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UNIVERSITĀTE
ANNO 1919

IEGULDĪJUMS TAVĀ NĀKOTNĒ

INTERNATIONAL SCIENTIFIC CONFERENCE
“THE CURRENT STATE AND PERSPECTIVE OF THE
COREGONID LAKES”

1st – 2nd November 2012
Daugavpils (Latvia)

PROGRAMME AND ABSTRACTS

European Social Fund (ESF) project “Formation of interdisciplinary research group for securing the sustainability of salmonid lakes in Latvia”

Agreement No. 2009/0214/1DP/1.1.1.2.0/09/APIA/VIAA/089

Ieguldījums tavā nākotnē!

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CONFERENCE PROGRAM

Thursday, November 1

REGISTRATION & OPENING

- 10:30 – 15:00 **Arrival of participants and registration**
Park Hotel „Latgola” Ģimnāzijas 46, Daugavpils, Latvia
- 15:00 – 15:10 **Conference opening, welcome message**
Rector of Daugavpils University, Academician of LAS
Arvīds Barševskis, Daugavpils University

PLENARY SESSION

- Chairperson: Natalja Škute**, Daugavpils University, Latvia
- 15:10 – 15:40 **European Social Fund project “Formation of interdisciplinary research group for securing the sustainability of salmonid lakes in Latvia” summarization**
Artūrs Škute, Daugavpils University
- 15:40 – 16:20 **Flows of dissolved organic carbon (DOC) from territory of Latvia and factors controlling it**
Māris Kļaviņš, University of Latvia
- 16:20 – 17:00 **Current state and trends of Lithuanian mesotrophic lakes: ecological status, glacial relicts and non-indigenous species**
Kęstutis Arbačiauskas, Vilnius University
- 17:00 – 17:30 **The genetic monitoring of nature freshwater animal populations in Latvia**
Natalja Škute, Daugavpils University

WELCOME RECEPTION

- 18:00 – 22:00 **Social evening, sauna**
Park Hotel “Latgola”

Friday, November 2

BREAKFAST

- 07:30 – 08:30 **Breakfast**
Park Hotel “Latgola”

ORAL SESSION

- Chairperson: Artūrs Škute**, Daugavpils University, Latvia
- 09:00 – 09:20 **Assesment of the sediment chemical quality in salmonid lakes in Latvia**
M. Jankēviča, J. Šīre, I. Kokorīte, M. Kļaviņš
- 09:20 – 09:40 **Concentration of biogenic element compounds in the Lake Usma and their potential impacts on salmonid fish species**
J. Kārklīš
- 09:40 – 10:00 **Seasonality of phytoplankton biomass and species composition in salmonid lakes in Latgale, Latvia**
I. Konošonoka, J. Šīre

COFFEE BREAK

10:00 – 10:20

Coffee break

ORAL SESSION

Chairperson: Kęstutis Arbačiauskas, Vilnius University, Lithuania

10:20 – 10:40

Findings of *Emys orbicularis* in salmonid lakes in Latvia
M. Pupinš, A. Pupiņa

10:40 – 11:00

Investigation of the predator-prey interactions between fish populations in Lake Rāzna (Latvia) with generalized discrete time-dependent Lotka-Volterra model
A. Škute, V. Bardačenko, A. Solomenikovs

11:00 – 11:20

Phenotypic changes of vendace *Coregonus albula* (L.) in the lakes of Lithuania
V. Umbrasaitė, E. Bukelskis, A. Kaupinis

11:20 – 11:40

A non-destructive DNS sampling method from Salmonidae fish scales for genetic analysis
A. Kārklīnš, N. Škute

COFFEE BREAK

11:40 – 12:00

Coffee break

POSTER SESSION – 5 MIN PRESENTATIONS AT THE POSTERS

Chairperson: Mihails Pupiņš, Daugavpils University, Latvia

12:00 – 12:45

Occurrence of Cladocera and genetic diversity of certain species in Latvian salmonid lakes
A. Brakovska, J. Paidere, R. Škute, N. Škute, A. Škute, M. Stepanova, E. Iliško, I. Dimante-Deimantoviča

The current status of Coregonidae in the lakes of Latvia
Ē. Aleksejevs, J. Birzaks, M. Strūģis

Management of coregonid fish stocks in Lithuanian waters
E. Bukelskis, A. Kaupinis

Temporal and spatial distribution of fish in the northern part of the Lake Svente
P. Jurevičs, A. Škute

Characters of paleovegetation change in Lakes Pilveļu, Pilcines and Padēlis
L. Rūtina, A. Ceriņa, K. Stankeviča, M. Kļaviņš

Hydrometeorological parameters, aquatic and sediment chemistry of Lake Engure
M. Zariņš, M. Kļaviņš, I. Kokorīte, V. Rodinovs, Z. Avotniece, G. Sprinģe, A. Briede, M. Jankēvica, L. Dreijalte

LUNCH

13:00 – 14:00

Lunch

Park Hotel “Latgola”

November 1 – 2, 2012

ORAL SESSION

Chairperson: Jana Paidere, Daugavpils University, Latvia

14:00 – 14:20

Morphological and genetic variability of population structure of vendace *Coregonus albula* (L.) in seven Latvian lakes

J. Oreha, N. Škute

14:20 – 14:40

Native vendace *Coregonus albula* and alien peled *C. peled*: genetic comparison and introgressive hybridizations

E. Borovikova, V. Artamonova, A. Makhrov

14:40 – 15:00

Invasive fish *Percottus glenii* in biotopes of *Bombina bombina* in South-East Latvia

A. Pupina, M. Pupinš

15:00 – 15:20

Whitefish (*Coregonus lavaretus* (L.)) stocking in Latvia

M. Zinģis, I. Rutkovska, R. Medne

COFFEE BREAK

15:00 – 15:20

Coffee break

POSTER SESSION – 5 MIN PRESENTATIONS AT THE POSTERS

Chairperson: Aija Brakovska, Daugavpils University, Latvia

15:20 – 16:00

Estimation of eutrophication in some Latvian salmonid lakes by changes of the zooplankton communities compared with the earlier investigations

N. Markelova, O. Valpētere, L. Gasimova, J. Paidere

Applicability of zooplankton community study for ecological quality assessment of salmonid water lakes in Latvia during summer, 2010

