UDK: 582.661.51-195
Received: 15.11.2017
Accepted:11.12.2017
Original scientific paper

Acta Musei Macedonici Scientiarum Naturalium, 2017, Vol. 20, pp: 31-40
ISSN: 0583-4988 (printed version)
ISSN: 2545-4587 (on-line version)
Available on-line at: www.acta.musmacscinat.mk

Rediscovery of *Aldrovanda vesiculosa* L. and new data on its distribution in the Republic of Macedonia

Daniela Jovanovska[1*], Maja Mladenova[2], Elena Minova[2], Natalija Melovska[3], Ljupčo Melovski[1]

[1]Institute of Biology, Faculty of Natural Sciences and Mathematics, Ss. Cyril and Methodius University, Skopje, Republic of Macedonia
[2]Biology Students' Research Society, Faculty of Natural Sciences and Mathematics, Ss. Cyril and Methodius University, Skopje, Republic of Macedonia
[3]Macedonian Ecological Society, Blvd. Boris Trajkovski, 7-9a, Skopje, Republic of Macedonia
*corresponding author, e-mail: danielajovanovska9@gmail.com

Abstract
Aldrovanda vesiculosa L., widely known as the waterwheel plant, is a rare aquatic plant that holds the status of a globally endangered (EN) species. Extant populations of *A. vesiculosa* are rare in Europe and there are only few sites left in the Balkans. In Macedonia, the species was last recorded in 1980 and according to many researchers the plant was considered as extinct in the area. In this paper, we present the recent finding of *Aldrovanda vesiculosa* and new data on its distribution in Macedonia, including an assessment on the specific habitat type and evident threats.

Key words: conservation, habitat, free-floating vegetation, Lake Prespa, threats, waterwheel plant

Introduction

Aldrovanda vesiculosa L. is a rare aquatic carnivorous plant that historically inhabited a wide variety of wetland habitats throughout Europe (Adamec 1995, Breckpot 1997), Asia, Africa and Australia (Cross 2012). Due to the decline in its natural habitat throughout its otherwise patchy distributional range, today *A. vesiculosa* is a rare "treat" and holds the status of a globally endangered (EN) species (Cross 2012). Extant populations of *A. vesiculosa* are rare in Europe (Adamec 1995, 1997, Breckpot 1997, Cross 2012) and there are only few sites in the Balkans (Breckpot 1997, Cross 2012). However, the number of localities with extant populations is "on the rise". Previously considered as extinct, the waterwheel plant was rediscovered in Serbia (Tomović et al. 2009) and Prespa Lake in Greece (Cross 2012). Generally, those areas known to sustain extant *A. vesiculosa* populations in the Balkans are mostly managed and protected areas like: "Srebarna" and "Dragoman Marsh Complex" (Bulgaria); the "Zasavica" Special Nature Reserve (Serbia) and Prespa Lake, all listed as Ramsar sites (The Ramsar convention on wetlands 2017). Still, promotion and application of conservation measures within protected areas, without taking into account the landscape-scale effects over the intrinsic properties of wetland habitats, do not always succeed in sustaining those sensitive and vulnerable populations (as exemplified by the recent extinction of populations in the Obedska Bara Special Nature Reserve in Serbia, Cross 2012).

In Macedonia, the species was first registered by Micevski (1963) as part of the association *Lemneto-Spirodeletum polyrrhizae* W. Koch 1954 subass. *aldrovandetosum* (H-ic & Micev. 1960) H-ic & Micev. 1969. It is a very rare community known to be present only on one location in the littoral zone of Prespa Lake - below village Dolno Perovo (Micevski 1963, 2001). The plant was recorded in the shallow water fringed by common reed (*Phragmites australis*) beds, forming complex with other floating vegetation typical for this community (*Spirodela polyrrhiza, Lemna minor, Salvinia natans, Hydrocharis morsus-ranae, Utricularia australis*). Its presence was legitimately last recorded in 1980,

also by Kiril Micevski (MKNH 5857-5859; 5863-5867). Though *A. vesiculosa* was selected as an A (ii) species for appointing Prespa Lake littoral zone as an Important Plant Area (Melovski et al. 2010) according to many researchers the plant was considered as extinct in the area (Talevska et al. 2009, Angelova et al. 2014, Brajanoska et al. 2014).

