BDEE 2021

sciforum

Conference Proceedings Paper

The Floristic Composition of Irrigation Ponds and Water Reservoirs in Albania after the Long Persistent Drought of 2016–2017

Attila Rigó [1*] and Zoltán Barina [2]

[1] Department of Nature Conservation & Landscape Ecology, Hungarian University of Agriculture and Life Sciences, Gödöllő, Hungary; rigo.attila@hallgato.uni-szie.hu
[2] H-1095 Budapest, Ipar utca 3., Hungary; quercusbz@gmail.com
* Correspondence: rigo.attila@hallgato.uni-szie.hu

Abstract: The occurrence of temporary wetland habitats was once frequent in Europe, especially in the Mediterranean region, but attenuating nowadays. The role of anthropogenic aquatic habitats (such as irrigation ponds) in biodiversity and nature conservation has recently become more important. Small irrigation ponds and greater water reservoirs are common parts of the landscape in Albania. The persistent drought of 2016–2017 allowed us to explore the floristic diversity of the beds of dried irrigation ponds and reservoirs. The timing of the field survey was early autumn based on knowledge of the expected appearance of mud vegetation. We recorded the physical parameters of the ponds (location, altitude, the slope angle of the embankment, and bedrock). The cover of each species, water surface, and mud has been estimated by circuiting the whole reservoir. Altogether 129 ponds and reservoirs were studied, more than 3400 new floristic records referring to 324 vascular plant species (of which 35 are adventive) were recorded. Most of the dried irrigation ponds were rather sparsely colonized. Irrigation ponds can serve as a refuge for plants that are connected to wet habitats, but grazing and manuring in and around them can be a threat by promoting the spread of invasive and nitrophilous plants.

Keywords: Albania; anthropogenic aquatic habitats; invasive plant species; irrigation pond; mud vegetation; water reservoir

1. Introduction

The abundance and biodiversity of natural aquatic ecosystems is decreasing [1]. The occurrence of temporary wetland habitats was once frequent in Europe, especially in the Mediterranean region, but attenuating nowadays [2]. Man-made aquatic ecosystems (e.g. irrigation ponds, water reservoirs) can be a refuge for plant and animal communities that are connected to aquatic habitats [3]. The role of these small artificial water bodies in biodiversity and nature conservation is important [4]. Besides being a refuge, these anthropogenic sites can be a threat by providing habitat to invasive plants [5].

Mud vegetation can be developed on the dried beds of artificial water bodies [6]. Exposed mudflats are nutrient-rich ephemerous habitats with favourable edaphic conditions, thus pioneer mudflat species are usually short-lived annuals, which are germinating almost simultaneously and finish their life cycle in a very short time (only few weeks) if the circumstances (decreasing water level) allow it [7–8]. There are numerous publications worldwide that aim to study the vegetation in anthropogenic wetland sites [7, 9–11]. The review of Deil [8] summarized our knowledge on ephemeral wetland habitats around the world (including anthropogenic ephemeral wetlands).

Albania is rich in waters, there are 152 rivers and streams, 247 natural lakes and about 800 artificial water reservoirs (in Albanian: rezervuar) and ponds (in Albanian: pellg) [12]. The artificial water reservoirs and irrigation ponds – according to their size – have major role in flood protection,

producing hydro-power, water supply and irrigation in agriculture [13]. The persistent drought of 2017 in Albania [14] offered us an opportunity to examine the mud vegetation on the dried bottoms of different-sized irrigation ponds and water reservoirs. There were some remarkable findings in reservoirs on previous expeditions [15], but their flora has not been systematically studied previously as far as we know.

The aim of our research was to explore the floristic and habitat diversity of these ephemeral stands and evaluate their biogeographical and nature conservation role. The main questions of our research were the followings: (1) What are the ecological requirements and life forms of the plants that colonize water reservoirs? (2) Are there alien species in the reservoirs and what is their role when compared to native species? (3) Do the type of bedrock, the size, the altitude, the range of water surface or the biogeographical environment have any effect on the composition of the flora of water reservoirs? (4) Do reservoirs have a significant role in nature conservation by conserving some rare species?

