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WETLAND AREA CHANGE IN KLAIPEDA COUNTY

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Abstract
Wetlands are the most important natural resources, they are the sources of biological, cultural, and economic diversity. The article presents an analysis of the current situation of the wetland area in Klaipeda county.
Analytical, comparative, statistical, and logical analysis methods were used for the investigation.
The aim of the investigation is to carry out the analysis of Klaipeda county's wetland area during the period between the years 2002 and 2022.
In 2022, wetlands occupied 1.21 percent of Klaipeda's county, i.e. 6,337.53 ha. In 2002, the area of wetlands in Klaipeda county was 1.68 percent and occupied 8,748.33 ha. So, in Klaipeda county during the period between the years 2002 and 2022 wetland area decreased by 2,410.80 ha or 27.56 percent. After the analysis of the change in wetland areas in the districts of Klaipeda county, it can be seen that in all municipalities, wetland areas decreased in the period of 2002 – 2022. Many wetlands in Klaipeda county have been exploited and managed for various purposes. Large wetland areas have been drained and reclaimed mainly for agriculture and the establishment of human settlements. Monitoring and inventory of wetlands are important for of conserving and managing wetland resources. An important element of all peatland restoration projects is a programme of monitoring to check results and progress.
The aim of the investigation is to carry out the analysis of the Klaipeda county wetland area during the period between the years 2002 and 2022.
Key words: wetland area, change, climate change.

Introduction

Article relevance. Wetlands are important features in the landscape that provide numerous beneficial services for people, fish, and wildlife. Some of these services, or functions, include protecting and improving water quality, providing fish and wildlife habitats, storing floodwaters, and maintaining surface water flow during dry periods. These valuable functions are the result of the unique natural characteristics of wetlands. Inventory and monitoring of wetlands and adjacent uplands are important for of conserving and managing wetland resources.

Wetlands are ecologically sensitive systems and provide a lot of significant services to the human population (Gokce, 2019). They are complex ecosystems that harbor a large diversity of species. Wetlands are among the most threatened ecosystems on our planet, due to human influences such as conversion and drainage (Verones et. al., 2013).

The authors S. L. Ozesmi and M.E. Bauer state that it is important to inventory and monitor wetlands and their adjacent uplands to conserve and manage wetland resources (Ozesmi, Bauer, 2002).

There is now more and more discussion about the inevitable need to conserve wetlands, as they play a particularly important role: wetlands are highly productive and support a wide variety of ecosystem goods and services (Gallant, 2015); wetland ecosystems provide an optimum natural environment for the sequestration and long-term storage of carbon dioxide (CO_2) from the atmosphere (Mitsch et. al., 2013); help regulate regional climate (Marshall et.al., 2004); wetlands retain water during dry periods, thus keeping the water table high and relatively stable. During periods of flooding, they mitigate flood and trap suspended solids and attached nutrients (Prasad et.al., 2002); they have been found to cleanse polluted waters, protect shorelines, and recharge groundwater aquifers (Mitsch et. al., 2015); at local scales wetlands provide food, fiber, filtering of contaminants, sediment storage, flood control, wildlife habitat, recreation, aesthetics, and other functions (Millenium…, 2005); wetlands provide critical habitat for continental and intercontinental migratory species (Myers, 1983).

These functions are important not only within the wetlands themselves but also to surrounding ecosystems (Greb et. al., 2006).

