

Overview of the pond slider *Trachemys scripta* (Thunberg in Schoepff, 1792) (Testudines: Emydidae) records in Montenegro

Vuk IKOVIĆ, Jelena POPOVIĆ, Slađana GVOZDENOVIĆ-NIKOLIĆ*

NGO Montenegrin Ecologists Society, Martinići bb, 81410 Danilovgrad, Montenegro

*Corresponding author; E-mail: sladjana87gvozdenuvic@gmail.com

Abstract. The Pond Slider is one of the 100 world's most invasive alien species, widely introduced to Europe and all over the world. The number of specimens recorded in nature is increasing in the Balkans, including Montenegro. In this paper, we present literature and new findings of pond sliders in this country. So far, 10 known localities have been identified, most of them in the Mediterranean biogeographical region. Records are from different aquatic ecosystems, including lakes, ponds, rivers and streams. Locality Mrke-Blizna is identified as a potential breeding site, as numerous specimens are present here including hatchlings.

Key words: invasive species, distribution, pond slider, Montenegro

Izvleček. Pregled najdb okrasne gizdavke *Trachemys scripta* (Thunberg in Schoepff, 1792) (Testudines: Emydidae) v Črni gori – Okrasna gizdavka je ena od 100 najbolj invazivnih tujerodnih vrst na svetu, ki je bila vnesena v Evropo in po vsem svetu. Na Balkanu, vključno s Črno goro, se število osebkov, zabeleženih v naravi, povečuje. V tem prispevku predstavljamo literaturne in nove najdbe okrasnih gizdavn v Črni gori. Do zdaj je bilo v državi zabeleženih 10 nahajališč, večinoma v mediteranski biogeografski regiji. Podatki so iz različnih vodnih ekosistemov, tako jezer, ribnikov, rek kot potokov. Nahajališče Mrke-Blizna je potencialno mesto razmnoževanja, saj je bilo tu najdenih veliko osebkov, vključno z mladiči.

Ključne besede: invazivne vrste, razširjenost, okrasna gizdavka, Črna gora

Introduction

The pond slider *Trachemys scripta* (Thunberg in Schoepff, 1792) is among 100 of the World's worst invasive alien species (Lowe et al. 2000). It originated from SW USA, and has been and still is introduced worldwide as a pet (Speybroeck et al. 2016). Although three subspecies are recognized, i.e. the yellow-bellied slider *T. s. scripta* (Thunberg in Schoepff, 1792), the red-eared slider *T. s. elegans* (Wied-Neuwied, 1839) and the cumberland slider *T. s. troostii* (Holbrook, 1836), new molecular findings by Vamberger et al. (2020) challenge the current intraspecific systematics of *T. scripta* and suggest that the conspicuous differences in colouration and pattern reflect population-specific, rather than taxonomic, differentiation.



The pond slider specimens are released in nature by irresponsible owners and up until now the species has become distributed in the wild in almost all European countries, where they also breed successfully (e.g. Vamberger et al. 2012; Standfuss et al. 2015; Speybroeck et al. 2016; Stănescu et al. 2017; Koren et al. 2018; Urošević et al. 2019; Kornilev et al. 2020). As the European Union banned import and trade of *T. s. elegans* in 1997, other two subspecies have become substitute species in the pet markets (Urošević et al. 2019). Since 2014, all three subspecies have been listed under Regulation (EU) on the prevention and management of the introduction and spread of invasive alien species (EU 2014).

In this paper, we present all available literature and unpublished data on the current range of *T. scripta* ssp. in Montenegro.

Material and methods

Data for this study are compiled from published literature, websites, and unpublished records collected during different field surveys in the last eight years. Unpublished records also include data donated by other colleagues and local people (see Acknowledgments). The authors' unpublished records were made during their field surveys for the native freshwater turtles *Emys orbicularis* (Linnaeus, 1758) and *Mauremys rivulata* (Valenciennes, 1833) using traps – *hoop-nets* (Mali et al. 2014) in the coastal area of the country in the territory of Municipalities Herceg Novi, Tivat, Kotor, Budva, Bar and Ulcinj. Species identification is done according to Bringsøe (2006).

Results and discussion

Two subspecies are present in Montenegro, *T. s. elegans* and *T. s. scripta* (Tab. 1). All known findings of *T. scripta* ssp. are shown on the map (Fig. 1). There are a total of 10 localities where *T. scripta* ssp. were identified. Two recorded localities are from literature, seven localities are new, and at one locality the species is reconfirmed (Fig 1.).

