

# A continuing trend: *Plantago coronopus* spreads also along the roads in Bosnia and Herzegovina

Dávid Schmidt<sup>1</sup> & Semir Maslo<sup>2</sup>

<sup>1</sup> Sopron University, Faculty of Forestry, Department of Botany and Nature conservation, Bajcsy-Zsilinszky str. 4., 9400 Sopron, Hungary, e-mail: schmidt.david@uni-sopron.hu (corresponding author)

<sup>2</sup> Primary School, Lundåkerskolan, Södra Storgatan 45, 332 33 Gislaved, Sweden, e-mail: semmas@edu.gislaved.se

Received: February 11, 2020 ▷ Accepted: March 20, 2020

**Abstract.** The study reports the secondary spreading of *Plantago coronopus* in Bosnia and Herzegovina. Outside of its native area, it has been recorded from roadsides in several parts of the country. The new records mention different habitat conditions than in the natural range of the species, which probably is related to its secondary expansion also known from Central Europe.

**Key Words:** Halophytes, *Plantago coronopus*, road vegetation, species migration

---

## Introduction

Human beings now play a greater role in the spread and unintentional distribution of species than in any earlier period of time. As a vector, the role of the road network, international transport, urbanization, and tourism has been documented in detail for decades and is of increasing importance today, especially in West Europe, „The ecology of roads” is studied intensively and it is now regarded as a special branch of landscape ecology (Forman 2002). Ever more observations support the increasing species migration to Central and East Europe in recent years, for both introduced and native species. Roads are also known as migration corridors for the halophytic plants worldwide (Scott & Davison 1985, par Bailleul & al. 2006). Within their scope, roadsides provide narrow belts of herbaceous vegetation, typically a few meters wide (Forman & al. 2003). These corridors play an important role in facilitating the spread of invasive plants by providing a habitat for their establishment (Follak & al. 2018). During construction and maintenance

of motorways, long ecological corridors were created with special facilities.

Within the secondary spread of halophytes along motorways, one of the most spectacular phenomena is that of *Plantago coronopus* L. Based on recent results of floristic research along the roads in Central Europe (e.g. Schmidt & al. 2016), its spread was expected to continue and reach new territories. However, until recently, on the Balkan Peninsula only some scanty data have been published on halophytes occurring along the roadsides.

## The studied species

Inside genus *Plantago* L., the *P. coronopus* group contains annuals, biennials or perennials, with one to many rosettes (Chater & Cartier 1976). Marhold (2011) listed the following synonyms: *P. aschersonii* Bolle, *P. ceratophylla* Hoffmanns. & Link, *P. columnae* Gouan, *P. tenuis* Hoffmanns. & Link, *P. coronopus* subsp. *ceratophylla* (Hoffmanns. & Link) Franc.

The species reaches 3–(5–15)–30 cm of height. It develops rich rosettes from its continuously growing taproot (Sell & Murrell 2009). Leaves 2–20 × 0.1–0.5 cm, linear to lanceolate, dentate, and mostly appressed to the ground. Fleshy, flat and usually with a margin dentate or lobate, seldom entire [var. *weldenii* (Rchb.) Pott.-Alap.], glabrous or shortly hairy. Young rosettes usually with entire, fleshy leaves. Long stems develop from the centre of rosettes (15–)40–60(–80) 2–25 cm (Schmidt & al. 2016). Stems patent, subsequently ascending. Spikes 1–6 cm long and 0.3–0.4 cm wide. Bracts ovate and subacute, or abruptly attenuate into a long apex, shorter than or equal to the calyx. Corolla brown, lobes oval with apiculate apex, corolla tube pubescent. Stamens four, with pale filaments and bright-yellow anthers. Capsule 1.5–2.5 mm locular; seeds 3–6, 0.8–1 mm long, brownish-pink (Chater & Cartier 1976, Sell & Murrell 2009).

