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# PALAEO-GEOGRAPHIC CHANGES IN THE SĀRNATE FORMER LAGOON AREA

## Paleoģeogrāfisko apstākļu pārmaiņas Sārnates bijušās lagūnas teritorijā

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**Abstract.** Due to the lowering of the Littorina Sea level before approximately 5000 years, Sārnate lagoon was separated from the sea and became a shallow lagoon lake, which gradually terrestrialised and filled in with peat. The aim of the research project reported in this paper was to characterise the changing palaeo-geographical conditions in the former Sārnate lagoon area, as recorded by changes in sediment properties, pollen and plant macro-remain composition. The plant macro-remain and pollen studies indicate intensive human activity in the area during the latter part of the Holocene climatic optimum and the first part of the Late Holocene, Subboreal, including a record of Water chestnut (*Trapa natans*) fruits and pollen in the gyttja under the grass peat, indicating that water chestnut grew in the lake adjacent to the settlement. The presence of cereal and weed pollen confirms that agriculture was also being practiced, at least during the final phase of occupation, in the late 6th and the 5th millennium BP.
**Keywords:** *Littorina, gyttja, peat, pollen, plant macro-remains, water chestnut*

### Introduction

The Sārnate, former lagoon area, located in the Coastal Lowland belt near the open Baltic Sea coast of western Latvia (Figure 1) has been influenced by various geological processes in different developmental stages of the Baltic Sea. Due to the lowering of the Littorina Sea level approximately before 5000 years, the lagoon was separated from the sea, turning the former lagoonal area into a lake basin, which became overgrown and developed into Sārnate Mire (Mūrniece et al. 1999; Kalniņa et al. 2011). This area is interesting not only in terms of geology and Baltic Sea development, but also from the perspective of archaeology. Thus, the wetland settlement site of Sārnate, located within this area, constitutes one of the richest sources of information concerning human lifeways in the East Baltic during the period approximately 5900–5000 BP, i.e., corresponding in climatic terms to the early part of the Late Holocene (Bērziņš 2008).

Silt and silty sand with a small amount of organic matter was deposited in the area of the present-day Sārnate Mire during the Younger Dryas (12 900 cal. years BP), with the fall in the level of the Baltic Ice Lake. During the Ancylus Lake stage the area contained one or more shallow coastal lakes, which were cut off from the open water of the lake on the western side by a narrow (0.3–0.5 km wide) spit of land (Grinbergs 1957; Veinbergs 1996). Freshwater lime accumulated in some parts of the Sārnate lake, and thin layers of peaty gyttja were formed on their shores. During the Littorina Sea transgression, at the beginning of the Holocene climatic optimum, sea water entered the low-lying area in the environs of Sārnate and other stretches of the coastline with lower topography, and reached a height above present sea level of 5–6 m. This formed a large,

shallow lagoon, which was cut off from the sea through the process of long-shore drift. The water level during the Littorina regression fell and the lagoon rapidly divided into separate lakes, which became overgrown, and mires were formed (Mūrniece et al. 1999).


Figure 1. **Location of study sites. 1 – Sārnate Neolithic site** (Lat. N 57.10898882; Long. E 21.4559243) **and core Sārnate IX** (Lat. N 57.108 3979; Long. E 21.4582771); **2 – Outcrop at the Baltic Sea Bluff between the rivers Vičaka and Pāžupīte** (Lat. N57.0714669; Long. E 21.4155118) (authors' figure)

The occupation of the Sārnate archaeological site falls in a period after the Littorina Sea regression (Mūrniece et al. 1999). Records from the lagoon, lacustrine and bog sediments at Sārnate can be used to trace the changes after the maximum of the Littorina transgression. The first palynological studies at Sārnate lagoon area and the archaeological site were done by A. Dreimanis (1947). Later, detailed pollen analysis was undertaken by M. Galeniece (1960) and D. A. Agranova (Doluhanov 1977). The first information about the large amount of *Trapa* fruits collected by Stone-Age man in the Sārnate Bog settlement is described by E. Šturms (1940).

Water chestnut fruits were also found in the settlement site during the excavations conducted by L. Vankina (Vankina 1970). Samples collected during this excavation from Dwelling O of the Sārnate archaeological site were later analysed by

complex plant macro-remain analysis (Ceriņa et al. 2013). Plant macro-remains have been studied in the sediment sequence from the north-western edge of Dwelling O, where charred plant remains were found in the cultural layer at the top of the sequence. It was revealed that the dwelling had been established on a lacustrine gyttja layer with remains of aquatic plants: yellow water-lily *Nuphar lutea*, water chestnut *Trapa natans* and common club-rush *Scirpus lacustris* (Ceriņa et al. 2013).

The aim of the research reported in this paper is to characterise the changing palaeo-geographical conditions in the former Sārnate lagoonal area, as recorded by changes in sediment properties, pollen and plant macro-remain composition.

**Data and Methods**

The study presented in this paper is based on the results of investigations at three points in the Sārnate former lagoon area: 1) sediment samples from the core Sārnate IX (Lat. N 57.1083979; Long. E 21.4582771), taken at the margin of the present-day Sārnate Mire, immediately south-east of the central part of the archaeological site ; 2) samples of sand from the hearths of Dwelling K and Dwelling 11 of the archaeological site (Lat. N 57.10898882; Long. E 21.4559243), and 3) samples from organic sediment layers formed in the Sārnate lagoonal area during the Holocene and nowadays revealed at the Baltic Sea bluff between the rivers Vičaka and Pāžupīte (Lat. N 57.0714669; Long. E 21.4155118) due to coastal erosion.

Sampling: Sampling has been performed using recommended approaches for sediment core sampling (Berglund and Ralska-Jasiewiczowa 1986). Coring and sediment sampling were undertaken using a soft sediment sampler with 50 cm long camera with diameter 7 cm. The sediment monoliths were placed in a special cartridge and wrapped in poly-ethylene film to preserve natural moisture, brought to the laboratory and sliced into 5 cm intervals. The outer margins were systematically discarded, as these could have been contaminated during sampling.

Plant macro-remain analysis: Plant macro-remains have been extracted and identified from two bulk (volume 1 l) sediment samples of sand with charcoal fragments recovered during the excavation conducted by L. Vankina and stored at the National History Museum of Latvia: 1) a sample from the hearth of Dwelling K (1949 excavation), belonging to the final phase of occupation, c. 5580–4800 BP; and 2) a sample from the hearth of Dwelling 11 (1959 excavation), with non-diagnostic archaeological remains, not attributable to a particular phase. The overall site plan, showing the location of the dwellings, can be viewed in the publication by V. Bērziņš (2008: 61). In the case of the sediment samples from the outcrop north of the mouth of the Pāžupīte, the material from the sediment sequence was divided into 10 sub-samples and used for plant macro-remain analysis. The volume of each sub-sample was approximately 200 ml. Preliminary processing of the plant macro-fossil samples was undertaken in the laboratory, using flotation to separate the light fraction (flot), collected on a 0.25 mm sieve, from the heavy fraction (residue). Recovery and

determination of the plant remains and other sub-fossil remains was then undertaken. The samples for plant macro-remain analysis were prepared following standard techniques (Warner 1990). Plant macro-remains were identified using available reference material, as well as pictures and descriptions in Velichkevich and Zastawniak (2006; 2008).

## Results

### Samples from Dwelling 11 and Dwelling K of the Sārnate archaeological site

A large number of macro-remains, predominantly charred, such as fruits of *Trapa*, *Corylus,* as well as seeds of *Nuphar lutea Scirpus lacustris, Chenopodium alba* and *Fragaria vesca*, have been found in the samples of sands from the archaeological excavation of the hearths (Dwelling 11 and Dwelling K). The sediment of the hearth of Dwelling 11 contained fruits of *Trapa natans* (200 fragments), *Corylus avellana* nut fragments (46), one *Pinus sylvestris* pine cone scale fragment, a fragment of Poacea (charred grain fragment), *Nuphar luteum* (charred seed) and *Scirpus lacustris* (2 seeds).The sample from the hearth of Dwelling K predominantly contained achenes of sedges *Carex* sp. (14) and common club-rush, *Scirpus lacustris* (19). Seeds of other plants were present in small numbers: *Chenopodium album* – three nutlets, a few seeds of aquatic plants *Potamogeton perfoliatus* (1) and *Nuphar luteum* (1), as well as achenes of *Polygonum aviculare, Galeopsis ladanum*, *Fragaria vesca* and *Potentilla anserina*. The *Potamogeton* seed is not charred, while the rush and sedge seeds are only partly charred. Most of these plants were used for food.

### Core Sārnate IX, at Sārnate Neolithic site

Records from the lower part of the sequence show the presence of a *Hypnum* peat layer formed on sandy sediments earlier than 9670–9290 BP, when the depression of the former Sārnate Lagoon was almost dry, with some wet areas providing favourable conditions for *Hypnum* moss growth. The peat was covered by calcareous clay, which accumulated in a basin, evidently during the maximum Littorina Sea transgression. At a depth of 2.0–2.4 m from the section top calcareous clay with organic remains was deposited, earlier than 8050–7810 BP, when the water level in the basin fell somewhat and the clay became richer in plant and faunal remains. Higher up in Sārnate core IX, at a depth of 2.0–0.85 m, peaty gyttja was laid down. The water level in the basin gradually decreased and the lagoonal lake was progressively filled in and covered by wood-grass fen-type peat. Analysis of the earlier pollen studies data (Kalniņa et al. 2011) reveals their composition from sediments of core IX and is used for description of vegetation changes in the surroundings of the Sārnate site starting from the second half of the Early Holocene Boreal, when a pine forest was distributed on sandy soils in the area (Kalniņa 2018). Pollen composition at the base of the core, in the depth interval 3.25–3.65 m from top, represented by the *Hypnum* peat layer, is characterised by a dominance of birch *Betula*, a small amount of pine *Pinus* pollen and herb pollen, mainly represented by

Poaceae and Cyperaceae. From this time onwards, until the present day, the Sārnate area has been characterised by an open landscape. Pollen composition in the calcareous clay with organic remains and peaty gyttja (8050–7810 BP) reflects the widest distribution of broad-leaved trees (*Ulmus*, *Tilia*, and *Quercus*), alder and hazel in the area, characteristic of the Holocene Climatic Optimum (Atlantic climatic period). The pollen composition in the peaty gyttja at 1.9–1.25 m shows an increase in *Pinus*, *Picea* and *Quercus*, as well as in aquatic plant pollen (Nymphaceae, *Stratiotes aloides*, *Menyanthes*, Typhaceae). In this interval water chestnut *Trapa natans* pollen has been found, its presence also recorded in the depth interval 0.9–0.7 m (5090–4900 BP), represented by wood–grass peat showing a decrease in broadleaved tree pollen and an increase in *Picea* and herb pollen, including pollen of ruderals and cultivated plants, as well as in the amount of charcoal dust. The uppermost layer of the core contains pollen of cultivated plants (*Hordeum*, *Triticum*, *Avena*) and anthropogenic indicators *Plantago major/media, Chenopodium album, Polygonum aviculare, Urtica* and *Rumex acetosella*, dated to 4890–4670 BP and 3950–3770 BP.

**Outcrop at the Baltic Sea Bluff**

Organic sediment layers formed in the Sārnate area during the Holocene are nowadays being revealed due to coastal erosion. These sediment sequences can be studied at the Baltic Sea coastal bluff (Lat. N 57.0714669; Long. E 21.4155118) located between the River Vičaka to the north and the River Pāžupīte to the south. The bottom interval of this outcrop is represented by sandy and silty sediment layers, which are overlain by an organic layer consisting mainly of peat in various stages of decomposition. The lowest unit, is at 3.2–3.1 m depth from the top, formed 9780–9630 BP (Saulīte et al. 2007) and consists of well-decomposed sandy wood–grass peat, containing fragments of wood (with some charred pieces), as well as remains of grasses and Bryales. The admixture of sand decreases in the peaty gyttja further up in the section (3.1–2.8 m). This layer is rich in plant remains, including wood remains. *Carex* achenes and *Menyanthes trifoliata* seeds have been found (Figure 2). It is covered by poorly decomposed *Hypnum*–sedge peat with pressed structures containing *Carex* sp. achenes and *Menyanthes trifoliata* seeds (depth 2.8–2.7 m), formed 6230–6190 BP.

The layer of *Hypnum*–sedge peat is covered by *Hypnum*–reed peat (2.6–2.7 m), which is overlain by *Hypnum* peat with *Menyanthes trifoliata* seeds at 2.5–2.6 m depth. Conditions for plant growth changed at the depth 2.3–2.5 m, when grass–sedge peat with large numbers of *Carex* sp. achenes, fewer *Menyanthes trifoliata* seeds and some *Betula nana* achenes accumulated. The uppermost layer (depth: 2.3–2.2 m), consisting of well-decomposed grass peat with *Carex* sp. nutlets, *Cladium mariscus*, *Menyanthes trifoliata* and *Potentilla* seeds, as well as *Betula nana* achenes, is dated to 3610–3510 BP. The overlying peat layer, at 2.2–2.0 m depth, consists of well-decomposed, dense peat with branch fragments, many *Picea* sp. needle fragments, and small quantities of *Betula* sect. Albae and *Carex* nutlets, *Potentilla* achenes, charred

*Polygonum* achenes and *Viola* seeds. During the formation of this layer the ground water level was low and the fen became overgrown with forest. The top peat layer is covered by dune sands.

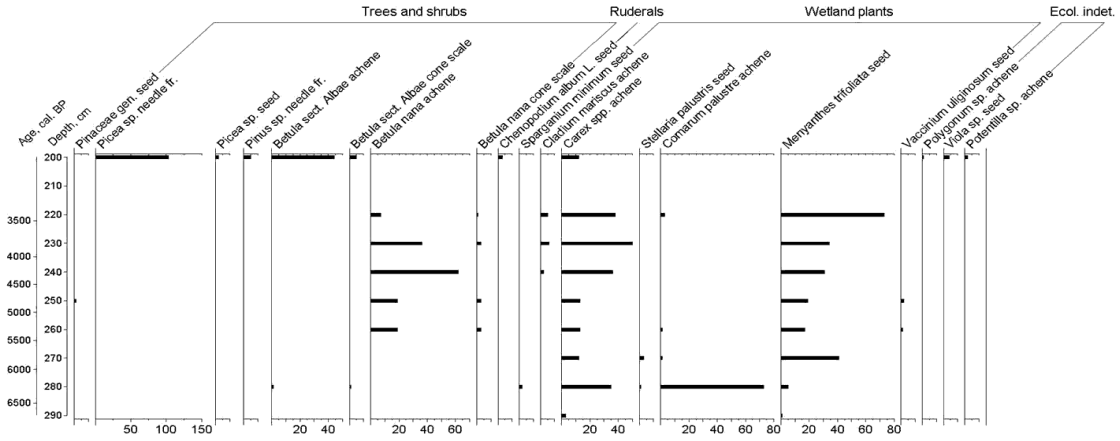


Figure 2. **Plant macro-remain diagram from peat deposits of the Baltic Sea Coastal Bluff between the rivers Vičaka and Pāžupīte** (authors' figure)

Plant macro-remain results are supported by pollen data from the same sediment section (Kalniņa et al. 2011). The pollen analysis shows that the layer of sand is rich in plants, providing pollen spectra characteristic of the vegetation of the climatic optimum, with the highest amounts of broadleaved trees: *Ulmus*, *Tilia* and *Quercus*. The depth interval 2.7–2.2 m contains pollen anthropogenic indicators *Plantago major/media*, *Chenopodium album*, *Polygonum aviculare*, *Urtica* and *Rumex acetosella,* dated to 3610–3510 BP, indicating human activity in the area.

## Conclusions

The shallow lagoon lake gradually became terrestrialised and in-filled with fen peat, and later also with raised-bog vegetation. The pollen data reflects vegetation development, starting with boreal pine forests in the Sārnate area, which changed to an open or mosaic landscape from the very beginning of the Holocene Climatic Optimum, before 8050–7840 BP, when substantial changes were caused by both climatic and sea-level change. The record of the Water chestnut (*Trapa natans*) pollen in the gyttja under the fen peat indicates that it grew there at the end of the Holocene Climatic Optimum.

Plant macro-fossil and pollen data along with archaeological evidence from the Sārnate archaeological site indicates intensive human activity in the area during the latter part of the climatic optimum and the first part of the Late Holocene (Subboreal). The sediment composition at the Sārnate site was changing: transformed from Littorina Sea lagoon to shallow lagoonal lake, this area was gradually terrestrialised and in-filled with fen peat and later also with raised-bog vegetation. The presence of cereal and weed pollen provides confirmation that agriculture was also being

practiced, at least during the final phase of occupation, in the late 6th and the 5th millennium BP.

**Kopsavilkums**

Paleoģeogrāfisko apstākļu pārmaiņu rakstura izpēte Sārnates bijušās lagūnas teritorijā ir saistīta ar šīs teritorijas ģeoloģisko uzbūvi un mūsdienu ģeoloģisko procesu norisi, kā arī ar akmens laikmeta mītņu izpēti šajā teritorijā. Veikta nogulumu vecuma datēšana, sporu un putekšņu izpēte IX urbumam Sārnates apmetnes teritorijā, kā arī jūras krasta atsegumā ziemeļos no Pāžupītes ietekas jūrā. Priekšstatu par nogulumu veidošanos zemā purva apstākļos rada augu makroatlieku pētījumi. Ogļotas ezerrieksta un citu augu makroatliekas atrastas akmens laikmeta apmetnes "K" mītnes un 11. mītnes pavardu nogulumu paraugos.

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# CHANGES OF THE PALAEO-GEOGRAPHICAL CONDITIONS IN THE LAKE USMA DEPRESSSION DURING THE END OF THE LATE GLACIAL AND THE HOLOCENE

## Paleoģeogrāfisko apstākļu pārmaiņas Usmas ezera ieplakās leduslaikmeta beigās un holocēnā

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**Abstract.** Lake Usma occupies the lowest part of the Late Glacial glacio-depression at the Kursa Lowland (NW Latvia), where the Venta-Usma ice-dammed lake and the Baltic Ice Lake sediments have been accumulated. Geological and geo-morphological investigations have been carried out on the largest Lake Usma islands - Moricsala and Viskūži Island as well as at Košķēni Bay. Changes in palaeo-geographic conditions in the Lake Usma depression during the Holocene are evidenced by organogenic sediments from cores in Moricsala and Viskūži Island and in the lake bottom of Košķēni Bay. The loss on ignition analysis of these sediments has been carried out with the aim to determine changes of organic, mineral and carbonate matter proportions and the relative percentage in their composition, which together with macro-remain analysis data allow to gain better understanding about the character of the palaeo-geographic conditions during the lake's development,
**Keywords:** *relief, Košķēni Bay, loss on ignition, Moricsala, Viskūži Island*

### Introduction

Lake Usma, is located in the N-W part of Latvia and occupies the lowest part of the Late Glacial glacio-depression at the Kursa Lowland, where the Venta-Usma ice-dammed lake and the Baltic Ice Lake sediments have been accumulated. The lake is 13.5 km long and 6.2 km wide, oriented towards N-E (Figure 1 - a). The shoreline of the lake, bays and peninsulas is overgrown and paludified. There are four islands in the lake - Viskūži Island, Moricsala, Lielalksnīte and Mazalksnīte. Viskūži Island is the largest lake island in Latvia with length 3.1 km and 1.75 km wide. It is a natural border between the northern and the deepest southern part of Lake Usma. The peninsula at the eastern shore of the lake, Viskūži Island, and Amjūdze Peninsula forms a transverse elevation in the middle part of Lake Usma (Figure 1 – a, b).

The genesis of the Lake Usma depression and its surrounding area at the end of the last glacial and the Holocene has been described in published and unpublished interpretations in the late 20th century by Quaternary researchers E. Grīnbergs (Гринбергс 1957), I. Veinbergs (Вейнбергс 1975; 1999). Of particular note, mention should be made of the investigation carried out by I. Veinbergs and I. Jakubovska (Veinbergs and Jakubovska 1999), which was based on geological, geo-morphological and palynological research. In this study it was found that the glaciolimnic clay rhythm and the thickness of the layers series were conditioned by changes in the accumulation conditions at the end of the glaciation. Information about the

morphology of the lake depression and the islands and the fixed levels of terraces provided by the research data allows us to understand the Venta-Usma ice-dammed basin and the Baltic Ice Lake levels changes in the area of Lake Usma. Palynological analysis of organo-genic sediments was carried out for sediment sections from Moricsala, Ozoliņi valley, and Usma station bog in that study, however there was not given sufficient attention to the sediment composition. Recent studies include analyses of organo-genic sediments from Košķēni Bay, Moricsala and Viskūži Island (Figure 1 - a).

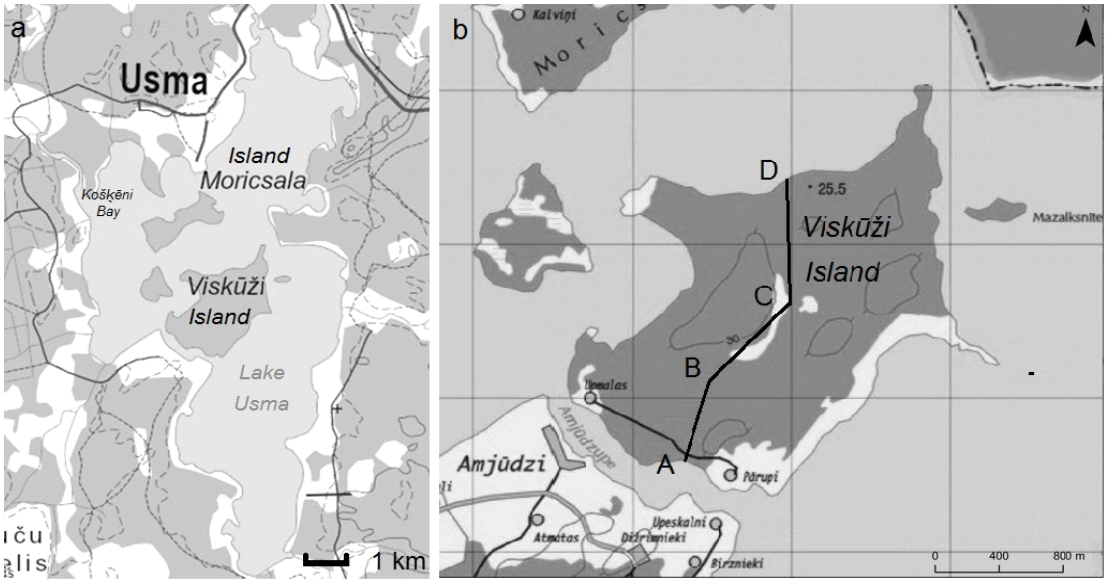


Figure 1. **Location of studied sites: a) in the Lake Usma; b) Viskūži Island.** Line A-B-C-D on the Viskūži Island shows the location of the geological longitudal section of the organic deposit distribution in the island valley (authors' figure using Latvian Geospatial Information Agency Map 1:100 000 (a) 1: 1:50 000 (b)).

The aim of this study is to find out the main stages of palaeo-geographic condition change during the development of Lake Usma as recorded in the sediments.

## Materials and Methods

The field work for this study was carried out on Moricsala and in Košķēni Bay and in 2016 on Viskūži Island. The sediments found in the adjacent areas of Lake Usma and its islands are sufficiently representative to trace the changes of paleo-geographic conditions at the end of the Pleistocene and in the Holocene by the sediment accumulations and lithological characteristics, thickness and sequences of the layers. More detailed geological and geo-morphological studies have been carried out on the two largest islands of the lake - Moricsala and Viskūži Island and in Košķēni Bay. Viskūži Island and Moricsala were formed as a result of ice meltwater basin sediment accumulation, and of the erosion of ice melting water streams and waves.

Sediments from the Moricsala, Košķene and Viskuži Island sections have been studied by loss on ignition analysis (LOI), macro-remain analyses and sediment age dating with the AMS $^{14}C$ method. LOI methodology was applied for sediment analysis in order to estimate the content of organic matter, carbonates and mineral matter in the sediment composition. Analysis was carried out by heating the samples sequentially at 550° C for 4 h and at 900° C for 2 h (Heiri et al. 2001). Fluctuations in values of these sediment characteristics point to changes in sedimentation conditions.

Samples (selected terrestrial macro-remains) were prepared according to the specifications and sent to the Poznań University laboratory for dating with AMS $^{14}C$ method.

**Results and Discussion**

Results of laboratory investigations help us to better understand the paleo-geographical conditions of Lake Usma. Loss on ignition analysis reveals quite unstable sedimentation conditons in the lower part of the Košķēni Bay sediments (Figure 2) in comparison with the Vizkūži Island section (Figure 3). A high proportion of carbonates in the lower part of both sites indicate favourable conditions for carbonate accumulation, which disappear upwards, before 6700 cal years BP (calibrated years before the present) in Viskūži sections and 5000 cal years BP. In the Moricsala section carbonates are found in only a very little amount (Ceriņa et al. 2017).

Particularly important information is provided by the results from LOI analysis of the 11 m thick organogenic sediment layer on Viskūži island (Figure 4 – core Z1) supported by the AMS $^{14}C$ datings. The Viskūži LOI diagram shows overlying sapropel composition in the lower part of the section (Zone 1) and contains a quite high amount of mineral matter and carbonates, but from the depth 8.6 m upwards, these values decrease (Figure 3). In the sapropel up to a depth of 7.56 m there are to be found regularly abundant waterfleas (Cladocera), which are present in both the litoral and pelagic part of the lakes. In the sediment section higher up, organic matter content increases significantly and reaches 90-95%. Aquatic animal remains from a depth of 7.55 m upwards are to be found in a small number of individual samples that indicate the disappearance of the open water surface and the accumulation of deposits started under fen conditions. There were also to be found *Sphagnum* and Hypnales moss leaves, bog fern leaves, Bogbean, sedge and Rannoch-rush seeds.

The main features of the morphology, relief and sediment characteristics are important criteria for palaeo-geographic development of the Lake Usma area. The geological mapping materials of Latvia in scale M 1:200 000 (1999), large-scale topographic maps and surface models of terrace created after the LGIA aerolaser scanning in 2016 data were used.

Viskūži Island is separated by a 300 m wide strait from the shore of Lake Usma, but a 160-200 m wide and 1.3 km long winding strait, separated from the island by the morphological similarity with the river, is named Amjūdzupe (Figure 1). Viskūži

Island, together with the above-mentioned peninsulas, forms a linear elevation drawn in the direction of SW-NE, the base of which may fix one of the positions of the active ice tongue at the end of the late Visla glaciation.

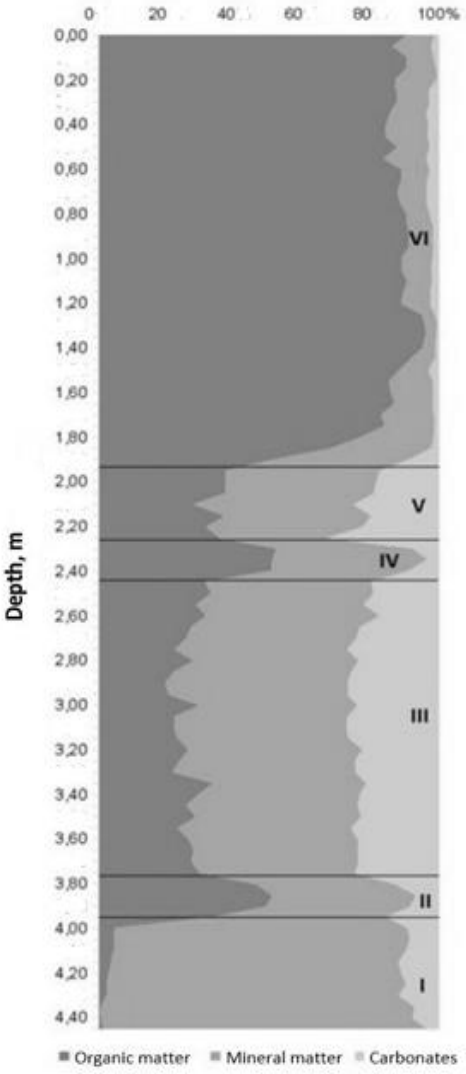


Figure 2. **LOI diagram of the Košķēni Bay sediments** (authors' figure)

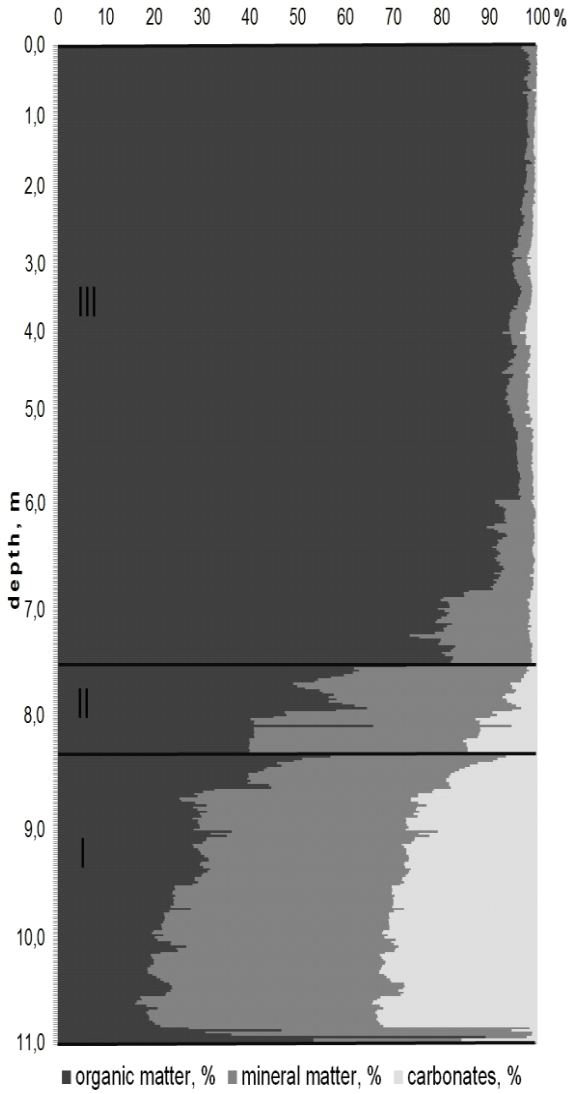


Figure 3. **LOI diagram of the Viskūži Island Mire deposits** (authors' figure)

There are three longitudinal embedded depressions in the underwater part of the lake bottom - the deepest is located at the southern part, to the NE from Moricsala and to the W from Moricsala. Considering that Lake Usma is formed as a glacio-depression (Аболтыньш et al. 1972), the orientation and elevation of Usma Lake is linear and allows us to assume that the asynchronous formation of the individual parts of the lake depression took place during the tongue-type deglaciation stage. Thus, Viskūži Island, along with the peninsulas on the shores of Lake W and E, lies above the end moraine that formed between the active tongue of the glacier in the north and the passive ice in the south. Partial morphological similarity and also the linearity of

the SW-NE are 1.7 km long and 0.2-0.7 km wide and are characteristic for Moricsala. There are several stages of erosion of the steep coasts on Moricsala and Viskūži Island. Moricsala is hipsometrically lower, so the height of its steep coasts is not more than 3-5 m, but for Viskūži Island they reach 6-8 m, vertical, unstable bluff parts. Mostly, around Moricsala, as well as around Viskūži Island, there are wide shallow water areas overgrown by reed belts that dampen wave energy (Veinbergs and Jakubovska 1999).

The two largest islands of the lake have differently articulated surface relief characteristics, but there are also flat surfaces and terraces at the same height above the lake level (Veinbergs and Jakubovska 1999), which apparently point to the levels of stabilization during the lake development. Not only the surface of the terrain but also the sediments found in the corings and observation sites indicate the conditions for the formation of the islands. In the 4 boreholes carried out in different places of Viskūži Island, in the highest part (28-32 m above sea level), there is to be found sand. Under these the changes of glaciolymnic clay and silt layers were recognized as being with a seasonal rhythmic character. Similar glaciolimnic sand, silt and clay have also been found on Moricsala (Veinbergs and Jakubovska 1999). It is only because of the absolute height difference, that the sediment strata in Viskūži Island is 4 m thicker.

On both islands there are also to be found areas of eolian relief, where dunes and deflation depressions alternate. The formation of eolian relief was possible at the time when the water level was falling and the glaciolimic sand did not cover the vegetation. The prevalence of glaciolimic sediments on both islands of the lake, as well as the erosion bluffs and terraces, are indicative of their initial formation in the same ice-melting water basin and can currently be classified as sediment accumulation and erosion remnants under basin conditions. According to the relief profiles made using LIDAR 2016 data for Viskūži Island, there are several notable levels of terraces and flat tops – 30 m, 28 m, 27 m, 23.5-24 m and 22 m above sea level. These levels are similar also to those on Moricsala, except for the two highest levels. The accumulation of glaciolimic clays and silt occurred in the Venta-Usma ice-dammed basin, while sand accumulation occurred in the Gulf of Usma in the Baltic Ice Lake (Гринбергс 1957; Страуме 1979; Veinbergs 1990). As the water level dropped, the surface of the islands was flattened and partially eroded. At the elevation mark 25 m above sea level. E. Grīnbergs (1957) and J. Straume (1979) noted that lake Usma separated from the Baltic ice lake, although later observations do not confirm this (Veinbergs and Jakubovska 1999). According to J. Straume's (1979) observations, the elevation of the terrace surface elevation varies from 24 m a.s.l. at the southern part of the lake to 26 m a.s.l. at the northern part, which indicates a different isostatic uplift speed. Changes in palaeo-geographic conditions in the Lake Usma depression in the Holocene are evidenced by the character of organogenic sediments, the samples of which were obtained by coring in mire depressions on Moricsala (Ceriņa et al. 2017), Viskūži Island (Strautnieks et al. 2017) and from the lake bottom in Košķēni Bay

(Štube et al. 2018 ). Layers of organogenic sediments at all 3 sites have both common and distinct features, including layer thickness.

The maximum thickness of the organogenic sediment is to be found on Viskūži Island, where it reaches 11 m. Organogenic sediments are concentrated in the Viskūži Island mire, which is developed in the S-folded valley with a length of 2.5 km, a width of 150-200 m, and relative height of the slopes being 6-8 m. On the slopes of the downhill, the expressive terraces are clearly visible at certain stages. The elevation of the surface in the lowering is 22-24 m above sea level, i.e., 1-3 m above the level of Lake Usma, which means that the partially buried lowering bed is 8 m below the current lake level. In the Viskūži paludified valley area there were found three different mire types: fen, transitional and raised bog. In core Z1 there has been identified an 8 m thick peat layer, which covers 3 m thick sapropel strata (Figure 4 – core Z1) shown in the longitudinal section of Viskūži Mire (Figure 4). The absolute age for the peat layer in the valley bottom of deepest core Z1 at the depth 10.93 cm laying below the sapropel, just above the medium-grained sand, the absolute age AMS $^{14}C$ is 9080 ± 50 BP was determined. This peat contains only green moss residues, a small amount of sedge and Bogbean seeds, which are generally characteristic of plant composition in fens. No residues of aquatic animals have been detected.

Seeds and bark fragments of pines have been found in the peat layer and show that the island had been covered with pine forests at this time.

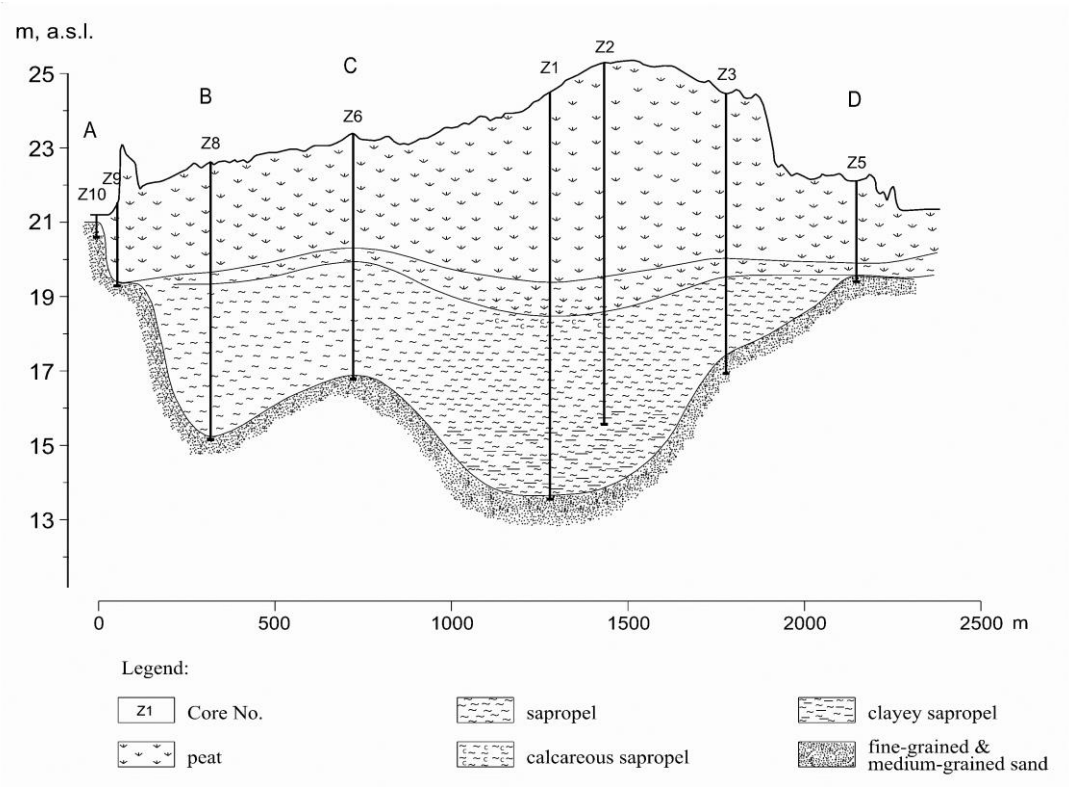


Figure 4. **Geological longitudinal section of the S-folded valley crossing Viskūži Island** (authors' figure)

Investigation data reveals that up to the present day the accumulation of sapropel and peat has been undisturbed and steadily rapid - around 1.2 m per thousand years. On Moricsala, the thickness of the organogenic sediment is only 1.2 m, where the age of the sapropel layer is 9450 ± 50 BP. The thickness of the sediment layer is 10 times smaller, which is likely to be an explanation for the facially different position where the accumulation of sapropel was limited by the action of surface waves, which contributed to erosion of the accumulated material. The rate of accumulation of the peat layer was reduced by decomposition, as the lake and groundwater levels decreased. The relatively rapid accumulation of sapropel and peat has taken place in Košķēni Bay, where the lower 3.3 m of the stratum have accumulated in about 1000 years, between 6500-5500 years BP. The top 70 cm thick layer of peat has developed over 5500 years, which is most likely due to the decomposition of peat with improved aeration.

## Conclusion

The absolute age of the lower part of organogenic sediment layers in all studied sites is similar - over 9000 years. However, the thickness of these is different - 10.9 m, 4.0 m and 1.2 m, which can be explained by the facial difference. Changes in sediment, plant and aquatic remain composition indicate that sediment accumulation conditions have been changing and they were more different in the Lake Usma basin during the Holocene than at the end of the Late Glacial.

**Kopsavilkums**

Usmas ezera ieplaka izveidojusies glaciodepresijā Kursas zemienē, kur uzkrājušies Ventas–Usmas sprostbaseina un Baltijas ledus ezera nogulumi, kas raksturo paleoģeogrāfiskos apstākļus pleistocēna beigās un holocēnā. Detalizētāki ģeoloģiskie un ģeomorfoloģiskie pētījumi ir veikti divās lielākajās Usmas ezera salās – Moricsalā un Viskūžu salā, kā arī Košķēnu līcī. Salas ir gan ledājkušanas ūdeņu baseinu nogulumu akumulācijas, gan arī šo ūdeņu straumju un baseinu viļņu erozijas rezultāts. Viskūžu salas erozijas stāvkrasti un salu šķērsojošais erozijas padziļinājums liecina, ka tā ir ledājkušanas ūdeņu baseina gultnes un straumju erozijas paliksnis. Organogēno nogulumu slāņkopas apakšējā daļā nogulumiem noteiktais absolūtais vecums ir līdzīgs, tas pārsniedz 9000 gadu. Taču slāņkopas biezums ir ļoti atšķirīgs – 11 m, 4 m un 1,2 m. Atšķirīgais nogulumu biezums izskaidrojams ar faciāli atšķirīgo novietojumu. Nogulumu, augu un ūdensdzīvnieku atlieku sastāva pārmaiņas nogulumos liecina, ka Viskūžu salā ir bijis paleoezers, kurā nogulumu uzkrāšanās apstākļi ir bijuši mainīgi. Pētījumu rezultāti lokālajās vietās ir salīdzināmi, tomēr ir labi novērojamas faciālās atšķirības, kas saistītas ar dažādu nogulumu akumulācijas, erozijas vai sadalīšanās ātrumu.

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# EVIDENCE OF PALAEO-CLIMATE CHANGES AND THEIR IMPACT ON SEDIMENT ACCUMULATION CONDITIONS IN THE LUBĀNS STONE-AGE SETTLEMENT AREAS

# Liecības par paleoklimata pārmaiņām un to ietekmi uz nogulumu uzkrāšanās apstākļiem Lubāna akmens laikmeta apmetņu teritorijās

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**Abstract.** Changes in palaeo-climate and palaeo-geographic conditions have influenced palaeo-vegetation and sediment accumulation conditions during the development of Lake Lubāns. These circumstances have also affected human life conditions and the distribution of Stone-Age settlement sites. To discover notions about evidence of sediment accumulation condition changes and reconstruct the palaeo-geographic

conditions of Lake Lubāns, studies were undertaken in Stone-Age settlement areas and the palaeo-lake's overgrown and paludificated territories.

The investigations for this study were based on field work, including sampling, geological coring and probing, obtaining and documenting samples of sediments, as well as laboratory analysis on aspects such as loss on ignition, pollen and macroscopic remain analysis. The results have allowed us to make the conclusion that the most essential of reasons why Stone-Age people changed the sites of their settlements was due to lake water level fluctuations as well as to overgrowing and paludificating of the lake bays and shores.

**Keywords:** *Paludification, sediment accumulation, loss on ignition, Stone-Age*

## Introduction

The research area is located in the East Latvian Lowland, the Lubāns Plain and the Lubāns Wetland. The lake itself combined with its surrounding territories is situated in the lowest area of the Lubāns Plain. Notable among the characteristics of Lake Lubāns is its complicated geological structure, hydrographic network, large wetland covered areas and rich evidence about Stone-Age settlements. During the late glacial period Lubāns palaeo-lake was at least three times the size it is today (Grūbe 2006).

Due to the complicated geological development of Lake Lubāns and the Lubāns Plain, palaeo-geographic conditions around Lake Lubāns in various places are diverse (Эберхардс 1985). It is essential to mention that Lake Lubāns and its surrounding territories is a unique place not only in Latvia but also in a global context. Around the ancient and present day lake shores and many nearby rivers there have been discovered more than 30 ancient settlement sites. And is is exactly at the Lubāns Stone-Age settlement sites that there have been found the most bone and horn sculptures not only in Latvia but also in the eastern Baltic territory (Лозе 1988; Segliņš et al. 1999). Lake Lubāns is one of the largest of these kind of archaeological research areas not only in the Baltic states but also in Europe. The overall territory covers some 100 000 hectares where 24 nationally protected archaeological sites are located (Loze 1990). For those reasons, further researches into any of this archaeological site's environmental changes are significant to obtain a better overall understanding about the specific territory's geological development and palaeo-environmental changes during the existence of Stone-Age settlements around the ancient Lake Lubāns shore.

During the time period 2016 – 2017, studies were undertaken in the N and NE part of the Lubāns palaeolake – the Iča and Lagaža settlement areas (Paparde et al. 2017). In order to reconstruct sediment accumulation condition changes for the whole ancient Lubāns territory, it was required also to study the W and S parts of Lake Lubāns – the Asne and Sūļagols settlement areas. These additional expeditions took place during 2018 – 2019. Specific settlement sites were chosen because they are interesting in a palaeo-geographic aspect and also because of the lack of any existing geological information about them.

## Data and Methods

During the study process different types of data and versatile materials were used, including sediment samples from field works, the author's prepared cartographic materials, performed laboratory analysis and visualised results in conversant diagrams and charts. In addition to obtaining samples for further investigations so as to reconstruct palaeo-geographic and sediment accumulation condition changes during field works, geological coring and probing was also undertaken as was the obtaining and documenting of sediment monoliths, and transportation of these samples to the laboratory of Quaternary Environment studies at the University of Latvia. A combination of different laboratory methods was used to get the best results on aspects such as loss on ignition, pollen and macroscopic remains analysis. A plausible palaeo-geographic reconstruction can be made only by comparison and combination of different laboratory analysis results and data from diverse geological coring sediment samples.

Loss on ignition analyses of the Quaternary lake sediments provide an opportunity to investigate changes in the past environment. Curve fluctuations in diagrams can indicate sediment accumulation condition changes, water level fluctuations, lake shore overgrowing and paludification processes. With these methods seven geological cores were analysed: Sūļagols – U1, Iča – U1, Iča – U2, Iča – U3, Lagaža – U1, Lagaža – U2 and Lagaža – U3 with a total length of 10.6 m of sediment samples. Each sediment monolith was analysed to within a 1 cm accuracy, meaning 1060 samples in total. Loss on ignition analyses was used to estimate organic, mineral and carbonate matter in sediments.

Pollen analysis, the study of fossil pollen and spores, is one of the key methods for reconstruction of past vegetation dynamics and environment changes. The results of this method can provide an insight into long term changes of various plant species and also indicate human influence on vegetation, therefore sediments from two cores were analysed – Iča – U1 (69 samples) and Lagaža – U1 (39 samples). Macroscopic remain analysis can reveal significant information about palaeo-climate and palaeo-vegetation as well as give evidence about early human impact on vegetation and the beginnings of agriculture (Paparde et al. 2017). In total, a macroscopic remain analysis was done for 63 sediment samples and with 5 cm accuracy. Samples from two sediment cores were analysed – Iča – U1 (40 samples) and Lagaža – U2 (23 samples).

## Results

During the field work in 2016 at Iča and the Lagaža Stone-Age settlement territories, six sediment cores were made with a total length of 7.6 m - three cores at each Stone-Age settlement area. Field work for this research took place in the northern part of Lake Lubāns. All sediment samples and monoliths were taken to use for further laboratory analyses. As well, from the pit wall of the Iča settlement area 5 extra sediment samples (each approximately 2.0 – 2.5 litres) were collected to use for macroscopic remain analysis. During the 2018 research field work that continued in

the southern and western part of Lake Lubāns, four sediment cores were made with a total length of 10.0 m – one in each research area, including Sūļagols and Asne Stone-Age settlements, Garanču Mire (Sūļagols) and the Kausliena Peisa Mire (Figure 1).

At the Iča - U1 borehole the cultural layer was separated from 0.63 to 1.35 m, hile the Lagaža - U2 borehole cultural layer was in the interval from 0.35 to 0.67 m. According to the results of loss on ignition analyses, changes in percentage values of carbonates, mineral and organic matter have indicated sediment accumulation condition changes in the northern and southern part of Lake Lubāns. Iča – U1 and Lagaža – U2 representing North but Sūļagols – U1 representing South. The results of the loss on ignition analysis of the surrounding area of Sūļagols, Iča and Lagaža settlements are reflected in the drafted diagrams (Figure 2). Depending on the changes in sediment composition, four zones (I-IV) were sub-divided for Sūļagols, seven zones (I-VII) for Iča and four zones (IV-VII) for the Lagaža settlement area.

