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Content

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Determination of bathymetric and morphometric parameters of Lake Mazais Baltezers for water stratification studies

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Keywords: morphometry, morphometric parameters, stratification

The Lake Mazais Baltezers is one of the largest lakes in the vicinity of Riga. The Lake Mazais Baltezers has long been economically significant. Its importance has increased between 1901 and 1903, when the Gauja-Daugava canal was dug out, which allowed the timber from the Gauja basin to be discharged through the Lake Kīšezers to the Daugava River (Stakle, 1935). Currently, due to hydromorphological transformations, the Lake Mazais Baltezers has been included in the list of water bodies at risk.

Genesis and morphometry of the lake play a major role in its physical, chemical and biological processes, such as biogeochemical cycling of nutrients, stratification regime, oxygen conditions, the intensity of primary production and many others. These processes vary over time, depending on the factors that affect them, especially human activities and developments in the catchment area (Tundisi & Tundisi, 2012).

In a reservoir, wind-induced currents and the structure of the thermocline mainly control the vertical distribution of heat, dissolved substances, and nutrients in the water column. Understanding lake hydrodynamics is important for the management of water resources (Elçi, 2008). The onset of thermal stratification has an important influence on lake ecology as it separates processes of production and nutrient depletion in the epilimnion from processes of decomposition and nutrient regeneration in the hypolimnion and sediment. The reduction in surface mixed layer depth that occurs as the epilimnion is formed, for example, increases light availability per unit volume to phytoplankton (Woolway et al., 2013).

The strength of chemical stratification is defined by the difference in concentrations of a water quality parameter between the epilimnion and the hypolimnion. To evaluate the strength of physical stratification in lakes, several indices are used: Wedderburn number, Lake number,

Richardson and Froude numbers, Schmidt's stability index, Hutchinson's stability index. In order to calculate the indices, morphometric parameters of the lake must be known (Yu et al. 2010).

On September 8, 2018, fieldwork was carried out in the Lake Mazais Baltezers to collect depth data. Depth data were used to construct a bathymetric map and to determine morphometric parameters. The morphometric parameters of the lake are as follows: the area of the lake's surface – 193.9 ha, the area of the lake's island – 1.10 ha, the largest width of the lake – 1.10 km, the largest length of the lake – 2.47 km, the maximum depth of the lake – 11.1 m, the length of the shoreline – 8.38 km, the length of the shoreline of an island – 0.53 km. The results have been used to study the stratification processes of the Lake Mazais Baltezers waters from 22 April to November 4, 2018. Knowledge of the lake's terrain made it possible to study and determine the thicknesses and volumes of stratification layers and their changes in the lake (Aršauska, 2019).

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Upper Daugava and meanders – a national or international heritage value?

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Keywords: protected landscape area, nature conservation, UNESCO

The Upper Daugava valley with nine unique meanders (98 km from Piedruja to Daugavpils) is a depositary of outstanding values of nature, biodiversity, and landscapes reflecting also historical and cultural significance. This object represents a mixed – natural and cultural – world heritage value.

The river valley with its characteristic arches and typical upper flood terraces has formed before 13 – 15 thousand years, after the glacial period. During that time the river stream was so strong that it carried great masses of sand, gravel, large stones, and even cliffs, creating picturesque hills, deep ravines with springs, rivers and large river Daugava riffles. In the 45.4 km stretch from the Daugavpils and Krāslava towns, the river is composed of nine outstanding meanders that represent unique and nowadays exceptionally rare features. These unchanged geomorphologic formations belong to the context of large rivers of the world's Northern hemisphere.

Upper Daugava and its surroundings are characterised by rare plant and animal species because of the favorable conditions of the specific valley meanders, adjacent landscapes microclimate, and soil composition. The ecosystem of the upper part of Daugava serves as an ecological corridor for the migration of species.

The river as a natural watershed, transport and trade route has been beneficial and meaningful in cultural history. People in this region began to settle a long time ago – around 11 thousand years ago, creating a rich cultural impact on the landscape. Numerous archaeological, architectural, historical monuments indicate intense human activity since the archaic period, as shown by the remained ancient burial grounds, hillforts, castle ruins, palaces, churches, and settlements.

The nationally protected nature area – Protected Landscape Area "*Augšdaugava*" (Upper Daugava), including Nature Park "*Daugavas Loki*" (Meanders of Daugava), was established in

1990. In 2004 this region was included in the European Union NATURA 2000 list, covering 52 325 ha of high biodiversity values and luxurious boreal type landscapes. This nomination is elaborated in 2010 – the year declared by the United Nations the International Year of Biodiversity.

Justification of outstanding universal value was prepared according to the UNESCO Operational Guidelines (2004) and UNESCO World Heritage Centre at the following Web address: http://whc.unesco.org/en/tentativelists. The data of submission this document to the World Heritage list was 11.04. 2011. Before this document in the Latvian language was prepared and discussed at the Scientific Council at the Institute of Biology and at the Scientific council of the Academy of Sciences of Latvia.