2. Materials and methods

2.1. Study areas

Altogether 129 different sized water reservoirs from almost all regions of Albania were involved in the research. We located water reservoirs by using geoinformatics (Google Earth and QGis). Only artificially dammed water bodies (water reservoirs and irrigation ponds) were included in the research, the research was restricted to the strict territory of reservoirs (up to the possible water level). We excluded natural lakes, quarry ponds and tarns. The field work was achieved between 4th and 14th September 2017. The following data has been recorded for each reservoir: exact location (vicinity, GPS coordinates, altitude), gradient interval, size, type of bedrock, ratio of water surface, bare soil (mud), vegetation and composing taxa. Each reservoir was photodocumented.

2.2. Floristic procedures

The ratio of each species, water surface and mud surface has been estimated by circuiting the whole reservoir, no random plots have been established. For the identification of the species we used [16–26]. Nomenclature follows [15].

2.3. Data management and mapping solutions

We used Google Earth to track the loss of water of each reservoirs and ponds, as for most reservoirs, images of both wet and dry periods are available. We recorded the bedrock type on the field, and the field observations were specified by using the geological map of Albania. The gradient intervals of the slope angles of the reservoir dams were estimated in the field.

3. Results

3.1. General results

During the field research we carried out floristic surveys of 129 reservoirs in 9 of the 12 counties of Albania, the distribution of the surveyed reservoirs by region is not uniform (Table 1.). Based on the total dimensions (before drying) of the reservoirs, the visited reservoirs show a large variation in size, but the vast majority of the reservoirs have an area of less than 10 hectares (Table 2.). The altitude of the reservoirs varies from 11 to 1030 m a.s.l., 38.8% of them are located below 200 m a.s.l., 27.1 % between 200 and 600 m a.s.l., while 34.1% above 600 m a.s.l. More than 2/3 of the surveyed reservoirs were on some sedimentary rock, a total of 41 reservoirs were on flysch, 11 on limestone, and 36 on other, younger sediments. The remaining one-third is roughly evenly distributed among the following categories: serpentine, sand and clay (Table 3.). One of the reservoirs were on andesite bedrock. The water level and drying degree of reservoirs show significant variance, only 10 reservoirs

were fully dried and 5 reservoirs were full of water. However, a significant proportion of reservoirs were at some degree of drying.

Table 1. Distribution of reservoirs by county.

County	No. of reservoirs
Dibër	25
Shkodër	5
Lezhë	8
Durrës	12
Elbasan	16
Korçë	25
Tirana	13
Fier	7
Gjirokastër	18

Table 2. Size of the surveyed reservoirs.

Full size of reservoir (ha)	No. of reservoirs
<0,1	15
0,1-1	23
1-10	51
10-100	36
100-1000	2
>1000	2

Table 3. Distribution of reservoirs by bedrock.

Bedrock	No. of reservoirs
Flysch	41
Other sediments	36
Sand	14
Serpentine	13
Clay	13
Limestone	11
Andesite	1

3.2. *New distribution records*

We have found 4 new species for Albania, these are: *Ammannia coccinea* Rottb., *Dysphania pumilio* (R.Br.) Mosyakin & Clemants, *Lindernia procumbens* (Krock.) Philcox and *Verbena supina* L. [27], and confirmed the presence of *Cyperus serotinus* Rottb. in Albania. The latter has been found in the reed of an irrigation pond near Renc (Shkodër county). We also found a new locality for *Oldenlandia capensis* L., a plant native in Africa and the Middle-East, and within Europe so far only found on the muddy shores of Shkodra Lake. The plant was found in a reservoir near Shkodër, not far from its formerly known occurrences on the mud of Lake Shkodra and some surrounding reservoirs.

Our knowledge on the distribution of several rare species in Albania has expanded. One such species is *Chenopodium rubrum* L., which has so far had 2 occurrence data from Albania, but 10 new localities have also been found in the research. The survey evinced the inland occurrence of *Eclipta prostrata* (L.) L. – a rarely naturalized plant Albania – the plant had only 2 known localities near the seashores, but we have found it in 7 inland reservoirs.

