

**ANTHROPOGENIC EFFECTS ON ENVIRONMENT.
CASE STUDY: PEAT ISLANDS OF LAKE VLASINA**

UDC 502.1:551.42:551.438.22"Vlasina"(045)

Ana Momčilović Petronijević¹, Slaviša Trajković¹, Vladimir Randjelović²

¹University of Niš, Faculty of Civil Engineering and Architecture, Serbia
E-mail: momcilovicanact@yahoo.com

²University of Niš, Faculty of Science and Mathematics, Serbia

Abstract. *Floating islands represent residue of peat which swam out on surface of water after flooding former Vlasina peat-bog. These islands are refuges of plant and animal species characteristic from peat-bog habitats. These specific habitats destroyed to a great extent with exploitation of peat for different human needs and survival of many plant and animal species endangered.*

Key words: *Floating islands, peat, endangered species, Vlasinsko lake.*

1. INTRODUCTION

The world is facing great challenges in preservation of natural ecosystems. Survival of marshlands is not paid sufficient attention yet. The marshland ecosystems have a significant economic impact for the local population, and they contribute to reduction of poverty. In general, big problem for preservation of an environmental balance are the anthropogenic ill effects on aquatic ecosystems, biodiversity and environment [14].

Man has always brutally meddled with the destiny of Vlasina lake, driven by deliberate, preset goals, by carrying out rough interventions in nature which were always followed by a sequence of consequential changes (chain reaction), which were, as a rule, undesired and with unforeseeable outcomes.

The Vlasina area was placed under protection of the state in 2006, as an area of extraordinary qualities "Vlasina" spreading over 12,741 ha. Peat islands were placed under the 1st degree protection – comprising the highest level of protection – strict protection. Cutting of peat and destruction of floating islands has been strictly forbidden. The Secretariat of Ramsar Convention ranked the Vlasina area of Extraordinary characteristics on the list of internationally significant wetlands - on the basis of the Nomination Study done by the Institute for the Environmental protection of Serbia, and was officially sent by the Ministry of Environmental protection.

In the past period, the Peat cutting Company, a part of the HK "Simpo" from Vranje, seedling plant "Srbijašume" from Vlasotince, Movement "Gorani", from Niš, Cvečara from Vranjska banja and numerous private individuals have forever destroyed over 70 hectares of peat, floating islands, Contrary to the national and international protection, destruction of peat islands continues. The goal of this research is to draw attention of the professional public on the pernicious human influence on the ecosystems of peat islands of Lake Vlasina.

2. VLASINA PLATEAU

The Vlasina Plateau is located in the southeast Serbian on the territory of the municipalities Surdulica and Crna Trava, 30 km away from the South Morava valley in the west, and Serbian-Bulgarian border in the south (figure 1). There is no reliable evidence on the period when the Vlasina plateau became inhabited. However, it is known that prior to the arrival of the Slavs in these parts, there lived a variety of nations, such as Thracians, Illyrians, Romans and Vlachs and that the area was abundant in iron ore and that these mountains were covered with thick mixed-type coniferous and deciduous forests.



Fig. 1 The Vlasina plateau – position in Southeast Serbia (A) and topography (B)

The evident present-day absence of autochthonous coniferous forests is a consequence of zooanthropogenic influences. Namely, the softwood forests, which were dominant, were almost entirely destroyed for the mining purposes. Mining operations per se is destructive for nature. Regression of the coniferous forests was favorable for expansion of beech wood forests, which were cut down to clear the area for meadows and pastures.

Large areas which were until two centuries ago covered by the beech wood forests are nowadays barren, the soil has been washed down, and the secondary vegetation is growing there [10]. It is presumed that a lake was formed in the Vlasina depression during Pleistocene, by a large amount of rock and clay material which had obstructed the flow of an already existing river.

In the glacial periods, characterized by cold and dry climate, due to the climatic changes, an intensive mechanical decomposition of rocks took place. Rivers (creeks) running into the lake became torrentous, and carried large quantities of sediment which settled on the contact line with the alluvial plane of Vlasina, particularly along the banks. At first, the peat vegetation populated these areas. By further settling, it transformed into meadow peatland and meadows. This process of filling and growing transformed what used to be a lake first into a large peatland and than into what it is today. [3].