The justification was based on three different criteria from ten according to the UNESCO Operational Guidelines (2004).

This territory is an excellent example of multicultural living from ancient Balts, Vikings, and crusaders. The name Daugava (Dyna) is mentioned in the 10^{th} – 11^{th} century in written Scandinavian Gutasaga and the waterway Daugava was the road from Varangians to Greeks. Later this waterway was taken over by Russians, Poles, and Swedes. Daugava was a permanent trade route between Western and Eastern Europe until the North War (1700–1721).

On the banks of Daugava river, there are several cultural landscape types – ritual landscape (sacred buildings, ancient burial grounds, cemeteries, and crucifixes), social landscape, economic landscape (urbanization, farmer settlements) – and also ecological landscape (geology, vegetation, fauna, and human element).

Close to the country border Daugava river flows as a lowland (potamal) river. Near the town Krāslava the valley becomes deeper (40 m) and broader (2–4.5 km), starting to flow via meanders. Morphologically meanders of Upper Daugava are all different and have special historical names – Adamovas, Zvejnieku, Tartaka, Daugavsargu, Ververu, Rozališku, Butišķu and Elernes. In the territory of meanders, there is a very dense net of ravines – more than 300 forming unique ecological niches for flora and fauna.

The river is a key element in forming the landscape. Its course is full of riffles, banks with flat and steep slopes and nine very diverse meanders forming dynamic changing and highly three-dimensional landscape that has high aesthetic value. The especially high value of landscape is formed by the ratio of woods, meadows, agricultural areas, and relief. This boreal region with different landscape types is changing during seasons – from white winter, green

and sparkling spring, rich summer green woods and blossom full meadows and outstanding colour palette during fall.

The nominated area habitats host very rich and rare fauna and flora, belonging to boreal and nemoral regions. Daugava river serves as an important ecological corridor of species migration and from this point of view also its value is high in the context of transnational species migration. The river valley microclimate, the highest summer positive temperatures (2100–2500) for Eastern areal of Europe, and calcareous soil types support unique plant and fauna communities and some of the species are on the areal border and therefore must be of special attention for their protection.

This territory is among the richest places of species in Europe. Altogether there are 50 protected plant species. According to special monitoring, 139 bird species have been found, 33 of them are protected at the European level (2009/147/EC). Concerning invertebrates – 31 species are protected at European level (92/43/EEC), six of them – according to the Berne convention (1979) and another species are included in the list of the *(IUCN RED LIST)*. The bat's species are in a special protection list (92/43/EEC). Altogether there are 14 habitat types protected at the European level, serving as biotopes for a rich and diverse amount of species.

Statement of authenticity and/or integrity is one of the important milestones for UNESCO territory and upper Daugava with its meanders fulfill this criterion completely. Landscapes of the river are under potential threat from today's socio-economic pressures. There have been intentions to build a cascade of hydroelectric power stations (three already are operating on the Daugava river downstream, completely changing the natural ecosystem). In the future, species migration because of climate change is possible in the Daugava River. One can also observe human migrations and a diminishing number of a local community – ancient settlers of this land. The preservation of the Upper Daugava region is encouraged in order to maintain a unique cultural and natural landscape.

In 2011 the Upper Daugava and its meanders were nominated as UNESCO Latvian national heritage site.

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Council Directive 92/43/EEC of 21 May 1992 on the conservation of natural habitats and of wild fauna and flora: http://data.europa.eu/eli/dir/1992/43/oj

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The mitochondrial DNA D-loop sequence variation, population genetic structure and phylogeographic relationships of Eurasian perch (*Perca fluviatilis)*

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Keywords: *Perca fluviatilis*, mtDNA D-loop, haplotype, genetic diversity

Due to the fact that the perch is one of the best model species for studying the postglacial history of freshwater fish (Nesbø et al., 1999), it is reasonable to investigate the current genetic diversity of this species in Europe before intensified perch translocations among the EU countries and expansion of anthropogenic activities in relation to enhanced energetic demands in the Baltic Sea Region occur. The current genetic structure and phylogeographic relationships among perch populations in the Eastern Baltic region were studied based on mitochondrial DNA D-loop sequence variation of 489 individual perches collected at 19 sampling sites in Lithuania, Latvia, and Belarus. The great and unique haplotype variability, distribution and prevalence of different haplogroups in Lithuania, Latvia, and Belarus was established after results of current study were compared with the analogous results of several authors that studied D-loop variability of perch in other European regions (Refseth et al., 1998; Nesbø et al., 1999). Our research group revealed that 32 out of 37 different haplotypes found in all studied locations were detected exclusively in perch specimens collected in Lithuania, Latvia and Belarus. The newly obtained haplotypes were deposited in GenBank under accession numbers HM992571-HM992578, JX034742-JX034749 and MH028035-MH028050. The established haplotypes were separated by 1-2 mutations in the haplotype network and were attributed to 9 haplogroups designated with capital letters (A, B, C, D, E, F, H, J, and M). The greatest genetic diversity was detected in haplogroup B, which was represented by 14 different haplotypes. Based on SAMOVA analysis results the studied perch samples were attributed to four genetically differentiated groups reflecting the complex history of water bodies colonization in the Eastern