In the case of some species that are under-mapped in [15], it can be stated that, contrary to our previous knowledge, they are not uncommon in Albania. Such a species is, for example, *Conyza bonariensis* (L.) Cronquist, a species naturalized in Albania, was found in the mud vegetation of 24 reservoirs during the research and was first found in the eastern part of the country. *Euphorbia chymaesyce* L. previously had only 2 known occurrences in Albania, however we have found the species in more than 30 reservoirs, this species is probably also not uncommon in Albania.

3.3. *Vegetation character*

As a result of the research, 3473 floristic data referring to 324 vascular plant species were collected. Of the species found, 35 are non-native in Albania (17.8% of the alien species found in the country). In addition to 161 annual species, 163 perennial plant species were found. On average we found 25.9 species per reservoir. The maximum number of species per reservoir were 76, but there were 3 reservoirs without any terrestrial vegetation. A total of 124 species were found only in one reservoir. Most of the reservoirs were rather sparsely colonized, in 119 reservoirs the coverage of vegetation was less than 30% and maximum 90% of a reservoir was covered with vegetation. The presence of cultivated plants in the reservoirs was prominent, 7 (edible) cultivated species (e. g. *Citrullus lanatus* (Thunb.) Matsum. & Nakai) appeared as casual ephemers on the dried bed of reservoirs. The species found in the reservoirs belong to 55 plant families. Asteraceae, Poaceae and Fabaceae are represented by the largest number of species. Of the 10 most common species registered, all occur in more than 40% of reservoirs and 6 of them in more than half of the reservoirs (Table 4.). Of the most common species, there is only one adventive plant, *Paspalum paspalodes* (Michx.) Scribn. The floristic composition of reservoirs established on different bedrocks is slightly different (Table 5.). There is significant overlap between the most common species. Significant differences can be observed only in the case of the flora of reservoirs formed on serpentine, sand and clay in terms of the most common species.

Table 4. The 10 most common species found in water reservoirs in Albania

Species	**Found in % of reservoirs**
Mentha pulegium	58.91
Echinochloa crus-galli	57.36
Cynodon dactylon	57.36
Polygonum lapathifolium	55.04
Portulaca oleracea	52.71
Verbena officinalis	50.39
Paspalum paspaloides	49.61
Digitaria sanguinalis	48.84
Plantago major	41.86
Polygonum aviculare	41.86

Table 5. The 20 most common species on different substrates

Serpentine		**Limestone**	
Species	**Found in % of reservoirs**	**Species**	**Found in % of reservoirs**
Cyperus fuscus	69.23	*Plantago major*	54.55
Cynodon dactylon	61.54	*Echinochloa crus-galli*	45.45
Digitaria sanguinalis	61.54	*Typha angustifolia*	45.45
Echinochloa crus-galli	61.54	*Eleocharis palustris*	36.36
Paspalum paspaloides	61.54	*Equisetum palustre*	36.36

Polygonum lapathifolium	61.54	*Mentha pulegium*	36.36
Portulaca oleracea	53.85	*Heleochloa schoenoides*	36.36
Bidens tripartita	46.15	*Polygonum lapathifolium*	36.36
Juncus articulatus	46.15	*Portulaca oleracea*	36.36
Inula britannica	38.46	*Potamogeton pectinatus*	36.36
Eleocharis palustris	38.46	*Verbena officinalis*	36.36
Euphorbia chamaesyce	38.46	*Alisma lanceolatum*	27.27
Polygonum aviculare	38.46	*Xanthium strumarium*	27.27
Holoschoenus romanus	30.77	*Inula viscosa*	27.27
Pycreus flavescens	30.77	*Pulicaria vulgaris*	27.27
Juncus inflexus	30.77	*Sonchus oleraceus*	27.27
Mentha pulegium	30.77	*Tussilago farfara*	27.27
Lythrum salicaria	30.77	*Bolboschoenus maritimus*	27.27
Gratiola officinalis	30.77	*Cyperus fuscus*	27.27
Plantago major	30.77	*Euphorbia chamaesyce*	27.27

