



More road-killed Caspian Whipsnakes (*Dolichophis caspius*): an update on the species distribution along the Danube, in Romania

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Abstract.—*Dolichophis caspius* is present in Romania only in the southern regions, which partially represent its northern distribution limit. In recent years, new data on the distribution of *D. caspius* in the country have been collected, with many of these records being road-killed individuals. Conducted during 2013–2019, this survey further completes the information on this species' distribution in southern Romania, recording 55 (mostly new) distribution localities. *Dolichophis caspius* is a constant presence in the Danube meadow, and it also advances northwards along the Jiu, Olt, and Argeş River meadows. *Dolichophis caspius* was mostly found to inhabit areas with loess walls, but it was also present in flat areas with agricultural terrains. Most of these records were road-killed individuals. The high number of new distribution records could be driven by the last year's weather conditions, which were unusually warm and dry in the region. Also, the high number of road-killed snakes clearly reflects the increasing level of the human pressure on *D. caspius* in a region where natural habitats are becoming increasingly rare.

Keywords. Climate, Colubridae, habitat, loess walls, Reptilia, road mortality, Serpentes

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Introduction

The Caspian Whipsnake (*Dolichophis caspius*) is an Eastern-Mediterranean species (e.g., Tomović et al. 2014), present in Europe in its south-eastern regions, the Italian Peninsula, and the Balkan Peninsula (Sillero et al. 2014). A large part of its distribution range was probably populated shortly after the last glacial maximum (Nagy et al. 2010). The north-western limit of its distribution range reaches Hungary and Romania (see Nagy et al. 2010; Sahlean et al. 2014). In Hungary, it occupies only a very small territory near the Danube River, where it ascends farther north than in Romania, and in the last years new distribution records have been reported (e.g., Korsós et al. 2002; Bellaagh et al. 2008). Nevertheless, even the largest population in Hungary seems to be in decline (Frank et al. 2012). In Romania, *D. caspius* is present only in the southern part of the country, along the Danube River, especially in Dobruja (see Cogălniceanu et al. 2013; Sahlean et al. 2019). Its populations are considered to be declining in the country, with some regarded

as extinct (Iftime 2001–2002). The new distribution records of the last decades (Strugariu and Gherghel 2007; Covaciu-Marcov and David 2010; Sahlean et al. 2010; Ferenţi et al. 2011; Covaciu-Marcov et al. 2012a) updated the knowledge on the species distribution in Romania (Cogălniceanu et al. 2013). However, *D. caspius* was still recorded in new localities in more recent years (Iftime and Iftime 2015, 2017; Sahlean et al. 2019), while large gaps in its known distribution range still remain (Sahlean et al. 2019). The majority of the recent distribution records represent road-killed individuals (e.g., Covaciu-Marcov and David 2010; Ferenţi et al. 2011; Covaciu-Marcov et al. 2012a). Although these data indicate that *D. caspius* has a broader distribution range in Romania than was previously considered (Fuhn and Vancea 1961), they also confirm the pressure under which it is being subjected (Iftime 2001–2002). In the light of these facts, records of road-killed whipsnakes are of particular interest. Therefore, this note is an update on *D. caspius* distribution and road mortality intensity along the Danube in southern Romania.

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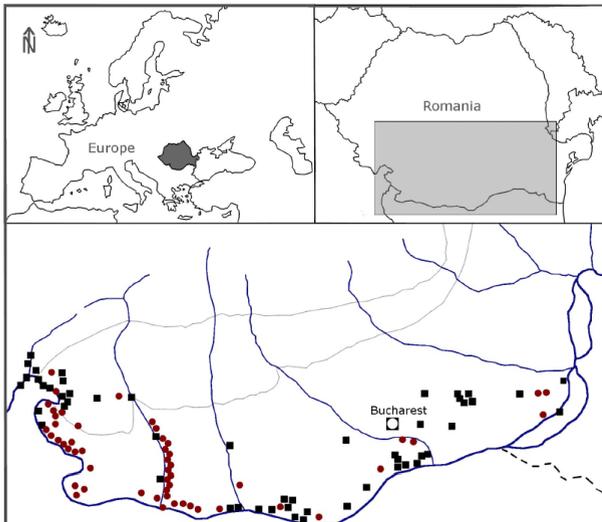


Fig. 1. *Dolichophis caspius* distribution in southern Romania. Squares: previous records (after Cogălniceanu et al. 2013; Iftime and Iftime 2016, 2017), red dots: new records.

