, in the middle of 80s temperature dropped up to 5.0 °C and then sharply increased up to 7.3 °C in 1989. SST growth in the Gulf of Finland coincides with air temperature and sea temperature growth. The climate change in the Gulf of Finland takes on special significance due to the fragility of the northern ecosystems and anthropogenic load.

ALIEN SPECIES IN THE RUSSIAN PART OF THE GULF OF FINLAND

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Keywords: alien species, non-indigenous species, Gulf of Finland

Alien or non-indigenous species - the species of organisms (plants and animals), which are not aboriginal (not originally native) for the certain area; in our case - non native for the Gulf of Finland and the Baltic Sea in the whole.

For getting the name "alien species" the organism first of all have to pass the first stage of invasion - to make a "big jump", what is transoceanic or transcontinental translocation. Thanks to anthropogenic "help" (like transportation by oceanic vessels or via artificial canals connecting originally isolated big geographical and faunistic areas) organisms-invaders are able to do such "big jump" in very short time with the speed of vessel (some days just needed for the "jump"). The next second stage of invasion is the dispersal within the new area, what goes on slowly and takes many years to fill the whole new area in accordance to ecological abilities of "new-borned" alien species. This dispersal may also be promoted and accelerated by human, but often invaders do this themselves by natural distribution. One more stage of alien species following invasion is possible - it is a new "big jump" to other new area(s). It may happen when organism becomes abundant in a new "fatherland". We call it "secondary invasion" or secondary "biological pollution".

The Gulf of Finland has unfavourable environmental conditions to most of representatives of both marine and freshwater organisms of the world, especially for ones from southern regions. Just two types of organisms may successfully inhabits here as follows:

- organisms specialized for mesohaline (estuarial) conditions;
- organisms with very high range of salinity tolerance (euryhaline). Both groups are not numerous world-wide and they are rare everywhere, so the number of potential invaders to the Gulf of Finland is very limited. Additional limitation for invaders naturalization is inclement climate conditions, what may prevent the survival and reproduction of many alien

species of southern origin. The scope of aliens in the Gulf of Finland consists of exactly highly tolerant organisms, the champions of survival; many from them are linked with fouling communities. The history of the Gulf of Finland modern biota gives examples of all mentioned above processes of alien species penetration and dispersal as "big jumps", "creeping distribution" and secondary invasion.

Zoological Institute of Rus. Acad. Sci. is a leading organisation of Russia for biodiversity investigations and alien species particularly. Twelve monitoring stations in the Russian part of the GoF are under the regular control annually. The list of alien species have been registered in this area consist of 40 species and plants (including some microalgae). About 90% of them are already naturalized or close to it, 2 species *Stenocuma graciloides* and *Dreissena bugensis* were registered only once. The scope of alien species is not homogenous. We have to distinguish "pioneer registrations" (observations of "big jump" *in statu nascendi*) and the results of slow gradul dispersal from other areas of the Baltic Sea, where the species firstly appeared. HELCOM proposed new alien species arrivals per time unit as an indicator of regional environmental status. As new arrivals we have to estimate only really new ones (= "pioneer" or "big jump" registrations). Doing so, last 5-6 years it was no new arrivals of alien species in the Russian part of the GoF, but only arrivals from neighbouring waters of Estonia and Finland, which in its turn was used as a transit zone for dispersal to Russia of several species like round goby *Neogobius melanostomus*, rockpool prawn *Palaemon elegans* or nudibranch mollusk *Tenellia adspersa*. These species were firstly "jumped" to Polish waters or other parts of the Baltic Sea long ago and afterwards moved to the Gulf of Finland step by step.

It was demonstrated that all alien species affects domestic ecosystems and the impact dependent of species abundancy. However the harm from them (environmental and economical damage) is not as significant as it was expected earlier. Some of alien species have positive biological meliorative influence to ecosystems as well like *Dreissena polymorpha* for hard bottom and *Marenzelleria spp.* for soft bottom communities.

Areas of warmed-up water at the NPPs Loviisa and Sosnovy Bor may serve as a refuge for warm-water alien species (for example mussels *Mytilopsis leucophaeata*). How this species got there is still riddle, what merits the special attention and careful study. Anyway this mollusk is unable to reproduce and overwinter outside of restricted area, impacted by NPP warm waters. Monitoring of alien species in the Gulf of Finland is needed for tracing out a changeable situation and for correct and cost-effective practical decisions.

**USING OF AQUATIC INVADER *GMELENOIDES FASCIATUS*
FOR MONITORING OF WATER POLLUTIONS IN THE
BALTIC SEA REGION**

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Keywords: chromosomal aberrations, monitoring, bioindicator

The genome of cells of bioindicator species is the first link during response to environmental stresses. Its integrity can be estimated by cytogenetic methods. Ana-telophase analysis is simple and powerful method to provide such assessment. We showed earlier that developing embryos of isopods can serve successfully for evaluation of environmental stress along coastal line of White and Barents Seas. The same results were obtained for some fresh water lakes and soil.

We used amphipod *Gmelinoides fasciatus* of Gulf of Finland to estimate their suitability for similar analysis. Preliminary results show that it is quite easy to get enough number of dividing cells from 7-10 animals for correct statistical analysis. The level of spontaneous chromosomal aberrations in relatively clean area in mitosis is comparable with corresponding frequencies in Isopods. It seems valuable to compare this level with that in native Baikal Lake's habitat and in other places under anthropogenic pressure for estimating sensitivity of this new possible bioindicator. The wide spread of *G. fasciatus* makes them promising for biomonitoring in Baltic region and North-West Russia.

CLIMATE CHANGE AND ANTHROPOGENIC IMPACT ON FISH STOCKS OF FINLAND GULF

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Keywords: Climate change, anthropogenic impact, fish stocks

The studies of regularities, relationship of external regime-forming factors and hydrometeorological processes of Baltic Sea with subsequent assessment of their development trends permit to reveal an ecosystem reaction to changes of weather conditions and model its state in next years.

However, represented tendencies to decrease in stocks of commercial fishes in nineties conditioned by natural factors are aggravated by increased anthropogenic load on the Baltic Sea ecosystem.