J. Paidere, A. Brakovska, E. Iliško, O. Griņko, I. Brūvere, I. Dimante-Deimantoviča

Distribution of *Mysis relicta* Loven and *Pallasea quadrispinosa* G.O.Sars in some Latvian lakes

M. Stepanova, V. Vežnovics, A. Škute

Peculiarities of zoobenthos communities of Latvia's coregonid lakes

A. Poppels

An examination of the method used in zooplankton counting

I. Dimante-Deimantoviča, J. Paidere, A. Brakovska, A. Škute

CONFERENCE CLOSING

16:00 – 16:15

Conference closing

Head of the scientific and local organising committee:

Artūrs Škute, Daugavpils University

CONFERENCE DINNER

18:00 – 21:00

Conference dinner, concert

„IN & OUT“ from Germany – blues, jazz, rock pop and boogie woogie concert

Park Hotel “Latgola”

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**EUROPEAN SOCIAL FUND PROJECT “FORMATION OF INTERDISCIPLINARY
RESEARCH GROUP FOR SECURING THE SUSTAINABILITY OF SALMONID
LAKES IN LATVIA”**

A. Škute

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In Latvia the normative quality parameters for ground and underground waters are set by the regulations of the Cabinet of Ministers of the Republic of Latvia that define also the priority fish waters. Salmonid lakes represent one of the priority water categories and European cisco (*Coregonus albula*) is salmonid that in Latvia in the 1930s occurred in 30 lakes, in the 1950-60s – in 11 lakes: Lake Drīdzis, Alūksnes, Lielā Gusena, Nirzas, Puzes, Rāznas, Sīvera, Stirnu, Sventes, Tērpes, and Usmas, while in the 1990s – only in five lakes (Ežezers, Lejas, Nirzas, Rāznas, and Usmas lake), i.e. this economically significant species is disappearing from lakes in Latvia. Since 1995, European cisco has been included in the 3rd category of rare species in Latvian Red Book. European cisco in Latvia is also included into the list of protected species of a limited use.

In order to solve the problem of sustainable use of salmonid lake resources in Latvia, an interdisciplinary research group was formed at Daugavpils University within European Social Fund framework that cooperates with LU Faculty of Geography and Earth Sciences. The research of Latvian salmonid lake waters is interdisciplinary; it involves environmental science, biology, physics, and mathematics.

The scientific significance of the research results is demonstrated by the opportunity to determine the reaction of freshwater ecosystem towards natural and anthropogenic environmental factor changes as well as adequate evaluation of the environment quality by means of new technologies and methods. Project results for the assessment of environment quality and its determining factors, especially under the present changing socioeconomic conditions, are essential from the ecological and nature protection perspective in the context of sustainable development of Latvia. The acquired data will be used for dealing with both regional and international ecological and socio-economic problems. Practical suggestions will be worked out for laws in environmental and other sectors of Latvian legislation as well as development planning documents for local governments and particular entrepreneur (lake manager) activities. This research was supported by grant European Social Fund project No.2009/0214/1DP/1.1.1.2.0/09/APIA/VIAA/089.

**THE GENETIC MONITORING OF NATURE FRESHWATER ANIMAL
POPULATIONS IN LATVIA**

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Genetic monitoring is the long-term surveillance of the state of population gene pools allowed to evaluate and predict their temporal and spatial dynamics, and to determine the limit of permissible changes in their state. There are four basic processes that determine evolutionary changes in population: random genetic drift, gene migration, gene mutation, and natural selection. The population should be defined in terms of natural history, geography, and is necessary to describe the distribution of the subpopulation structure of the system in time and space, and the material should be sampled in such a way as to comprehensively characterize the subpopulation structure by a complex of traits selected in advance. The analysis of population also involves: data on the demographic structure of population, data on body weight, size, and proportion of individuals, evaluation of individual genotypes for the maximum possible number of polymorphic gene loci, including various protein systems and systems of DNA polymorphism. This information makes it possible to analyze the distribution of poly- and monogenic traits and their variability, to estimate the ratios among components of gene diversity and to understand the state of genetic processes in population. In the Ecology Institute the genetic monitoring was beginning in different directions: the genetic monitoring of introduced and artificial finfish populations, the genetic monitoring of protected populations, the genetic monitoring of water indicator organisms and the genetic monitoring of invasive species. These different genetic monitoring directions require different approaches and methodology. The genetic monitoring of different freshwater species is in progress and results are discussed.

THE CURRENT STATUS OF COREGONIDAE IN THE LAKES OF LATVIA

Ē. Aleksejevs, J. Birzaks and M. Strūģis

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Publications from 1930 indicated that in lakes of Latvia only one Coregonidae family species vendace *Coregonus albula* (Linnaeus, 1758) have formed self-sustaining populations. This species was found in 15 to 30 lakes. Migratory whitefish *Coregonus* sp. was found in the lakes connected by rivers.

Artificial rearing of Coregonidae family species in Latvia was carried out from at least 1888. During the period from 1900 to 1968 vendace was restocked in 36 lakes. Ripus *Coregonus ladogae* Pravdin, Golubev & Belyaeva, 1938 was introduced from 1955 to 1980 in 14 lakes. At least 7 species and hybrids of Coregonidae were introduced in the lakes: inconnu *Stenodus leucichthys* (Güldenstädt, 1772), Peipsi whitefish *Coregonus maraenoides* Berg, 1916, Ludoga whitefish *Coregonus lutokka* Kottelat, Bogutskaya & Freyhof, 2005, peled *Coregonus peled* (Gmelin, 1789), muksun *Coregonus muksun* (Pallas, 1914), Baikal omul *Coregonus migratorius* (Georgi, 1775) and broad whitefish *Coregonus nasus* (Pallas, 1776). All together Coregonidae family species have restocked in 112 lakes of Latvia.

Since 1990 fish sampling by gillnets has been conducted in 316 lakes, 88 of them were lakes restocked by Coregonidae and 15 with native vendace populations reported. Vendace was found in 10 and whitefish *Coregonus* sp. in 4 of studied lakes, however introduced peled was observed only for a short time in 2 years period after restocking.

Most of the Coregonidae species introduced into Latvia's lakes have not formed self-sustaining populations and are no longer found. Also the number of vendace populations clearly decreased. In some lakes mass summer- kills of vendace were observed, possibly due to high water temperature and low oxygen saturation above the thermocline.