Materials and Methods

The information on the distribution of *D. caspius* in southern Romania was obtained from field studies realized between 2013 and 2019. In 2016, 2017, and 2018, the Danube meadow between Drobeta-Turnu Severin and Fetești was surveyed once each year, in spring or in autumn. Additional surveys occurred 2–3 times each year in the western sector, from Drobeta-Turnu Severin to Bechet, and 1–2 times each year in the Jiu River meadow, between Craiova and Bechet. In total, ~29 days were spent in areas which could shelter *D. caspius* populations. None of those days were dedicated specifically to *D. caspius*, and snakes were observed by chance during other field work in the region (e.g., Covaciu-Marcov et al. 2017a,b, 2018). Road-killed individuals were observed directly from the car by driving at speeds of 50–60 km/h on roads with low traffic, a method previously used in the region (Covaciu-Marcov et al. 2012a). In some cases, direct searches for snakes were conducted in favorable habitats, and the observed individuals were recorded and photographed. Road-killed individuals were also photographed, and those in better physical condition were collected and deposited in the zoological collection of the University of Oradea, Romania.

Results

Dolichophis caspius individuals were recorded from 55 distribution localities in southern Romania (Table 1), most of which (52) were new distribution records (Fig. 1). The majority of the new distribution records are located in the western part of southern Romania, in the historical region of Oltenia, in Mehedinți and Dolj counties. Overall, 73 individual *D. caspius* snakes were identified. Five of the whipsnakes were encountered alive, while the others were found killed either by humans (two individuals), or by cars on the roads (Fig. 2). Juveniles and adults of up



Fig. 2. Road killed *Dolichophis caspius* individual from Lișteva, Dolj County, Romania.

to 1.60 m total length were both found killed on roads. *Dolichophis caspius* individuals were mostly found in spring (April–May) and autumn (September–October).

Discussion

Compared to the previously available data (e.g., Cogălniceanu et al. 2013; Iftime and Iftime 2015, 2017; Sahlean et al. 2019), the results reported here more than double the number of *D. caspius* records in the Danube meadow. This confirms once again that the species presents a continuous distribution in the region (e.g., Ferentî et al. 2011; Covaciu-Marcov et al. 2012a). While this fact was already well-established in the central part of the meadow (Sahlean et al. 2010; Ferentî et al. 2011; Cogălniceanu et al. 2013; Iftime and Iftime 2015, 2017), in the western parts the new data completed the *D. caspius* distribution range between Drobeta-Turnu Severin and the Olt River (Fig. 1), where a large gap has existed until now (Sahlean et al. 2019). These new records also show a continuous distribution along the Jiu River between Bechet and Craiova, and confirm the sporadic presence of this species north of Craiova (e.g., Sahlean et al. 2019). Although the three previously known distribution localities along the Jiu River already indicated this, Caspian Whipsnakes were rarely recorded in the region (e.g., Sahlean et al. 2019), despite the presence of apparently favorable habitats. The whipsnakes are also continuously distributed between Olt and Jiu Rivers. Based on only four records, *D. caspius* seems less common in the area between Calafat and Bechet. The records from the Argeș River region confirm that the species is currently well represented, although it was previously considered extinct from one locality (Iftime 2001–2002).

Table 1. *Dolichophis caspius* distribution records in southern Romania. Asterisks (*) indicate previous records. County abbreviations: Mh = Mehedinți County, Gr = Giurgiu County, Cl = Călărași County, Tr = Teleorman County, Ot = Olt County, Dj = Dolj County, Il = Ialomița County.