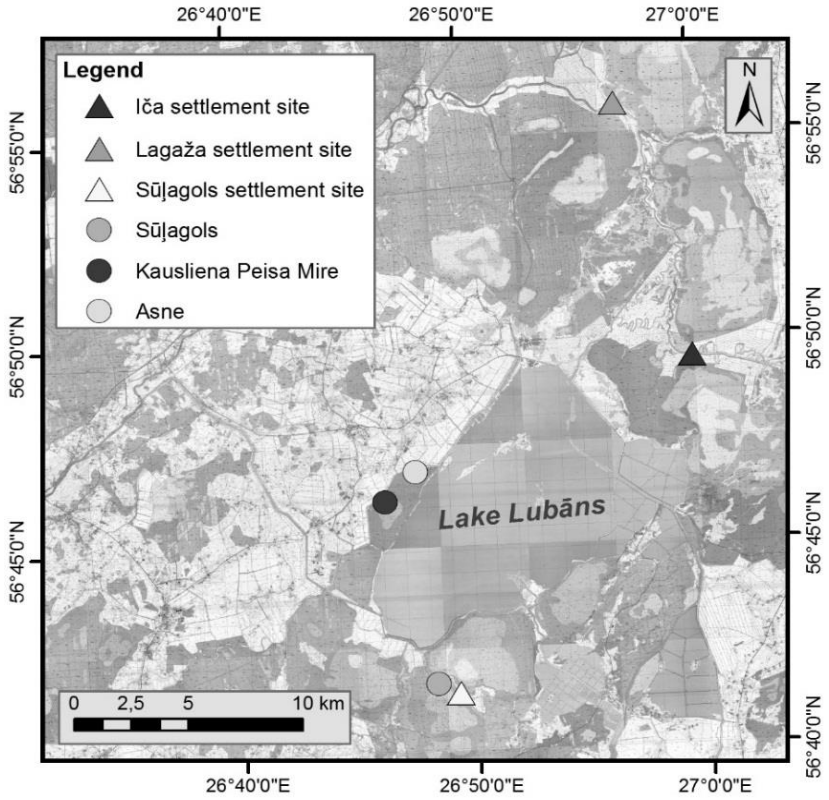


Figure 1. **Surveyed expedition sites and sampling locations, 2016 - 2018** (authors' figure using TOPO 10K PSRS 1979–1980)

Sūļagols – U1 is the deepest borehole that represents sediment accumulation condition changes in the southern part of Lubāns palaeo-lake. Zone I is represented by fine to medium grained sand. This interval reaches up to 98% of mineral matter. These sediments possibly accumulated during the late glacial. Zone II represents a sharp increase of organic matter from 3 to 78%. That shows the evidence of warm climate conditions and rapid development of vegetation. Zone III is dominated by peaty gyttja and organic matter increases from 66 to 88%. Curves of loss on ignition results in

diagrams indicate periodic changes in sediment accumulation conditions that may have been influenced by fluctuations of lake water levels. While in zone IV, dominated by peat, organic matter increases from 82 to 97%. That provides us with the evidence about intensive lake overgrowing and paludification processes. On the whole, Sūļagols – U1 borehole interval carbonates reach up to only 2.5%.

Iča – U1 and Lagaža – U2 boreholes represent sediment accumulation condition changes in the northern part of Lubāns palaeolake. The borehole from the Iča settlement area reveals that the amount of organic matter decreases with the depth of the sediment layers. Zone I – III is represented by sediments that accumulated under water conditions. Carbonates in this interval reach up to 12.5%. Zone II – VI coincides with the distribution of the cultural layer. This indicates that the accumulation of these sediments took place under dryland conditions and were influenced by human activities. Organic matter increases up to 20% in zone VII that indicate paludification processes in the northern part of Lake Lubāns means that during the time of this sediment accumulation the settlement area was no longer inhabited.

The results for the Lagaža – U2 borehole show that sediment accumulation took place in four diverse conditions. Zone IV is represented by the highest carbonate matter that indicates water influence on sediment accumulation processes. Zones V and VII represent evidence of palaeo-lake Lubāns shore overgrowing and paludification processes because in these intervals organic matter reaches up to 20%. Zone VI represents more stationary accumulation conditions and it also coincides with cultural layers of Lagaža Stone-Age settlement inhabitation. A lot of animal, fish bone and charcoal fragments were found.

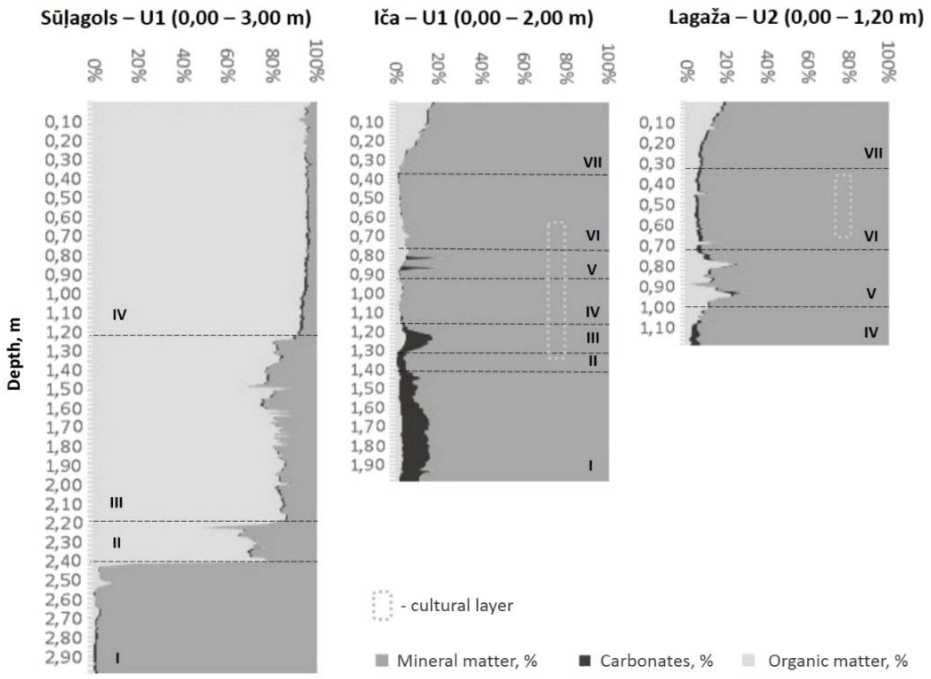


Figure 2. **Loss on ignition results for Sūļagols – U1, Iča – U1 and Lagaža –U2 cores** (authors' figure)

Based on the results of identified pollen percentages in the sediments and the distribution of the species in diagrams, in the Iča - U1 borehole there were four separated pollen zones (Figure 3), while three pollen zones in Lagaža - U2 borehole. Separated zones characterize the composition of palaeo-vegetation and sediment accumulation condition changes around nearby Lake Lubāns and also in the surrounding area. A Lithology description was attached to both analysed borehole sediments. Iča – U1 borehole is represented by silty clay, carbonatic silt, carbonatic sand with charcoal, fine sand and fine sand with plant remains while the Lagaža – U2 borehole is represented by carbonatic silt, fine sand, peaty silt and clayey silt. Results of analysis show what kinds of trees, shrubs, ruderals, cultivated plants and different herb species dominated in the settlement area and it also represents vegetation for Lake Lubāns northern part.

Pollen analysis for the Iča and Lagaža settlement site areas show that the most common growing tree species were birch *Betula*, pine *Pinus*, spruce *Picea* and alder *Alnus*. Grasses *Poaceae,* nettle *Urtica*, sorrel *Rumex* and goosefoot *Chenopodiaceae* covered wide open areas around the besides lake shore while forest groundcover was dominated by mosses *Bryales*, horsetails *Equisetum* and ferns *Polypodiaceae*. The ancient Lake Lubāns coastal area was covered by cattail *Typhaceae,* water lilies *Nymphaceae* and pondweed *Potamogetonaceae*. In both settlement areas water caltrop *Trapa natans* was found indicating that Stone-Age people used it as food.

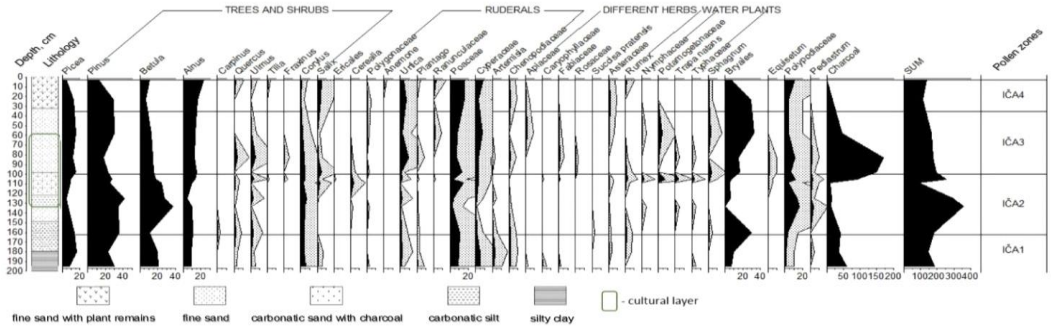


Figure 3. **Pollen results for Iča – U1 core sediments** (authors' figure)

Based on macroscopic remain analysis results the Iča – U1 borehole was divided into five macroscopic zones (MA zones) but Lagaža – U1 was divided into three zones (Figure 4). Results for the Iča – U1 borehole show that the carbonatic interval contains high muskgrass *Chara* concentration. The presence of this species in the lakes indicates clean water with a healthy ecosystem. The muskgrass served as a fish habitat, as they were caught by people who lived in the settlements. The results for the Lagaža – U1 borehole show that the cultural layer interval contains a big concentrations of fish bones together with charcoal and magmatic hearth stones. Also water caltrop *Trapa natans* was found in these sediments indicating what Stone-Age people used for edibles. These evidences prove that during the cultural layer sedimentation processes people used to live nearby the Lake Lubāns shore line.

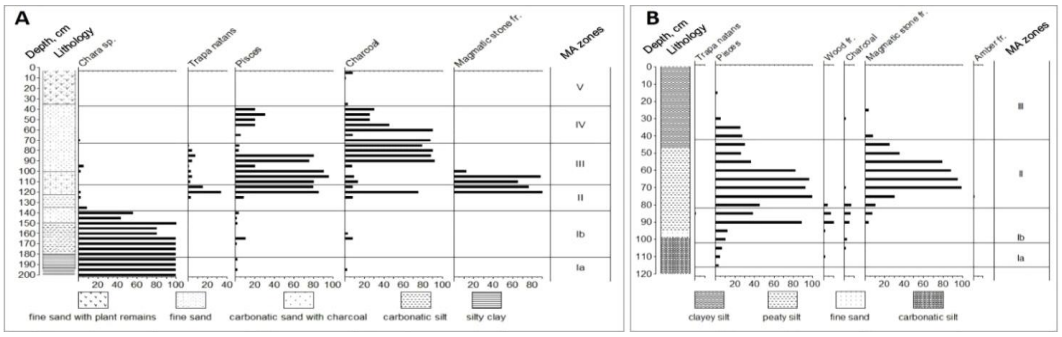


Figure 4. **Macroscopic remains associated with Lake Lubāns Stone-Age inhabitation.** A - Iča – U1 core; B - Lagaža – U2 core (authors' figure)

During field work at the Iča settlement site many macroscopic remains such as ceramic fragments, magmatic hearth stones, animal bone fragments and teeth were found in the pit wall (Figure 5).

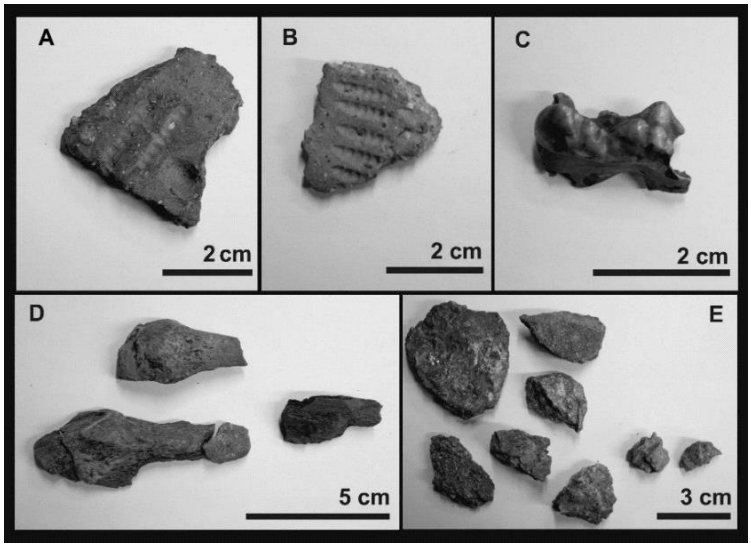


Figure 5. **Archaeological findings from the pit wall at Iča settlement area.**
A, B - ceramic fragments associated with comb ware culture; C - predatory animal tooth; D - animal bone fragments; E - magmatic hearth stones (authors' figure)

These research findings undoubtedly prove the presence of Stone-Age people and their living conditions. The biggest and most important macro remains were documented and well described. Most bone fragments were too small to define its kind and genus. But it was possible to get the idea about what kind of animals people used to hunt and eat during that time, such as sheep, pigs and roes. During the 20$^{th}$ and early 21$^{st}$ century a lot of archaeological excavations were undertaken in the Lubāns Plain. Research data also helps to learn more about palaeogeographic conditions in the area of the ancient Lake Lubāns and about Stone-Age living conditions and occupations.

## Conclusion

- Research concludes that among the most essential reasons why Stone-Age people changed the locations of their settlements were in consideration of water level fluctuations, lake shore overgrowth and paludification.

- During field work at the Iča and Lagaža settlement sites, among the obtained borehole sediment monoliths and collected pit wall sediment samples there was found to be a surprisingly large amount of evidence of Stone-Age habitats.
- The results of loss on ignition analysis revealed that in all prospected sections the amount of organic matter increases in the upper layer was related to coastal overgrowing intensification processes in the vicinity of Lake Lubāns.
- The highest values of mineral substances in sediment compositions were found in the lower layers of sections, which have accumulated under water conditions.
- The largest amount of carbonates in sediments is in the lower part of sections below the cultural layer, which shows that sediments before the creation of the settlements, including carbonates, have accumulated in the aquatic environment. The largest amount of carbonates was found in the core sediment samples of the Iča settlement, which is located closer to the lake than Lagaža.
- During the time of Stone-Age settlements, which occurred in the Neolithic Age and also durng the early Bronze Age, sediment accumulation took place in dryland conditions.
- According to analysed loss on ignition results and pollen diagrams the cultural layer sediments from the Iča and Lagaža settlement sites accumulated in the Holocene Climatic Optimum and Late Holocene.
- Research undertaken at the Sūļagols settlement site provides a lot of information about sediment accumulation processes, such as overgrowing and paludification. The composition of these sediments is thought to have been influenced by the rivers Suļka and Malmuta.
- Results of loss on ignition and macroscopic remain analysis reflect changes in sediment accumulation conditions that are closely related to changes in palaeoclimate.

**Kopsavilkums**

Pētījuma mēķis ir noskaidrot paleoģeogrāfisko apstākļu pārmaiņas Lubāna ezera ģeoloģiskās attīstības laikā. Pētījumā iegūtās liecības pierāda, ka viens no galvenajiem faktoriem, kas ietekmēja nogulumu uzkrāšanās apstākļus, bija paleoklimata pārmaiņas. Lai noskaidrotu Lubāna ezera un tā apkārtnes veidošanās apstākļus, ezerā mītošo dzīvnieku un augu sugas, kā arī vides apstākļus, kādi ir bijuši akmens laikmetā, šeit pētījumus ir veikuši ģeologi, ģeomorfologi, hidrologi, arheologi un biologi. Arheoloģiskajos izrakumos iegūts bagātīgs materiāls, kas sniedz liecības par akmens laikmeta iedzīvotāju sadzīvi un nodarbošanos. Ir pierādījumi par cilvēku nodarbošanos ar zvejniecību, medniecību un vēlāk arī lopkopību un zemkopību. Taču vēl nav pietiekami daudz informācijas par ģeoloģiskajiem procesiem un to, kā klimata pārmaiņu ietekmē mainījušies dabas apstākļi. Šāda veida pētījumi ir ļoti būtiski, lai, izzinot pagātni, varētu izprast mūsdienu situāciju.

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# CHANGES OF PEAT PROPERTIES IN DIFFERENTLY AFFECTED PARTS OF THE LAUGA BOG

# Kūdras īpašību pārmaiņas dažādi ietekmētās Laugas purva daļās

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**Abstract.** At the present time much attention on the identification and investigation of degraded peatland areas is mainly being undertaken by studies on growing bog plant species, vegetation cover continuity and character. However, it is also understood that to choose the most effective re-cultivation method it is necessary to know the properties of the remaining peat layers and local hydrological conditions. The aim of this study was to discover the characteristics of peat properties and their changes in three differently affected areas of the Lauga Bog. Field work included geological coring and the collecting of deposit samples for further laboratory analysis including loss on ignition (LOI) analysis, determination of the peat density, pH and magnetic susceptibility measurements. The obtained results reveal that peat properties in the Lauga Bog vary in differently affected areas. In the affected areas (Lauga-1 and Lauga-3) the top layer of the peat section has a higher natural density and larger proportion of mineral matter. Whereas a natural bog section is characterised by peat with lower natural density, a higher percentage of organic matter and lower pH is typical for raised bogs.

**Keywords**: *natural density, LOI analysis, pH, drainage*

## Introduction

At the beginning of the 21st century special attention was paid to the identification and exploration of affected or degraded peatland areas with cut-over and/or abandoned peat fields. At present, the degree of degradation of the peatlands is mainly assessed by the presence of the moisture-loving bog plant species and the character of vegetation cover. However, it has been found that in choosing the most appropriate re-cultivation method it is necessary to know the properties of the remaining peat layers and other characteristics of the areas for re-cultivation. It is considered that impact on the peatland area also affects the properties of the peat, especially after peat extraction. During the preparation of peatland for peat extraction, the hydrological regime of the field for peat extraction is altered due to drainage and removed vegetation. These measures promote peat compaction and increase of natural density, which also causes an increase in the mineral matter part in peat composition, especially near ditches (Aleksans 2015; Kalniņa et al. 2017).

Peat formation and accumulation in the bogs is mainly influenced by factors such as volume of precipitation, temperature, available oxygen required for aerobic processes, micro-organism colonies, chemical composition of decaying material, composition of peat-forming plants and other properties (Nomals 1930). In the process of peat accumulation, the peat forming plants not only decay and accumulate, but also undergo physical and chemical transformations (Silamiķele 2010). The main characteristics of peat are characterized by a number of indicators, such as degree of decomposition, botanical composition, ash content, moisture, as well as natural density, content and amount of organic matter, minerals and carbonates, pH, conductivity, magnetic sensitivity, etc.

It is considered that re-naturalization of the cut-over peat fields as restoration of the bog vegetation is not always useful. Other scenarios of re-cultivation, such as the planting of berries, forests, sphagnum mosses or other paludicultures, are also considered for rational use and management of these extracted peat fields depending on site conditions and economical aspects. For the realisation of re-cultivation measures, it is important to understand the parameters of the peat properties, the thickness of the remaining peat layers and the character of the hydrological regime. For the best way to assess the changes in the peat properties, research should be undertaken in several differently affected areas, as data comparison and analysis is required.

This study was based on the Lauga Bog investigations, which in the short term was located at differently affected areas. The Lauga Bog as a research location was chosen as it is one of the LIFE REstore project pilot areas, which aim to restore the hydrological regime, and to provide a sustainable and responsible management for the re-use of degraded peatlands in Latvia. Detailed multi-disciplinary studies of three peat sections nearby in the same peatland area have been carried out for the first time, which justifies the novelty of this study and also determines the need for investigation

with an aim to obtain detailed results so as to better understand the charater of peat properties during their formation and the effects of drainage (Dreimanis et al. 2017).

The Lauga Bog is located on the border between the Piejūra Lowland and the Idumea Highlands, in the southern part of the Metsepole Plain, west from the River Pēterupe (Figure 1). Lauga Bog is a raised type bog or moss bog, which is one of the largest peatlands in the VidusLatvia ((Middle Latvia) Lowland. The Lauga Bog has, as for raised bogs, characteristic vegetation, micro-relief and bog pools including Lake Višieris and Lake Lode (Zelčs 1994; Markots et al. 1989; Markots et al. 1993).

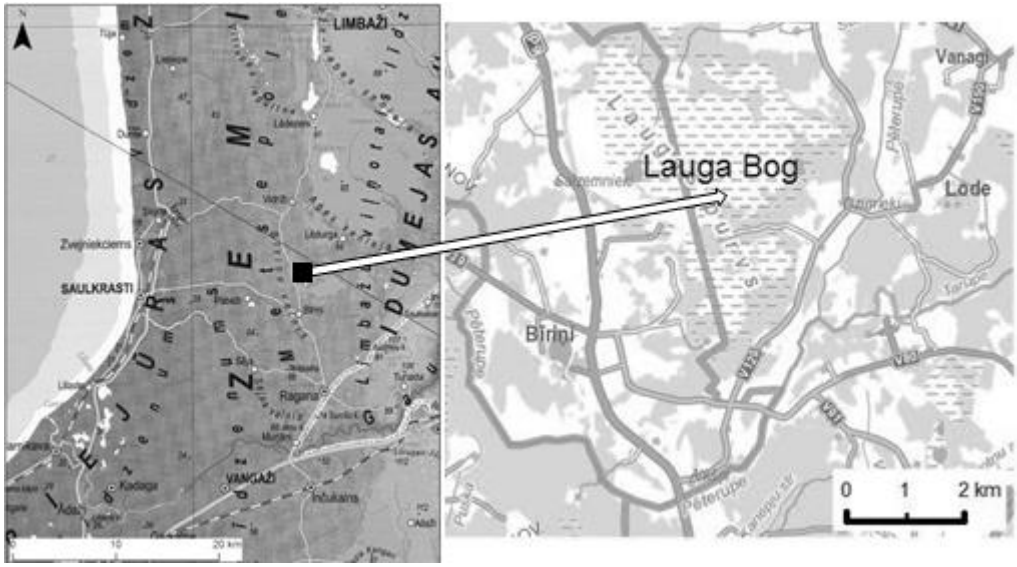


Figure 1. **Location of the Lauga Bog** (authors' figure using ORTOFOTO 5)

The aim of this study is to find out more about the changes of peat properties from peat sections in three differently affected Lauga Bog areas.

**Data and Methods**

*Field work.* The aim of the field work was to survey the affected and natural areas of Lauga Bog, to choose the most suitable places for study, to carry out geological coring, and to take samples with a camera-type soft sediment corer with a 1.0 m long camera. The obtained sediment monoliths were then evaluated and documented, assessed for sample colour and structure, and the characterstics noted for the boundaries between different peat types and the degree of peat decomposition according to the L. von Post scale. Taking into account that peat oxidises quickly and changes colour, it was especially important to describe monoliths and to take photos. Afterwards the monoliths were then wrapped in a film to avoid drying and prepared for transportation (Dreimanis et al. 2017).

The study was carried out in the western part of the Lauga Bog, where three different affected areas of the bog are located close to each other (Figure 2). Core Lauga-1 was undertaken in an area where the vegetation cover was removed, and a drainage system with ditches had been installed. Core Lauga-2 was established in a natural raised bog area at the foot of the bog dome, but core Lauga-3 was prepared in

an area partially affected by the contour ditch, where vegetation had not been removed, but the contour ditch is at about a 5 m distance. The Lauga Bog area was chosen for research because it is located close to each of the other different peatland areas. There is an untouched raised bog area, a peat field ready for peat extraction, and a peatland area with vegetation, but which is close to the main ditch.

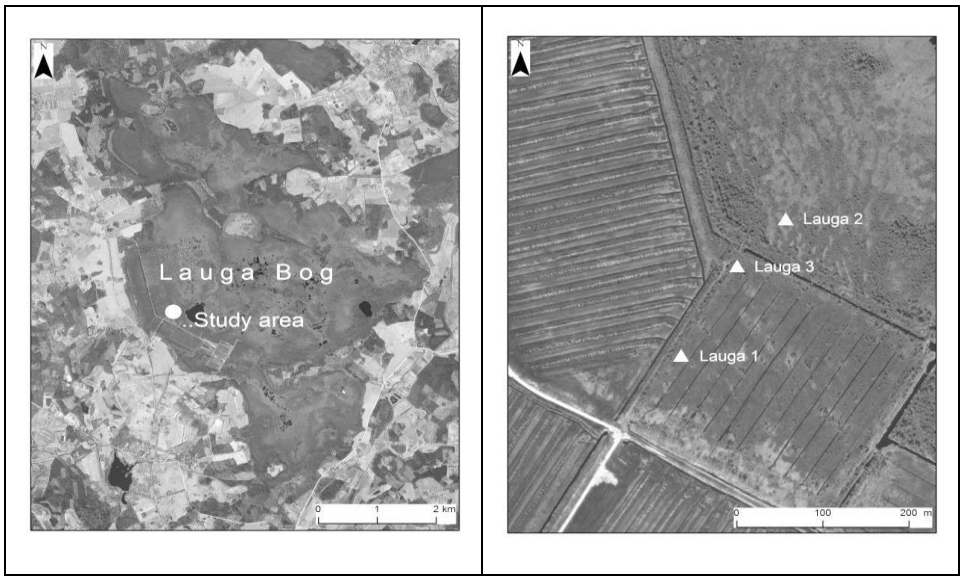


Figure 2. **The Lauga bog area and location of coring sites Lauga-1, Lauga-2 and Lauga-3 layout in differently affected and used areas** (authors' figure using ORTOFOTO 5)

*Laboratory works and sample processing.* In this study the peat deposits from the borehole Lauga-2 were analyzed in detail, as well as the upper layer of the peat section in the depth interval of 0.0-2.0 m from the boreholes: Lauga-1 and Lauga-3. The following peat research methods were used: natural density determination, loss on ignition (LOI), pH determination, magnetic sensitivity detection. In general, 2168 samples were used to characterise the peat deposits using these peat research methods (Dreimanis et al. 2017).

## Results

*Field work results.* During the field work, peat monoliths were obtained (Figure 3). In the core Lauga-1: 4.7 m is peat, 1.3 m – clayey blue-algae sapropel with silt admixture, depth of borehole – 6.0 m. In the core Lauga-2: 6.9 m is peat, 0.1 m – clayey blue-algae sapropel with silt admixture, depth of borehole – 7.0 m. In the core Lauga-3: 6.7 m is peat, 0.3 m – clayey blue-algae sapropel with silt admixture, depth of borehole – 7.0 m (Dreimanis et al. 2017).

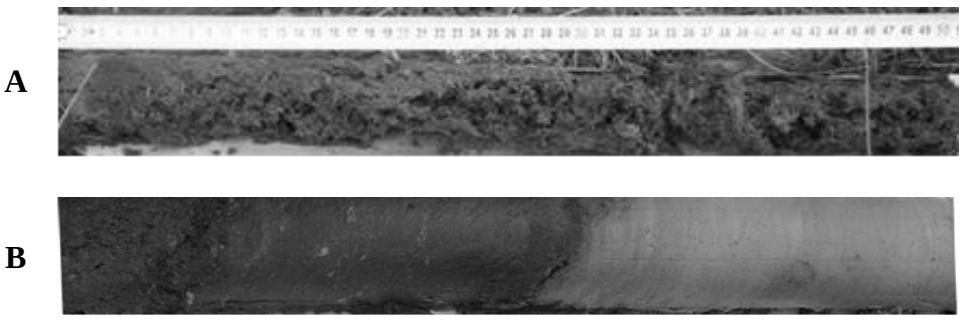

Figure 3. **Different deposit types in the Lauga-2 section:** A – low decomposed raised bog type *Sphagnum* peat; B – well decomposed fen type sedge peat in the left part and right part clayey blue-algae sapropel with silt admixture (authors' figure)

*Results of laboratory analysis.* The natural density analysis of deposits taken from the core of Lauga-1 and Lauga-3 from the affected part of the peatland have the highest values of natural density (Figure 4), which reveals the influence of drainage on the peat. It is particularly noticeable in the upper interval (0.00-0.15 m) of the Lauga-3 peat section (Figure 4). The Bog hydrological regime became one of change due to the installing of drainage ditches. This promotes peat drying out and compacting, which affects permanent changes of peat properties, especially with regard to peat natural density (Romanov 1968).

The results of the loss on ignition analysis show that there are small changes in the deposit composition in the largest part of the studied sections. Significant changes started just at the bottom of section, at the depth level where the peat deposit has sapropel admixture and has thus been gradually changed by blue-algae sapropel. In the borehole Lauga-2 (Figure 5) at the depth interval of 0.0-6.15 m, no significant changes were observed in the content of organic matter, mineral matter and/or carbonates. But in the section bottom, at the depth interval 6.15-7.00 m, the amount of organic matter was sharply decreasing and the mineral matter increased significantly. At the lowest depth interval 6.8-7.0 m an increase was observed in the amount of mineral matter due to silt admixture from the bog depression mineral surface.

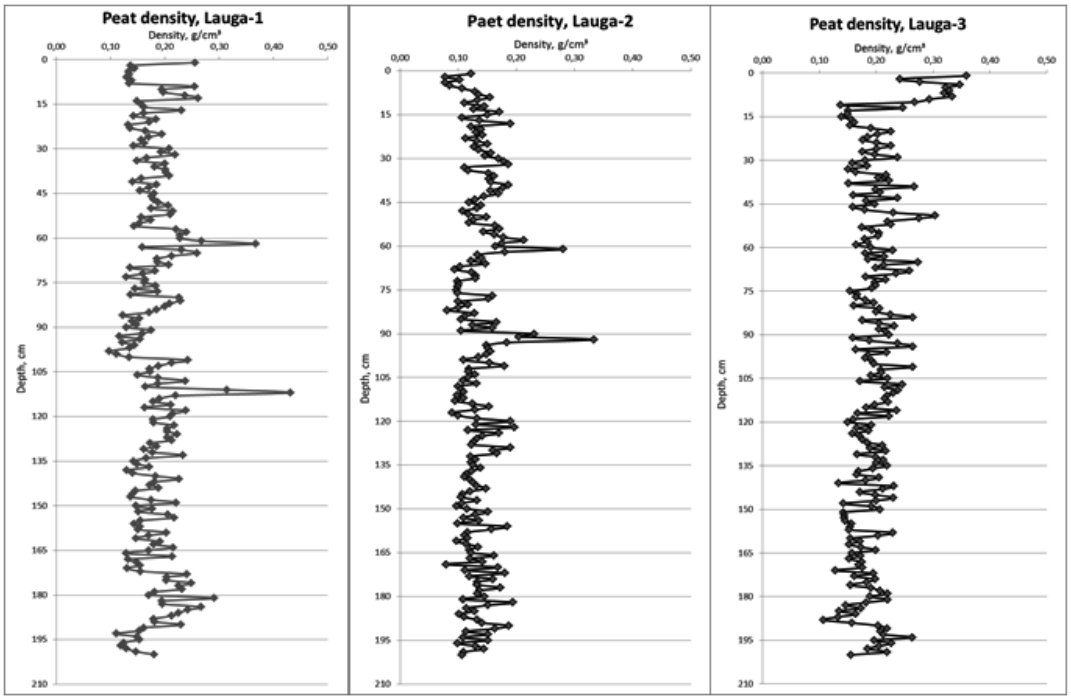


Figure 4. **Diagram showing changes in natural peat density in cores Lauga-1, Lauga-2 and Lauga-3** (authors' figure)

Such deposit composition reveals the accumulation of sapropel under the peat and indicates that the Lauga Bog had been formed due to an overgrowing of the shallow water basin. Small changes in the proportions of organic matter and mineral matter were detected in the section Lauga-2 at the depth interval 0.0-6.2 m and represented by low and medium decomposed raised bog peat. Therefore, results prove that the formation of peat layers took place under stable conditions. Research results do not show significant changes either in deposit composition or peat botanical composition (Dreimanis et al. 2017). However, some sharp and short changes were noticed in the sections Lauga-1 and Lauga-3 from affected areas, which allows us to consider, that it is a drainage influence. Carbonates are very small and their changes are negligible.

Analysis of the pH in the studied peat sections revealed changes from 3 to 4.7. The greatest impact of groundwater flows is observed in the borehole Lauga-1 (Figure 6), which is indicated by pH = 4.7. The pH of other boreholes is mainly influenced by precipitation waters, as evidenced by the acid environment (pH <4), especially for the natural bog Lauga-2 section. However, there also we find pH values increase in the upper part of the section in comparison with lower, where pH= 3. This might possibly be explained by changes in water level caused by human activities in Lake Višieris located nearby. As it is understood, the inflow of water into the bogs partly explains the pH level of the peat. Oligotrophic or raised type bogs that plants feed from precipitation waters, have low pH values, typically <4 (Laine and Vasander 1996; Charman 2002). So, any change in pH can be associated with anthropogenic affects, even if it is a natural bog, as in this case ... the natural part of the Lauga Bog.

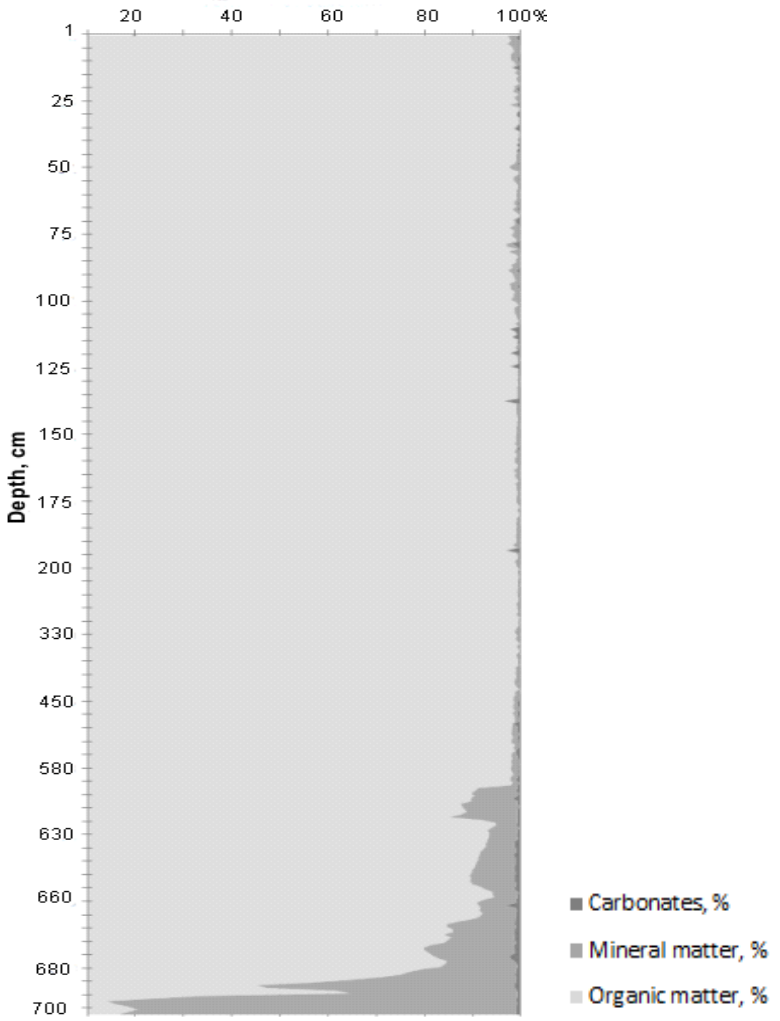


Figure 5. **Diagram of Loss on ignition analysis data for deposits in section Lauga-2** (authors' figure)

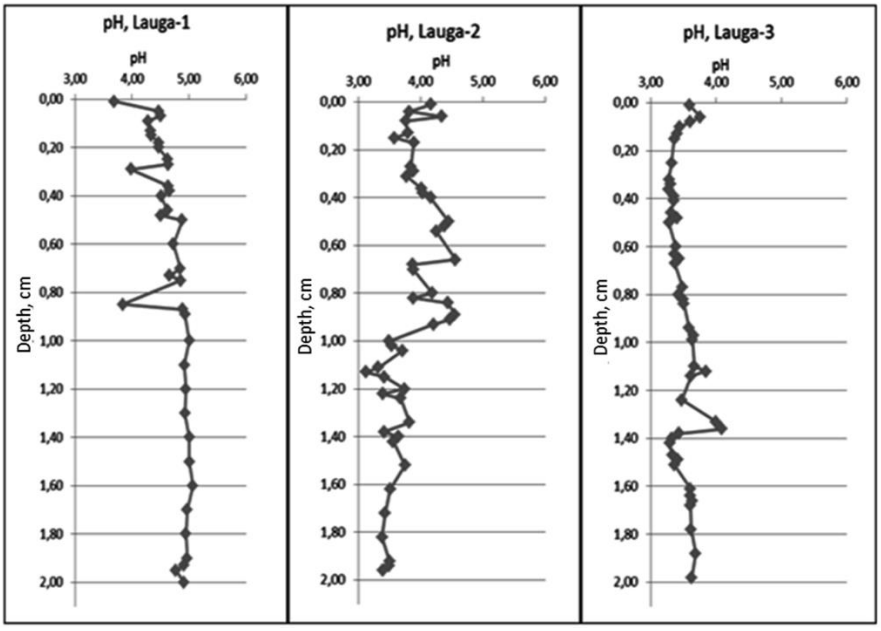


Figure 6. **Diagram of pH results of peat in cores Lauga-1, Lauga-2 and Lauga-3** (authors' figure)

Negative values for low and high frequency magnetic susceptibility of all boreholes, mean values and their minimum differences indicate that no magnetically susceptible minerals have been detected in the boreholes (Dreimanis et al. 2017).

## Conclusion

The upper peat layer in the affected part of the bog (Lauga-1, Lauga-3) became compacted due to drainage and natural density of peat increase and it is higher than in the natural part of the Lauga Bog (core Lauga-2).

In the affected part of the bog, the core Lauga-1 has two intervals with a rapid decrease in the amount of organic matter, while the section of the natural part (core Lauga-2) has no significant changes in the peat composition which indicates deposit formation under stable conditions.

More pronounced pH changes occur in the natural part of the bog, where pH values are low in the lower part but tend to increase upwards from the depth interval, probably also caused by anthropogenic impact. The highest pH values were detected in the borehole Lauga-1.

In various affected parts of the bog in the range of 0.0-2.0 m, there are negative magnetic susceptibility values indicating that there are no magnetically susceptible minerals in the peat.

Changes of properties in peat sections from degraded areas are different and reveal anthropogenic influence.

**Kopsavilkums**

Pētījuma mērķis ir noskaidrot, raksturot un salīdzināt kūdras nogulumu īpašības un to pārmaiņas trīs urbumos, kas atrodas dažādi ietekmētās Laugas purva daļās. Lai noskaidrotu kūdras īpašības un to pārmaiņas, tika veikti lauka pētījumi, tajā skaitā ģeoloģiskā urbšana un nogulumu paraugu iegūšana, lai veiktu analīzes laboratorijā. Šīs analīzes ietvēra kūdras blīvuma noteikšanu, karsēšanas zudumu analīzi, pH, magnētiskā jutīguma analīzi. Iegūtie rezultāti liecina, ka kūdras īpašības Laugas purva dažādi ietekmētajās teritorijās ir atšķirīgas. Purva ietekmētajās daļās augšējā kūdras slānī ir raksturīgs lielāks kūdras dabīgais blīvums un minerālvielu daudzums. Savukārt purva neskartajā daļā ir lielāks organisko vielu daudzums, mazāks dabiskais blīvums, kā arī zemāks pH.

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# HUMIC SUBSTANCES AND THE POTENTIAL OF THEIR USE IN AGRICULTURE

## Humusvielas un to izmantošanas iespējas lauksaimniecībā

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**Abstract.** Most important properties of the major soil and peat organic component – humic substances - have been compared, depending on their origin, including the isolation, basic properties, and recent concepts about the structure of humic substances. The influence of humic substances on plant growth has been re-assessed in light of the growing use of humic products in agriculture, and the most prospective areas for humus application have been evaluated. The properties of humic substances possibly influencing their impact on plant growth and, in general, their role in the environment have been analysed. Peat humic substances have substantial potential for use in agriculture.
**Keywords***: natural organic matter; agriculture; biological activity*

### Introduction

Humic substances (HS) are the main component of soil and peat organic matter (SOM), comprising up to 60 - 70% of content, but at the same time humic substances can be considered as one of the key elements in the bio-geo-chemical turnover of carbon, possibly being the most abundant of naturally occurring organic macro-molecules on Earth ($2 – 3 \times 10^{10}$ t) (Jones and Bryan 1998). As far as HS are able to interact with inorganic and organic substances, they act as carriers for the many influencing fluxes of elements in the environment. They also play an important role in the formation of fossil fuels and mineral deposits (MacCarthy 2001).

Humic substances are a general category of naturally occurring, biogenic, heterogeneous organic substances that can generally be characterized as being yellow to black in colour, of high molecular weight, and refractory (Aiken et al. 1985).

They consist of several groups of substances that, depending on their solubility, can be grouped as: humin which is the fraction of humic substances that is not soluble

in water at any pH; humic acid (HA) which is the fraction of humic substances that is not soluble in water under acidic conditions (<pH 2), but becomes soluble at greater pH; and fulvic acid (FA) which is the fraction of humic substances that is soluble under all pH conditions (Aiken et al. 1985).

Humic substances have many functions in the environment (Figure 1) (Orlov et al. 2002). In soils they participate in the formation of soil structure, thermal regime, but interacting with dissolved substances they influence the accumulation and release processes of nutrients and trace elements. Humic substances considerably influence soil biota and especially microbial activity.

The interaction of humic substances with organic substances can change their properties and fate in the environment. The most important observed impacts are:

1. increased apparent solubility of non-ionic hydrophobic substances;
2. reduced solubility of ionic organic substances;
3. reduced volatility of organic substances;
4. modified chemical reactivity of organic substances in the environment;
5. changes in the rate of organic bio-accumulation in the environment;
6. increased association of organic substances with sedimentary phases and particulate matter (Kļaviņš 1998).

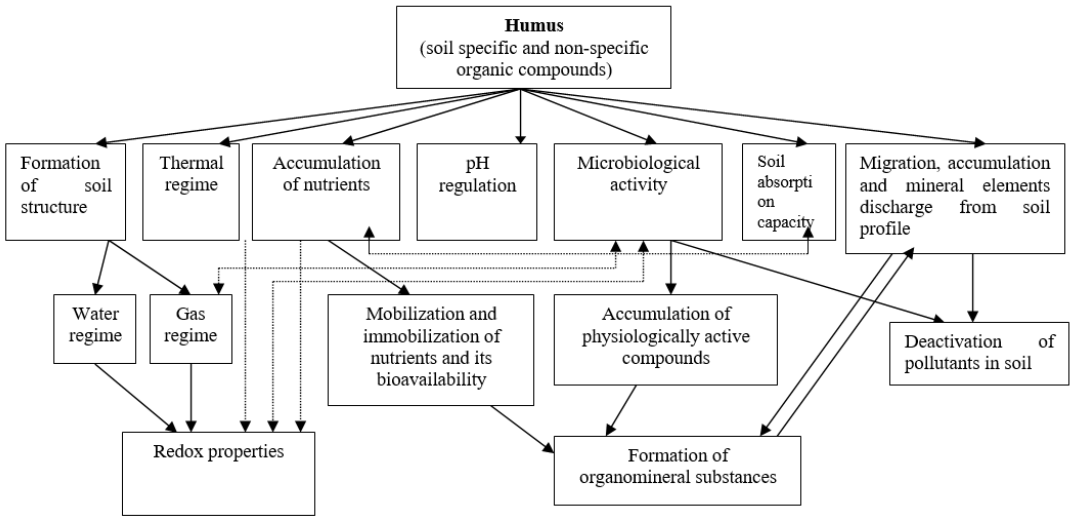


Figure 1. **Roles of humic substances in environment** (authors' figure using Orlov et al. 2002)

In general terms, humic substances may be considered as a matrix onto which environmental processes are imprinted, but, on the other hand, they can be considered as a reactive ingredient, actively participating in reactions and processes going on in the soil and aquatic environment. In so far as the major reservoir of humic substances are soils, they are an important factor in various areas of agriculture, such as soil chemistry, fertility, plant physiology and others. At the same time, humic substances can be considered as an important resource, as far as they may be extracted in industrial amounts from sources (soil, peat, coal and others) in which they are

abundant and consecutively applied to achieve or increase their positive impacts. The various roles of humic substances in soil environments, and their possible use in agriculture has been examined in recent reviews (Nardi et al. 2002), but the area of their use is steadily growing and thus systematization of available knowledge can be important to develop the most rational ways of application and development of new roles.

Therefore, this paper aims to re-assess the areas of use of humic substances in agriculture, analysing the latest knowledge about the structure of humic substances, their functions in environmental processes, including their physiological effects, the character of interaction between humic substances and soil ingredients, nutrients, trace elements and other biologically active substances of importance for agricultural applications. This knowledge can be important considering recently developed technologies for humus extraction, many new applications of humic substances and the growing market of industrially produced humic substances.

**Isolation and basic properties of humic substances**

Humic substances are generally extracted from soil and peat by treating with alkaline solutions (Stevenson 1994) while humic and fulvic acids are solubilised, but the residue contains the humin. After the acidification of the alkaline extract by addition of a strong acid, humic acid precipitates the remaining organic material in the solution and is referred to as the fulvic acid (Stevenson 1994). Further purification is often needed to clean up the HA and to separate the FA from other materials in the fulvic acid fraction, as well as to reduce the ash contents of the humic and fulvic extracts, and to fully convert the acid salts to their hydrogen forms. Evidently quite a lot of chemical degradation occurs during the extraction of HS. Thus, base-extracted HS is generally a combination of native and altered materials. The extracted HS are frequently dried by conventional evaporation or by lyophilization. Many other extraction procedures and variations have been used, some involving various organic solvents such as dimethylsulfoxide, dimethylformamide, and formic acid (Hayes and Clapp 2001). It is not surprising that materials extracted from soils or sediments according to procedures based on the above definitions actually consist of mixtures, and their properties depend on the specific conditions of extraction. Nevertheless, there is a remarkable uniformity in the average properties of all HA, FA, and humins (Schnitzer and Khan 1972). The elemental contents of HA, FA from very different sources are remarkably consistent (Kļaviņš 1998). Humic acids have been reported to have an average MW varying from about 800 Da for aquatic materials to greater than $1\times10^6$ Da for soil - and peat derived materials (Kļaviņš 1998). Humic substances have an abundance of oxygen-containing functional groups (carboxyl-, phenolic-, alcoholic-) which dominate their chemical properties. Humic substances occur in close association with other organic and inorganic materials in soil and sediments. Aquatic HS also occur in association with non-humic materials and may exist in colloidal or larger aggregate forms.

**Interaction between humic substances, nutrients and trace elements**

The influence of soil humus on plant growth is much regulated through ion uptake, and these influences have been studied by Vaughan and Malcom (1985), Chen and Aviad (1990), Varanini and Pinton (2001). The effects of HS on ion uptake are more or less selective and variable in respect to their concentration and to the pH of the medium (Clapp etal. 1998). HS may stimulate $NO_3^-$, $SO_4^{-2}$ and $K^+$ uptake by barley and oat seedlings (Maggioni et al. 1987). The most significant stimulatory effect has been found considering $NO_3^-$ uptake in oat roots.

The complexation of metals by humic substances is of particular interest because this complexation alters the toxicity and bio-availability of metal ions. The complexation of metals ions much reduce their toxicity in comparison with the free, hydrated metal ions (Florence and Batley 1980), however, substantial differences exist between different metal ions and the modification of metal ion toxicity depends also on properties of humic matter (Winner 1984). The interaction of humic substances with metals is important in plant nutrition and availability of metal ions as well as nutrients to plants in soils is a function of the speciation of the metals in the soil solutions surrounding the plant roots (Jarvis 1981). Considering the much differing toxicity and biological availability of different speciation forms it is thus important to consider not so much the total amount of metals, but rather their extractable forms (Alvarez et al. 2002). Humic substances exist both in the bound and in the dissolved phase. In the solid phase humic substances are present as coatings on mineral grains and possibly, in some instances, as separate particles. The most common type of interaction of metal ions with humic substances is ion exchange, in which protons on carboxylic acid groups are replaced by metal ions.

Most of the studies on the interaction of humic substances with anions have been concerned with the interactions of phosphorus species with humic substances as far as phosphorus is an essential plant nutrient. In the pH range of most natural waters and soils the predominant orthophosphate species in solution is $H_2PO_4^-$. Orthophosphate reacts with Fe(III) and dissolved humic substances to form high molecular weight complexes (Francko 1986). At the present time, mechanisms of phosphorus cycling in the environment have not yet been clearly elucidated; however, it is apparent that Fe(III)-humic substances-orthophosphate complexes are an important part of this cycling.

**Interaction between humic substances and organic molecules of importance for agricultural plants**

Organic compounds interact with humic substances in a number of different ways. Non-ionic organic compounds partition into insoluble humic substances in soils, whereas soluble humic substances solubilize non-ionic organics (Wershaw et al. 1969; Chiou et al. 1983). Ionic organic compounds can undergo ionic exchange reactions and charge-transfer complexation. In addition, some evidence exists for oxidative coupling reactions between xenobiotic organic compounds and humic substances. The

absorbtion of non-ionic organic compounds by wet soils involves partitioning of the organic compounds between the soil-water phase and the soil-organic phase. An analogous process to partitioning into an insoluble organic phase is the solubilization of hydrophobic organic compounds by dissolved humic substances. It has been found that humic acid enhances the solubility of DDT, but also of other hydrophobic pesticides in water (Misra et al. 1996). This increase in solubility is apparently brought about by the partitioning of the DDT molecules in the hydrophobic interiors of humic acid micelles. In a number of studies a variety of other hydrophobic organic compounds have been included as well as other humic substances, and a generally similar solubilization behaviour has been found (Misra et al. 1996; Shaw et al. 2000; Loffredo et al. 1999).