In this paper, we present the recent finding of *Aldrovanda vesiculosa* at the known locality of village Dolno Perovo and new data on its distribution in Macedonia, including an assessment on the specific habitat type and evident threats.

Material and methods

Study area

The Prespa Lakes' watershed is located in the central-western part of the Balkan Peninsula and encompasses the Greater Prespa Lake that lies on the border of Macedonia, Greece and Albania and the Lesser Prespa Lake shared between Greece and Albania (Fig. 1). The Prespa Lakes' basin hosts unique habitats with international conservational importance (UNDP 2010, Wagner and Wilke 2011, Albrecht et al. 2012). Also, the Prespa region provides for 69 rural areas out of which 44 are in Macedonia (Perennou et al. 2009a). The main occupation of the local population inhabiting Prespa Lakes watershed is agriculture and the agricultural activities are most intensive in Macedonia, where 72% of the land is used for agricultural purposes. Macedonian part of Prespa region is known for apple production which is also the main source of income for generations as the region provides near 68% of the total apple production in the country (State statistical office of the Republic of Macedonia 2012). Intensive agriculture along with tourism and medium-size industrial enterprises contribute to overall environmental pressure. The continuous and intensive anthropogenic pressure led to increased eutrophication of the Prespa Lake (Krstić 2012, Petrovska et al. 2014) and triggered a "chain reaction" of ecosystem deprivation.

The unique twist of natural and anthropogenic attributes of the region caught the attention of a number of international donors and agencies (MAVA foundation, GEF, UNDP, SDC, KfW, GIZ) followed by implementation of various project that aimed to face the environmental challenges. Starting with the trilateral agreement for establishing a protected area "Declaration on the creation of the Prespa Park and the Environmental Protection and Sustainable Development of the Prespa Lakes and their surroundings" signed in 2002, a number of NGOs committed for joint efforts to protect the Prespa Lakes watershed (Maragou and Mantziou 2000; Society for the Protection of Prespa et al. 2005). In 2010 another trilateral agreement "Agreement on the protection and Sustainable Development of the Prespa Park Area" (EU 2011) revived the "worn hopes" for transboundary conservation and sustainable management of the Prespa Lakes. In 2014, the Ohrid-Prespa area was declared as a transboundary UNESCO biosphere reserve. This international designations draw further attention to the importance of sustaining and managing the existing national categories of protected sites in the Prespa region. Particular attention is paid to Nature Park "Ezerani" where numerous conservation activities are foreseen (MES 2012, Ceroni 2013, Angelova et al. 2014) in order to sustain and improve the state of this wetland ecosystem. Recognizable by the large surface of reedbeds, Ezerani hosts a complex of plant communities and a great diversity of animal species, especially birds. The importance of reedbeds lies in its heterogeneity and the linking habitats of immersed, floating or submersed vegetation within (Angelova et al. 2014).

A decade of conservational activities and awareness raising has strived towards a measurable improvement of the overall integrity of the Prespa ecosystems (Perennou et al. 2009a, 2009b; Sekovski 2017). The Prespa region is still a pilot area for implementation of numerous conservational activities with joint transboundary efforts (PrespaNet 2017) to sustain and further improve the ecosystem of Lake Prespa.

Field surveys

The sites for detailed research were selected in accordance with the available historical information on the species range and distribution (Micevski 1963) and its habitat requirements (Adamec 1995, 1997, Breckpot 1997). In 2016 Prespa Lake shoreline was checked through continuous movement and the sites where *A. vesiculosa* was present were marked with a GPS point. The presence of *A. vesiculosa* was also expected in other localities in NP "Ezerani" and its immediate vicinity but due to the thick impassable belt of reed those sites could not be assessed. In 2017, the same localities visited a year before, were re-checked.

