

# Recent doctoral theses (ecology and environmental sciences) in Lithuania

Compiled by Virginija KALCIENĖ

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## POTATO CYST NEMATODES *GLOBODERA ROSTOCHIENSIS* AND *GLOBODERA PALLIDA*, AND THEIR CHEMOECOLOGICAL INTERACTIONS WITH THE HOST PLANT BULVIŲ CISTINIAI NEMATODAI *GLOBODERA ROSTOCHIENSIS* IR *GLOBODERA PALLIDA* BEI JŲ CHEMOEKOLOGINĖS SAŪVEIKOS SU AUGALU ŠEIMININKU TYRIMAS

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**The thesis defended:**  
24 April 2012  
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Potato cyst nematodes *Globodera rostochiensis* and *Globodera pallida* are one of the most important solanaceous plant pests. Up to 80% of the potato crop can be lost when no measures are taken against these pests. In fact, both species of potato cyst nematodes are included in quarantine pest lists all over the world.

Identification of potato cyst nematode species is exposed to morphological similarities and overlapping morphometric measurements between species. Only modern molecular techniques allow more accurate identification of potato cyst nematode species. Hence, it is important to apply these techniques in order to reliably identify these species in Lithuania.

Potato roots release chemical compounds into the soil which attract nematodes. Unfortunately, none of the potato released active compound (or compounds) is yet identified. For this reason, detailed examination of nematode behavior as well as analysis of bioactive chemical compounds released by potato roots are essential. Identification of these chemical compounds may lead to the ability of disturbing normal nematode behavior. Inhibition of nematode chemoreceptor activities may also disrupt normal nematode behavior. Accordingly, this knowledge could be applied for biological control of these quarantine pests.

The aim of the research was to establish the composition and prevalence of potato cyst nematode species in Lithuania, as well as characteristics of potato cyst nematode chemoecological interactions with the host plant. Morphological and for the first time in Lithuania molecular (PCR) analysis of potato cyst nematodes collected from soil samples from all 10 counties of Lithuania showed that only one species of potato cyst nematodes – *G. rostochiensis* is detected in Lithuania (common in all counties), while *G. pallida* is not detected. For the first time it was revealed that potato released nonspecific metabolite linalool and specific metabolite  $\alpha$ -solanine are attractive to potato cyst nematodes. For the first time it was evaluated that zinc sulphate inhibits nematode chemoattraction to  $\alpha$ -solanine. For the first time, comparative analysis of gas chromatography of potato root released chemical compounds showed that at least three chemical compounds other than linalool and  $\alpha$ -solanine are present in potato root emissions.

**Key words:** *Globodera* spp., identification of potato cyst nematodes, chemoecological interactions

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**POPULATION GENETIC STRUCTURE OF SALMON (*SALMO SALAR* L.) AND SEA TROUT (*SALMO TRUTTA* L.) IN LITHUANIAN RIVERS**  
**GENETINĖ LAŠIŠŲ (*SALMO SALAR* L.) IR ŠLAKIŲ (*SALMO TRUTTA* L.) POPULIACIJŲ**  
**STRUKTŪRA LIETUVOS UPĖSE**

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13 June 2012  
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The aim of this study was to assess genetic diversity of Lithuanian salmon and sea trout populations, to investigate spatio-temporal population structure of sea trout and to provide recommendations for sustainable management of genetic resources. Genetic diversity, genetic differences and relationships among wild and enhanced salmon and trout populations were estimated, hierarchical structure and temporal stability of the genetic diversity and structure of sea trout populations were assessed. Also, the level and patterns of contemporary gene flow among sea trout populations were estimated.

The results of this study revealed that the level of genetic diversity in Lithuanian salmon and sea trout populations was high despite recent population size bottlenecks in many of them. All the examined river basins exhibited similar levels of genetic diversity in spite of significant differences in the estimates of their smolt production. The level of genetic diversity in wild, enhanced and farmed populations of salmon and sea trout in Lithuania was quite similar, i. e. consistent with the Lithuanian supportive breeding program that is based only on wild spawners of local origin. Populations inhabiting different rivers and different tributaries of the same river were genetically differentiated. Population structure of analyzed sea trout populations corresponded to three main river basins: Akmena–Danė, Bartuva and Nemunas. Structuring within Nemunas basin was significantly weaker. Based on the results of the gene flow, Lithuanian sea trout was characterized as a population system with asymmetric and distance restricted contemporary gene flow. It was also evident that human mediated gene flow from stocked to wild populations alters hierarchical as well as spatial population structure of Lithuanian sea trout.