The process was accelerated by "lowering of the Vlasina riverbed" to the level of the bottom of Blato, resulting in the "subsiding of the water table in the Vlasina depression" [3], and also by anthropogenic influences – forest clearing which resulted in increased evaporation and erosion, and thus increased influx of sediment into the depression, and finally by mining operations, where the ore separation was done by water rinsing, whereby the waste was transported to depression.

Vlasinsko Blato – peatland was the largest peatland, and thus a habitat of this kind in the Balkan peninsula, and possibly in southern Europe [10]. According to its origin, morphologic and vegetative characteristics, it belongs to the so-called transient peatlands or Übergagsmoore [7, 8, 16], and some authors place it among the raised peatlands or Hochmoore [1, 4], which are characteristic of boreal parts of Eurasia. This peatland was most likely created during the last Würm period of glaciation 10,000 years ago [10]. It is unique in Europe, by a number of specific and richness of flora and fauna. As such, it has been attracting many explorers.

3. PEAT ISLANDS OF VLASINA LAKE

Present day Vlasina lake was formed in the area where in the past there was a peatland known as Vlasinsko Blato, with patches of water surface from where the River Vlasina flowed out. By the end of 1946, in the place where Vlasinsko Blato formed a funnel, the Vlasina dam construction began (figure 2). The works were completed in spring 1949. Since then till 1954 the lake filled with water, from the immediate watershed of the lake. In this manner the highest dam lake in Serbia of the time was created, as it is at 1213m above sea level at the times of the highest water table. The lake is 10.5 km long, with average width of 1.77 km, total surface area around 16 km² and volume of 165*10⁶ m³, maximum depth of 34 m, and average depth 10.3 m. Due to water release into a hydro power plant system „Vrla", the depth is not constant.

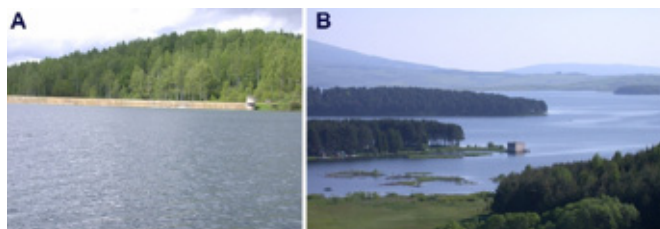


Fig. 2 Dam (A) and panoramic photograph of the lake with the Entry structure (B)

The lake water table fluctuates for up to 15 m [10], whereby the surface area decreases to 5.6 km². It belongs to the group of chilly lakes, with the mean annual water temperature of 9°C and the maximal in August of 18.5°C. The lake has extraordinary conditions for hunting and particularly fishing tourism. It is the largest and most significant tourist center in the south of Serbia [5].

By construction of the big earthen dam more than 240 meters long and the 34,5 five meters high and by creation of the accumulation a large part of the peatland was flooded.

Vlasinsko Blato had a surface area of about 10.5 km², prior to flooding, out of which 1/3 was peatland, and the rest was composed of marshy and wet meadows. [2].

The peatland is formed by the incomplete decomposition of dead biomass, which is dictated by the stagnant water and low temperatures which disables the activities of the micro-organisms, that is, decomposition in the matter cycling process [10]. Namely, decomposition of biomass is arrested, so the significant part of it preserved its cellular structure.