Native distribution of *Plantago coronopus* in Europe follows the coastline. It grows in the maritime areas of West and South Europe (including the southern part of Scandinavia), on the North African coasts and the Azores, Madeira, and Canary Islands. From the Black Sea region, it expands across the Middle East, Caspian region and Central Asia to Afghanistan and Tajikistan (Chater & Cartier 1976, Fedorov 2001, Hegi & Pusch 2009). In the European countries, it is a typical plant of the salt-affected sand dunes and rocks. On the Balkan Peninsula, it is recorded along the sea-coast in Slovenia (Jogan 2007), Croatia (Nikolić 2020), Montenegro (Rohlén 1942), Bulgaria (Kozuharov 1995), Albania (Barina 2017), Greece (Dimopoulos & al. 2013), and European Turkey (Tutel 1982). Inland occurrences are known from the territories with warmer climate, mostly in lowlands and the adjoining valleys (Beck & al. 1974, Hadžiablahović 2010). In the southern areas, it occurs also in the lower hilly regions, up to 450–600 m a.s.l. (Kozuharov 1995, Dimopoulos & al. 2013, Barina 2017). In Serbia, only subsp. *weldenii* occurs in the vicinity of Vranje (Josifović 1974). The closest occurrence to the Balkans related to the Central-European expansion along the roads is known from Northeast Slovenia, near the motorway (Bakan 2017).

Stančić & al. (2008) listed it among the coastal plants in Croatia, which populated halophilous ruderal habitats, saltmarshes and other habitats near the sea. Barina (2017) reported it also from disturbed places, seldom in dry scrub and at roadsides.

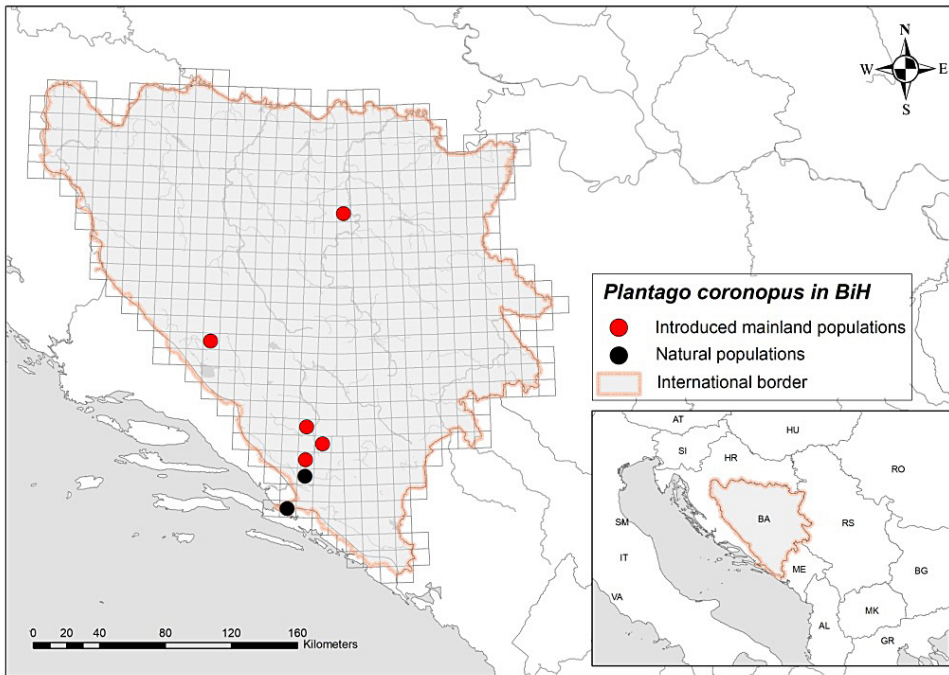
In Bosnia and Herzegovina, it also occurs along the short Adriatic Coast [however, Marhold (2011) did not list it]. It is most probably native only to the area of Neum (Kutleša & Lakušić 1964) and in the vicinity of Dretelj, near River Neretva (Beck & al. 1974). The latter locality is farther from the sea (about 23 kilometers), but has a Mediterranean vegetation. Here it can be found in salty habitats, which is the natural habitat type of the species.