**CURRENT STATE AND TRENDS OF LITHUANIAN MESOTROPHIC LAKES:
ECOLOGICAL STATUS, GLACIAL RELICTS AND NON-INDIGENOUS SPECIES**

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There are about 160 lakes with surface area over 100 ha in Lithuania among which there are deep, mesotrophic lakes. These are the most valuable inland water bodies which definitely deserve regular scientific observations of their status, sustainable management and protection when required. The main threats for the naturalness of mesotrophic lakes in Lithuania currently are the anthropogenic pollution, non-indigenous species and probably global climate change. Recently, for the cost effective evaluation of the ecological status of lakes the method based on the eulittoral macroinvertebrate assemblages was developed and tested. Results of this investigation will be presented and discussed. The deterioration of the ecological status of deep mesotrophic lakes primarily induces alterations in the deep hypolimnion waters which are the habitat of glacial relict crustaceans. Thus, the status of these animals can also be used for the evaluation of lake change trends. Consequently, the information on glacial relict crustaceans, benthic as well as planktonic, available for the last few decades will be presented and analysed. Lithuanian lakes are unique because they were massively subjected to introductions of Ponto-Caspian peracaridans in the second half of the 20th century. Not everywhere introduced species succeeded to establish permanent populations, however, in the invaded lakes they induced the substantial change of native communities. Environmental factors affecting peracaridan invasion success, consequences of introductions and other relevant lesson from that ill-advised human activity will be discussed.

**NATIVE VENDACE *COREGONUS ALBULA* AND ALIEN PELED *C. PELED*:
GENETIC COMPARISON AND INTROGRESSIVE HYBRIDIZATION**

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Non-native species of the Coregonidae were introduced in the many lakes of the Northern Europe. At the same time it is known that very common process for this group of fish is hybridization. The aim of this study was to analyse the genetic relationships between two close species, vendace *Coregonus albula* and peled *C. peled*, because these data can be useful for understanding the origin and taxonomical status of these species as well as monitoring of interspecific hybridization.

Samples of the vendace and peled were collected from 2003 to 2011. Genomic DNA was extracted using the phenol-chloroform extraction protocol or the Diatom®DNA Prep 100 (“IzoGen”, Moscow). We performed PCR-RFLP analysis of the mitochondrion *ND-1* fragment (about 2050 bp). Also a fragment of the *ND-1* gene (300 bp) was sequenced.

The sequences of the studied fragment of all specimens of the peled entirely coincided with the *E-1* variant of the vendace, although we studied the mtDNAs of fishes from two local populations and analysed samples belonging to two different composite haplotypes from each population. At the same time we found specimens with peled’s type composite haplotype in vendace’s population from Rybinsk reservoir (upper reaches of Volga River) although peled was not observed in catches after its introductions in the middle of XX century.

The obtained data allow us to discuss different models of the relationships between two species. First, vendace and peled may be assumed to be ecological forms of the same species. Second, the data may also be interpreted as a consequence of the introgressive hybridization between vendace and peled. The possibility of this case was observed in the population of Rybinsk reservoir. Third alternative is that peled and vendace originated from a common ancestor and have diverged recently.

OCCURRENCE OF CLADOCERA AND GENETIC DIVERSITY OF CERTAIN SPECIES IN LATVIAN SALMONID LAKES

A. Brakovska, J. Paidere, R. Škute, N. Škute, A. Škute, M. Stepanova, E. Iliško and I.

Dimante-Deimantoviča

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In Latvia there are 26 lakes categorized as priority fish lakes for salmonid fish species. Studies on cladocerans as salmonid fish prey are of particular interest. Common Cladoceran species such as *Daphnia cucullata* can be used as a good model organism for ecological genetics studies.

In order to study salmonid fish food base i.e. zooplankton diversity and genetical diversity of *D. cucullata* in the Lakes Dridzis, Svente, Riča and Geraņimovas-Ilzas, zooplankton samples were taken from May to September 2010 and 2011. Zooplankton was collected from the deepest part of each lake and physical, chemical parameters of water were determined.

The lakes were stratified during summer and the mean transparency of lakes over the season was 5.27 m. Temperature was 9-10°C below the edge of the metalimnion. In the deepest layers of the hypolimnion water temperature decreased to 4-5°C. Dissolved oxygen levels ranged from 0.63 mg/l (hypolimnion) to 9.20 mg/l (epilimnion). The zooplankton was characterized by a relatively small quantity within the thermocline.

Cladocerans contributed significantly to the total zooplankton biomass in the lakes (on average min 6.8 % in May 2010, max 70 % in July 2010). The highest Cladocera biomass was observed from June to late July, what can be explained by seasonality. The most dominant species were *Diaphanosoma brachyurum*, *D. cucullata*, *Bosmina crassicornis*, *B. longispina*, *B. longirostris*.

D. cucullata was found in all lakes. The genetic structure and plasticity of *D. cucullata* was studied with nuclear randomly amplified polymorphic DNA (RAPD) method. For this study we used Carl Roth randomly primers for PCR amplification of DNA samples. Primer sequences were amplified with DNA of *D. cucullata* samples of the three deepest lakes, i.e. Dridzis, Svente, Riča and Geraņimovas-Ilzas and polymorphic DNA band sizes were from 200 to 3000 bp. The number of polymorphic DNA band of *D. cucullata* in the three investigated lakes is different.

Research was supported by project No. 2009/0214/1DP/1.1.1.2.0/09/APIA/VIAA/089.

MANAGEMENT OF COREGONID FISH STOCKS IN LITHUANIAN WATERS

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In Lithuania waters two forms of whitefish are found – marine whitefish *Coregonus lavaretus lavaretus* (L.), which migrates from Baltic Sea to freshwaters for spawning, and lake whitefish *Coregonus lavaretus holstatus* Thien, which is found in 17 lakes.

Only marine whitefish is important for commercial fishery. There are about 500 kg of this kind of fish cached in Lithuanian waters every year however, commercial caches in Russia reaches 3-7 tons.