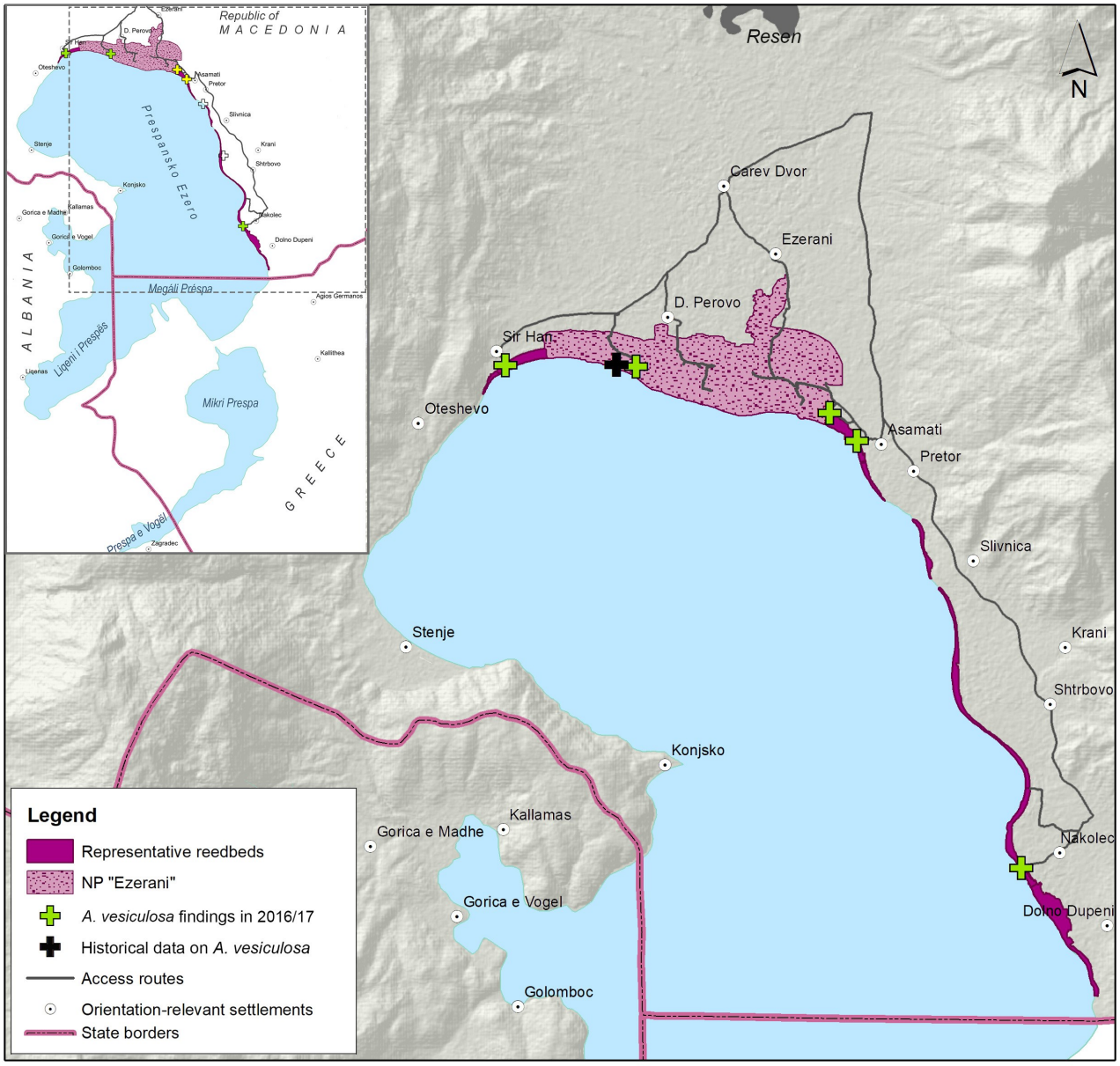


Figure 1. Distribution of *Aldrovanda vesiculosa* L. along Prespa Lake littoral in Macedonia including a general geographical representation of both Greater and Lesser Prespa Lakes

Laboratory work

Plant specimens were identified in accordance with Flora of the Republic of Macedonia (Micevski 1985, 1998, 2001) and Flora Europaea (Tutin et al. 1972, 1980). Plant nomenclature followed The Euro+Med PlantBase (Euro+Med 2006). The habitat types in which *A. vesiculosa* can be found, or is associated with, in Prespa were listed with reference to EUNIS (Davies et al. 2004). Taxon vulnerability was discussed in accordance with the data provided under the IUCN Red List of threatened species (Cross 2012) and assessed according to the guidelines of IUCN (2012). Collected specimens are stored in Herbarium Melovskiorum (MKMEL 11593, 11594).