Sand		**Other sediments**	
Species	**Found in % of reservoirs**	**Species**	**Found in % of reservoirs**
Verbena officinalis	71.43	*Mentha pulegium*	63.89
Cynodon dactylon	64.29	*Verbena officinalis*	63.89
Echinochloa crus-galli	64.29	*Echinochloa crus-galli*	61.11
Portulaca oleracea	64.29	*Polygonum lapathifolium*	58.33
Xanthium strumarium	57.14	*Portulaca oleracea*	50.00
Mentha pulegium	57.14	*Cynodon dactylon*	47.22
Lycopus europaeus	50.00	*Sonchus oleraceus*	44.44
Plantago major	50.00	*Polygonum aviculare*	44.44
Polygonum lapathifolium	50.00	*Convolvulus arvensis*	41.67
Sonchus oleraceus	42.86	*Plantago major*	41.67
Cyperus fuscus	42.86	*Paspalum paspaloides*	38.89
Juncus articulatus	42.86	*Potentilla reptans*	38.89
Heleochloa alopecuroides	42.86	*Xanthium spinosum*	36.11
Paspalum paspaloides	42.86	*Cyperus fuscus*	36.11
Pulicaria dysenterica	35.71	*Bidens tripartita*	33.33
Pulicaria vulgaris	35.71	*Holoschoenus romanus*	33.33
Xanthium spinosum	35.71	*Chrozophora tinctoria*	33.33
Heliotropium europaeum	35.71	*Digitaria sanguinalis*	33.33
Corrigiola litoralis	35.71	*Solanum nigrum*	33.33
Citrullus lanatus	35.71	*Xanthium strumarium*	30.56

Flysch		**Clay**	
Species	**Found in % of reservoirs**	**Species**	**Found in % of reservoirs**
Mentha pulegium	65.85	*Paspalum paspaloides*	76.92
Cynodon dactylon	63.41	*Polygonum lapathifolium*	76.92
Digitaria sanguinalis	60.98	*Lycopus europaeus*	69.23
Echinochloa crus-galli	58.54	*Mentha pulegium*	69.23
Polygonum lapathifolium	56.10	*Cynodon dactylon*	69.23

Polygonum aviculare	53.66	*Portulaca oleracea*	69.23
Portulaca oleracea	51.22	*Typha angustifolia*	69.23
Typha angustifolia	51.22	*Digitaria sanguinalis*	61.54
Plantago major	46.34	*Aster squamatus*	53.85
Juncus articulatus	43.90	*Cyperus fuscus*	53.85
Potentilla reptans	43.90	*Echinochloa crus-galli*	53.85
Eleocharis palustris	41.46	*Verbena officinalis*	53.85
Paspalum paspaloides	41.46	*Conyza canadensis*	46.15
Pulicaria dysenterica	39.02	*Xanthium strumarium*	46.15
Euphorbia chamaesyce	39.02	*Inula viscosa*	46.15
Solanum nigrum	39.02	*Euphorbia chamaesyce*	46.15
Verbena officinalis	39.02	*Salix alba*	46.15
Solanum nigrum	39.02	*Bidens tripartita*	38.46
Verbena officinalis	39.02	*Sonchus oleraceus*	38.46
Inula britannica	34.15	*Citrullus lanatus*	38.46

Of the found species 158 (48.8%) are connected to natural wetlands, of these, 10 belong systematically to the *Isoeto-Nanojuncetea* group. These species are: *Blackstonia acuminata*, *Cyperus fuscus*, *Cyperus michelianus*, *Eleocharis acicularis*, *Gnaphalium uliginosum*, *Heliotropium supinum*, *Lindernia procumbens*, *Ludwigia palustris*, *Lythrum hyssopifolia*, *Verbena supina*. Most of these species, with the exception of *Cyperus* taxa, proved to be very rare, several of which were found only in 1–2 reservoirs. In the drier, upper parts of the reservoirs, taxa of non-aquatic habitats were common, e.g. *Cynodon dactylon* and *Conyza canadensis*. Both ruderal and semi-ruderal elements were represented in significant numbers.

