

Recent doctoral theses (ecology and environmental sciences) in Lithuania

Compiled by Virginija KALCIENĖ

DIVERSITY AND FUNCTIONAL ROLE OF PLANKTON CILIATES IN AN EUTROPHIC COASTAL LAGOON

PLANKTONO INFUZORIJŲ ĮVAIROVĖ IR FUNKCINIS VAIDMUO EUTROFINĖJE PRIEKRANTĖS LAGŪNOJE



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The principle aim of this study is to reveal the species diversity and patterns of plankton ciliate seasonal succession and to evaluate their grazing role in the eutrophic coastal lagoon ecosystem.

During the seasonal studies in the oligohaline and freshwater parts of the Curonian Lagoon 81 species / taxa were found, 6 of them, the brackish / marine species, were recorded for the first time in the Curonian Lagoon. In the oligohaline part of the lagoon, salinity increase above 4 PSU leads to the decrease of biodiversity (H' index), 2–3 fold decrease of total ciliate abundance and in relative abundance of nanociliates ($<20\ \mu\text{m}$) compared to freshwater and low salinity ciliate assemblage (0–2 PSU). In the Curonian Lagoon four seasonal phases can be distinguished according to the structure of ciliate community: winter, early, late spring and summer/autumn, environmental factors influencing the patterns of seasonal changes of these groups are analyzed in this study.

For the first time, dilution technique with size-fractionation of phytoplankton was applied in the coastal waters of the Baltic Sea to estimate ciliate grazing on different phytoplankton size fractions. In the freshwater part of the Curonian Lagoon significant ciliate grazing effect on pico-fraction of phytoplankton was estimated, while in brackish assemblage – on nano-fraction of phytoplankton.

This study is intended to contribute to the knowledge of the biodiversity of ciliate communities in eutrophic coastal waters. Data from this study could be used to develop the bioindicators for environmental quality assessment. The results of this study could be used to improve the existing ecosystem models by incorporating the microbial components for a better understanding how eutrophication processes may be controlled by micro-grazers in eutrophic coastal waters.

Key words: plankton ciliates, taxonomy, seasonal dynamics, dilution experiments, Curonian Lagoon

**THE EFFECTS OF WOOD ASH AND NITROGEN ON GROUND VEGETATION IN
VACCINIO-PINETUM STANDS**
**MEDIENOS KURO PELENAI IR AZOTAS: DIFERENCIJUOTAS BEI KOMPLEKSNIS
POVEIKIS BRUKNINIŲ PUŠYNŲ (*VACCINIO-PINETUM*) GYVAJAI DIRVOŽEMIO
DANGAI**



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In Lithuania the energy production from the forest wood comprises up to 90% of the total biomass derived energy. Increasing use of wood fuel increases the removal of the plant essential nutrients from the ecosystem because the branches, tops and needles / leaves contain a relatively higher amount of nutrients than stems. Compared with the removal of the stems-only, the nutrient losses from the forest ecosystem increase up to 5 times. One way to return nutrients to the ecosystem is to apply forest fuel waste, wood ash, as fertilizers.

In this study the effects of the differential wood ash fertilization and ash fertilization in complex with nitrogen on the ground vegetation structure (species composition, abundance), biomass and chemical composition in *Pinus sylvestris* stands (forest type – *Vaccinio-Pinetum*) were estimated. For the first time, the long-term impact of nitrogen as well the influence of the high nitrogen doses on ground vegetation structure and abundance in Scots pine stands growing on infertile sandy soils (Haplic Arenosols) were studied in Lithuania. The spreading of the nitrophylous plant species in the ground vegetation in pine stands during 20 years period was detected. The role of the trees competition in the soil rhizosphere zone on ground vegetation was examined. The following soil and ground vegetation parameters were estimated: soil moisture, pH and chemical composition, also the biomass of vascular plants, coverage, biomass and chemical composition of the typical plant species *Vaccinium vitis-idea* L. in *Vaccinio-Pinetum* stands.