Even though researchers have paid a great deal of attention to wetland loss and status, the actual extent of wetland loss on a global scale, especially the loss caused directly by human activities, and the actual extent of currently surviving wetlands remains uncertain (Hu et. al., 2017).
Scientists D. Mao, Z. Wang, J. Wu, B. Wu, Y. Zeng, K. Song, K. YI, L. Luo (Mao et. al., 2018) say that humans benefit from multiple ecosystem services of wetlands, but massive wetland loss has occurred worldwide due to rapid urbanization. To assess the problem, it is necessary to quantify the spatial extent of urbanization-induced wetland loss. Also, wetland loss is caused by natural causes and the conversion of wetlands for agricultural and industrial use (Coleman et. al., 2008). Wetland losses and degradation result from drainage for agriculture, filling for urbanization, and road construction (Zedler, 2004).
Wetlands all over the world have been lost or are threatened in spite of various international agreements and national policies, this is caused by: the public nature of many wetlands products and services; user externalities imposed on other stakeholders; and policy intervention failures that are due to a lack of consistency among government policies in different areas (economics, environment, nature protection, physical planning). All three causes are related to information failures, can be linked to the complexity and 'invisibility' of spatial relationships among groundwater, surface water, and wetland vegetation. Integrated wetland research combining social and natural sciences can help in part to solve the information failure to achieve the required consistency across various government policies (Turner et.al., 2000).
So, an integrated wetland research framework suggests that a combination of economic valuation, integrated modelling, stakeholder analysis, and multi-criteria evaluation can provide complementary insights into sustainable and welfare-optimizing wetland management and policy.

Methodology of research and materials
Comparative, analytical, statistical, statistical, and logical analysis methods were used for the investigation.
The article analyses the work of Lithuanian and foreign scientists, published in scientific publications.
The land fund statistics of the Republic of Lithuania (Nacionaline zemes..., 2002-2022), graphically depicted in figures, were used for the fulfillment of the research of the wetland area change in Klaipeda county for the years 2002 - 2022. Fig. 3 was made using the ArcGIS program. This figure shows the percentage of the area occupied by wetlands in the Klaipeda districts.
The article analyzed and assessed the current state of the wetlands in Klaipeda county. The study provides the wetland area change analysis in Klaipeda county and in the districts of the county. The 20 years period, i.e. the period between the years 2002 and 2022, was selected for the determination of the change. Statistics data were systematized and analyzed and the expression of the percentage was calculated during the preparation of the research.
The object of the investigation – is the Klaipeda county wetland area.
The aim of the investigation. To carry out the analysis of the Klaipeda county wetland area during the period between the years 2002 and 2022.
Tasks of the investigation:
1. To describe wetlands in Klaipeda county.
2. To analyze wetland area change in Klaipeda county during the period between the years 2002 and 2022.
3. To examine the wetland area change in the county districts changes.

Discussion and results
The status quo of wetland in Klaipeda county. Wetland habitats serve essential functions in an ecosystem, including acting as water filters, providing flood and erosion control, and furnishing food and homes for fish and wildlife. They do more than sustain plants and animals in the watershed, however. Many wetlands are not wet year-round because water levels change with the seasons.
There are three types of wetlands identified in Klaipeda county (Fig. 1):
1. Low moors are widespread in lakes, river valleys, inter-hill valleys, and on the outskirts of raised bogs.
2. Intermediate moors are widespread in habitats where nutrients are insufficient for fen peat and nutrients and are still too high for raised bog peatlands.
3. Raised bogs. These wetlands are fed only by rainwater and snowmelt, the excess of which flows from the raised surface of the wetland to the edges (lag). Lakelets of various sizes and lake branches can be found in the big raised bogs.

Fig. 1. Distribution of wetland types in Klaipeda county (Lietuvos pelkių, 2022)

In Klaipeda county, there are a lot of different types of wetlands and unevenly distributed within the county. The most important wetlands of Klaipeda county are the Aukstumala wetland and the Svencele wetland.

In the area of Silute district, the *Aukštumala* swamp is flooded - the world's first scientifically described high bog. Occupying a large area of 2,500 hectares, the Aukštumala wetland is truly unique. A natural part of the bog 1,017 ha belongs to preserve, the other part 1,500 ha is a peat bog, exploitation of which has a negative impact on the bog. The whole wetland area belongs to Nemunas Delta Regional Park which is included in the list of Natura 2000. Also, the park and Aukstumala bog is included in the list of Convention on Wetlands of International Importance Especially as Waterfowl Habitat (Ramsar Convention). Aukstumala wetland restoration projects have been implemented:

- Restoration of the raised bog in the Aukštumala Telmological Reserve (2006-2007). During the project, canals and ditches were ponded, and 100 ha of woody vegetation was cleared, thus stopping the degradation of the swamp and water evaporation. Partitions were built in the cut-out places and the water level was raised. The management measure for restoring the hydrological regime of the Aukštumala Telmological Reserve bog covered 1001 ha.
- LIFE project Peat Restore. The LIFE Aukstumala project achieved its main objective to restore the Aukštumala bog to favourable conservation status. They also managed to increase the area of the active raised bog by 15.17 percent. 1,170 dams were installed on small ditches and 15 dams on collective ditches. In addition, 85 km of small ditches and 15 km of larger ones were blocked using peat and plastic pile sheets. This created favourable conservation status in 600 ha of the habitat.

Svencele bog is the largest natural and not yet destroyed coastal raised-bog with neighbouring fens and wet forest in Klaipeda county. Besides, this is the only not yet destroyed coastal raised-bog in Lithuania and among few in the eastern Baltics, which still keeps natural or semi-natural features in the whole area of the bog (Improvement..., 2022). The bog area covers more than 1,200 ha. It was formed during the post-glacial period in the area of the former coastal lagoon. However, the area was affected by drainage in the mid of the 20th century. Although the habitats were not destroyed by human activities like in many other coastal bog complexes of Lithuania, the regular drainage of the bog affected or partly destroyed the

natural habitats and speeded their succession process, thus, losing some of the natural bog features, which are also important for the number of the protected species.
In order to preserve the remaining natural values and restore the damaged hydrological regime of the wetland, the Lithuanian Ornithological Society was implementing a project „Improvement of the conservation status of Svencele“, the aim was to restore the favorable conservation status of Svencele by restoring the hydrological regime and restoring the habitats of rare and endangered birds and plants.
In order to restore the hydrological regime of the Svencele bog damaged by reclamation, to stop the mineralization processes taking place in the bog and the transformation of bog habitats into forest habitats, special forest cuttings to support the biological diversity were designed on an area of 275.4 ha.
Wetland restoration and protection are important to maintain critical wildlife habitat. To achieve this goal, it is important to invest in programs that help implement, support, or coordinate local restoration efforts (United States…, 2022).
Wetland area change in Klaipeda county and districts. Klaipeda county is situated in the western part of Lithuania, in the Pajuris lowland. The county adjoins the Curonian Bay and the Baltic Sea.
In 2022, wetlands occupied 1.21 percent of Klaipeda's county, i.e. 6,337.53 ha. (Fig. 2). Most of them are small and unevenly distributed within the county. In 2002, the area of wetlands in Klaipeda county was 1.68 percent and occupied 8,748.33 ha. So, in Klaipeda county during the period between the years 2002 and 2022 wetland area decreased by 2,410.80 ha or 27.56 percent.

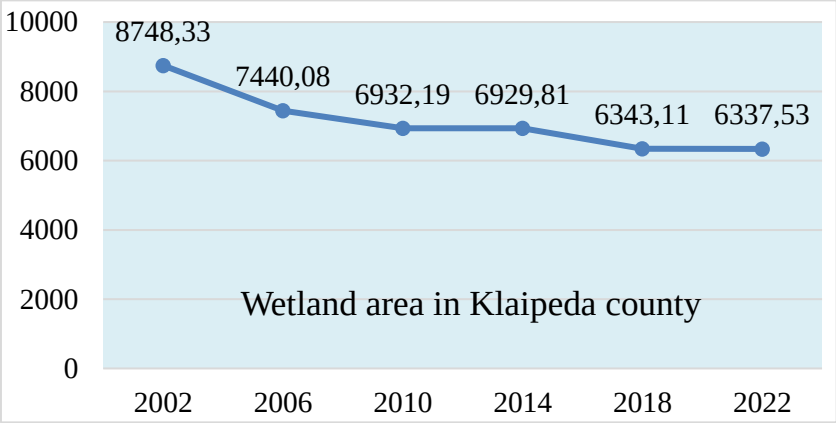


Fig. 2. Wetland area change in Klaipeda county in ha in 2002-2022 (Nacionalinė, 2002-2022) (Consisted by the author of the article)