A number of different types of ionic interactions have been reported between humic substances and organic compounds. In the simplest case, the organic compound exists in solution as cations that can be bound by carboxylate groups of humic substances. Amino acids and triazine herbicides would bind to humic substances by this mechanism at low pH values where the nitrogen containing groups would be protonated, but hydrogen bonding can also take place between humic substances and basic herbicides such as substituted urea herbicides (Kam and Gregory 2001). The groups most likely to enter into hydrogen-bonding interactions would be hydroxyl and carboxylic acid groups on the surfaces of the humic substance membrane-like aggregates (Kļaviņš 1998).

**Impact of humic substances on metabolic processes in plants**

The suggestion that HS can have a direct effect on plant metabolism, considers that these substances are taken up into plant tissues (Vaughan and Malcom 1985). As far as they have a poly-anionic (acid) nature, HS could simply act as surface-active molecules (Nardi et al. 1991). By decreasing the pH at the surface of the plasma membranes of root cells, HS may counteract the alkalinization which occurs when $NO_3^-$ is used as an N source (Raven and Smith 1976).

The plasma membranes of plant cells possess several redox activities that can be related to both plant nutrition and cell wall formation and lignification. In this context, it has been shown that, in oat roots, HS inhibited NADH oxidation in either the presence or absence of an artificial electron acceptor (ferricyanide) (Pinton et al. 1995).

There are many reports showing that HS, extracted from a wide range of soils, were able to enhance respiration of higher plants (Vaughan and Malcom 1985), with the effects of FA more pronounced than that of HA. These results have been interpreted in varying ways. At first, humic substances can act as substrates or respiratory chain catalysts, but they can also stimulate the peroxidase (Muscolo et al. 1993). A second aspect that has been examined concerns photosynthesis. Even in this case, our information is fragmentary and not very recent. Although indirect, the most prominent effect of HS application to growing plants was an increase of chlorophyll

content which, in turn, could affect photosynthesis (Sladky 1959). However, the increase of chlorophyll alone did not necessarily result in higher yields. HS, applied to the growth solution, stimulated enzyme activities related to the photosynthetic sulphate reduction pathway. This positive effect of HS has also been observed on the main photosynthetic metabolism in maize leaves, where a decrease in starch content was accompanied by an increase of soluble sugars (Merlo et al. 1991). This change appeared to be mediated by variations of the activity of the main enzymes involved in carbohydrate metabolism.

**Applications of humic substances in agriculture**

Composts originating from animal manures, sewage sludge or paper-mill sludge have been shown to contain large amounts of humic substances (Garcia et al. 1995; Maggioni et al. 1987; Valdrighi et al. 1996). Studies of the positive effects of these humic substances on plant growth, when full requirements for mineral nutrition have been met, have resulted in consistently positive effects on growth independent of nutrition (Chen and Aviad 1990). For instance, in controlled experiments, humic substances increased dry matter yields of corn and oat seedlings; numbers and lengths of tobacco roots (Mylonas and Mccants 1980); dry weights of shoots, roots, and nodules of soybean, peanut, and clover plants (Tan and Tantiwiramanond 1983); vegetative growth of chicory plants (Valdrighi et al. 1996); and induced shoot and root formation in tropical crops grown in tissue culture (Goenadi and Sudharama 1995). The typical growth response curves that have been reported to result from treating plants with humic substances show progressively increased growth with increasing concentrations of humic substances, but there is usually a decrease in growth at higher concentrations of the humic materials (Chen and Aviad 1990). Hypotheses accounting for this stimulatory effect of humic substances at low concentrations are numerous, the most convincing of which suggests a "direct" action on the plants, which is hormonal in nature, together with an "indirect" action on the metabolism of soil micro-organisms, the dynamics of uptake of soil nutrients, and soil physical conditions (Casenave de Sanfilippo et al. 1990; Chen and Aviad 1990; Muscolo et al. 1993, 1996, 1999). Other mechanisms which have been suggested to account for promotion of plant growth by humic substances include: enhanced uptake of metallic ions and increases in cell permeability (Chen and Aviad 1990).

During the last decade, the biological activities of humic substances, particularly those derived from earthworm faeces, have begun to be investigated. Dell'Agno1a and Nardi (1987) reported hormone-like or plant-growth regulator effects, of depolycondensed humic fractions obtained from the faeces of the earthworms *Apporectodea rosea* (Eisen) and *Apporectodea caliginosa* (Sav), on plants. Nardi et al. (1988) reported that humic materials produced in the faeces of *A. rosea* and *A. caliginosa* exhibited auxin-, gibberellin-, and cytokinin-like activities. Treating carrot cells with humic substances obtained from the faeces of the earthworm *A. rosea*

increased their growth and induced morphological changes similar to those produced by auxins (Muscolo et al. 1999).

In a recent study (Atiyeh et al. 2002) some effects of humic acids, formed during the breakdown of organic wastes by earthworms (vermicomposting), on plant growth were evaluated. The incorporation of vermicompost derived humic acids, into either type of soilless plant growth media, increased the growth of tomato and cucumber plants significantly, in terms of plant heights, leaf areas, shoot and root dry weights. Plant growth increased with growing concentrations of humic acids incorporated into the medium up to a certain proportion, but this differed according to the plant species, the source of the vermicompost, and the nature of the container medium. Plant growth tended to be increased by treatments of the plants with 50-500 mg/kg humic acids, but often decreased significantly when the concentrations of humic acids derived in the container medium exceeded 500 – 1000 mg/kg. These growth responses were most probably due to the hormone-like activity of humic acids from the vermicomposts or could have been due to plant growth hormones adsorbed onto the humates.

**Conclusions**

In contrast to the highly specialized and individualized roles of molecules in biological processes, the functions of HS in the environment do not necessitate the participation of specific molecules. The functions of HS in the soil environment (such as pH-buffering, binding of clay particles, serving as a reservoir for various micro-nutrient metal ions, sequestration and transport of metal ions, retaining moisture, etc.) are less specific than those in biological systems. In fact, the general functions of HS in the soil could, in principle, be satisfied by many of the direct, unaltered products of living cells such as proteins, poly-saccharides, or poly-nucleotides. The molecular heterogeneity that is characteristic of HS serves a vital role in the ecological system. Humic substances constitute the only natural organic material that can survive in bulk and still possess the requisite chemical reactivity to perform the various functions for sustaining soil quality and promoting plant growth.

It is clear from the above that HS may positively influence higher plant metabolism. Still, the yet unknown nature of HS prevents us from drawing more conclusive results concerning the effects of HS on plant growth. We can only consider that HS appear to influence the metabolism of plant cells at different levels. Their effects may, therefore, be different and be additive, overlapping, or, in some cases, mechanistic related. This apparently puzzling situation can be, however, rationalized by hypothesizing that HS have several targets that can be explained partly by their chelating capacity and partly by their hormone-like activity. This is not surprising, considering the complex and differentiated nature of HS. Therefore, more research is necessary to explain the positive effects of HS on higher plants. In particular these studies have to be, primarily, focused on the following topics: (1) the availability of humus in the soil solution and in the rhizosphere; (2) the link between humus activity

and the presence in the soil solution of active metabolites of various microbes; and (3) the use of more characterized HS in experiments on plant metabolism.

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**Kopsavilkums**

Rakstā aplūkotas nozīmīgākās augsnes un kūdras galvenās organiskās sastāvdaļas – humusvielu īpašības atkarībā no to izdalīšanas apstākļiem, izcelsmes, kā arī to iespējamie struktūras modeļi. Izvērtēts humusvielu iespējamās darbības modelis uz augiem, kas varētu būt pamatā humusvielu saturošu preparātu izmantošanai augu augšanas nodrošināšanai un stimulēšanai.

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# CHARACTERISTICS OF PEAT PROPERTIES FROM EXTRACTED PEATLANDS IN THE CONTEXT OF SUSTAINABLE MANAGEMENT

## Izstrādāto purvu kūdras īpašību raksturojums ilgtspējīgas apsaimniekošanas kontekstā

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**Abstract.** The degradation level and re-cultivation possibilities of extracted peat fields have usually been evaluated using data from vegetation studies, and partly from hydrological measurements. Very little attention has been paid to the remaining peat layer properties; however, this is important for the planning and choice of scenario for re-cultivation. The aim of this study has been to investigate the properties of the remaining peat section with special attention to the top layer. This research project included the following laboratory methods: loss – on ignition method, pH, degree of peat decomposition botanical composition and natural peat density analysis. The results of this study point to those peat properties that are changing due to extraction processes. The obtained results suggest that peat properties in the studied affected peatlands vary differently. The top layers of the peat section have a higher natural density and increased amount of mineral matter. The main changes observed were in the peat natural moisture, pH, mineral content, degradation rates, and ash content, which in the extracted peat field were associated with hydrological regime modification.
**Keywords:** *deposit composition, natural density, botanical composition, degree of decomposition, pH*

### Introduction

Peat is the natural resource of Latvia whose potential for use is important for the development of the country, but which is not yet fully understood and has not achieved its full economic potential. It is also necessary to identify which re-cultivation measures should be promoted as being more efficient, economical and more bio-diversity friendly with the least possible negative impact on climate change.

When the peatland is being prepared for peat cutting, the vegetation is removed in the planned extraction area and the hydrological regime is changed by the drainage system. The part of mineral matter increases in the content of peat, especially at the top of the section with resultant peat compaction. Upon completion or discontinuation of peat extraction, the remaining top layer of peat differs by the degree of its natural density, as well as other peat properties, including the proportion of mineral parts in the peat composition and the degree of decomposition.

By exploring and studying the degraded peat fields, the focus, so far, has been on the analysis of peatland vegetation, most often assessing its re-generation potential. In order to select the most suitable type of re-cultivation, it is necessary to carry out research and to evaluate the state of each specific peat field and the properties of the remaining layer of peat (Lācis 2010). Several LIFE projects have been implemented in Latvia, as a result of which restoration of the hydrological regime of the peatland has

been carried out, eliminating the consequences of the reclamation by man and facilitating the improvement and restoration of the mire habitat status (Pakalne 2013).

For planning management and re-cultivation of the peatlands, it is necessary to determine the properties of the remaining peat layers, which have previously rarely been studied in Latvia. It was decided to research the pilot areas of the LIFE REstore project - at the Lielsalas, Drabiņu, Kaigu and Ķemeri peatland fields because there are planned or already undergoing re-cultivation processes. For peat extraction sites where re-cultivation is going to be started, the project implementers need to be informed about the best form of re-cultivation. It is necessary to develop a methodology and action plan for the full evaluation of territories from the geological, quality, economic and biological aspects of the site, thus gaining confidence in the purpose and type of further use of each territory.

## Materials and Methods

During the elaboration of this research work theoretical studies and practical aspects of the research were carried out. Research consisted of several expeditions, territory survey and field work in the peat fields of the Lielsalas, Kaigu, Drabiņu, and Ķemeri peatland (Figure 1). Collected deposit samples were taken to the laboratory for processing and analyses. During the cameral work, information collected during fieldwork and the results of laboratory analyses were processed and visualized. The data obtained at the end of the study were analysed, interpreted and compared.

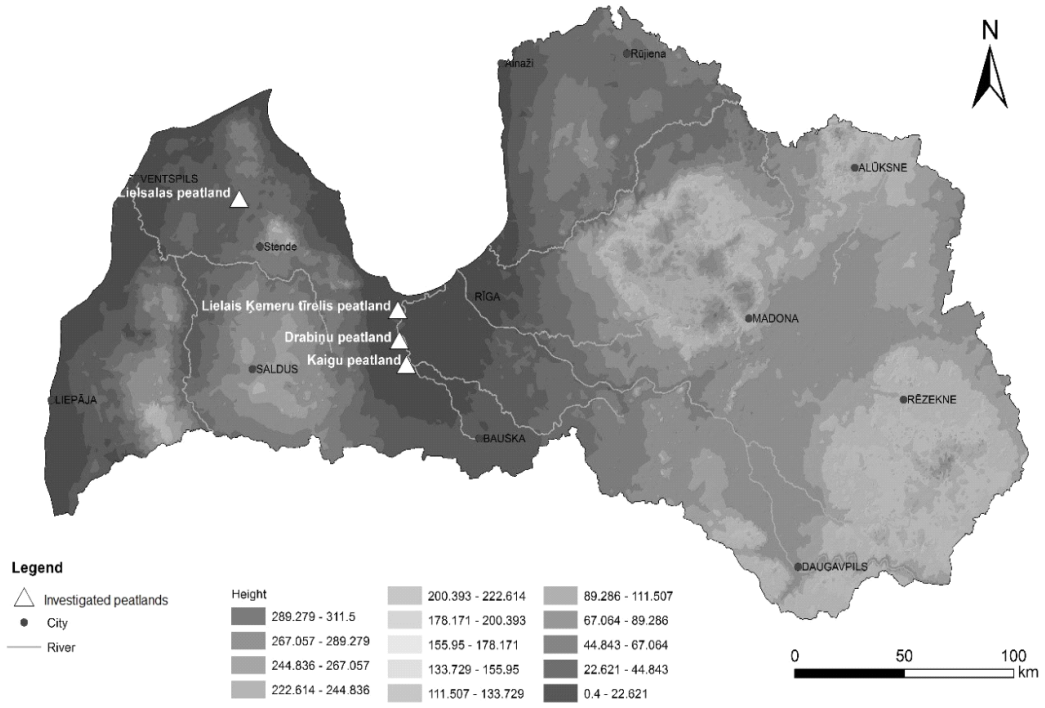


Figure 1. **Location of the investigated peatlands** (authors' figure)

Field studies were conducted and deposit samples were collected in three expeditions on 29 September, 13 October and 28 October 2016. In each of these peat

fields, at the beginning, soundings were made to find the most suitable place for the geological coring and collecting of deposit samples. Geological coring was performed by using a soft sediment core with a 0.5 m long chamber. Nine cores were performed during the field work and deposit monoliths were obtained. Deposit monoliths were required to perform a complete analysis in the laboratory including the questions of loss on ignition, magnetic sensitivity, pH, degree of peat decomposition and botanical composition analysis.

Loss on ignition analysis is used to determine the percentage of organic matter accumulated in peat, mineral matter and carbonates deposited in the sediment in the form of calcium carbonates or other sediment samples (Heiri et al. 2001). This method is based on successive sample heating at 550° C and 900° C in special muffle furnaces. In addition to the determination of organic matter, mineral content and carbonates, formulas are used to calculate ash, peat density and dry matter.

The natural density of peat is observed as the mass (air sample) and undisturbed volume ratios of the monolith sample. Peat air mass was obtained by at least 12 hours drying at 105° C. The accuracy of the results may be affected by the deformation of the peat sample and disruption of the natural structure during transportation (McKeague 1976; ASTM-D4531-86 2002).

The pH of the peat is measured in a solution with a 1:5 ratio of sample to reagent. The solution is prepared from 1 part peat sample and 5 parts de-ionized water (ISO 10390 2005).

Peat samples were removed at different intervals (taking into account loss on ignition results of the analysis) at the extracted peat fields where the most significant changes were observed in the amounts of mineral matter.

The method of peat decomposition degree is based on the area of the unstructured part of the peat (humus) identification of the peat preparation and its expression as a percentage of the total preparation square. The field determination is performed in a binocular microscope with magnification by 56-140 times.

Peat botanical composition is determined on the basis of the macroscopic and microscopic features of the peat and the identification of the main plants of peat composition. This is important for peat type determination. Botanical composition of peat allows for an understanding of the bog vegetation dynamics during peatland development over time. The composition of the peat-forming plants together with data on the degree of peat decomposition characterises peat properties, as well as helps reconstruct paleo-ecological conditions during the peat accumulation.

## Results

### Results of loss on ignition analysis

Significant changes in the sediment composition of all investigated cuts are due to a significant increase in the percentage of minerals in the lower and upper part of the deposit sections, indicating anthropogenic effects. The increase in minerals in the upper part of the incisions indicates the effects of wind and mineralization of the soil.

The diagrams of loss on ignition analysis results are divided into zones (I – IV) (Figure 2).

Organic substances dominate in all sections of the Lielsala peatland. The increase of the mineral content is observed in the base of the incisions and decreases upwards. The carbonate content is small (not more than 1%) in all sections of the Lielsala peatland, indicating that the minerals of the carbonate content have not flushed.

The remaining layer of the Lielsala peatland part and the increase in the amount of minerals in the peat composition may be explained by peat sowing and compaction as a result of susceptibility, which indicates the significant impact of human activity.

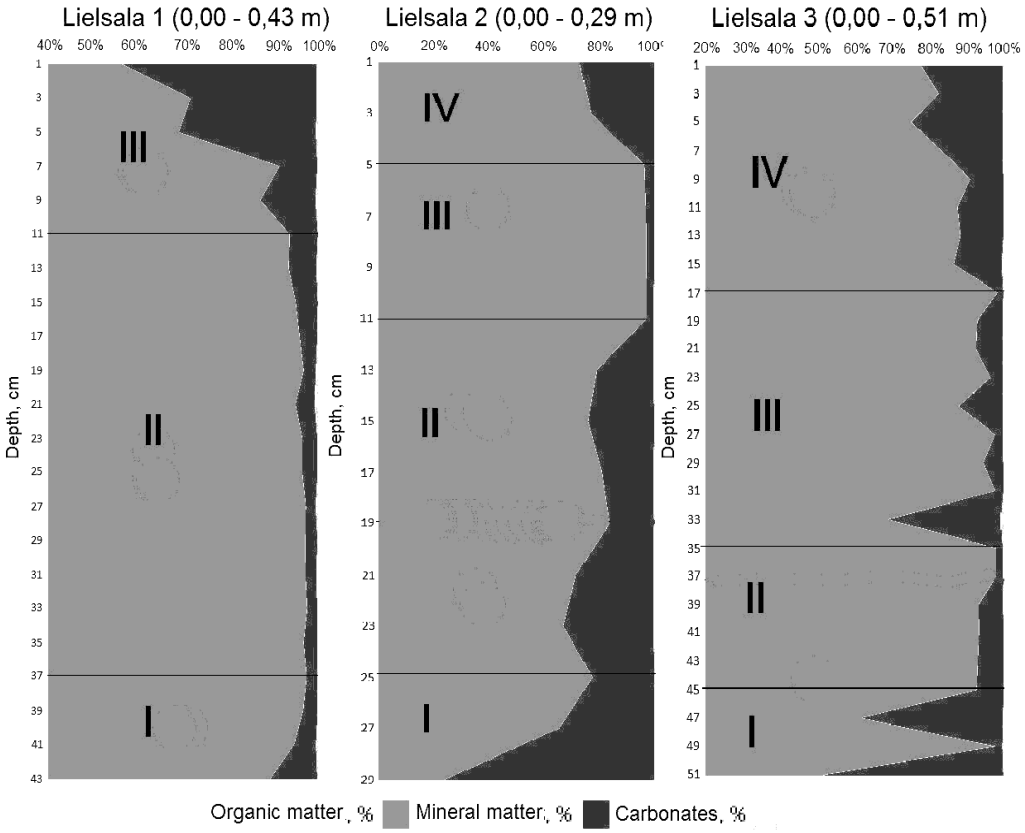


Figure 2. **Results of loss on ignition analysis from different sites of the Lielsala peatland** (authors' figure)

## Peat decomposition degree and botanical composition analysis

The remaining peat layer in different extracted peat fields consists of various peat types with different degrees of decomposition, which can be explained by the fact that peat formation started in different peatland areas at different times and under different environmental conditions.

The obtained results of this study allow us to conclude that the remaining peat layer in the excavated fields of the Kaigu peatland consists of all three consecutive types of peat: fen, transitional and raised bog type. All of these are well decomposed by more than 40% apart from the upper layer of the *Sphagnum*, whose decomposition degree decreases to 32%, but it is still well-decomposed peat. Such a degree of

decomposition is not characteristic for raised bog peat types and suggests that peat cutting and drainage affects peat properties.

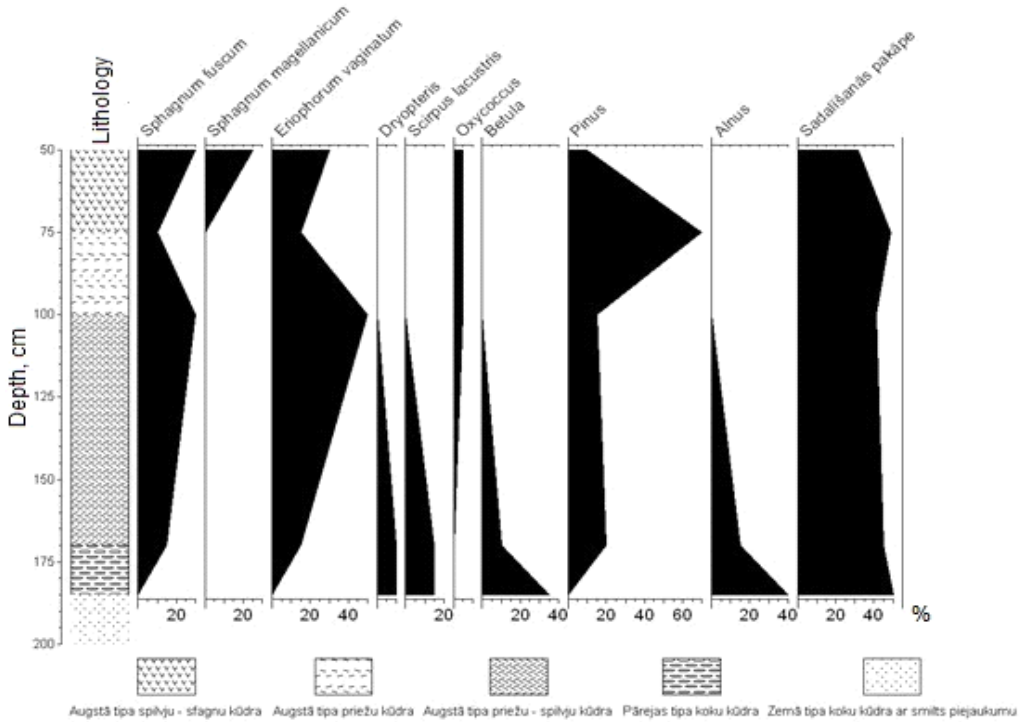


Figure 3. **Results of botanical composition analysis from the Kaigu peatland** (authors' figure)

The analysis of the obtained results allows us to conclude that the remaining peat layer in the fields of the extracted part of the Kaigu Peatland consists of peat represented by all three peat types: fen, transitional and raised bog peat. All of these are well-decomposed by over 40%, except, for the top layer of the cotton grass-Sphagnum peat itself, with a decomposition degree of 32%.

**Results of pH analysis**

The results of the pH analysis from the Drabiņas peatland peat section show that the lower depth interval (2.0 – 1.60 m) has the highest pH values, possibly related to the significant amount of mineral matter, forming about 30% ash in the peat composition.

In the upward direction (1.60 – 0.80 m), the pH values gradually decrease from 5.7 to 4.3, which can be related to the natural raised bog/transitional mire environment and is supported by raised bog type *Sphagnum fuscum* peat in this depth.

The upper part of the peat section is characterised by gradual increase in pH values, while peat forming vegetation composition in this depth interval indicates plant feeding with atmospheric precipitation and suggests an acid environment. Taking in account this fact and obtained pH results it can be determined that the upper peat layer is affected by drainage and surface waters.

**Results of natural peat density analysis**

The natural density of peat is an important characteristic of peat. After that, it is possible to determine the effect of bog drainage on peat compaction and density, which is expressed as the volume of unmodified and immature monolithic sample volume and completely dry, dried sample (Krūmiņš et al. 2012).

Previous studies have shown that peat density in natural bogs increases with depth as well as a higher degree of decomposition and increase in the percentage of mineral matter content in peat (Šnore 2013). The density of remaining peat layers differs from the natural bog's peat density. Normally, the density increases at the bottom of the peat layer due the weight of the peat, but in extracted peatlands density values are higher, due to drainage.

After analysis of the remaining peat layers, the trends of peat density changes differ from natural bogs. The main difference is the increase in the density of the peat in the upper part of the sections, where it is larger than in the base of section. In the increment, the Lielsala 2 density increases significantly in the range of 0.25 - 0.13 m. This can be explained by an increase in the degree of peat decomposition, which reaches 35% in this range.

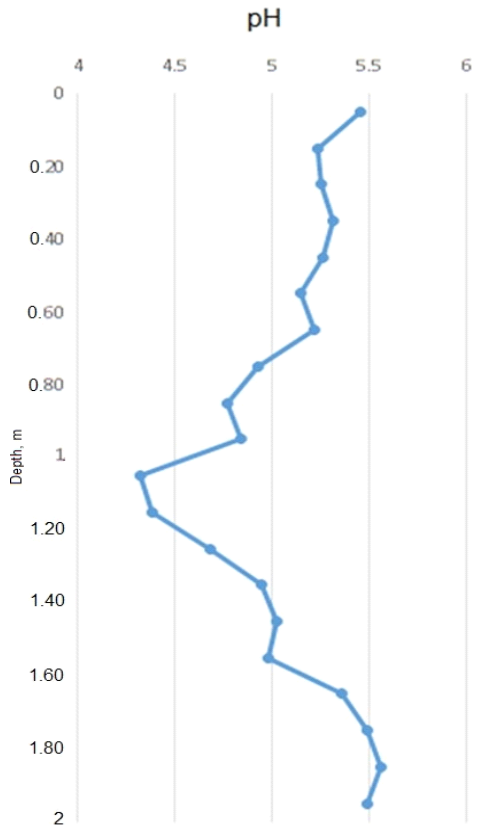


Figure 4. **Results of pH analysis from the Drabiņu peatland** (authors' figure)

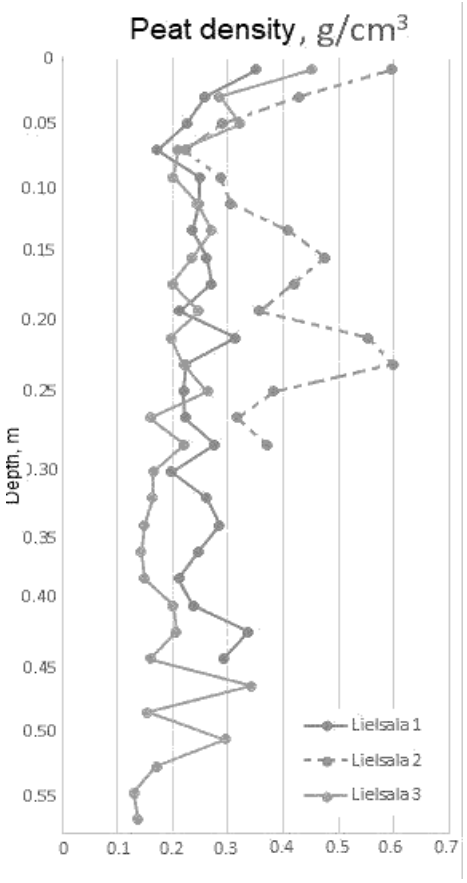


Figure 5. **Results of natural peat density analysis from the Lielsalas peatland** (authors' figure)

## Conclusion

- The density of the remaining peat layers differs from the natural peat bogs. Usually it increases in the upper part of the deposit section compared to the base of the section.
- Factors that affect natural density indicators in the studied areas are the degree of decomposition of peat, pH, and the amount of mineral part in deposit composition and the change of peatland hydrological regime.
- Significant changes in the sediment composition in all investigated peat sections are due to a significant increase in the percentage of mineral matter in the lower and upper parts of the sections that are characteristic of the extracted peatlands.
- The characteristics of peat from the peatlands of Lielsala, Drabiņu, Kaige and Lielais Ķemeru tīrelis were mainly influenced by changes in the hydrological regime caused by the drainage of peat fields.

**Kopsavilkums**

Līdz šim galvenā uzmanība degradēto kūdras lauku apzināšanā un izpētē tiek veltīta purvu veģetācijas analīzei, galvenokārt novērtējot tās atjaunošanās iespējas. Pētījuma mērķis ir raksturot četru izstrādāto purvu – Lielsalas, Kaigu, Drabiņu un Ķemeru tīreļa kūdras slāņu īpašības, izmantojot lauka darbu un laboratorijas pētījumu metodes: karsēšanas zudumu analīzi (*LOI*), pH, kūdras botāniskā sastāva un sadalīšanās pakāpes analīzi un kūdras dabīgā blīvuma analīzi.

Pētījumā iegūtie rezultāti norāda uz to, ka galvenās kūdras īpašību pārmaiņas cilvēka darbības ietekmētajos purvos ir kūdras dabīgā mitruma samazināšanās, blīvuma palielināšanās, pH un minerālvielu daudzuma palielināšanās, kas saistāma ar kūdras lauka hidroloģiskā režīma pārmaiņām nosusināšanas rezultātā.

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# FITNESS OF AIR QUALITY MEASUREMENT EQUIPMENT FOR REAL-TIME AEROBIOLOGICAL MONITORING: CASE STUDY FROM RĪGA

## Gaisa kvalitātes novērtēšanas aprīkojuma izmantošana reālā laika aerobioloģiskajā monitoringā: Rīgas piemērs

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**Abstract.** There are about 300 aerobiological monitoring stations in Europe, providing regular observational data on pollen and spore concentration in the air. The data is available with a delay of 1-2 weeks or even more, which makes direct use for model-based forecasting immensely problematic. Automatic real-time pollen monitors are too expensive for massive deployment. Therefore, the primary attention is presently being put either to forecasting models that do not use observations in daily routine or to alternative ways for near real-time equipment for pollen monitoring. One of the solutions is an adaptation of existing air quality equipment for the needs of aerobiological monitoring. This study performs an analysis of the GRIMM monitoring station capability for the afore-mentioned purposes.
**Keywords***: aerobiology, air quality, alternative aerobiological monitoring, total real-time pollen counts*

### Introduction

The importance of aerobiological research follows at least two main lines – human health issues - through pollen allergy (*polinosis*) (Newson et al. 2014; Ring et al. 2012), as well as phenology and agriculture as studies of the timing of phenological phases and the productivity of plants (Aguilera and Ruiz-Valenzuela 2014; Orlandi et al. 2005). Both lines support the necessity of aerobiological forecasts of pollen and related processes including the start/end of flowering (Ritenberga et al. 2016), annual pollen productivity of plants (Ritenberga et al. 2018), and the inter-seasonal fluctuation of pollen depending on meteorological and environmental conditions. Precise forecasting models require data *as fresh as possible* because one of the most accurate air quality forecasts is the *persistence forecast* - which states that yesterday's actual situation is the best forecast for today (Sofiev et al. 2017).

The dense network of manual aerobiological sites (Figure 1) requires a regular, time-consuming effort on the job as all the samples are counted manually using microscopes. Automatic real-time pollen monitors, capable of providing necessary aerobiological data on time, are too expensive for massive deployment. Therefore, the primary attention currently is put to forecasting models that do not use observations in daily routine, being only calibrated and evaluated against them in an offline mode. Automatic pollen monitoring trials from different producers have begun at several European monitoring stations (Scheifinger et al. 2013), but for the time being, its accuracy is far behind the manual monitoring accuracy (Crouzy et al. 2016; Šauliene

et al. 2019). Scientists are continuously looking for automatization of the aerobiological monitoring and data collection.

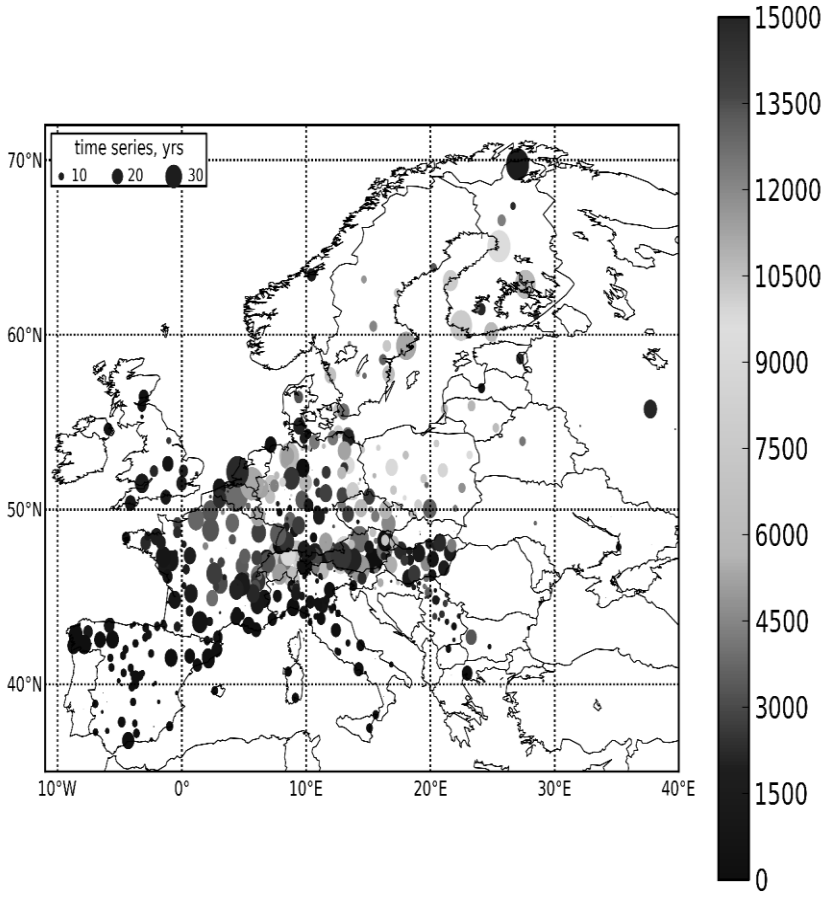


Figure 1. **The density of European Aero-allergen Network monitoring stations** (Ritenberga 2017)

This present study aims to evaluate the potential of the GRIMM air quality monitoring station for aerobiological research during the start of the pollen season when only several (1 to 3) pollen species are present in the air and when is possible to separate these by seasonal timing of plant flowering.

## Data and Methods

Monitoring of air pollution was performed in the central part of Rīga city (N56°57’02’’, E24°06’57’’), Latvia. The relative height for data collection is 23 meters agl, and two different samplers were used for air pollution measurements:

- Firstly, aerobiological monitoring was made by using the Hirst type 7-day Burkard pollen-spore trap (Hirst 1954). Data acquisition was carried out by requirements developed by a data quality control group (Galán et al. 2014; Oteros et al. 2013), who formulated the recommendations for monitoring processes and equipment. Seven days are required for data collection and at least one day for the manual microscopic analysis of pollen samples. Pollen recognition and counting procedures were performed at the University of

Latvia Faculty of Geography and Earth Sciences (UL FGES) Quaternary laboratory using a Primo Star Light Microscope under × 400 magnification and by choosing a vertical counting method - 12 vertical traverses (Carinanos et al. 2000) with the distance of 2 mm, thus, covering a daily sample of 14×48 mm. Later, re-calculation to concentration was performed by using a convertional factor.

- Every single aerosol particle was detected by GRIMM EDM and allocated to a defined particle size based on the intensity of the scattering light signal. This precise and reliable single particle (particulate matter, further PM) count allows for simultaneous measurement of the fractions $PM_{10}$, $PM_{2.5}$, $PM_1$ and also the particle size distribution in 31 size channels. To guarantee the precision of the measurements, and to protect the measuring cell from contamination, the constant 1,2 l/min sample air flow is filtered and brought back into the device as rinsing air. Particulate matter data collected by the pollution monitoring station for the same periods was re-calculated to 2 hours data (because of the minimal step of pollen data) for the year 2014 and daily values for the year 2017.

Filtering of data, normalization and data analysis was performed by using the R programming tool.

**Results**

As GRIMM does not provide exact pollen-sized PM channels, data was merged from size 25 μm to 31 μm to cover all the possible pollen size range (for hazel, birch, alder). Making data from the above-described devices comparable, normalization was performed by deviation to mean hourly/daily values depending on the year.

It was assumed that moderate wind conditions and even some air turbulence, usually responsible for vertical air flow in an urban environment, is not sufficient to bring heavy, pollen-sized PM at the height of 23 m. Thus, this study explored GRIMM PM output from channel 25-31 μm as biological particles, i.e., as pollen.

The analysing period from mid-April to the beginning of June fits in with the birch flowering season in Latvia. The first peak of the data (Figure 2, lower panel) possibly demonstrates the end of the hazel/alder pollen season. Daily data (Figure 2) of *pm_Betula-sized_norm* and *Betula_conc_norm* does not display the well-seen relationship, at the same time, higher resolution of the same data (Figure 3) provides additional information on inter-connection of the particles from different devices.

As previously described (Ritenberga et al. 2016; 2017) the substantial role of air temperature (in the timing of birch phenological phases and pollen season start/course/etc.) is confirmed by the current study. Visualisation of the result (Figure 2) confirms the hypothesis of GRIMM measured particles as being pollen because PM is not as sensitive to temperature changes as particles with biological origin. The curve of birch-pollen-sized particles and the birch pollen concentration curve repeats all the peaks from the increase of air temperature.

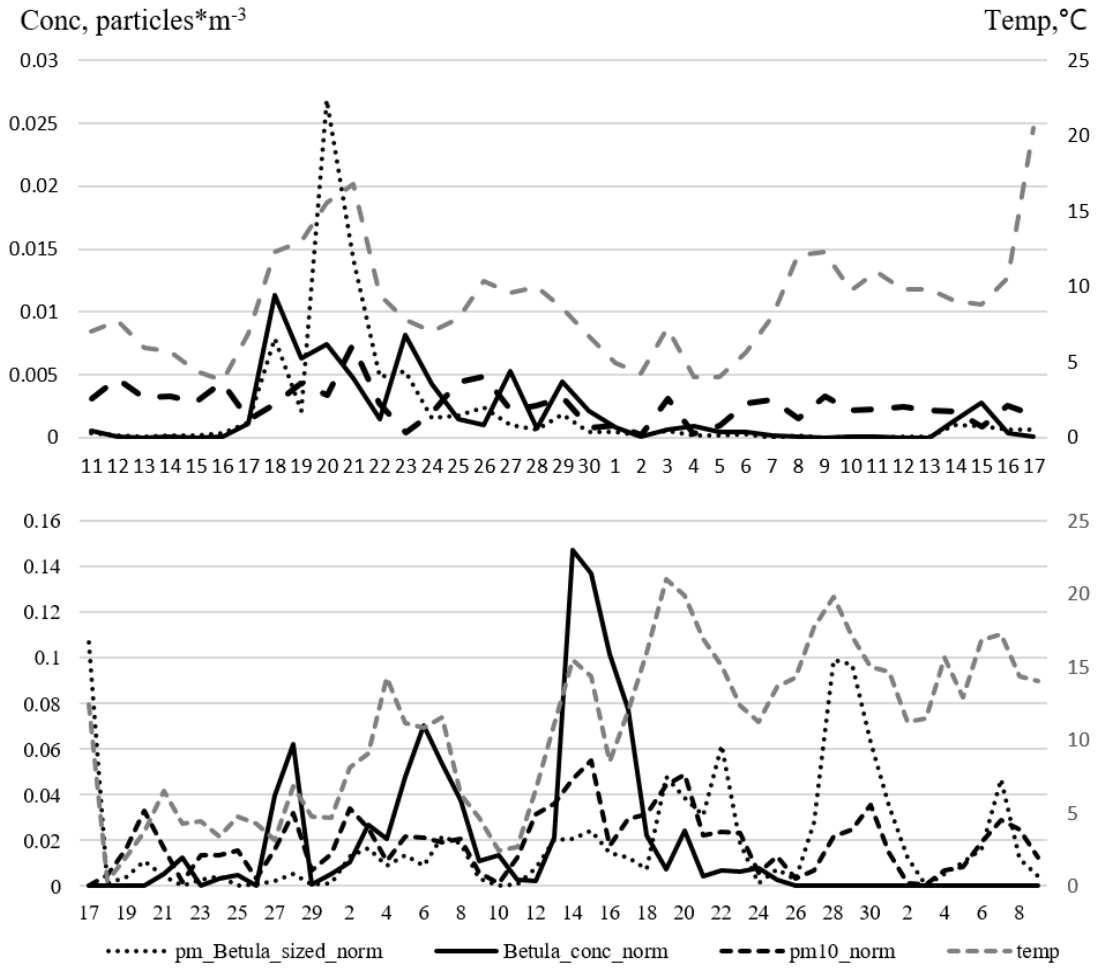


Figure 2. **Comparison of the seasonal passage of normalized particle daily concentrations: the example of 2014** (upper panel) **and 2017** (lower panel) (author's figure)

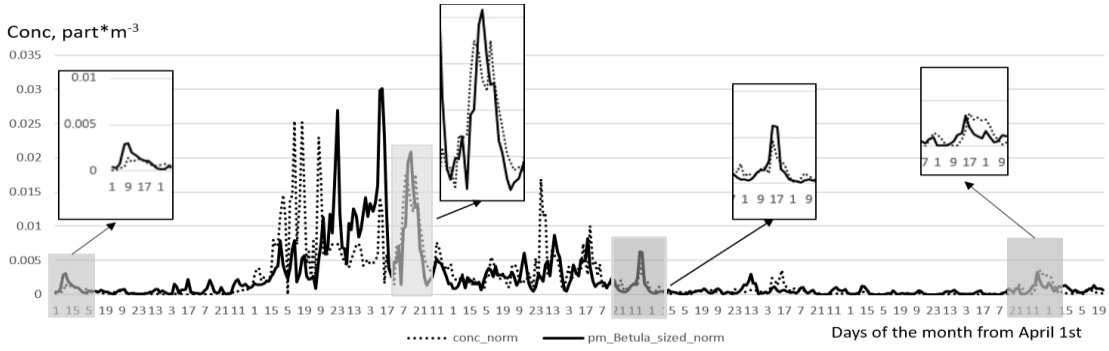


Figure 3. **Seasonal variation of air pollution bi-hourly data: the example of 2014** (author's figure)

There is not enough daily data for the reliable performance of the statistical analysis. Correlation analysis was performed only for seasonal bi-hourly data, thus presenting the correlation coefficient *r* of 0.7-0.85 depending on the analysed period of both years.

However, GRIMM is designed for particulate matter measurements, and the exclusion of possible presence of heavy dust particles allows us to admit the use of the device for total high-resolution (i.e., hourly or bi-hourly) pollen measurements. Figure 3 demonstrates a noticeable coincidence of values - several examples zoomed. The patterns of both curves are similar despite the significant difference in absolute values at the beginning of the season which was probably caused by the presence of alder and hazel pollen in the air.

Normalization of the data doesn't allow us to evaluate absolute difference and an insufficient amount of data doesn't allow us to define calibration criteria for both devices. So far, the only possibility for absolute value calculation seems to be through the seasonal pollen index as described (Ritenberga et al. 2018).

Diurnal mean variation was observed in data from both devices. It follows diurnal temperature changes. Figure 4 shows a smooth tracking of the temperature curve by the output from the GRIMM device, whereas Burkard is a much sharper device with a bigger time-step. Resolution of GRIMM allows us to receive *ideal* diurnal pollen curve (Kasprzyk et al. 2001).

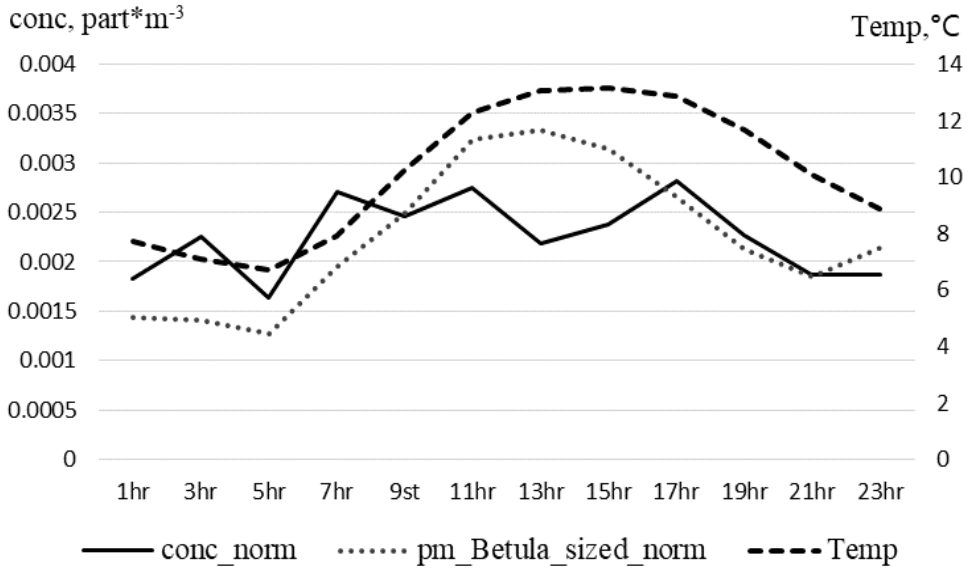


Figure 4. **Mean hour-to-hour variation of air pollution: the example of 2014** (author's figure)

## Conclusion.

The hypothesis on the fitness of air quality monitoring stations for pollen observation is partly confirmed - it is possible to use GRIMM for recording total pollen counts and in the case of:

- description of calibration coefficient for both devices as well as
- proper evaluation of wind speed impact on the vertical profile of particulate matter – here, the difference of pollen and PM mass allows us to measure big aerosols (pm > 25 μm) as pollen at the height of 25-30 m agl.

Further studies should be performed to clarify the above-mentioned objectives. The accuracy of GRIMM for pollen monitoring depends on the timing of the measurements. The long-year mean and seasonal variation of pollen spectra helps us to better define the proper time for single taxon monitoring, as distinguishing by pollen type is not possible using the mentioned technique.

## Acknowledgement

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**Kopsavilkums**

Eiropā ir ap 300 aerobioloģisko monitoringa vietu, kas regulāri veic putekšņu un sporu mērījumus gaisā. Ņemot vērā izmantoto mērierīču specifikāciju, dati ir pieejami ar 1–2 nedēļu nobīdi, kas ietekmē putekšņu koncentrācijas prognožu precizitāti. Automātisko reālā laika putekšņu monitoru iegāde un kalibrācija prasa lielus finanšu ieguldījumus. Kā iespējamo risinājumu var minēt prognostisko modeļu uzbūvi, kas gandrīz neprasa novērojumu datus, vai esošo mērierīču pielāgošanu putekšņu un sporu reālā laika mērījumiem. Viens no variantiem ir gaisa kvalitātes mērīšanas aprīkojuma izmantošana aerobioloģisko mērķu sasniegšanai. Šis pētījums izvērtē GRIMM gaisa kvalitātes monitoringa stacijas datu izmantošanu, lai mērītu putekšņu koncentrāciju noteiktā laika periodā.

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# LANDSCAPE OF SEMI-WILD LARGE HERBIVORES IN THE SPECIALLY PROTECTED NATURE TERRITORIES OF LATVIA

## Lielie pussavvaļas zālēdāji īpaši aizsargājamās dabas teritorijās Latvijā

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**Abstract**. Semi-wild large herbivores have been present in the Latvian landscape now for just on 20 years. Nevertheless, the available information about the already implemented introduction projects is scattered and fragmentary. The aim of this paper is to outline and discuss the landscape of semi-wild animal grazing projects in the specially protected nature territories (SPNT) throughout Latvia, focusing on the project implementation contexts, locational factors and current management issues. The results of this study show that grazing areas of semi-wild herbivores are located mainly in nature parks and nature reserves. The typical location for the establishment of a grazing site is a former agricultural land area that has been abandoned by its previous users due to unsuitable conditions for profitable agricultural activity and which is located close to a natural waterbody. The main goal for all of the analyzed introduction projects was the restoration and protection of open landscape and grassland habitats. According to the research results, at

present, the main problem regarding grazing sites of semi-wild large herbivores, is the existing policy framework. This study raises many questions about the future of semi-wild herbivores in Latvia and these should be addressed in further in-depth studies.

**Keywords**: *semi-wild large herbivores, grazing animal landscape, introduction, re-wilding, natural grazing*

## Introduction

Large herbivores had an important role in shaping the natural landscape of Europe in the pre-agrarian period. By the allowing of grazing they maintained the natural grasslands, influenced the species composition in habitats of their surroundings and by uprooting the smaller trees and de-barking the larger ones, they even changed the closed forests on a local scale (Vera 2000; Vera et al. 2007; Vermeulen 2015) - a habitat that, according to traditional succession theories (see Clements 1916), is the final stage of vegetation succession in lowland Europe. Due to the development of farming and over-hunting, the number of wild large herbivores in Europe rapidly decreased – some species were driven out of their surroundings to more remote territories, other species became extinct. The species that completely vanished from European nature were wild horses (*Equus ferus)* or tarpans and wild cattle (*Bos primigenius)* or aurochs – the last known auroch died in 1627 in Poland and the last tarpan in 1887 in Ukraine (Vermeulen 2015).