Both forms of whitefish lives in Lithuanian lakes: form with low number of gill rakers (has 19-25 gill-rakers), and form with high number of gill rakers (has 33-34 gill rakers). Every year about 1.5-2.5 million whitefish larvae are incubated, raised shortly and released in Lithuanian lakes. Whitefish introduction to the lakes is successful. During the first year after introduction the whitefish biomass reaches 25 % of total lake biomass. It is noticed that introduced whitefish grows faster in the new environment than in their native lakes. Whitefish gonad maturation and spawning was recorded in lakes 3-4 years after introduction. Hence artificial breeding of lake whitefish is necessary for their survival in Lithuanian lakes.

European vendace *Coregonus albula* (L.) inhabits about 78 lakes in Lithuania. Approximately 20-30 million larvae of vendace are incubated per year. Since 1993 about 260.4 million European vendace larvae has been released in to the Lithuanian lakes. Nevertheless during this period commercial caches decreased from 20-50 tons to 4-5 tons per year. The major cause of vendace population decline was irrational commercial fishery and changes in structure of the ichtiocenosis. In 2011 commercial caches increased up to 44 tons, hence vendace populations have recovered in Lithuania. This recovery deals with the new restrictions in the fishery, which limits fishery equipment, but not weight of the commercial caches.

AN EXAMINATION OF THE METHOD USED IN ZOOPLANKTON COUNTING

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In the frames of the European Social Fund project „Formation of Interdisciplinary Research Group for Securing the Sustainability of Salmonid Lakes in Latvia” zooplankton’s abundance and diversity was analysed.

Most of the investigated lakes are slightly eutrophicated. Both pelagic and littoral micro crustacean (Cladocera and Copepoda) samples contain a large number of animals. The method of micro crustacean counting is applied when 3x2 ml subsample replicates are counted from 100 ml up to 200 ml (in cases when density of specimens is high) sample. However, this kind of method gives data on relative abundance of most common taxa and faunal composition of rare species remains unclear.

In the preliminary research, we estimated possibility to contribute towards comprehension of taxonomic structure of micro crustacean community. For that purpose, subsample replicates were counted and in addition, the rest of the sample was briefly examined for species presence/absence records.

Preliminary research results showed that for littoral samples significant number of micro crustacean species can be added after the rest of the sample was examined – less than 50 % of the total species can be found when only subsamples are examined. Sometimes rare species were represented with a single or few animals. For pelagic samples difference between recorded species number from subsamples and whole sample was not so pronounced. In most of the cases, additional species found in pelagic zone were littoral species appearing by chance. However, complete examination of the pelagic sample gives important information about big predator species presence like *Bythotrephes longimanus* and *Leptodora kindti* usually found in comparatively low numbers and therefore not always recorded when routine counting method is applied.

Examination of the whole sample is more time-consuming, however it should be done if it is essential for the research targets. Correct processing of samples is of importance for understanding taxonomic structure of micro crustacean community, for instance in bioindicator research.

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**ASSESSMENT OF THE SEDIMENT CHEMICAL QUALITY IN SALMONID LAKES
IN LATVIA**

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Freshwater ecosystems have changed significantly due to human activities, leading to accumulation of supplementary nutrients, thus increasing primary productivity in many lakes and causing structural changes in food webs.

Studies on lake sediment composition can provide valuable information about character of lake development and thus can be used to study long-term natural and anthropogenic impacts on lakes and their catchment. The aim of this study is not only to evaluate possible anthropogenic pressures and concentrations of phosphorus, nitrogen and heavy metals in 18 salmonid lake ecosystems in Latvia, but also to estimate the possible impacts of the land use as well.

The studied lakes are mesotrophic and eutrophic. Additionally during the summer and winter seasons hypoxic conditions can be observed in most of the studied lakes. Lake sediments can be characterized as rich in organic matter; loss-on-ignition (550 °C) can exceed 45 %. Total phosphorus concentrations in upper part of sediments vary from 300 to 2400 mgP/kg with the highest concentrations attributed to areas with direct human impact (e.g., municipal effluents and historically accumulated pollution from intensive farming practices during the Soviet period). Phosphorus speciation analyses reveal that up to 25 % of extractable P is found in reducible form, which can be released in water column under hypoxic environmental conditions. Relatively inert HCl-extractable P fraction comprises the largest part of total phosphorus concentration in sediments (up to 44 %). Concentrations of heavy metals in sediments of studied lakes are very low to low (Cu, Zn, Cd, Pb) or medium (Ni and Cr) according to the criteria of Swedish EPA.

The research has been carried out with financial support of European Social Fund (ESF) project No. 2009/0214/1DP/1.1.1.2.0/09/APIA/VIAA/089 „Formation of interdisciplinary research group for securing the sustainability of salmonid lakes in Latvia”.

**TEMPORAL AND SPATIAL DISTRIBUTION OF FISH IN THE NORTHERN PART
OF THE LAKE SVENTE**

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Lakes are important freshwater habitats providing significant attraction for the public. Moreover, according to the Water Framework Directive, member states of European Union need to achieve good ecological status of surface waters based on different groups of biota. Therefore understanding of freshwater ecosystem functions is an important condition for effective management of coregonid lakes.

The study site is located in the south-eastern part of Latvia. Lake Svente is a relatively deep, slightly eutrophic lake of surface area 7.35 km². The northern part of the lake is 20–35 m deep and has a strongly marked depression (35 m). Features of temporal and spatial distribution of pelagic fish were studied using hydroacoustic methods. Hydroacoustic technique has the obvious advantage of being non-lethal. Data collection was performed in August, 2010, 2011 and 2012. Acoustic data were collected by a BioSonics DT-X digital echosounder operating at the frequency of 200 kHz. Fish were sampled during the day and night on the same line transect. Line transect was crossing the deepest part of the lake. The acoustic data were processed by using Echo view 4.9 software. Physicochemical parameters of the water column were measured same as vertical samples of zooplankton were collected at the deepest part of the lake.

Study results confirmed significant time and depth effects on estimates of fish abundance in the pelagic zone. Differences in the spatial distribution of larger and smaller fish were observed depending on the time of the day. The interaction between fish and zooplankton was found to be ambiguous and complex. This study was supported by ESF project “Formation of interdisciplinary research group for securing the sustainability of salmonid lakes in Latvia” No.2009/0214/1DP/1.1.1.2.0/09/APIA/VIAA/089.