Results and discussion

In 2016 abundant populations of *A. vesiculosa* were recorded in four sites within NP "Ezerani" and its immediate vicinity, and in one site Nakolec (Fig. 1, Tab. 1). The *A. vesiculosa* plant was observed in patches of shallow water arranged in-between the lake and the reedbed, mainly along the abandoned boat passages among the reeds, formerly used by fishermen in the area (Fig. 2). Also, the sites were always in the mere vicinity of the inflow of an intermittent lowland rivulets and streams. The *A. vesiculosa* population creates a complex with other floating or submersed plants, mainly: *Hydrocharis morsus-ranae* and *Salvinia natans*, includ-

ing other free-floating and rooted submerged vegetation of nutrient-rich waterbodies (*Najas marina* subsp. *major*, *Lemna minor*, *Utricularia australis*, *Ceratophyllum demersum*, *Myriophillum spicatum*, *Potamogeton perfoliatus*).

Generally, it was observed that the preferred habitat of *A. vesiculosa* in Prespa Lake is very diverse and includes various floating or submersed plant communities that are fringed by reedmace–common reed *Scirpo –Phragmitetum* association. Considering this, it can be presumed that *A. vesiculosa* presence should be expected on few more localities along the strip of the most representative reedbeds along Prespa Lake shoreline (as assessed by Nikolov et al. 2012, elaborated in Angelova et al. 2014) - Nature Park Ezerani, Pretor, Nakolec and Shtrbovo (Fig. 1). Total reedbed area along the Macedonian shore of the lake was assessed to be 3.2 km^2 (Nikolov et al. 2012) and this area could be considered as potential Area of Occupancy (AOO) of *A. vesiculosa*.

Though *A. vesiculosa* is mostly observed to accompany other plants, it prospers only as long as the plant community remains open. On the sites where *Hydrocharis morsus-ranae* has dominant coverage, *A. vesiculosa* was absent. In general, *A. vesiculosa* is "sensitive to competition with filamentous algae and vascular aquatic plants that form denser stands" (Adamec 1997) and when in microhabitat of *Hydrocharidetum morsus-ranae* Langendonck 1935, *A. vesiculosa* specimens are suppressed (Kamiński 1987).

The habitat types in which *A. vesiculosa* can be found, or is associated with, in Prespa are listed under the C1.2 : Permanent mesotrophic lakes, ponds and pools and C1.3 : Permanent eutrophic lakes, ponds and pools with reference to EUNIS (Davies et al. 2004). Specifically: C1.222 Floating *Hydrocharis morsus-ranae* rafts; C1.225 Floating *Salvinia natans* mats; C1.226 Floating *Aldrovanda vesiculosa* communities; C1.32 Free-floating vegetation of eutrophic waterbodies and C1.33 Rooted submerged vegetation of eutrophic waterbodies. Details on the localities and the observed habitat threats are recorded in Tab. 1.



Figure 2. Typical *A. vesiculosa* habitat along Prespa Lake littoral (a) and *A. vesiculosa* L. (b)

The *A. vesiculosa* sites were re-visited in 2017 and it was noted that the number of sites was reduced. It was observed that there is a decrease of water level, as a result of typical fluctuations for Prespa Lake, most probably caused by natural variations in rainfall (Perennou et al. 2009a). The water level reduction resulted with reduction in available habitat and may have led to change of ecological parameters and increase of nutrient concentration on sites. In that direction, on a long-term, climate change could also be identified as a potential threat. Organic and solid waste disposal and abandonment of traditional fishing practices (encroachment of existing boat passages among the reeds) in exchange of intensive fishing on more available and open sites, as use of nets and motor boats, could also be indicated as relevant contemporary threats.