Around the 1920-30s, scientists created two new herbivore breeds through cross-breeding of existing primitive cattle and horse breeds. The two new breeds were Heck cattle and *Konik polski* horses which resembled the extinct aurochs and tarpans by appearance and had the capability to survive in the wild. After the creation of these new herbivore breeds, the idea of introducing them into the wilderness was born (Lorimer and Driessen 2013; Vermeulen 2015). According to the research of some well-recognized authors (Vera 2000; Vermeulen 2015), the (re)introduction of large herbivores in the European landscape is a fundamental part of restoring the natural balance of eco-systems or ‘re-wilding’ – a term that is largely used to describe the restoration of natural processes (Jorgensen 2015; Vermeulen 2015). One might ask the question that, amongst all the other herbivore species that did not become extinct, why bother with wild cattle and horses? As a matter of fact, it is a widely held view that each of the indigenous large herbivore species in Europe had its own role in the eco-system that cannot be overtaken by other species (Vermeulen 2015). The basic idea of introducing animal species that resemble the extinct herbivores, was to replace the missing grazing animals in the landscape, so they can participate in the creation of landscapes once again (Kugler and Broxham 2014; Vermeulen 2015). Probably the best known introduction project is the Oostvaardersplassen in the Netherlands – at the beginning of the 1980s, the Dutch scientist Frans Vera commenced an experiment in the Oostvaardersplassen polder by introducing Heck cattle, *Konik polski* and other large herbivores in the territory to ‘re-wild’ the landscape of Oostvaardersplassen. After Vera’s experiment, the idea of introducing large herbivores gained popularity

and these introduction projects gradually spread all over Europe (Lorimer and Driessen 2013).

In Latvia, the first large herbivores were introduced in 1999 at the Nature Park "Pape" as a part of WWF Latvia's project that aimed to restore the natural habitats in the Pape polder – a former agricultural territory (Zariņa et al. 2018). However, even though just on 20 years have passed since the first introduction project and at the time the project was controversially received (Schwartz 2005; Schwartz 2006; Zariņa and Treija 2015), there has still been no in-depth analysis and/or discussions made available for study. Most of the studies done thus far focus only on particular aspects of these grazing projects, for example, changes in vegetation of the grazing sites (Mednis 2008; Gruberts and Štrausa 2011), the attitudes of society (Schwartz 2005; Zariņa and Treija 2015) or the emergence of post-productivist ideas in the former agricultural lands of Latvia (Zariņa et al. 2018).

Thus, the aim of this paper is to outline and discuss the landscape of semi-wild animal grazing projects in the specially protected nature territories (SPNT) of Latvia, focusing on the various project implementation contexts, locational factors and current management issues.

We used field observations, interviews, analyses of literature and documents to understand the geography and time-line of the introduction projects, as well as to create a database consisting of the accounts of introduced animal species, initial and current size of animal populations, geographic location, size of grazing areas and landscape characteristics. Our fieldwork was conducted in 2018, when we visited altogether 4 grazing areas. We conducted 8 semi-structured interviews with park managers and experts. The interviews were conducted in 2018 and 2019.

## Semi-wild herbivore grazing sites in specially protected nature territories of Latvia

The grazing areas of semi-wild large herbivores of SPNT are situated in geographically different locations (Figure 1), all of which were established from 1999 to 2007 (Figure 2), mainly in nature parks and nature reserves. Since 2007 no new semi-wild grazing areas have been established. According to the conducted interviews, the main reason for this phenomenon might be the issue of insufficient funding – most of the grazing sites were established with the financial support of various nature conservation projects. Since the project conclusion, the main source of funding for maintenance of the grazing sites consists only of subsidies, which, according to the interviewed managers of the grazing sites, do not cover all the costs. Another factor is the lack of grassland territories that are large enough for the establishment of grazing sites. However, this aspect requires further in-depth study.

All of the cases bear a similar objective – the protection and restoration of mosaic landscape and grasslands. Another significant trait, common to almost all of the cases, is their link to the internationally significant bird breeding, nesting and

wintering sites. Therefore, the aim of restoring the mosaic landscape is partly connected to the needs of bird species conservation and management.

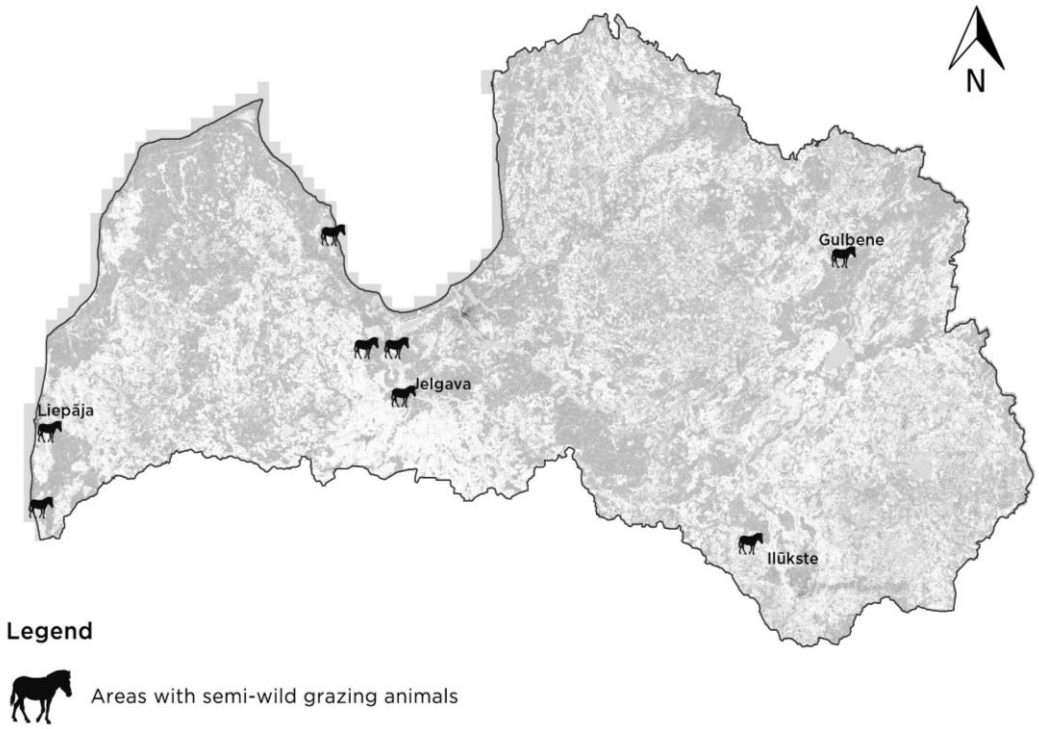


Figure 1. **The spatial distribution of semi-wild large herbivore grazing sites in SPNT of Latvia** (authors' figure based on data from kartes.geo.lu.lv, topographical map M:10 000 LGIA)

Currently the area of semi-wild grazing territories in SPNT throughout Latvia ranges from less than 100 ha to 400 ha (see Table 1). The largest grazing areas are located in the Nature Park "Pape" and the Nature Park "Dviete Floodplain". According to research results, the number of semi-wild herbivores has significantly increased since the establishment of grazing areas in all introduction sites (see Table 1). There are two main reasons for this. Firstly, in the initial stages of the introduction projects, new animals were added to the herds for larger genetic variation as limited variation of genes may lead to weaker population (see Vermeulen 2015). Secondly, the natural population increase – the number of live births thus far is larger than the number of deaths. However, the significant growth of populations raises the question of overpopulation (Nolte et al. 2014; Moseby et al. 2018). The question of optimal population density should be addressed in future studies.

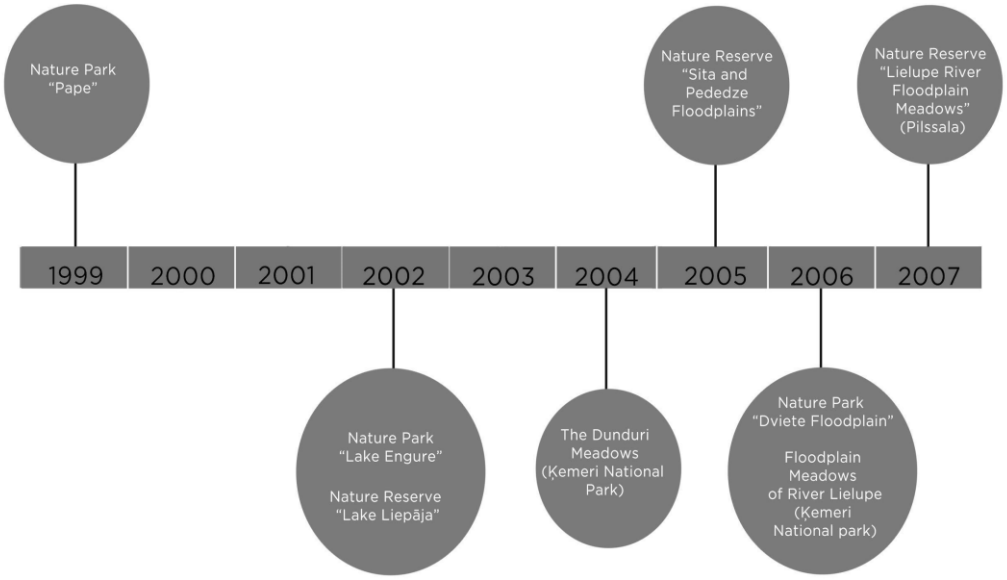


Figure 2. **Time-line of introduction projects in SPNT of Latvia** (authors' figure)

Table 1. **The semi-wild large herbivore grazing sites in SPNT of Latvia**

| | **Type of protected nature area** | **Type of introduced herbivores** | **Initial number of introduced herbivores** | **Current number of large herbivores (2018)*** | **Size of the grazing area, ha (2018)** |
|---|---|---|---|---|---|
| **Pape** | Nature park | Semi-wild horses and cattle, European bison | 18 horses, 23 cattle, 5+12 bison | 100 cattle, 100 horses, 5 bison known (escaped from the enclosure in 2009) | 400 |
| **Lake Engure** | Nature park | Semi-wild horses and cattle | 5 cattle, 6 horses | 50 cattle, 6 horses | 100 |
| **Lake Liepāja** | Nature reserve | Semi-wild horses and cattle | 8 cattle, 10 horses | 40 cattle, 20 horses | 140 |
| **Ķemeri (The Dunduri Meadows)** | National park | Semi-wild horses and cattle | 15 cattle, 10 horses | 69 cattle, 99 horses | 180 |
| **Sita and Pededze Floodplains** | Nature reserve | Semi-wild horses and cattle | 23 cattle, 20 horses | information n/a | 250 |
| **Dviete Floodplain** | Nature park | Semi-wild horses and cattle | 17 cattle, 13 horses | 130 cattle, 50 horses | 400 |
| **Ķemeri (Floodplain of River Lielupe)** | National park | Semi-wild horses and cattle | 15 cattle, 10 horses | 74 cattle, 67 horses | 280 |
| **Pilssala (Floodplain Meadows of River Lielupe)** | Nature reserve | Semi-wild horses | 16 horses | 71 horses | 70 |

* approximate number, according to managers of grazing sites

**Landscapes of semi-wild herbivores grazing areas**

According to the historical cartographic materials, all of the semi-wild herbivore grazing sites are located in former agricultural lands – abandoned arable lands and grasslands. This aspect indicates the adaptation to post-productivist management practices in the agriculturally marginal areas that used to be part of the productivist agriculture system (Zariņa et al. 2018). Some of the semi-wild herbivore grazing sites include forest areas and bogs as well, for example, in the Nature Park "Lake Engure" and in the Dunduri Meadows of the Ķemeri National Park. All of the territories are characterized by wet conditions and the presence of rivers or lakes. This trait might be explained by several reasons. Firstly, the presence of wet conditions suggest, that these territories are not suitable for economically profitable agricultural activity and therefore were abandoned by previous users. Secondly, the wet floodplain meadows - in such areas grazing is considered to be more effective than mechanical management. Thirdly, the presence of natural waterbodies enables the availability of drinking water for animals.

Figure 3. **Landscape of the grazing site at the Nature Park "Lake Engure"** (authors' figure)

The analysis of orthophoto maps shows that since the introduction of semi-wild herbivores the landscapes of grazing areas have changed - the shrub coverage of grasslands has decreased and the landscape has become more open (Figure 4). Although further research is required, the preliminary observations indicate that the introduction of semi-wild large herbivores is successful regarding the aspect of landscape maintenance.

**Figure 4. Grazing area in the Nature Park "Dviete Floodplain": changes in the landscape from 1995** (left) **to 2014** (right) (authors' figure based on orthophoto maps from kartes.geo.lu.lv)

## Management of semi-wild herbivore grazing sites

There are two very different approaches to the management of semi-wild large herbivore populations (Kugler and Broxham 2014). In one approach, the introduced animals are considered to become a natural part of landscape and the main goal of their introduction is to recreate the natural balance of ecosystems as it was in the pre-agrarian era. In the other approach, the introduced animals are considered to be just an alternative means for grassland habitat management. The former represents the implementation of Western wilderness values, while the latter is related to protection of specific species and habitats according to place-based nature protection goals. The different management models are directly connected to the main problem regarding semi-wild animal populations in Latvia - legal framework. According to interviews with the managers of the grazing sites, the current legal framework classifies semi-wild herbivores as livestock and therefore they are subject to the same regulations. The interviewed managers state that the current laws are not compatible with the approach that sees the introduced animals as a part of the natural landscape, because the fulfillment of requirements (ear tagging or chipping of animals, blood and milk analysis etc.) requires regular contact with humans. This means that the animals cannot develop their natural behaviour and integrate into the ecosystem. The interviewed managers of grazing sites suggest that changes in the legal framework should be considered.

On the other hand, the responsible authorities state that the existing legal framework is necessary as the introduced grazing animals live in fenced areas and their welfare depends on the activities of the grazing site managers. Secondly, the introduction of grazing animals is linked to a greater risk of the transmission of diseases and other problems that can be avoided by human supervision. However, the case of Latvia is not to be considered unique. Studies show (see Vermeulen 2015; Rewilding Europe 2019) that the discussion about legal framework regarding semi-wild grazing animals is topical in other European countries as well.

## Conclusion

According to the authors (Vera 2000; Vera et al. 2007; Vermeulen 2015), the (re)introduction of large herbivores in the European landscape is a fundamental part of restoring the natural balance of ecosystems. In Latvia the first semi-wild large herbivores were introduced in 1999 at the Nature Park "Pape". Since then, pastures of semi-wild large herbivores have been established in various SPNT, mainly in nature parks and nature reserves. The most popular herbivore breeds for introduction are *Konik polski* horses and Heck cattle, but other similar crossbreeds are present in the grazing areas as well. All of the grazing sites are located in the former arable lands and grasslands.

The conducted interviews elucidated legal framework as the main issue regarding the management of semi-wild grazing animal populations. According to current laws, semi-wild grazing animals are classified as livestock. The interviewed managers of grazing sites state that the laws should be modified and legal exceptions for semi-wild animals should be made in order to fit the actual situation – the semi-wild animals are not used to regular human presence, therefore meeting the current legal requirements is almost unattainable.

The results of this study raise a number of questions that should be addressed in further situational explorations. Firstly, the question of legal framework - the opinion of different stakeholders should be analyzed, as well as case studies of semi-wild large herbivore grazing sites should be conducted to evaluate advantages and disadvantages of different management approaches. Results of such studies would provide crucial information for possible legal framework improvements. Secondly, the time dimension of the introduction projects. Results show that no new semi-wild herbivore grazing areas have been established since 2007. According to the interviews, this might be linked to insufficient subsidies and the lack of suitable territories for the establishment of pastures. However, this aspect requires further in-depth study. Thirdly, the semi-wild herbivore populations themselves - there are still many unanswered questions regarding optimal population densities and population dynamic. Finally, landscapes of semi-wild herbivores. In-depth studies about the landscape changes, society's perception of the new rural landscapes with the presence of large herbivores and the role of herbivores in Latvia’s landscape should be undertaken.

**Kopsavilkums**

Latvijā pirmie pussavvaļas lielie zālēdāji tika ieviesti jau 1999. gadā dabas parkā „Pape”, taču informācija par Latvijā īstenotajiem introdukcijas projektiem joprojām ir nepilnīga. Šis pētījums ir veikts, lai apkopotu un analizētu informāciju par introducēto pussavvaļas zālēdāju ganībām īpaši aizsargājamās dabas teritorijās (ĪADT) Latvijā, akcentējot projektu ieviešanas kontekstu, ganību ģeogrāfiskā novietojuma faktorus un pašreizējās apsaimniekošanas problēmas. Pētījumā analizētas 8 ievērojamākās pussavvaļas zālēdāju ganības ĪADT. Pētījumā noskaidrots, ka visas analizētās ganības ir ierīkotas vietās, kas pēc vairākām pazīmēm ir savstarpēji līdzīgas – tās atrodas bijušajās lauksaimniecības zemēs, ko raksturo ūdeņu (ezera vai upes) klātbūtne, pārmitri apstākļi un retas biotopu vai putnu sugas. Cita iezīme, kas līdzīga visiem analizētajiem projektiem, bija formulētais introdukcijas mērķis – mozaīkveida ainavas un

zālāju biotopu uzturēšana. Kopumā iegūtie rezultāti nodrošina būtisku informācijas bāzi turpmākajiem pētījumiem.

Pētījumā veiktās intervijas parādīja, ka pašlaik galvenā problēma pussavvaļas zālēdāju ganību uzturēšanā ir spēkā esošie likumi, kas pussavvaļas zālēdājus klasificē kā mājlopus, līdz ar to pakļaujot tos tādām pašām likumdošanas prasībām. Pēc ganību apsaimiekotāju domām, būtu jāveic likumu grozījumi, lai tos pielāgotu reālajai situācijai. Interešu konflikts starp atbildīgajām valsts instancēm un ganību apsaimniekotājiem ir viens no jautājumiem, kam plānots pievērst uzmanību turpmākajos pētījumos. To rezultāti iezīmēja arī citus pussavvaļas zālēdāju ganību aspektus, kam būtu nepieciešams pievērsties turpmākajos pētījumos, to skaitā ainavu pārmaiņām ganību teritorijās un introducēto zālēdāju lomai un tās uztverei Latvijas lauku ainavā.

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# NATURE CENSUS - THE FIRST DETAILED, SCIENTIFICALLY-GROUNDED INFORMATION ABOUT LATVIA'S NATURE VALUES

## Dabas skaitīšana – pirmā detalizētā un zinātniski pamatotā informācija par Latvijas dabas vērtībām

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**Abstract.** The purpose of this article is to analyse the importance of major inventories of nature values – the mapping of habitats of EU importance – in the context of introducing and implementing a nature conservation policy in compliance with the necessity to integrate the requirements of those EU directives concerning specially protected nature areas into the governance system of Latvia. This paper examines the inventory of nature values from different perspectives – the introduction and implementation of policy, cross-sector co-operation and the integrity of national natural resource databases.

**Keywords:** *nature conservation, implementation of EU directives, sustainable development for natural values, Latvia*

### Introduction

Until 2014, only 10% of Latvian territory had been made accessible to the distribution maps of the protected species and habitats of European Union (further in the text – EU) importance. The main part of this data consisted of information about the already mapped special areas of conservation. Moreover, in most cases, this data was more than 5 years old. Such a situation had resulted during the recession (i.e., from 2008 to 2014), when financial resources for the monitoring of data related to nature were reduced significantly (Ministry of Environmental Protection and Regional Development 2013). The lack of voluminous and qualitative data influences the efficiency of nature - and environmental protection; it also has an adverse impact on Latvia's ability to maintain EU commitments and its ability to report on general environmental indicators and their changes in the entire territory of Latvia. Thus far, information about the habitat distribution of EU importance, and its occurrence in Latvia, has been based on an extrapolation of monitoring or other data, which does not reflect the situation at the level of specific areas, but rather provides an insight into the possible situation in the entire country. As a result of such data extrapolation, the occurrence of some habitats of EU importance in the country can possibly be assessed too pessimistically (i.e. without knowing the overall situation in the entire country, or about stricter limitations that are set for some types of habitats, thus unreasonably

restricting economic activities) or too optimistically, thus allowing for the possibility to destroy habitats of EU importance due to economic activities. Considering that Latvia has undertaken commitments to form and to maintain the network Natura 2000, the purpose of which is to preserve the set proportion of the habitats of EU importance, the EU is entitled to bring judicial proceedings against the country and to enforce sanctions for non-implementation of the EU Nature Directive (European Commission 2018). Before the establishment of Natura 2000, most of the EU countries conducted a comprehensive inventory of nature values, including the mapping of habitats and forming a network of protected nature areas according to the EU guidelines, yet not all countries had sufficient resources to conduct it properly. One such project was implemented in Latvia (Ministry of Environmental Protection and Regional Development 2001; Latvian Fund for Nature 2002), yet it did not include mapping of habitats for the entire country, therefore, since that time there have been debates within the sector about the need to organize the mapping of habitats of EU importance (European Commission 2013) throughout the national territory. From 2017 to 2019, for the first time in the history of Latvia, and following common methodology, data on habitat distribution of EU importance was collected throughout the national territory. Such large-scale data collection, done in a relatively short period of time, is possible thanks to the EU Cohesion fund, which financed 85% of the project "Pre-conditions for better bio-diversity preservation and ecosystem protection in Latvia".

**The Importance of Nature Census in Introducing the Nature Conservation Policy**

Latvia takes part in global environmental protection and climate processes to ensure preservation of the planet for future generations. As a full EU member, Latvia must implement the common EU nature conservation policy, which differs significantly from the nature conservation practice that had been implemented before joining the EU. For Example, Specially Protected Nature Territories (further in the text – SPNT) were established in Latvia for purposes that not always prioritized the protection and conservation of nature values. For instance, the Law on Specially Protected Nature Territories (originally adopted in 1993) lays down the categories of special areas of conservation according to which, e.g., nature reserves are the territories which represent cultural, historical and nature values of a specific region and which are suitable for public recreation and education, whilst economic activities are organized ensuring the conservation of cultural, historical and nature values, i.e., the occurrence of nature values and enhancement of their quality is not a priority. Yet irrespective of the nationally defined SPNT status (i.e. a nature reserve or a protected landscape area), if the territory is a Natura 2000 site, economic activities must be planned so as not to deteriorate the status of the existing nature values and to improve them in future. To ensure a favourable conservation status for species and habitats, the implementation of EU nature conservation requirements is carried out on the basis of two European Council directives:

- Directive 92/43/EEC of 21 May 1992 "On the conservation of natural habitats and of wild fauna and flora" (European Commission 1992);
- Directive 2009/147/EC of 30 November 2009 "On the conservation of wild birds" (European Commission 2009).

In Latvia, requirements of these directives were carried over by the law "On protection of species and habitats" (2001); the law "On specially protected nature territories" (1993); the law "On environmental impact assessment" (1998) and the subordinate regulations of the Cabinet of Ministers and other legislative acts. The underlying idea of the EU nature conservation policy is the concept of "conservation in a favourable status of selected habitat types and species of Community interest" (Veinla 2009), which must ensure the long-term existence and functioning of protected species and habitats not only within the special areas of conservation (SPNT, hereinafter the term is used within the meaning of the law "On specially protected nature territories"), but also outside them. This is a complex task for any country, because SPNT regulations partially ensure the conservation of nature values within the conservation areas by setting the restrictions for economic activities. Outside these areas the status "protected" can be granted to species by limiting or prohibiting their exploitation, and it is much more complex when it comes to habitats. Therefore, it is essential that the most important and valuable areas which offer the greatest bio-diversity are included in the SPNT category. Without having the information about the mapping of habitats of EU importance and species distribution throughout the country, we cannot be certain that the existing Natura 2000 network provides species and habitats of national importance with the required protection status. At national level, it must be ensured that a set proportion of habitats (including special habitats) from the total surface area of the country is included in the Natura 2000 network (also known as the network of special areas of conservation of EU importance) (European Commission 1997).

## The Importance of Nature Census in Implementing the Nature Conservation Policy

Mapping the habitats of EU importance is crucial not only for the implementation of EU requirements, but also for Latvia's municipalities, entrepreneurs and other economic operators so as to be able to plan and develop their economic activities. Namely, according to the legislation of Latvia, it is permitted to carry out an envisaged activity if it does not have an adverse effect on ecological functions and the integrity of a protected site of EU importance, which is a part of the Natura 2000 network and as long as it does not contradict with its establishment and conservation purposes (Law 1993). One of the most important Environmental Impact Assessment (further EIA) objectives is to predict the impact of a specific activity on a habitat in a specific location and to compare it with the total habitat area in the country and all Natura 2000 sites. Conservation of a habitat is considered to be favourable if its natural range and surface areas are unchanged or are expanding; they have the characteristic structure and

functions which are necessary for sustainable existence of a habitat; and it is expected that they will keep existing in the near future. It must be ensured that there are favourable conditions for the protection of the typical species in these areas. If there is no available information in the country concerning habitat distribution of EU importance, then in each EIA such an assessment must be conducted within the specific area and the comparative information about the country in general is based on extrapolated data. The EIA initiator must involve the relevant nature experts, both increasing the expenses and prolonging the obtainment of permission. Moreover, one can always question the relevance of the assessment in respect to the total surface area of the national habitats of EU importance. At the same time, it must be pointed out that after carrying out the EIA procedure, economic operators expressed their reproach, when the location of their envisaged economic activities was identified as a habitat of EU importance or a habitat of protected species, and as a result the intended economic activities were restricted or prohibited. The number of such reproaches would very likely be much smaller if the information concerning the nature values in the specific area was made available prior the EIA procedure, and it were possible to take it into account before planning of activities.

**The Importance of Nature Census in Promoting Cross-Sectoral Co-operation**

Information about habitats of EU importance and habitats of protected species must be considered when planning territorial development at local and regional level. Furthermore, there is a case-law in Latvia which states that when planning territorial development, both nature conservation and environmental protection and economic development interests must be balanced out (Constitutional Court 2008). This means that insufficient information delays the integration of nature conservation requirements into the development plans of other sectors and prevents balanced and sustainable development. These problems are also emphasized in the "Guidelines for Environmental Policy (2014-2020)" (Ministry of Environmental Protection and Regional Development 2014). Lack of data on habitat distribution is also regarded as one of limiting factors for natural resource management in "Guidelines for Forestry and Related Sectors (2015-2020)" (Ministry of Agriculture 2015). In considering the forestry sector, it is important to emphasize that information about habitat distribution and its quality is mandatory to be able to reach inter-institutional agreement on specially protected national forestry areas. Similarly, data collected during the mapping of habitats of EU importance would allow for an update of the coastal dune protection zone of the Baltic Sea and to improve the quality of the territorial planning. Often such nature conservation measures as the establishment of micro-reserves is used to limit or stop the planned construction on site because during the territorial planning stage the intended use of the territory was not discussed thoroughly and the occurrence of nature values on site was not assessed properly.

**The Importance of Nature Census in Improving National Natural Resource Databases**

Besides the collecting of data on habitats of EU importance, the quality of information in national natural resource databases is also constantly improving. For instance, as the data of different national authorities and organizations is constantly being co-ordinated, mistakes and inaccuracies are identified and eliminated. Such data exchange offers a practically applicable result. For example, there is co-operation between the Nature Conservation Agency and the Rural Support Service (RSS) which implements the rural support policy at national level (MK 2015). Data collected during the mapping of habitats of EU importance and concerning the grasslands of high nature value is transferred to the RSS to administer the payments for management of grasslands of high nature value more effectively.

When starting the inventory of nature values, the criteria for surveyed and non-surveyed areas were set by the Cabinet of Ministers (Ministry of Environmental Protection and Regional Development 2016). There was established the methodology for mapping the habitat distribution of EU importance, according to EU directive 92/43/EEC of 21 May 1992 "*On the conservation of natural habitats and of wild fauna and flora*" (European Commission 1992) and for their quality and organization of work (for a full description of the methodology see the reference: Nature Conservation Agency 2016), which was co-ordinated with the Ministry of Agriculture and confirmed by the Ministry of Environmental Protection and Regional Development. To illustrate the diversity of data used, the authors of this article indicate below the sources of natural resource databases from which to select information about different types of habitats.

- Forestry and Mires. These include areas which must be surveyed by experts *in situ* on a mandatory basis, as well as areas where an *in situ* survey is not required due to a small probability of discovering any nature values (non-surveyed areas). The main data sources were the associations of State Forest Service (SFS), JSC "Latvia's State Forests", Nature Conservation Agency (NCA), Environment State Bureau (ESB), State Environmental Service (SES), and Latvian Peat Association. To distinguish different types of forestry habitats, geo-morphological data on distribution of ash trees and inland dunes was used, tracing the areas that are surveyed on a mandatory basis from the maps of the Latvian Environment, Geology and Meteorology Centre (LEGMC). Furthermore, in co-operation with experts, a watershed between the coastal dunes and inland dunes was set.
- Grasslands. Mandatory surveyed and non-surveyed agricultural areas are selected by using data provided by the Rural Support Service, Nature Conservation Agency, Latvian Fund for Nature and State Land Service (SLS). For example, "mandatory surveyed" status was assigned to agricultural areas, which correspond to the code "type of use of cultivated plants and lands", indicated in the RSS database "710 – perennial grasslands", and grasslands of

high nature value found in the habitat section of the nature database "Ozols", whereas the areas which correspond to other cultivated plants were excluded from the "surveyed" class.

- Freshwaters. No distinction was made between "mandatory surveyed" and "non-surveyed" areas. All water courses of natural origin were selected for mapping purposes. Namely, information provided by the LEGMC, SLS and the land amelioration cadastre was used for these purposes. Topographic maps provided by the Latvian Geo-Spatial Information Agency were also used in the process. Artificial water courses and hydro-electric power stations, as well as other significantly modified water courses (amelioration systems) were excluded from the mapping process.
- Rocks and caves of EU importance. The mapping of these habitats had a solely informative nature. Before mapping the rocky habitats and caves, the experts had to carry out the geological and geo-morphological information analysis of each mapping square, using the terrain maps of the LEGMC, sediment maps, real material (point) maps of rocky habitats and hydro-geological maps with indications of springs.

The status of "non-surveyed area" was assigned to the national and local areas of transportation (including motor roads and railways), communication infrastructures and their protection zones, as well as the protection zones of amelioration systems outside the special areas of conservation and micro-reserves, and the geo-spatial data which was available to the experts. Areas, where EIAs had been conducted or concluded for the past 3 years, and SPNTs, for which a nature conservation plan has been developed for the past 3 years, are also included in the "non-surveyed area" category.

Not all nature databases provide information in the form of geo-spatial data, moreover, such information is not always correct. Often, information in the database is not updated for the entire data set, sometimes there are inconsistencies of information in databases of different national authorities. For example, a specific area can be defined as a forest in the SFS database, whereas according to RSS this area is managed as a canola field, and there is completely different information about this area in the State Unified Computerized Land Register. Sometimes situations occur, where the plant cover of an ameliorated system is inventoried as a forest, forest plots reaching the rivers and lakes, parking lots and courtyards. During the Nature Census, there were many inconsistencies identified between the SLS data (cadastre) and the real situation.

**Conclusion**

Sustainable management of natural resources is based on decisions which are made, considering comprehensible and qualitative data analysis. As in any other sector, there is a necessity for fundamental data inventory when it comes to the effective management of special areas of conservation and nature values. However, this process is also accompanied by negative trends, e.g., misleading the public and

even fraudulent conduct by dishonest individuals or companies in a specific habitat group. Therefore, the authors of this article emphasize that after the Nature Census, the volume of publicly-available information about the nature values of Latvia will increase significantly. This will contribute to ensuring decision-making transparency and will decrease possible corruption, moreover, it will accelerate the speed of passing legislative acts and decision-making related to economic activities in special areas of conservation.

Although, primarily, the mapping of habitats of EU importance is a contribution to introducing an effective and liable nature conservation policy, the process of Nature Census raises many issues related to the national governance system and reaching the aims to introduce sustainable development principles. A good example of that is the heated debates among representatives of different sectors about the SPNT proportion in Latvia. The nature conservation sector indicates the factors that prevent the assignment of adequate favourable conservation status and even destroy the natural resources of Latvian and of EU importance (Report to European Commission 2012), whereas the sectors of nature development and management draw attention to the "abundance" of SPNT, which hinders economic activities (Public Broadcasting of Latvia 2017). Thus, irrespective of how important the data collected during the Nature Census is, its use for determining the SPNT will depend on political decision-makers, who, hopefully, will make their decisions, based on constructive inter-sectoral debates that are oriented on sustainable development.

Habitats of EU importance are only one of many identified Latvian nature values. There is a lack of data concerning the distribution of protected species in the country. Not always shall conservation and management of habitats of EU importance contribute to the conservation of species. Consequently, after analysing Nature Census data related to the distribution of specially protected species in the country, there shall remain many unidentified factors, and Nature Census will not be a solution to all problems in the nature conservation sector. To make the best use of the Nature Census results, it would be important to enhance the habitat monitoring programs so as to provide up-to-date, scientifically grounded data about the entire country. This could be used later on to ensure a balanced decision-making. Nevertheless, the nature conservation sector must realize that species and habitat conservation cannot be planned long-term, while ignoring the interests of the third parties, and the other sectors must understand that integration of nature conservation principles in the sector policies and their implementation is cheaper and more efficient than trying to save and renew something that has already become almost extinct.

**Kopsavilkums**

Laikā līdz 2014. gadam tikai 10 procentiem no Latvijas valsts teritorijas bija pieejamas Eiropas Savienības nozīmes aizsargājamo sugu un biotopu izplatības kartes. Apjomīgu un kvalitatīvu datu trūkums ietekmē dabas un vides aizsardzības efektivitāti, kā arī negatīvi iespaido Latvijas spēju pildīt ES saistības un iespējas ziņot par vispārīgiem vides indikatoriem un to pārmaiņām Latvijas valstī kopumā. Tāpēc laikā no 2017. līdz 2019. gadam pirmo reizi Latvijas vēsturē notiek ES nozīmes biotopu izplatības datu ieguve

pēc vienotas metodikas visā valsts teritorijā jeb Dabas skaitīšana. Raksta mērķis ir analizēt ES nozīmes biotopu kartēšanas nozīmi dabas aizsardzības politikas ieviešanā un īstenošanā atbilstoši ES direktīvu prasību integrēšanu Latvijas valsts pārvaldībā pār īpaši aizsargājamām dabas teritorijām. Rakstā apskatīta dabas vērtību inventarizācija politikas ieviešanas, īstenošanas, starpnozaru sadarbības un valsts nozīmes dabas datu bāžu integritātes aspektā. Vienlaikus akcentējot, ka Dabas skaitīšana aktualizē arī daudzus problēmjautājumus valsts pārvaldības sistēmā un valsts mērķu īstenošanā ilgtspējīgas attīstības principu ieviešanā.

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# PROJECTED CHANGES IN THE NUMBER OF INHABITANTS OF LATVIA IN THE EVENT OF THE STABILIZATION OF EMIGRATION

## Latvijas iedzīvotāju skaita prognozējamās pārmaiņas, stabilizējoties starpvalstu migrācijai

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**Abstract.** The decline in population is a significant problem for Latvia, the causes and consequences of which have been brought to the attention of many researchers. The aim of this study is to perform a mathematical analysis of the population and the main components of its changes at the national level to evaluate the use of these indicators in the estimation of population changes. The methods of this research are based on data regression analysis. The statistical analysis of this work uses the data of the Central Statistical Bureau of Latvia. The study also utilised Statistical Office of the European Union (Eurostat) population projections at the national level. The results of this research are based on data regression analysis. Although linear regression models evaluate changes in the population of Latvia and show very strong correlation, they must be treated critically.

The population migration balance is not predictable based on historical observations and/or by using mathematical models. In migration balance forecast models that are based on mathematical statistical methods, the uncertainty is so great that the practical value of such models is negligible.

**Keywords:** *population of Latvia, regression analysis, population forecasts, natural growth, population migration balance*

### Introduction

The decline in population is a significant problem for Latvia, the causes and consequences of which have been brought to the attention of many researchers. Most research is devoted to studying the impact of mobility and migration on territorial

disparities (Krišjāne et al. 2017; Zhitin et al. 2018; Arbidane and Markevica 2016; Göler et al. 2014; Apsīte et al. 2012; Krišjāne and Bērziņš 2012, etc.). The prediction of the population is important in planning the availability of labour (Arbidane and Markevica 2016; Kekla and Senfelde 2016, etc.) as well as other economic and social activities (Klavenieks and Blumberga 2016; Berloviene and Samusevich 2016 etc.).

The aim of this work is to perform a mathematical analysis of the population and the main components of its changes at the Latvian national level in order to evaluate the use of these indicators in the estimation of population changes.

**Data and Methods**

The statistical analysis for this work uses the data of the Central Statistical Bureau of Latvia (CSB) last updated on 1 January 2018. In turn, the calculation of the forecasts in Table 3 includes the more recent population figure on 1 January 2019. The research process also used Statistical Office of the European Union (Eurostat) population projections at the national level, as well as development planning documents by the government and government structures of Latvia.

Methods incorporated in this study are based on data regression analysis. As a regression co-efficient criterion for rejecting or accepting a zero hypothesis, a rule was set that the zero value would not be in the confidence interval of a regression co-efficient with a 95% probability. Unless otherwise stated in this work, a 95% probability was used to assess the statistical significance.

**The strategic goal of Latvian population and population forecasts.**

According to the main Latvian strategic planning document *Sustainable Development Strategy of Latvia until 2030* (approved by the Latvian Parliament in 2010) the aim of Latvia is to reach a population level of more than 2.02 million by 2030 (Sustainable... 2010). The Government of Latvia decided not to change this goal in 2015 (Latvijas Ilgtspējīgas... 2015), specifying that this goal is moving forward satisfactorily. This target was considered to be likely to be achieved if the population will exceed 1.93 million in 2020 (Indikatori… 2015). The exact same goal for 2020 was also included in the National Development Plan of Latvia for 2014-2020 (National Development Plan… 2012). Unfortunately, according to the CSB data, on January 1, 2019, there were only 1.92 million inhabitants in Latvia. Given the demographic and migration trends in Latvia, neither the 2020, nor the 2030 target can be achieved. Such conclusions follow from the Latvian population forecasts published by the Ministry for the Economy of Latvia (Informatīvais… 2018) and Eurostat (Table 1).

Forecasts for 2020 and 2030 were not published in the Labor Market Forecasts by the Ministry for the Economy of Latvia (Informatīvais… 2018). These values were calculated by the author based on the average size of population changes recorded in the report (negative 0.6% per annum in 2018-2025 and negative 0.2% in 2026-2035).

The population projection prepared by the Ministry for the Economy of Latvia is based on assumptions that natural growth will be -4.6 promile per year, while international migration will increase linearly reaching a positive value starting from 2024.

Table 1. **Latvian population forecasts (millions)** (Eurostat and Ministry for the Economy data)

| Year | Baseline projections | Lower fertility | Lower mortality | Higher migration | Lower migration | Ministry for the Economy |
|---|---|---|---|---|---|---|
| **2020** | 1.912 | 1.890 | 1.913 | 1.896 | 1.927 | 1.911 |
| **2025** | 1.831 | 1.791 | 1.835 | 1.799 | 1.863 | 1.864 |
| **2030** | 1.744 | 1.688 | 1.751 | 1.696 | 1.792 | 1.845 |
| **2035** | 1.662 | 1.592 | 1.673 | 1.600 | 1.724 | 1.818 |
| **2040** | 1.599 | 1.513 | 1.614 | 1.527 | 1.671 | - |

Eurostat's 2015 projection (Eurostat database 2015) looks at five scenarios by changing assumptions on birth rates, mortality (in different age and gender groups) and total migrant numbers.

When comparing the projections calculated by Eurostat in 2015 with real population data in 2019, it can be concluded that the Eurostat baseline projection was the most accurate one, but still too optimistic. On January 1, 2019, the population of Latvia was 5.6 thousand smaller than the Eurostat baseline projection. The projection based on lower mortality was 6.4 thousand lower, but the projection based on higher migration was 6.7 thousand higher than in reality.

**Linear regression of changes in population in Latvia**

In observing the numbers of the population in Latvia, which is decreasing year after year, there is a temptation to plug these numbers in to the regression model to predict future population.

By incorporating the annual change of the population of Latvia (from the restoration of independence, 1991-2018) into a simple linear regression analysis the determination co-efficient is 0.994 (Table 2). The regression co-efficient shows that the number of people in this period on average decreased by 26.6 thousand per year, while the confidence interval of the regression co-efficient (95%) ranged from between minus 25.5 and minus 25.7 thousand a year with a fantastically high level of confidence (t Stat = -63.6).

Looking at the period 2004-2018 and 2009-2018, the determination and regression co-efficient deteriorates, but the correlation remains almost functional. The linear regression determination co-efficient for the annual change in Latvia's population from EU accession (2004) to 2018 is 0.985. During this period, the population decreased by

26.1 thousand people per year on average, while the confidence interval of the regression co-efficient (95%) was between minus 24.1 and minus 28.0 thousand per year.

Table 2. **Linear regression analysis of the annual change of the population of Latvia**

| Time | Determination co-efficient | Regression co-efficient x1000 | Regression co-efficient lower 95% | Regression co-efficient upper 95% | Regression co-efficient t Stat |
|---|---|---|---|---|---|
| **1991-2018** | 0.994 | -26.609 | -27.470 | -25.749 | -63.567 |
| **2004-2018** | 0.985 | -26.081 | -28.023 | -24.140 | -29.023 |
| **2009-2018** | 0.958 | -24.094 | -28.185 | -20.004 | -13.584 |

Looking at the most recent trends (after the 2008-2009 world financial crisis), the co-efficient of linear regression determination for the change in population of Latvia per year (2009-2018) is 0.958. During this period, the population decreased on average by 24.1 thousand per year, while the confidence interval of the regression co-efficient (95%) ranged from between minus 20.0 and minus 28.2 thousand per year.

The estimated number of inhabitants was calculated based on the actual population in 2018. Since the regression co-efficient is negative, it can be predicted that the population will decrease by the size of the regression co-efficient. The scenario for the most pessimistic population changes is formed by calculating the trend of 1991-2018. Looking at the population change 2009-2018, the linear regression model shows that in 2040 the population should be between 1.314 and 1.494 million.

In the linear regression model for population, the regression co-efficient is directly proportional to the arithmetic difference in population change over one year. Conversely, population changes are based on the sum of two components: the natural growth of the population and the balance of migration during the year. Both of these components in Latvia's case have been negative since 1991 and their sum was also negative.

To check the correctness of the linear regression model for the population, one should check whether both components are predictable with simple linear regression.

**Statistical analysis of natural growth**

The numerical changes in the absolute size of demographic variables depend on population size. With similar conditions (population structure, economic and demographic behaviour, etc.), a population of 2.7 million will show a higher birth incidence, and number of deaths and other demographic variables than a population of 1.9 million. According to the linear regression analysis, the natural increase in the absolute size of the Latvian population between 1994 and 2018 was almost functionally related to the population. The co-efficient of determination between

population and natural growth was 0.78 (Figure 1). With a population drop of 10,000, natural growth between 1994 and 2018 fell by an average of 152 people per year.

It follows that as the population decreases, the impact of natural growth on population size will decrease in absolute terms. To improve the regression model for forecasting, a relative indicator should be used instead of natural growth - the natural growth per 1000 population.

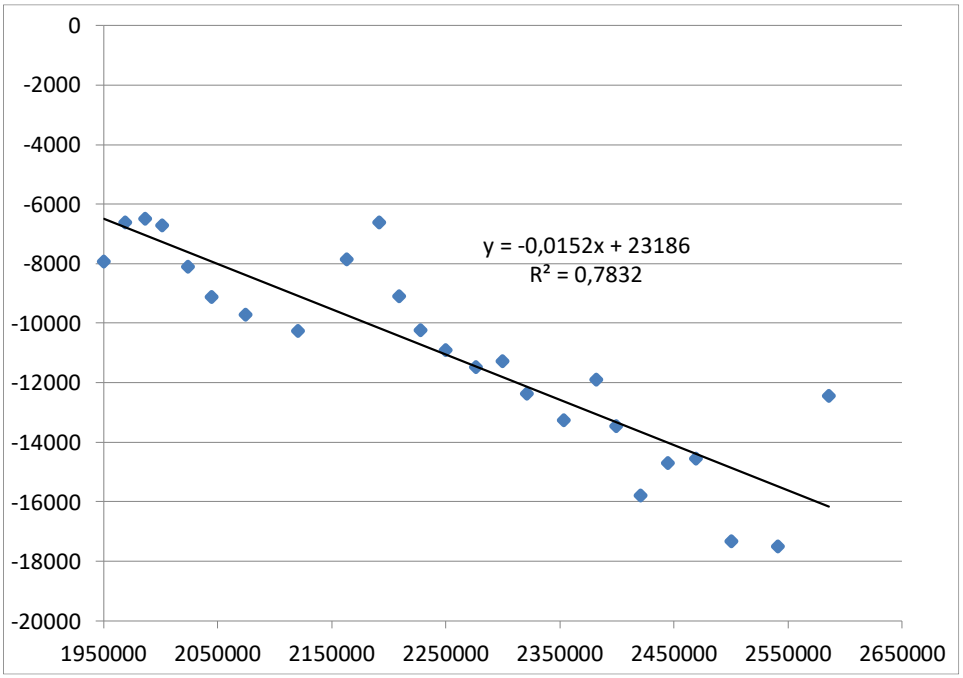


Figure 1. **Regression between population** (horizontal axis) **and natural growth** (vertical axis) (author's calculations using Statistical Bureau of Latvia data)

Before incorporating the natural growth per 1000 population in the model, it is necessary to determine whether this change in the indicator shows a statistically significant trend over time. According to the linear regression analysis, natural growth per 1000 inhabitants in Latvia between 1994 and 2018 had a statistically significant tendency to increase with a determination co-efficient of 0.78. During this period, natural growth per 1,000 inhabitants increased on average by 0.14 each year. The change in natural growth per 1000 inhabitants (regression co-efficient confidence interval) ranged between 0.11 and 0.17 per year (t Stat = 8.7). If the observed increase in natural growth per 1000 inhabitants will remain, the forecast model should take into account that natural growth per 1000 population will continue to increase. On the other hand, when evaluating the latest trends (2010-2017), one cannot say unambiguously whether natural growth per 1000 inhabitants is increasing or decreasing. Regression analysis shows that in 2010-2017 the confidence interval of the regression co-efficient for natural growth per 1000 inhabitants is very wide (t Stat is only 2.7) and with a 98% confidence in the regression co-efficient confidence interval includes null, which means that with a 98% reliability the zero hypothesis cannot be rejected. Evaluating the trend in 2010-2017 the natural increase per 1000 inhabitants could be considered

as a discrete random value that fluctuates around a certain average of -3.86847. It could be accepted that fluctuations in the near future will not exceed the intervals of two standard deviations (95% reliability) in the forecast model natural increase of 1000 inhabitants with 95% could range from -5.14 to -2.59. Forecasting the number of inhabitants may use the approach that in the near future the natural growth per 1000 inhabitants will fluctuate around the 2010-2017 average.

**Statistical analysis of the migration balance**

In theory, the absolute value of the migration balance should be closely related to the population. In countries with a high birth rate and many young people, it would be logical that the negative value of the migration balance would increase. In the developed countries, however, as the population grows, opportunities for emigrants to gain admittance are increasing, and so as the population increases, the positive balance of migration may increase. Conversely, as the population decreases, migration to the absolute value of the balance should decrease over time. By performing a regression analysis of Latvia's net migration data for the period from 1991 to 2017 and between 2004 and 2017 with a confidence level of 95%, the zero hypothesis that the migration balance changes according to population size cannot be rejected. Likewise, the zero hypothesis about the increase or decrease of the migration balance over time cannot be rejected. In all cases, the regression co-efficient confidence interval includes null.

Table 3. **Latvian population forecasts** (thousands)

| Year | Natural growth per 1000 inhabitants will be between -5.14 and -2.59, while migration balance will be minus 10,000 | Natural growth per 1000 inhabitants will be between -5.14 and -2.59, while the net migration will be zero | Eurostat projection with sensitivity test: no migration recalculated with correction based on 2019 actual population[1] |
|---|---|---|---|
| **2025** | 1802-1831 | 1862-1890 | 1884 |
| **2030** | 1707-1758 | 1814-1866 | 1845 |
| **2035** | 1614-1685 | 1768-1842 | 1806 |
| **2040** | 1523-1614 | 1723-1818 | 1772 |

[1]The 2015 population forecast for Latvia was re-calculated to include the actual population of 2019. Eurostat projection Sensitivity test: no migration is reduced by difference between Eurostat projection Sensitivity test: no migration (2019) and the actual population (2019).

Between 1991 and 2017, the migration balance did not have a functional relationship with the population and change over time, so in using the mathematical statistical method it is not possible to predict the migration balance with a practical usable confidence interval. The average migration balance in 2008-2017 was 17.80 thousand inhabitants with a standard deviation of 10.20 thousand. This means that with 95% confidence (two standard deviations), the migration balance can be

between the threshold of plus 3.60 thousand and minus 38.2 thousand. Using such confidence intervals, the confidence interval of the forecasts was so broad that the practical use of forecasts was questionable.