3.4. *Nature conservation assessment*

Most of the species found are not of high conservation value, 110 species were evaluated in IUCN World Red List in the LC category and 70 species were evaluated in IUCN Mediterranean Red List in the LC category. Only 1 species included in the Albanian Red List: *Spirodela polyrhiza* (L.) Schleid (VU). A total of 35 adventive species were found during the research, which were widespread in reservoirs, but in most cases were present only with a small cover.

4. Discussion

Reservoirs were surveyed on a random basis based on abiotic parameters, regional distribution, and altitude distribution. Outstanding species richness was recorded with the 324 taxa found. In these small areas 10% of Albania's flora was detected in a short single period of the growing season. After two years of drought, mud vegetation can develop in these artificial ephemeral habitats, in addition water reservoirs can be a refuge for plants that are connected to wet habitats [3]. It is also worth to mention that in the long drought of 2016–2017 xerophilous and perennial plants could colonize large parts of the reservoirs.

Research shows that by targeting certain habitat types, we can greatly increase our knowledge on the flora of a country or region.

The composition of the flora of reservoirs is determined by substrate (e.g. *Eclipta prostrata* (L.) L. grows on clay and *Chenopodium rubrum* L. grows on sand) and by altitude (e.g. *Lippia nodiflora* (L.) Michx. in the lower Mediterranean regions).

It has been observed that some adventive species spread regionally (e.g. *Dysphania pumilio* R. Br. is found only in the south).

Even if these ephemeral mudflats presence is hectic, yet plants that are connected to wetland habitats appear when the conditions are favourable for them [8].

In addition to experiencing high species richness, the ratio of adventive species is high, especially if we take into consideration the fact that Albania is the least infected country in Europe by aliens [28]. The reasons for this may be that these bare soil surfaces can easily be colonised by aliens [29] and grazing and manuring in and around reservoirs can help the spreading of alien (potentially invasive) species [28], but grazing can also prevents or reduces the spread of invasive plants [30].

5. Conclusions

Overall, we can significantly expand our knowledge of the flora of a given region through a targeted study of a habitat type. In the case of such a globally attenuating ephemeral habitat, this is of high importance. The collected records enable us to evaluate the reservoirs as ephemerous habitats in further viewpoints. Further research perspectives may include: the connection between the rate of annuals and biennials/perennials and the length of drought, and investigating the connection between the spectrum of floristic elements and the reservoir's geographical location.

Acknowledgments: We would like to thank Zoltán Nemcsok, who participated in the field work as a university student.

Author Contributions: A.R. and Z.B. conceived, designed and performed the research, analyzed the data; A.R. wrote the paper.

Conflicts of Interest: The authors declare no conflict of interest.