In respect to the type of vegetation, that is plant species dominating in the plant cover, from whose decomposition the peat is formed, there are four different types of peat in Vlasina area.:

- Peat created by the incomplete decomposition of reed or *Phragmetitum* – peat, which is very rare in the Vlasina area. The thickness of the peat layer is less than 50 cm.
- Peat created by the incomplete decomposition of horsetail (*Equisetetum* – peat), which is widely present on the Vlasina Plateau. It is similar to the previous type by its physic-chemical properties. It is often the base layer of peat island, mixed with moss peat.
- Peat created by the incomplete decomposition of sedges (*Caricetum* – peat) is the most commonly present in the Vlasina area. It is arranged over the peat created by decomposition of reed, or it "floats" on the water, similar to the moss peat, and it can be as thick as 1 m. It is composed of intertwined roots and not completely decomposed plant blades. It is very often the base layer of moss peat.
- Moss peat is very widely distributed type of peat on the plateau. This kind of peat is created by the incomplete decomposition of peat mosses from the *Sphagnum* genus. It can be more than 1 m thick. It is often laid over other types of peat. This peat constitutes the peat islands of Vlasina lake, in it is also frequently present near the water courses and their springs.

Out of 500 ha of peatland, 2/3 were flooded. The non-submerged parts of the peatland nowadays occupy around 30 ha, 1.0 – 3.5 m thick [10] and they are situated around springs and creeks flowing into the lake. Also, creation of new peat is arrested or slowed down, and reserved for the deeper zones.

After submerging, layers of peat detached from the bottom of the lake, and came afloat forming the peat islands. In the fifties, during the lake filling phase, they covered 1/3 of the lake and were up to 4 m thick.

A part of the floating islands connected to the lake side (4,543 with the total surface area of around 37 ha, with 440,000 m³ of peat), or ran ashore onto the shallow bottom of the lake (2,663 with the total surface area of around 170 ha with 243,000 m³ of peat), or floated on the water (79 with the total surface area around 78 ha and 91,000 m³ of peat) [10]. The size of these islands varied, from the smallest ones to those over 10 ha large,

according to the surveying data (KO Vlasina Rid), and some (not the largest ones) islands were in 1969 treated as individual cadastre estates [17].

Nowadays, the width of the largest peat island is 250 m, and the length 400 m, while the remaining several islands are not more than 100 m long, with the peat 1.0 to 1.5 m thick. The recent estimates state that the total surface area of peat islands in Vlasina lake is not 8 – 10 ha [17].

These data suggest that the surface area of peat islands in the relatively short time interval was decimated. This process of extinction of peat islands is continuing. The observation of Vlasina lake in the first part of April 2009 showed that apart from the island "Mobi Dik", famous for its woods consisting of Downy Birch (*Betula pubescens*) variety, and various species of willows (*Salix rosmarinifolia*, *S. aurita*, *S. pentandra*), which ran aground in the vicinity of the Fishing Camp near Promaja site, and one island which ran aground in Murina dolina (Murina valley), there were no other islands, at least, not those floating on the island. A large part of small islands are located on the fringe of the lake, but they are damaged to a significant extent.

The peat islands come afloat with the vegetation that used to be growing on them in the past, or, if coming from greater depths, without any vegetation. The bare islands first see the growth of pioneering vegetation, and in the later period, through the series of successive stadiums, some form of peatland vegetation. Their surface area may become enlarged as they grow on the fringes. Namely, some plant species with well-developed rhizome, such as the Marsh Cinquefoil (*Potentilla palustris*) and Swamp Horsetail (*Equisetum fluviatile*), create a network collecting other, not completely decomposed plants, forming the peat soil in this process.

4. WILDLIFE OF PEAT ISLANDS

Contemporary history of the Vlasina peatland can be divided in two periods: period before flooding and that after the flooding of the Vlasina peatland. In the period when the botanical research of the Vlasina peatland (1880), until its submerging (1949) there were 206 species recorded in the peatland [9, 10], both endemic and subendemic. The peatland was characterized with very rich fauna, and particularly significant was ornithofauna, consisting of a number of autochthonous boreal elements.

Construction of the great earthen dam and formation of the dam lake change the characteristics of the entire area, and particularly of peatland habitats. Yet, as it was remote from the main Balkan traffic routs, the Vlasina plateau and fragments of once largest peatland in the Balkan, successfully resisted the time and human intervention, and supplied pleasure and satisfaction to the explorers and lovers of nature as it had natural rarities which could not be found on other mountains in southeast Serbia. However, in the recent period, this unique natural creation has been on the verge of distinction. Cutting and destroying peat in other ways led to the destruction of large areas of peatland, and one of the best developed populations of carnivorous plant Roundleaf Sundew (*Drosera rotundifolia*) on the Balkan peninsula is about to lose its optimal habitat. Because of this, the contemporary nature researchers face very serious issues concerning protection of the Vlasina Plateau and revitalization of a severely degraded plant cover.