By dividing population changes into two components, it can be concluded that population changes due to natural delivery are predictable using mathematical statistics, but changes in population due to migration balance are not rational to predict using mathematical statistics methods. Therefore Eurostat, in addition to the five forecast scenarios, also calculates the potential population change for no migration for all EU Member States. It is likely that a rational population forecast should be made by forecasting the change in the migration balance with qualitative research methods. For instance, by assuming that the natural growth per 1000 inhabitants will remain at the 2008-2017 average level, we will create two scenarios (Table 3). In the first, let us assume that from 2019 onwards, the average migration balance will stabilize at the 2015-2017 level (minus 10,000 inhabitants per year), while in the second, we may assume that from 2019 onwards, the average migration balance will stabilize at zero.

## Conclusions

Decreasing population means less internal demand and less labour supply. It follows that there are presently no signs of a rapid change in Latvia's economic development. The population of Latvia will continue to decline even if the migration balance stabilizes at zero.

In turn, Eurostat's calculation based on assumptions about age and gender differences in mortality for each year is within the confidence interval of the forecast, based on a simple mathematical analysis of natural growth.

Though linear regression models evaluate changes in the population of Latvia and show very strong correlation, they must be treated critically.

The population migration balance is not predictable on the basis of historical observations and by using mathematical models. In migration balance forecast models that are based on mathematical statistical methods, the uncertainty is so great that the practical value of such models is negligible.

**Kopsavilkums**

Šī darba mērķis ir veikt iedzīvotāju skaita un tā pārmaiņu galveno komponentu matemātisko analīzi nacionālā līmenī, lai apzinātu šo indikatoru izmantošanu iedzīvotāju skaita pārmaiņu novērtējumā. Darba statistiskajā analīzē ir izmantoti Centrālās Statistikas pārvaldes dati un *Eurostat* veiktās iedzīvotāju skaita prognozes. Darba rezultātu pamatā ir datu regresijas analīze. Secinājums darba rezultātā: lai gan lineārās regresijas modeļi, vērtējot Latvijas iedzīvotāju skaita pārmaiņas, demonstrē ļoti augstus ciešuma rādītājus, pret tiem ir jāizturas kritiski. Savukārt iedzīvotāju migrācijas saldo nav viennozīmīgi prognozējams, ņemot vērā tā vēsturiskos novērojumus un izmantojot matemātiskos modeļus.

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# EMIGRATION AND REMITTANCES PATTERN ANALYSIS IN *LAGGING-BEHIND* REGIONS OF THE BALTICS: CASE STUDIES FOR NARVA, DAUGAVPILS AND VISAGINAS

# Emigrācijas un transfērmaksājumu izpēte Baltijas valstu nomales reģionos: Narvas (Igaunija), Daugavpils (Latvija) un Visaginas (Lietuva) piemēru analīze

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**Abstract.** In this paper the author is studying the economic effect of emigration in three lagging-behind Baltic regions over the past decade. During this time span the influence of emigration on the economy is analyzed in terms of the size of migration flows, taxation system differences and the level of remittances in the Baltic countries, all of which affect local economies / communities.

An analysis in made of three distinctive *lagging-behind* regions: Estonian Narva, Latvian Daugavpils and Lithuanian Visaginas. The overall impact of emigration on the economies of the Baltic countries is evaluated by a weighting of negative and positive factors.

In order to measure the influence of emigration on the selected Baltic economies – two quantitative approaches were developed. Each of these scenarios contains different sets of parameters and these combinations describe the economic impact of migration. Underlying formulae of the undertaken approaches, with small modifications, may be used for the examination of similar issues in other regions and countries.

**Keywords:** *economic migration, remittances, taxes, Baltic region, lagging-behind regions, Narva, Daugavpils, Visaginas*

## Introduction

Migration nowadays is a new norm for the expression of attitude. People are leaving one socio-economic environment in order to explore the benefits of another. Migration derives from a set of fundamental causes: inequalities in development, employment prospects, incomes and living conditions between and within the countries (King 2008).

The World Bank's annual research on migration shows that the quantity of people changing location is constantly growing (WB 2017). The size of remittances and money transfer services are following the same trend and developing rapidly.

Latvian emigration studies undertaken by O. Krasnopjorov (2011) and M. Hazans (2013) prove that emigration from Latvia has had a significant impact on the economy. M. Hazans reported that emigration could be up to 200 thousand people, which is more than 10% of the Latvian population. Migration researcher O. Krasnopjorov analyzed emigration patterns by comparing in-flows and out-flows of people at Rīga airport and at Latvian harbours. He concluded that the total number of emigrants could be around 177 thousand people.

Not only Latvia, but the whole Baltic region was hugely influenced by emigration over the last ten years. Latvians, Lithuanians and Estonians were leaving in

massive numbers towards the direction of the Western and Northern European countries. A number of studies show the negative impact of emigration (Krasnopjarov 2011) and fewer researches are taking a balanced approach in analysing not only the negative side of the emigration, but also the benefits (Hazans 2013).

In this study the author is modelling the economic impact of emigration not only on the national economies of each of the Baltic countries, but as well on the regions, which are exposed to emigration to the highest extent. Economically *lagging-behind* regions in the Baltics during the past ten years have been experiencing both the positive and negative impacts of migration.

It is essential to emphasize that in some cases it was impossible to extract statistical information about all three economically *lagging-behind* cities - Narva, Daugavpils and Visaginas. In these cases – information was gathered about the larger statistical regions – Ida-Viruma, Utena and Daugavpils counties.

Skilled and unskilled migrants have an opposite effect on the expenditure of government programs such as unemployment compensation and other existing social benefit (Borjas 1995). But it is important to mention that models in this research are examining the very basic relationship between migrants and their national economies and the skills and professional degrees of the emigrants are not taken into consideration in these basic scenario calculations.

The regional scope of this research is linked with the distinctive economically *lagging-behind* regions: Estonian Narva, Latvian Daugavpils and Lithuanian Visaginas. The objective of this study is (1) to measure the behaviour of emigration in the selected regions (2) to compare the emigration process and its patterns within the Baltic countries and (3) to evaluate the overall impact of emigration in economically *lagging-behind* regions.

**Data and Methods**

The main limitation for this study was the unavailability of regional statistics and the segmentation of national data into the regions. This study is based on statistical information analysis and on the adjustment of available data on *lagging-behind* regions.

While studying emigration and remittances in the economically *lagging-behind* regions the author of this study was using different international organisation sources - World Bank annual reports (2017), The International Organisation for Migration and information from each of the three Baltic country statistics bureau data bases (2018).

As well, and in order to understand the impact of migration, the author developed an economic equation, where taxes, number of emmigrants, and remittance levels are encapsulated. In economic terms, emigration translates into unpaid taxes from salaries and from the everyday expenditure on goods and services (Borjas 1995). At the same time, the migrant country-of-origin economy is gaining remittances and expenditure tax, which is paid from spending the money received from emigrants.

Two scenarios were developed with a different impact ratio to the emigrant country-of-origin economies.

In the first model, the smallest impact on emigrant country-of-origin economies is projected. In this scenario, factors such as average number of emmigrants per year, minimum wage level and Value Added Tax (VAT) are taken into consideration. VAT is multiplied with minimum wage in order to see the spending impact of one potential emigrant on the country-of-origin economy.

The second model is an average impact scenario on migrant country-of-origin economies. Average number of emmigrants per year, average wage, income tax and VAT are considered. It projects that all of the emigrants would have been paying taxes from an average salary and VAT from the expenditure had the emigrants stayed in the country-of-origin. So, in this model, the average wage is multiplied with VAT and Income tax in order to evaluate the impact of one potential emigrant on the country-of-origin economy.

In both models the author is comparing unpaid taxes with the size of existing remittances. In the first scenario the impact of one migrant is evaluated by VAT from a minimum wage expenditure. In the second scenario the impact of one migrant is evaluated by VAT and Income taxes from an average wage expenditure. In both scenarios the economic effect of emigrations is compared with existing remittances flow.

**Research Results and Discussion**

The three Baltic countries – Latvia, Lithuania and Estonia were facing the brutal reality of EU competition for labour over the past decade. Access to free movement throughout the EU in combination with economic problems in the Baltic region had a huge impact on the community. The population of the Baltic region in 2008 accounted for 6.7 million population. In less than a decade the Baltic region's population shrank by approximately 630 thousand people (Figure 1).

However, over the same time period all three Baltic economies gained a significant amount of remittances, which were sent by migrants to their families and friends back home. Since 2008, emigrants from the Baltic countries transferred more than 35 billion EUR to their homes and families (World Bank 2018).

The Baltic GDP has constantly been growing since 2010, but still in 2017 it did not reach pre-crisis level. Baltic remittances were following the track of the GDP fluctuations, but during the economic downturn remittances were more likely to grow, than fall. For example, in 2009 remittances slightly grew, while the economies of the three Baltic countries continued to shrink (Figure 1).

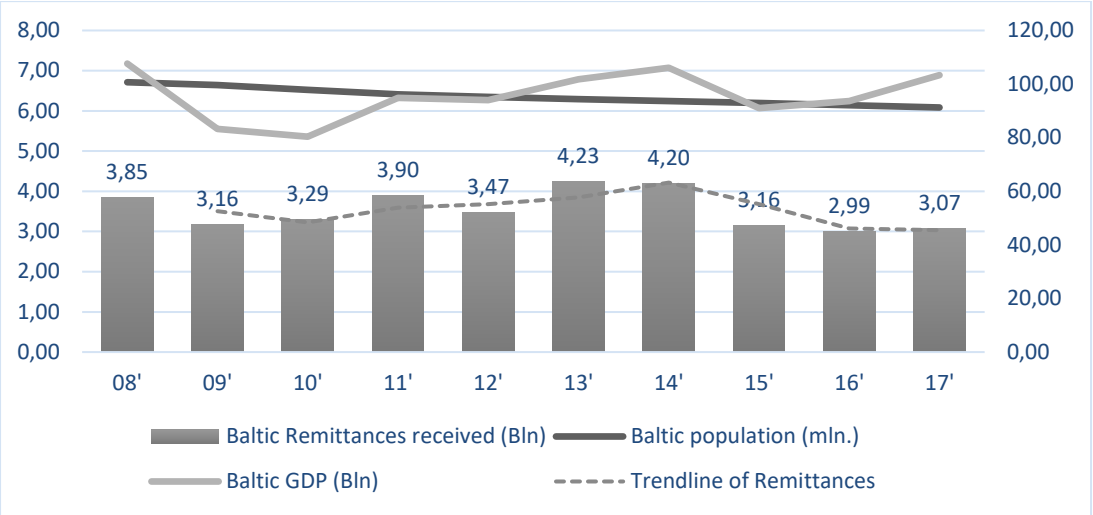


Figure 1. **GDP, remittances and population change in Baltic region 2008-2017** (author's figure based on National Statistics Bureau data)

In less than ten years the Baltic countries lost a huge part of their population: Lithuania - more than 370 thousand, Latvia - 240 thousand and Estonia - 50 thousand people.

Remittances sent to Baltics were following the economic curves of the respective countries but only the Estonian market showed constant remittance growth throughout the past ten years. In Latvia the flow of remittances has been constantly falling since 2008. In Lithuania the growth of remittance amounts was rapid until 2015 and then remittances had a huge downturn by more than 35%, however, the pace of de-population in Lithuania continued at the rate of 30 thousand people per year.

Another level of complexity is connected with regional disparities and levels of economic development within the Baltic countries. In an EU context, the Baltic region is not at all perceived as a *lagging behind* region. Nevertheless, several regions of Latvia, Lithuania and Estonia are economically *lagging behind* the average economic prospects in the Baltic region.

The Latvian Daugavpils, Estonian Narva and Lithuanian Visaginas regions all have many social, economic and even linguistic characteristics in common. All three towns are located in close proximity to the Eastern border of the EU, share a predominantly Russian socio-linguistic environment and all three regions are sharing a bad economic situation.

Baltic *economically lagging regions* can be divided into poor *low-income* and *low-growth* areas. For example, Estonian Narva and Latvian Daugavpils match with characteristics of a *low-income* area. These cities are converging rapidly and gaining higher value for the Estonian and Latvian economies. However, Lithuanian Visaginas is definitely a *low-growth* area, because it is experiencing stagnant productivity and job destruction.

Table 1. **Visual representation of GDP share in three *lagging behind* regions - Visaginas, Daugavpils and Narva (2008-2018)** (author's calculations based on National Statistics Bureau data)

| % of the GDP | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 | 2015 | 2016 | 2017 |
|---|---|---|---|---|---|---|---|---|---|---|
| Ida Viruma county | 8.0% | 7.60% | 8.20% | 8.30% | 7.60% | 7.90% | 7.30% | 6.50% | 6.00% | 6.00% |
| Daugavpils county | 2.99% | 3.19% | 3.02% | 3.28% | 3.19% | 3.20% | 3.10% | 2.90% | 2.90% | 2.88% |
| Utena county | 4.10% | 4.20% | 3.50% | 3.50% | 3.30% | 3.20% | 3.20% | 3.10% | 2.90% | 2.80% |

Daugavpils is the second largest town in Latvia by population size, but it accounts only for less than 3% of GDP (Table 1). The capital of Rīga accounts for 54% of GDP. The situation is similar in other Latvian cities with national status: Liepāja, Rēzekne, Jelgava, Jēkabpils, Jūrmala, Valmiera and Ventspils. The total share of 8 Latvian national-status cities accounts for less than 15% of the Latvian GDP. And the weight of these towns is even downsizing: from 2013 to 2016 - the GDP share dropped by 0.9% (CSB 2018).

Narva city is the second largest town in Estonia in terms of population size. It is located in the Ida-Viruma region, which is facing similar regional development problems. Ida-Viruma's share in the Estonian GDP has been shrinking throughout the past decade and it is now around 6% (Table 1). Similarly, as in the Latvian case - most of the Estonian economic activity is concentrated in the capital city, which accounts for more than 53% of the Estonian GDP and, as well, Tallinn's share of the Estonian GDP is continuously growing (Statistics Estonia 2018).

In Lithuania the bulk of GDP is concentrated around several Lithuanian cities: Vilnius, Kaunas and Klaipeda. Economic activity in these three municipalities is generating more than 70% of the Lithuanian GDP. The four regions of Telšiai, Alytas, Marijampole and Utena account for approximately 15% of the national GDP. Economic activity is more widely distributed across Lithuania than it is in Latvia and Estonia.

However, these *lagging behind* regions have similar characteristics: The Utena county share of the National GDP decreased throughout last decade from 4.1% down to a 2.8% share of the GDP. But from the perspective of the population – Visaginas lost 35% of its population in the past 10 years (OSP 2018).

Throughout the past decade overall remittance levels in the Baltic countries decreased. In Latvia it dropped by 35%, in Lithuania by 17%. Estonia was the only country of the Baltic trio to see an uplift of remittances by over 39%.

There is no official information about the distribution of remittance flows within each of the three Baltic countries. That is why the distribution of the remittances is adjusted to a regional share of the GDP. In such a way, remittances are distributed economically evenly.

An adjusted distribution of the remittances in these regions followed and even deepened the trend, as on a national level: remittances in the Latvian Latgale region decreased by more than 38%, in the Lithuanian Utena region by more than 43%, but in the Estonian Ida-Viruma region grew by only 5%. So, in the *lagging behind* regions distribution of the remittances is slowing down as well.

**Results**

The level of remittances is still relatively small in all three Baltic countries. As the five-year trend shows: the size of remittances has been decreasing continuously over the last five years. Nevertheless, the relative size of the remittances in 2017 in the Baltics is around 3% (Figure 1).

In the first model it is projected that if all the emigrants stayed in Latvia they would have spent only the minimum wage and paid VAT to the national budget. This scenario reveals that, on average, each year one emigrant would have generated approximately 937 EUR paid as VAT. Alternatively, one emigrant, on average, in one year sends more than 2000 EUR as remittances.

The second model of the Latvian market shows that one emigrant, in economic terms for the Latvian budget, equals on average up to 4500 EUR in unpaid taxes annually. This model projects that each year, on average, the Latvian budget loses around 1 billion EUR from 220 thousand emigrants (Table 2).

Table 2. **Model of emigration's average-impact scenario on the Latvian economy**
(author's calculations based on National Statistics Bureau data)

| | Average wage | VAT | Income tax | Loss from 1 migrant/monthly | Loss from 1 migrant/annually | Loss from 220 thousands of migrants annually (mln.) |
|---|---|---|---|---|---|---|
| 2016 | 827 | 21% | 24% | 372.2 | **4465.8** | 982.5 |
| 2017 | 884 | 21% | 24% | 397.8 | **4773.6** | 1050.2 |
| 2018 | 961 | 21% | 24% | 432.5 | **5189.4** | 1141.7 |

Remittances sent from abroad are boosting the Latvian economy annually - during the past decade the level of remittances never dropped under the 1.2 billion EUR benchmark. In terms of factors included in the second model, that means that emigration is still beneficial for the economy of the country-of-origin, but if the average wage continues to grow, then the benefit from taxes should outgrow the current benefit from remittances.

Similarly, if the Lithuanian economy was observed, through the prism of the first Model, then the value of one emigrant per year is on average 866 EUR. The overall effect from 350 thousand migrants annually has been growing for the last five years and in 2018 reached 353 million per year (Table 3).

Table 3. **Model of emigration's minimum-impact scenario on the Lithuanian economy** (author's calculations based on National Statistics Bureau data)

| | Minimum wage | VAT | Loss from 1 migrant/monthly | **Loss from 1 migrant/annually** | Loss from 350 thousands of migrants annually (mln.) |
|---|---|---|---|---|---|
| 2016 | 350 | 21% | 73.5 | **882.0** | 309 |
| 2017 | 380 | 21% | 79.8 | **957.6** | 335 |
| 2018 | 400 | 21% | 84.0 | **1008.0** | 353 |

On average, in the last 10 years, Lithuanian emigrants sent home a total amount of 1.606 billion EUR annually. In economic terms, every emigrant generates a 4.590 EUR value for the Lithuanian economy each year. This economic positive impact is 4 times higher than the annual loss of unpaid value added tax from the minimum wage.

In the last five years the level of remittances decreased, but it is still a substantial amount and remittance amounts are higher than possible unpaid VAT and income taxes from the average local salary. However, if the decrease of remittances continues, then almost certainly the total amount of unpaid taxes from 350 thousand emigrants will have a higher economic impact on the Lithuanian state budget.

In Estonia the size of the emigration flow was much smaller than in the other two Baltic countries. Overall, 50 thousand people emigrated and annually, on average, 451 million. EUR were sent as remittances. This means that every Estonian emigrant generated more than 9030 EUR annually for the Estonian state budget. This was twice as much as the Lithuanian emigrant and 1.5 times more than the Latvian emigrant.

Table 4. **Model of emigration's average-impact scenario on the Estonian economy** (author's calculations based on National Statistics Bureau data)

| | Average wage | VAT | Income Tax | Loss from 1 migrant/ monthly | **Loss from 1 migrant/ annually** | Loss from 50 thousand migrants annually (mln.) |
|---|---|---|---|---|---|---|
| 2016 | 1146 | 20% | 20% | 458.40 | **5500.8** | 275.04 |
| 2017 | 1221 | 20% | 20% | 488.40 | **5860.8** | 293.04 |
| 2018 | 1242 | 20% | 20% | 496.80 | **5961.6** | 298.08 |

Models of both scenarios (minimum and average) show that emigration is still beneficial for the Estonian economy. The value of unpaid taxes, even in the most positive case scenario, was reaching 5961 EUR per person annually (Table 4). Although this amount exceeds any other Baltic emigrant possible positive impact on the economy, it is nevertheless still two times less than the already existing annual remittances flow.

Both minimum & average impact scenarios indicated that regionally, emigrants could heavily support Estonian Narva, Latvian Daugavpils and Lithuanian Visaginas if they stayed and paid at least VAT from a minimum salary. The minimum envisaged impact on regional economies from unpaid taxes in the minimum impact scenario is

measured from 2 million EUR up to 7.8 million EUR annually (Table 5). The impact is very much dependent on the number of emmigrants and level of wages.

Table 5. **Model of emigration's minimum-impact scenario on the Baltic regions** (author's calculations based on National Statistics Bureau data)

| | Minimum annual unpaid taxes per 1 emigrant (EUR) | Number of emmigrants | Total amount of unpaid taxes (mln.EUR) |
|---|---|---|---|
| Daugavpils | 937.4 | 8720 | 8.2 |
| Visaginas | 866.7 | 2338 | 2.0 |
| Narva | 1081.1 | 7170 | 7.8 |

In the average impact scenario envisaged the annual effect from unpaid taxes is 7.7 million EUR in Visaginas, 39.1 million EUR in Narva and 39.5 million EUR in Daugavpils (Table 6). This means that the regional cities could have earned up to 39 million EUR if emigrants came back and started to pay VAT and income tax from an average salary. The overall economic impact depends on average salary level and the size of the emigration in the corresponding country.

Table 6. **Model of emigration's average-impact scenario on the Baltic regions** (author's calculations based on National Statistics Bureau data)

| | Average annual unpaid taxes per 1 emigrant (EUR) | Number of emmigrants | Total amount of unpaid taxes (mln.EUR) |
|---|---|---|---|
| Daugavpils | 4533.8 | 8720 | 39.5 |
| Visaginas | 3310.2 | 2338 | 7.7 |
| Narva | 5451.8 | 7170 | 39.1 |

The calculated effect from unpaid taxes, even in an average impact scenario, reaches only 70% of the annual total amount of remittances. That means that with the current socio-economic environment in the regions of the Baltic countries it will be at least 30% more beneficial for local economies to receive remittances from abroad. Of course, this assumption is based only on those economic factors, which are included in the average impact model.

## Conclusion

Economically *lagging behind* regions in the Baltics are suffering from similar problems: low economic activity, high emigration and very limited opportunities in the regions. Even though it is evident that remittances are an essential part of the economy, the amount of remittances has been decreasing over the past five years.

Nevertheless, the economic weight of each emigrant, in terms of capability of paying taxes, is growing. In the light of the economic growth of the Baltic economies - minimum and average salaries are increasing, which as well boosts the total value of taxes, which emigrants could have paid.

All three Baltic countries are currently benefiting from remittances, on average receiving 3.5 billion EUR annually. With the current socio-economic environment, the

benefit from remittances is bigger than the total amount of unpaid taxes of all the emigrants living abroad.

Among the three Baltic countries, the most generous regional emigrants are from Narva, generating more than 9000 EUR annually per person in the form of remittances. Emigrants from Daugavpils are sending, on average, annually sending 6700 EUR per person and emigrants from Visaginas 4600 EUR per person.

The model for the emigration average-impact scenario in the Baltic regions showed that the amount of taxes, which emigrants could have paid, is not exceeding the 75% threshold. Daugavpils - 68%, Visaginas - 72% and Narva – 60% of remittances.

Interestingly, in Estonia, where the average wage is higher than in the other two countries, taxes are not surpassing the 60% threshold of remittances. The reason for Estonian Narva being different and for the other two Baltic economically lagging regions being similar could be rather geographical. Daugavpils and Visaginas are located in close proximity to each other and the communities are very much inter-connected.

It is important to mention, that both models are taking into account a very limited number of factors, which makes it possible to measure only the short-term impact of emigration. In a long-term calculation many additional factors must be considered, such as emigrant intellectual capacity, possible value-adding production, investments in social care, education and others.

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**Kopsavilkums**

Šajā rakstā autors pēta emigrācijas ekonomisko nozīmi trīs Baltijas valstīs un salīdzina tās ietekmi uz trim atpalikušiem Baltijas reģioniem – Visaginu (Lietuva), Daugavpili (Latvija) un Narvu (Igaunija). Analizēta pēdējo desmit gadu informācija. Tiek pētīta emigrācijas ietekme uz ekonomiku, ņemot vērā emigrācijas plūsmas apjomu, nodokļu sistēmas atšķirības un naudas pārvedumu apjomu Baltijas valstīs.

Šī pētījuma mērķis ir 1) izmērīt emigrācijas ekonomiskās sekas uz Baltijas valstīm; 2) salīdzināt emigrācijas procesu un tā atšķirības Baltijas valstīs un 3) izmērīt kopējo emigrācijas ietekmi uz ekonomiski atpalikušiem reģioniem.

Emigrācijas ietekme uz Baltijas valstu ekonomiku vērtēta, summējot tās negatīvos un pozitīvos faktorus. Darbā izmantotas divas kvantitatīvas pieejas, lai novērtētu emigrācijas ietekmi uz izvēlētajām Baltijas valstīm un izraudzīto reģionu ekonomiku. Katrā no šiem scenārijiem ir dažādi parametru kopumi, un šīs kombinācijas apraksta migrācijas ekonomisko ietekmi. Pieeju pamatā esošās formulas ar nelielām pārmaiņām var tikt izmantotas līdzīgu jautājumu izskatīšanai citos reģionos un valstīs.

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# EXPLORING LABOUR MIGRATION FROM LATVIA: GEOGRAPHIES OF ORIGIN

## Darba spēka migrācijas izpēte Latvijā: izbraukšanas ģeogrāfija

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**Abstract.** The aim of this study is to explore labour migration geographies in order to reveal peculiar aspects of emigration spatial distributions between core and peripheral sending regions and destination country choices. In this study the term *core* is considered the capital of Latvia, Rīga, and the term *periphery* is considered as the remaining statistical regions in Latvia as well as the receiving countries which are identified as the UK, Ireland, Germany, Norway and Sweden. The study is based on a database derived from an online survey and analysed through statistical methods.

The findings suggest that the profiles of labour migrants differ sharply in terms of geographic context in Latvia. Migrants from the *core* part of the country were more educated, skilled and had worked in the tertiary sector of the economy prior moving away from Latvia than their counterparts from *peripheral* regions. In addition, other findings show that migrants from the *core* are less likely to be circular migrants, but more often than not, migrants from the *periphery* use their own efforts to find a job in the destination country. In terms of destination country geographies, emigrants from the *core* more often choose Germany, Norway and Sweden, but emigrants with lower hierarchy in education and occupation levels engage more in circular movements by repeatedly going to Ireland and the UK.

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**Keywords:** *labour migration, core, periphery, Latvia, youth*

### Introduction

Sources of human capital as substantial forces in the economic development of Western countries are often attracted from poorer economies. Migration flows from

Central and Eastern-European countries are global economic semi-peripheries and are examples of relations among *core* and *periphery* (Torok 2017). Migration from the European *periphery* are seen as a factor facilitating *peripheralisation* (Lulle 2019). Bartlett and Prica (2013) show evidence of the existence of *core* regions, *peripheral* regions and super-*peripheral* regions. The Low intensity of peripheral economies that are overshadowed by core regions enforces factor mobility which includes various forms of labour mobilities (Bosworth and Venhorst 2018). Analysis of migrants to the 'escalator region' in the UK (Fielding 1992) suggest that selectivity of migration relates to workers occupying lower and higher levels of the labour sector displaying the complex nature of occupational mobility (Findlay et al. 2009, McCollum et al. 2018). Spatial disparities and societal changes, in economic development and demographic characteristics, are intertwined in several ways. Economically weak regions are often affected by both age and gender selective out-migration, leading to an unbalanced demographic and to socio-economic structures (Leibert 2016; Wiest 2016) however, in the case of Latvia, both age and gender are not statistically significant pre-conditions for out-migration.

The aim of this study is to explore labour migration geographies in order to reveal peculiar aspects of emigration spatial distributions between core and peripheral sending regions and destination country choices. In this study an analysis of labour migration is used to reveal peculiar aspects for different spatial distributions of core and peripheral regions of a sending country, and which are associated with peripherality and exclusive dependance on the centres (Skeldon 1997). Furthermore, we look at the geographies of destination countries. Countries of destination were previously identified with centrality, accumulation of human resources, and connectedness (Skeldon 1997).

To study geographical aspects of out-going migration flows we use the geographical division of Latvia in two distinct regions. Firstly, we assume that core includes urban areas around Rīga - the economic center of Latvia. Secondly, periphery is considered as being all other urban and rural regions in Latvia, where economic activity is less dense (Pierīga, Kurzeme, Zemgale, Latgale and Vidzeme).

The analysis examines quantitative features of labour migrants in Latvia considering the core-periphery divide. The analysis focuses on following two specific research questions:

- What are the main features of labour emigrants from core and peripheral parts of Latvia?
- How does the core and peripheral divide translate into choice of destination?

The regional geographies of out-migration in relation to low economic activity and unemployment leading to peripheralisation tendencies are little researched thus we seek to attract more attention by exemplifying the case of Latvia.

## Data and Methods

The dataset consists of 2567 responses from Latvian emigrants in the main destination countries. The study was conducted via an online Internet-based data collection method and the questionnaire was tailor made. The rapid development of information and communication technologies allows migration scholars to adapt these methods for their research (McCollum and Apsite-Berina 2015; Oiarzabal 2012; Reips and Buffardi 2012). This particular study was conducted in 2016 and administered through the social network site (www.draugiem.lv). Acquired data was analysed using the Crosstab chi-square test. The survey reveals that the main destination countries for Latvian emigrants are the United Kingdom, Ireland, Germany, Norway and Sweden.

Figure 1 illustrates the distribution of respondents among the statistical regions of Latvia. In the case of Kurzeme, the share of young labour migrants is greater than for other regions which is also confirmed by the statistical office where the highest number of emigrants in the last three years have been registered as being from the Kurzeme region (CSP 2018).

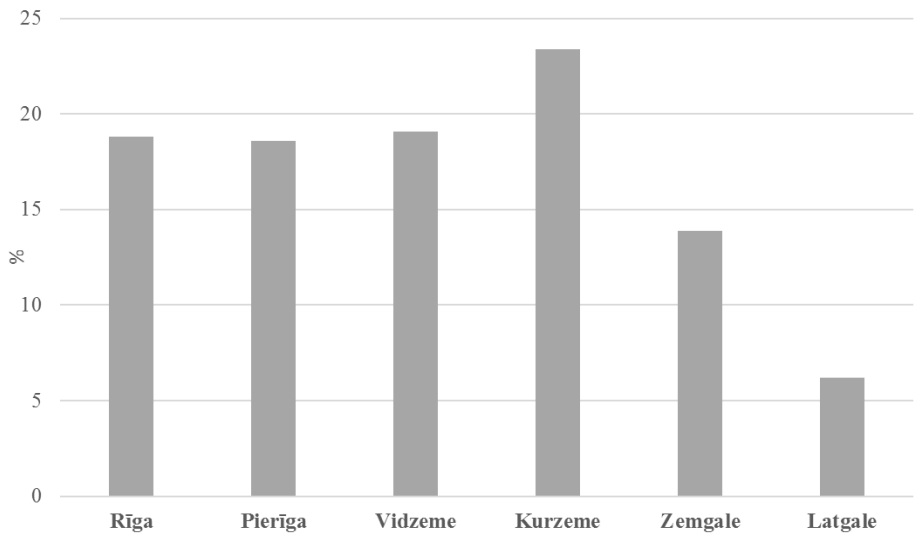


Figure 1. **Labour migration from regions of Latvia** (Survey 2016, n=2567)

## Results

Table 1 displays the profile of labour emigrants residing in one of the top destination countries (the UK, Ireland, Germany, Norway and Sweden). The analysis disaggregates the sample according to place of origin before emigration and shows the percentage of respondents from core and peripheral territories in Latvia.

Table 1. **Characteristics of labour migrants from core and periphery locations in Latvia**

| Variable | Core | Periphery | $X^2$ |
|---|---|---|---|
| | % | % | |
| ***Gender*** | | | |
| Male | 39,2% | 37,7% | 0,36 |
| Female | 60,8% | 62,3% | |
| ***Educational level*** | | | |
| Primary education or less | 8,5% | 12,8% | **63,55**** |
| Secondary education | 21,2% | 25,7% | |
| Post-secondary non-tertiary education | 29,1% | 38,2% | |
| Tertiary education | 41,2% | 23,3% | |
| ***Age group*** | | | |
| Below 35 years of age | 48,5% | 52,4% | 2,96 |
| Above 34 years of age | 51,5% | 47,6% | |
| ***Occupational status abroad*** | | | |
| Student, pupil | 5,6% | 5,4% | **34,88**** |
| House-person, caring, and other not in employment | 15,4% | 15,9% | |
| Manual | 20,7% | 29,0% | |
| Skilled manual | 22,8% | 24,9% | |
| Clerical and other administrative | 13,5% | 12,0% | |
| Professional, manager | 22,0% | 12,7% | |
| ***Occupational status in Latvia (before emigration)*** | | | |
| Student, pupil | 12,9% | 17,6% | **70,16**** |
| House-person, caring, and other not in employment | 7,9% | 12,8% | |
| Manual | 8,1% | 16,3% | |
| Skilled manual | 16,2% | 17,1% | |
| Clerical and other administrative | 26,1% | 19,9% | |
| Professional, manager | 28,8% | 16,5% | |
| ***Recruitment channels*** | | | |
| Friends and relatives | 46,1% | 59,4% | **33,47**** |
| Recruitment agency | 12,5% | 12,6% | |
| Own efforts | 29,4% | 20,4% | |
| Advertisement | 12,0% | 7,6% | |
| ***Circular migration*** | | | |
| Yes | 51,0% | 42,9% | **10,56**** |
| No | 49,0% | 57,1% | |
| ***Country of destination*** | | | |
| United Kingdom | 38,4% | 40,4% | **26,77**** |
| Germany | 22,8% | 18,7% | |
| Ireland | 12,7% | 21,1% | |
| Norway | 13,5% | 11,3% | |
| Sweden | 12,7% | 8,5% | |

***p<0.001 **p<0.05 *p<0.1

The differences in terms of characteristics of labour migrants between core and periphery parts of the country were confirmed by the chi-squared test (Table 1). Eight variables in total were tested. Results reveal that slightly more men have emigrated from core than from periphery, but that a higher percentage of labour emigrants from periphery are women. However, statistical analysis shows that these differences are not statistically significant, meaning that there is no gender-based difference in terms of emigration geographies from Latvia. From Table 1 it can be observed that there are also no statistically significant differences between core and periphery in terms of age group.

Six of the analysed variables confirmed statistically significant differences among the studied groups. As it is evident from Table 1. there are differences in terms of education, occupation before and after emigration, country of destination, recruitment channels and choice of destination countries.

There are differences in terms of education level. A greater share of the surveyed labour migrants with tertiary education departed from the core. Meanwhile more migrants holding an education level lower than tertiary moved from peripheral regions (76.7%) compared to core (59.8%). These findings suggest that the level of investment in human capital prior to emigration has been greater among those from the core than for those residing in peripheral parts of the country.

Furthermore, occupational status also exemplifies core-periphery differences. More skilled and qualified labour migrants (professionals, managers and administrative workers) emigrated from the core. At the same time most of the manual workers departed from peripheral regions of the country. Similar findings are displayed in occupational status analysis at the destination country. Migrants who moved away from the core more often found employment consistent with their previous skills, but migrants from the periphery were more likely to become manual workers. In the case of migrants from the periphery, the majority - nearly 30% abroad are employed as manual labourers, however, before emigration they were doing clerical or other administrative jobs. Peripheral migrants in terms of occupational status positions experience a double downward shift. In addition, labour migrants from core parts of the country experience an even sharper downward occupational mobility experiencing shift between status and place (Schuster 2005). Similar to migrants from peripheral regions, also migrants from core parts abroad are often employed as manual workers (23%). But prior to migration, the majority of respondents (27.8%) were employed as professionals and managers.

Eastern European migrants traditionally rely on the support of informal social networks and use this as a source of information on employment opportunities. Analysis reveals statistically significant differences among labour migrants from core and periphery locations in terms of recruitment channels. The share of migrants who use friends and relatives as sources of information for employment abroad is (59%) from periphery and (46%) in the case of core. Another feature is that labour migrants from core parts of Latvia have relied more on their own efforts to find employment abroad that can be linked to a higher level of education and more specific requirements for employment abroad. As it was noted before, migrants from core parts experience occupational downward mobility to a much lower extent than do labour migrants from periphery locations.

Interestingly, repeated migration and circular movements are more evident among labour migrants from the periphery, but first time migrants more often come from the core. This point exemplifies migration as a strategy to overcome periodic employment issues in peripheral Latvia. First time emigrants from the core parts of Latvia emigrate mainly to access higher levels of income.

Analysis of the geographies of labour migrants from Latvia in the receiving countries is differentiated among labour migrants from core and periphery. Overall, the variety of background among migrants from core and peripheral parts of the country show statistically significant differences in their destination countries. The largest number of labour migrants from Latvia is going towards the United Kingdom where labour migrants from periphery slightly exceed their counterparts from the core. A similar trend is also evident in the case of Ireland where migrants from the periphery slightly outnumber migrants from central parts. However, labour migrants from core parts of the country are more evident in cases of the so-called new destination countries such as Germany, Norway and Sweden.

**Conclusions**

This analysis allows us to identify distinctive features of labour migrants within the EU. The geographical scale of this analysis focuses on the distinction between core parts of Latvia and the peripheral regions. Similarly, the geographic approach is used to illustrate destination country choices among labour migrants from the core and the periphery.

The results suggest that there are differences as the majority of analysed aspects showed statistically significant results among labour migrants from core and peripheral parts of the country. Among the analysed respondents there was no gender and age difference when looking at the core-periphery divide contrary to other studies (Leibert 2016; Wiest 2016). Previous studies have found that younger people emigrate from peripheral parts which can be related to opportunities and life style migration (Korpela 2009), but in the case of Latvia some of the age-specific conditions can be met by migrating to the core part of the country where educational and employment opportunities are more diverse.

However, there are a number of differences among labour migrants originating from core and periphery locations in Latvia. Emigrants from the core part of the country can be characterised, firstly, as having tertiary education; secondly, to be a qualified worker before emigration (professionals, managers and administrative workers) and to be more likely to occupy a similar position also in the country of destination; thirdly, they have found employment abroad more pro-actively, are more first-time movers and have chosen destination countries such as Germany, Sweden and Norway. Overall, these are migrants with a high human capital who tend to move to ‘escalator regions’ (Fielding 1992) where higher levels of social mobility (Smith and Sage 2014) and occupational mobility (Findlay et al. 2009) can be accessed.

Against this backdrop, labour migrants from periphery locations mostly hold a secondary or vocational education, and before emigration are employed as clerical and other administrative workers, but once abroad to a higher extent, they concentrate their efforts in low-skilled manual work sectors thus experiencing a downward occupational mobility. Labour migrants from the periphery more often are circular migrants and as

a country of destination they mostly choose Ireland and the UK where the strong support of friends and relatives is ever present.

More so, it is evident that labour migrants from core and peripheral parts of the country select different destinations. Reverse patterns can be observed as migrants from core parts generally hold a higher level of education and are higher in the occupational hierarchy and, as a destination country choose relatively new destinations – Germany, Norway and Sweden. By contrast, labour migrants from peripheral parts having a seconday level of education and manual labour work as a prime choice for employment abroad, have moved mostly to Ireland and the UK.

In Europe, countries with sparsely populated regions experience a population decline which is a result of working age people choosing out-migration, mainly due to the lack of employment and life experience opportunities. De-population in rural parts of the country is a concern in many countries, thus further studies on the question of non-migrants, emigrants, return migrants and immigrants are important.

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**Kopsavilkums**

Raksta "Darbspēka migrācijas izpēte Latvijā: izbraukšanas ģeogrāfija" mērķis ir izpētīt darbaspēka migrācijas ģeogrāfiskos aspektus, analizējot emigrācijas īpatnības, kas raksturīgas izbraukšanai no centrālajiem un perifērajiem Latvijas reģioniem, kā arī emigrantu galamērķa valsts izvēli atkarībā no viņu iepriekšējās dzīvesvietas. Analīze veikta, ņemot vērā galamērķa valstīs (Lielbritānija, Īrija, Vācija, Zviedrija un Norvēģija) esošo Latvijas emigrantu tiešsaistes aptaujas datus. Rezultāti parāda, ka darba migrantu raksturojums krasi atšķiras atkarībā no izcelsmes vietas Latvijā. Migranti, kuri pirms emigrācijas dzīvojuši valsts ekonomiskajā centrā Rīgā, ir ar augstāku izglītību un nodarbinātības raksturu salīdzinājumā ar migrantiem no Latvijas perifērajiem reģioniem. Turklāt migrantiem no Rīgas retāk ir iepriekšēja migrācijas pieredze, un viņi papildus radu un draugu atbalstam darba meklējumos ārvalstīs biežāk ir proaktīvi. Galamērķa valsts izvēle emigrantiem no centra biežāk ir Vācija, Norvēģija un Zviedrija, bet emigranti, kuriem ir vidējā izglītība un zemākas prasības darba tirgū, biežāk iesaistās cirkulārajā migrācijā un atkārtoti dodas uz Īriju vai Lielbritāniju.

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# MOBILITY MOTIVATIONS AND EXPERIENCES OF HIGHLY SKILLED LATVIANS ABROAD

# Augsti kvalificētu Latvijas emigrantu mobilitātes motivācija un pieredze ārvalstīs

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**Abstract.** The aim of this paper is to analyse career migration of the highly skilled from Latvia in the context of post-accession migration since the EU enlargement of 2004. Based on secondary analysis of survey data, the study addresses three empirical questions: What are the motives of these highly skilled migrants, both for the initial migratory move and future mobility? What are the structural factors influencing the decisions of the highly skilled? What kinds of jobs do they actually obtain, and how do they get those jobs? The theoretical framework of the study is a synthesis of several theories, taking into account and testing the concept of liquid migration and its applicability to the career migration of the highly skilled from Latvia. The data analysis demonstrates that the concept of liquid migration does not characterise most typical migration patterns from Latvia, especially the migration patterns of the highly skilled in STEM areas. Contrary to the dominant characteristics of liquid migration, the highly skilled often choose long-term settlement and register abroad as employees.

**Keywords**: *career migration of the highly skilled, liquid migration, post-accession migration*

## Introduction

Migration patterns and trends among highly qualified specialists have been investigated in many countries. At the same time, studies on the mobility of highly

qualified specialists in Latvia are under-represented; also, studies on return migration are very few in Latvia (Krišjāne et al. 2013; Hazans 2015; Hazans 2018; Kļave and Šūpule 2015). Recent studies on emigration processes in Latvia show that the proportion of highly educated people leaving Latvia significantly increased during the years of the economic crisis of 2009-2011. Different studies show that Latvia is suffering a serious brain drain effect (Krišjāne et al. 2013: 104). Highly educated emigrants are over-represented in Science, Mathematics, IT and Medicine (Hazans 2018). Hazans also concludes that so far, return migration is not compensating the brain drain from Latvia (Hazans 2015), and emigration has contributed to a shortage of high- and medium-skilled professionals educated in Science, Mathematics, ICT and Medicine, as well as experienced engineers and technicians (Hazans 2018). In this context, it is important to analyse the career migration of the highly skilled from Latvia, their migration motives and intentions, and career development.

When Central and Eastern European countries joined the European Union in 2004, and some years later, when Western European countries removed the last restrictions for the free movement of labour, inflow of the highly skilled to Western European countries increased exponentially (ICF 2018). The individual migration decisions of all migrants, including the highly skilled, are influenced by a complex interplay of push and pull factors at macro, meso and micro level (Faist 1997; King et al. 2016). One of the strategies to enter into the labour market is studying abroad (ICF 2018). Many well-educated women from Central and Eastern European countries come to Western European countries due to their romantic relationship. At the same time, they often continue their studies in the chosen destination country and stay there thanks to their talents (Matyska 2019). As a core part of skilled migration literature, including the debates on return migration policies, a discussion on circular migration has emerged (Kuvik 2012). These discussions have been inspired by the contributions of Chinese and Indian high-tech workers to the development of their countries-of-origin (Hooper and Sumption 2016).

The theoretical framework of this study is inspired by the concept of liquid migration, and the study tests if this concept is useful for the understanding of career migration among the highly skilled from Latvia. Studies on intra-European migration indicate that the migration process after 2004 differs from the dominant migration patterns of the twentieth century (Glorius et al. 2013). Social scientists talk about new types of migrants, among them being highly qualified workers who seek employment in the Western knowledge economies (Engbersen and Snel 2013). New trends also need new theoretical concepts, and one of the new concepts characterizing current migration processes is the concept of liquid migration. According to Engbersen and Snel (2013), liquid migration is a typical phenomenon of post-accession migration, characterising contemporary labour migration patterns from Central and Eastern Europe to Western Europe, and it has six dominant characteristics: (1) the temporality of a stay abroad; (2) invisibility (the temporal nature of residence often goes hand in hand with non-registration and contributes to invisibility); (3) it is predominantly

labour migration; (4) it is mostly regular migration; most migrants have legal residential status; (5) it is unpredictable, because labour migrants react and adapt to altering conditions in the different labour markets; (6) it is more individualistic, because there is a trend that family ties have become looser and more fragile among migrants from CEE countries. At the same time, recent studies on labour migration patterns from Central and Eastern Europe to Western Europe reveal the trend of transition to longer-term settlement and the diversity of labour migration patterns (Friberg 2012; Bygnes and Erdal 2017 etc.). The analysis of career migration among the highly skilled from Latvia aims to determine if the concept of liquid migration is applicable to the migration patterns of the highly skilled from Latvia. The analysis is focused on the first and the most important feature of liquid migration: the temporality of a stay abroad, because other characteristics are very connected to this (invisibility of migration and adaptiveness to altering conditions), or needs more in-depth analysis of societal changes. The last aspect refers especially to the question about family ties and the trend that they have become looser and more fragile among migrants from CEE countries.

## Data and Methods

The data source used for the analysis of career migration of the highly skilled is an emigrant survey organized within the Project "The emigrant communities of Latvia: national identity, transnational relations, and diaspora politics". An online Internet-based method was used to engage with Latvian migrants, and the survey was organized from August to October 2014. A total of 14048 Latvian nationals from 118 countries participated in the study.

For the purpose of this particular analysis a sub-sample of labour migrants has been developed. This sub-sample includes only those who are first-generation emigrants from Latvia and who were working at the time of the survey. In total, the sub-sample has reached 7798 respondents, out of which 331 were highly skilled managers and professionals in STEM areas (Science, Technology, Engineering, and Mathematics) with a Masters or Doctoral degree.

The approach of data analysis is based on comparison of the highly skilled in STEM areas (Science, Technology, Engineering, and Mathematics) with other labour migrants from Latvia. To determine whether there is a significant difference in the answers of the two groups, Pearson's chi-squared test or Yates's correction for continuity is used.

## Results

### Highly skilled Latvian emigrants: main characteristics

As has been found already by other studies (Goldmanis 2015; Hazans 2015), the educational and professional structure of Latvian migration varies depending on the destination. According to survey data, highly skilled managers and professionals in STEM areas with Masters and Doctoral degrees are not concentrating in one particular

country, but are more dispersed around different countries. This is a different trend in comparison with other Latvian emigrants, who are concentrated mostly in the UK (Table 1). However, if we look at particular states, the share of highly skilled Latvian emigrants is greater in the UK (14%), closely followed by Germany (11%) and the U.S. (11%). It should be added that differences in destination countries among the highly skilled and others are statistically significant ($\chi^2$=207.826, df=10, p=0.000).

Data analysis shows that highly skilled emigrants in STEM areas with a Masters and/or Doctoral degree are older than other labour migrants. Half of the surveyed highly skilled emigrants are aged 35-54 years (among others – 42%). 34% are aged 25-34 (among others – 38%), and 16% are older than 55 years (among others – 7%). There are almost no highly skilled emigrants in STEM areas with a Masters and/or Doctoral degree in the age group 15-24 years (among others – 13%). These differences are statistically significant ($\chi^2$=81.498, df=3, p=0.000). The differences in age structure can be explained by the time necessary for the highest levels of education (Masters and Doctoral degree).

Table 1. **Destination countries of the highly skilled and others**

| | **Other emigrants (N=7466)** | **Highly skilled (N=330)** |
|---|---|---|
| UK | 38 | 14 |
| Germany | 10 | 11 |
| Russia | 2 | 9 |
| Sweden | 4 | 8 |
| Norway | 7 | 4 |
| Ireland | 9 | 4 |
| Other European countries | 20 | 22 |
| U.S. | 4 | 11 |
| Canada | 1 | 4 |
| Other | 5 | 13 |

% of those who have given a definite answer, N=7796

If we look at the gender of highly skilled emigrants in STEM areas, we can see the trends characteristic in many countries (Grigoleit-Richter 2017; Kirk et al. 2017), namely, that women are less represented in this group. If among other emigrants 37% are male and 63% are female, then among highly skilled emigrants in STEM areas the share of male is 54% and the share of female is 46% (these differences are significant: $\chi^2$=39.527, df=1. p=0.000; $\chi^2_{Yates}$=38.802, df=1. p=0.000).