Baltic region–presumably dependent on the last deglaciation period. The existence of a great and unique genetic diversity of contemporary perch populations in Latvia and Lithuania (Sruoga et al., 2007; Butkauskas et al., 2012) as well as in other parts of the Baltic Sea Region could be rationally explained by postglacial migrations of this species. Nesbø et al. (1999) assumed that the R1 (Southern Europe) refugium presumably served as a founder population for the present perch lineages in Europe but it appeared did not contribute to the most recent colonisation of the glaciated areas in the Baltic Sea Region. It could be suggested that after the last deglaciation, the representatives of the perch that originated from the R2 (Black Sea area), R3 (Western Europe) and R4 (Eastern Europe) refugia reached the Baltic Sea Region together with genetically distinct group, originating from earlier not recognised refugia, that encompasses representatives of haplogroup B. In general, our assumptions about the colonisation patterns of the perch in Europe fulfil the gap regarding population genetic structure of perch offered by previous authors.

The determined genetic diversity of perch could be used as a background database for tracking changes of population genetic structure forced by the impact of growing anthropogenic activities.

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Silica and amber nano and micro size particles influence on model organisms/systems

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Keywords: bio textiles, succinite, *Lemna minor*, *Drosophila melanogaster,* microscopic fungi

The first results of EUREKA project **E!11170, IFSITEX** (Innovative multifunctional biotextile, integrated with silica dioxide and succinite development, and its impact on biosystems) are presented. The project concept is related to comprehensive research based on development of innovative biotextile with the potential ability to mitigate the negative impact of adverse external environment factors on living organisms (Chen et. Al., 2003, Agarwal et. al, 2007, Lyashenko, 2014, Lyashenko, 2014, Grauda et. al., 2015).

The amber and silica dioxide nanoparticles are being studied as potential row material for integration in synthetic and natural fibres used to produce novel bio textiles materials. Amber is a fossilized tree resin, which has been appreciated for its color and natural beauty since Neolithic times (Grimaldi, 2009). The amber (succinite) was completely dissolved and its composition was studied in detail based on the Gas Chromatography-Mass Spectrometry method. Separation and detection of extracted unknowns from amber was conducted on an Agilent 6890 gas chromatograph interfaced to a 5973 MSD mass spectrometer (Agilent Technologies, Santa Clara CA). The spectra from the mid-point of each peak were searched against an NIST02 spectral library using NIST/EPA/NIH Mass Spectral Library search software (Version 2.0a). As a result, it was found that from 143 identified compounds of Baltic amber 45 were amber acid and its compounds, the bioactivity of these compounds remains to be determined.

Investigations of influence of the amber and silica dioxide (Grauda et. al, 2015) nano particles were carried out using model organisms and cells of eukaryotes and prokaryotes. Newly developed textiles (samples) are going to be tested on the cells and on the model objects. Detection of influence of nanoparticles on the molecular, nuclear and DNA levels are carried out tracking possible changes at some chloroplast DNA or nuclear genes (Butkauskas et.al, 2012, Ragauskas et.al, 2014) induction of retrotransposone activity, providing comet test, using the microscopy, flow cytometry (Grauda et.al., 2015), DNA sequencing methods. On the cell level, the immature pollen cultures in one nuclei stage was found as a highly sensitive model system to detect the influence of different environmental factors. Possible genotoxic and stimulating effects of studied nanoparticles as well as protective properties of newly developed biotextile materials with incorporated amber and silica dioxide nano particles will be tested establishing series of experiments trying to reveal long-term impact and to evaluate protection properties against unfavourable environmental factors using fruit fly *Drosophila melonogaster* lines by researches of the Laboratory of Environmental Genetics from Institute of Biology, University of Latvia (IBUL). The impact of nanoparticles on mycelia growth of the microscopic fungi *Aspergillus niger* and *Chaetomium cocliodes* was implemented as additional testing procedures by researchers ot the Laboratory of Experimental Entomology and Microbiology (IBUL). Optimized radial growth test of fungal mycelia (Minova et al., 2015) was used for the determination of antifungal activity. Selected clones of *Lemna minor* will be used as model objects conducting testing experiments by staff of the Laboratory of Molecular Ecology from the Nature Research Centre (NRC, Vilnius, Lithuania). Influence of Low frequency Electromagnetic fields (LFEMF) on growing speed, green mass and other parameters of *Lemna minor* clones will be studied after series of experiments of different design will be carried out trying to reveal possible changes on DNA level after some genes involved into process of adaptation to elevated level of LFEMF will be sequenced and obtained molecular data will be compared with homologous DNA sequences of non-impacted control clones.