According to the findings and results of this study, future management strategies of these species should consider maintaining of individual populations even at tributary level and ensuring the natural levels of gene flow among populations.

**Key words:** Baltic Sea, Atlantic salmon, sea trout, population genetics, contemporary gene flow

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**INFLUENCE OF ETHYLENE, GIBBERELLIN AND ABSCISIC ACID ON THE MORPHOGENESIS CONTROL IN ASPEN (*POPULUS TREMULA* L.) AND ITS HYBRIDS UNDER DESIGNED ENVIRONMENTAL CONDITIONS**  
**ETILENO, GIBERELINO IR ABSCIZO RŪGŠTIES REIKŠMĖ DREBULĖS (*POPULUS TREMULA* L.) IR JOS HIBRIDŲ MORFOGENEZĖS VALDYMUI MODELIOJAMOMIS APLINKOS SĄLYGOMIS**

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The course of plant physiological processes is dependent on the activity of certain chemical compounds referred to as plant hormones. Since these compounds control the transmission of environmental signals in plant cells, studying the principles of hormonal regulation is one of the most important tasks in contemporary plant ecology. Although many studies have already been conducted on the effects of plant hormones ethylene, gibberellin and abscisic acid, the data concerning the interaction of these three hormones in the induction of plant response to various environmental factors in different experimental systems are quite inconsistent. During the present study, a combined investigation of ethylene, gibberellin, and abscisic acid was conducted on aspen and hybrid aspen *in vitro* cultures. The morphogenetic responses of several *Populus* genotypes to applied hormones and related growth regulators were comprehensively evaluated under designed environmental conditions. For the first time it was demonstrated that aspen morphogenesis *in vitro* and aspen morphogenetic response to certain growth regulators, such as gibberellin antagonists, are essentially dependent on the microenvironment conditions determined by the form and volume of culture vessel. Following the obtained results, perspectives are opened for further studies of tree micropropagation based on the purposeful coordination of environmental conditions and growth regulators, which should diminish the use of the latter.

**Key words:** aspen, culture conditions, explant, micropropagation, plant hormones

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**GREAT CORMORANT *PHALACROCORAX CARBO SINENSIS* DIET AND ITS EFFECT ON THE FISH POPULATIONS AND THEIR COMMUNITY IN THE EUTROPHIC CURONIAN LAGOON ECOSYSTEM**  
**DIDŽIOJO KORMORANO *PHALACROCORAX CARBO SINENSIS* MITYBA BEI POVEIKIS ŽUVŲ POPULIACIJOMS IR JŲ BENDRIJAI KURŠIŲ MARIŲ EUTROFINĖJE EKOSISTEMOJE**

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The rapid expansion of Great Cormorant populations during the second part of the 20th century has caused many conflicts, mostly with fisheries. Although evidence is often insufficient, cormorants are often considered as an important reason for depleted fish stocks. This study of Great Cormorant diet took place in the largest Lithuanian colony near Juodkrantė. Important for the impact evaluation cormorant nutrition aspects, including diet composition, its temporal variation and feeding selectivity, were determined. The reliability of pellet analysis for quantitative dietary assessments was evaluated for the first time using a stable isotope mixing model. Great Cormorant impact on spatial fish distribution was also assessed for the first time. This study is one of very few that have been undertaken using long-term cormorant diet and fish community data. The results of our study are important for providing improved assessments of the long-term effects of cormorants on fish communities in large, complex, highly productive aquatic systems. The practical significance of this study is its evaluation of competition between cormorants and commercial fishermen, which enables to substantiate the need to regulate cormorant population. Although commercially targeted fish species dominated Great Cormorant diet, the extent of direct competition was negligible. Assessment of cormorant impact on invasive Round Goby populations is also important. The increasing importance of gobies in the diet appears to have changed the role of Great Cormorant in the ecosystem.