References

1. European Environment Agency (EEA). The European environment — state and outlook 2015: synthesis report,. European Environment Agency: Copenhagen, Denmark, **2015**; 205 pp.
2. Zacharias, I.; Zamparas, M. Mediterranean temporary ponds. A disappearing ecosystem. *Biodiversity and Conservation* **2010**, *19*, 3827–3834. DOI: http://dx.doi.org/10.1007/s10531-010-9933-7.
3. Chester, E.T.; Robson, B.J. Anthropogenic refuges for freshwater biodiversity: Their ecological characteristics and management. *Biological Conservation* **2013**, *166*, 64–75. DOI: https://doi.org/10.1016/j.biocon.2013.06.016.
4. Céréghino, R.; Boix, D.; Cauchie, H.-M.; Martens, K; Oertli, B. The ecological role of ponds in a changing world. *Hydrobiologia* **2014**, *723*, 1–6. DOI: https://doi.org/10.1007/s10750-013-1719-y
5. Striers, I.; Crohain, N.; Josens, G.; Triest, L. Impact of three aquatic invasive species on native plants and macroinvertebrates in temperate ponds. *Biological Invasions* **2011**, *13*, 2715–2726. DOI: https://doi.org/10.1007/s10530-011-9942-9.
6. Šumberová, K.; Lososová, Z.; Fabšičová, M.; Horáková, V. Variability of vegetation of exposed pond bottoms in relation to management and environmental factors. *Preslia* **2006**, *78*, 235–252.
7. Salisbury, E.J. The pioneer vegetation of exposed muds and its biological features. *Philosophical Transactions of the Royal Society of London. Biological Sciences* **1970**, *259*, 207–255. DOI: https://doi.org/10.1098/rstb.1970.0059
8. Deil, U. A review on habitats, plant traits and vegetation of ephemeral wetlands – a global perspective. *Phytocoenologia* **2005**, *35(2–3),* 533–705. DOI: https://doi.org/10.1127/0340-269X/2005/0035-0533.
9. Alves-da-Silva, S.C.; Bona, C.; de Chiara Moço, M.C.; Cervi, A.C. Floristic survey and species richness of aquatic macrophytes in water supply reservoirs. *Check List* **2014**, *10(6)*, 1324–1330. DOI: http://dx.doi.org/10.15560/10.6.1324.
10. Croce, A. Vascular flora of eight water reservoir areas in southern Italy. *Check List* **2015**, *11(2)*, 1593. DOI: http://dx.doi.org/10.15560/11.2.1593.
11. Poschlod, P; Rosbakh, S. Mudflat species: Threatened or hidden? An extensive seed bank survey of 108 fish ponds in Southern Germany. *Biological Conservation* **2018**, *225*, 154–163. DOI: https://doi.org/10.1016/j.biocon.2018.06.024.
12. Pano, N. *Pasuritë ujore të Shqipërisë*; Akademia e Shkencave e Shqipërisë: Tirana, Albania, 2015; 634 pp.
13. Lushaj, B.; Hoxhaj, F.; Ndini, M.; Selenica, A.; Pambuku, A.; Dafa, I.; Hasimi, A.; Zaimi, K.; Marku, M.; Çomo, E.; Vako, E.; Isufaj, S; Myrtaj, B. General Overview of the Transboundary Waters of Rivers, Lakes,