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Structure of mesofauna as biological indicator for gradient city centre-suburb in urban ecosystem

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Keywords: bioindication, Riga, soil mesofauna, urban environment

The soil comes at the forefront as the main component of the ecosystem, providing plant growth and living conditions for numerous other organisms. Urban soils are formed as a result of anthropogenic transformation of the region's natural soils in areas where urban infrastructure is under development by construction of buildings, roads, tunnels, electricity, and communications transmission networks, water supply, and sewerage systems. Despite the obvious indications that increase of biodiversity in cities can be achieved only by increasing the area of habitat patches and creating a network of corridors (Beninde et al., 2015) in most cases historical factors of city development provides patchworks consisting of very small elements such as tree lawns along streets and flower beds.

In order to ensure necessary ecosystem services, green territories need specific soil and vegetation management, which requires certain input of money. To reduce these costs, man is objectively interested in as much as possible to rely on the soil ecosystem self-regulating capabilities. From this point of view, a compromise must be found between the visual appearance of urban habitats and the provision of self-regulatory capabilities of these ecosystems. Soil animals are good indicators of the state of the urban soil ecosystem, so special attention should be paid to their studies (McIntyre, 2000). Soil microarthropods – collembola and soil mites represent a taxonomically highly diverse groups, that can be found in different urban habitats (Niedbala et al., 1982).

We analyse the data from a pilot survey of the microarthropod community's distribution along the urban gradient from the centre of Riga city towards rural areas,

called by Klausnitzer (1987) the urban-rural gradient "Arbor – Eremeus". The question to be answered was weather microarthropod communities can be used for assessment of the self-regulatory capacity of the urban habitat soils. According to the division by Klausnitzer (1987), we identified six habitat types on the urban-rural gradient of the Riga city: street lawns, park lawns, private garden lawns, cemetery lawns, urban forests, suburban forests. The goal was set to identify differences between microarthropod communities of different urban habitats at different taxonomic resolution, beginning from taxonomic group, family level and ending with species level.

Soil samples were collected in late September / early October in 21 plots on the urban-rural gradient. Three random soil samples were collected with a soil corer (5 cm diameter, 10 cm depth) in each sample plot. Samples were pooled and microartropods were extracted by the Tullgren method. Soil pH and content of organic matter were determined.

First results

Oribatida was the most abundant group of microarthropods which included 37 families. Seven families were found in 10 different habitats. Springtails (Collembola) were the second most abundant group including 11 families. The most abundant family was Isotomidae found in 20 habitats. The lowest abundance of microarthropods was registered in street lawn habitats strongly affected by intensive traffic. Oribatid mites density showed statistically significant correlation with soil pH and content of organic matter. Collembola had no correlation with these environmental factors. The density of Oribatids increased towards suburban forests. Mesostigmata mites increased with decreasing anthropogenic impact. Collembola population density fluctuated irregularly on the urban-rural gradient.

Species collection of the material is currently underway. A further study will reveal differences between microarthropod communities of different urban habitats on the species level.

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Waterbirds breeding on some territories of Riga Freeport in lower Daugava

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Keywords: waterbirds, breeding, lower Daugava

In the past the lower reaches of Daugava have been quite rich in waterbirds due to numerous grassy coasts and islets very suitable both for breeding, resting and feeding (Sawitzky 1899; Berzins 1946; Grigulis 1960). Since the middle of the 20th century the area of such territories has reduced considerably as a result of different economic activities, and species diversity and numbers of breeding birds in these territories has decreased (Strazds 1980; Strazds 1983; Strazds, Strazds 1988; Vīksne 2003). This article deals with recent situation in three sites potentially suitable for waterbirds.

The monitoring of the breeding waterbirds in the territory of Riga Freeport (RFP) in protected nature sites "Mīlestības saliņa", "Krēmeri", and Island Žurku has been started in 2007 (financed by RFP). It is necessary as breeding biotopes of many waterbirds are endangered and numerous species inhabiting them are decreasing during the last decades. Part of species are listed in different international and national documents related to nature protection. In 2008-2015 and 2018 the RFP has performed different measurements improving biotopes for breeding waterbirds in sites mentioned above.

Data about waterbirds breeding in these sites were gathered during inventories in May – June, counting (mainly larids) or evaluating (according to flying individuals of other species) the number of nests/breeding pairs.

Mīlestības saliņa. In 2009 several artificial islets have been created, a floating platform was anchored to attract breeding larids and other waterbirds in the SE lake of this island. These measures had no expected results, most credibly due to the lack of free population reserves of corresponding species. As previously, both lakes of the island hold small numbers of several breeding (Great Crested Grebe *Podiceps cristatus*, Coot *Fulica atra*, Mute Swan *Cygnus olor*, Mallard *Anas platyrhynchos*, Gadwall *Anas strepera*) and feeding/resting (Cormorant *Phalacrocorax carbo*, Great Egret *Egretta alba*, Grey Heron *Ardea cinerea*, larids) species. The

coasts of both islets are overgrown by reed, shrubs and trees, the vegetation on islets are low-suitable for waterbirds, floating platform was washed ashore in 2011 or 2012 and broke down. Hardly even after large biotechnical measures the situation for breeding waterbirds on this island could improve in the nearest future and the transformation of this territory could not been included in the priority list of activities.