The current presence of *A. vesiculosa* in the Prespa Lake littoral may be a "yield" of the joint conservation efforts and awareness rising in the Prespa Lake watershed. Wetland restoration and improved management of the Nature Park "Ezerani" in addition to the marked improvement of physical-chemical parameters in the Prespa Lake as stated in Sekovski (2017), may have allowed for Lake Prespa again to meet the ecological requirements of *A. vesiculosa* as described in (Kamiński 1987; Adamec 1995, 1997). Following, the reappearance of *A. vesiculosa* on the Macedonian part of

Table 1. Locality specifics and observed habitat threats on all sites visited along Prespa Lake shoreline in 2016 and 2017.

Locality	Coordinates	Threats
Sir Han	*X* 20.941638 *Y* 41.003149	Most eminent threats were agriculture/organic waste disposal and solid waste discharge In terms of species abundance, the habitat condition in 2016 could be assessed as more favorable than in 2017, mainly due to the observed decrease of water level and subsequent change of environmental parameters.
Ezerani (Dolno Perovo)	*X* 20.980713 *Y* 41.002819	No significant threats were recorded but solid waste disposal was observed in the mere vicinity of the locality. In terms of species abundance, the habitat condition in 2016 could be assessed as more favorable than in 2017, mainly due to the observed decrease of water level and subsequent change of environmental parameters.
Ezerani (Asamati)	*X* 21.038710 *Y* 40.992300	Most eminent threats were agriculture/organic and solid waste disposal and intensive fishery (use of nets and motor boats). In terms of species abundance, the habitat condition in 2016 could be assessed favorable. In 2017 the *A. vesiculosa* presence was not recorded.
Ezerani (Asamati)	*X* 21.046914 *Y* 40.986007	Most eminent threats were agriculture/organic and solid waste disposal and intensive fishery (use of nets and motor boats). In terms of species abundance, the habitat condition in 2016 could be assessed favorable. In 2017 the *A. vesiculosa* presence was not recorded.
Krani	*X* 20.941653 *Y* 41.003178	Most eminent threats were solid waste disposal and wastewater discharge and tourism. *A. vesiculosa* presence was not recorded.
Pretor	*X* 21.061495 *Y* 40.969747	Most eminent threats were solid waste disposal and wastewater discharge and tourism. *A. vesiculosa* presence was not recorded.
Nakolec	*X* 21.095974 *Y* 40.889005	Most eminent threats were agriculture/organic waste disposal and fishery (use of nets and motor boats). In terms of species abundance, the habitat condition in 2016 could be assessed as more favorable than in 2017, mainly due to the observed decrease of water level and subsequent change of environmental parameters. The presence of *A. vesiculosa* is also expected toward the bordering locality of Metileec (below village Dolno Shtrbovo). Due to the thick impassable belt of reed, the site could not be accessed without boat.

Prespa Lake could be a result of re-germination of dormant seeds. Still, the mechanisms regulating *A. vesiculosa* germination in its natural environment remain unresolved (Cross et al. 2016) and in the case of Prespa Lake, re-inhabiting by dispersal should also be considered. In this context it is worth noting that *A. vesiculosa* was too re-discovered on the Greek side of Prespa Lake in 2011 (Cross 2012). Considering that Prespa Lake is an interconnected system the plant may have been dispersed by the natural water flow or by birds - known to have an important role for short distance spread of *A. vesiculosa* (Breckpot 1997).

Considering the natural vulnerability of Prespa Lake ecosystem sensitive to lake level oscillations and anthropogenic impacts constant monitoring of the *A. vesiculosa* population is needed in order to detect the actual causes of fluctuation of its population in numbers and sites.

In view of its limited distribution in the country and following its global conservation status as endangered (EN), as the fact that *A. vesiculosa* has been regarded as critically endangered throughout most of Europe (Cross 2012), it is suggested that the species is placed in the group of critically endangered species (CR) within the territory of Macedonia under B2(a,c) and/or C2(b) criteria (IUCN 2012).