Most findings have been recorded in the Mediterranean biogeographical region (< 30 m a.s.l.) and one finding in the Alpine biogeographical region (about 650 m a.s.l.). This is related to the fact that more systematic surveys have been done in the coastal area, which was not the case as far as other parts of the country are concerned. The records made in Croatia by Koren et al. (2018) were almost equal in the Mediterranean and Continental regions, without any findings in the Alpine region, while Urošević et al. (2019) reported that most pond slider findings in Serbia were in habitats below 100 m a.s.l. In Bulgaria, the pond slider's vertical distribution ranged from sea level up to 956 m, with most findings below 250 m a.s.l., and just three findings above 600 m a.s.l. (Kornilev et al. 2020). Contrary to our results, the above mentioned field survey data include both, random findings and targeted surveys for the pond slider.

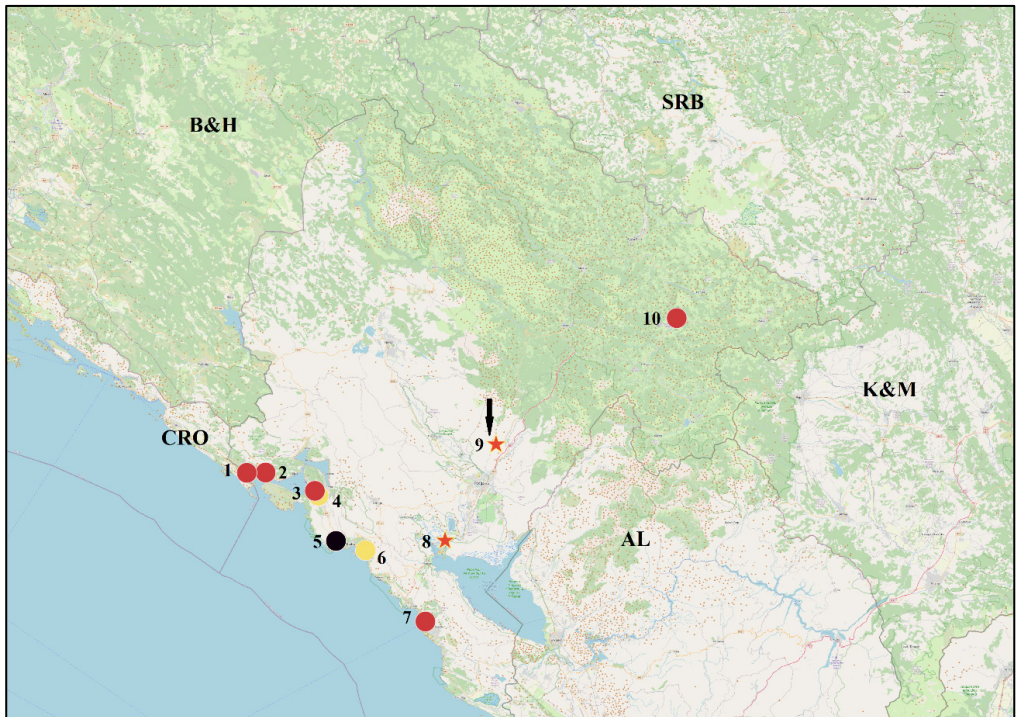


Figure 1. Map showing the findings of *Trachemys scripta* ssp. in Montenegro: yellow circle – published record; black circle – reconfirmed record; red circle – unpublished new record; red asterisk – unpublished record, some data available on internet sites (see Tab. 1 for links). Arrow indicates the potential breeding site (Mrke-Blizna), where hatchlings were observed.

Slika 1. Zemljevid, ki prikazuje nahajališča *Trachemys scripta* ssp. v Črni gori: rumen krog – objavljen podatek; črn krog – ponovno potrjen podatek; rdeč krog – neobjavljen nov podatek; rdeča zvezdica - neobjavljen podatek, podatki iz internetnih virov (glej, Tab. 1 za povezave). Puščica prikazuje potencialno mesto razmnoževanja (Mrke-Blizna), kjer so bili najdeni mladiči.