Inhabitants of peat islands on Vlasina are attracting attention of the nature explorers. As special attention to this area is paid by the botanists, who have been researching flora and vegetation of the peatland for more than a century – where a sanctuary has been found by many relict plant species – evidences of geologic and climatic past of the entire environment. Remains of the Vlasina peatland were represented by small or large areas in the valleys of the biggest lake tributaries and peat islands. It is certainly a unique attraction to watch in hazy mornings the "ghostly lake farers" on the peat islands, this fantastic reincarnation of once largest peatland in the Balkan Peninsula. After construction of the dam and filling of the dam lake, the mighty deposits of peat partially came afloat and nowadays represent a rare natural phenomenon. These islands are very quickly populated by characteristic peat vegetation dominated by sphagnum mosses and variety of sedges (*Carex echinata*, *C. curta*, *C. flava* and the other). There are other characteristic representatives of peat vegetation growing on the floating islands: narrow and broad-leaved Cotton grass (*Eriophorum angustifolium* and *E. latifolium*), Sundew (*Drosera rotundifolia*), Marsh cinquefoil *Comarum palustre*, Buckbean (*Menyanthes trifoliata*), Marsh lousewort (*Pedicularis palustris*), Greater spearwort (*Ranunculus lingua*) and the others



Fig. 3 Characteristic representatives of peatland flora: 1. *Pedicularis palustris*, 2. *Menyanthes trifoliata*, 3. *Eriophorum angustifolium*, 4. *Drosera rotundifolia*, 5. *Potentilla palustris*

The study of the plant cover of peat islands can yield the chronological development of peat vegetation on Vlasina, while by studying the settled and sedimented pollen in the peat can provide reconstruction of the historical development of forest vegetation in this area.

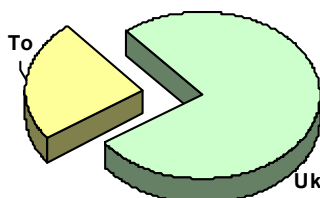
Analysis of the development sequence of peat vegetation demonstrated that the last in the sequence are - wood plants, characterized particularly by Downy Birch (*Betula pendula*) and Rosemary leaf Willow (*Salix rosmarinifolia*) [11]. Analysis of pollen at a variety of depths indicated that prior to this stage, the coniferous forests were dominant in the

area. An interesting finding in the peat are remnants of typical boreal species, whose areal is nowadays in the north of Europe, which supports the proposition that the boreal conditions were once dominant in these habitats. For instance, those are Rannoch-rush (*Scheuchzeria palustris*) and Cottonsedge (*Eriophorum vaginatum*).

These new conditions were cause for distinction of some twenty plant species; for some of them, the peat islands were the only habitat. Those are Jacob's ladder (*Polemonium caeruleum*), carnivorous Common butterwort (*Pinguicula vulgaris*), slender cotton-grass (*Eriophorum gracile*) and others. Some plant species were brought to the brink of extinction in our country, because this is their only known habitat. Mud sedge (*Carex limosa*) [11] is also endangered along with the already mentioned downy birch, buckbean, marsh cinquefoil and lousewort. There is no many endemic and subendemic plant species on the peat islands. The only endemic species characteristics for peatland vegetation is Campion (*Silene asterias*). New conditions were favorable for the development of a different flora and fauna.