Furthermore, this paper encourages complementation and revision on data deficiency and a joint regional detailed assessment of the species distribution in order to provide an objective insight into the national and regional threat status of this species.

Acknowledgements

The presence of *A. vesiculosa* in 2016 was registered during the monitoring done within the project *Conserving wild plants and habitats for people in the south and east Mediterranean* (IPAmed project) run by Plantlife UK and IUCN and sponsored by MAVA foundation, nationally coordinated by the Macedonian Ecological Society.

The distribution data in 2017 were obtained during the field studies organized in the frame of the 'Monitoring and conservation of lake-bound species and habitats', as part of the project: "Conservation and Sustainable Use of Biodiversity at Lakes Prespa, Ohrid and Shkodra/Skadar (CSBL), funded by Federal Ministry for Economic Cooperation and Development (BMZ), implemented by Deutsche Gesellschaft für Internationale Zusammenarbeit – GIZ and EuroNatur (Partnered with Ministry of Environment, Forestry and Water Administration of Albania, Ministry of Environment and Physical Planning of Macedonia, Ministry of Sustainable Development and Tourism of Montenegro).

We thank both reviewers for their contribution, especially Bojan Zlatković for his valuable input on an earlier version of the manuscript.

References

Adamec, L., 1995. Ecological requirements and recent European distribution of the aquatic carnivorous plant *Aldrovanda vesiculosa* L. - a review. Folia Geobotanica et Phytotaxonomica 30: 53–61.

Adamec, L., 1997. Will the Rare Aquatic Carnivorous Plant *Aldrovanda vesiculosa* Survive in Europe? Aquaphyte Newsletter 17: 4–5.

Albrecht, C., Hauffe, T., Schreiber, K., Wilke, T., 2012. Mollusks biodiversity in a European ancient lake system: lakes Prespa and Mikri Prespa in the Balkans. Hydrobiologia 682(1): 47–59.

Angelova, N., Jankovski, A., Fotiadis, G., Brajanoska, R., Melovski, L., Shumka, S., Velevski, M., Avukatov, V., Nikolov, L., 2014. Conservation Action Plan for Reedbeds in the Prespa Lakes Watershed. UNDP/ GEF project 'Integrated ecosystem management in the Prespa lakes basin'.

Brajanoska, R., Matevski, V., Avramoski, O. , Velevski, M., Velkovski, N., Ivanovska, S., Karadelev, M., Kostadinovski, M., Levkov, Z., Melovski, L., Melovska, N., Slavevska-Stamenković, V., Stipcarov, B., Hristovski, S., Dzabirski, V., 2014. Fifth National Report Towards the Convention on Biological Diversity. Ministry of Environment and Physical Planning, Skopje.

Breckpot, C., 1997. *Aldrovanda vesiculosa*: description, distribution, ecology and cultivation. Carnivorous Plant Newsletter 26: 73–82.

Ceroni, M., 2013. Breaking new grounds in conservation in the Republic of Macedonia: The economic case for long-term protection of the Ezerani Nature Park. United Nations Development Programme (UNDP).

Cross, A., 2012. *Aldrovanda vesiculosa*: Cross, A.: The IUCN Red List of Threatened Species 2012: e.T162346A901031.

Cross, A.T., Adamec, L., Turner, S.R., Dixon, K.W., Merritt, D.J., 2016. Seed reproductive biology of the

rare aquatic carnivorous plant *Aldrovanda vesiculosa* (Droseraceae). Botanical Journal of the Linnean Society 180 (4): 515–529.

Davies, C.E., Moss, D., Hill, M.O., 2004. EUNIS habitat classification revised 2004. Report to: European Environment Agency-European Topic Centre on Nature Protection and Biodiversity.

EU, 2011. Agreement on the Protection and Sustainable Development of the Prespa Park Area. Official Journal of the European Union 54 (L 258/2).

Euro+Med (2006-) Euro+Med PlantBase - the information resource for Euro-Mediterranean plant diversity. Published on the Internet http://ww2.bgbm.org/EuroPlusMed/12/8/2017.