Highly skilled individuals in STEM areas are to be found in emigration for a longer time in comparison with others. 36% of the highly skilled are in emigration already for more than ten years (among others – 20%). 29% are in emigration for 6-10 years (among others - 30%). 35% of the highly skilled are in emigration for five years or less (among others - 50%). These differences are statistically significant ($\chi^2$=28.513, df=4, p=0.000).

**Career experiences of the highly skilled**

The questionnaire included two questions on the occupational position of emigrants abroad: one question was about their occupational position after the first year in emigration, and the other was about their situation now. The survey results show that 84% of the highly skilled in STEM areas were employees at the time of the survey, 9% were businessmen and 7% were self-employed. Conversely, after the first year in emigration, 21% were students and only 4% were businessmen. This means, firstly, that during their stay abroad about 5% have managed to develop their own businesses. Secondly, the survey data confirms the findings of other studies that universities are powerful recruitment channels for highly skilled migrants (Ackers 2005).

The highly skilled in STEM areas are both in emigration and in their current job for a longer period of time. Survey data shows that 13% of the highly skilled have been working in their current organisation for more than 10 years (among others – 4%). 20% of the highly skilled have been working in their current organisation for 6 to 10 years (among others – 16%). 24% of the highly skilled have been working in their current organisation for 6 to 10 years (among others – 28%). 43% of the highly skilled and 52% of others have been working in their current organisation for less than three years (these differences are significant: $\chi^2$=59.834, df=3, p=0.000).

It is interesting that, according to the survey results, finding one's first job in emigration is very different between highly skilled emigrants and others. The most popular way of finding a first job among the highly skilled was by applying for a vacancy in a tender; 46% found their first job in this way (among others this was mentioned in 20% of cases). For others, the most popular way to find the job was with the help of friends and relatives. This was mentioned by 17% of the highly skilled and 46% of others (these differences are significant: $\chi^2$=106.070, df=4, p=0.000).

97% of the highly skilled in STEM areas have a written contract and are included in the social security system of the destination country. Among other Latvian emigrants this share is slightly smaller – 88% have a written contract and are included in the social security system of the destination country (these differences are significant: $\chi^2$=19.340, df=4, p=0.001).

**Motivation for emigration and return intentions**

The questionnaire included several questions measuring the motives for emigration. After the evaluation of 16 possible reasons, respondents were asked to choose the most important one. The survey results show that the three main arguments for emigration most often mentioned are: (1) financial problems, difficulties living with a low level of income (19%); the opportunity to earn a lot better abroad (10%); the possibilities to develop (to get a good education and/or to build a career) (9%).

Among highly skilled labour migrants from Latvia, the argument for emigration most often mentioned is the possibility to develop (to get a good education and/or to build a career - 24%, among others - 8%). Financial problems and difficulties living

with a low level of income were mentioned by 4% of highly skilled (among others - 20%); the opportunity to earn a lot better – 7%, among others - 11% (these differences are significant: $\chi^2$=176.786, df=17, p=0.000).

Table 2. **Return intentions: the highly skilled and others. %**

| | **Highly skilled (N=328)** | **Others (N=5724)** | **Total (N=6052)** |
|---|---|---|---|
| Consider returning in next six months | 2 | 4 | 4 |
| Consider returning in next five years | 15 | 13 | 13 |
| Consider returning after retirement | 16 | 21 | 21 |
| Under specific conditions | 43 | 40 | 40 |
| More likely not | 12 | 14 | 14 |
| Definitely not | 12 | 8 | 8 |

% of those who have given a definite answer, N=6052

Regarding return intentions, the answers of the highly skilled do not differ very much from others (Table 2). One of the explanations for low return intentions can be found in the critical evaluation of the possibilities for finding a decent job in Latvia. The possibility of finding a job in Latvia corresponding to one's qualifications has been evaluated as good by 33% of the highly skilled and 25% by others (these differences are statistically significant: $\chi^2$=10.921, df=4, p=0.027). The possibility of finding a job in Latvia with a decent salary has been evaluated even more critically. Only 10% of those highly skilled and 7% of others evaluate this possibility as good (these differences are not statistically significant: $\chi^2$=5.276, df=4, p=0.260).

## Discussion and Conclusions

The analysis of career migration of the highly skilled from Latvia was focused on two groups: highly skilled managers and professionals in STEM areas (Science, Technology, Engineering, and Mathematics) with a Masters and/or Doctoral degree and other labour migrants from Latvia. Main arguments of particular interest about the experiences of highly skilled managers and professionals in STEM areas were based on the fact that highly educated emigrants are over-represented in Science, Mathematics, IT and Medicine, and return migration does not compensate for brain drain (Hazans 2015, Hazans 2018).

Based on secondary analysis of the survey data, the study shows that the main motive for emigration among the highly skilled is the possibility for development (to get a good education and/or to build a career), but not financial problems, which characterise the motives of other emigrants. At the same time, the opportunity to earn a lot better is also an important motive for emigration.

A brief analysis of some aspects of working life and career management of highly skilled emigrants shows important differences between the two groups. In comparison with others, the highly skilled more often choose permanent jobs and invest more time in them, and they also use different recruitment channels for finding their jobs. The most popular way to find a first job among the highly skilled was by applying for a vacancy in a tender.

Contrary to many other issues, the return intentions of the highly skilled do not differ from other emigrants from Latvia. 2% of emigrants currently working are considering returning in the next six months, 15% are considering returning in the next five years, and 16% are considering returning after retirement. All in all, a majority of highly skilled managers and professionals in STEM areas are presently not planning to return to Latvia and are settled in the particular destination country.

From the data presented above it follows that the concept of liquid migration does not characterise current migration patterns from Latvia. In particular, highly skilled managers and professionals in STEM areas do not fit the dominant characteristics of liquid migration, defined by Engbersen and Snel (2013). Firstly, the current trend features a long-term settlement practice, not the temporality of a stay abroad. Secondly, people tend to register abroad as employees and do not stay invisible to state offices anymore. At the same time, the intra-European migration regime has some characteristics of liquid migration, namely, because it is mainly labour-motivated, and it is strongly facilitated by the free movement of workers within the EU. It can be concluded that the concept of liquid migration is not helpful for the understanding of career migration of the highly skilled from Latvia, but we can see that both structural factors and individual motives and lifecycle stages influence migration decisions on initial moves and return intentions.

The author considers that there is no one unified labour migration pattern characterising contemporary labour migration patterns from Central and Eastern Europe to Western Europe, but a diversity of different types and a complex set of factors underlying these types, which need to be explored in further studies.

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**Kopsavilkums**

Raksta “Augsti kvalificētu Latvijas emigrantu mobilitātes motivācija un pieredze ārvalstīs” mērķis ir analizēt augsti kvalificētu Latvijas emigrantu karjeras migrācijas pieredzi un novērtēt, vai tās raksturošanai ir izmantojams teorētiskajā literatūrā piedāvātais “likvīdās migrācijas” jēdziens. Ņemot vērā emigrantu aptaujas sekundāro datu analīzi, rakstā tiek aplūkoti šādi jautājumi: migrācijas motivācija, darba pieredze un atrašana, atgriešanās plāni. Empīriskajā analīzē pamatotie secinājumi kritizē “likvīdās migrācijas” jēdziena skaidrojuma potenciālu attiecībā uz pēdējos gados vērojamajiem migrācijas procesiem Latvijā, īpaši attiecībā uz augsti kvalificētiem un izglītotiem speciālistiem STEM jomās (zinātne, tehnoloģijas, inženierzinātnes un matemātika).

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# SOCIO-DEMOGRAPHIC COMPOSITION OF THE GEOGRAPHICALLY IMMOBILE URBAN POPULATION

# Dzīvesvietu nemainījušo pilsētas iedzīvotāju sociāli demogrāfiskais sastāvs

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**Abstract.** Most of the populace remains geographically immobile according to classical migration theories. An important consideration that limits change of place of residence is attachment to that place and its people, as well as some life-shaping circumstances such as job prospects, education, raising children and the buying of a residential property (Fischer et. al. 2000). More than half of the residents of Rīga (419146) in 2018 have lived in the same neighbourhood for at least 18 years (CSB 2018). This raises the question as to whether they also share common socio-economic circumstances. Geographically immobile residents are the core of the population. Study analyses on the socio-demographic background of geographically immobile residents of Rīga, who have not changed location since the 1990s, used data from a 2015 survey (n=867). The residential 'harbours' for long-term residents are Soviet socialist period-built apartment-block housing neighbourhoods. Having a population of school-age children, people in retirement and/or on a low income might contribute to some of the reasons for staying at one place for longer periods of time in suburban Rīga. The socio- demographic characteristics of the geographically immobile population displays differences among respondents residing in different neighbourhoods. Among the neighbourhoods with the highest share of geographically immobile respondents, the areas located on the outskirts of the capital city are less attractive than those more central and with higher incomes and children.

**Keywords:** *geographical immobility, residential mobility, Rīga.*

## Introduction

*Geographical immobility* refers to a difficulty for people to move to different places of residence (Cambridge University Press 2011). Despite the fact that migration researchers usually concentrate on moving, most people remain geographically immobile (non-mobile). An important consideration that limits mobility is attachment to a place and its people (Fischer et al. 2000). Research studies on geographical immobility in Sweden show that the longer the period of time lived in the one place, the less the probability of moving away, because local knowledge and social ties that have developed over a period of time - insider advantages - might be lost in the event of changing place of residence (Fischer et al. 2000). On the other hand, at some stages of life, the decision to move is necessary to adjust for a new situation or circumstances (Figure 1).

Research studies on geographical immobility are often related to the labour market (e.g. Fischer et al. 2000; Green and Canny 2003), because an inability to move for work reasons may be a cause of unemployment. Financial issues may constrain geographical mobility between regions and countries despite wage differences, because of the costs of moving, variation in housing prices and in cost of living, all of which may be determinants of geographical immobility (Greenwood 1997; Fischer

et al. 2000). Nevertheless, yet another decisive reason for residential stability may be the individual chosen career strategy. According to the research on work-directed relocation in England, people may choose to develop their career by change of employers and/or commuting patterns rather than by change of location, which may be on behalf of family members, or, a self-employed person who aims to become an entrepreneur using location specific benefits (Green and Canny 2003). Research on residential stability is important as the issue of geographical mobility and immobility contributes to temporal spatial inequalities through segregation, gentrification and the transmission of wealth (Coulter et al. 2013). A significant question in researches on geographical immobility is to do with housing policy and the availability of accommodations. Contrary to tenant-market dominant western European cities, many of the Central and Eastern European cities, after the mass privatisation of housing that took place in the 1990s, ended up with home owner dominated housing markets (Herfert et al. 2012). This specific feature of post-Soviet socialist countries - that a large number of dwellings are owned by inhabitants - contributes to geographical immobility (see Figure 1). Nowadays, a still high share of owner-occupied housing and the lack of public housing is a distinctive feature in Eastern and Central European cities (Kovacs and Herfert 2012).


Figure 1. **Contributing factors for geographical immobility and/or mobility** (author's figure based on Fischer et al. 2000).

Previous studies on geographical immobility in Latvia have focussed on rural areas in the context of migration (Krišjāne et al. 2017). However, a large portion of residents in Rīga are geographically immobile. More than half of the residents (419146) have lived in the same neighbourhood for at least 18 years (CSB 2018). At present, the neighbourhoods of Rīga City that were built during the Soviet period of socialism are still home for almost three quarters (466394) of the City of Rīga population (CSB 2011). This raises the question as to whether the Soviet built neighbourhoods are 'harbours' of geographically immobile residents. Do they share common socio-demographic characteristics? The issue of geographically immobile residents in Rīga is an important area for research because numerous previous researches on Rīga and its surroundings focus more on the spatial mobility of its residents. Nevertheless, geographically

immobile residents represent the core of the population. The aim of this study is to investigate the socio-demographic background of the geographically immobile residents of Rīga who have not changed their place of residence since the 1990s.

**Data and Methods**

The data used in this study was obtained from the 2015 Rīga City Council survey among 2043 randomly (with quota elements) selected respondents in the age group 15-75 with face-to-face interviews on their own premises. The aim of the survey was to investigate levels of satisfaction with services available to residents of Rīga in addition to, and including, questions about residential satisfaction and the migration experience. The survey consisted of 84 questions in total. For this research project I used a sample of 867 residents who have remained in their current place of residence even since the 1990s. In order to analyse socio-demographic background descriptive statistics were used. In total, 10 variables were taken into consideration – gender, age group, language spoken, occupation, income level per person, family status, neighbourhood of residence, neighbourhood where working/studying, neighbourhood where spending leisure time, period of housing built and attitude towards Soviet period built neighbourhoods.

**The Population of Rīga**

The capital of Latvia is a shrinking city - between the population census of 2000 and that of 2011, Rīga has lost one sixth of its population, because of a trend of negative natural growth balance across Latvia and negative internal migration (CSB 2000; CSB 2011). Previous researches on the question of geographical mobility in Rīga indicate that the inner city has lost residents more rapidly than other parts of the city and thus the share of residents living in neighbourhoods built during the period of Soviet socialism have grown (Krišjāne and Bērziņš 2014). The population Census of 2011 reveals that majority of the population 93% (601314) lives in large scale housing estates (consisting of more than 30 dwellings), but also that a large part - 72% (466394) lives in Soviet period built residences (CSB 2011). A similar number - 71% (462721) of residents live in housing that is owned by a member of their household (CSB 2011). These geographically immobile residents are concentrated in neighbourhoods where Soviet period built apartment-block housing is dominant e.g. Vecmīlgrāvis, Imanta, Pļavnieki, Bolderāja, Ziepniekkalns, Purvciems, Ķengarags and Zolitūde, according to the statistics (from 2000 and also from 2018) on internal mobility in Rīga (CSB 2018). Furthermore, the highest share of geographically immobile residents in neighbourhood areas is to be found in the periphery of the capital (Figure 2).

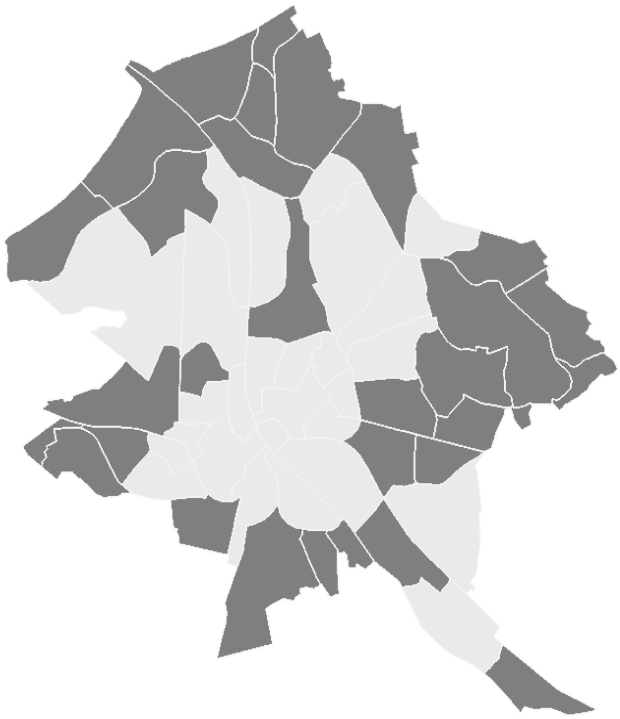

Figure 2. **The neighbourhoods of Rīga with the highest share of geographically immobile residents** (author's figure based on CSB 2018)

## Background of Geographical Immobility

The results of this research study reveal that most of the geographically immobile respondents (80%) live in Soviet period built housing. Moreover, neighbourhoods of large scale housing estates have a good image in the opinions of most respondents (79%) and they are quite likely to spend their leisure time in the neighbourhood where they live. At the same time only less than half (37%) of the respondents work or study in the local neighbourhood, which tells us that there might be other reasons for keeping the same residence for so long a time even if it is not close to work or school. Another geographical immobility contributing factor might be that of having children in the family, because almost one third of respondents (29%) have school-age children. Also, one third of respondents are now at retirement age, which might be a contributing factor for their choice to stay at their residences for a longer period of time (Table 1). The distribution between age groups and the ethnic division of long-term respondents seems even.

Table 1. **Socio-demographic characteristics of geographically immobile respondents (%) (n=867)**

| ***Age group*** | ***%*** |
|---|---|
| 25-34 | 20 |
| 35-44 | 16 |
| 45-54 | 19 |
| 55-64 | 22 |
| 65-75 | 23 |
| ***Sex*** | ***%*** |
| Female | 61 |
| Male | 39 |
| ***Occupation*** | ***%*** |
| Unemployed | 7 |
| Employed | 66 |
| Retired | 27 |
| Studying | 1 |
| ***Language spoken*** | ***%*** |
| Latvian | 46 |
| Russian | 54 |

When looking at geographically immobile respondents by neighbourhood the socio- demographic characteristics reveal differences among respondents residing in the various different neighbourhoods. Among the neighbourhoods with the highest share of geographically immobile respondents the neighbourhood areas located in the outskirts of the capital are less attractive to those suburbs with higher incomes and children than the more centrally located ones. In the periphery of the capital city, in Vecmīlgrāvis neighbourhood, more than two thirds of respondents are with low income; almost one third is in retirement and most of these households have no children. As opposite situation is to be observed in the more centrally located suburb of Ķengarags where more than half of the respondents are with middle or high income and a significant portion have school-age children (38%). The reason why Ķengarags has attracted those with higher incomes and children might be a result of the closeness and good connection with public transport to the city centre – the centre of finance and of work places and where there is a concentration educational institutions.

## Conclusion

In Rīga City, the population has been declining over the past several decades. Especially evident de-population is to be observed in the central area of the city. Residential housing has been replaced by hotels and offices and its residents have been replaced by tourists in the inner city - the centre of business with a rich historical heritage. Meanwhile, the residential population has been more stable in the peripheral areas of the capital. Studies show that neighbourhoods on the outskirts of the city,

which consist of pre-dominantly Soviet socialist period-built apartment-block housing, are characterized by a high proportion of long-term residents. The specific feature of the Soviet socialist period-built apartment-block housing is that most actual residing tenants in the 1990s became home owners after the massive privatisation of previously state owned dwellings, and it is significant that this has contributed to residential stability.

The findings of this study suggest that such factors as family status, occupational status and income level are also important in shaping the distribution of the geographically immobile population in Rīga by neighbourhoods and not by gender, ethnicity or age group which is mostly similar in extent within all of the populace.

These findings can further be explained with the fact that having school-age children or being of retirement status and/or having a lower income level might contribute to the decision of staying at one place for a longer period of time in certain neighbourhoods of Rīga. The neighbourhood areas located in the outskirts of the capital are less attractive than the more central to those with higher incomes and children.

The findings indicate that the major 'harbours" for long-term residents are the Soviet socialist period-built apartment-block housing neighbourhoods (e.g. Vecmīlgrāvis, Imanta, Pļavnieki, Bolderāja, Ziepniekkalns, Purvciems, Ķengarags and Zolitūde). These neighbourhoods have a good image in the eyes of geographically immobile residents and they are more likely to spend their leisure hours in the neighbourhood where they live. At the same time only less than half of these residents either work or study in the local neighbourhood, which suggests that residents are more likely to change commuting patterns rather than the place of residence.

Further studies of the significance of different factors shaping the profile of the geographically immobile population would be worthwhile. In this case, a more detailed analysis could also be undertaken on the effect of housing policy and socio-economic factors.

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**Kopsavilkums**

Lielākā daļa cilvēku nekur nepārceļas un uzskatāmi par ģeogrāfiski nemobiliem saskaņā ar migrācijas teorijām. Nozīmīgs iemesls, kas ierobežo pārcelšanos, ir piesaiste vietai un cilvēkiem un dzīves notikumi, piemēram, darbs, mācības, bērna piedzimšana un īpašuma iegāde (Fischer et al. 2000). Vairāk nekā puse Rīgas iedzīvotāju (419146) 2018. gadā dzīvoja tai pašā vietā, kur pirms 18 gadiem (CSB 2018). Tas rada jautājumu, vai šiem nemobilajiem iedzīvotājiem ir līdzīgs sociālekonomiskais raksturojums? Nemobilie rīdzinieki ir nozīmīgs pētījuma objekts, jo vairāki iepriekšējie pētījumi par Rīgu un tās aglomerāciju fokusējās uz iedzīvotāju telpisko mobilitāti. Tomēr nemobilie rīdzinieki veido iedzīvotāju kodolu. Pētījumā, izmantojot 2015. gada aptaujas anketas datus (n=867), analizēts to Rīgas iedzīvotāju sociālekonomiskais raksturojums, kuri nav pārcēlušies kopš 1990. gada. Ilgtermiņa iedzīvotāji lielākoties apdzīvo padomju laikā būvētos mikrorajonus (Vecmīlgrāvi, Imantu, Pļavniekus, Bolderāju, Ziepniekkalnu,

Purvciemu, Ķengaragu un Zolitūdi). Dažādās apkaimēs dzīvojošo ilgtermiņa iedzīvotāju raksturojums atšķiras. Vecmīlgrāvja apkaime, kas atrodas Rīgas nomalē, ir mazāk pievilcīga iedzīvotājiem ar augstākiem ienākumiem un bērniem, nekā tuvāk centram esošais Ķengarags. Nepilngadīgi bērni, mājoklis īpašumā un zemi ienākumi ir nozīmīgi faktori nemobilitātei Rīgas apkaimē.

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# RESIDENTIAL PATTERNS OF IN-MIGRANTS IN RĪGA

## Iekšzemes migrantu apdzīvojuma iezīmes. Rīgas piemērs

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**Abstract.** Population distribution and internal migration are closely related to each other and are sensitive to changes that are evoked by various political, economic and social processes. The distribution of population sub-groups has been mostly studied in post-socialist cities in relation to ethnic and socio-economic segregation. However, the importance of internal migration has been less investigated. This paper uses 2000 and 2011 census data and aims to evaluate the residential patterns of in-migrants in the neighbourhoods of Rīga. Key findings have revealed that levels of in-migrant concentration are higher in the inner city neighbourhoods, whereas the degree of activity is considerably lower in the city outskirts. Comparison of 2000 and 2011 patterns show a decrease of in-migration activity for more than half of the neighbourhoods, with the exception of numerous panel housing estates to the east from the inner city.
**Keywords:** *internal migration, population distribution, Rīga.*

### Introduction

Political, economic and social transformations since the collapse of state socialism in Central and Eastern Europe (CEE) have been crucial in the changing nature of population distribution and settlement patterns. These changes have been most evident in urban areas of the region, where such development has drawn scholarly and public attention to the topic of socio-spatial differentiation in post-socialist cities. Numerous researches have been conducted in relation to urban social inequalities and have also paid attention to mobility related processes such as suburbanisation and gentrification, mostly addressing population differentiation among city neighbourhoods (e.g. Brade et al. 2009; Kovacs and Herfert 2012; Kährik and Tammaru 2010; Temelová et al. 2011; Gentile et al. 2012). Another body of literature that is closely related to population distribution has tried to address the issue of social segregation in the cities of CEE, mostly trying to study either the ethnic or socio-economic intra-urban geography of the total population (e.g. Gentile and Tammaru 2006; Marcińczak et al. 2012; Marcińczak et al. 2014; Krišjāne and Bērziņš 2014; Tammaru et al. (eds.) 2015). However, the linkage between internal migration and population distribution has been less studied.

According to Central Statistical Bureau data for 2018, Rīga, the capital and largest city of Latvia, housed 637971 residents or approximately one third of the total national population. It can be considered as the most important urban centre of Latvia, and holds significant primacy in the country's political, social and cultural functions. The population of Rīga is reported to be almost eight times higher than in the 2nd most populated urban centre – Daugavpils. Although, the importance of Rīga is unambiguous, the total population of the city has decreased by 16.7% during the period from 2000 to 2017. Mobility processes can be considered as the main cause for such changes. Respectively, Rīga has lost 11% of its population at the expense of

migration, whereas the decline in relation to natural balance has been less significant (-5.7%). Although, this can partially be explained with increased international migration outflows (especially from 2008 to 2011), the most specific contributor to steady population decline in Rīga can be attributed to internal migration and its resulting process – residential suburbanisation. As a result, Rīga had been losing population in exchange with its suburban hinterland – Pierīga; whereas, the capital city is gaining population at the expense of all other statistical regions (Vidzeme, Zemgale, Kurzeme and Latgale). Such inter-regional relations also reflect on internal migration numbers that define Rīga as the main hub of internal migration activity. In 2016, 29.6% of all internal migration flows were related to Rīga.

Therefore, internal migration can be considered as very significant in re-shaping population distribution in the post-socialist space (e.g. Kontuly and Tammaru 2006; Krišjāne and Bērziņš 2012; Novotný and Pregi 2015), and this study aims to evaluate residential patterns of in-migrants in the neighbourhoods of Rīga by examining 2000 and 2011 Population Census rounds. Location quotient (LQ) is used as a descriptive measure to assess the concentration of internal migrants within the neighbourhoods of Rīga.

**Data and Methods**

The data used in this study was drawn from the 2000 and 2011 population census rounds provided by the Central Statistical Bureau and focussed solely on Rīga city. The data on internal migrants to Rīga was thus derived. The available dataset is the most reliable source of information for the population composition in Latvia. However, the census data categorises persons as migrants only for a limited timespan. Thus, according to the census data collection specifics, a person was considered an internal migrant to Rīga if the following criteria applied:

- In 2000, on answering the question about their place of residence one year before the Census had been taken (as of 31 March 1999), residents had chosen the "Other" option, and later indicated any other municipality of residence except Rīga.
- In 2011, on answering the question about whether the person lived in the same place of residence one year before the Census had been taken (as of 1 March 2010), the resident had replied negatively (No – meaning that not only the dwelling had been changed, but also the municipality), and in the next question had indicated their previous municipality of residence (not Rīga).

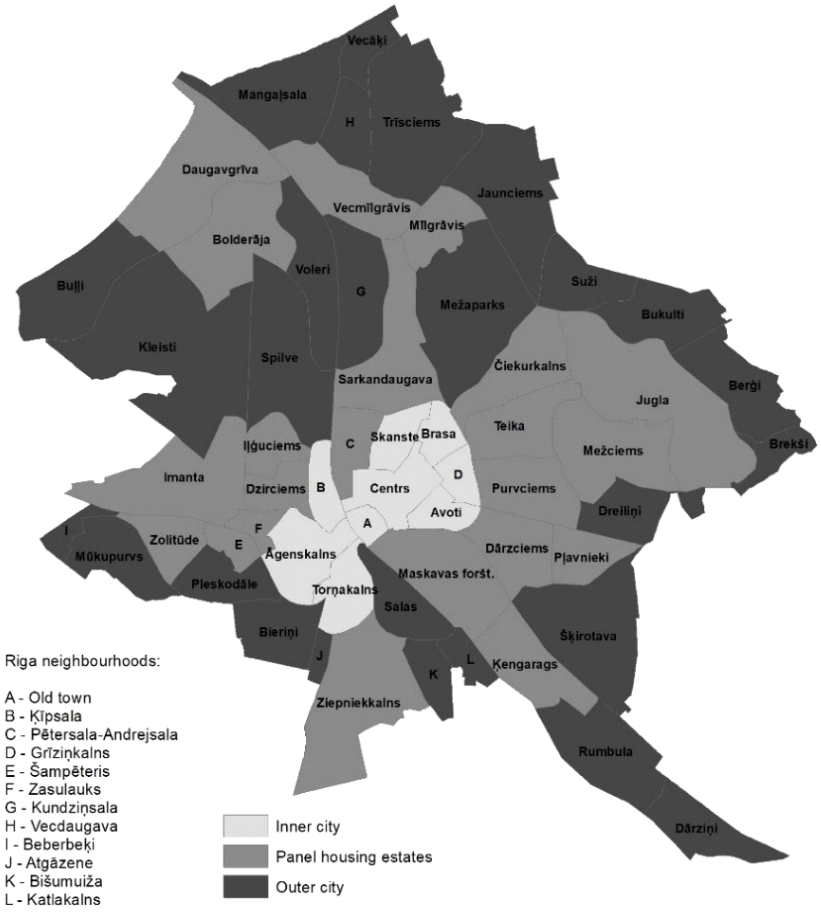


Figure 1. **Map of neighbourhood units in Rīga divided into urban zones** (authors' figure based on Riga City Council data)

Thus, 8012 residents in 2000 (1.25% of the total city population), and 5012 residents in 2011 (0.8%) were categorised as internal migrants to Rīga. Migration activity in the latter case was considerably lower due to the effects of the global economic crisis which resulted in higher international migration activity. In order to gain a better understanding, the neighbourhood residential patterns in the results chapter were studied using the division of Rīga into 3 distinctive urban zones (Figure 1) that are based on historical development and general patterns of built-up areas following the boundaries of neighbourhoods. Such division can be found in a great majority of cities in CEE (e.g. Sýkora 2009; Kovács and Herfert 2012). The zones are as follows: 1) inner city; 2) panel housing estates; 3) outer city.

The next step included the conversion of census data to cells of a hexagonal grid (see Reardon and O'Sullivan 2004; Brown and Chung 2006). The grid consists of 2002 cells that are fully or partially within the borders of Rīga and occupy approximately 16.5 ha. In total, there were 685 cells with registered in-migration activity in at least one of the censuses. With such data, it is possible to map in detail where members of a particular social strata were concentrated in Rīga. A previous study by Krišjāne et al. (2015) had used a similar methodology to map the occupational and ethnic composition of the population in the neighbourhoods of Rīga.

The in-migrant spatial data was analysed using the Geo-Segregation Analyzer 1.2, and calculated as location quotients (LQ). This analytical statistic measure was used to illustrate spatial patterns of concentration (see Brown and Chung 2006). In this case, it shows the representation of in-migrants within a spatial unit in comparison to the city average (3.5). Therefore, 3 gradation categories were chosen for visual representation:

- LQ < 1.5 – to highlight spatial units with rather low in-migrant representation;
- 1.5 < LQ < 3.5 – to emphasize spatial units with neutral in-migrant representation similar to the city average;
- LQ > 3.5 – to distinguish spatial units with high in-migrant representation above the city average rate.

**Results**

The intra-urban geography of internal migrant groupings has similar patterns with higher representation in the neighbourhoods closer to the city centre for both 2000 and 2011 (Figure 2). Respectively, neighbourhoods such as Centrs, Brasa, Grīziņkalns and Avoti are located in the inner city where the proportion of rental dwellings is usually higher. Another cause for such an in-migration pattern in the central part could be explained with a typically younger population composition. Census data shows that 11 neighbourhoods had a positive or neutral average age of population in 2011 in comparison to 2000. Three of the four afore-mentioned inner city neighbourhoods were among these, whereas one (Grīziņkalns) has a slightly negative difference. In addition, inner city neighbourhoods are very attractive for residents previously or currently involved in student migration. Thus, even though these neighbourhoods are attractive to in-migrants; they also witness higher out-migration by way of both residential mobility and out-migration to Pierīga.

High, and on some occasions, above average concentrations of in-migrants are characteristic to neighbourhoods with a considerable share of high-rise standardised and pre-fabricated panel housing estates such as those at Purvciems, Teika, Imanta, Iļģuciems, Vecmīlgrāvis, Jugla, Ķengarags and Sarkandaugava. Even though, these neighbourhoods can be characterised as being with above average in-migration activity, there has been neither increase or decrease of in-migrant representation in certain spatial units in 2011. High concentrations (>3.5) can be explained with the status of panel housing estates in the housing market. In this case, the dwellings in these neighbourhoods are more affordable and thus more in demand by in-migrants. Meanwhile, the changing pattern of panel housing estates can also be interpreted as a result of the global economic crisis that affected the conditions of the housing market. Nevertheless, panel housing neighbourhoods still maintained their *status quo* during the 2000s as an economically attractive destination for potential in-migrants. Such attractiveness can be linked with the fact that Soviet-era standardised apartment buildings, which are highly evident in the afore-mentioned neighbourhoods, house a

considerable proportion of urban dwellers. As the research of Krišjāne et al. (2015) observed, approximately ¾ of Rīga's urban population lived in panel housing estates in both 2000 and 2011. In 2011, the population had experienced a slight increase. By contrast, the inner city population had decreased.

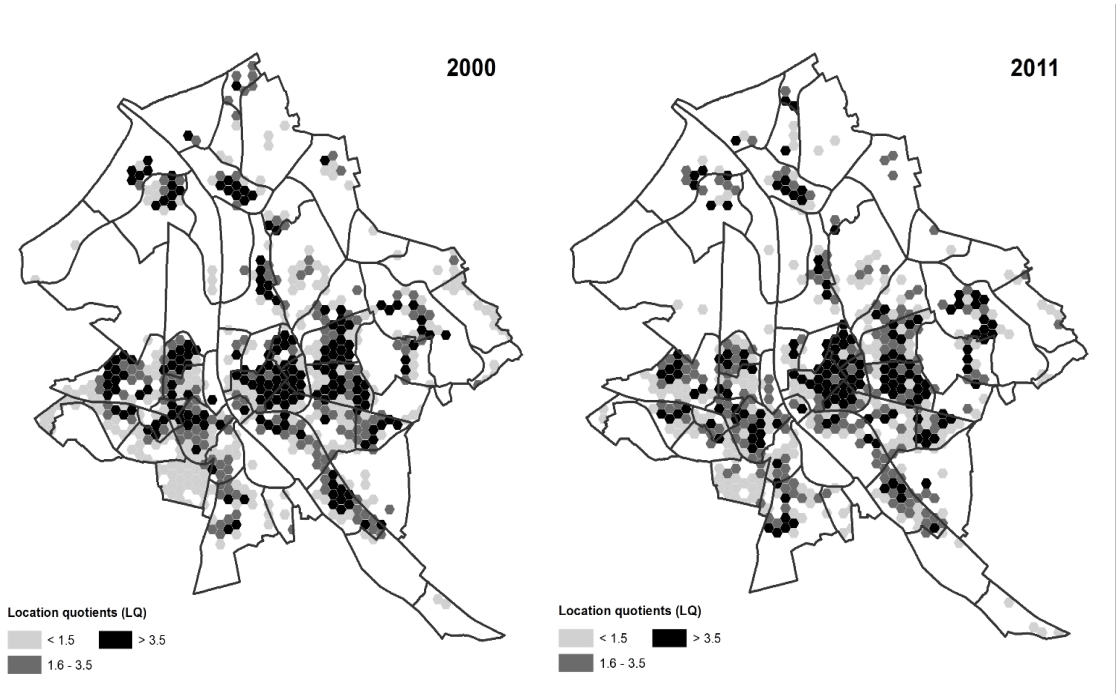


Figure 2. **Internal migrant representation (LQ) in Rīga neighbourhoods in 2000 and 2011** (authors' figure based on Population Census 2000 and 2011 data)

Comparison between 2000 and 2011 in-migrant concentration patterns show a higher overall representation in 2000. More than half of the 58 neighbourhoods (35) in Rīga have lower concentrations in their spatial units, whereas 18 territorial units have experienced increase in the representation of in-migrants from other municipalities. Finally, 6 neighbourhoods remained unchanged in terms of concentration. Interestingly, Brasa and Skanste are the only inner city neighbourhoods to witness an increase. In the former, the neighbourhood of Brasa is characterised by lower in-migration flows, that have slightly increased in the eastern part. In the latter case, Skanste has been the only inner city neighbourhood with a positive population increase from 2000 to 2011. This phenomenon may mostly be explained with the numerous constructions of high-rise modern residential buildings (see Treija and Bratuškins, 2014) in the area that attracted in-migration flows.

Panel housing estates show similar patterns of in-migrant representation. Out of 22 neighbourhoods only 7 had a higher concentration of in-migrants than in 2000. These include Jugla, Mežciems, Purvciems, Dārzciems, Pļavnieki, Ziepniekkalns and Zolitūde. The first five are located to the east of the city centre and are bordering each other. Interestingly, previous research on the distribution of occupational groups in

Rīga (Krišjāne et al. 2015) found that there has been an increase in concentration of the highest socio-economic group and the area of higher representation of this socio-economic subgroup has extended eastwards. Therefore, both cases could be linked to the attractiveness of these neighbourhoods in the housing market and the presence of the economic crisis.

Outer city neighbourhoods have a lower population density, and thus have considerably lower in-migration flows than do the other two urban zones. Nonetheless, in terms of migrant concentration, eight neighbourhoods have witnessed increase. Those include Bieriņi, Dārziņi and Dreiliņi – the areas with housing and residential patterns similar to municipalities within the suburban ring outside of the Rīga city borders.

**Conclusion**

In this paper it has become evident how residential patterns of in-migrants have evolved and transformed through analysis of the 2000 and 2011 Census data. Results have shown that the intra-urban geography of internal migrants had similar patterns with higher representation in the neighbourhoods closer to the city centre for both years. This could well be explained by the fact that the proportion of rental dwellings in these areas is usually higher. However, even though the inner city is attractive to in-migrants; it also witnesses higher out-migration.

High and above average concentrations of in-migrants are characteristic to panel housing estates. High concentrations can be explained by the affordability of dwellings in high-rise residential buildings that are located in these areas, and are thus more in demand by in-migrants. Meanwhile, the changing pattern (increase or decrease in 2011) of panel housing estates can be interpreted as a result of the global economic crisis that affected the conditions of the housing market.

Comparison between 2000 and 2011 in-migrant concentration patterns showed higher overall representation in 2000. Thirty five neighbourhoods had lower concentrations in their spatial units, whereas 18 territorial units experienced an increase in representation of in-migrants from other municipalities. The migrant concentration has most notably increased eastwards from the city centre and can be linked to the development of the housing market during the time of the economic crisis.

The authors of this study plan to expand this research and incorporate the analysis of 2016 and 2017. Such an addition would allow for the evaluation of post-2011 development of residential patterns in Rīga, and the extent and importance of internal migration as a driving force in evoking changes in population distribution. The question of Residential Mobility would be a decent addition to the focus of this research. In such a case, it would be possible to assess whether short distance moves within post-socialist city borders are more or less impactful than internal migration.

## Acknowledgement

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**Kopsavilkums**

Iekšzemes migrācijai ir noteicoša nozīme iedzīvotāju izvietojuma attīstības veicināšanā. Migrācijas plūsmu raksturs var atšķirties un attīstīties dažādu politisku, ekonomisku un sociālu procesu ietekmē. Dažādu iedzīvotāju sastāva grupu izvietojuma īpatnības ir plaši pētītas postsociālistisko pilsētu kontekstā saistībā ar etnisko vai socioekonomisko segregāciju. Tomēr izvietojuma saikne pilsētās ar iekšzemes migrāciju tikusi mazāk pētīta. Šis pētījums vizualizē migrantu izvietojuma telpiskās atšķirības, parādot to telpisko koncentrāciju vai izkliedi starp Rīgas mikrorajoniem. Lai to panāktu, izmantoti 2000. un 2011. gada Tautas skaitīšanas dati, kas tika ģeoreferencēti un vizualizēti sešstūra šūnu režģa veidā. Katrā Rīgas mikrorajonā no citām pašvaldībām gada laikā iebraukušie iedzīvotāji tika attiecināti pret kopējo iebraucēju plūsmu visā pilsētā, izmantojot novietojuma koeficientu (*LQ).* Pētījuma galvenie rezultāti norāda uz paaugstinātu migrantu koncentrāciju pilsētas centrālajā daļā, kamēr perifērajā daļā migrācijas aktivitāte bijusi krietni zemāka. Novērtējot izvietojuma attīstības iezīmes starp 2000. un 2011. gadu, redzams iekšzemes migrantu koncentrācijas samazinājums lielākajā daļā pilsētas, kas lielā mērā saistāms ar globālo ekonomisko krīzi un mājokļu tirgus īpatnībām. Izņēmums gan ir vairāki daudzstāvu dzīvojamo apbūvju rajoni, kas atrodas austrumu virzienā no pilsētas centrālās daļas, kur migrantu koncentrācija pat palielinājusies.

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# DEFINING THE COMMUTING REGIONS OF LATVIA

# Latvijas svārstmigrācijas reģionu noteikšana

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**Abstract.** In this research paper the geography of travel to work is analysed based on origin–destination commuting flows between municipalities. The aim of this study is to define work-related commuting regions of Latvia using the most recent data derived from the 2011 Population Census. The analysis demonstrates potential insights to be gained in defining regional patterns in the structure of work-related commuting flows using census data. The findings identify 17 commuting regions in Latvia and highlight the importance of Rīga in the context of the Latvian labour market. Two types of commuting regions were identified – mono-centric regions attracting large numbers of commuters in the main employment centre and poly-centric regions with more diversified travel-to-work flows.

**Keywords***: travel-to-work patterns, commuting behaviour, regions, census.*

## Introduction

In the last few decades, the processes of mobility (population movement) have had a tendency to become more diverse and more voluminous. Travel-to-work flows between municipalities represent a significant part of human mobility. Studies on the peculiarities of work-related commuting in post-socialist countries have mostly focused on the largest cities and their urban regions or agglomerations (Ahas et al. 2010; Novak and Sykora 2007; Novotny 2016). Country-wide or regional commuting patterns have been studied considerably less frequently (e.g. Klapka et al. 2013; Kraft et al. 2014; Marcinczak and Bartosiewicz 2018). The Statistical Bureau of Estonia has defined labour migration regions based on 2011 Census data (Statistics Estonia 2014). ESPON functional urban regions research has paid attention to all regional types

(ESPON 2005). However, researchers, including Ludek Sykora and Ondrej Mulicek (2009), argue that their approach ends up providing imprecise information about agglomerations which is contrary to the results of all previous research.

In Latvia, the research has also largely focused in past on various facets of commuters in the Rīga agglomeration (Krišjāne and Bērziņš 2009; Krišjāne et al. 2012). The borders of the Rīga agglomeration have been re-defined four times (first occasion in 1996) since the fall of socialism in 1991 (Bauls et al. 1999; RDPAD 2004; RDPAD 2012; RDPAD 2017). One notable exception is the research on "Latvian Population Mobility in the Transitional Period" (Bauls and Krišjāne 2000), where labour commuting flows to the largest cities were analysed for the years 1991 and 1999. However, nearly two decades have passed since these studies, and there is still a lack of sufficient knowledge concerning commuting patterns outside the Rīga agglomeration. Other largest cities and non-metropolitan regions house approximately 45% of the Latvian population and that is an important part of the national labour market (RDPAD 2017).

The **aim** of this study is to define the work-related commuting regions of Latvia using the most recent data derived from the 2011 Population Census.

**Data and Methods**

The commuting of employed persons between the administrative territories (municipalities) is the dataset that was used for this paper. Data was generated by processing the information on residence and workplace addresses (their so-called mis-match) from the 2011 Population Census. Only municipalities between which commuting flows are at least 10 people were included in this dataset.

In-bound and out-bound commuting flows among municipalities, as well as turnover, was analysed not just to define the commuting regions, but also to characterize the general patterns. Data on total population was used to explain some of the results, namely the differences between regions. The following steps were utilised to define the commuting regions of Latvia:

- First, the main employment centres were identified (based on in-bound commuting flows);
- Next, it was determined whether (and how) municipalities are connected to the main employment centres;
- Based on the connections, it was identified whether these centres have a significant number of (voluminous) connections, so that a region can be defined;
- Those municipalities which did not have a pronounced connection with any centre were further analysed to determine their connections and, conversely, whether a municipality is the main centre, one of the centres or simply a part of a region. For this purpose, both out-commuters and in-commuters were analysed. Since most municipalities outside of the Rīga commuting hinterland had a small number of (significant) connections with other

municipalities, only the most voluminous were considered. No commuter thresholds were defined for creation of regions, due to significant differences between the various municipalities;

- Two types of regions were identified: mono-centric and poly-centric. The former had either a main employment centre or municipalities that encompass the largest regional cities as their core. Whilst poly-centric regions had more diversified travel-to-work flows among several municipalities;
- In some isolated cases a municipality was included into the particular region despite not having a significant connection with the employment centre. The reason for inclusion was that it had a significant link with other municipalities belonging to that region.

The commuting hinterland of the capital city was defined differently. For a municipality to be a part of Pierīga region, the number commuters to and from Rīga had to be above the average (national level), which is heavily impacted by numbers in the municipalities near Rīga, meaning that members of this region have the highest numbers in country; 1007 and 191 respectively and with a strong connection to other municipalities of the hinterland. For municipalities to be included in the Lielrīga region, such characteristics had to be met - a below average number of commuters in at least one of the two instances (to or from Rīga) and/or a prevalent connection with other Lielrīga region municipalities. The reason for this type of criteria is that for most municipalities the number one out-bound connection is with Rīga. Both regions were classified as poly-centric, since commuting within these regions was more pronounced than for any other region (especially for Pierīga).

Region names were derived from the Statistical regions of Latvia - a level of territorial aggregation, which (to an extent) shows the four historical / cultural regions of Latvia. There are some exceptions, meaning there are municipalities that belong to different regions.

**Results**

Based on the number of commuters between municipalities, derived from the 2011 Population Census, a total of 17 labour commuting regions were identified, with 11 of them being mono-centric. They are shown in Table 1.

The capital city of Rīga, due to its being the main employment centre of Latvia, is not a part of any region, rather it is a region by itself. In every municipality (119) there are at least 10 people who work in Rīga, whereas at least 10 people from Rīga travel to work in 83 municipalities. Rīga is the main destination of commuters from 81 municipalities. A total of 119970 people commute to Rīga, while 15825 people commute from the capital. This region is the only one where in-bound commuters outnumber their counterparts.

Table 1. **Commuting regions of Latvia by type** (author's calculations, based on CSB 2018)

| **Mono-centric regions** | | **Poly-centric regions** | |
|---|---|---|---|
| **Region / city – employment centre** | **Total number of commuters (in-bound and out-bound)** | **Region** | **Total number of commuters (in-bound and out-bound)** |
| Kurzeme - Liepāja | 15379 | Northern Kurzeme; | 12987 |
| Latgale - Balvi | 1727 | Southern and Central Kurzeme | 7391 |
| Latgale - Daugavpils | 17094 | Lielrīga | 56298 |
| Latgale - Ludza | 3330 | Pierīga | 79665 |
| Latgale - Preiļi | 3399 | East - North East Vidzeme | 5419 |
| Latgale - Rēzekne | 11283 | Northern Zemgale | 6733 |
| Rīga | 135795 | **Sum** | **168493** |
| Vidzeme - Cēsis | 10143 | | |
| Vidzeme - Valmiera | 16003 | | |
| Zemgale - Jēkabpils | 8591 | | |
| Zemgale - Jelgava | 25695 | | |
| **Sum** | **248439** | | |

Most of the municipalities belong to Lielrīga region (19). These territories are not as connected to Rīga as the ones from Pierīga region. However, this connection is significant enough. Another characteristic separating these two groups is that commuting between neighbouring municipalities is less prevalent (less varied). Similarly to other regions, municipalities of this region have a higher number of out-bound commuters. However, the two regions stand out in this aspect due to significantly higher numbers. The total number of out-bound commuters (43469) is three times as many as in-bound commuters (12829). The Lielrīga region is the only non-continuous region, since it has two parts, as seen in Figure 1.

Nine territories belong to the Pierīga region. These territories are closely linked to Rīga, since it is the main destination for labour commuters and one of the main sources of in-bound commuters. These municipalities are closely linked to the capital due to the common labour market and also due to proximity, which is an important pre-requisite of commuting (Boyle et al. 1998; Sultana and Weber 2007). Commuting between these municipalities is common but not as common as to Rīga. Pierīga has an even higher number of out-bound commuters – 54706, more than twice as many as in-bound ones (24959).

The Liepāja region consists of nine municipalities located in western-southwestern Kurzeme. The City of Liepāja has the sixth largest number of in-bound commuters (right behind Olaine municipality). This region has 6608 in-bound commuters, with 5035 of them travelling to Liepāja, and 8771 out-bound commuters.