Table 1. Extinct (EW), extremely endangered (Cr), endangered (En), vulnerable (Vu) and slightly endangered plants (LR) on the peat islands of Vlasina lake

Name of the species	Category of the endangerment in the flora of Serbia	Category of the endangerment in the flora of the Vlasina Plateau
<i>Polemonium caeruleum</i>	Ew	Ew
<i>Juncus capitatus</i>	Ew	Ew
<i>Caldesia parnassifolia</i>	Ew	Ew
<i>Betula pubescens</i>	Cr	Cr
<i>Carex limosa</i>	Cr	Cr
<i>Ranunculus lingua</i>	Cr	Cr
<i>Utricularia minor</i>	Cr	Ew
<i>Comarum palustre</i>	En	En
<i>Eriophorum gracile</i>	En	Ew
<i>Drosera rotundifolia</i>	Vu	En
<i>Menyanthes trifoliata</i>	Vu	Vu
<i>Ranunculus aquatilis</i>	Vu	LR
<i>Stellaria palustris</i>	Vu	En
<i>Silene asterias</i>	Vu	En
<i>Dianthus superbus</i>	Vu	Vu
<i>Salix rosmarinifolia</i>	Vu	En
<i>Salix pentandra</i>	Vu	Vu
<i>Ranunculus flammula</i>	LR	LR
<i>Pedicularis palustris</i>	LR	En
<i>Pinguicula vulgaris</i>	LR	Ew



Graph 1. Relationship of a number of endangered species from the peat islands (TO) and the total number of endangered species (UK) in the flora of the plateau

Peat islands are not only a treasury of a variety of plant species, but also a habitat of various species of animals, primarily birds. In the peatland vegetation, the following birds make their nests: Northern Lapwing (*Vanellus vanellus*) Yellow Wagtail (*Motacilla flava*), and also White Stork (*Ciconia ciconia*), Grey Heron (*Ardea cinerea*), Corn bunting (*Emberiza calandra*), variety of ducks (*Anas querquedula*, *A. crecca*), Greenshank (*Tringa nebularia*) and the other. Yet, formation of the dam lake contributed to the significant degradation of ornitofauna in the entire area. Many species nesting on the peatlands have forever vanished from these parts, and the greatest loss, not only for this area but for the whole country is the disappearance of a colony of Cranes (*Grus grus*), which used to inhabit the Vlasina peatland. Some other species of birds also migrated from the peatland; apart from the mentioned Cranes, those are Snipe (*Gallinago gallinago*) and Meadow Pipit (*Anthus pratensis*). However a new species migrated to lake, Tufted duck (*Aythya fuligula*), and formed one of the largest population in our country [15].

16 species of fish inhabit Vlasina lake, many of them connected to the habitats around and below the peat islands. Those are Perch (*Perca fluviatilis*) and Goldfish (*Carassius auratus*). Presence of rare Balkan endemic species is very interesting, such as Roach (*Rutilus macedonicus*) and Greek Rudd (*Scardinius graecus*), which have been discovered in the lake only recently. However, the probable extinction of Minnow (*Phoxinus phoxinus*), which was until two decades ago common in the ichthyofauna of the lake.

Unreasonable exploitation of natural resources inexorably leads to decrease of biodiversity, which always follow the same scenario: population decrease of a species, extinction of species, degradation of biocenoses, and eventually, disappearing of biocenoses. The similar destiny awaits the peat islands, which carry some specific plant communities, which are characteristic particularly for that type of habitat. Some peatland plants and animals have already disappeared from the floating islands of Vlasina, and some, according to the IUCN categorization [6], belong to the extremely or critically endangered species. Extinct or extremely endangered taxa in Serbian flora [13] in the area of the Vlasina plateau are 11 species, out of which 7 is inhabiting or used to inhabit the peat islands. Apart from that, another 75 plant species may be considered belonging to some lower category of endangerment, out of which 11 inhabit the peat islands, and 2 have disappeared from this area (tab. 1). In other words, every tenth species on the Vlasina Plateau has been endangered to some degree, and a quarter of this number are inhabitants of the peat islands (figure 4).