Krēmeri Nature protection area. Since 1980s this reed dominated area is known as a rich waterbird breeding site (Strazds 1980; Strazds 1983). The status of nature protected area has been stated here in 1993, the Nature Protection Plan was elaborated for the period of 2007-2016. Coastal reed was cut here in 2009-2012, a floating platform created. As a result after longer time period colonies of the Black-headed Gull *Larus ridibundus* were found here in 2010-2015, as well as breeding of other (including protected) waterbird species (Table 1). This site as a resting/feeding site is used also by other bird species. After ceasing of reed/shrub and tree cutting the composition and number of breeding waterbirds has changed negatively due to overgrowing of coasts. Neither larids nor wading birds have used this site for breeding (mainly due to massive damages by red fox in 2015). Birds breeding in reed beds are less influenced. This waterbody is still used as a resting/feeding place by many waterbirds (Anatidae, herons, waders etc.), the Great Bittern *Botaurus stellaris* breeds here as well. Also other species related to waters are stated here (Great Reed Warbler *Acrocephalus arundinaceus*, Reed Warbler *Acrocephalus scirpaceus,* Savi's Warbler *Locustella luscinioides*, Reed Bunting *Emberiza schoeniclus*, Bearded Tit *Panurus biarmicus*, Penduline Tit *Remiz pendulinus*). Almost every visit a Marsh Harrier *Circus aeruginosus* (single or up to two specimens) has been seen here.

The RFP performed large activities during November 2018 – reed, shrubs and trees have been cut along the coast of the waterbody. Unfortunately, successful breeding of larids was not confirmed in 2019 (about 10 nests of the Black-headed Gull initiated in May were abandoned afterwards, probably due to continuous attacks by Hooded Crows *Corvus corone cornix*). Cut territories overgrow with reed very fast, consequently, the site was not suitable for breeding waders as well.

Recommendations developed for reconstruction and maintenance of favourable conditions for waterbird breeding include mainly reed cutting in 30-40 m wide belt along the open water edges, and cutting of bushes/trees in 30-40 m wide belt along the coast. These cutting should be repeated in following 2-3 years, then a break of 2-3 years can be allowed. Such protocol should be carried out henceforward. A construction of small (10x20 m) floating

platform is welcomed, it should be placed in the centre of the waterbody and covered with pebbles and gravel. Obligatory measure is the predator control, otherwise it will cause the "ecological trap" – birds will start to breed in this vegetation-suitable place but the breeding will fail due to mammalian predation. This site could serve as a suitable place for birdwatchers – it is relatively rich in birds, easy accessible, and birds can be observed from short distance without disturbing them.

Table 1. Waterbirds breeding and residing in Krēmeri nature protection area in 2007-2019

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Gr.Crested Grebe *Podiceps cristatus*							1 nest	?				
Great Bittern *Botaurus stellaris*	?	?	?	?	?	1 pair	?	1 pair	1♂	1♂	1♂	1♂
Grey Heron *Ardea cinerea*	?	?	2 sp.**	5 sp.	1 sp.	4 sp.	3 sp.	?	1 sp.	1 sp.	2 sp.	1 sp.
Great Egret *Egretta alba*					1 sp.						2 sp.	1 sp.
Coot *Fulica atra*	1 pair	?	?	4-5 pairs	>5 pairs	>3 pairs	>10 pairs	>5 pairs	5 sp.	>6 sp.	?	≥2 pairs
Moorhen *Gallinula chloropus*							1 pair					
Water Rail *Rallus aquaticus*									>5♂	>5♂	1♂	1♂
Herring Gull *Larus argentatus*							some sp.				some sp.	
Black-headed Gull *L.ridibundus*		Tens of sp.	20-30 pairs	150-200 pairs	150-200 pairs	ca.250 pairs	ca.150 pairs	ca.300 pairs				50-10 pairs
Common Tern *Sterna hirundo*										some sp.	some sp.	1 sp.
Lapwing *Vanellus vanellus*		?	1 pair	4-5 pairs	3-5 pairs	2 pairs	1 pair	1 pair			1 sp.	10 sp., ≥1 pair
Little Ringed Plover *Charadrius dubius*												2 pairs rutting
Ringed Plover *Ch. hiaticula*											2 sp.	
Common Sandpiper *Actitis hypoleucos*												1 sp.
Snipe *Gallinago gallinago*											2 sp.	≥1 pair
Mute Swan *Cygnus olor*		?	1 pair	1 pair	1 pair	1 pair	1 pair with chicks	1 pair		1nest, 1 non-breed pair	1 pair	1 nest
Wigeon *A. penelope*							1♂		5 sp.			1♂