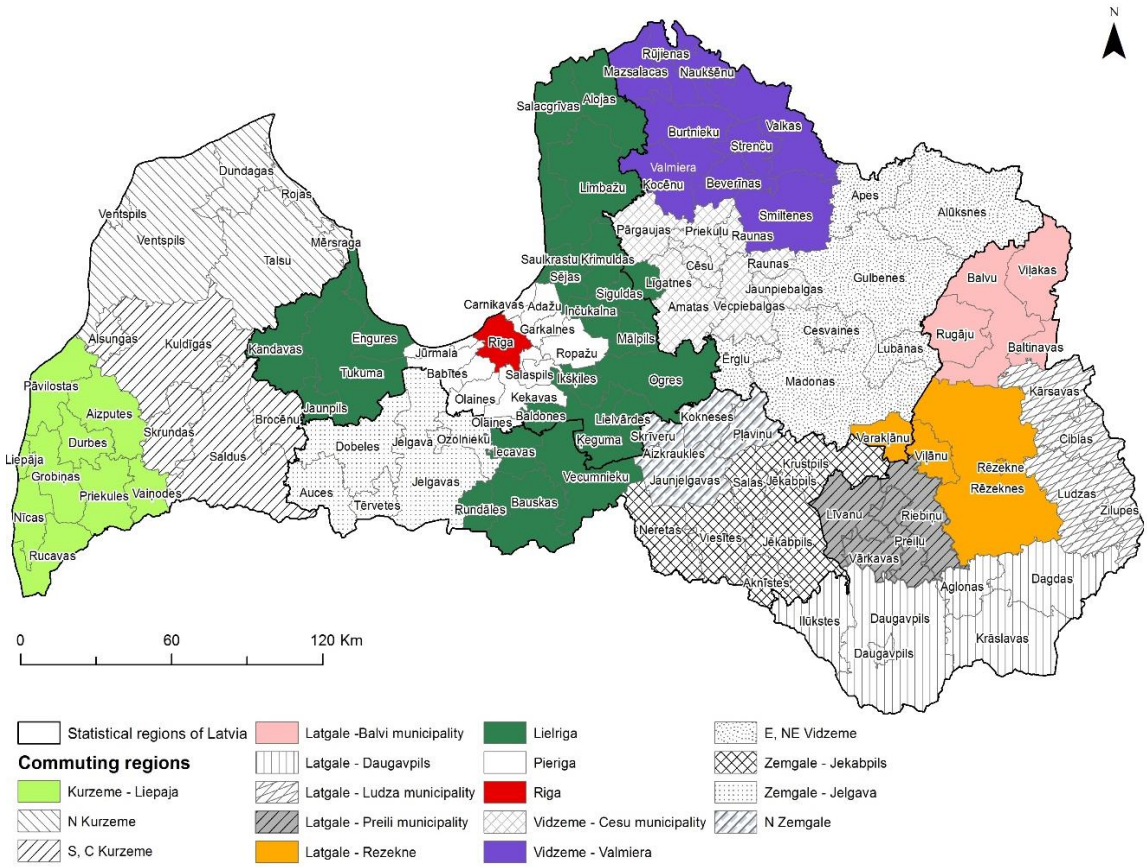


Figure 1. **Commuting regions of Latvia** (author's figure based on Central Statistical Bureau of Latvia data)

There are two other Kurzeme regions. Unlike the Liepāja region these regions are not mono-centric. The northern region has two centres – Ventspils and Talsi municipality. The former has less connections yet attracts more commuters, whereas the latter is more connected within the region. 4588 individuals commute in to the municipalities of this region, whereas 8399 commute out from them. The other region, which covers the rest of Kurzeme, also has two centres (the municipalities of Kuldīga and Saldus) but has a smaller number of commuters – 2368 to and 5023 from.

The Daugavpils region stretches through the southern part of Latgale, encompassing six municipalities. Its centre has the fourth largest number of in-bound commuters (right behind Mārupe municipality) – 5575. Despite the city of Daugavpils being an important regional centre, this region is also predominantly a commuter sender region, with 6521 in-bound commuters and 10573 out-bound commuters.

The Latgale – Balvi municipality region, along with three other Latgale regions of Rēzekne, Ludza municipality and Preiļi municipality, is tied to the smallest number of municipalities (four) that make up a region. In terms of numbers it has the smallest number of both in-bound and out-bound commuters (525 and 1675). Also, it has the smallest difference between these commuter groups (-1150) behind Rīga. Another unique characteristic is that the centre of this region is the main source of in-bound commuters for other municipalities of the region. Two other regions of Latgale also have a small number of commuters – 1087 and 2243 for the Ludza region; 1109 and

2290 for the Preiļi region. Rēzekne has the smallest number of connections, with three, because Varaklāņi municipality is more connected to neighbouring Viļāni. Nevertheless, commuter numbers are much higher than for all other Latgale regions, except Daugavpils. 4874 people commute to the municipalities of this region, whereas there are a total of 6409 in-bound commuters.

The third largest region (10 municipalities), is Vidzeme – Valmiera region. Most municipalities in this group have a strong link with Valmiera, but commuting within the region is quite pronounced, which is why, despite having a lesser connection to the centre, Naukšēni municipality was included in this region. The total number of in-bound commuters (6913) is higher than, for instance, that of the Daugavpils and Liepāja regions. The number of out-bound commuters is 9090.

Another mono-centric region in Vidzeme is the Cēsis municipality region. It encompasses a total of seven municipalities. Commuting is not as pronounced as for the Valmiera region. The municipalities of this region have 4136 in-bound commuters and 6007 out-bound.

Seven municipalities make up the Eastern, Northeastern Vidzeme region. Madona municipality is the main centre, while Alūksne is also a significant sender and receiver of commuters. 5043 people commute from the municipalities of this region but there are only 1690 in-bound commuters.

The Zemgale - Jelgava region, consisting of seven municipalities, is an interesting case. The city of Jelgava does have a major connection with Rīga (6363 commuters to Rīga and 523 from Rīga; both above average values); however it is also an important regional centre. As a matter of fact, Jelgava has the second largest number of in-bound commuters (6309). For this reason, the city is the centre of the Zemgale - Jelgava region and not a part of the Pierīga or Lielrīga region. In total, the municipalities of this region have 8349 in-bound commuters (mostly to Jelgava) and 17346 out-bound commuters, making it the most active region after Rīga, Pierīga and Lielrīga. The Auce and Tērvete municipalities are included in this region, while being more closely linked to Dobele municipality, which in turn has a link with Jelgava.

Northern Zemgale is a poly-centric region (centres - Aizkraukle and Jaunjelgava municipalities), whereas Zemgale – Jēkabpils, as the name suggests, is mono-centric. That is not the only difference - The northern region has a much smaller number of in-bound commuters (1192 compared to 3282). The difference between out-bound commuters is not as significant, with the Jēkabpils region having a total of 5309 and Northern having 4227 commuters.

**Conclusions**

The results of this study clearly highlight the importance of Rīga in the national labour market in terms or work-related commuting. The number of people travelling to work in the capital city far exceeds the number of commuters travelling to the other largest employment centres.

The Pierīga and Lielrīga regions reflect the commuting range of Rīga, which is especially evident by the structure of out-bound flows from Rīga. These flows are significantly higher in areas near the capital, due to development and expansion of businesses (also known as commercial suburbanisation) in recent years. In-bound flows play a lesser role, since for most municipalities the number one out-bound connection is with Rīga. Nevertheless, the flows tend to be higher in the vicinity of Rīga. This could be explained by the large numbers of people who have moved from Rīga to the suburbs, while retaining their jobs in the capital (residential suburbanisation).

Results also indicate that the other largest employment centres – cities, except Jūrmala and Ventspils, form mono-centric regions with numerous significant connections. Jūrmala is an integral part of the Pierīga region, where out-bound commuting is more prominent. Meanwhile, the city of Ventspils only has a major connection with Ventspils municipality, which could be explained by the fact that other municipalities of Northern Kurzeme are located far from this city.

In general, mono-centric regions attract large numbers of commuters while poly-centric regions have more diversified travel-to-work flows with several employment centres.

This study paves the way for future research. Available data allows for in-depth analysis to be conducted. This dataset allows to calculate numerous variables and to explore, as well as analyse, regional differences.

## Acknowledgement

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**Kopsavilkums**

Šajā pētījumā analizēta ceļa uz darbu ģeogrāfija, ņemot vērā svārstmigrantu plūsmu starp pašvaldībām. Šī pētījuma mērķis ir noteikt svārstmigrācijas reģionus, izmantojot jaunākos datus, kas iegūti 2011. gada Tautas skaitīšanā. Analīze parāda potenciālos ieskatus, kurus var iegūt, definējot ar darbu saistītu pārvietošanās plūsmu struktūru reģionālos modeļus, izmantojot Tautas skaitīšanas datus. Rezultāti parāda, ka Latvijā ir 17 svārstmigrācijas reģioni, un uzsver Rīgas nozīmi valsts darba tirgū. Tika identificēti divi reģionu veidi – monocentriski, kas piesaista lielu skaitu svārstmigrantu galvenajā nodarbinātības centrā, un policentriski ar daudzveidīgākām pārvietošanās plūsmām.

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# INNER CITY OR OUTSKIRTS: WHERE ARE RESIDENTS MORE SATISFIED? THE CASE OF JELGAVA

# Iekšpilsēta vai nomales: kur iedzīvotāji ir vairāk apmierināti? Jelgavas piemērs

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**Abstract**. Residential satisfaction is an important issue in any urban development policy. In order to ascertain the level of residential satisfaction in Jelgava in 2018 a population survey was conducted, in which 961 residents were questioned. Since the urban environment of Jelgava is not homogeneous, respondents were grouped according to the place of residence in two parts of the city - the inner city and the outer city. The results revealed that the overall satisfaction with life in Jelgava is relatively high, but this indicator is not influenced by the respondent's place of residence in the urban area. There were no statistically significant differences between respondent satisfaction in the inner city and/or the outskirts with life in general, household financial situation, educational facilities, air quality, noise level, cleanliness and/or job opportunities. By contrast the location of residence in one or another urban zone affects satisfaction with public transport, health-care services, sports facilities, cultural facilities, the state of the streets and buildings, public places, green areas and the availability of retail shops - respondents living in the inner city are more satisfied with all of these factors compared with those living on the city outskirts.
**Keywords:** *residential satisfaction, urban zones, second-tier city, Jelgava*

## Introduction

The number of *satisfaction* studies in different fields of science since the middle of the 20th century has grown rapidly, as identifying the level of satisfaction can help to improve services, products and policies. The expressed interest of geographers in satisfaction research is related to spatial expressions of satisfaction and thus residential satisfaction is most often studied. It is a complex concept influenced by various environmental and socio-demographic variables (Lu 1999). According to Amerigo and Aragones (1997) residential satisfaction is defined as the positive emotional state an individual feels towards his or her living environment and which will influence his or her behaviour to maintain or increase the link with that environment. It is often associated with the migration intentions of residents (Frijters et al. 2011) and especially within neighbourhoods in the same city (Nowok et al. 2018). Previous research has proved the relationship: the less satisfied a person is with residence, the greater is his desire to move (Fang 2006; Nowok et al. 2018).

Residential satisfaction may be studied from different viewpoints and factors that influence it, and one of these is the spatial factor. Previous studies have revealed that place of residence in the urban morphological structure affects residential satisfaction (Dekker et al. 2011). There are studies which reveal that suburbanites tend to be more satisfied than centrality residents (Speare 1974), residents of semi-central areas are more satisfied than others (Gentile 2015; Kovacs and Douglas 2004). At the same time there are research studies that did not find an impact as a result of location. For example,

Gentile (2005) points out that residential satisfaction varies more significantly according to housing types rather than according to a neighbourhood's distance from the city center.

Residential satisfaction in the context of Central-Eastern Europe has been studied in the Czech Republic (Temelova et al. 2012; Hanák et al. 2015; Špačková et al. 2016); Estonia (Kährik et al. 2011); Poland (Gorczyca and Grabinski 2017). In the academic field residential satisfaction in Latvia has been little studied. Parsova and Sidelska (2017) have studied household opinion regarding their accommodations and criteria that influence this in the cities and rural areas of Latvia. Krūmiņš, Bērziņš and Sechi (2018) have investigated how both mobility and static factors affect the assessment of young individuals with regard to the question of residential satisfaction in Rīga. Overall residential satisfaction has also been studied in Jelgava (Feldmane 2018), but residential satisfaction in the different urban zones within medium sized cities of Latvia has not yet been researched. As a consequence of this situation the research question for this study is to investigate how location of residence in the inner city or outskirts affects residential satisfaction in the case of Jelgava.

**Data and Methods**

In 2018 a survey of the residents of Jelgava (hereinafter - The Survey) was carried out in order to ascertain the level of satisfaction with the place of residence, and 961 persons in total were interviewed. Respondents were asked to assess their satisfaction with life in Jelgava and the factors affecting this according to the Likert 5-point scale, where "1" is "very dissatisfied" and "5" – "very satisfied". The factors affecting residential satisfaction in Jelgava were as follows: overall life satisfaction, satisfaction with the household financial situation, public transport, health-care services, sports facilities, cultural facilities, the state of the streets and buildings, public spaces, green spaces, availability of retail shops, educational facilities, the quality of the air, noise levels, cleanliness, safety and job opportunities.

Within the framework of the study, the city of Jelgava was divided into two urban areas – the inner city and the outer city (Figure 1). The inner city is located in the central part of the city, it is historically the oldest part of Jelgava, dominated by apartment complexes built during the years of Soviet socialism. The inner city is also an area where business and trading activities dominate. By contrast, the outer city is the territory outside the city center. It is not homogeneous, and it contains both housing estates built during the Soviet socialist era, as well as private houses. The growth of private houses built in recent years is vividly evident in this urban zone.

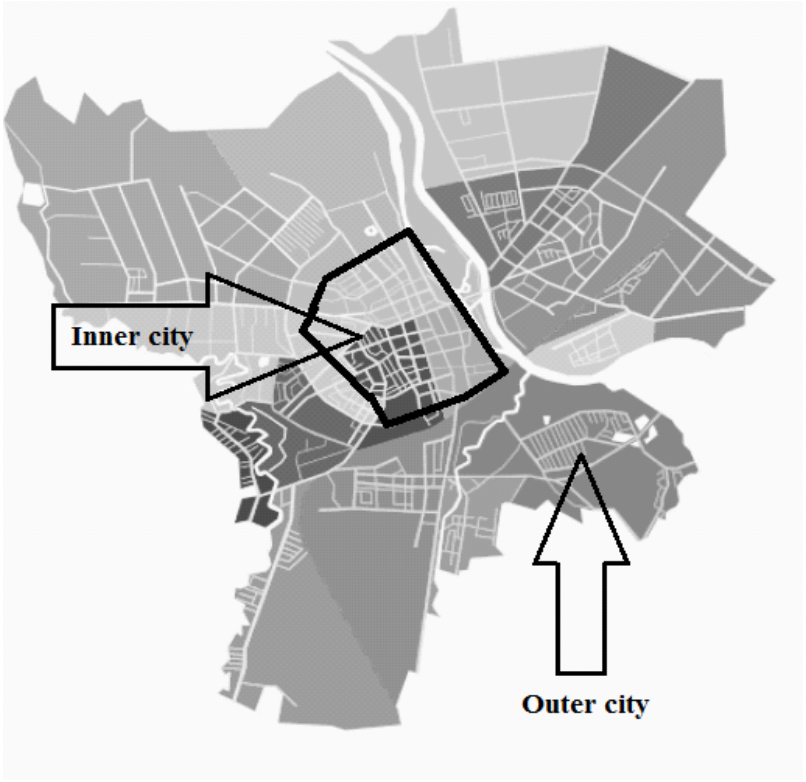


Figure 1. **Urban zones of Jelgava** (author's figure based on Neighborhoods of Jelgava data)

Data arrays were grouped according to divided urban zones in order to assess whether there were differences in residential satisfaction between the two zones and data descriptives are depicted in Table 1.

Table 1. **Descriptive statistics**

| | | | Urban zone | |
|---|---|---|---|---|
| | | N | Inner city | Outer city |
| **Total** | | **961** | **100%** | **100%** |
| Gender | male | 337 | 37.6% | 33.0% |
| | female | 624 | 62.4% | 67.0% |
| Age | 18-25 | 303 | 36.5% | 27.6% |
| | 25-35 | 249 | 25.6% | 26.1% |
| | 35-45 | 137 | 12.7% | 15.5% |
| | 45-65 | 172 | 16.5% | 19.0% |
| | 66 and more | 100 | 8.7% | 11.8% |
| Nationality | latvian | 791 | 84.9% | 80.2% |
| | other | 170 | 15.1% | 19.8% |
| Marital status | lives alone | 401 | 46.8% | 37.7% |
| | married or cohabiting couple | 560 | 53.2% | 62.3% |
| Type of housing | flat in an apartment house | 577 | 67.1% | 54.5% |

| | | | Urban zone | |
|---|---|---|---|---|
| | | N | Inner city | Outer city |
| | private house | 231 | 14.4% | 31.7% |
| | dormitory | 153 | 18.6% | 13.8% |
| Period of house construction | before 1946 | 43 | 5.2% | 3.9% |
| | 1946-1991 | 753 | 84.9% | 73.1% |
| | 1991-2001 | 84 | 5.9% | 11.0% |
| | after 2001 | 81 | 4.0% | 11.9% |

Since results of the Kolmogorov - Smirnov test for normality data were found to be inconsistent with the normal distribution, a non-parametric data processing method - the Mann Whitney test - was used in the data analysis process to better determine whether there were statistically significant differences in residential respondent satisfaction between the now clearly defined urban zones of Jelgava.

## Results

Overall satisfaction with life in Jelgava has been assessed as rather high in that 80.2% of all respondents answered that they are somewhat satisfied or very satisfied with it. Although respondents from the inner city have indicated that they are slightly more satisfied with life in the city as 82.5% of respondents from inner city and 78.4% from outskirts are satisfied (Figure 2), we must observe, though, that comparing these results with the Mann Whitney test, no statistical significance is observed. This means that in this particular case study, location of residence does not influence overall satisfaction with city.

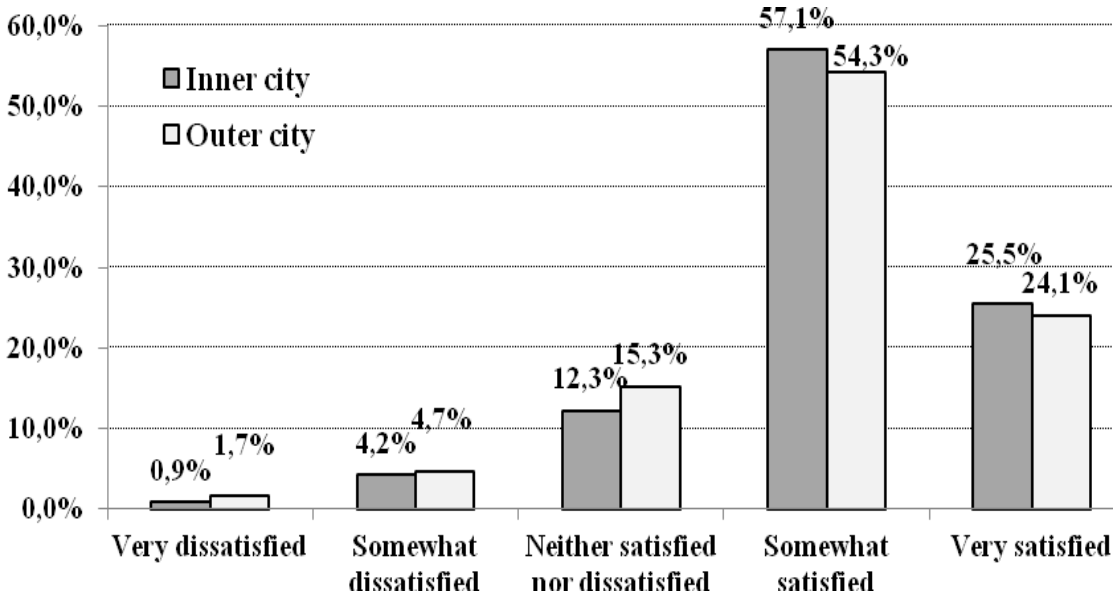


Figure 2. **Satisfaction with life in Jelgava in different urban zones, %** (author's figure)

The Survey respondents were also asked to evaluate their satisfaction level with life in general, taking into account their household financial situation and various other factors that could influence residential satisfaction. Overall, the residents of Jelgava

are the most satisfied with their green spaces, educational facilities, the availability of retail shops, cleanliness and access to cultural facilities, while satisfaction is lowest with public transport, lack of job opportunities, the state of streets and the building and health care services. Statistical differences between satisfaction of these factors in the two urban zones were tested (Table 2) and no differences were observed between respondent satisfaction with life in general, in financial situation, with educational facilities, the quality of the air, the noise level, cleanliness and job opportunities. By contrast, urban zone respondents expressed satisfaction with such factors as public transport, health-care services, sports facilities, access to cultural facilities, the state of the streets and buildings, public spaces, green spaces and availability of retail shops.

Table 2. **Comparing the differences between urban zone involvement regarding residential satisfaction with the Mann-Whitney test**

| **Grouping variable** | **Factor** | **Z** | ***p-value*** |
|---|---|---|---|
| Urban zones | Satisfaction with life in Jelgava | -1.27 | 0.204 |
| | Satisfaction with life in overall | -1.519 | 0.129 |
| | Satisfaction with financial situation | -0.681 | 0.496 |
| | Public transport | -2.964 | 0.003 |
| | Health care services | -2.391 | 0.017 |
| | Sports facilities | -2.409 | 0.016 |
| | Cultural facilities | -4.264 | 0.000 |
| | The state of the streets and buildings | -3.628 | 0.000 |
| | Public spaces | -2.27 | 0.023 |
| | Green spaces | -2.716 | 0.007 |
| | Availability of retail shops | -3.601 | 0.000 |
| | Educational facilities | -0.189 | 0.85 |
| | The quality of the air | -0.687 | 0.492 |
| | The noise level | -0.61 | 0.542 |
| | Cleanliness | -1.614 | 0.106 |
| | Safety | -2.939 | 0.003 |
| | Job opportunities | -0.498 | 0.619 |

To determine in which urban area residents are more satisfied with the above-mentioned factors, the mean levels of satisfaction for each aspect in both urban areas were compared. Despite the fact that the respondent group from the inner city is mostly younger than those from the outer city and respondent housing in the city center is dominated by flats in apartment buildings built in the Soviet era of socialism – factors, which could be related with lower residential satisfaction – nevertheless, as it is illustrated in Table 3, the satisfaction level of all statistically different factors is higher in the inner city. Those who live in the city center most likely do not use public

transport or use it rarely because everything is within walking distances. Therefore, respondents from the inner city more often have answered that they are neither satisfied nor dissatisfied (44.3%) and 23.3% were dissatisfied with public transport in Jelgava, while 35.5% of respondents living on the outskirts were dissatisfied. Naturally, residents of the inner city were also more satisfied with health-care services, cultural facilities, public spaces and the availability of retail shops as the inner city is the area where the main commercial, cultural and medical institutions are concentrated. On the other hand, as it might be expected, residents from the outskirts must be more satisfied with the green spaces and the state of the streets and buildings as the outskirts are associated with more green areas because of forests at the edge of the city and newer housing stock. Nevertheless, the results of the Survey illustrate an opposite situation as the satisfaction level with green spaces and the state of the streets and buildings is lower than in the city center. The main reason for these results may be explained by the fact that the inner city of Jelgava has become more attractive in recent years; there are many parks and squares while the outer city has experienced fewer changes. While the streets of the inner city have been repaired, there are many smaller streets and roads around the city center that are still in poor condition and without asphalt pavement.

Table 3. **Comparing the means between urban zone involvement regarding residential satisfaction**

| Factor | Min | Max | Inner city | | Outer city | |
|---|---|---|---|---|---|---|
| | | | N | Mean | N | Mean |
| Satisfaction with life in Jelgava | 1 | 5 | 424 | 4.02 | 536 | 3.94 |
| Satisfaction with life in overall | 1 | 5 | 425 | 4.02 | 536 | 3.99 |
| Satisfaction with financial situation | 1 | 5 | 422 | 3.58 | 535 | 3.50 |
| Public transport | 1 | 5 | 421 | 3.11 | 534 | 2.89 |
| Health care services | 1 | 5 | 423 | 3.34 | 533 | 3.18 |
| Sports facilities | 1 | 5 | 421 | 3.84 | 533 | 3.73 |
| Cultural facilities | 1 | 5 | 425 | 3.95 | 535 | 3.76 |
| The state of the streets and buildings | 1 | 5 | 425 | 3.35 | 536 | 3.11 |
| Public spaces | 1 | 5 | 424 | 3.77 | 536 | 3.65 |
| Green spaces | 1 | 5 | 425 | 4.06 | 535 | 3.94 |
| Availability of retail shops | 1 | 5 | 424 | 4.03 | 536 | 3.81 |
| Educational facilities | 1 | 5 | 423 | 3.98 | 536 | 4.01 |
| The quality of the air | 1 | 5 | 424 | 3.69 | 536 | 3.66 |
| The noise level | 1 | 5 | 423 | 3.50 | 536 | 3.46 |

| Factor | Min | Max | Inner city | | Outer city | |
|---|---|---|---|---|---|---|
| | | | N | Mean | N | Mean |
| Cleanliness | 1 | 5 | 425 | 3.94 | 535 | 3.83 |
| Safety | 1 | 5 | 425 | 3.80 | 536 | 3.64 |
| Job opportunities | 1 | 5 | 425 | 3.03 | 535 | 3.01 |

## Conclusion

Residential satisfaction is a complex concept that includes individual satisfaction with their living environment and its perception as an important condition for the further development of the urban environment. Although the results of this study reveal that an overall satisfaction with life in Jelgava does not depend on the urban area in which the resident lives, the satisfaction level is tied to several factors that influence overall residential satisfaction in the city and varies between the inner city and the outskirts of Jelgava. Satisfaction with such factors as public transport, health-care services, sports facilities, access to cultural facilities, the state of the streets and buildings, public spaces, green spaces and the availability of retail shops is significantly higher in the inner city, as the main commercial, cultural and administrative activities are located in the city center. At the same time, satisfaction level with life in general, the financial situation, educational facilities, the quality of the air, the noise levels, cleanliness and job opportunities is almost the same in the inner city as it is in the outskirts. The results confirm that distance to the city center is an important issue also in medium-sized cities and that the outer city is an area where public services and infrastructure should not be neglected among the further improvements and developments to provide equal living conditions for all residents.

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**Kopsavilkums**

Dzīves vietas novērtējums ir pozitīvs emocionāls stāvoklis, ko indivīds izjūt pret savu dzīvesvietu un kas notur vai palielina saikni ar šo dzīvesvietu (Amerigo and Aragones 1997). Savukārt ir būtiski noskaidrot šī novērtējuma līmeni un ņemt vērā ikvienu vietu turpmākās attīstības plānošanā. Lai noskaidrotu dzīvesvietas novērtējuma līmeni, 2018. gadā Jelgavā tika īstenota iedzīvotāju aptauja, kurā kopumā tika aptaujāts 961 pilsētas iedzīvotājs. Tā kā Jelgavas urbānā vide nav viendabīga, dzīvesvietas atrašanās dažādās pilsētas urbānajās zonās var atšķirīgi ietekmēt dzīvesvietas novērtējumu, tādēļ respondenti pētījuma gaitā tika sagrupēti pēc dzīvesvietas divās pilsētas daļās – iekšpilsētā un ārpilsētā. Rezultāti parādīja, ka kopējais dzīvesvietas novērtējums Jelgavā ir visai augsts, jo 80,2% no respondentiem kopumā ir apmierināti ar dzīvi Jelgavā, turklāt šo rādītāju neietekmē respondenta dzīvesvieta pilsētas urbānajā telpā. Statistiski būtiskas atšķirības starp iekšpilsētas un ārpilsētas respondentu atbildēm netika konstatētas apmierinātībā ar dzīvi kopumā, mājsaimniecības finansiālo situāciju, izglītības iestādēm, gaisa kvalitāti, trokšņu līmeni, sakoptību un darba iespējām. Tajā pašā laikā dzīvesvietas atrašanās vienā vai otrā urbānajā zonā ietekmē apmierinātību ar sabiedrisko transportu, veselības aprūpes pakalpojumiem, sporta un kultūras objektiem, ielu un ēku stāvokli, publiskajām vietām, zaļajām zonām, kā arī mazumtirdzniecības veikalu pieejamību, turklāt tika konstatēts, ka respondenti, kas

dzīvo iekšpilsētā, visus šos faktorus vērtē augstāk nekā iedzīvotāji, kuru dzīves vieta atrodas ārpus pilsētas centra.

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# THE PROCESS OF SUBURBANISATION IN BABĪTE RURAL MUNICIPALITY AFTER THE YEAR 2000

## Suburbanizācijas procesi Babītes pagastā pēc 2000. gada

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**Abstract.** Since the year 2000 the population in rural territories surrounding Rīga has grown mainly at the expense of migration. These territories have been intensively built up over the past 20 years. As result - many new single-family-house villages have appeared in landscape areas or within the borders of already existing villages. One of the rural municipalities experiencing intensive suburbanisation in its territory after the year 2000 is Babīte parish (a rural municipality), where the population has increased considerably and building of new dwelling houses is rapidly growing, forming new residential districts and new villages. The goal of the present study is to characterise changes in housing in Babīte parish (rural municipality) since 2000 under the influence of suburbanisation. The analysis of the present situation proves that Babīte parish has become an attractive place of residence in suburban Rīga with developing housing and a growing population.
**Keywords:** *suburbanisation, Rīga area, Babīte parish, villages.*

### Introduction

Since the year 2000 in Latvia, many new single-family-house villages have appeared in the outskirts of large cities, close to highways, in landscape areas or within the borders of already existing villages (Grīne and Strautnieks 2012; Grīne and Strautnieks 2018). A typical example is to be found in the rural territories surrounding Rīga, the capital of Latvia. These territories have been intensively built up over the past 20 years. This can be explained not only by the favourable geographical situation, closeness to the main highways and good traffic links from these areas to the capital, but also by good access to public services and a visually attractive landscape. Since 2000 the population in the rural territories surrounding Rīga has grown mainly at the expense of migration – people have moved to the suburban rural territories to live but still work and access public services in town, thus favouring the growth of outskirt migration. Another type of suburbanisation observed in the area is when people (and also companies) move to suburbs where blocks of flats are being built. After the year 2000 the intensity of suburbanisation and migration to the suburban Rīga area has been regulated by housing construction, the housing market and the outreach of jobs (Bērziņš 2011).

One of the rural municipalities experiencing intensive suburbanisation in its territory since 2000 is Babīte parish (rural municipality; *pagasts*), where the population has increased considerably, and the building of new dwelling houses is rapidly growing, forming new residential districts and new villages.

The aim of the present study is to characterise changes in housing at Babīte parish (rural municipality) after the year 2000 under the influence of suburbanisation.

## Data and Methods

The principal sources of the present research are:

- published statistical data by the Central Statistical Bureau of Latvia (CSB) about the number and age structure of the population in Babīte parish (rural municipality) and its villages in 2000, 2011, 2016-2018;
- analysis of the cartographical material – orthophotographs of 2013 and 2015, a topographic map (scale 1:10 0000) by the Map browser of the University of Latvia (data source - Geospatial Information Agency of Latvia (LGIA));
- planning documents of the Babīte county - Development Programme of Babīte county for 2014-2020, Sustainable Development Strategy of Babīte county until 2030 and Spatial Planning of Babīte Parish of Riga district from 2008 till 2020;
- public opinion poll results of 2018 (203 respondents), field survey results of 2017-2018. A population survey was undertaken to find out what kind of income levels the residents had gone to live in the Babīte parish and their connection with Rīga. The survey included questions about type of housing and year of construction, about residence (reasons for choosing a place to live, satisfaction with the place of residence, future plans for living), as well as questions about workplace, age, income, use of transport by respondents, goals and frequency of visits to Rīga.

## Principal Results and Discussion

Babīte parish with an area of 165.3 sq. km. is situated in the central part of Latvia, bordering with Rīga and the Town of Jūrmala. According to statistical data provided by the Central Statistical Bureau of Latvia (CSB), in 2018 Babīte parish was inhabited by 8977 people, which is approx. 87% of the population of the Babīte county (*novads*), the density of population being 54.3 people per sq.km. The most part of the territory of Babīte parish is covered by agricultural land and forests, a lake and bogs.

The housing of Babīte parish is formed by historically established villages and a network of detached homesteads, as well as new detached houses and villages built during the previous 10 – 15 years. At present, Babīte parish comprises 17 villages mainly located not far from the principal highways and the Rīga city border. In some cases the merging of villages has been hindered by natural or artificial obstacles, for instance highway A5 between Piņķi and Beberi villages and highway A9 between Dzilnuciems and Skārduciems. In other cases the villages have merged together, so that it is difficult to spot the border between the villages, as is the case with Piņķi and Sēbruciems or Spilve and Mežāre. The expansion of villages takes place at the expense of agricultural lands. Some new villages have formed closed areas.

Present day housing in the villages reflects the building types of the 1990s, as well as the manner of the first decade of the 21st century. We can see detached single family houses, terraced houses and blocks of flats (Mieze 2018). Up to the year 1999 Babīte, Piņķi and Spilve villages were intensively built over. Since 2000 intensive

construction of new dwellings has been carried out in such villages as Lapsas, Sēbruciems, Vīkuļi, Dzilnuciems, Priežciems, Mežāre, Spilve (its new part) and Piņķi (Saliena). The financial crisis affected the intensity of construction works – the most active house building took place until 2008.

Today, new buildings cluster not only around the former residential centres and highways, but also a good way of the highways, as well as next to or even in the forests. Expansion of housing can be seen in such villages as Mežāres, Spilve, Brīvkalni, Sēbruciems, Vīkuļi, Priežciems, Lapsas and Piņķi. According to data (Babītes novada attīstības… 2012) in the year 2012 the largest villages by territories occupied were Piņķi (659 ha), Spilve (444 ha) and Trenči (378 ha). However, analysis of the cartographical material shows that in 2018 also Mežāres, with a territory of 379 ha belongs to the largest villages. By density of population today the largest villages are Babīte, Piņķi and Priežciems (Babītes novada attīstības… 2012). With the expansion of housing territories, also the population continues to grow in the villages and in the municipality at large (Figure 1).

After 2000 the population in Babīte parish continued growing. During the period between 2000 and 2018 it has grown by 38.5% (approx. 3 500 people) or, on average, by 200 people a year.

Between 2000 and 2018 the population has grown in all age groups (except in the age group between 15 and 24), and especially in the age group up to 6. It is worthy of note that in 2018, in every age group (except age groups between 15 to 24 and 55 to 64), the number of people exceeded 1000. Thus, in 2018, 16% of the population of Babīte parish were of the age group between 35 and 44 and 14% of the age group were between 45 and 54. From 25% to 34% is a comparatively large percentage of economically active population.

According to data of the CSB, the population in Babīte parish has grown mainly on account of migration. Between 2000 and 2018 some 48% of people (2674 individuals) have not changed their place of residence, 1744 have left the area (including emigrants to the EU) and 3817 individuals have newly arrived. The fact that twice as many people have arrived in the rural municipality than have left it has remained constant also between the years 2011 and 2018.

The data of the CSB reveals that in the period between 2000 and 2018 Babīte residents have migrated mainly to Rīga, Rīga suburbs (the Mārupe and Ķekava counties) and the Town of Jūrmala. A similar tendency appears in immigration – people have arrived in Babīte parish mainly from Rīga, the Town of Jūrmala, and the counties of Jelgava and Mārupe.

This is also confirmed by the survey data. The data from a public opinion poll shows that people arriving in Babīte parish are mainly townspeople from Rīga and Jūrmala. They have moved over mostly due to family reasons (approx. 36%), purchase of housing (approx. 31%) as well as in search of a more attractive environment (approx. 20%). Many of them had previously lived in multi-story apartment houses.

Besides, 90% of the respondents do not plan to change their place of residence in the nearest future. 10% of the respondents plan to move to Rīga or abroad.

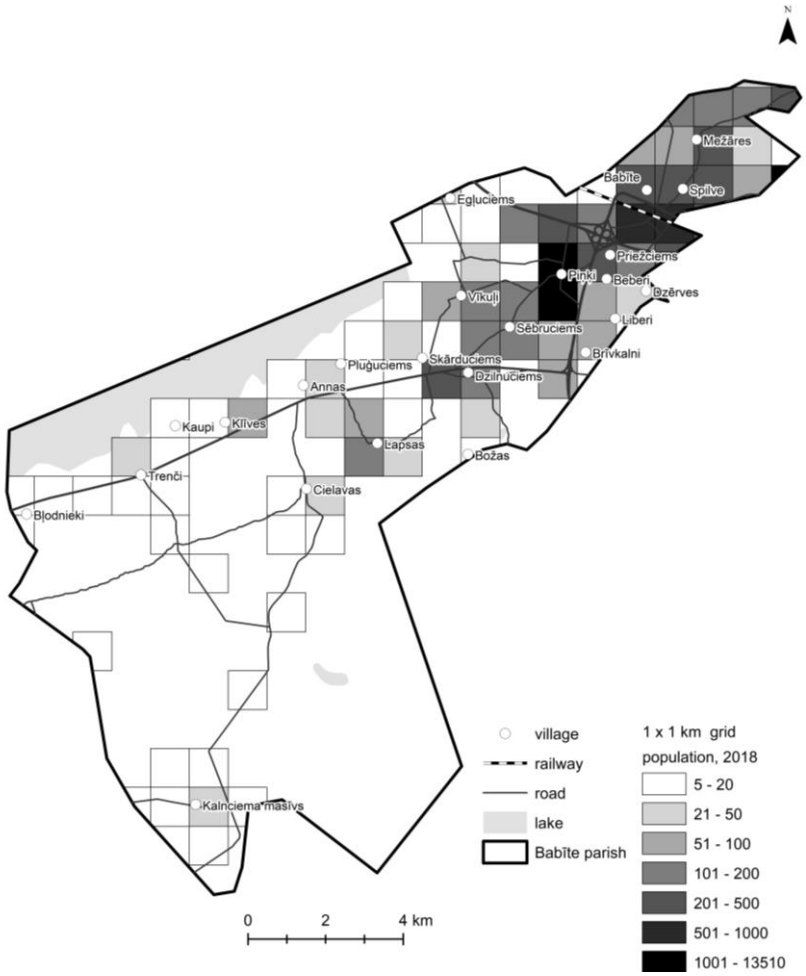


Figure 1. **Settlement of Babīte parish, 2018** (authors' figure based on Central Statistical Bureau of Latvia data)

The population has grown mainly in the village areas. More than 95% of people live in village areas. The proportion of village dwellers has grown from 95% in 2000 to 97% in 2018. According to statistical data the largest villages by population are Piņķi (3135 people), Babīte (1247 people) and Spilve (1114 people). There are villages, such as Liberi, Dzērves, Cielavas, where the number of population does not exceed 50 people. The greatest growth of population (by more than 400 people) between 2000 and 2018 has been registered in the villages of Mežāre, Spilve and Piņķi. The population has also grown in the villages of Priežciems and Sēbruciems by more than 200 people.

Today, out of all inhabitants in Babīte parish ~35% live in Piņķi village, ~14% - in Babīte village and ~12% in Spilve village. It is worthy of note that between 2000 and 2018 the population dropped considerably in Piņķi village (by ~14%) and in Babīte village (by ~6%). It follows that in other villages the number of population has grown, especially in the villages close to the border of Rīga, as, for example, in Mežāres (by ~8%) and Spilve (by ~5%). This is due to the intensive building of

detached single-family houses. Already by 2008 it was noted in the documents of spatial planning that Spilve and Mežāre villages are turning into the so-called Rīga "dormitory areas", where people have moved their residences while keeping their jobs in Rīga. The new inhabitants are more linked with Rīga than with the village owing to closeness of the city and good traffic (Rīgas rajona Babītes … 2007/2008). Resident polls also pointed out that choosing Babīte parish as a place of residence - buying a home or building a home - paid attention to the quality of the building, the infrastructure, the availability of schools and kindergartens, the availability of public transport, and the availability of utilities for land (Mieze 2018).

A public opinion poll showed that 95% of the respondents liked living in the parish. Such an assessment is related to good road infrastructure, good landscapes, accessibility of public transport, sense of security and proximity to Rīga. Some 85% of the respondents liked the tidy dwelling, 80% - its environment and 84% - the neighbours. The respondents who were only partly satisfied or dissatisfied with the environment and dwelling mostly lived in blocks of flats.

The most densely populated area of Babīte parish is its Northern and North Eastern part. It is the territory surrounding the centre of the parish, the Rīga border area and the area at the crossing of highways A5 and A10. According to statistical data it is the Eastern territories of Babīte parish, especially the area around the Piņķi, Beberi, Babīte, Mežāres and Spilve villages, which have become densely populated between 2000 and 2018 (Figure 1). This can be explained by the process of suburbanisation and development of villages owing to their favourable geographical position, road infrastructure and comparatively good public transport. Most of the respondents either working or studying in Rīga (78%) commute between the villages and Rīga. The commuters go to Rīga mostly on working days. They usually travel by their own cars (71%) and sometimes also by public transport (26%). The data from the public opinion poll shows that travelling to Rīga by public transport usually takes from 20 to 40 minutes, sometimes even up to 60 minutes. Travelling from villages close to the Rīga border to Rīga centre by one's own car takes up to 20-40 minutes, sometimes up to 50-60 minutes (as it is from the village of Lapsas). If the job location is either in Mārupe, Ķekava or Jūrmala the respondents mostly commute by their own cars. As the field survey data shows, there is an increasing migration to work and back (Mieze 2018).

As the answers to the public opinion poll showed, the respondents mostly go to Rīga not only because of jobs or studies, but also for shopping, entertainments and medical services. As to access to public services in the parish, the respondent evaluation varied – 36% of respondents were satisfied, 38% - were partly satisfied, but 26% - unsatisfied. Respondents also stressed that the lack of services in the rural municipality can be easily replaced with the amenities within Rīga. Therefore, as the answers of the public opinion poll showed, the respondents go to Rīga for shopping a few times in the week.

The respondents who work at the municipality travel to work either by bicycle (50%) or by public transport (38%). As to the quality of public transport services in Babīte parish, 58% of the respondents are satisfied, 24% are partly satisfied but 18% are dissatisfied. From the group of the respondents who travel to work by public transport 57% are satisfied with bus services, but from those who travel to work by their own cars ~52% find public transport services sufficient.

Most of the respondents who travel to Rīga either because of jobs or studies find their income higher than those working at the municipality. ~82% of the respondents working in Rīga earn above the average salary (i.e. 700 EUR), while only 38% of the respondents working at the municipality earn more than the average salary. The data of the opinion poll also testifies that ~53% of the respondents are dissatisfied with job opportunities being offered in Babīte parish, while 27% are only partly satisfied.

Taking into account the public opinion poll, briefly: the characteristics of the respondents from Babīte parish - a short distance to the center of Rīga, the infrastructure development, convenience, good ecological conditions, the availability of forest areas, homogeneous social environment and appropriate property prices (Mieze 2018).

**Conclusion**

The analysis of the present situation leads to the conclusion that Babīte parish has become an attractive living space in the Pierīga area - changes in the population are taking place, the number of inhabitants in the parish continues to increase. In Babīte parish there is a characteristic suburbanisation process - the construction of new houses near the Rīga city border, close to the main roads A5, A10, A9, Lake Babīte and forest areas. The construction of new houses is changing the landscape - new individual houses are appearing in the old villages, new villages are being formed. The construction is also related to the return of agricultural land in building territories. In Latvia, there is a tendency for residents to choose their place of residence on the outskirts of the city, as the main reasons are family, housing, work and nature. Babīte parish is one of those in which the number of inhabitants in the parish increases mostly at the expense of in-migration from the capital city. The proximity of Rīga, the road network and transport options make it easy to reach the city, thus ensuring the possibility of working and providing various services, on the other hand - providing better quality of life and environment - dwelling, nature, calm, recreation.

Babīte county spatial planning documents worked out 5 years ago envisaged further development of Babīte parish by promoting a balanced development of housing, density of population, transport, business, access to public services and attractive environment. The document also envisaged further growth of the population. Thus, Babīte parish of 2020 has been planned as a place of residence with properly organised infrastructure suitable for families, but after 2030 – as a fashionable place of residence in Suburban Rīga (Babītes novada ilgtspējīgas … 2015).

**Kopsavilkums**

Iedzīvotāju skaits lauku teritorijās ap Rīgu kopš 2000. gada palielinās galvenokārt migrācijas procesu rezultātā. Intensīva apbūve ir notikusi lauku teritorijās ap Rīgas pilsētu, kas saistās ne tikai ar izdevīgo ģeogrāfisko stāvokli, galveno autoceļu tuvumu, labo satiksmi, bet arī ar pakalpojumu pieejamību un sasniedzamību un ainaviski pievilcīgo dzīves telpu. Rezultātā veidojas jauni privātmāju ciemi, kā arī notiek jauno ciemu daļēja saplūšana ar vēsturiskajiem. Viens no pagastiem, kur kopš 2000. gada ir notikušas ievērojamas pārmaiņas apdzīvojumā – palielinājies iedzīvotāju skaits, notikusi strauja apbūve, ceļot jaunas dzīvojamās mājas, veidojot jaunus māju rajonus, jaunus ciemus, ir Babītes pagasts. Šīs pārmaiņas apdzīvojumā norāda uz intensīvu suburbanizācijas procesu šajā teritorijā. Pētījuma mērķis – raksturot pārmaiņas apdzīvojumā suburbanizācijas procesu ietekmē Babītes pagastā pēc 2000. gada.

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# DIVERSITY OF GENTRIFICATION IN THE INNER CITIES OF RĪGA AND PRAGUE – THE CASE OF ĀGENSKALNS AND HOLEŠOVICE

# Ģentrifikācijas daudzveidība Rīgas un Prāgas iekšpilsētā – Āgenskalna un Hološovices piemērs

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**Abstract.** This paper analyses gentrification from two perspectives - cultural consumption and changes in population composition as observed in two inner-city neighbourhoods that are gentrifying, Āgenskalns in Rīga and Holešovice in Prague. Both quantitative and qualitative methods were employed - such as field study and observation, Census data analysis, interview, analysis of reviews on internet platforms, as well as the mapping of results. The study revealed that both neighbourhoods experienced an influx of young and educated residents. It was also concluded that both neighbourhoods experienced major changes in the

cultural scene over the past years, turning from being once neglected to now very hip areas. The study also showed that Holešovice is more popular among foreigners than Āgenskalns. The findings suggest that the location of newly opened places in both neighbourhoods follows concentrated patterns.
**Keywords:** *gentrification, cultural consumption, population composition, inner cities, neighbourhood trajectories*

## Introduction

The process of gentrification has been studied globally for the past several decades, with the research originally starting in the global West. With the changing of global development patterns, the definition of the term has slightly changed over the years, as well. Contemporary gentrification studies include social, economic, ethnic, and cultural aspects. With the currently booming culture of *hip* and aesthetic youngsters, it is important to observe the changes of the cultural scene particularly in gentrifying neighbourhoods. Globally, neighbourhoods that have a special, alternative atmosphere, for example – the artistic Montmartre in Paris, or the home of the carnival, Notting Hill in London - are often linked to gentrification processes. Gentrification, however, is not the same everywhere and a lot depends on the pre-conditions of urban development.

While most gentrification studies in the post-socialist space emphasize the importance of the real estate market, social exclusion in the inner city (Kovacs 2009; Kovacs et al. 2013), urban renewal in terms of new built gentrification by either state-funded or private investment (Sykora 2005), and the rent gap phenomena (Holm et. al. 2015), it is also claimed that gentrification is a process of migration and, therefore, studies on population composition changes are important. The newcomers, or gentrifiers, are often described as being young (under 40), often couples without children or single-person household owners, middle-class or having higher income than previous residents of the specific neighbourhood (Gorczynska 2017).

In former Socialist countries, some examples of gentrification, in terms of cultural consumption, might be the famous ruin bars of Budapest (Smith et. al. 2018) or Užupis – the self-proclaimed artist republic in the capital of Lithuania. However, the academic research of cultural aspects of gentrification is rather limited. The example from Vilnius shows that the pioneer gentrifiers were the artists, yet they were later followed by middle and upper-class residents (Standl and Krupickaite 2004), while the example from Warsaw shows that since the 1990s, the relationship between the cultural and the economic capital of specific residential groups has evolved (Gorczynska 2017).

This paper looks at gentrification from two different perspectives: cultural consumption and population composition. The neighbourhoods studied are Āgenskalns in Rīga, the capital of Latvia, and Holešovice in Prague, the capital of the Czech Republic (Czechia). Cultural consumption, in this context, is meant to be the consumption that is related to cultural and lifestyle activities, such as art galleries, designer cafes etc. In simple words, these are the modern *hipster* venues. The aim of this study is to research the cultural consumption and changes in the population composition in the neighbourhoods observed. The main tasks are to identify the

places, associated with the *hipster* culture and to map their geographic locations to identify the gentrifiers of both neighbourhoods.

**Data and Methods**

A Field Study was undertaken with the aim of observing and identifying examples of gentrified places, in terms of cultural consumption, in the neighbourhoods of Holešovice in Prague and Āgenskalns in Rīga. The field study took place in both neighbourhoods in late 2018 and January 2019. During the field study, the main focus was on artistic venues such as art galleries, markets, venues that are hosting contemporary art events, coffee roasteries, and, frankly speaking, venues that are often labelled as *hipster* places.

Interviews: During the research process, a semi-structured interview with the councillor for social policy of Prague 7, Ing. Jakob Hurrle, was conducted. The main questions of the interview were about the overall transformation of Holešovice in the past and the present, about cultural consumption and its patterns in Holešovice, and about future scenarios for the development of Holešovice as a gentrified neighbourhood.