**CONCENTRATION OF BIOGENIC ELEMENT COMPOUNDS IN THE LAKE
USMA AND THEIR POTENTIAL IMPACTS ON SALMONID FISH SPECIES**

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One of the priority freshwaters in Latvia are salmonid fish lakes. For adequate development of salmonid fish species, water quality must fit specific criteria. An important factor affecting water quality is the amount of nutrients in it. Most important elements are nitrogen and phosphorus. Those element compounds (ions) - ammonia, nitrites, nitrates and phosphates are considerable pollutants of water ecosystems. As a consequence such processes begin to occur - eutrophication of water basins, more intense growth of aquatic plants and protista, dissolved oxygen depletion, which leads to the putrefactive process. These processes lead to chemical water quality deterioration, which means that conditions are unsuitable for adequate salmonid species development.

The research aim is to assess the factors that determine Lake Usma water chemistry and flow of nutrients in Lake Usma. This is done through the ecosystem survey, water sampling and quantitative and qualitative analysis. The research provides information on Lake Usma pollution with biogenic elements (nitrogen and phosphorus) and the biological and chemical oxygen consumption in water (COD, BOD).

Following methods were applied – water samples collecting, water samples preparing for COD and BOD analyses, spectrophotometry.

Within the study author reflects likely sources of nutrient pollution - groundwater movement, the nearest aquatic ecosystems and potential contamination of land, mostly agricultural land. During research author found that the biogenic element compounds in Lake Usma has increased, especially the total phosphate content. After analyzing the oxygen consumption in the water it can be concluded that the chemical oxygen consumption is above the norm and a total quantity of dissolved oxygen is insufficient for salmonid species development.

It is necessary to develop proposals to reduce the amount of biogenic elements in Lake Usma ecosystem both at present and in the long term as this is of importance for creating favorable conditions for salmonid fish species like vendace *Coregonus albula* existence. In Kurzeme district Lake Usma is the only lake inhabited by vendace.

**FLOWS OF DISSOLVED ORGANIC CARBON (DOC) FROM TERRITORY OF
LATVIA AND FACTORS CONTROLLING IT**

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The impact on sea and coastal areas is influenced by chemical composition of waters and loads of dissolved substances to the sea. Of importance in this respect are flows of natural organic substances – humic substances (major part of dissolved organic carbon - DOC). The number of studies on DOC during the last few years is very much growing. The aim of this study is to describe long term changes of DOC concentrations in surface waters quality of Latvia, factors controlling DOC runoff, spatial variability of water chemical composition, possible impacts of pollution sources, and to analyze the characters of compositional changes.

Within this study the DOC concentrations in the major rivers and lakes of Latvia have been determined. Impact of other major water ingredients on DOC budgets has been studied. The dynamics of DOC flows depending on land use pattern and soil properties in Latvia are described, including emissions by industrial and agricultural production. The water chemistry of a large number of lakes and rivers has been determined and the possible impact of water chemical composition on water quality has been evaluated.

As a tool spectral analysis of DOC has been used, for example applying fluorescence index. The changes of DOC concentrations follow a pattern common for rivers in Northern Europe and much depends on the river discharge regime. Average concentration of total organic carbon (TOC) in the River Salaca basin is about 25 – 30 mg/l. Seasonal changes of concentrations of organic carbon are more pronounced in the tributaries than in the River Salaca. Higher concentrations of organic carbon are observed in autumn. In the pool of TOC, a major role is played by dissolved organic substances and only during spring and autumn seasons particulate organic carbon reaches up to 5 % of the TOC.

**SEASONALITY OF PHYTOPLANKTON BIOMASS AND SPECIES COMPOSITION
IN SALMONID LAKES IN LATGALE, LATVIA**

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The studied lakes are located in SE part of Latvia – in Latgale. All of the studied lakes are of glacial origin and therefore classified as deep (mean depth >9 m) or medium deep (5 – 9 m), slightly and moderately eutrophic. Due to morphometric properties most of the studied lakes are dimictic. Water samples were taken from depth of 0.5m and hypolimnion for general water chemistry and phytoplankton analyses. Sampling was performed in November, 2010 and March and August, 2011. Concentration of dissolved oxygen, conductivity, pH and water temperature were measured in situ by using portable probe HACH Q40d.

In November, 2010 phytoplankton biomass in studied lakes was in range from 0.176 mg l⁻¹ in Drīdzis to 1.09 mg l⁻¹ in Rāzna. Dominant algal groups in terms of abundance and cell count were planktonic diatoms and cryptophytes. Two different phytoplankton societies can be distinguished with dominant species of *Fragilaria crotonensis*, *Asterionella formosa* in Lakes Drīdzis and Svente, and *Aulacoseira* ssp. in Lake Rāzna. A planktonic diatom with lightly silificated frustule *Urosolenia longiseta* was reported from Lake Svente.

In March, 2011 phytoplankton biomass was very low, ranging from 0.004 mg l⁻¹ in Jazinka to 0.007 mg l⁻¹ in Drīdzis and constituted mostly from planktonic diatoms and filamentous cyanophytes. Most frequently occurring cyanophyte species were *Anabaena spiroides* and *Planktolyngbya limnetica*.

During summer period phytoplankton biomass was highest, ranging from 0.38 mg l⁻¹ in Lake Stirnu to 10.7 mg l⁻¹ in Lake Laucesa. By the species richness chlorophytes dominated in all sampled lakes. However, different algal groups dominated in terms of biomass, mostly cyanophytes and diatoms, with exception in Lake Laucesa where dinoflagellates accounted for 5.37 mg l⁻¹ from total biomass.

Phytoplankton biomass in Lakes Drīdzis and Svente was low throughout all seasons, ranging from 0.006 mg l⁻¹ in Svente (March, 2011) to 0.97 mg l⁻¹ in Rāzna (August, 2011).

In total 194 phytoplankton taxa were identified in all studied lakes.

**ESTIMATION OF EUTROPHICATION IN SOME LATVIAN SALMONID LAKES
BY CHANGES OF THE ZOOPLANKTON COMMUNITIES COMPARED WITH
THE EARLIER INVESTIGATIONS**

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The aim of this study was to estimate eutrophication in some of the salmonid lakes in Latvia by changes of the zooplankton communities during summer, 2011 and to compare obtained data with earlier investigations. The samples of zooplankton were obtained in the deepest site of the lakes at 0.5 m depth with Hydro-Bios plankton net (64µ) in the Lakes Bēšons, Cārmans, Dubuļu, Jazinkas, Ilzas-Ģeraņimovas, Sventes, Riču and Cērps. Simultaneously, the water physico-chemical parameters were measured by a HACH DS5 water multiparameter sonde.