Species	2008	2009	2010	2011	2012	2013	2014	2015	2016	2017	2018	2019
Mallard *A. platyrhynchos*	1 pair	?	some pairs	>2 pairs	some pairs, 26 sp.	some pairs	22 ♂; some pairs	some pairs	7 sp.	1 ♀ with chicks	1 ♀ with chicks	22 sp.
Shoveler *A. clypeata*				1 pair?	?	?	2♂		1♀,2♂			≥1 pair
Teal *A. crecca*				1 pair?	?	?	?		10 sp.	1 pair, >18 sp.		
Garganey *A. querquedula*		?	1 pair	1 pair?	?	?	?	2 pairs?		1 pair		1 pair?
Gadwall *A. strepera*										1 pair	1 pair	2 pairs
Pochard *Aythya ferina*									1♂			
Marsh Harrier *Circus aeruginosus*	?	?	1 sp.	1 pair?	?	1 pair	?	1 pair?		1 pair?	1 sp.	1 pair

*Also data given by V.Smislovs, E.Smislovs, R.Matrozis, A.Arnicāns, A.Grīnbergs, I.Grīnberga are used in table

** sp. - specimen

Island Žurku. Improvement of conditions for breeding waterbirds (mainly larids) including cutting of shrubs and trees as well as (partly) clearing from drifted garbage has been performed by RFP in 2007, 2009, 2011, 2015 and 2018. In 2009/2010 ship landing was created with connection to the island. After 2010 a navigation device was constructed on the island and wharf piles mounted in the water on both sides of it. Visits by humans has been rare and temporary. There are no indications showing negative impact of ship loading on breeding of birds. Also no traces of predator activities (American mink, fox) were stated on the island during observation period.

The species composition and number of breeding waterbirds are shown in the Table 2. Breeding colonies of Black-headed Gull and Common Tern *Sterna hirundo* observed at the beginning of study period have vanished. The number of breeding Herring Gulls *Larus argentatus* has increased considerably from 20 nests in 2002 till 404 nests in 2010. Now this number is relatively stable (230-300 nests). The number of breeding Mallards has grown reaching about 20 nests in 2019. In 2019 the nesting of Gadwall was stated here for the first time.

We recommend maintaining of this island as potential breeding site for larids as numbers of such sites both in Latvia in general and in Riga and their vicinity continue to diminish.

Activities performed by RFP in general should be considered as positive. They have been successfully on the Island Žurku and in Krēmeri nature protected area though after ceasing of

biotechnical measures both species diversity and number of breeding/residing waterbirds have decreased considerably. Activities performed on the Mīlestības saliņa have not given any positive results.

Table 2. Number of breeding waterbirds (pairs) on Island Žurku in 2002-2015 and 2018-2019

Species	2002	2003	2006	2007	2008	2009	2010	2011	2012	2013	2014	2015	2018	2019
Black-headed Gull *Larus ridibundus*	350 - 400	1350	0	14	105-110	0	0	0	0	0	0	0	0	0
Herring Gull *L.argentatus*	20	175	130-150	140-150	340	265	404	300	338	230	240	352	352	301
Common Tern *Sterna hirundo*		50	0	5	35	0	0	0	0	0	0	0	0	0
Arctic Tern *S.paradisaea*	some						0	0	0	0	0	0	0	0
Oystercatcher *Haematopus ostralegus*		?	1	1	2	2	1-2	1	1-2	0	0	0	0	0
Mallard *Anas platyrhynchos*		?	≥1	≥1	≥6	7-10	ca. 10	some	some	some	ca.10	ca.15	10-15	ca 20
Gadwall *A.. strepera*														1

Activities performed by RFP in general should be considered as positive. They have been successfully on the Island Žurku and in Krēmeri nature protected area though after ceasing of biotechnical measures both species diversity and number of breeding/residing waterbirds have decreased considerably. Activities performed on the Mīlestības saliņa have not given any positive results.

Planning further arrangements relating reconstruction/maintaining of appropriate biotopes for waterbirds, the priorities should be order as follows: Krēmeri nature protection area, Island Žurku, Mīlestības saliņa.

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Research on effects of extremely low-frequencies electromagnetic fields radiation on biological models in controlled environment

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Keywords: Extremely low-frequency electromagnetic field, water plants *Lemna minor L*., EMF long time exposure

Plants are essential components of a healthy ecosystem. Many of them easy to grow in controlled laboratory conditions. Therefore, they can be useful test organisms. However, there is still a lack of investigations of EMFs effects on plants. In this work, the effect of extremely low EMFs on the growth of duckweed (*Lemna minor* L.) has been investigated (1-3). Instrumentation for controlled exposure to EMF was designed at the Institute of Biology, University of Latvia.