Great importance of peat soil and its usage in horticulture, organic food production and cosmetic industries (dominantly the sphagnum peat which is a good absorbent) [12], and lately in architecture, too, that is in the permaculture settlement construction (due to its lightweighness it has been used for construction of roofs which have a low impact on the environment) is intensifying the exploitation. Besides, other forms of endangering peat lead to its total extinction from these regions. The causes of destruction of peat islands can be roughly divided in natural and anthropogenic. The peat islands that have come afloat are mechanically destroyed by an intensive action of the lake water waves which can be as high as 60 cm. Instead of positioning the islands into a more protected and sheltered parts of the lake so that to their destruction by collision could be prevented, they get cable-hooked and anchored to the lakeside with no prior plan, sometimes exactly to the part of the lakeside which is most exposed to the impact force of the waves. This is what happened to all the islands that floated to the so-called Entry structure because of the potential obstruction of the dam outlet tunnel and the threat they posed to the function of the "Vrla" hydro electric power plant.

In the winter period 1991, an island 350 – 400 m long and up to 250 m wide was wind-swept to the vicinity of the dam. The following winter, the island was either purposefully or unintentionally drawn in between the Dugi Del island and a cape of the same name, into the location where peat was being cut intensively.

The largest island now, „Mobi Dik", was driven ashore on the southwest lakeside nearby Promaja, and has been exposed to the intensive degradation since.

Degradation and destruction of vegetation have been accelerated in those islands attached to the shore. By attaching them, they were made easily accessible. They are most frequently used for fishing, and fishing holes are drilled in them, very often the peat vegetation is trampled upon and set to fire. Peat shrubbery is cleared and rubbish is discarded. The peat vegetation suffers from water deficiency on those islands which have been aground for a protracted period of time, due to the fluctuation of the water level (up to 15 m). Consequences of these anthropogenic impacts are reduction of the living space of autochthonous plant and animal communities thus endangering their survival; another consequence is the change of authenticity of habitats, bringing about receding of peat vegetation and emergence of regressive or secondary stages in vegetative development. Yet, the most drastic is the physical destruction of islands, that is peat cutting for commercial purposes.

Even though it is legally prohibited, in the last 20 (perhaps even more) years of the past century, intensive cutting of peat by the peat processing factory operating in the system of the furniture factory „Simpo" from Vranje (figure 4 and 5) was carried out, as well as by private businessmen. The former cut the peat at two locations, „Blato" (at Božički channel inflow) and „Taraija" (what a coincidence, exactly on the spot where the largest peat island was towed and driven aground in winter 1992, of which only fragments have survived till nowadays), and the latter along the west lake side.

According to some, not entirely precise data, the company annually cut between 10,000 and 15,000 m³ of peat. Calculations indicate that 1 – 1.5 ha of peat islands or 20 – 30 ha during the entire cutting period have been mechanically crushed to produce garden compost. Over 30 ha of autochthonous habitats was crushed, together with the flora, which was in good part relict, boreal and tertiary.

The very fact that cutting was performed by machinery, means that the used machinery needs to be transported to the cutting site, that is to the very lakeside, and that access roads had to be built for it. Regarding the temporary character of these roads, they were adapted to the conditions of the terrain, and thus very often longer than necessary, meaning that the surface area of the destroyed nature is even greater, just as the harmful exhaust gas emission. Saprobiological analysis in some places where peat was cut exhibits increased saprobic indices, which certainly affects the ichthyofauna in these parts of the lake.



Fig. 4 Factory for peat processing „Simpo" in Đumruk



Fig. 5 Peat processing plant (left) and peat store area (right) next to the previously factory mentioned

4. CONCLUSIONS

The Vlasina peatland, and particularly peat islands, which freely float on the lake surface if sanctioned by the man, are under the strong impact of anthropogenic factor. By reduction and change of the habitat of plant and animal species, the survival of their communities is so endangered that they tend to completely disappear from the lake. Some species become extinct, at some the populations are reduced, and in the vegetative succession occurs degradation and regression. Physical destruction of peat islands, natural phenomena rare in the world, can be qualified as an environmental catastrophe. As peat islands are a unique phenomenon and give home to rare and endangered species, the re-

maining fragments should be physically protected, degraded areas revitalized, and legal norms enforced in order to protect this natural wealth.