The lakes were stratified during summer and water physico-chemical parameters varied between epilimnion, metalimnion and hipolimnion.

In general, compared to earlier investigations (1950s – 1990s), the lakes trophy has mainly increased or not changed. For example, the Lake Sventes has changed from mesotrophic (in 1950s – 1960s) to eutrophic, slightly eutrophic (in 1990s). However according to data of zooplankton abundance, biomass and species composition in summer, 2011 the Lake Svente is estimated as mesotrophic. Lakes Sventes, Ilzas-Ģeraņimovas, Cērps and Bešons compared to earlier investigations have become mesotrophic, Lakes Cārmans, Jazinkas and Dubuļu are meso-eutrophic, and the Lake Riču – poorly eutrophic.

In the Lakes Ilzas-Ģeraņimovas, Jazinkas, Bešons was observed such a large, glacial-relict copepod as *Eurytemora lacustris*, and in the Lakes Sventes and Riču - *Limnocalanus macrurus*. This species also indicated good water quality of the studied lakes.

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**MORPHOLOGICAL AND GENETIC VARIABILITY OF POPULATION
STRUCTURE OF VENDACE *COREGONUS ALBULA* (L.) IN SEVEN LATVIAN
LAKES**

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Morphological and genetic variability within and among seven natural Latvian populations of *Coregonus albula* (L.) was evaluated. Morphological variability was assessed using 8 plastic and 3 meristic characters of fish individuals. Genetic variability was estimated on the basis of 20 enzyme loci, 6 microsatellite loci and 10 randomly amplified polymorphic DNAs (RAPDs) primers. The analysis was performed to evaluate morphological and genetic diversity among individuals of vendace populations from Lakes Svente, Rāzna, Nirza, Drīdzis, Stirnu, Alūksnes and Ežezers to assess intra-specific variation.

The analysis revealed statistically significant morphological and genetic variation among individuals of studied *C. albula* populations. Genetic variation within samples was significantly higher for microsatellites and RAPD than for enzyme loci. Although all used methods showed a high degree of heterogeneity among samples. A high degree of morphological and gene diversity, genetic relationships were also revealed. We assumed that genetic drift as a natural selection result was the main factor affecting the morphological and genetic differentiation of vendace populations in studied lakes.

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**APPLICABILITY OF ZOOPLANKTON COMMUNITY STUDY FOR ECOLOGICAL
QUALITY ASSESSMENT OF SALMONID WATER LAKES IN LATVIA DURING
SUMMER, 2010**

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According to the Latvian environmental legislation, lakes with high water quality and suitability for such protected salmon fish species as vendace *Coregonus albula* (L.) and whitefish *Coregonus lavaretus* (L.) existence are included in the list of priority fish waters. This status has been assigned to 26 large, deep Latvian lakes. Zooplankton animals are important indicators of the ecological status in freshwater lakes ecosystems.

The aim of this study was to determine the changes of zooplankton abundance and species composition of the salmonid water lakes in Latvia during summer, 2010 and to investigate whether structural changes of zooplankton communities provide information about their ecological quality and trophy.

Quantitative and qualitative analyses (comparison of means, analysis of regression, TWINSPAN) of the zooplankton communities between the different lakes groups show that abundance of zooplankton and taxonomic structure was changing with different degree of the lakes eutrophication. Lakes were divided in three different groups of trophy by zooplankton communities – mesotrophic, meso-eutrophic and eutrophic.

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**PECULIARITIES OF ZOOBENTHOS COMMUNITIES OF LATVIA’S COREGONID
LAKES**

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Investigations of Coregonid lakes are carried out due to salmonid fishes. These deep eutrophicated lakes are situated in the Eastern part of Latvia. Zoobenthos species composition, number of individuals and biomass was investigated in the Lake Drīdzis, Lake Rušonu, Lake Rāzna and Lake Ilzas-Geraņimovas and other lakes. Distribution of the benthic communities in the lakes is not uniform. Maximal biomass (g m^{-2}) and number of individuals ($\text{individuals m}^{-2}$) are stated in the littoral zone where highest biodiversity of invertebrates is observed. Less biomass (g m^{-2}) and number of individuals ($\text{individuals m}^{-2}$) are stated in the deepest section of lake due to mass development of Chironomidae and in small amount development of *Pisidium* sp. Littoral zone characterises by high biomass ($5.7\text{-}15.0 \text{ g m}^{-2}$) and high number of individuals ($4000\text{-}7500 \text{ individuals m}^{-2}$). Littoral zone is dominated by Mollusca, Trichoptera, Ephemeroptera and Varia. Profundal zone characterises by small number of individuals ($100\text{-}3500 \text{ individuals m}^{-2}$) and biomass ($0.2\text{-}3.2 \text{ g m}^{-2}$). Zoobenthos of investigated lakes is rich by juvenile stages of macroinvertebrates what is of importance for Coregonid fishes.

INVASIVE FISH *PERCCOTTUS GLENII* IN BIOTOPES OF *BOMBINA BOMBINA* IN SOUTH-EAST LATVIA

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Perccottus glenii is an invasive fish from far East in Latvia and a serious danger for *Bombina bombina* according “Protection Plan for *B. bombina* in Latvia” approved by Ministry of Environment in 2007.

The investigation of each pond by netting was repeated 5 times a year in 2004-2012. The search of *B. bombina* was carried out by both audial and visual methods. *P. glenii* is found in 5 water bodies, inhabited by *B. bombina* in populations from Ilgas, Demene, Medumi at a distance of no more than 1-2 km from Lithuania and Belarus.

After the invasion of *P. glenii*, *B. bombina* ceases to spawn successfully in the biotope, eggs or tadpoles cannot be usually observed in it, although, in the absence of *B. bombina*, in other reservoirs nearby *B. bombina* males can continue to vocalize in the biotope. It can be assumed that *B. bombina* avoids being in the reservoir which is inhabited by *P. glenii*, as well as tadpoles avoid spreading throughout the reservoir. In the colonized by *P. glenii* reservoir vocalizing *B. bombina* chooses highly structured (with many plants and boughs) parts of the biotope.