Pond slider findings in Montenegro are from different aquatic ecosystems, including lakes, ponds, rivers, and streams close to urban areas. Those results are in agreement with data from other Balkan countries (Jelić & Jelić 2015; Koren et al. 2018; Urošević et al. 2019; Kornilev et al. 2020), which unequivocally confirms the fact that specimens are released by owners in urban aquatic ecosystems as unwanted pets. Our results indicated that among most localities one to five specimens were observed, while at the pond at Mrke-Blizna, numerous specimens exist. This locality is also identified as a potential breeding site, as hatchlings are present here (personal communication with owners). Here, a shelter for animals was built, and humans often bring Pond Sliders with intention to release them into the pond (personal communication with owners). This locality is quite isolated and far away from natural aquatic ecosystems (about 7 km away from the Morača River), so this population can be considered as under control if we keep in mind that Pond Slider presence in the isolated ponds, e.g. more than several kilometres apart, especially in the Mediterranean part of the country, somewhat limits their propagation potential, as well as their potential of spreading to different habitats (Ryan et al. 2008).

Table 1. Overview of all known records of *Trachemys scripta* ssp. in Montenegro, with details on localities, dates of findings, number of observed individuals and reference/legator.**Tabela 1.** Pregled vseh znanih podatkov za *Trachemys scripta* ssp. v Črni gori, s podrobnostmi o lokaciji, datumih najdbe, številu opaženih osebkov in viru/nabiralcu.

Locality number	Locality	Latitude, Longitude	Altitude [m a.s.l.]	Date	Reference/Ligator	Subspecies	Notes
1	River Sutorina, Herceg Novi	42.451858, 18.498898	10	15.04.2017	Vuk Iković	<i>T. s. elegans</i>	1 individual, adult, caught in trap
1	River Sutorina, Herceg Novi	42.454012, 18.497619	10	09.10.2018	Vuk Iković	<i>T. s. elegans</i>	1 individual, adult, caught in trap
1	River Sutorina, Herceg Novi	42.456739, 18.501610	10	15.04.2017	Vuk Iković	<i>T. s. elegans</i>	1 individual, adult, caught in trap
2	Brackish water in marina, Meljine, Herceg Novi	42.453887, 18.559895	0	18.03.2023	Danijel Đorđević	<i>T. s. scripta</i>	1 individual
3	Lake Tivat, Tivat field, Tivat	42.413256, 18.721259	10	2017	Vuk Iković	<i>T. s. elegans</i>	1 individual, adult, caught in trap
4	Pond Lovanja, Tivat field, Kotor-Tivat	42.402000, 18.733300	11	15.06.2019	Ljubislavljević, 2022	<i>T. s. scripta</i>	1 individual
5	Lake Jaz, Mrčevo field, Budva-Kotor	42.294401, 18.793939	10	24.04.-29.04.2005	Lužnik et al. 2006	<i>T. s. elegans</i>	
5	Lake Jaz, Mrčevo field, Budva-Kotor	42.294401, 18.793939	10	9.05.2008	http://www.hylawe-rkgroep.be/jeroen/index.php?id=45	<i>T. s. elegans</i>	
5	Lake Jaz, Mrčevo field, Budva-Kotor	42.294401, 18.793939	10	13.07.2017 06.09.2018	Vuk Iković	<i>T. s. elegans</i>	3 individuals, adults, caught in trap
5	River Jaz, Mrčevo field, Budva-Kotor	42.290230, 18.793454	10	17.07.2015	Aleksandar Simović	<i>T. s. elegans</i>	1 individual
5	River Jaz, Mrčevo field, Budva-Kotor	42.294988, 18.793107	10	07.07.2016 23.03.2017 21.06.2017	Vuk Iković	<i>T. s. elegans</i>	3 individuals, adults, caught in trap
5	River Jaz, Mrčevo field, Budva-Kotor	42.290552, 18.795492	10	20.08.2017	Vuk Iković	<i>T. s. elegans</i>	1 individual, adult, caught in trap
6	Stream in Kamenovo, Budva	42.273701, 18.890569	20	23.04.-29.04.2005	Žagar et al. 2013	<i>T. s. elegans</i>	1 individual