Klaipeda county includes the districts of Klaipeda, Kretinga, Skuodas, and Silute, the city of Klaipeda as well as the resorts of Neringa and Palanga.
According to the data of 2022, the wetlands in Klaipeda county are situated in Silute district (2.13 percent or 3,590.80 ha) and Klaipeda district (1.48 percent or 1,952.67 ha). In the other five districts, wetlands account for less than 1 percent. The lowest number of wetlands was found in Neringa (0.03 percent or 3.71 ha) and Klaipeda city (0.08 percent or 8.03 ha) (Fig. 3).

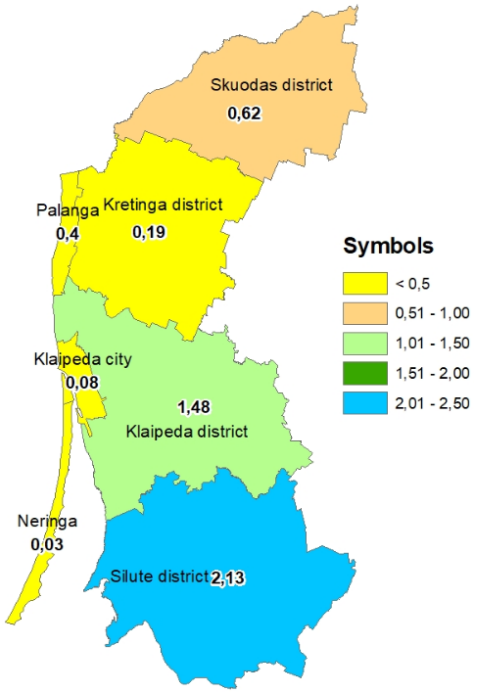
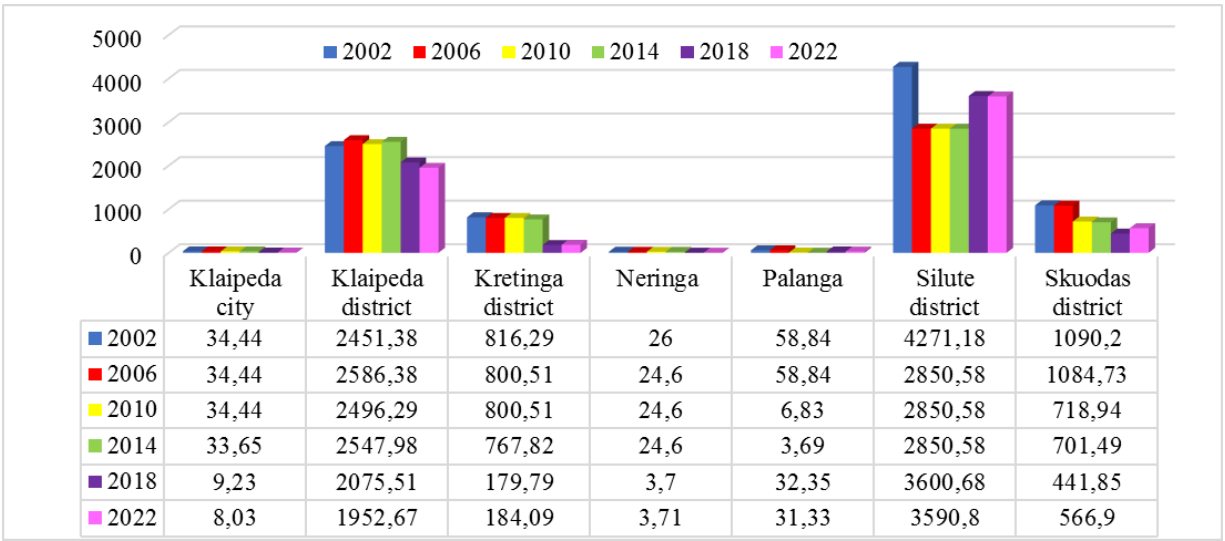


Fig. 3. Wetlands in Klaipeda districts in percent in 2022 (Consisted by the author of the article)

After the analysis of the change of wetland areas in the districts of Klaipeda county, it can be seen that in all municipalities, wetland area decreased in the period of 2002 - 2022 (Fig. 4).