## Material and methods

Our targeted investigations were carried out along some main routes of Bosnia and Herzegovina. We searched especially on road No M-16 (E661) between Bosanska Gradiška – Buško Jezero, No M-17 (E73) between Kotorsko – Čapljina, and No 17.2 between Bosanski Brod – Kotorsko. Furthermore, we searched the remaining areas of A1 motorway between Zenica – Ilidža. A detailed list with data from the new localities was provided. Metadata of locations (locality, habitat, geographical coordinates, elevation, date of collection and collector) were recorded. A phytocoenological relevé was recorded, according to the Braun-Blanquet (1928) method, with estimates of plant covers in percentage. Herbarium specimens collected in Maglaj were deposited in the Herbarium of the National Museum of Bosnia and Herzegovina in Sarajevo (SARA) and in the Natural History Museum of Budapest (BP). Distribution of *Plantago coronopus* in Bosnia and Herzegovina was shown on a standard UTM grid (10 × 10 km) by two symbols. Localities in the natural habitats were indicated by black dots on the map, while the introduced mainland populations were indicated by red dots (Fig. 1).

## Results and discussion

Outside the native distribution of species, the first population along roadsides was found in 2015, along the road M-16 southwards from the city of Livno. The species has formed a several meters long monodominant patch with several thousands of specimens. In 2017, three more locations were discovered in the valley of River Neretva in the vicinities of Buna, Počitelj, and Mostar. In the first two locations, *P. coronopus* grew on the edge of the road, while in Mostar it was found in the



**Fig. 1.** Distribution of *Plantago coronopus* in Bosnia and Herzegovina.

former military area Sjeverni Logor, in disturbed sites often used for car stops, with a dense group of plants occupying an area of *ca.* 10 m<sup>2</sup> (Fig. 3). In 2019, the species was discovered on the edge of road M-17, in the northern part of the country near Maglaj. In this locality, the species grew in a 40 m long stand at the roadside (in direction to Doboj) (Fig. 2). In order to determine the coenological affinities, the following phytocoe-

nological relevé was outlined in Maglaj (D. Schmidt, 08.08.2019, relevé size: 2 × 0.5 m, cover in percentage): *Plantago coronopus* 50, *Ambrosia artemisiifolia* 10, *Medicago lupulina* 3, *Medicago × varia* 2, *Plantago lanceolata* 2, *Cichorium intybus* 0.5, *Trifolium dubium* 0.5, *Bromus hordeaceus* 0.3, *Taraxacum* sect. *Ruderales* 0.2, *Pimpinella saxifraga* 0.2, *Arenaria serpyllifolia* 0.1, *Lotus corniculatus* 0.1, *Cerastium pumilum* 0.1.



**Fig. 2.** Habitat of *Plantago coronopus* in Maglaj (Photo: David Schmidt).





Fig. 3. Habitat of *Plantago coronopus* in Mostar (Photo: Semir Maslo).

The first record of this species in Bosnia and Herzegovina was from the lower part of the Neretva Valley, above Dretelj, where it was found on a sandy embankment by Karl Maly in 1912. The voucher specimen was deposited in the Herbarium of the State Museum in Sarajevo (SARA, inventory number: 38098). The new occurrences in the Neretva Valley were linked to the old finding of Maly. However, the difference was that the new stands were observed in an anthropogenic habitat.