**Key words:** Curonian Lagoon, Great Cormorant, cormorant diet, Round Goby, cormorant impact

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**EFFECTS OF HYDROMECHANICAL LAKE REMEDIATION ON DISTRIBUTION OF METALS AND METALLOIDS IN BOTTOM SEDIMENTS**  
**HIDROMECHANINIO EŽERŲ VALYMO POVEIKIS METALŲ IR METALOIDŲ PASISKIRSTYMUUI DUGNO NUOSĖDOSE**

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Although hydromechanical lake remediation projects have been carried out for several decades, there still is a lack of evidence about the changes in environmental status after such projects, while scientific literature regarding redistribution of metals and metalloids caused by hydromechanical bottom sediment removal is especially scarce both in Lithuania and in other countries. Research of the dissertation consisted not only of extensive geochemical field work and laboratory analysis, but also of methods of mathematical statistics and spatial interpolation. Results of the research and their analysis allowed to conclude that hydromechanical lake remediation results in changes of the contents of metals and metalloids of interest and their spatial redistribution in lake bottom sediments, which are specific to each metal and metalloid, thus cumulative indicators should be used to assess overall changes in sediment quality of the remediated lakes. Calculation and statistical analysis of such indicators – total sediment contamination index ( $Z_d$ ) and surface interpolation of its values allowed to evaluate statistical significance of changes in contamination degree of the newly formed surface sediment layer and to assess cumulative spatial redistribution of metals and metalloids caused by hydromechanical lake remediation. The data provided in the dissertation are especially significant in preparation and design of future sediment removal projects and in determining their feasibility.

**Key words:** lake sediments, hydromechanical remediation, dredging, metals, spatial distribution and interpolation, kriging, X-ray fluorescence analysis

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**PATTERNS OF OPTICALLY ACTIVE COMPONENTS AND PHYTOPLANKTON DISTRIBUTION IN ESTUARINE PLUME IN THE SOUTH EASTERN BALTIC SEA**  
**ESTUARINĖS KILMĖS VANDENS MASIŲ OPTIŠKAI AKTYVIŲ KOMPONENTŲ IR FITOPLANKTONO PASISKIRSTYMO DĖSNINGUMAI PIETRYČIŲ BALTIOJE**

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The impact of large rivers as a primary interface between terrestrial and ocean environments is important on a regional / continental and a global scale. Till recently the extremely unstable in time and space plume area was investigated only from the perspective of floristic changes of phytoplankton and modeled salinity. The investigations were based on the monitoring data which are conservative in the spatial resolution of stations and temporal resolution of observations. In our study we applied satellite based remote sensing data for the determination of the plume area.

However, firstly, the validation of chlorophyll *a*, coloured dissolved organic matter (CDOM) and total suspended matter (TSM) derived from MERIS/Envisat data with *in situ* measurements in Lithuanian Baltic Sea coastal waters should be performed. MERIS images were processed using five processors for coastal and inland waters – FUB, C2R, Eutrophic, Boreal and standard Level 2.

CDOM was selected as the most appropriate bio-optical indicator of plume in Lithuanian Baltic Sea coastal waters. The maps of CDOM derived from MERIS imagery for the summer of 2005–2011 were analyzed. The investigation of the plume will improve the understanding of the plume spatial distribution in Lithuanian Baltic Sea waters essential for Water Framework Directive and Marine Strategy Framework Directive. Finally, the patchy distribution of optically active constituents over the salinity gradient was observed, and different phytoplankton characteristics in the plume and non-plume area were identified. Finally, once the appropriate algorithms are established for the prediction of optically active water components, satellite based remote sensing technique may serve as a valuable tool for the investigation of ecological processes within the water basins and different water masses, and can be an additional information source for the assessment of water quality.

**Key words:** optically active components, phytoplankton, spatial distribution of the plume area, salinity gradient, water quality, satellite remote sensing, Baltic Sea

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