The study leads to the conclusion that the impact of wood ash and nitrogen on bryophytes is negative, while the impact on vascular plants is positive. However, the effect of nitrogen on vascular plants depends not only on the nitrogen dose but also on input frequency. Trees competition in the rhizosphere mitigates the effects of wood ash and nitrogen on ground vegetation in *Vaccinio-Pinetum* stands.

Key words: wood ash, nitrogen, ground vegetation structure, *Vaccinium vitis-idea* biomass chemical composition, Lithuania

CHANGES IN CONSUMPTION AND THEIR ENVIRONMENTAL IMPACT IN LITHUANIA IN THE CONTEXT OF EUROINTEGRATION PROCESS VARTOJIMO POKYČIAI LIETUVOJE IR JŲ POVEIKIS APLINKAI EUROINTEGRACIJOS KONTEKSTE



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The most important objective of the ES cohesion policy is the convergence of lifestyle of new and old EU member states. The fast convergences of the EU countries determine not only the fast economic growth in the new members, but also the fast boost in consumption, which endanger the environment. Therefore in Lithuanian national strategy for sustainable development is stated the goal that in case of economy growth the environmental impact should grow at least twice slower than production and consumption.

The aim of the research was to analyze the convergence of socio-economic and environmental indicators in the EU, to estimate the impact of socio-economic factors on consumption and to assess environmental impact of consumption and the determinants of environmentally friendly behaviour.

In the work the convergence of the socio-economic and environmental indicators in the EU countries was analyzed in complex. It was evaluated that Lithuania was catching-up the old EU member states by all investigated socio-economic indicators, however, by emission of acidifying compounds it even exceeded the level of EU₁₅. The fast increase of disposable income determined the changes in Lithuanian consumption structure, when the consumption expenditure for luxury goods grew very fast and it slowed down the growth in environmental impact of increasing consumption. The environmental impact of consumption (except transport) increased considerably slower than consumption or it did not increase at all.

Environmentally friendly behaviour of citizens is mostly determined by personal general values, evaluation of importance of the main environmental problems, and willingness to assume the responsibility for the solution of environmental problems. Therefore, seeking to reduce the environmental impact of consumption it is important to provide more information about the main environmental problems and to develop the willingness to contribute to the solutions of environmental problems in the daily life.

Key words: sustainable development, convergence, environmental impact, sustainable consumption, environmentally friendly behaviour

EMPIRICAL MODELLING OF MACROZOOBENTHOS SPECIES DISTRIBUTION AND BENTHIC HABITAT QUALITY ASSESSMENT

EMPIRINIS MAKROZOOBENTOSO RŪŠIŲ PASISKIRSTYMO MODELIAVIMAS IR DUGNO BUVEINIŲ KOKYBĖS VERTINIMAS



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Marine spatial planning and ecosystem-based management involves different methods of assessing the quality of habitats. The increase of information on spatial environmental parameters triggered the application of different species distribution models in benthic ecology. In this study empirical modelling is being used for the assessment of benthic habitat quality in aquatic ecosystems. A comparative analysis of four species distribution modelling methods (generalized additive models, multivariate adaptive regression splines, maximum entropy and random forests) was performed for predictions of the occurrence and biomass distribution of 23 macrozoobenthos species in Lithuanian marine area. These models, together with data on fish diet, were integrated in the system for the benthic habitat quality assessment in terms of food provision for Baltic cod, European flounder and eelpout. Also, biological valorisation of Lithuanian marine area was performed based on species traits, species richness, rarity of habitats and the status of benthic communities. Empirical modelling based on video survey data was applied for the assessment of the habitat alteration range caused by invasive bivalve *Dreissena polymorpha*.