Besides varying cyclically nature factors (temperature regime, duration of vegetation period, liquid-water content of year, salinity, food reserve and etc.) anthropogenic factors have an adverse effect on condition of fish stocks of Gulf of Finland, primarily hydraulic engineering works (production of rock materials, dredging, alluviation, soil grounds etc).

Consequences of these works are loss of fish spawning grounds and pasturages, decrease in productivity of all biota components owing to change of hydrological reservoir parameters and as a result decrease in fish harvesting.

Noted that in the predicted hydrological situation (tendency to fall of temperature and increase in entry of brackish waters) one can expect positive changes in the condition of fish stocks of the Baltic Sea, including inhabiting the Gulf of Finland.

To preserve and recover depleted stocks of the most valuable fish species it is essential to continue a working out measures of reproduction of natural fish populations, development of recreational aquaculture, construction of artificial spawning areas.

**STOCK DIVERSITY OF HERRING IN THE NORTHERN
BALTIC: IS THE SEPARATE ASSESSMENT OF THE
HERRING IN THE GULF OF FINLAND POSSIBLE?**

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Keywords: Gulf of Finland herring stock diversity, growth, assessment, management

Maintaining the biological diversity is one of the main goals of sustainable management of exploited fish stocks. Therefore, the assessment and management should ideally take place on the basis of natural populations (stocks). However, lack of methods allowing fast and reliable discrimination between fishes belonging to different populations and temporal/spatial variability of migrations are the main problems, leading in most cases to various compromises while establishing assessment/management units. The Baltic herring (*Clupea harengus membras* L.) show a remarkable geographical variability. The local stocks (up to 10-12 in the Baltic Sea) have differences in morphology, growth pattern and stock dynamics, and can be divided into the gulf stocks and open sea stocks. Three gulf stocks (Gulf of Riga herring, Gulf of Finland herring and Gulf of Bothnia herring) and the stock of Northern Baltic proper inhabit the Northern Baltic. The discrimination between gulf and open sea stocks is based on differences in otolith shape and growth pattern. The Gulf of Riga herring and the Gulf of Bothnia herring are assessed and managed as a separate units whereas the rest two have been treated as parts of Central Baltic Herring stock complex (Subdivisions 25- 28.2, 29&32). The Gulf of Finland herring, however, was assessed by ICES as a separate stock. The main goal of the present study was to explore the possible trends in the Gulf of Finland herring stock since 1990 when it was included to the Central Baltic Herring stock complex.

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**ATLAS OF TROUT (*SALMO TRUTTA*) AND SALMON
(*SALMO SALAR*) POPULATIONS OF THE GULF OF
FINLAND RIVERS**

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Keywords: Atlas of fish, trout salmon, Gulf of Finland, management, conservation

The Atlas of Finnish Fishes, which was first published in 1998, offers specific information on the distribution of indigenous fish species with accurate maps. The status of the stocks is described under the themes such as the origin of stocks, category of threat and degree of self maintenance. The electronic version of the Atlas was developed and can now be found on www-pages of Luke. In Gulf of Finland Year 2014 it was decided to start a compilation of a Fish Atlas of Gulf of Finland with the most vulnerable and valuable anadromous species, trout and salmon. The biology of species, status of the populations, genetics, threats, management and conservation are briefly described. The information of the Atlas offers a basis for planning future conservation and restoration strategies and the sustainable use of resources of these species, as well as gives an overall view of their state for the whole Gulf of Finland region. The aim is to create an updated joint net based Atlas of other Gulf of Finland species, too.

ENVIRONMENTAL AND TECHNOLOGICAL ASPECTS OF SUSTAINABLE AQUACULTURE DEVELOPMENT AT THE GULF OF FINLAND

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Keywords: sustainable aquaculture, offshore fish farming, submersible cages, Gulf of Finland

Aquaculture in the Gulf of Finland (GoF) has a great potential for development based on innovations especially with applications of green technologies and production methods. Gulf of Finland has the biggest rate of water exchange among the all Baltic Sea water areas; it is about four times more than Gulf of Bothnia has. But presently the aquaculture production in the GoF is minimal (few cage farms at the sheltered bays along the Finland coast line) because of technological and environmental concerns. It is possible to decrease environmental load from fish farming due to better feed, more professional husbandry, and larger scale of cage farms moved further offshore. Obviously open sea sites in the offshore areas will meet the problems of storm waves and ice fields but these hazards could be solved using submersible cages. At frozen areas and ice-infested waters submersible cages are solution for all-year round and seasonal fish farming. Before winter time cages will sink into safety depth to prevent the ice hazard. Submersible cages are suitable for any sea areas; resistant and durable; have minimal visual impact; help to avoid users' conflicts. Modern versions of submersible fish-farming system requires minimum expenses of servicing which is performed similar to those with conventional floating cages. Offshore fish farming must be the subject of spatial maritime planning for sustainable aquaculture and "Blue growth" in GoF countries (Finland, Estonia and Russia).

HOW WINTER pH HAS CHANGED OVER THE LAST 40 YEARS IN THE GULF OF FINLAND

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Keywords: pH, winter, vertical, annual, trends, climate change

Since the 1880s, the pH of ocean surface waters has fallen on average by 0.1 units and values of 7.8-7.9 are expected by the end of this century. The Baltic Sea will be no exception to this development, and the pH decrease is expected to be even more pronounced in the Baltic Sea, due to low buffer capacity in some basins. The Baltic Sea has been monitored regularly for a vast number of variables for more than 50 years. These data are a valuable tool for documenting and for generating further understanding of the impacts of environmental change. In this study, we present an analysis of the pH over the last 40 years along a gradient of stations from the east to the west in the Gulf of Finland. The aim is to analyse the variability of the pH according to the depth during the winter months. We use the wintertime data as summer pH usually is high following algal photosynthesis. Salinity, temperature and oxygen data will also be included in the analyses. All data were obtained from the Finnish Environment Institute and the Finnish Meteorological Institute. Our working hypothesis is that pH is decreasing in winter months, not only at the surface, but also in the deeper areas. The results will be discussed in further detail.