Locality number	Locality	Latitude, Longitude	Altitude [m a.s.l.]	Date	Reference/ Legator	Subspecies	Notes
7	River Željeznica, Bar	42.106214, 19.089180	3	21.05.2018	Vuk Iković	<i>T. s. elegans</i>	2 individuals, adults, caught in trap
8	Lake Skadar, Vranjina, Podgorica	42.301400, 19.147000	25	9.05.2022	(HP Eckstein) https://observation.org/locations/129858/observations/?date_after=2022-04-20&date_before=2023-04-20&species=1424&species_group=&rarity=&search=&user=&sex=&life_stage=&activity=&method=	<i>T. s. elegans</i>	1 individual
9	Pond in Mrke-Blizna, Podgorica	42.534905, 19.305896	430	2019, 2020, 2021, 2022, 2023	https://www.facebook.com/Prihvatili%C5%A1te-i-Oporavak-%C5%BDivotinja-Crna-Gora-112032268830136	<i>T. s. elegans</i>	numerous, adults and juveniles
9	Pond in Mrke-Blizna, Podgorica	42.534905, 19.305896	430	2019, 2020, 2021, 2022, 2023	https://www.facebook.com/Prihvatili%C5%A1te-i-Oporavak-%C5%BDivotinja-Crna-Gora-112032268830136	<i>T. s. scripta</i>	numerous, adults and juveniles
10	Lake Batuni, Berane	42.845306, 19.887668	650	12.04.2022	Stefan Ralević	<i>T. s. ssp.</i>	1 individual, caught by fishing hook

On 18.03.2023, one individual of *T. s. scripta* was observed by locals in brackish water at Meljine – Herceg Novi (Lazure Marina). In the vicinity of this marina runs the stream named »Nemila«, where *E. orbicularis* and *M. rivulata* occur (Vuk Iković, personal unpublished data), so we assume that the Nemila stream probably washed *T. s. scripta* specimen into the sea. According to the locals, the turtle was quite active, swimming and basking on the surface. This finding is not surprising if we have in mind that *T. s. elegans* has a strong resistance to high salinity (Hong et al. 2014) and can even live in low salinity water environments (Gibbons et al. 1979).

Among all habitats at the coast, as well as in Lake Skadar, native terrapins *E. orbicularis* and *M. rivulata* are present (Jovanović 2009; Stanković 2009; Žagar et al. 2013; Polović & Čađenović 2014; Katnić et al. 2017; Crnobrnja-Isalović et al. 2018; Ljubisavljević 2022; Iković Vuk personal unpublished data), so in future these terrapins could possibly compete with the pond slider. This competition can be related to food, egg-laying sites, basking places, as well as pathogens

transmission (Koren et al. 2018; Kornilev et al. 2020) and better adaptation to pollution (Ljubisavljević 2022).

Although the Law on Invasive Species was adopted in Montenegro in 2019 (Official Gazette of the Republic of Montenegro No. 18/2019), it has still not come into effect due to delays in the preparation and adoption of the List of invasive species (Ljubisavljević 2022).

In conclusion, it is necessary to implement monitoring of this invasive species in Montenegro and to make a plan for the future removal of this species from the natural habitats to minimize its possible negative impact on native terrapins (*E. orbicularis* and *M. rivulata*) and aquatic ecosystems in Montenegro. Education is also of great importance to avoid the unconscionable release of terrapins into nature when they become unwanted pets.

Povzetek

Okrasna gizdavka *Trachemys scripta* (Thunberg in Schoepff, 1792) je po vsem svetu razširjena kot domača žival (Speybroeck et al. 2016) in je ena najbolj invazivnih tujerodnih vrst na svetu (Lowe et al. 2000). Vrsta je postala široko razširjena po Evropi, tudi v Črni gori.

V tem prispevku predstavljamo vse razpoložljive literaturne in še neobjavljene podatke o trenutni razširjenosti vrste *T. scripta* ssp. v Črni gori, zbrane v zadnjih osmih letih. Avtorji so zbrali podatke na obalnem predelu države, med terenskimi raziskavami domorodnih sladkovodnih želv *Emys orbicularis* (Linnaeus, 1758) in *Mauremys rivulata* (Valenciennes, 1833).

V Črni gori sta bili doslej ugotovljeni dve podvrsti, in sicer na 10 nahajališčih. Da večina najdb izvira iz mediteranske biogeografske regije, je povezano z dejstvom, da je bilo več sistematičnih raziskav opravljenih v obalnih predelih. Vrsta je bila najdena predvsem v bližini urbanih območij, v različnih vodnih ekosistemih, vključno z jezeri, ribniki, rekami in potoki. To povežujemo z možnostjo, da lastniki izpustijo osebkke v mestne vodne ekosisteme, ko postanejo nezaželeni ljubljenci. Na vsakem nahajališču je bilo zabeleženih od enega do pet osebkov, razen v Mrke-Blizni, kjer je bilo najdenih veliko osebkov, vključno z mladiči (osebna komunikacija z lastniki), in zato je ta lokacija potencialno mesto razmnoževanja.