The simultaneous presence of *P. glenii* and *B. bombina* tadpoles in the biotope can indicate that *P. glenii* has appeared in the biotope relatively not long time ago. The long-term (no less than 2 seasons) presence of *P. glenii* in a small reservoir causes the disappearance of *B. bombina* tadpoles, as well as larvae of other amphibians.

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FINDINGS OF *EMYS ORBICULARIS* IN SALMONID LAKES IN LATVIA

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Emys orbicularis (Linnaeus, 1758) is semi-aquatic Reptile of Europe. Latvia is situated on the northern edge of its distribution. *E. orbicularis* uses different types of water bodies: ponds, canals, small rivers, marshes, and lakes. The research and optimization of water biotopes is important part of the "Plan of conservation of European pond turtle *E.orbicularis* in Latvia", approved by Ministry of Environment in 2008.

The study of the distribution of *E.orbicularis* was carried out in 1985 - 2012. The interrogation of the inhabitants of Latvia (especially fishermen and biologists) was used as a primary method. The main aim of the field expeditions was to investigate types of water biotopes used by *E.orbicularis*.

41% of identified biotopes (n=59) of findings (n=92) of *E.orbicularis* in Latvia were lakes. In three cases these were the salmonid lakes:

1. Lake Drīdzis; year: 1986; plausibility: low; number: 1; age: no information.
2. Lake Riču; year: 1995; plausibility: highest; number: 1; age: adult; sex: female.
3. Lake Ārdavs; year: 2001; plausibility: normal; number: n>1; age: juveniles.

In 1972 possible prints of hunting of *E.orbicularis* were observed in River Silupite, connecting Lakes Riču and Sila.

Large salmonid lakes are too cold and aren't preferable feeding biotope for *E.orbicularis*. But these lakes have a wide catchment areas, big sizes, and connection with other water bodies through rivers. Therefore the lakes can have a role of distribution water corridors for *E.orbicularis*, also for trans-border contacts between *E.orbicularis* in Latvia and in Belarus, because Lake Riču is trans-border lake.

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**CHARACTERS OF PALEOVEGETATION CHANGE IN LAKES PILVEĻU,
PILCINES AND PADĒLIS**

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Paleovegetation studies of lake development using karpology method (analysis of seeds and fruits in sediments) can provide significant information about evolution of lakes and indirect data about changes of water level, run-off changes and geochemical processes in catchment area of the lakes.

In this study vegetation changes during the evolution of three eastern Latvia lakes – Pilcines, Pilveļu and Padēlis and its likely reasons were investigated. These lakes are small and shallow, glacial origin lakes. The catchment territories of these lakes are mostly covered by forests and mires.

Full sediment profiles (4 m in Lakes Pilveļu and Padēlis and 3 m in Lake Pilcines) were taken and each was cut into 10 cm slices (each sample approximately 50 cm³). Until analysis samples were stored at - 20°C. Samples for macrofossils analyses were washed through sieve (0.25 mm) by using gentle spray of water. The residue was investigated using a microscope. Loss on ignition (*LOI*) method was used to estimate moisture, organic matter and carbonate content of sediments.

In Lake Padēlis seven plant assemblages were determined using the macrofossils analysis method and six plant assemblages were determined in Lakes Pilcines and Pilveļu as well. Based on different requirements for each assemblage, it was clarified, that characters of vegetation change in each lake have different pattern due to diversity of sediment composition in the catchment area and human impact. It was established that anthropogenic pressure to the ecosystems of lakes has increased during the past decades.

INVESTIGATION OF THE PREDATOR-PREY INTERACTIONS BETWEEN FISH POPULATIONS IN LAKE RĀZNA (LATVIA) WITH GENERALIZED DISCRETE TIME-DEPENDENT LOTKA-VOLTERRA MODEL

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Understanding predator-prey interaction between fish species in the lakes represents difficulties not only in data collection but also in computation as well as in interpretation of results. Basing on identification of non-stationary coefficients of the discrete Lotka-Volterra model the present research puts forward an interpretation of modeling results based on the aggregate catch biomass of the considered predator-prey species in the lake Razna (Latvia). The respective data have been collected over a period of time of several decades. Modeling the observed predator-prey biomass involved a generalized discrete non-stationary Lotka-Volterra-type model where the population of predators was determined not only by the number of prey consumed but also by other factors which were not directly measured in the data collected.

Identification of non-stationary coefficients of the Lotka-Volterra simulation model allowed to evaluate quantitative characteristics dynamics of the species described in the model. Obtained dependencies for the two interacting predator-prey species in Razna lake are also discussed in our research.

The validation of the model used in the research and, consequently, proof of its adequacy was performed through numerous experiments. Another proof of models adequacy is the consistency of its results with those obtained from independent research, whereas the higher the number of independent research available for the reference, the higher level of validation has the model. Thus it is impossible to obtain comparative characteristics of the results vis-à-vis other models. However, several computations can be used for an indirect verification of the model, thus coefficient $b(t_i)$ of transformation of prey into predator biomass has an average value of -0.14 which can be further used in experimental testing of the model.

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**A NON-DESTRUCTIVE DNS SAMPLING METHOD FROM SALMONIDAE FISH
SCALES FOR GENETIC ANALYSIS**

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Sea trout *Salmo trutta* L. together with other representatives of the Salmonidae fish, is among the most valuable biological resources in Latvia. Modern studies of population genetics rely increasingly on DNA markers amplified by polymerase chain reaction (PCR) for detecting genetic variations within and among populations. Such information is useful for planning conservation strategies of this species. Conservative genetic programs whenever possible have to use the least destructive and least invasive DNA sampling methods to limit disruption and damage to the endangered, vulnerable or declining study organisms.

Since the collection of a few scales does not harm the fish, the genetic diversity can be analyzed in protected fish populations with minimal influence on fish. We have developed a field sampling method for obtaining high quality DNA from Salmonidae fish scales. DNA samples were extracted from dried and frozen scales (scales size about 1-5mm) of 38 Sea trout specimens by existing method after Kumar (2007) with our modification. The quality and quantity of DNA was determined by spectrophotometer as ratio OD260/280, OD260/230. DNA samples were successfully amplified in PCR by the locus-specific four microsatellite primers and provided reproducible results which were checked by 10% agarose gel electrophoresis.