REFERENCES

1. Adamović, L. (1909): *Die Vegetationverhältnisse der Balkanländer (Mosische Länder)*. - Die Vegetation der Erde. Verlag von Wilhelm Engelmann. Leipzig.
2. Cvijić, J. (1896): Izvori, tresave i vodopadi u istočnoj Srbiji. Glas SKA, Beograd.
3. Cvijić J., (1896): Morfologija i hidrografija istočne Srbije, SANU Beograd.
4. Früh, J., Schröter, C. (1904): *Die Moore der Schweiz*. Bern.
5. Gocić, M, Stanković, P., Trajković, S., Branković, S., Stanković, M. (2006): *Integrirani monitoring životne sredine osnova održivog turizma*, Naučni skup Prirodni resursi – osnova turizma, *Ecologica* 13 (12), 147 – 152.
6. IUCN Species Survival Commission, (1994): *IUCN Red List Categories*, 40th Meeting of the IUCN Council, Gland.
7. Katić, D. (1910): *Vlasinska tresava i njezina prošlost*. Spomenik Srpske Kraljevske Akademije, prvi razred, 50 (8): 14-56. Beograd.
8. Košanin, N. (1910): *Vlasina biljnogeografska studija*. Glas Srpske Kraljevske Akademije, 81: 86-186. Beograd.
9. Košanin, N. (1910a): *Elementi Vlasinske flore*. Muzej srpske zemlje, 10: 142. Beograd.
10. Randelović, V. (1994): *Geobotanička studija Vlasinske tresave*. Magistarska teza. Biološki fakultet. Beograd.
11. Randelović, V. (2002): *Flora i vegetacija Vlasinske visoravni*. Doktorska disertacija. Biološki fakultet Beograd.
- 11a. Randelović, V., Blaženčić, J. (1997): *Hidrofilna flora i vegetacija Vlasinskog jezera*. In: Blaženčić, J. (ed.): *Vlasinsko jezero - hidrobiološka studija*. Biološki fakultet Univerziteta u Beogradu. 208-230.
12. Rydin, H., Jeglum, J., (2006): *The Biology of Peatlands*, Oxford University Press.
- 12a. Simonović, P., Nikolić, V., (1997): *Ihtiofauna Vlasinskog jezera - stanje i perspektiva*. In: Blaženčić, J. (ed.): *Vlasinsko jezero - hidrobiološka studija*. Biološki fakultet Univerziteta u Beogradu. 179-198.
13. Stevanović, V., ed., (1999): *Crvena knjiga flore Srbije, 1*, Ministarstvo za životnu sredinu R Srbije, Biološki fakultet Univ. u Beogradu, Zavod za zaštitu prirode Srbije, Beograd.
14. Trajković, S. (2008): Kvalitet vode reke Nišave kao indikator održivog vodosnabdevanja sa izvorišta "Medijana", *Ecologica*, 15 (52), 57-62.
15. Vasić, V., Šoti, J. (1979): *Višegodišnje promene u sastavu ornitofaune Vlasine*. II Kongres ekologe Jugoslavije, 1691-1704. Zagreb.
16. Weber C (1908): *Aufbau und vegetation der moore Norddeutschlands*. Englers Botanische Jahrbücher. *Beiblatt* 90: 19-34.
17. Zavod za zaštitu prirode Srbije, (2006): *Predeo izuzetnih odlika Vlasina*, studija zaštite, Beograd.

ANTROPOGENI UTICAJI NA ŽIVOTNU SREDINU. STUDIJA SLUČAJA: TRESETNA OSTRVA VLASINSKOG JEZERA

Ana Momčilović Petronijević, Slaviša Trajković, Vladimir Randjelović

Ploveća ostrva predstavljaju ostatke treseta koji su isplivali na površinu vode nakon potapanja nekadašnje vlasinske tresave. Ova ostrva su refugijumi biljnih i životinjskih vrsta karakterističnih za tresavska staništa. Eksploatacijom treseta za različite potrebe čoveka u većoj meri su uništena ova specifična staništa, čime je ugrožen opstanak mnogih retkih biljnih i životinjskih vrsta.

Ključne reči: *ploveća ostrva, treset, ugrožene vrste, Vlasinsko jezero*