The newly found localities of *Plantago coronopus* along roads in Bosnia and Herzegovina have probably a different origin (at least in Maglaj and Livno), and may be related to the secondary expansion of the species. On the Balkan Peninsula, this type of occurrence of the species has been so far unknown. In the Pannonian region of Slovenia, it was observed by Bakan (2017), which was obviously related to its huge populations in Southwest Hungary (Schmidt & al. 2016). Otherwise, the closest occurrence to the new locality in Maglaj was 70 km northwards in Slavonia, where it formed huge populations alongside A5 motorway around Slavonski Brod (D. Schmidt, 2019, unpublished data). Most likely, the stand in Maglaj was connected to the Slavonian populations across the M-17 main road, and the first recognized initially naturalized populations in the continental area of Bosnia and Herzegovina. Furthermore, the M-17

road was part of E73 as a Pan-European Corridor and the main axis between Hungary and the Croatian seacoast. In Bosnia and Herzegovina, it ran from the northern border with Croatia in Bosanski Brod, towards the southern border with Croatia. Mention deserves the fact, that construction of a higher-level road network in Bosnia and Herzegovina was still stalled. Similarly, according to our observations, development of salt-tolerant vegetation along motorways is not a typical phenomenon yet.

List of new localities of *Plantago coronopus* in Bosnia and Herzegovina

1. Livno, Herzegovina, at the edge of the main road M6-1, about 300 meters southwards from the inhabited area of Livno (43°48'55"N 16°59'58"E, 716 m a.s.l.), observed by D. Schmidt (11.07.2015)
2. Mostar, Herzegovina, former military area Sjeverni Logor (43°21'16"N; 17°48'35"E, 65 m a.s.l.), observed by S. Maslo (02.07.2017)
3. Buna, Herzegovina, at the edge of the main road M-17, about 200 m southwards of the junction to village Hodbina (43°14'54"N; 17°50'13"E, 36 m a.s.l.), observed by S. Maslo (04.11.2017)
4. Počitelj, Herzegovina, Ševaš Njive, at the edge of the main road M-17, about 2 km northwards of Počitelj, (43°09'28"N; 17°45'38"E, 29 m a.s.l.), observed by S. Maslo (04.11.2017)

5. Maglaj, Bosnia, at the edge of the main road M-17, 120 m southwards of the junction to town Maglaj (44°33'09"N 18°05'38"E, 175 m a.s.l.), observed by D. Schmidt (08.06.2019)

**Acknowledgments.** The authors would like to thank Nermina Sarajlić for the help during studies of the SARA Herbarium, and Đordije Milanović for the mapping of distribution of the taxon.

This work was carried out within the framework of the project „EFOP-3.6.1-16-2016-00018 – Improving the role of research+development+innovation in higher education through institutional developments assisting intelligent specialization in Sopron and Szombathely”.