Key words: species distribution modelling, macrozoobenthos, benthic habitat quality, biological valorisation, random forests

INVESTIGATION INTO POPULATION GENETIC STRUCTURE OF EEL *ANGUILLA*
ANGUILLA (L.) AND PERCH *PERCA FLUVIATILIS* L. WITHIN THE CONTEXT OF
ANTHROPOGENIC ACTIVITY
UNGURIO *ANGUILLA* *ANGUILLA* (L.) IR EŠERIO *PERCA FLUVIATILIS* L.
POPULIACINĖS-GENETINĖS STRUKTŪROS TYRIMAI ANTROPOGENINIO POVEIKIO
KONTEKSTE



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Seeking for a sustainable exploitation of the populations of commercially valuable fish species without causing danger to their genetic resources it is necessary to amass extensive data about the population genetic structure of this fish species. When preparing the thesis a total of 221 eel and 262 perch was analysed. Fish samples collected in Lithuania and Latvia were studied using microsatellite DNA, the mtDNA D-loop region and mtDNA *cyt b* markers. Original primer pairs Ang1 and Ang2 have been designed for the mtDNA analysis of the eel. On the basis of the *Anguilla* genus species mtDNA D-loop region data obtained during work it can be stated that inland and territorial water bodies of Lithuania contain no *A. japonica* and *A. rostrata* species. The molecular investigations carried out indicate that the population genetic structure of the European eel is characterized by the genetic mosaic which is formed due to the existence of reproductively isolated groups. Statistically significant genetic differentiation between the eel groups naturally recruited to Lithuania and Latvia and introduced to Lithuanian lakes has not been determined ($p > 0.05$). However, the eels stocked into different lakes of Lithuania differ in their genetic diversity. Pairwise comparisons of the Lithuanian and Latvian perch populations based on the mtDNA D-loop region data revealed that the perch population of Lake Drūkšiai was statistically significantly ($p < 0.05$) different from all other perch populations. The existence of the contact zone of different perch genetic lineages extending from the south-western part of Lithuania to the central part of Latvia was detected. The comparison of the distribution patterns of haplotypes in Europe revealed the peculiarities of the perch populations found in the Baltic States.

Key words: *Anguilla anguilla*, *Perca fluviatilis*, population genetic structure, molecular markers, Lithuania

**DEVELOPMENT AND APPLICATION OF THE INFORMATION SYSTEMS ON AQUATIC
NON-INDIGENOUS SPECIES
VANDENS SVETIMKRAŠČIŲ RŪŠIŲ INFORMACINIŲ SISTEMŲ KŪRIMAS IR
TAIKYMAS**



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Non-indigenous species (NIS) invasions and their impacts have become an area of increasing interest for scientists, managers, policy makers and members of the public. In the study “Development and application of the information systems on aquatic non-indigenous species” a new information system on aquatic NIS was developed to integrate multiple data on NIS taxonomy, biological traits, environmental characteristics, bioinvasion impacts, introduction events, pathways and vectors, and other important data for bioinvasion research and management. The system was integrated with a developed specialized computerized application for assessment of biopollution impacts. The developed integrated system was applied for data storage and analysis, such as identification of most invasive species, most important introduction pathways, predominant taxonomic groups of NIS, and options for the Biopollution index method optimization.

Key words: invasive species, impacts, information system, Biopollution index method, biopollution assessment

**DRINKING WATER DISINFECTION BY-PRODUCTS – TRIHALOMETHANES
EXPOSURES EFFECTS ON CONGENITAL ANOMALIES RISK
PAŠALINIŲ VANDENS DEZINFEKCIJOS PRODUKTŲ – TRIHALOMETANŲ
EKSPONICIJOS POVEIKIS ĮGIMTŲ ANOMALIJŲ RIZIKAI**



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Congenital anomalies are the major cause of infant morbidity and mortality and throughout later life. Epidemiological studies have suggested that pregnant women exposed to water DBPs containing elevated THM concentrations may be at a greater risk for adverse pregnancy outcomes, including foetal growth and congenital anomalies, characterised by structural deformities. However, findings of the studies completed to date have been inconsistent. Etiological studies show that toxic chemical substances, unfavourable social and demographic factors affecting pregnant women may have impact on the fetus development. However, the biological mechanisms by which THMs may affect the congenital anomalies formation remain unclear.