Zelo pomembno bi bilo uvesti spremljanje *T. scripta* v Črni gori in spodbujati izobraževanje, da bi se izognili brezobzirnemu spuščanju želv v naravo, ko te postanejo nezaželeni ljubljenci.

Acknowledgements

This work was supported by several projects: »Checking the distribution and populations' status of the highly endangered Balkan Terrapin (*Mauremys rivulata*) in Montenegro«; »Determination of the degree of vulnerability and distribution Balkan Terrapin in Montenegro« and »Assessment of demographic structure and protection measures of the Balkan Terrapin (*Mauremys rivulata*) in Montenegro« implemented by NGO Montenegrin Ecologists Society and financed by Rufford Foundation. The authors thank Danijel Đorđević, Stefan Ralević and Aleksandar Simović who shared their findings on the pond slider in Montenegro. The authors also thank the reviewers who improved the paper with constructive comments.

References

- Bringsøe H. 2006. Invasive alien species fact sheet – *Trachemys scripta*. In: online database of the north European and Baltic network on invasive alien species; [accessed 14.7.2014]. <https://www.nobanis.org>.
- Crnobrnja-Isalović J, Polović L, Ljubisavljević K, Čadenović N, Čuburić T, Haxhiu I. 2018. Diversity and conservation status of batrachofauna and herpetofauna in the Lake Skadar region. In: Pešić V, Karaman G, Kostianoy AG, editors. The Skadar/Shkodra Lake Environment. Cham: Springer International Publishing. Cham. p. 383-414. (The Handbook of Environmental Chemistry; vol. 80). <https://doi.org/10.1007/978-3-319-99250-1>
- [EU] European Union. 2014. Regulation (EU) No 1143/2014 of 22 October 2014 on the prevention and management of the introduction and spread of invasive alien species; [accessed 20.9.2023]. <https://eur-lex.europa.eu/eli/reg/2014/1143/oj>
- Gibbons JW, Keaton GH, Schubauer JP, Greene JL, Bennett DH, McAuliffe RM, Sharitz RR. 1979. Unusual population size structure in freshwater turtles on barrier islands. *Georgia Journal of Science*. 37: 155-159.
- Hong ML, Zhang K, Shu CH, Xie D, Shi HT. 2014. Effect of salinity on the survival, ions and urea modulation in red-eared slider (*Trachemys scripta elegans*). *Asian Herpetological Research*. 5(2): 128-136. <https://doi.org/10.3724/SP.J.1245.2014.00128>
- Jelić L, Jelić D. 2015. Allochthonous species of turtles in Croatia and Bosnia and Herzegovina. *Hyla*. 2015(1): 53-64.
- Jovanović M. 2009. Amphibia and Reptilia of Štoj plain (Ulcinj, Montenegro). *Bulletin of the Natural History Museum*. 2: 137-152.
- Katnić A, Jovičević M, Iković V. 2017. Actions for the ecological valorisation of Buljarica cove. Podgorica: Montenegrin Ecologists Society and Environmental Programme.
- Koren T, Štih A, Burić I, Koller K, Lauš B, Zadravec M. 2018. The current distribution of Pond Slider *Trachemys scripta* in Croatia. *Natura Sloveniae*. 20(1): 33-44. <https://doi.org/10.14720/ns.20.1.33-44>
- Kornilev YV, Lukanov S, Pulev A, Slavchev M, Andonov K, Vacheva E, Verligov V, Mladenov V, Georgieva R, Popgeorgiev G. 2020. The alien Pond Slider *Trachemys scripta* (Thunberg in Schoepff, 1792) in Bulgaria: Future prospects for an established and reproducing invasive species. *Acta Zoologica Bulgarica*. 72(4): 571-581.
- Lowe S, Browne M, Boudjelas S, De Poorter M. 2000. 100 of the World's Worst Invasive Alien Species: A selection from the Global Invasive Species Database. Auckland: The Invasive Species Specialist Group, Species Survival Commission, World Conservation Union.
- Lužnik M, Bogdan A, Hočevar M, Vamberger M, Žagar A. 2006. Poročilo skupine za plazilce. In: Lužnik R, Vinko D, editors. Ekosistemi Jadrana Črna Gora 2005 Pelješac 2006 Spomladanski biološki dnevi Jovsi 2006. Ljubljana: Društvo študentov biologije. p. 9-17.
- Ljubisavljević K. 2022. First record of the Yellow-bellied Slider, *Trachemys scripta scripta* (Testudines: Emydidae) in Montenegro. *Herpetological Notes*. 15: 493-497. <https://doi.org/10.1002/wsb.427>