IUCN, 2012. IUCN Red List Categories and Criteria: Version 3.1. Second edition. Gland, Switzerland and Cambridge, UK: IUCN, iv + 32 p.

Kamiński, R., 1987. Studies on the ecology of *Aldrovanda vesiculosa* L. II. Organic substances, physical and biotic factors and the growth and development of *A. vesiculosa*. Ekologia Polska 35.

Krstić, S.S., 2012. Environmental Changes in Lakes Catchments as a Trigger for Rapid Eutrophication - A Prespa Lake Case Study. In: Piacentini, T. (ed.). Studies on Environmental and Applied Geomorphology pp. 63–118. In Tech.

Maragou, P., Mantziou, D., 2000. Assessment of the Greek Ramsar wetlands. WWF, Athens.

Melovski, L., Matevski, V., Kostadinovski, M., Karadelev, M., Angelova, N., Radford, E., 2010. Important Plant Areas in the Republic of Macedonia. Special issue of Macedonian Ecological Society. Book 9. Skopje, 128 p.

MES, 2012. Management Plan for the Nature Park 'Ezerani' 2012-2021. UNDP/GEF project 'Integrated ecosystem management in the Prespa lakes basin'.

Micevski, K., 1963. Typological research on marsh vegetation in Macedonia. God. zb., Biol., 14: 79-130.

Micevski, K., 1985. The flora of the Republic of Macedonia. Vol. I. Book 1. Macedonian Academy of Sciences and Arts, Skopje, 1-152 p.

Micevski, K., 1998. The flora of the Republic of Macedonia. Vol. I. Book 4. Macedonian Academy of Sciences and Arts, Skopje, 781-1113 p.

Micevski, K., 2001. The flora of the Republic of Macedonia. Vol. I. Book 5. Macedonian Academy of Sciences and Arts, Skopje, 1121-1430 p.

Nikolov, L., Avukatov, V., Redjovikj, E., Nikudinoska, A., Jovanovska, D., Melovski, Lj., 2012. Mapping of wetlands surrounding Prespa Lake. p. 179, In: Abstract book. 4th Congress of Ecologists of the Republic of Macedonia with International participation. Ohrid, Macedonia. October 12-15, 2012. Macedonian Ecological Society

Perennou, C., Gletsos, M., Chauvelon, P., Crivelli, A., DeCoursey, M., Dokuli, M., Grillas, P., Grovel, R., Sandoz, A., 2009a. Development of a Transboundary Monitoring System for the Prespa Park Area. Society for the Protection of Prespa (SPP), Agios Germanos.

Perennou, C., Gletsos, M., Chauvelon, P., Crivelli, A., DeCoursey, M., Dokuli, M., Grillas, P., Grovel, R., Sandoz, A., 2009b. Development of a Transboundary Monitoring System for the Prespa Park Area, Annexes. Society for the Protection of Prespa (SPP), Agios Germanos.

Petrovska, M., Conevski, T., Krstic, S., Blinkov, I., Stavric, V., Chukaliev, O., Longholt, J., Ristovski, I., Kočovski, Z., Mincev, I., Dinev, Ġ., Mileski, J., Dimov, M., Bojkovska, R., Talevski, T., Talevska, M., Slavevska-Stamenković, V., Stafilov, T., Kaevski, I., Blinkova, M., 2014. Prespa Lake watershed management plan. UNDP/GEF project 'Integrated ecosystem management in the Prespa lakes basin'.

PrespaNet, 2017. 'Transboundary Prespa – Review of Conservation Efforts: A report to the Prespa Ohrid Nature Trust', Society for the Protection of Prespa, Macedonian Ecological Society, Protection and Preservation of the Natural Environment Albania. Agios Germanos, 154 pages.

Sekovski, D., 2017. Closing the Cycle Lake Prespa Basin.