Groundwater and Trend of them, in Albania. *Online International Interdisciplinary Research Journal* **2016**, *6(1)*, 418–446.
14. Drought Management Centre for Southeastern Europe (DMCSEE). *Drought Monitoring Bulletin. Overview from February to September 2017*; **2017,** 15 pp. Available online: http://www.dmcsee.org/uploads/file/430_dmcsee_bulletin_season2017.pdf
15. Barina Z. (ed.). *Distribution atlas of vascular plants in Albania*; Hungarian Natural History Museum: Budapest, Hungary, **2017**; 492 pp. ISBN 978-963-9877-29-0
16. Demiri, M. *Flora ekskursioniste e Shqiperise*. Shtëpia Botuese e Librit Shkollor: Tirana, Albania, **1983**; 986 pp.
17. Paparisto, K.; Demiri, M.; Mitrushi, I; Qosja, Xh. *Flora e Shqiperise. Vol. 1*; Akademia e Shkencave e RPS të Shqipërisë Qendra e Kërkimeve Biologjike: Tirana, Albania, **1988**; 457 pp.
18. Qosja, Xh.; Paparisto, K.; Demiri, M.; Vangjeli, J.; Balza, E. *Flore de l'Albanie (Flora e Shqiperise). Vol. 2*; Akademia e Shkencave e Republikes se Shqiperise Qendra e Kerkimeve Biologjike: Tirana, Albania, **1992**; 446 pp.
19. Qosja, Xh.; Paparisto, K.; Vangjeli, J.; Ruci, B. *Flore de l'Albanie (Flora e Shqiperise). Vol. 3.* Akademia e Shkencave e Republikes es Shqiperise Instituti i Kerkimeve Biologjike: Tirana, Albania, **1996**, 331 pp.
20. Vangjeli, J.; Ruci, B.; Mullaj, A.; Paparisto, K.; Qosja, Xh.2000. *Flore de l'Albanie (Flora e Shqiperise). Vol. 4*; Akademia e Shkencave e Republikes es Shqiperise Instituti i Kerkimeve Biologjike: Tirana, Albania, **2000**; 502 pp.
21. Vangjeli, J. (2003): *Udhëheqës fushor i florës së Sqipërisë*; Akademia e Shkencave e Shqipërisë: Tirana, Albania, **2003**; 598 pp.
22. Tutin, T.G.; Heywood, V.H.; Burges, N.A.; Moore, D.M.; Valentine, D.H.; Walters, S.M.; Webb, D.A. *Flora Europaea. Volume 1. Lycopodiaceae to Platanaceae*; Cambridge University Press: Cambridge, Great Britain, **1964**; 464 pp.
23. Tutin, T.G.; Heywood, V.H.; Burges, N.A.; Moore, D.M.; Valentine, D.H.; Walters, S.M.; Webb, D.A. *Flora Europaea. Volume 2. Rosaceae to Umbelliferae*, 3rd ed.; Cambridge University Press: Cambridge, Great Britain, **1981**; 469 pp.
24. Tutin, T.G.; Heywood, V.H.; Burges, N.A.; Moore, D.M.; Valentine, D.H.; Walters, S.M.; Webb, D.A. *Flora Europaea. Volume 3. Diapensiacea to Myoporaceae;* Cambridge University Press: Cambridge, Great Britain, **1972**; 385 pp.
25. Tutin, T.G.; Heywood, V.H.; Burges, N.A.; Moore, D.M.; Valentine, D.H.; Walters, S.M.; Webb, D.A. *Flora Europaea. Volume 4. Plantaginaceae to Compositae (and Rubiaceae)*; Cambridge University Press: Cambridge, Great Britain **1976**; 505 pp.
26. Tutin, T.G.; Heywood, V.H.; Burges, N.A.; Moore, D.M.; Valentine, D.H.; Walters, S.M.; Webb, D.A. *Flora Europaea. Volume 5. Alismataceae to Orchidaceae (Monocotyledones)*; Cambridge University Press: Cambridge, Great Britain **1980**; 452 pp.
27. Mesterházy, A.; Matus, G.; Király, G.; Szűcs, P.; Török, P.; Valkó, O.; Pelles, G.; Papp, V.G.; Virók, V.; Nemcsok, Z.; Rigó, A.; Hohla, M; Barina, Z. Taxonomical and chorological notes 5 (59–68). *Studia botanica hungarica* **2017,** *48(2)*, 263–275. DOI: https://doi.org/10.17110/StudBot.2017.48.2.263.
28. Barina, Z.; Rakaj, M.; Somogyi, G.; Erős-Honti, Z.; & Pifkó, D. The alien flora of Albania: history, current status and future trends. *Weed Research*, **2014**, *54(2)*, 196–215. DOI: https://doi.org/10.1111/wre.12061.
29. Walther, G.-R.; Roques, A.; Hulme, P.E.; Sykes, M.T.; Pyšek, P.; Kühn, I; Zobel, M.; Bacher, S.; Botta-Dukát, Z.; Bugmann, H.; Czúcz, B.; Dauber, J.; Hickler, T.; Jarošík, V.; Kenis, M.; Klotz, S.; Minchin, D.; Moora, M.; Nentwig, W.; Ott, J.; Panov, V.E.; Reineking, B.; Robinet, C.; Semenchenko, V.; Solarz, W.; Thuiller, W.; Vilà, M.; Vohland, K.; Settele, J. Alien species in a warmer world: risks and opportunities. Trends in Ecology & Evolution 2009, 24(12), 686–693. DOI: https://doi.org/10.1016/j.tree.2009.06.008.
30. Maron, J.L.; Vilà, M. When do herbivores affect plant invasion? Evidence for the natural enemies and biotic resistance hypotheses. *Oikos* **2001**, *95*, 361–373. DOI. https://doi.org/10.1034/j.1600-0706.2001.950301.x.