The population genetic structure was analysed by four microsatellite primers. Information of the genetic structure of Sea trout *S. trutta* L. wild population may be useful for sustainable development and preservation of genetic diversity of fish populations.

**DISTRIBUTION OF *MYSIS RELICTA* LOVEN AND *PALLASEA QUADRISPINOSA*
G.O.SARS IN SOME LATVIAN LAKES**

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Mysis relicta and *Pallasea quadrispinosa* are relict crustacean species of postglacial origin. *M. relicta* and *P. quadrispinosa* inhabit deep, oligotrophic and mesotrophic lakes. The relict crustacean species were studied in the 1960's in Latvian freshwater lakes.

Recent studies were done in some Latvian deep lakes of Latgale highland (the Daugava River basin) and in two trans-boundary lakes (Belarus-Latvia). Study of *M. relicta* and *P. quadrispinosa* was started in July, 2012. Samples were collected from one study site in Lakes Svente, Lejas, Drīdzis, Sitas, Riču, Sīvers and Dubuļu and from two study sites in Lake Geraņimovas Ilzas using a tow net.

M. relicta was found in Lakes Svente, Geraņimovas Ilzas and Riču. There were 210 individuals of *M. relicta* at a depth of 10 meters, 11 individuals at a depth of 10 – 45 meters in Lake Geraņimovas Ilzas and 14 individuals at a depth of 13 – 20 meters in Lake Riču. However, only single individual of *M. relicta* was determined at a depth of 25 – 30 meters in Lake Svente.

P. quadrispinosa was determined in six Latvian Lakes – Svente, Geraņimovas Ilzas, Drīdzis, Lejas, Riču and Sitas. There were 16 individuals of *P. quadrispinosa* at a depth of 25 – 30 meters in Lake Svente, 30 individuals at a depth of 13 meters in Lake Lejas, 13 individuals at a depth of 10 meters in Lake Geraņimovas Ilzas, 55 individuals at a depth of 10 – 50 meters in Lake Drīdzis and 16 individuals at a depth of 10 – 45 meters in Lake Riču. However, only single individual of *P. quadrispinosa* was determined at a depth of 10 – 27 meters in Lake Sitas.

M. relicta and *P. quadrispinosa* were not determined in Lakes Dubuļu and Sīvers, but *P. quadrispinosa* was found in these lakes in the 1960's.

In summary, since investigations done in 1960's *M. relicta* has appeared in Lakes Svente and Riču, while *P. quadrispinosa* has appeared in Lakes Sventes, Riču and Sitas.

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**PHENOTYPIC CHANGES OF VENDACE *COREGONUS ALBULA* (L.) IN THE
LAKES OF LITHUANIA**

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Vendace *Coregonus albula* belongs to Salmonidae family, Coregoninae subfamily. This group is known as phylogenetically young; therefore, variations in the growth rate and morphological characters of individuals are common within populations. It is said that morphological variations depend more on the hydrologic and hydrobiologic parameters of the lake where vendace live than on the genetic heredity. Thus when parameters in the lake are changing, there is a possibility that morphologic parameters of vendace are changing too. The main aim of this work was to evaluate the growth rate of vendace in different Lithuanian lakes which have different trophic levels and hydrological parameters. It was also aimed at performing a morphological analysis of these vendace, to set reasons of observed differences and, finally, to compare the results with earlier vendace investigations in Lithuania. All the measurements of morphometric parameters were made by sliding calipers.

By using Von Bertalanffy equation the investigated populations distribute into three groups according to the growth rate. It is noticed that the growth rate of vendace in the same population could change during quite short time period, but significant influence of the growth rate to morphometric parameters was not observed. It is possible that during a 10 years period some of the investigated populations became similar in three morphometric parameters. Morphometric parameters of vendace in Gavys, Baluošas and Asalnai lakes became similar. The reason of this fact could be population mixing because of artificial breeding and/or the alterations in ecological conditions of these lakes.

**HYDROMETEOROLOGICAL PARAMETERS, AQUATIC AND SEDIMENT
CHEMISTRY OF LAKE ENGURE**

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The Lake Engure is located in the western part of coastal lowland of Latvia. Surface area of the lake is 40.46 km², maximum depth is 2.1 m, average depth is 0.4 m, and volume of the lake is 16.8 million m³.

The aim of this study was to analyze hydrometeorological and chemical parameters of water and concentration of trace elements in the sediments of Lake Engure, same as to analyze factors influencing trace elements availability.

Two sampling stations for aquatic chemistry in lake were located in central and southern part close to inflowing river, and third station was located near the Mērsrags canal. Water chemical and biological studies of Lake Engure were carried out during the vegetation period, June and July from 1995 until 2010. Water chemical analyses for calcium and carbonate ions, biochemical oxygen demand, chemical oxygen demand, nitrogen compounds, phosphorus compounds and other parameters were done. Sediment sampling was carried out with aim to get impression about lake sediment composition, thickness and accumulation rates. Organic mater, carbon mater, biologically available phosphorous, major metals and trace elements were analyzed in sediments. Sediment dating by using ²¹⁰Pb analysis was done at the Nature Research Centre of Lithuania.

The Lake Engure within its territory has a very high heterogeneity of sedimentation conditions. In the northern part of the lake organic matter content is randomly increasing over the last two decades, indicating intensive, but stable production of organic substances and their sedimentation. Frequent inflows of brackish waters near the Mērsraga canal are observed. The ion ratios and water chemical composition is influenced by intrusions of sea water. Because of that, extremely high concentrations of Cl⁻ (1605 mg l⁻¹), Na⁺ (1260 mg l⁻¹), K⁺ (49 mg l⁻¹), SO₄²⁻ (225 mg l⁻¹) were observed in 2007. Within a study period other analyzed aquatic parameters didn't have dramatic fluctuations.

WHITEFISH (*COREGONUS LAVARETUS (L.)*) STOCKING IN LATVIA

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A few forms of whitefish (*Coregonus lavaretus (L.)*) were found in Latvia - in salt water spawning, anadromous and freshwater form. The anadromous whitefish stocked from the 1893 to 1961 in the Latvia rivers. Freshwater whitefish stocked from the 1888 to 1981 in the lakes and reservoirs on the Daugava. Since 2008 fish resources are replenished by stocking anadromous and freshwater whitefish every year. Since 1988, whitefish were stocked in more than 70 waterbodies.