Society for the Protection of Prespa, WWF-Greece, Protection and Preservation of Natural Environment in Albania, Macedonian Alliance for Prespa, 2005. Strategic Action Plan for the Sustainable Development of the Prespa Park, Executive Summary. Society for the Protection of Prespa, WWF-Greece, Protection and Preservation of Natural Environment in Albania, Macedonian Alliance for Prespa, Agios Germanos.

State statistical office of the Republic of Macedonia, 2012. Regions in the Republic of Macedonia, 2012. Skopje, 114 p.

Talevska, M., Petrovic, D., Milosevic, D., Talevski, T., Maric, D., Talevska, A., 2009. Biodiversity of Macrophyte Vegetation from Lake Prespa, Lake Ohrid and Lake Skadar. Biotechnology & Biotechnological Equipment 23 (supl): 931–935.

The Ramsar convention on wetlands, 2017. The List of Wetlands of International Importance. Ramsar Convention Secretariat.

Tomović, G., Zlatković, B., Niketić, M., Perić, R., Lazarević, P., Duraki, Š., Stanković, M., Lakušić, D., Anačkov, G., Knežević, J., 2009. Threat status revision of some taxa from 'The Red Data Book of Flora of Serbia 1'. Botanica Serbica 33 (1): 33–43.

Tutin, T.G., Heywood, V.H., Burges, N.A., Valentine, D.H., Walters, S., Webb, D.A., 1972. Flora Europaea. Cambridge University Press, Cambrige, England, 399 p.

Tutin, T.G., Heywood, V.H., Burges, N.A., Valentine, D.H., Walters, S., Webb, D.A., 1980. Flora Europaea. Cambridge University Press, Cambrige, England, 476 p.

UNDP, 2010. Assessment and evaluation of biodiversity on national level - Report and National Catalogue (Check List) of species. United Nations Development Programme, Skopje.

Wagner, B., Wilke, T., 2011. Preface 'Evolutionary and geological history of the Balkan lakes Ohrid and Prespa'. Biogeosciences 8 (4): 995–998.

Повторно откривање на *Aldrovanda vesiculosa* L. и нови податоци за нејзината дистрибуција во Република Македонија

Даниела Јовановска, Маја Младенова, Елена Минова, Наталија Меловска, Љупчо Меловски

Воденичарчето (*Aldrovanda vesiculosa* L.) е ретко акватично растение кое има статус на глобално загрозен вид (EN). Природните популации на *A. vesiculosa* се ретки во Европа, а нејзиното распространување на Балканот е ограничено на неколку локалитети. Во Македонија, видот последен пат бил регистриран во 1980 година, а според многу истражувачи воденичарчето се сметало за исчезнато. Во трудот се дискутираат најновите податоци за распространувањето на *A. vesiculosa* во Македонија, специфичниот тип на живеалиште и евидентните закани. Воденичарчето е регистрирано на пет локалитети по должина на крајбрежниот појас на Преспанското Езеро. Од 2016 до 2017 година забележано е намалување на бројот на локалитети и промени во видовиот состав на заедниците на слободно-пловечка и флотантна вегетација. Имајќи ја предвид природната ранливост на Преспанско Езеро и антропогениот притисок врз овој екосистем, неопходен е постојан мониторинг на популацијата на *A. vesiculosa* со цел да се евидентираат вистинските причини за флуктуација во популациите на воденичарчето во однос на бројност и локалитети. Со оглед на ограничената дистрибуција на воденичарчето во Македонија, притоа имајќи го предвид нејзиниот глобален статус на како загрозен вид (EN), како и тоа дека *A. vesiculosa* има статус на критично загрозен вид (CR) низ поголемиот дел од земјите во Европа, се предлага овој вид да се вклучи на листата на критично загрозени видови (CR) на територијата на Македонија според критериумите B2 (a, c) и/или C2 (b) (IUCN 2012). Воедно, неопходна е заедничка регионална детална проценка за постојната дистрибуција на воденичарчето, како и надополнување и ревизија на недостигот на податоци со цел да се обезбеди објективен увид во националниот и регионалниот статус на загрозеност на овој вид.

Клучни зборови: воденичарче, закани, зачувување, Преспанско Езеро, слободно-пловечка вегетација, хабитат