ABUNDANCE AND FEEDING OF CYPRINID FISHES IN EASTERN GULF OF FINLAND

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Keywords: fish, diet, coastal shallow waters, invasive species, eastern Gulf of Finland

A study was conducted in mid of July of 2014 in shallow coastal areas (depths from 0 to 1.5 meters) of the Gulf of Finland. The beach-seine samples were collected in selected habitats on northern and southern shores of the eastern Gulf of Finland, from Neva bay to the western Russian border. In the studied area, 15 Cyprinid fish species were recorded. Food composition of 4 species (*Rutilus rutilus*, *Alburnus alburnus*, *Gobio gobio*, *Leuciscus leuciscus*) was investigated. Planktonic species from Cladocera (*Chydorus sphaericus* and *Alona sp*) and Rotifera (*Keratella cochlearis*) dominated in stomach contents. Such benthic invertebrates as Chironomidae also were found in stomachs. All taxa together accounted for more than 80% of the biomass of food and presented in more than 70% of stomachs Cyprinid fish species. The dominant fish species in the surveyed area were bleak (*Alburnus alburnus*) and roach (*Rutilus rutilus*). Specimens of both species were presented in samples of juveniles and adults. Bleak was mostly numerous in July along the southern shore of the Neva bay, in the Resort area of Saint Petersburg, and in the Vyborg bay. Abundance of bleak reached 244 ind/100m² in the Neva bay and varied from 232 to 1612 ind/100m² in the Vyborg bay. Roach was mostly abundant on the shallows in the open part of the eastern Gulf of Finland and reached 15 ind/100m² on the Southern coast and 23 ind/100m² on the Northern coast. Other Cyprinid species were common but less abundant.

TOWARDS AN EVIDENCE-BASED PROBABILISTIC RISK MODEL FOR SHIP GROUNDING ACCIDENTS

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Keywords: Ship Grounding, Bayesian Belief Network, Evidence-Based Modeling, Strength of Knowledge

Most of the risk models for ship-grounding-accidents are based on expert opinions. This has caused the models merely present imaginary scenarios that are based on the intuition of their developers. The major issue with such type of models is their limitation in supporting the process of risk management, since they do not reflect the reality to the extent required. This paper presents an evidence-based approach to structure a model assessing the probability of ship-grounding-accidents, which is more suitable for risk management purposes. The approach focuses on using evidential data of ship-grounding-accidents extracted from the actual accident and incident reports. The probabilistic model that is developed gathers, in causal fashion, the evidential contributing factors in a ship-grounding-accident. The outcome of the model is the probability of a ship-grounding-accident given the prior and posterior probabilities of the contributing factors. Moreover the uncertainties associated with the elements of the model are clearly communicated to the end-user adopting a concept of strength of knowledge. The model can be used to suggest the proper risk control measures mitigating the risk. By running uncertainty and sensitivity analyses of the model, we define the areas that need more research in order to be able to make educated decisions. The model suggests that the high-level critical parameters that need proper control measures for the sea area analysed here are the complexity of waterways, traffic encounter situations, and the ship being off course. The critical area that calls for more investigation is the onboard presence of a sea-pilot.

**THE RESULTS OF LONG-TERM MONITORING RESEARCH
OF VASCULAR PLANT FLORA OF THE OUTER ISLANDS
OF THE GULF OF FINLAND (LENINGRAD REGION)**

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Keywords: vascular plants, outer islands, the Gulf of Finland

The vascular flora of the outer islands (Gogland, Seskar, Moschny, Bolshoy Tyuters, Maly Tyuters, Maly, Nerva, Sommers, Kokor) has been studied thoroughly in 1990-s, and 762 vascular plant species were registered on these islands with the total area 60 sq. km

In 2004, and 2009-2015 monitoring investigations on the outer islands of the Gulf of Finland have been carried out by the author, special attention was paid to the threatened plants and rare plant communities on the islands. For the first time the islands Rodsher, Severny Virgin, Yuzhny Virgin have been investigated. 40 new species have been recorded, among them such rare and protected in the Leningrad Region vascular plant species as *Corydalis intermedia* (L.) Merát, *Saxifraga tridactylites* L., *Euphorbia palustris* L., *Ruppis brachypus* J. Gay, *Luzula campestris* (L.) DC. The total number of vascular plant species known from the outer islands for the moment is 801 species. The flora of the outer islands is the richest in species, the most original and specific among the islands in the Russian sector of the Gulf of Finland. Long-term floristic investigations on the outer islands of the Gulf of Finland identify these islands as one of the most important plant areas (IPAs) in Europe, where effective protection monitoring and management systems should be targeted.

Gulf of Finland Trilateral Co-operation Scientific Forum, 17-18 November
2015, Tallinn, Estonia

HEAVY METALS IN THE SEDIMENTS OF THE GULF OF FINLAND

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Keywords: heavy metals, sediment toxicity, sediment quality, environment

The Gulf of Finland is surrounded by three industrialized countries: Finland, Russia and Estonia. The large harbors of St. Petersburg, Vyborg, Helsinki and Tallinn together with a few others as well as many smaller ports are located there. The population density is very high and the two capitals (Helsinki, Tallinn) are home to one million people, while St. Petersburg has more than three million inhabitants. The catchment of the Gulf of Finland is actively cultivated and there are well developed wood-processing industrial plants mostly located along the rivers with outlets in the Gulf of Finland. All these factors make the Gulf a pool with natural but also very high anthropogenic load. Industrial waste, loads from agricultural activity as well as from naval and merchant fleets sooner or later end up in the Gulf of Finland. The gulf receives annually about one million ton of particulate matter of which a great part is of natural origin, but still a significant part is of anthropogenic origin. Scientists have during the last decades collected data on the sea floor sediments of the Gulf of Finland and a summary of the distribution of heavy metals in the sediments are presented here. Majority of the heavy metals tend to have higher anomalies in the east and north, with a notable hotspot of mercury near the outlets of the Kymi River.

ASSESSING NEAR-BOTTOM VELOCITY FIELD USING UNDERWATER CAMERA

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Keywords: particle image velocimetry, autonomous underwater camera, velocity field, vorticity field, resuspension, sediment transport, sediment cloud, near bottom flow, Gulf of Tallinn

Particle image velocimetry is one of the fewest methods that is able to record non-intrusively and simultaneously the whole velocity field in a measurement area. Particles that are moving along with water flow can be illuminated by an artificial light source and recorded by high speed camera. Saved recordings can then be extracted into consecutive images which are analysed and compared to find the displacement vectors that are used to compose two-dimensional velocity and vorticity field maps.