## References

- Bakan, B.** 2017. *Plantago coronopus* L. – In: **Bakan, B.**, Floristic news from Pomurje (NE Slovenia) [Floristične novosti iz Pomurja (SV Slovenija)]. – *Hladnikia*, **40**: 41-42.
- Barina, Z. (ed.)** 2017. Distribution Atlas of Vascular Plants in Albania. Hungarian Natural History Museum, Budapest, 492 pp.
- Beck, G., Maly, K. & Bjelcic, Ž.** 1974 The Flora of Bosnia and Herzegovina. (Flora Bosne i Hercegovine) IV. Sympetalae 3. Sarajevo.
- Braun-Blanquet, J.** 1928. Pflanzensociologie. – Springer, Berlin, 330 pp.
- Chater, A. & Cartier, D.** 1976. *Plantago*. – In: **Tutin, T.G., Heywood, V.H., Burges, N.A., Moore, D.M., Valentine, D.H., Walters, S.M. & Webb, D.A. (eds)**, Flora Europaea. Vol. 4. Cambridge Univ. Press, Cambridge, pp. 38-44.
- Dimopoulos, P., Raus, Th., Bergmeier, E., Constantinidis, Th., Iatrou, G., Kokkini, S., Strid, A. & Tzanoudakis, D.** 2013. Vascular Plants of Greece: An Annotated Checklist. Berlin: Botanic Garden and Botanical Museum Berlin-Dahlem; Athens: Hellenic Botanical Society. [Englera 31].
- Fedorov, A. (ed.)** 2001. Flora of Russia. V. The European Part and Bordering Regions. – CRC Press, Boca Raton, 532 pp.
- Follak, M., Eberius, M., Essl, M., Fördös, A., Sedlacek, N. & Trognitz, F.** 2018. Invasive alien plants along roadsides in Europe. – *EPPO Bulletin*, **48(2)**: 256-265.
- Forman, R.T. & Godron, M.** 2003. Road ecology: science and solutions. – Island Press, Covelo, California.
- Hadziablahović, S.** 2010. The vascular flora of Ćemovsko Polje (Montenegro). – *Nat. Montenegr.*, **9(1)**: 7-143.
- Hegi, G. & Pusch, J. (eds)** 2009. Illustrierte Flora von Mitteleuropa **6(1)**. – Weissdorn-Verlag, Jena, 99 pp.
- Jogan, N. (ed.)** 2001. Gradivo za atlas flore Slovenije. [Materials for the Atlas of Flora of Slovenia]. Center za kartografi jo favne in flore, Miklavž na Dravskem polju, 443 pp.
- Josifović, M.** 1974. The Flora of SR of Serbia (Flora SR Srbije). – Srpska akademija nauka i umetnosti, Beograd.
- Kozuharov, S. (ed.)** 1995. Flora Republicae Popularis Bulgaricae. Vol. 10. Serdica: Aedibus Acad. Sci. Bulgaricae. 428 p. (In Bulgarian).
- Kutleša Lj. & Lakušić R.** 1964. Flora and vegetation of the Klek peninsula (Flora i vegetacija poluotoka Kleka). – *Godišnjak Biološkog Istituta Univerziteta u Sarajevu*, **17**: 61-115.
- Marhold, K.** 2011+. *Plantago*. – In: **Euro+Med Plantbase** – the information resource for Euro-Mediterranean plant diversity. <http://ww2.bgbm.org/euroPlusmed/> Retrieved January 2020.
- Martinčič, A.** 1999. Small flora of Slovenia (Mala flora Slovenije), Ed. 3., Ljubljana.
- Nikolić, T. (ed.)** 2020. Flora Croatica database. University of Zagreb, Faculty of Science, Department of Botany and Botanical Garden, Zagreb. <http://hirc.botanic.hr/fcd>. (accessed 10 January, 2020).
- Nikolić, T. & Topić, J. (eds)** 2005. Red Book of Vascular Flora of the Republic of Croatia. Ministry of Culture, State Institute for the Protection of Nature, Zagreb.
- Rohlena, J.** 1942. Conspectus Florae Montenegrinae. – *Preslia*, **20-21**: 1-506.
- Schmidt, D., Dítětová, Z., Horváth, A. & Szűcs, P.** 2016. Coastal newcomer on motorways: the invasion of *Plantago coronopus* in Hungary. – *Stud. Bot. Hung.*, **47(2)**: 319-334.
- Scott, N. E. & Davison, A. W.** 1985. The distribution and ecology of coastal species on roadsides. – *Vegetatio*, **62**: 433-440. [http://dx.doi.org/10.1007/978-94-009-5524-0\\_48](http://dx.doi.org/10.1007/978-94-009-5524-0_48)
- Sell, P. & Murrell, G. (eds)** 2009. Flora of Great Britain 3: *Mimosaceae-Lentibulariaceae*. Cambridge Univ. Press, Cambridge, 624 pp.
- Stančić, Z., Brigić, A., Liber, Z., Rusak, G., Franjić, F. & Škvorc, Ž.** 2008. Adriatic coastal plant taxa and communities of Croatia and their threat status. – *Acta Bot. Gallica*, **155(2)**: 179-199.
- Tutel, B.** 1982. *Plantago* L. – In: **Davis, P.H. (ed.)**, Flora of Turkey and the East Aegean Islands. Vol. 7: 504-521. Edinburgh Univ. Press.
- Tutin, T.G., Heywood, V.H., Burges, N.A., Valentine, D.H., Walters, S.M. & Webb, D.A.** – Flora Europaea 1-5, Cambridge Univ. Press, Cambridge 1964-1980.