Duckweed (*Lemna minor* L.) line 'BOLD4' was maintained under conditions on the 5 ml STEINBERGS nutrient solution (ISO 20079). Experimental cultures were started by transferring 1 plant with 2-3 fronds to sterile plastic Petri dish (35x10 mm with ventilation). In Growth chamber model KBWF 240 (produced BINDER GmbH, Germany) was exposed 20 plants and 20 plants grow as controls (unexposed). Controls were kept in the same growth conditions (temperature 24^0C, 16/8 hours light/darkness photoperiods) as treated ones but in a field-free environment outside the instrumentation for generating EMFs. A magnetic field was created by a copper wire coil with a radius of 200 mm and a height of 100 mm. For powering coils alternating current generator was used along with a digital processor to control the current through the coils. Duckweeds were exposed to a magnetic field of 50 Hz with a density of 1 µT for 6 weeks. The Three-axis Hall Magnetometers THM1176-LF ("Low Field" model, MetroLab, Switzerland) are used to measure and control magnetic field strength. After exposure duckweed growth was monitored during one week by counting the number of plants and expressed as relative plant numbers. Results are represented as mean values from ten replicates and shown as percentages of control. The significance of the results was evaluated by T-Test ($P<0.05$). The

results are expressed as mean values of two independent experiments and shown as percentages of control.

Exposure of *Lemna minor* for six weeks (1008 hours) to the extremely low-frequency electromagnetic field of 50 Hz (1 μT) slightly reduced the *Lemna minor* growth Table 1. The differences are significant between the exposed and unexposed plants only in the 1st step of the experiment after 2- ($P<0.05$) and 3-weeks ($P<0.01$) exposition. For the 2nd step of the experiment, 20 healthy plants were selected after three weeks of exposition. Significant differences between the exposed and unexposed plants were not found. It has been suggested that *Lemna minor* has the ability for adaptation to long-time exposure of an extremely low-frequency electromagnetic field of 50 Hz.

Table 1. Reproduction percentages dynamics of duckweed (*Lemna minor)* after six weeks (1008 hours) exposure of an extremely low-frequency magnetic field of 50 Hz (1 μT). The differences are significant ($P<0.05$) between the exposed and unexposed plants only after 2- and 3-weeks exposition.

	1st step of experiments				2nd step of experiments			
	Start 1	1 week 168 h	2 weeks 336 h	3 weeks 504 h	Start 2 504 h	4 weeks 672 h	5 weeks 840 h	6 weeks 1008 h
Control	100 N=20	335±32 N=20	733±53 N=20	978±60 N=20	100 N=20	294±29 N=20	535±43 N=20	728±57 N=20
Exposed	100 N=20	283±28 N=20	588±67 N=20	775±50 N=20	100 N=20	298±31 N=20	558±46 N=20	863±49 N=20
T-tests	P>0.05	P>0.05	P<0.05	P<0.01	P>0.05	P>0.05	P>0.05	P>0.05

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Litter decomposition study using the method of a standardized Tea bag

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Keywords: litter decomposition, tea bag, TeaComposition initiative

Litter decomposition is the most important component of the carbon and nutrient life cycle in terrestrial ecosystems. During litter decaying CO_2 is released in the atmosphere and may contribute to global warming. Using tea as standardized substrate, which has different decomposition rates, harmonizes litter decomposition studies and provides a comparison for these processes across the ecosystem types worldwide. In 2016, the European LTER proposed the use of a standardized substrate (TeaComposition initiative) on the plots of member states of the global ILTER network to conduct research on the impact of climate effects, litter quality and land use on litter decomposition intensity across regions and vegetation types worldwide.

At the beginning of June 2016, with the help of *UNILEVER* sponsorship, two types of Lipton tea packets were delivered to all participants of the experiment:

- Green Tea (ingredients: 89% Green Tea, other - natural flavours)
- Rooibos Tea (93% Rooibos Tea, other - natural flavours).

Tetrahedron tea bags are made of fine mesh, with 0.25mm openings, the material of the teabag allows for microorganisms and mesofauna to enter the bags (Keuskamp et al., 2013; Wang et al., 2019).

In the Engure LTSER ecoregion, two sample points were selected: one of them is pine forests on dry sandy soils, the other - mixed forests on wet soils. On 29 June 2016, tea bags were placed on both plots according to the protocol provided by the TeaComposition initiative. In the first round of the experiment, the exposed tea bags were delivered to the laboratory after three months (29 September 2016), in the second round after one year (29 June 2017), followed by the 3rd round in June 2018 and the 4th round 2019 June.

The first research results (exposure time three months, after one year) at a local scale (Latvia) and a global scale (Djukic et al, 2018) showed that the litter type (rooibos vs green tea) in the early stages of decomposition is the main factor explaining 65% of the data variation. The

results of the two-factor variance analysis (univariate GLM) showed that there are statistically significant differences in the rate of decomposition intensity between green and rooibos tea. No statistically significant difference was found in the rate of degradation intensity between the two habitats at the early stage of the study.

The analysis of the results from the 3rd data series (June 2018) shows statistically significant differences, not only between tea types ($F=29.543$; $P<0.001$), but also between habitats (pine forest and mixed forest) ($F=12.384$; $P<0.05$). The biggest tea bags mass loss was observed at the sample point in a mixed forest on wet soil. It can be explained by extremely dry summer (2018).