In 2013 an autonomous underwater camera was built with an aim to observe the bottom of the coastal areas where fast ferries are generating waves that cause strong sediment resuspension and coastal erosion. Using lasers and sheet forming optics the movements of the suspended sediments were captured. It is possible to map instantaneous flow patterns, measure near-bottom velocity profiles, detect complex turbulent flows and observe sediment cloud formation. The underwater camera has been tested in different places in the vicinity of the Gulf of Tallinn and has proven its potential both in scientific and applied research. This presentation gives an overview about the technical specifications, limitations and main results of the camera.

This study was supported by Estonian Environmental Investment Centre (project 609) and by a grant 9052 from Estonian Science Foundation.

BIRD AND MAMMAL ARTIFICIAL HABITATS OF THE EASTERN PART OF THE GULF OF FINLAND

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Keywords: birds, mammals, artificial habitats, the Gulf of Finland (GOF)

Investigations were carried out in 2013-2015 on the coastal line, artificial islands and the dam in the eastern part of GOF. Artificial habitats are divided into 2 types: 1) buildings on the shore which provide an opportunity to a number of species (*Passer montanus*, *Hirundo rustica*, *Delichon urbica*, *Sturnus vulgaris*, *Muscicapa striata*, *Mus musculus*, *Rattus norvegicus*, etc.) to breed in close proximity to the gulf and use the coast as a feeding biotope (*Vulpes vulpes*); 2) man-made landscapes: the dam, old fortresses and storm surge barriers. 5 main habitats were determined in the second type: plots with trees and scrub, manmade sandy banks, grasslands, boulder ridges, old buildings and storm surge barriers. 28 bird and 9 mammal species were found out there; 5 species from them are included in Helcom Red List of Baltic Sea species, 4 species - into Red Data Book of Leningrad region. The most preferable habitats are boulder ridges (31%, 12 species), 10 (25,5%) inhabit grasslands, 9 (23%) - "park" areas, 4 (10%) - inside fortresses, nests of 3 bird species (8%) were founded at the storm surge barriers, the only one - *Riparia riparia* - inhabits manmade sandy banks, but its abundance comes up to 100 pairs (fort Totleben). The commonest species are *Larus ridibundus*, *Sterna hirundo*, *S.paradisaea*, *Aythya fuligula*, *Mergus merganser*, *Microtus sgr.arvalis*, *Sylvaemus uralensis*.

This study was conducted under financial support from SPbSC RAS and TOPCONS project (N° 2011-022-SE511).

Gulf of Finland Trilateral Co-operation Scientific Forum, 17-18 November
2015, Tallinn, Estonia

***GMELINOIDES FASCIATUS* IS A NEW BIOINDICATOR OF GENETIC BIODIVERSITY IN FINNISH BAY AREA**

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Keywords: genetic biodiversity, bioindication, chromosomal aberrations, crustaceans

Our previous data have demonstrated ability using some crustacean species to analyse environmental strain during biomonitoring of some coastal line of White and Barents Seas as well as fresh water reservoirs and soil.

High anthropogenic activity in the Finnish Bay area results in bringing a lot of invading species of hydrobionts. The crustacean *Gmelinoides fasciatus* is an amphipod invader from Baikal Lake which has successfully adapted to the Baltic Sea region. It is interesting to estimate the influence of a new habitat on the invader genome. For the fundamental purposes it seems interesting to compare different genetic parameters of these crustaceans in original (native) and invading ecosystems.

The possibility of *Gmelinoides* developing embryos to serve as a bioindicator of genetic diversity in Finnish Bay has been checked. Preliminary results show that this amphipod crustacean has enough amount of dividing cells for cytogenetic analysis. Therefore this invertebrate could be convenient for studying genetic stability of its genome under different environmental pressure.

The research supported by RFBR grant 15-29-02526.

**SATELLITE MONITORING OF GULF OF FINLAND FOR
ASSESSMENT IMPACT OF DREDGING ACTIVITY DURING
«PORT BRONCA» CONSTRUCTION**

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Keywords: Gulf of Finland (GoF), remote sensing (RS), dredging, suspended sediments (SS)

For analysing intensity and spatial distribution of contaminated water caused by dredging during «Port Bronca» (PB) construction, satellite monitoring of the GoF based on MODIS and Landsat-8 data was implemented (for 2012-2015 period). The construction of PB carry out in the southern western corner of Neva Bay. Presented research is a part of the Finnish-Russian project TOPCONS, ENPI-CBC programme. Decoding and analysis of series of RS data allowed us to reveal hydro-optical heterogeneities caused by phytoplankton development and by SS. Obtained RS scenarios of spatio-temporal distribution of water turbidity reflect levels of SS concentration and depend from hydro-meteorological situations (including saline water intrusions and upwelling) and from dredging intensiveness. Analyses of Landsat-8 data allowed to develop method for identify areas with very high levels of water turbidity (with SS concentrations above 100 mg/l). Results of GOF monitoring clearly show that scales and intensity of anthropogenic impact on the aquatic environment are significant and essentially exceed the expected according PB Project's «Environmental Impact Assessment».

**REFLECTIONS OF PREY QUALITY AND ORGANIC
TOXICANTS IN BIOCHEMISTRY OF SALMON IN THE
GULF OF FINLAND COMPARED TO OTHER BALTIC
FEEDING AREAS**

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Keywords: environmental toxicant, EROD, MDA, dioxin, PCB

Salmon (*Salmo salar*) were caught in late in autumn in the open sea at the Gulf of Finland and two other feeding area and liver was sampled for biochemical determinations. Concentration of malondialdehyde (MDA) as indication of oxidative stress was determined and EROD activity was measured as indication of toxicity of organic halogenated or aromatic toxicants. Prey fish quality was characterised by measuring fatty acids, carotenoids and thiamine. Those parameters were also related to concentrations of dioxins and PCBs analysed in same individuals.