Analysis of Tripadvisor, Foursquare, Facebook and Google reviews. After identifying gentrifying places in both Holešovice and Āgenskalns, an analysis of reviews of selected venues was made in order to understand who the main visitors are and what are the most common keywords they use to describe the specific place. Using this method, it must be noted that not all reviews written in the English language are written by residents of English speaking countries, therefore the nationality of visitors cannot always be defined.

Census data analysis: During the research process, the results of the Population Census of both countries were analysed. In the case of Czechia, the Population Census data from 2001 and 2011 was used. In the case of Latvia, data from 2000 and 2011 was used to compare the population composition of Āgenskalns and Holešovice and to observe the differences between the years.

Mapping of the gentrified places, which were identified during the field study. Software used: ArcGis 10.2.2.

**The neighbourhoods studied**

Āgenskalns, a neighbourhood in the inner city of Rīga, is located on the left side of the river Daugava. Originally, the area served as a vacation housing neighbourhood for German resident-citizens, which later turned into a neighbourhood populated mostly by artisans or simple workers, such as fishers, cabmen, anchor-men, wine barrel carriers etc. Mainly built in the 19$^{th}$ century, Āgenskalns can be described by its rather chaotic street network. Until WWI, the neighbourhood developed without a specific plan. Nowadays it is a gentrifying neighbourhood, with a gradual change in population composition, signs of a new-build gentrification, studentification and new cultural, lifestyle venues.

Holešovice is a part of the municipal district Prague 7 in the northern part of Prague, added to Prague in 1884. This neighbourhood was mainly built in the 19th century as well. Historically, the neighbourhood had a mixed function – it was heavily industrialized closer to the harbour, yet overall, it served as a residential neighbourhood for working class persons. Over the past 10 years it had experienced a rapid development and may now be considered as a "good address" to live (Hurrle, 2018). Nowadays it is regarded as a gentrifying neighbourhood, which has experienced a change in population composition, having signs of new-build gentrification and new cultural, lifestyle venues.

**Results**

While the population has declined in Āgenskalns and grown in Holešovice, decennial census data reveals that population composition has changed in both neighbourhoods (Table 1).

The percentage of persons aged 20-39 years has grown in both neighbourhoods, suggesting that the new, incoming residents are young people. This applies to both capital cities as well. While Āgenskalns shows an increase of 1% for people aged 65 years and more, the percentage of this same age group in Holešovice has decreased. Speaking of one-person households, the percentage has increased in both neighbourhoods and cities overall, however, the trend is more obvious in Āgenskalns and Rīga. The results also show that the percentage of university educated persons and residents having high socio-occupational status has grown in both neighbourhoods and cities.

Āgenskalns and Holešovice, both having a history of being residential neighbourhoods for mainly working-class persons, are currently gentrifying. The findings suggest that the new residents, who are, in this context, the gentrifiers, are young educated persons, often having a high socio-occupational status, which is a common pattern in the gentrification discourse. While other studies suggest that some of these gentrifiers might be expats (Cook 2010), the nationality of the residents of Rīga and Prague was not analysed in this paper.

Table 1. **Changes of population composition in Āgenskalns, Rīga, Holešovice and Prague** (source: Czech Statistical Office and Central Statistical Bureau of Latvia)

| | **Āgenskalns** | | **Rīga** | | **Holešovice** | | **Prague** | |
|---|---|---|---|---|---|---|---|---|
| | **2000** | **2011** | **2000** | **2011** | **2001** | **2011** | **2001** | **2011** |
| Population | 34381 | 26819 | 764329 | 658640 | 14369 | 15262 | 1169 106 | 1268796 |
| Mean age | 39.6 | 41 | 39.8 | 41.8 | 43.2 | 40.05 | 41.3 | 41.9 |
| People aged 20-39 years (in %) | 28.9 | 30.9 | 28 | 30.3 | 31.2 | 40.1 | 29.5 | 35.00 |
| People aged 65 years and over (in %) | 16.9 | 17.9 | 15.7 | 18.6 | 20.00 | 14.9 | 16.00 | 15.8 |
| 1 person households (in %) | 12.1 | 18.9 | 9.6 | 16.2 | 46.1 | 47.7 | 36.9 | 38.4 |

| | Āgenskalns | | Rīga | | Holešovice | | Prague | |
|---|---|---|---|---|---|---|---|---|
| | **2000** | **2011** | **2000** | **2011** | **2001** | **2011** | **2001** | **2011** |
| People living in home-ownership (in %) | 36.8 | 60.9 | 55.4 | 71.6 | 25.6 | 46.00 | 48.4 | 52.6 |
| University educated in population 15+ (in %) | 19 | 30.3 | 19.9 | 30 | 12.8 | 19.9 | 16.2 | 20.7 |
| High socio-occupational status among employed (in %) | 23.1 | 34.8 | 23.1 | 33.4 | 11.7 | 17.2 | 13.2 | 16.5 |

The former industrial neighbourhood of Holešovice, as previously mentioned, has experienced significant changes in the past 10 years. Historically, as different parts of Prague 7, Holešovice was the poorer part, yet its neighbouring Letna was considered better, always being an elegant artist locale. However, this is now changing and the overall image of Holešovice has improved – which is also acknowledged by the rise of rent-pricing (Hurrle 2018). In terms of culture, the main changes have been observed on Komunardu street. While this street has always had many shops and facilities, they were rather more intended for proletarian residents, offering everyday services. Approximately 5 years ago this all started to change and now, besides the everyday facilities like mini-markets and key-cutter shops, Komunardu Street is also the home for several coffee shops and cafes. However, this street is not the only place for *hipsters* in Holešovice. Venues such as the Cross Club, DOX Centre for Contemporary Art, VNITROBLOCK, La Fabrika and others are welcoming both foreigners and locals.

The neighbourhood of Āgenskalns is quite diverse, having both Soviet housing and nationally preserved wooden buildings as well. The neighbourhood has lately been more welcoming for young persons, due to the relatively cheap rents (which are now starting to rise) and the close location to the city center. Due to the influx of younger inhabitants, including students, in the past 5-10 years Āgenskalns has experienced the opening of new cafes and some art venues as well. Yet, speaking of arts and the *hipster* lifestyle, the most prominent example that is always mentioned is the Kalnciema Quarter (Kalnciema kvartāls), located on Kalnciema street. Other examples of cultural consumption include the expansion of the café franchise Ezītis Miglā, the re-opening of the Āgenskalns Market, the seasonal art gallery Mākslai Vajag Telpu, the creative café Hāgenskalna Komūna and others.

Āgenskalns and Holešovice are located more than 1000 km from each other and have different historical backgrounds, with Holešovice having an important industrial past, but Āgenskalns being a residential neighbourhood since its beginning, yet both of the neighbourhoods have something in common as well – both are gentrified. While

there is evidence of new-build gentrification, studentification etc., the recent increase of cultural capital and cultural consumption is undeniable.

A similarity that both neighbourhoods share is the fact that the new cafes and restaurants also have a function in the hosting of creative events, such as concerts, pop-up shops, acoustic evenings etc. During the review analysis it was noted that most of these cafes were said to have a great variety of vegan/vegetarian options, which is nowadays a sign of trendiness. It also shows that the restaurant has a specific target audience.

Speaking of location for the *hipster* places, the main points in Āgenskalns are Kalnciema street itself and the area around the market (Figure 1), while in Holešovice it is Komunardu street and streets close to it – Tusarova and Delnicka (Figure 2), with small exceptions. This can be explained by the fact that Komunardu always had a kind of a shopping function, moreover, this street has tram tracks, therefore, it is easily accessible. The location of former factory buildings also plays a key role. Accessibility is also an important aspect for Āgenskalns – in front of the market building, there is a junction of 5 streets, which makes it easily accessible from different directions.

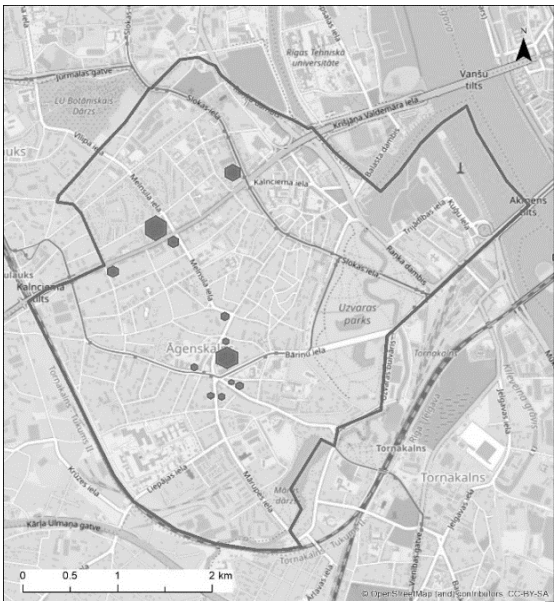


Figure 1. ***Hip* places in Āgenskalns, based on field study** (author's figure)

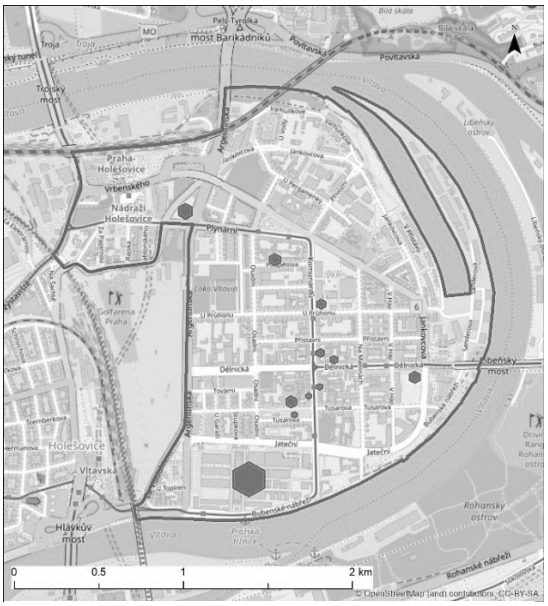


Figure 2. ***Hip* places in Holešovice, based on field study** (author's figure)

In evaluating records on the analyzed social network sites, it seems that the case of Āgenskalns is completely opposite to Holešovice, in terms of reviews. While Āgenskalns had a notable lack of reviews from foreigners, it sometimes seemed that the venues studied in Holešovice lack local Czech reviews. Overall, the venues in Holešovice had much more reviews than the ones in Āgenskalns. This might be because the population of Prague is twice as large as the population of Rīga. Prague is also welcoming noticeably more tourists and migrants than does Rīga. The only place

that had a significant amount of foreigner reviews was the Kalnciema Quarter – perhaps since it is the most famous venue of this kind. In both cases, visitors of the venues studied were mainly young persons.

## Conclusion

While gentrification might be a common discourse topic in Western countries, the studies in CEE countries mainly started only after the collapse of the Socialist regimes. It is usually seen from the perspective of real estate, privatization, the restitution policies of the 1990s, and changes in the socio-economic composition of the residents of a specific neighbourhood, yet less attention has been paid to cultural changes that have also come along.

Āgenskalns and Holešovice – both being classified as former working-class neighbourhoods (Holešovice has an industrial past, too) are currently experiencing changes, both in the compositional make-up of their residents and in cultural life. The findings suggest that the new residents, who are, in this context, the gentrifiers, are young, educated persons, often having a high socio-occupational status, which is a common pattern in the gentrification discourse. With the fast development of both neighbourhoods in recent years, new cultural facilities such as art galleries or concert venues have been opening alongside alternative cafés and co-working spaces. Most cafes of this kind also serve as concert venues. The venues in Holešovice are attracting visitors from all over the world, however, the findings suggest that only one place in Āgenskalns keeps up with the foreign visitors, while the rest is famous only among locals. Since the venues in Holešovice are popular among visitors, this also shows that gentrification is linked to touristification – the increase of tourists can contribute to the process of gentrification (Lees et. al. 2007). Geographically speaking, the main changes in Holešovice have been noticed on Komunardu street (and some streets crossing it), yet in Āgenskalns the leading spot is Kalnciema street, together with the area around the Āgenskalns market.

Since both neighbourhoods studied are currently experiencing an influx of new, mainly young residents, changes in the cultural scene and rising rent prices, the future development scenario remains rather unclear. The rent pricing must be controlled in order to stay affordable for middle-class residents, and the offer and demand for *hipster* places must be in balance. In addition, for a better understanding of the cultural consumption patterns in both Āgenskalns and Holešovice, there is need for further detailed investigation. An in-depth research, focused specifically on consumption patterns, would allow us to predict the possible future of the currently booming *hipster* cultural scene in Āgenskalns and Holešovice.

## Acknowledgement

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**Kopsavilkums**

Pētījuma mērķis ir analizēt ģentrifikāciju divās iekšpilsētas apkaimēs – Āgenskalnā (Rīgā) un Holešovicē (Prāgā) – divos aspektos – kultūrkapitāla patēriņš un iedzīvotāju sastāva pārmaiņas. Pētījumā izmantotas gan kvalitatīvās, gan kvantitatīvās metodes, piemēram, apkaimju apsekojums, tautas skaitīšanas rezultātu analīze, intervija, interneta platformu atsauksmju analīze un rezultātu kartēšana. Rezultāti parāda, ka abās apkaimēs ir palielinājies jaunu un izglītotu iedzīvotāju īpatsvars. Tāpat tika secināts, ka gan Āgenskalnā, gan arī Holešovicē pēdējo gadu laikā ir notikušas ievērojamas pārmaiņas kultūras dzīvē, kā rezultātā kādreiz novārtā pamestās apkaimes ir kļuvušas par pievilcīgām vietām. Rezultāti parāda, ka Holešovice, atšķirībā no Āgenskalna, ir arī ārzemnieku iecienīta un ka jaunatvērto moderno iestāžu atrašanās vietas abās apkaimēs nav izvēlētas nejauši.

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# IMPOSED STALINISM: NARRATING RĪGA'S URBAN SPACE THROUGH SOVIET FILMS FROM 1945 TO 1953

# Īstenotais staļinisms: Rīgas atveids padomju perioda filmās no 1945. līdz 1953. gadam

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**Abstract.** Cinema is essentially a geographic art, a way of "writing the world". By bringing a geographic perspective to examining how cinema evokes a location, we gain a better understanding of the way we socially construct place/location in our geographical imaginations. Studies of films can inform us about new historio-graphical perspectives on space, architecture and urban imagery, and thus advance new critical insights into the geo-historical formation of urban modernity.

The focus of this study is to describe the portrayal of Rīga's urban space under Stalin's regime. The mixed method approach is used to interpret the representation of Stalin's Soviet occupied Rīga. This exposes different elements and processes about the formation of Soviet Rīga's cinematic landscape. Spatial analysis of Stalin's Rīga not only displays which sites were transformed in cinematic places but also acts as an archaeological tool that explores hidden residential settings during the Soviet period.

This study sheds light on innovative methods in historical analyses of geographical thought and practice, where films have been considered as geographic practice for visual language with a goal to evoke viewer experiences of inhabiting Soviet urban space. This paper acknowledges both development and spatial organization of urban space in Stalin's Rīga, and that politically restricted space uncovers gaps and contradictions in the official Soviet history by creating an alternative history of Soviet Rīga.

**Keywords**: *cinema, Soviet Rīga, representation, apartment, visual methodology*

## Introduction

Landscape as text is the dominant metaphor in film geography because it provides a means by which to explore the intersection between the narration of films and geography (Lukinbeal 2005). In studying cinematic landscape, acknowledgment of cultural values and historical background of the geographical location is important, and allows us to understand and interpret a place of residence (Kennedy and Lukinbeal 1997). The interest of Geographers in film arose simultaneously from two streams of thought: humanism and socio-cultural studies (Kennedy and Lukinbeal 1997). The central property that has been reviewed in geographical studies of cinema, is the transformation of the location's look/appearance (Lukinbeal 2012), which allows the viewer to suspend belief and accept that a narrative is taking place in a particular locale.

The era of Stalin was a time of profound change for the people of the Soviet Union. Cities were transformed into new urban conglomerations that bore the mark of socialist planning and Soviet ideological theories of urban living. Industries were created and new towns established where none had existed before. The Stalin era Rīga experienced economic and political transformations through the deconstruction of specific urban structures, such as churches. There was also some reconstruction and

remodelling of the historical buildings that were in the best repair. Some new monuments and enormous expansion of factories appeared, that changed Rīga from being city of merchants into a city of workers. New transport lines and bus routes reached out to these new industrial areas.

In a study of Soviet history and design, historian Susan Reid found that the reflection of domestic life has hardly been the dominant angle from which to study the Soviet Union (Reid 2009). Neglect of human comfort, shortage of living space and re-design of urban structures were some of the questions/issues that were hidden from the official ideology but coded into films. Thus, this study investigates how living spaces were depicted in the films of the Stalin era and interprets the discourse on residential areas of Rīga. A cinematic analysis of Latvian documentary and fiction movies unfolds the spatial realities of Soviet Rīga where the city is transformed not only through new construction unities, but also by celebratory events and everyday people.

**Data and methods**

To better understand the subject, an advanced research approach was developed that exposes various processes about the formation of Soviet Rīga's cinematic landscape under Stalin's regime. The research consists of a qualitative visual approach that offers an effective and critical way of describing city-space, as well as of quantitative analysis that allows us to examine the similarities and disparities of urban landscape. Spatial analysis of Soviet Rīga displays which sites were transformed in cinematic places and acts as an archaeological tool that explores hidden urban settings during the Soviet period.

276 films from 1945 through 1953 were randomly selected for this study. The data about films was collected using the database of the National Film Centre of Latvia. Content analysis of films was accomplished in which each film was divided into 5-minute intervals (Hazan 1997). Grouping video materials allowed for the possibility to review represented urban structures in more detail. Secondly, each sequence was described by reference to eight indicators, based on previous research about Stalin's housing (Reid 2006; Reid 2009): geographical location, social description, furnishing, appliances, representation of public or semi-public space, *mise-en-scène*, actor's monologue or dialogue, and filming techniques used.

The analysis of cinematic content of two genres – fiction (2 films) and documentary (274 films) – consisted of a comparison of films with actual urban processes and development of housing. The films were divided into twelve categories depending on their geographical and functional structure, including natural objects, residential areas, street-level, industries, engineering constructions, recreational areas, cultural and religious structures, transportation system and others. In total, 601 spatial points were identified and mapped into the film analysis.

The mapping and analyses of the filmed sites reveals a stratigraphy of texts written across residential living spaces in Stalin's Rīga. Collected quantitative data was stored in a spatial database (QGIS software) to employ methods of geographical

information systems on analysing and visualization of data. Various methods of geographical information systems, including cartographical approach, data frequency applying approach and spatial auto-correlation, were used to acquire more precise and data-based results.

**Results**

Stalin brought an end to the state-sanctioned debate among modernists on the future of the socialist city. Accordingly, ongoing series of Five-Year Plans accelerated urbanization and industrialization throughout Soviet-occupied Latvia. City-planning was considered as an essential alternative to *chaotic* capitalist development, with the potential to meet the needs of the urban population. Consequently, a comprehensive master plan was released in 1945, with a focus on post-war reconstruction, housing, military complexes, industry, transportation, and public green space (Bunkše 1979; Hurina 2015).

Another symbol of Soviet power under Stalin's regime was the naming and renaming of streets and institutions on behalf of major politicians or events (Ļeņina street, *Komunāru* square and others) (Grava 1993). The plasticity, verticality, symmetry and hierarchy of forms and functions of architecture were accomplished during the Stalin government years (Varga-Harris 2008), however the time-frame during which an attempt to implement Stalinist stylistics in architecture in Latvia took place was just too short. In many cases, it was either organically synthesised with local features, or introduced as a foreign body (Rudovska 2012).

Housing for residents remained insufficient, as elites were given apartments in the city (Gentile and Sjöberg 2006). Basic human needs were neglected in favour of industrial development and an image of grandiosity and the unwanted/less desirable social classes were excluded through urban design (Bodenschatz 2014; Gentile and Sjöberg 2010; Varga-Harris 2015). The highest social status residents stayed in the city centre, while workers lived on the outskirts of the city. Also, new residential developments tended to follow a *kvartal* model, in which buildings were bound by a city block with shops at street level and shared interior courtyards (French 1995; Reid 2006; Richardson 2010). However, the massive construction of residential housing was not possible, and housing revealed high building costs with outdated design solutions, limitation of construction management and inadequate technical equipment (Grava 1993; Hurina 2015).

The purpose of socialist realism was to limit cinematic representation to a specific and highly regulated faction of creative expression that promoted Soviet ideals. Cinematic representation of landscape during the Stalin period was limited by rigid censorship. More attention was paid to the spoken text in films. Consequently, certain ideas were easier to put to the public through images, dialogue and cinematic narrative (Mazierska 2014). Throughout the period of Stalin's regime, cinematic representation of both urban and rural areas is passive and distracted from the main cinematic character. Films do not reveal genuine urban space, but cities are portrayed rather from above or at

a distance, idealizing the space and prohibiting arbitrary representation of dwellings (Näripea 2004).

Stalin period films are characterized by an idea of utopia (Prokhorov 2011). A great number of films from this period interpret heroic scenes of World War II. Cinema supports the main policy of Stalin's regime of the 1940s, rejection of the class struggle within the country and declaration of the creation of the united Soviet people, who had no ethnic, national, race or class problems. Living space in the cinema is depicted as monotonous, continuing Stalin's artificial *grand style* with submissive crowds and enormous buildings (Matvejs 2017). Genre modification of this period: generally, a war or historical drama and news-reel (Federov 2015).

Rīga's city-space in the cinema between 1945 and 1953 is depicted as monotonous and detached from the main character. The main themes of analysed films are concerned with the new political system, industrial achievements, residential routine and acquisition of rural landscape. Both fiction films (*Dēli* - Ivanovs 1946; *Mājup ar uzvaru* - Ivanovs 1947) interpret heroic scenes from World War II by using realistic scenes in showing everyday life. The intention to maintain a national identity is depicted by the representation of activities that are taking place in the countryside. News-reels from this period tend to support the main policy of Stalin's regime, rejection of the class struggle within the country and a declaration of the creation of the united Soviet people.

The main functional structure (18% of spatial points) represented in films is the recreational area that includes outdoor recreational zones, such as parks and forests (Mežaparks, Šmerlis), or outdoor sports venues (Dinamo stadium) (Figure 1). Politically, the individual function of providing recreation was not considered as being genuinely socialist (Nuga 2016). However, for the socialist system these areas form a way of promoting healthy and entertaining leisure time after work. The reproduction of recreational areas in films was particularly increasing in 1950. Representation of these zones correlated also with the increase of and depiction of industries in films. Thus, depiction of these areas was becoming a cinematic guide to show citizens how to fill their free time after a day of hard work.

The second most depicted geographical structure (14% of spatial points) in films is Rīga's street-space with two major roads – Brīvības street and Kr. Valdemāra street. In most films, both streets are depicted from above or at a distance in order to underline the broad structure and ability to hold large numbers of people. The representation of these streets is used as a propaganda gimmick. They are wide enough to hold a public demonstration that exemplifies worker solidarity, technological achievements and military might. In 12 films, Kr. Valdemāra street is depicted as being the central axis by which the workers go to Victory square where the military parade is being held. Depiction of streets is complemented by ideological texts such as "*On a sunny morning in May, hundreds of thousands of people fill the streets and boulevards of Rīga*" (*Padomju Latvija Nr. 17* - Jevsikovs 1951).

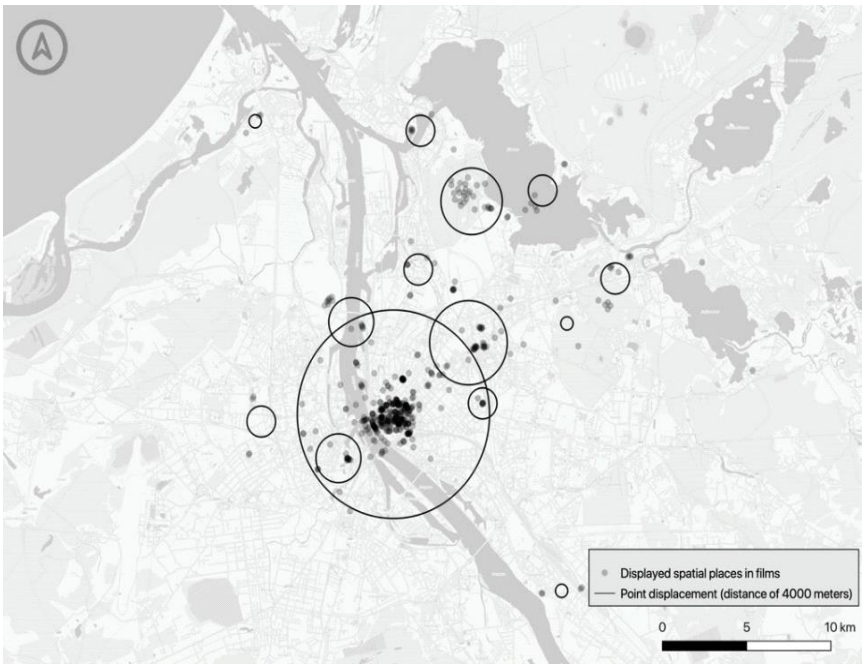


Figure 1. **Represented geographic locations in films between 1945 and 1954** (author's figure)

Another important spatially functional group that is portrayed in films is the growing industrial sector (14% of spatial points), including VEF, RER, the textile factory in the Jugla area and other factories. Initially film-makers represented construction sites (Rīga Shipyard) and light industry (the Chocolate Factory "Laima" or Jaunciems Paper Mill), but starting with 1948 the depiction of machinery, consumer electronics and textile industry had increased. Cinematic scenes with industrial zones are complemented by an ideological text about achievements of the workmen: "*The "Red October" factory team already completed its annual plan in October this year*" (*Padomju Latvija Nr. 47* - Goldberga 1946). Factories in films were being glorified by focusing cinematic attention on the new technologies and methods used in various industries.

The growth of industries also contributed to the representation of residential structures. Between 1946 and 1953 seventeen films portrayed the construction of four to five-story residential apartment buildings. Each film emphasized the necessity of apartment allocation for industrial workers. In news-reels apartment scenes are characterized by spoken text that highlights anniversaries and the accomplishments of Five-year plans. For example, in *Padomju Latvija Nr. 16* (Čardiņina 1948) the building process is being idealized: "*the first 56 apartments will be ready on the day of The Anniversary of the Great October Socialist Revolution*".

Other major geographical and functional structures depicted in films include: administrative buildings (7% of spatial points), public squares (7% of spatial points), culture facilities (7% of spatial points), historical objects (6% of spatial points), panoramic views of the city (6% of spatial points), educational institutions (6% of spatial points) and economic zones (6% of spatial points), such as the harbour or the

Central market. Rīga's cinematic representation under Stalin's regime does not seek to reveal public service facilities (hospitals, fire brigades, police) or religious institutions. Since 1952, more foreign-states appear in films: Kolkhoz in Azerbaijan, Opening of the Volga-Don canal, whaling in the Bering Sea and other scenes.

## Conclusion

This study set out to determine the manner and practices of representing the city space of Rīga under Stalin's regime. The study has revealed that between 1945 and 1953 the representation of Rīga is central with major geographical structures being the Old Town and parts of the city between Elizabetes and Tallinas streets. Outside the central part of the city, in most cases the films depict industrial and recreational areas. This idea exemplifies that socialist realism depicted reality of imagination: focusing on industrial areas in combination with recreational zones. Another visual aspect of Stalin's urban symbolism represented in films is the use of large public squares (Uzvaras laukums and Esplanāde), where it was possible to gather people and hold parades. However, various substantial public service facilities were ignored in official representation due to the limited resources and shortcomings in these structures.

The analysis of films has shown that negativity was not permitted in urban representation under Stalin's regime. Instead, sentiment about flawless living standards was created, by presenting common images. Cinematic representation of city-space in Stalin's period is characterized by an artificial utopia. For instance, representation of Stalinist-era apartments with mono-functional and spatially discreet rooms, focusing on the family dining table or *stolovaia* at the centre that expressed a *petit-bourgeois* layout (*Padomju Latvija Nr. 41* - Šuļatins 1952). The landscape is static and detached from the hero becoming as a pictorial background. The films also emphasise that from 1945 there was a strong tendency to talk about preliminary industrialization plans and to gradually prepare for mass production.

The most obvious finding to emerge from this research is that city-space is frequently depicted in films, thus becoming an integral part of visually represented space during Stalin's regime. Public squares, an overview of the city, street-space, vast recreational areas and newly built industrial zones are at the centre of urban representation. However, living space is not cinematic and portrayal of both the Soviet apartments and residential housing is limited. Also, other geographical and functional structures are mostly abandoned, such as public services or neglected space. It confirms the tendency of Soviet cinema to refuse the representation of imperfect space.

**Kopsavilkums**

Par telpas vizuālo reprezentāciju tiek uzskatīts attēls, kurā ir ietverts ierobežots vēstījuma kopums, savukārt filmas nav nejaušs attēlu atveids, bet gan pārdomāts pilsētvidē pastāvošo sociālo, ekonomisko un politisko procesu raksturojums. Kultūras ģeogrāfija tiecas pilsētas attēlus un tajā notiekošos procesus raksturot kā daļu no kultūras ainavas. Pilsētvides reprezentācija filmās ir viena no nozīmīgākajām pieejamajām kultūras ģeogrāfijā, sniedzot pētniekiem iespēju skaidrot pilsētu ar paņēmieniem, kādus nepiedāvā tradicionālās dabas un sociālās zinātnes.

Raksta mērķis ir izzināt Rīgas dzīvojamo telpu diskursu Staļina laika kinematogrāfijā laika periodā no 1945. līdz 1953. gadam. Atsevišķas, ar nodomu izvēlētas, kinematogrāfiskās metodes tiek lietotas padomju filmās, dzīvojamo platību atklājot kā politiski pārvaldītu telpu ar skaidri raksturotām telpiskām funkcijām un iedzīvotāju kategorijām, kurām šo telpu ir atļauts apdzīvot. Pētījums ietver 276 dokumentālo un spēlfilmu analīzi. Rīgā uzņemto filmu saraksts pētījuma veikšanai tika iegūts, izmantojot Nacionālā Kino centra datu bāzi.

Lai novērtētu padomju kinematogrāfisko materiālu, tika izmantota A. R. Hazana filmu pētījuma metode, katru filmu sadalot piecu minūšu intervālos. Katrs no apskatītajiem filmas intervāliem tika raksturots pēc astoņiem iepriekš noteiktiem indikatoriem: atveidotā objekta atrašanās vietas, cilvēku skaita, iekštelpas iekārtojuma, publiskās un semi-publiskās telpas atveida, mise-en-scène, runātā teksta un filmēšanas tehnikas. Šis pētījums izskaidro paņēmienu kopumu, kādā dzīvojamā telpa tika atveidota Staļina laika kino. Pētījumā apskatītās filmas tika iedalītas 12 kategorijās pēc to ģeogrāfiskās un funkcionālās struktūras, nošķirot dabas objektus, atpūtas vietas, inženierbūves, dzīvojamos rajonus un citas struktūras. Kopā 601 telpiskais punkts tika identificēts un izmantots pētījuma kartogrāfiskā materiāla izveidē.

No 20. gadsimta 40. gadu vidus līdz 50. gadu vidum galvenās filmās atveidotās telpiskās struktūras ir Vecrīga un Rīgas centrs. Ārpus pilsētas centra tiek atveidotas industriālās būves un rekreācijas zonas, tādējādi veidojot utopisku pilsētas telpas atveidu: nevainojamu un visiem pieejamu publisko telpu līdzās ar platībā strauji augošajiem Rīgas industriālajiem rajoniem.

Pretstatā publiskajai telpai, privātās telpas atveids Staļina laika filmās ir ierobežots. Šī perioda spēlfilmās tiek atveidotas lauku un Rīgas centra dzīvojamās telpas, atklājot kara radītās sekas un veidojot atsauci uz starpkaru perioda greznajām iekštelpām, turpretim dokumentālās filmas atklāj mono-funkcionālu interjeru, uzmanību vēršot uz ģimenes ēdamgaldu viesistabā (stolovaja). Pētījums atklāj, ka Staļina laika pilsētas telpa kinematogrāfijā tiek atveidota bieži, tādējādi kļūstot par nozīmīgu filmās atveidotā stāstījuma struktūru. Lai gan Staļina laika filmas lielā mērā atveido Rīgas centrālo daļu un ārpus tās esošos publiskos laukumus, atpūtas un industriālās zonas, tomēr dzīvojamā telpa nav kinematogrāfiskā atveida centrālā vienība, padomju dzīvoklis atveidots tikai 11 pētītajās filmās.

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# TOURISM INFORMATION PROVIDERS IN LATVIA: DEVELOPMENT AND CHALLENGES

# Tūrisma informācijas sniedzēji Latvijā: attīstība un izaicinājumi

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**Abstract**. The tourism information system uniting tourism information providers is one of the important players within the tourism industry both for destination development and for tourists. Since the first tourism information providers in Latvia started operations in 1994 it has been important to evaluate the development of this sector of the overall tourism industry. Therefore, the objective of this study is to analyse the achievements and challenges in the development of tourism information providers as part of the tourism information system in Latvia after 1991. For the purposes of reaching the objective of this paper, analysis and interviews with experienced managers of tourism information centres were used as the main research methods. The paper reveals that significant progress has been achieved in this area and tourism information providers have become important players for tourism development in Latvia at all levels – municipal, regional and national.

**Keywords:** *tourism development, tourism information, tourism information centres, tourism information providers*

## Introduction

Significant changes in all areas of development have taken place in Latvia since 1991. However, the tourism information system is among those which was built completely from scratch. After the initial activities in the area of tourism information in Rucava, then part of the Liepāja region, it was only in 1994 that permanent tourism information centres were established in four municipalities of Latvia – the cities of Salacgrīva, Tukums, Jūrmala and Limbaži. Taking into account the sufficient duration of their operation: 25 years, it is essential to summarise and assess the results of the development and operation of the tourism information system, since they are of interest to all parties involved - tourism information providers, state institutions and entrepreneurs engaged in the tourism industry.

According to the explanation by Dimitrios Buhalis, tourism information centres (TICs) provide information and reservations for destinations and tourism companies. Operated by local, regional or national organisations, they aim to facilitate the visits of consumers and to assist organisations in implementing their policies, by increasing tourist length of stay and expenditure (Jafary 2000).

In Latvia, the forms and the key operational conditions for tourism information providers are governed by the Tourism Law. The current edition of the Tourism Law defines three categories of tourism information providers - a tourism information centre, a tourism information point and a tourism information stand (Tourism Law 1998).

The Tourism Law also establishes the functions of the government and municipalities on the issues of tourism information providers. Municipalities shall: determine the prospects of tourism; provide measures for the provision of comprehensive and precise information in Latvia and foreign countries on tourism opportunities; participate in the development and financing of tourism information centres, points and stands (Tourism Law 1998).

Since the guaranteeing of operations of tourism information providers lies within the scope of municipal responsibilities, municipalities are those, which establish the legal status, operational conditions and specific functions of any particular tourism information provider. The specific situation in Latvia requires that the functions of tourism information centres in the country are significantly broader than elsewhere. The main directions for the activities of most TICs include collection, summarising and systematisation of information, providing of information to tourists, the organisation and conducting of marketing of a territory, organising of co-operation with entrepreneurs and promotion of the tourism business, co-operation with local authorities and their experts for the purposes of developing local tourism, addressing the issues of professionalism and education (Lattūrinfo 2014). Therefore, tourism information centres in their respective municipalities largely work also as destination management organisations (DMOs). One of the definitions provided by Inskeep in 1991 says that the DMO assumes the destination's central management functions, namely, strategic planning and destination development as well as product development and marketing (Pechlaner and Fuchs 2002).

The respective areas, particularly with regard to the operational specifics of tourism information providers have not been analysed often in a scientific research context. However, some authors have addressed, for instance, the topic of the role and responsibility of destination management organisations and tourism information providers in promoting tourism information in the online environment (Assenova et al. 2018) and the issues related to the financing of tourism information services in Poland and Hungary (Mayer and Pawlicz 2010). A few publications in the media and individual professional publications on related problems of TIPs (Smuškova 2017) have been devoted to this issue in Latvia. Several studies have also been conducted as part of the graduation papers of students at higher education institutions. The objective of this study is to assess the most significant aspects of the activities of tourism information providers over the course of 25 years. The research questions include: 1) What have been the main challenges for the operation of tourism information providers? 2) What are the main success stories and their contribution to the tourism industry of Latvia and to regional development from the perspective of the veteran managers of the tourism information centres?

## Data and Methods

The existing study has been implemented in 2019 and aims to sum up and analyse the development of the tourism information system in Latvia since 1991.

Qualitative research methods were used and included analysis of documents and regulations, as well as the conducting of eight semi-structured interviews with current and former managers of municipal tourism information centres - experts who have worked in the field for at least 13 years (i.e. more than a half of the research period) in at least two time-periods singled out in the study (see Table 1). This kind of selection of respondents ensures that their personal experience allows them to identify and compare the achievements, problematic issues and gains of the tourism information provider system over a longer period of time. The interviews dealt with four areas: the most significant events which have affected the formation and development of the tourism information provider network; the key challenges in the course of the period from 1994 to 2019; the main achievements in this area of tourism and the most significant gains of the operation of tourism information providers at the municipal, regional, national and international levels. Content analysis method was used for the interpretation of results of interviews.

Table 1. **The most significant events, which affected the development of the tourism information system of Latvia**

| Year | Event |
|---|---|
| 1994 | The first four permanent tourist information centres commence their operation |
| 1994 | The first professionally trained tourism information centre employees graduate Rīga School of Tourism |
| 1996 | Latvian Association of Tourism Information Organisations LATTŪRINFO founded |
| 1998 | The Tourism Law legally defines the status of a tourism information provider establishing their responsibilities at the national and municipal levels |
| 1999 | The first tourism information office abroad - Baltic Tourism Information Centre (BTIC) - commences its work in Munster. In 2003 it was moved to Berlin. Offices of the Latvian Tourism and Development Agency/Baltic Tourism Information were later opened in Helsinki, Moscow and London |
| 2001 | The national tourism information provider standard *LVS 200-7* was developed and adopted |
| 2001-2003 | State investment project *Development of Latvian tourism information centre network* implemented |
| 2002 | LATTŪRINFO becomes a member of the European Union of Tourism Officers (EUTO) |
| 2004 | The Central Latvian Tourism Information Centre opened in Rīga (disbanded later) |
| 2004 | Professional standards for a tourism information consultant were developed. The profession of a *Tourism Information Consultant* was included in the Latvian professional classification registry |
| 2009 | Territorial restructuring of tourism information providers in compliance with the administrative-territorial reform of Latvia |
| 2012 | Latvian tourism information centres commence their accession to the Latvian tourism service quality system "Q-Latvia" |
| 2013 | The organisation of the annual Latvian *tourism information fair* events commenced in various regions of Latvia targeted at boosting travel within the country, particularly, during the so-called off-season. |
| 2014 | LATTŪRINFO publishes its *Handbook for tourism information providers* |
| 2017 | Co-operation with the Latvian Society of Lawyers, outlining and specifying positions and discussing regulations concerning the various sectors of the tourism industry, |

| Year | Event |
|---|---|
| | particularly, with respect to the development of the industry in the regions of Latvia. |
| 2019 | Internal industry discussions as well as discussions in the Saeima on the amendments to the Tourism Law regarding restrictions on the services of TICs related to unfair competition in the public and private sectors. |

## Results

The quantitative dynamics represent one of the most vivid objective indicators of the development of the tourism information provider system. Until 2008 the number of tourism information providers grew quite significantly - from 4 in 1994 to 92 in 2008 (Doniņa et al. 2018) and as part of this study, at around 130 in 2018.

Analysis of the documents of the Latvian Association of Tourism Information Organisations LATTŪRINFO was performed as well as on the facts outlined during the interviews, and revealed a number of significant events, which affected the tourism information provider system. These events are chronologically summarised in Table 1.

Summing up the most significant events affecting the tourism information provider system, one can conclude that they can be divided into three different periods. The first one was concluded in 2001 by the establishment of the status by the Tourism Law and the creation of the national standard for tourism information providers, which eliminated uncertainties on the key issues as to who was considered as a tourism information provider, their categories and sources of financing. The next period lasted until the administrative-territorial reform commenced in 2009, which significantly affected the location and operation of the tourism information provider network and therefore initiated the third distinctive period in the activities of tourism information providers.

Based on the views expressed by the persons interviewed, the main **challenges** related to each period, which are undoubtedly linked with activities and events performed during each particular period, have been recorded, summarised, grouped and reflected in Table 2.

Some experts have noted the challenges, which in their estimation have been topical throughout the period of operation of the tourism information providers: different legal status and funding of tourism information providers, which affects their operation and co-operation activities, the lack of a single national supervisory institution the role of which is partially fulfilled by LATTŪRINFO; the prolonged uncertainty on the issue of certification of tour guides; the fact that the development of tourism in municipalities is largely based on the enthusiasm of the employees of tourism information providers which can eventually decrease and affect negatively the results of their work.

In assessing the **accomplishments** of the tourism information provider system as a whole during the defined period, experts have singled out the following: 1) the commencement of operations of tourism information centres under conditions of limited support; amendments to the Tourism Law on the implementation of activities of tourism information providers; the development of a tourism information provider

standard; the establishment of the professional association LATTŪRINFO uniting and representing the industry interests; the creation of a real co-operation network of tourism information providers; the establishment of a centralised tourism information provider in the centre of Rīga, however short-term it might have been, the establishment of the joint tourism information industry day tradition.

Assessing the results of tourism information providers at various levels, the respondents provided multi-fold answers., which can be divided into several individual sections. The respondents pointed to the following **gains** resulting from the activities of tourism information providers in Latvia:

Table 2. **The key challenges for the providers of tourism information in Latvia during various periods**

| 1994- 2001 | 2002 - 2008 | 2009 - 2018 |
|---|---|---|
| The limited support by responsible governmental institutions to the information providers established by individual enthusiasts | Successful implementation of investment projects designed for the development of the national tourism information system | Territorial restructuring of the tourism information providers in compliance with the administrative-territorial reform of Latvia |
| The lack of understanding in most of the municipalities on the importance of the tourism information system and as a consequence: insufficient financing and the lack of conformable support and provision | Commencement of the process of certification of tourism information providers in compliance with the national standard of Latvia, later: Q-Latvia, the quality system in tourism | Work-related organisational changes and the diversification of functions of tourism information providers brought by the changes in the legal status of TIS |
| Unclear legal status of Tourism information centres and their means of financing up until the amendments to the Tourism Law implemented in 1998 | Substantial increase of workload and its diversification related to active participation in the available EU projects | Active engagement in the EU supported projects targeted at the development of tourism in municipalities and regions |
| The lack of unified quality standards | Opportunities for significantly improving the material provisions of tourism information providers in the framework of the EU supported projects | New challenges related to the changes in the use of means and methods of marketing (e-environment, social networks, etc.) |
| Inadequate quality of work of many tourism information providers. | Regional co-operation and activities in the framework of established and/or strengthened regional tourism associations | Search for new forms of co-operation in tourism with tourism entrepreneurs driven by the sharing economy |
| Insufficient understanding by the general public on the input of municipalities in tourism and the financing of tourism information providers | Engagement in international experience exchange activities in the framework of the common European Union of Tourism Officers (EUTO) projects | Raising the legal issue regarding the operations of tourism companies, municipalities, TIS and the ensuring of fair competition as well as changes in the area of package tourism services |

| 1994- 2001 | 2002 - 2008 | 2009 - 2018 |
|---|---|---|
| Limited access to external (European Union) funding for the development of tourism information centres | The entry of newly qualified experts in the tourism information system who had acquired higher education in the area of tourism | Possible changes in the framework of the planned administrative-territorial reform |

1) **At the municipal level**: an institutionalised system of promoting tourism development has been created (3 interviewees); an institution for tourism information providers has been created and operates as a "business card" for each respective municipality serving guests in several foreign languages; tourism information providers have been recognised as important promoters of the development of their respective territories; tourism-related entrepreneurial activity has been activated significantly and a business community has been created (5); an image/brand of a municipality as a tourism destination has been formed and its public recognition has been promoted (8); advertising of local businesses has been performed and the promotion of local production and sales of locally made souvenirs has been promoted; public tourism infrastructure has been improved; a comprehensive tourism database in several languages has been created (2); the development of tourism has been promoted in general (2); municipalities have gained a better understanding and recognition of tourism as a branch of the economy;

2) **At the regional level:** a tourism development-oriented institutional system has been created; co-operation among various parties interested in the development of regional tourism has been provided, including co-operation in the framework of the regional tourism association (4); a common regional identity has been created and its recognisability has been promoted (4); thanks to the professional and active work of TICs, municipalities have understood and are supportive of joint regional activities in the area of tourism;

3) **At the national level:** regional and parish level a tourism destination image has been formed and is being promoted (2); regional tourism associations and LATTŪRINFO are good co-operation partners for the Latvian Investment and Development Agency in implementing joint goals and activities (2); TICs are the most knowledgeable co-operation partners for other professional tourism organisations in addressing topical issues and forming of market offers in their respective territories; the tourism service databases created by tourism information providers are used by various state institutions (e.g. The State Revenue Service) for their own direct purposes;

4) **At the international level:** co-operation partners have been found and many international projects have been successfully implemented (2); the image and recognition of Latvia as a multi-faceted tourism destination and a trustworthy co-operation partner has been improved (2); LATTŪRINFO and tourism information providers have proven their professionalism in their international activities, thus raising the status of the industry and Latvia in general (2); international journalists and

bloggers consider tourism information centres as a quality source of information and co-operation partners; the activities of TICs have on many occasions ensured the attraction of specific project-based co-operation partners for several local companies.

## Conclusion

The study results lead to a number of conclusions, which are listed below.

After 1991 the tourism information system and the network of tourism information providers in Latvia was formed completely from scratch and, as the result of 25 years of operation and thanks to the support by municipalities, has become a crucial player for the development of tourism in various regions of Latvia. The support of state institutions has not been particularly intense. However, the development of the system was substantially boosted by providing an orderly regulatory basis (the status of tourism information providers, sources of financing, quality standards) as well as by the implementation of the state investment project for the development of the TIC network in Latvia. The availability of the European Union funding for the promotion of tourism and the development of the digital environment substantially affected the workload and functions of tourism information providers. According to the most experienced Latvian heads of tourism information centres, the operation of the tourism information system has provided significant input in the development of tourism and the respective territories at all levels: municipal, regional, national and international.

Assessing the results of the study in the context of future developments, it should be stressed that they reflect the development of the system as stated in various documents and the subjective opinions of long-term managers of tourism information centres. In future, they should be supplemented with specific indicators as well as the assessments of persons who joined the system at a later stage and also by the opinions of other parties: municipalities, state institutions, regional and professional tourism associations.

**Kopsavilkums**

Tūrisma informācijas sniedzēju tīkls Latvijā 25 darbības gados ir attīstījies gan kvantitatīvi, gan kvalitatīvi, saņemot pašvaldību un valsts atbalstu, kā arī lielā mērā baudot tajos strādājošo darbinieku ieinteresētību. Ilglaicīgi stādājošo Tūrisma informācijas centru vadītāju vērtējumā Tūrisma informācijas sniedzēji ir devuši būtisku ieguldījumu ne tikai tūrisma attīstībā, bet arī kopējā teritoriju attīstības un atpazīstamības veicināšanā pašvaldību, reģionu, nacionālajā un arī starptautiskajā līmenī.

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Manuscripts must be submitted in an electronic format together with a printout. The text should be typed with standard-size letters (12 points) on paper of A4 format, with 1 ½ spacing and margins at least 2.5 cm.

Recommended length is from **6 to 8 pages**. The manuscript should include: (1) title (as short as possible, precise and well understandable), (2) author(s) name(s), institution, postal and e-mail addresses, (3) abstract (up to 200 words) and keywords, (4) main text (in a conventional research paper – introduction, materials and methods, results, discussion and conclusions, acknowledgements), (5) references, (6) summary (up to 200 words in English),

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Piemēri:

Examples:

Dansereau, P. (1966). Ecological impact and human ecology. Darling, F.F. and Milton, J.P. (eds.) *Future environment of North America.* New York: Natural History Press Garden City, 425-462.
Gregory, K. (2000). *The changing nature of physical geography*. London: Arnold.
*Latvijas zeme, daba, tauta*, I-III, (1936-1937). Rīga: Valters un Rapa.
Lewis, M.W. (2000). Global ignorance. *The Geographical Review*, 90 (40), 603-628.
Rediscovering Geography Committee (1997). *Rediscovering geography. New relevance for science and society*. Washington DC: National Academy Press.
Rutkis, J. (ed.) (1967). *Latvia: country and people.* Stockholm: Latvian National Foundation.
Centrālā statistikas pārvalde. Galvenie statistikas rādītāji 2015.gadā: http://www.csb.gov.lv/sites/default/files/publikacijas/2015/nr_03_Latvija_2015_galvenie_statistikas_raditaji_15_00.pdf (18.01.2016)

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