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Assessment of macrophytes and hydromorphological quality of streams in Latvia

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Keywords: hydromorphological quality, macrophytes, running water

The importance of macrophytes in river biological assessment is formally recognised under the Water Framework Directive and this group of organisms is an obligatory element in the monitoring of the ecological status of surface waters. The European Water Framework Directive lists aquatic macrophytes as one of the biological quality elements needed for assessing the ecological status of surface water bodies (Anonymous, 2000).

Since the adoption of the Water Framework Directive, growing attention has been paid to hydromorphology as a water quality determinator. Hydromorphological alterations (straightening, water level fluctuations due to hydropower plants) is one of the most significant pressures within Latvian rivers, but there is no method to assess it. On the whole, it is well known that hydromorphological pressure significantly affects streams, but without proper methods, we cannot prove it.

A total of 40 small and medium-sized streams of Latvia were investigated. Data were collected during the vegetation season in 2017. Macrophytes and ecological quality of streams were measured by using the Latvian Macrophyte index for Rivers (MIR_LV) (Uzule, Jēkabsone, 2016). To determine the hydromorphological quality of rivers, the Hydromorphological River Index (HMI) was used.

From 40 investigated rivers, 22 streams had high ecological quality, 15 streams – good ecological quality, two streams had moderate ecological quality, but only one stream had very bad ecological quality. The highest ecological quality was found in the river Rauna (EQR (ecological quality ratio)=1.36), river Šķervelis (EQR=1.21), river Vaidava (EQR=1.20) and river Vija (EQR=1.00). Only in one river (Ālave) ecological quality was very bad, where EQR=0.11.

The species richness ranged from six to 23 species per site; on average 14 macrophyte taxa per stretch were found. The lowest number of species was found in the rivers Rauna and Šķervelis (six species), but the largest number of species was in the rivers Rinda and Tirza (23 species), Tērvete and Amula (22 species), Pērse and Svitene (21 species). Vegetation cover in the investigated streams varied from 1% (rivers Pilsupe, Rauna, and Tūlija) to 90% (river Ālave).

We conclude that it is not possible to assess hydromorphological pressure using existing routine monitoring assessment methods used in Latvia. One of the possible solutions could be the development of a new index using only macrophyte species sensitive to hydromorphological alterations. However, due to multiple pressures, it will be difficult to separate diffuse pollution (nutrient enrichment) impact from river straightening or land-use pressure impact.

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About modulative processing method of innovative products from natural substances

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Keywords: biological effect, discarded antlers, red beetroot juice, ultrafiltration

The development of the national economy requires the creation of innovative technologies and products. This problem is topical for agriculture, food, and health in Latvia also. The use of natural resources for this purpose is of great interest.

In recent years, attracts attention in the biological activity of red beet (*Beta vulgaris*) and its potential utility as a functional nutrition and disease prevention has been growing. The different fitoderivate juices were investigated (Table 1).

Table 1. Amount of iron, vitamin C, betanin and vulgaxantine I in vegetable juices

Vegetable juice	Fe, mg/·L	Betanin, mg·/L	Vulgaxantin - I, mg/L	Ascorbic acid, mM
Cucumber	1.25	0	0	0.57
Pumpkin	1.13	0	0	0.56
Zucchini	2.13	0	0	0.81
Carrot	1.75	0	0	0.52
Red beetroot	3.08	770	581	0.84
Sugar beetroot	1.18	2.5	55	0.74
Fodder beetroot	1.01	0	96	0.77

As a result of the study revealed that the most reach composition in iron, vitamin C, antioxidant pigment (betanin, vulgaxantine I) was red beetroot juice (RBRJ).

To increase RBRJ specific activity, the ultrafiltration method used to fractionate deproteinized juice through separation by molecular mass using "Ultracel" membranes. The biological effect of developed fractionated red beetroot juice (FRBRJ) was investigated. Experimental studies of FRBRJ in chickens demonstrated its protective effect against Cd-induced oxidative stress, specifically stimulation multiple intestinal iron absorption, immunomodulating action, etc. The results of the research have prospects for clinical use.

It is well known that reindeer products are widely used by people. These days there is of interest in growing deer in Latvia also. However discarded horns of these animals almost not used. Studies on the application of discarded antlers as a feed additive in broilers were conducted. Powder from ossified horns of noble deer (*Cervus elaphus*) and fallow deer (*Dama dama)*, found in the territory of Latvian farm "Dangas", was developed and analyzed. Composition of the obtained ultrafine product represented a valuable complex of organic (amino acids, vitamins, fats, carbohydrates) and mineral (Ca, P, Mg, Na, K, Zn, Cu, Mn, Se) substances. Administration of water suspension of fine horn powder in chickens *per os* showed a safety, good bioavailability of product, bodyweight stimulation and immune activity increase. Experimental data allowed us to conclude that discarded antlers can serve as a source for effective feed additive for poultry.

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