RELEASE OF TEXTILE MICROPLASTICS DURING MACHINE WASHING

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Keywords: microplastics, polyester, textiles, machine washing, household, sewers, Gulf of Finland

Microplastics are widely spread in the environment, which along with still increasing production have aroused concern of their impacts on environmental health. For instance, plastics ingestion in seabirds has been estimated to reach 99% of all species by 2050. The objectives of this study is to quantify the number of microplastics that discharge from washing machine to sewers and to estimate its contribution to microplastics concentrations earlier reported from the marine samples of coastal Finland. Four various types of polyester textiles are selected for the tests. A sample of washing water is filtered and the microplastics fibres are counted under the optical microscope. The results will present the microplastics number released during sequential washings from various types of polyesters under selected washing conditions. The microplastics numbers will be given in counts per washing water and counts per textile mass. On a basis of the results, the contribution of textile-based polyester fibres to the total amount of microplastics in coastal Gulf of Finland is computationally estimated. This study will shed light on the role of household machine washing as a discharger of microplastics and provide tentative recommendations how to mitigate these emissions.

FATE AND EFFECTS OF NONYLPHENOL IN A TERRIGENOUS FUNGUS *PENICILLIUM EXPANSUM*

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Keywords: nonylphenol, terrigenous fungus, oxidative stress

Nonylphenol (NP) is the most abundant environmental pollutant classified as an endocrine disrupter capable of interfering with the hormonal system of numerous organisms. It originates from the degradation of nonylphenol ethoxylates which are widely used in industrial and domestic products. Nonylphenol has been referred to in the list of substances of particular risk to the Baltic Sea and in the list of priority hazardous substances in the Water Frame Directive, as well as in the 3rd draft Working Document on Sludge of the EU. Many studies have indicated that nonylphenol exhibits toxicity to aquatic organisms. Since NP exhibits a low solubility in water and high hydrophobicity, it has a great tendency to bioaccumulate and partition to organic-rich sediments. However there are no studies on the assessment of the nonylphenol - induced stress response in terrigenous fungi playing great role in the functioning of the aquatic biocenoses in sediments.

The aim of this study was to assess the effect of the nonylphenol - induced stress on the adaptive protection factors of the fungus *Penicillium expansum* and to evaluate the ability of the strain for NP eliminatiotin.

The fungal strain *Penicillium expansum* was isolated from the bottom sediments of the coastal zone of the eastern Gulf of Finland. This strain is tolerant to the action of nonylphenol in comparison with other types of aquatic organisms (fish, protozoa, blue-green algae). Toxicity concentration values of nonylphenol EC₅₀ for *Penicillium expansum* 20 mg/l, EC₉₀ >100 mg/l.

It has been found that under oxidative stress induced by NP the synthesis of enzymatic protection factors - superoxide dismutase, catalase as well as nonenzymatic (melanin-like pigments, extracellular polysaccharides) were increased. It was shown that with increasing antioxidation factors the malondialdehyde concentration (biochemical marker of lipid peroxidation) in cells of the fungus was reduced.

Penicillium expansum was able to decrease the NP concentration in culture medium. The results revealed that during the first 24 h of incubation, NP at the concentration of 50 mg/l and 100 mg/l was eliminated from the culture medium by 60% and 42% respectively. As terrigenous fungi play a significant role in the functioning of the heterotrophic block of bottom sediments and NP increasingly seen to be persistent toxic organic and endocrine disruption, these results may be ecological relevant for aquatic systems.

**CELLULAR RESPONSES AND BIOREMOVAL OF
NONYLPHENOLS BY THE CYANOBACTERIA
PLANKTOTHRIX AGARDHII 1113**

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Keywords: nonylphenols, cyanobacteria *Planktothrix agardhii*, oxidative stress, geosmin, 2-methylisoborneol, microcystins, bioremoval

Nonylphenols (NPs) are widely used in industrial, agricultural and household applications such as detergents, emulsifiers, dispersing and antistatic agents, and solubilizers. Moreover NPs are metabolic intermediate from the microbial transformation of nonionic surfactants, nonylphenoethoxylates (NPEOs), that are of the most widely used group of surfactants. Compared to its parent substances, NPs are more persistent in the environment, highly toxic to aquatic organisms and are a potential estrogen disruptor. NPs and NPEOs have been identified as priority hazardous substance under the EQS Directive (2003/105/EC) and have been referred to in the list of substances of particular risk to the Baltic Sea. NPs have frequently been detected in all environmental compartments. The significant concentrations of NPs are found in surface waters (up to $644 \mu\text{g l}^{-1}$).

The present study aims to investigate the cellular responses of cyanobacteria *Planktothrix agardhii* 1113 to stress caused NPs and to reveal the ability of *P. agardhii* to biodegrade the NPs.

The strain used was isolated from the Baltic Sea (the Neva Bay) during water blooming.

We have demonstrated that NPs suppressed algal growth, increased the levels of the photosynthetic pigments - chlorophyll *a*, carotenoids and phycobiliproteins and protective compounds – exopolysaccharides, proteins and the amino acid proline.

The *P. agardhii* could effectively resist the oxidative toxic effect of high NPs concentrations by elevating its superoxide dismutase and catalase levels as well as level of reduced glutation. The level of malondialdehyde, a routinely index of lipid peroxidation was also increased. The increases of these components of the antioxidant system in *P. agardhii*, due to NPs, further

supporting the evidence that this algae was able to rapidly and efficiently remove excessive reactive oxygen species.

The *P. agardhii* 1113 was demonstrated to produce geosmin and 2-methylisobomeol (MIB), secondary metabolites which produce earthy and musty tastes and odours. The cyanobacterial growth inhibition was accompanied with increasing of synthesis of geosmin and MIB by *P. agardhii* 1113.

Three different microcystins were isolated from *P. agardhii* 1113. The main microcystin in this strain was found to be demethylmicrocystin - RR. Our study showed that NPs in the growth inhibitory concentrations significantly promoted microcystin production by *P. agardhii* 1113. NPs also notably increased the microcystin release into cultural medium.

The *P. agardhii* 1113 was found to be able to decrease the NPs concentration in cultural medium for initial NPs levels below 4.0 mg/l. NPs were removed more quickly in the present of the *P. agardhii* 1113 (half-life – 0.75 – 2.5 days) than in its absent (half-life -2.5 – 5.5 days) at initial concentrations of NPs – 0.5 — 4,0 mg/l respectively.