The objective of the research was to evaluate the effects of drinking water THMs exposure during pregnancy for major congenital anomalies risk. Our findings provide new data on pregnant women organism response to toxic substances formed in drinking water during disinfection by chlorine considering dose-response relationship. For the first time, controlling for the main confounding variables was evaluated dose-response relationship between the internal THMs dose and congenital anomalies risk. This study shows some evidence for a relationship between THM internal dose and risk of congenital anomalies. Particularly, increase of prenatal exposure to brominated THM during first pregnancy trimester might increase the risk of congenital heart and other congenital anomalies.

This research provides additional insight into the etiological mechanisms of congenital anomalies and stimulates to apply appropriate means for congenital anomalies prevention. The results of this epidemiological study stress the need for appropriate policy and interventional programs aimed at reduction of adverse pregnancy outcomes.

Key words: drinking water by-products, THM, internal dose, congenital anomalies

VIRUS-BACTERIA INTERACTIONS UNDER DIFFERENT CONDITIONS OF COASTAL ECOSYSTEMS

VIRUSŲ IR BAKTERIJŲ SĄVEIKA SKIRTINGOMIS PRIEKRANTĖS EKOSISTEMŲ SĄLYGOMIS



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Viruses are the most abundant and of greatest diversity life-forms in the World's Ocean, creating the highest natural selective force on the cellular life. The effect of virus infection has much broader ecological implications for ecosystem functioning than just mortality of host organisms. Viral activity promotes the cycling of nutrients within microbial loop, suppresses transfer of energy and organic matter to higher trophic levels, drives particle aggregation and enhance sinking, determines community structure, temporarily improves fitness, survival and/or resistance of infected cells, modulates gene transfer via transduction and regulates population (bloom) dynamics.

Virus-host interaction models predict that viral predation is a key controlling mechanism for community regulation in highly productive coastal ecosystems. However, the role of viruses in the coastal lagoons of the Baltic Sea is largely overlooked and lacks a detailed description of their seasonal dynamics and spatial distribution as well as virus-mediated processes such as bacterial mortality and recycling of carbon and nutrients. In addition, none of the studies performed in the Baltic Sea region to date addressed the question of how climate change and in particular global warming might influence virus activity in terms of virus production and virus induced bacterial mortality.

This study aimed to evaluate the patterns of virus-host interactions based on the assessment of viral impact upon host community structure, abundance and mortality. The research involved field sampling surveys and mesocosm experiments using natural microbial communities from two different Baltic Sea coastal ecosystems, the Curonian Lagoon (Lithuania) and Kiel Fjord (Germany). The mesocosm experiments in the Kiel Fjord were performed in climate change perspective by evaluating the effect of temperature change on virus-induced bacterial mortality.

The research broadens our understanding about the role of viruses in the microbial loop by providing evidence for significant virus contribution to prokaryotic community regulation in the studied ecosystems. This study also attempts to provide an insight into how climate change will affect biotic interactions and, thus, ecosystem services. The mesocosm experiments revealed the possibly existing temperature threshold significantly modulating virus activity. Further, this dissertation addresses the question of how field-based observations and experimental results might explain possible feedback processes of different types of interactions in the context of ecosystem functioning, eutrophication and global warming, and provide insights into how habitat with all its complexity by covering physical, chemical and biological elements rather than individual factor allows better understanding of the ecology of viruses in the coastal environments of the Baltic Sea.

Key words: virus-mediated bacterial interactions, frequency of infected cells, virus burst size, climate change, Curonian Lagoon, Baltic Sea