	Klaipeda city	Klaipeda district	Kretinga district	Neringa	Palanga	Silute district	Skuodas district
2002	34,44	2451,38	816,29	26	58,84	4271,18	1090,2
2006	34,44	2586,38	800,51	24,6	58,84	2850,58	1084,73
2010	34,44	2496,29	800,51	24,6	6,83	2850,58	718,94
2014	33,65	2547,98	767,82	24,6	3,69	2850,58	701,49
2018	9,23	2075,51	179,79	3,7	32,35	3600,68	441,85
2022	8,03	1952,67	184,09	3,71	31,33	3590,8	566,9

Fig. 4. Wetlands area change in hectares in districts of Klaipeda in 2002-2022
(Consisted by the author of the article)

Analyzing the data on the change of wetlands as a percentage, it was found that the largest decrease in this land use was in Neringa (85.73 percent), Kretinga district (77,45 percent) and Klaipeda city (76,68 percent). The least change in the area of wetlands was in Silute district (15.93 percent) (Table 1).

Table 1

Wetlands area change in hectares and percent in districts of Klaipeda county in 2002-2021
(Consisted by the author of the article)

District	Wetland area decreased ha	Wetland area decreased percent
Klaipeda city	26,41	76,68
Klaipeda district	498,71	20,34
Kretinga district	632,20	77,45
Neringa	22,29	85,73
Palanga	27,51	46,75
Silute district	680,38	15,93
Skuodas district	523,30	48,00

A small part of the wetlands disappeared due to natural landscape development processes (changes in local moisture balance, formation of river valleys, etc.). Many wetlands are disappearing due to lower groundwater levels during land reclamation and peat exploitation. The condition of many of the surviving wetlands in Klaipeda county is gradually deteriorating due to still operating drainage systems, pollution and climate change, destabilizing the human environment and reducing the prospects for future survival. Wetlands destruction has increased flood and drought damage, nutrient runoff and water pollution, and shoreline erosion, and triggered a decline in wildlife populations and etc. Wetland loss can add stress to remaining wetlands. For example, if fewer wetlands are available to filter pollutants from surface waters, those pollutants could become more concentrated in the remaining wetlands. Wetland loss can also decrease habitat, landscape diversity, and connectivity among aquatic resources. Wetlands are valuable for flood protection, water quality improvement, shoreline erosion control and etc.It is very important to save and restore wetlands because they are particularly vulnerable to a warming climate. Warmer temperatures and the increased use of water for irrigation reduces the supply of water for wetlands, which leads to a higher concentration of pollutants, such as agricultural chemicals, that settle there. Such high concentrations of contaminants can destroy wetlands and every living organism that lives there. Also, changes in temperatures can significantly change the plant and animal life of wetlands. There are many reasons why it is essential to conserve wetlands. They are vital for biodiversity, purifying water, reducing flooding, and fighting against climate change.

Conclusions

1. In 2002, the area of wetlands in Klaipeda county was 1.68 percent and occupied 8,748.33 ha. In 2022, wetlands occupied 1.21 percent of Klaipeda's county, i.e. 6,337.53 ha. During the period between the years, 2002 and 2022 wetland area decreased by 2,410.80 ha or 27.56 percent.
2. According to the data of 2022, the wetlands in Klaipeda county are situated in Silute district (2.13 percent or 3,590.80 ha) and Klaipeda district (1.48 percent or 1,952.67 ha). In the other five districts, wetlands account for less than 1 percent.
3. After the analysis of the change of wetland areas in the districts of Klaipeda county, it can be seen that in all municipalities, wetland areas decreased in the period of 2002 – 2022. it was found that the largest decrease in this land use was in Neringa (85.73 percent), Kretinga district (77,45 percent) and Klaipeda city (76,68 percent). The last change in the area of wetlands was in the Silute district (15.93 percent).

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