CHANGE OF THE GULF OF FINLAND AQUATIC BIOTA NEAR THE AREA OF CONSTRUCTION MMPK "BRONKA"

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Keywords: zooplankton, zoobenthos, fish

Marine multifunctional transshipment complex "Bronka" (MMPK "Bronka") is located in the southwestern part of the Neva Bay of the Gulf of Finland near the town Lomonosov. MMPK "Bronka" construction was launched in 2011 and carried out until now. The works included land reclamation and deepening the approach channel. GosNIORKH was carrying out the fisheries monitoring in 2011, 2013, 2014.

At that period the following changes (most pronounced in 2014) in the biota of the construction area are marked.

The ecological state of the aquatic environment worsened due to increasing the concentration of suspended particles to 376.0 mg/l at the surface and to 1830.0 mg/l at the bottom. The water transparency decreased to 0.03-0.10 m (Secchi disk).

The abundance of fish feed base has also decreased. Zoobenthos biomass in areas of the highest turbidity decreased to 0.07-0.08 g/m³ (August 2014). Share cladocerans has also decreased. Rotifers were completely absent. The number of benthic invertebrates species decreased in 1.5 times from June to October 2014. Stocks of feed zoobenthos (for fish) decreased from 5.52 to 2.97 g/m².

The low effect of spawning freshwater fish complex (mainly perch, including pikeperch) and semi-anadromous smelt is marked. The impact on the fish had a cumulative prolonged character. The change in bio-productivity of the area was caused by the loss of the spawning grounds and pastures because of exclusion productive section of the bay for the port territory.

MONITORING OF PAH-METABOLITE CONCENTRATIONS OF PERCH BILE IN OPEN GULF OF FINLAND COMPARED TO COASTAL AREAS

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Keywords: PAH, perch, bile, monitoring

Perch (*Perca fluviatilis*) were sampled yearly in August from 2006 to 2009 in the Gulf of Finland at Haapasaari waters and two coastal locations east and west from the city of Hamina to monitor biliary PAH-metabolite concentrations. Both female and male perch were sampled and in addition to bile total body weight and length and liver weight were registered. PAH-metabolite (1-OH-pyrene) concentrations are examined in relation to sex and other body characteristics (body weight and length and liver weight) and open sea and coastal samples are compared.

FATE OF MICROPLASTICS IN SOFT MARINE SEDIMENTS

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Keywords: microplastic, sediment, transport, bioturbation, Baltic Sea

Microplastics are small plastic fragments (< 5 mm) present in oceans worldwide occurring from the sea surface to the deep seafloor. It is estimated that eventually most of the plastics will sink to the bottom but their interactions with marine organisms and effects in marine ecosystems are not well known. A laboratory experiment was conducted to investigate the role of bioturbation in spreading microplastics in soft sediments. Pieces of fishing line (three different sizes, < 300 µm) were added to 30 sediment cores. Half of the cores contained common species of the benthic fauna in the northern Baltic Sea (*Macoma balthica*, *Marenzelleria* spp., *Monoporeia affinis*) in natural densities to model the function of the community. After the experiment sediment cores were sliced according to depth and the plastics in each layer were separated using saturated NaCl solution and counted. Animals were dissected to count the amount of ingested microplastics using epifluorescence microscopy. The results show that benthic invertebrates are able to transport microplastics in the sediment. This study is unique in using microplastics that actually exists in the marine environment and possibly the first to demonstrate the transportation of microplastics in the sediment by benthic invertebrates. The information on interactions between microplastics and benthic fauna is crucial when assessing the fate of microplastics; distribution and availability to the animals on the seafloor.

THE ROLE OF CYANOBACTERIA IN THE NORTHERN BALTIC SEA - GOOD, BAD OR ONLY UGLY?

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Keywords: cyanobacteria, zooplankton, food web, indicators

Blooms of cyanobacteria are and will be a recurrent phenomenon in the northern Baltic Sea. Their maximum abundance coincides with the productive period of zooplankton and pelagic fish. The immediate effects of diazotrophic blooms on other phytoplankton or pelagic grazers may vary. They have been shown to be positive, negative or neutral depending on the target group considered, in experimental studies and analysis of field data. We used Baltic Sea monitoring data from 2 coastal and 12 open sea stations to explore the effect of cyanobacteria on the non-diazotrophic part of the phytoplankton community and on zooplankton. The association of cyanobacteria to phytoplankton composition and diversity, and zooplankton abundance, breeding success, size structure and diversity was analysed statistically. The results show that an increase in diazotrophic cyanobacterial biomass does not necessarily decrease the diversity (evenness) of the phytoplankton community, and that the decrease in the mean size of zooplankton with increasing cyanobacterial biomass may be due to a simultaneous increase in the nauplius to female ratio of mesozooplankton. The study also aimed at finding suitable food web indicators for the EU Marine Strategy Framework Directive (MSFD) and Water Framework Directive (WFD).

DINOFLAGELLATE CYST DYNAMICS IN THE NORTHERN BALTIC SEA

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In the Gulf of Finland, northern Baltic Sea, dinoflagellates *Peridiniella catenata*, *Biecheleria baltica*, *Scrippsiella hangoei* and *Gymnodinium corollarium* form an important part of the spring bloom. These species also produce resting cysts, which have the potential to contribute to the seeding of the new bloom. Thus, we investigate the magnitude of this contribution by comparing the ratios of live vs. empty cysts of *B.baltica* from surface sediments before, during and after the spring bloom. Cyst counts of dinoflagellate species contributing to the spring bloom will be coupled with phytoplankton data to study if the cysts are locally produced or transported to the area later. In addition, influence of environmental gradients, e.g. nutrients, salinity, to the cyst-producing species community structure and abundance will be investigated. Results from Gulf of Finland will be coupled with data from northern Baltic Proper and Gulf of Riga in order to detect overall and basin specific trends in cyst dynamics.