- Mali I, Brown DJ, Ferrato JR, Forstner MRJ. 2014. Sampling freshwater turtle populations using hoop nets: Testing potential biases. *Wildlife Society Bulletin*. 38(3): 580-585. <https://doi.org/10.3906/zoo-1303-7>
- Polović L, Čadenović N. 2014. The herpetofauna of the Great Ulcinj Beach area including Ada Island (Montenegro). *Turkish Journal of Zoology*. 38: 104-107.
- Ryan TJ, Conner CA, Douthitt BA, Sterrett SC, Salisbury CM. 2008. Movement and habitat use of two aquatic turtles (*Graptemys geographica* and *Trachemys scripta*) in an urban landscape. *Urban Ecosystems*. 11(2): 213-225. <https://doi.org/10.1007/s11252-008-0049-8>
- Speybroeck J, Beukema W, Bok B, Voort Van Der J, Velikov I. 2016. Field guide to amphibians and reptiles of Britain and Europe. London/New York: Bloomsbury.
- Standfuss B, Lipovšek G, Fritz U, Vanberger M. 2015. Threat or fiction: is the pond slider (*Trachemys scripta*) really invasive in Central Europe? A case study from Slovenia. *Conservation Genetics*. 17(3): 557-563. <https://doi.org/10.1007/s10592-015-0805-2>
- Stanković D. 2012. Poročilo skupine za dvoživke. In: Presetnik P, editor. Ekosistemi Jadrana. Črna Gora 2009. Ljubljana: Društvo študentov biologije. p. 37-44.
- Stănescu F, Sos T, Samoila C, Dan C. 2017. *Trachemys scripta* in the east and south European region. A review of the invasion extent. In: Trichkova T, Tomov R, Vladimirov V, Kalcheva H, Vanev Y, Uludağ A, Tyufekchieva V. editors. Proceedings of the 7th ESENIAS Workshop with Scientific Conference Networking and Regional Cooperation Towards Invasive Alien Species Prevention and Management in Europe; 2017 March 28-30. Sofia (BG): IBER-BAS, ESENIAS. p. 121. <https://doi.org/10.13140/RG.2.2.24311.47527>
- Urošević A, Popović M, Maričić M, Pomorišac G, Petrović D, Grabovac D, Surla A, Medenica I, Avramović S, Golubović A. 2019. New data on the spread of *Trachemys scripta* (Thunberg in Schoepff, 1792) (Testudines: Emydidae) and its subspecies in Serbia. *Acta Zoologica Bulgarica*. 71(2): 247-251.
- Vamberger M, Lipovšek G, Gregorič M. 2012. First reproduction record of *Trachemys scripta* (Schoepff, 1792), in Slovenia. *Herpetozoa*. 25(1/2): 76-79.
- Vamberger M, Ihlow F, Asztalos M, Dawson JE, Jasinski SE, Praschag P, Fritz U. 2020. So different, yet so alike: North American slider turtles (*Trachemys scripta*). *Vertebrate Zoology*. 70(1): 87-96. <https://doi.org/10.26049/VZ70-1-2020-06>
- Žagar A, Cafuta V, Drašler K, Jagar T, Krofel M, Lužnik M, Ostanek E, Petkovska V, Planinc G, Sopotnik M et al. 2013. A review of eleven short-term reptile surveys in the Western Balkans. *Hyla*. 2013(1): 3-18.



© 2023 Vuk Iković, Jelena Popović, Slađana Gvozdenović-Nikolić.

To je prostodostopen članek, objavljen pod določili licence Creative Commons Priznanje avtorstva 4.0 Mednarodna, ki dovoljuje neomejeno rabo, razširjanje in kopiranje v kakršnemkoli mediju ter obliki, pod pogojem, da sta navedena avtor in vir.

This is an open-access article distributed under the terms of the Creative Commons Attribution 4.0 International License, which permits unrestricted use, distribution, and reproduction in any medium, provided the original author and source are credited.