BALTIC HERRING (*CLUPEA HARENGUS MEMBRAS L.*) OF WEIGHT-AT-AGE-AT-LENGTH ANALYZES FROM THE ESTONIAN COASTAL WATERS AND FOOD SAFETY

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Introduction

Authors selected Baltic herring (*Clupea harengus membras L.*), because: they can be caught in all parts of the Baltic Sea; they are important commercial fish; their biology is fairly well known; they are of suitable size for pre-analytical sample treatment; they are easy to collect. In our earlier work [1] it became evident that every catch (or population) of Baltic herring is unique, so the parameters of different catches (or populations) cannot be described as a single array. In this study we compared Baltic herring weight-at-age-at-length data collected in 2002 -2010 (Figure 1).

Methods and Materials

For selection of the aggregate Baltic herring sample, we must know, first of all, the predominant length and age of the Baltic herring in different catches and catching places. Regions used for Baltic herring biological parameters research in our work (Table 1), for a statistical analyses of weight-at-age-at-length of Baltic herring (*Clupea harengus membras L.*) from the Estonian coastal waters during the 2002 - 2010 period, gives the fish weight, length and age recommendations at the base of six regions (Table 1).

Table 1. Regions used for the Baltic herring biological parameters research from the Estonian coastal waters

Eastern part of Gulf of Finland	epF
Central part of Gulf of Finland	cpF
Western part of Gulf of Finland	wpF
Open part of Baltic Sea	oB
Open part of Baltic sea -	oBF
Gulf of Riga	

Charts were made using MS ExcelPivotTable procedure for weight (vertical), length (horizontal) and average age (central eliminating after cells with less than 3 fishes).

Results and Discussion

The need for adequate biological sampling in ecotoxicological investigations is demonstrated in [2-5]. At the base of the COMMISSION REGULATION (EC) No 1883/2006 of 19 December 2006 laying down methods of sampling and analysis for the official control of levels of dioxins and dioxin-like PCBs in certain foodstuffs, the aggregate sample uniting all incremental samples shall be at least 1 kg. Special recommendations in case a size and/or weight class/category predominant (about 80% or more of the batch), the sample is taken from fishes with the predominant size or weight. All 2323 individual fish are studied separately for their relationship between the length (cm), weight (g) and age (years) (Figure 1). Period 2005-2010, average (predominant) length of Baltic herring in our catches below 15 cm and at the present time the age of the Baltic herring in the coastal waters of Estonia mostly 2-4 years (Figure 2). There are no big differences by the regions (Figures 2 and 3). The total weight and length of all fish were measured to the nearest of 0.1 g and 1 mm, respectively. The otoliths of fish were taken for age determination.

Conclusion

By way of derogation from Commission Regulation (EU) No 1259/2011 of 2 December 2011 amending Regulation (EC) No 1881/2006 as regards maximum levels for dioxins, dioxin-like PCBs and nondioxin-like PCBs in foodstuffs, Finland and Sweden may authorize the placing on their market of wild caught Baltic herring larger than 17cm and intended for consumption in their territory with levels of dioxins and/or dioxin-like PCBs and/or nondioxin-like PCBs higher than those set out in commission regulation. Period 2005-2010, average length of Baltic herring in Estonian catches below 15 cm, below than 17 cm. Ward off the toxication of Estonians with dioxins and dioxin-like polychlorinated biphenyls, the consumption of large Baltic herring with a length more than 22 cm (more than 8 year old) should be eat not more than couple of times of month [2-5].

Acknowledge

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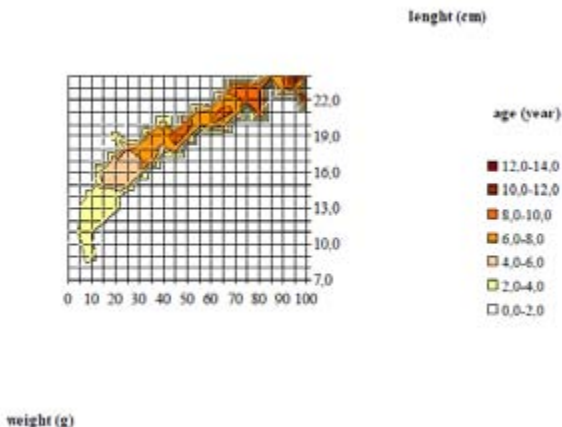


Figure 1. Age (1-10 years)-dependent length (≤ 24 cm) and weight (≤ 100 g) in the 2323 individual Baltic herring samples, analysed from Estonian coastal waters (2002-2010) (<http://www.vet.agri.ee/?op=body&id=821>)

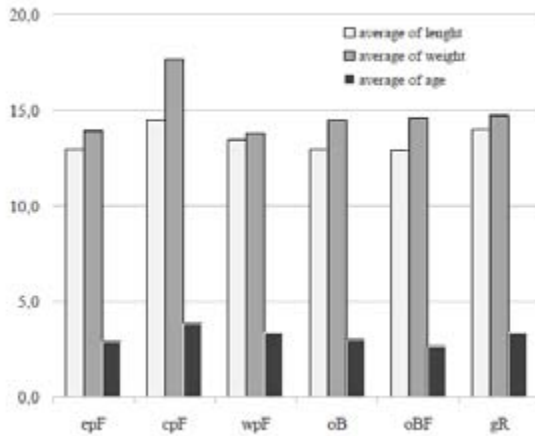


Figure 2. Average weight (g), length (cm) and age (years) of the Baltic herring samples caught at the six different catching areas along the Estonian coastal waters period 2005 -2010.

F + M + JUV

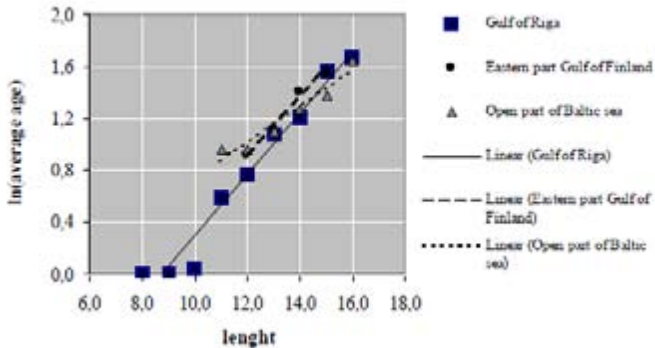


Figure 3. Median length (cm) - dependent \ln (average age) in the Baltic herring samples, analysed from Estonian coastal waters (2005-2010) (JUV-juvenile herring, F- female herring and M - male herring).

HIGH-RESOLUTION VIEW ON THE HALOCLINE AND HYPOXIC LAYER DYNAMICS IN THE GULF OF FINLAND

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The near-bottom water in the Gulf of Finland, which is often hypoxic, is separated from the rest of the water column by the quasi-permanent halocline. The position and strength of the halocline are sensitive to the long-term changes of vertical stratification in the Baltic Sea as a whole, to the wind-forced modifications of the estuarine circulation, mesoscale processes and local mixing events. However, it is not well quantified yet what is the relative contribution of local processes and along-gulf advection of the near-bottom salt wedge to the changes in halocline strength and amount of hypoxic water. The main aim of the present study is to characterize the dynamics of the halocline and related changes in the oxygen conditions in the deeper part of the Gulf of Finland at the synoptic time scale. The analysed data was acquired by an autonomous water column profiler deployed in the central part of the gulf in 2014 and at the gulf entrance area in 2015. The profiler was set to measure every 3 hours between 2 and 80 (90) m depth. A five-day glider mission was conducted close to the profiler in 2015 to map spatial variability of the halocline. The registered parameters included temperature, salinity, dissolved oxygen, and turbidity. Processes discussed are: salt wedge advection and related variations in the halocline shape and oxygen conditions; wind-generated mixing and changes in the water column structure, including the cold intermediate and upper layer; local oxygen consumption.

**IMPORTANCE OF CORRECT DISTRIBUTION
CONTRACTING PARTIES SHARES IN FORMATION OF
NUTRIENT LOAD WITH NARVA RIVER FOR HELCOM
BALTIC SEA ACTION PLAN IMPLEMENTATION**

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Keywords: nutrients, load, transboundary water objects

With the aim to reduce the Baltic Sea eutrophication HELCOM developed country allocated reduction targets (CART) for each of Baltic Sea country. The CART takes into account, inter alia, net input load of a particular country to the formation of a nutrient load with transboundary rivers. Determination of CARTs and reference load was performed on the basis of the countries' information transmitted to HELCOM in the framework of the Baltic Sea Pollution Load Compilation (PLC). Distribution of reference load (and thus CARTs) for transboundary rivers is preliminary and requires further clarification. Planning of cost-effective measures to achieve the HELCOM CARTs should be supported by quality information about the total actual load from the country and components which formed it. With regard to transboundary rivers, this factor is the key importance, as in the case of an incorrect determination of the contribution from the one side, measures may be either insufficient for the total actual load from the river, or unreasonably excessive and therefore unprofitable. By simulating the situation based on the example of the Narva River it can be assumed that if the actual contribution of Russia is significantly lower than values laid within the HELCOM reference load, the Russian side will be necessary to take additional measures. Thus, formation nutrient load with transboundary rivers and the Contracting Parties shares require further clarification by concerned countries, to ensure the development of effective measures to achieve the HELCOM CARTs and improve coherence (or improve concurrence of actions). Neighbouring states should bring the issues of data and activities coordination aimed on achieving of HELCOM CART, in the agenda of bilateral commissions.

Ensuring the correct distribution of the parties contribution in the formation of the nutrient load with transboundary waters acquires distinct significance

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in the light of trilateral cooperation project "Gulf of Finland Year-2014" aimed, inter alia, to the assessment of each country's quota in the formation of the nutrient load on the Gulf of Finland.

**ASSESSMENT OF MICROBIAL AND VIRUS
CONTAMINATION OF WATER AREAS THE NEVA BAY
AND THE EASTERN PART OF THE GULF OF FINLAND**

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Keywords: intestinal bacteria, intestinal viruses, contamination of water areas

As object of research the data of natural researches of hallmarks of the water culled at gidrologo-hydrochemical and sanitary-bacteriological stations of water areas in an alignment of a complex of protective constructions from inundations of the Neva bay and East part of Gulf of Finland served.

Last years in water areas of the Neva bay and East part of Gulf of Finland great volume of hydraulic engineering works and port Bronka building is made. For analysed area a high level of suspended substances, in the majority bind to technogenic influences. There is a contamination of water areas, silting bottom-dwelling deposits and the congenial conditions for long circulation of intestinal microorganisms (an E.coli Salmonella, etc.) and viruses (virus of a Hepatitis A, Rotaviruses, etc.) are created.

Under the program of natural researches co-ordinated with the conforming nature protection organisations, sanitary microbiological researches were conducted in water area of the Neva bay and East part of Gulf of Finland simultaneously with hydrochemical supervision The analysis of results of laboratory researches during the last years testifies to redistribution of contaminations in a region of the raised maintenance of suspended substances in these parts, and it means that contamination fields of studied water area not pathogenic and pathogenic microorganisms accompanies the building of port complexes bound to an alluvium of terrains in area Bronka and Lomonosov, etc.

It is positioned that water area of the Neva bay and East part of Gulf of Finland are characterised by the average level of faecal contamination to what laboratory indexes of an index of colibacilli testify, level if-phages, detection of a pathogenic microorganism and intestinal viruses. The special concern invokes contamination bacterial and virus pathogens of a southwest part (st. 17 and st. B-1) and northern (st. B-6) parts CPS (Dam), northern part

of water area of the Neva bay (st. 42, st. 1 and st. 2). Taking into account an actual problem of enriching of an ecological state of unique aqueous object what the Neva bay is, many years are fulfilled by us the plan of complex ecological monitoring with use of perennial experience and the results received at carrying out of researches in the Neva bay and East part of Gulf of Finland.

The received results of researches in the Neva bay and East part of Gulf of Finland, testify to necessity of urgent complex measures on decrease and technogenic and an anthropogenic load on aqueous objects that should lead to stabilisation and possible enriching of an ecological state of studied water areas by means of control of a hydrological mode and an ecological situation with use of technology of manoeuvring by gates of water throughput constructions of the Complex of protective constructions of St.-Petersburg from inundations.

Experience of conducting complex ecological monitoring can be realised and on other aqueous objects of environment, in different regions of Russia and other countries of the world.

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