No.	County	Locality	Date(s)	Geographic coordinates	Road-killed	Human killed	Alive
1	Mh	Drobeta Turnu Severin - north	2 VI 2018 24 V 2015	44°39'28.90"N, 22°40'01.68"E	1 2	-	-
2	Mh	Gogoșu	3 VI 2018 6 X 2018	44°23'14.62"N, 22°33'26.21"E	3 3	-	-
3	Mh	Scăpău	14 X 2018	44°28'47.93"N, 22°43'34.29"E	1	-	-
4	Mh	Șimian	14 X 2018	44°35'53.62"N, 22°43'30.40"E	1	-	-
5	Mh	Chilia	21 VI 2016	44°29'02.32"N, 22°39'37.35"E	1	-	-
6	Mh	Izvoarele	21 VI 2016	44°17'48.87"N, 22°40'50.31"E	2	-	-
7	Mh	Pristol / Gârla Mare	21 VI 2016	44°13'08.71"N, 22°44'15.95"E	1	-	-
8	Mh	Vrata	21 VI 2016	44°12'13.75"N, 22°49'15.53"E	1	-	-
9	Mh	Batoți	15 X 2017	44°30'42.25"N, 22°40'22.16"E	1	-	-
10	Mh	Vânju Mare / Bucura	10 V 2014	44°24'39.12"N, 22°51'52.83"E	1	-	-
11	Mh	Arginești / Butoiești	28 VI 2015	44°34'39.33"N, 23°24'07.66"E	1	-	-
12	Mh	Devesel	X 2013	44°28'12.50"N, 22°41'07.16"E	1	-	-
13	Mh	Jiana Mare	IX 2014	44°24'20.97"N, 22°40'46.09"E	1	-	-
14	Mh	Gruia / Pătulele	V 2013	44°18'12.86"N, 22°44'27.07"E	1	-	-
15	Mh	Gruia	V 2013	44°17'00.83"N, 22°42'19.39"E	1	-	-
16	Mh	Balta Verde	30 IX 2019	44°20'17.70"N, 22°36'03.54"E	1	-	-
17	Mh	Izimșa	20 X 2019	44°10'48.17"N, 22°58'11.72"E	-	-	1
18	Gr	Hotarele	1 IX 2018	44°10'16.00"N, 26°22'10.25"E	1	-	-
19	Gr	Teiușu	1 IX 2018	44°10'06.40"N, 26°17'16.02"E	1	-	-
20	Gr	Plopșoru	1 IX 2018	44°00'39.49"N, 25°59'38.07"E	1	-	-
21	Gr / Cl	Greaca / Căscioarele*	12 IV 2014	44°07'37.37"N, 26°25'04.89"E	-	-	1
22	Tr	Zimnicele	1 IX 2018	43°39'52.82"N, 25°25'48.42"E	1	-	-
23	Tr	Seaca*	2 IX 2018	43°44'53.29"N, 25°04'07.76"E	1	-	-
24	Tr	Pleașov	23 IV 2017	43°51'13.39"N, 24°45'24.40"E	-	1	-
25	Tr	Năvodari	23 IV 2017	43°44'29.75"N, 25°06'48.68"E	1	-	-
26	Tr	Suhaia*	23 IV 2016	43°44'58.42"N, 25°13'40.21"E	1	-	-
27	Ot	Corabia E	2 IX 2018	43°46'13.59"N, 24°33'42.76"E	1	-	-
28	Ot	Potelu	12 IV 2014	43°45'21.57"N, 24°12'35.60"E	-	-	2
29	Ot	Ianca	IV 2013	43°46'45.28"N, 24°09'19.17"E	1	-	-
30	Dj	Călărași	2 IX 2018	43°47'11.23"N, 24°01'36.88"E	2	-	-
31	Dj	Bechet E	2 IX 2018	43°47'02.17"N, 23°58'43.39"E	1	-	-
32	Dj	Făcăi	13 X 2018	44°16'13.17"N, 23°49'16.72"E	-	1	-
33	Dj	Malu Mare	13 X 2018	44°15'23.80"N, 23°50'24.29"E	1	-	-
34	Dj	Malu Mare / Secui	13 X 2018, 14 X 2017	44°13'00.25"N, 23°51'49.08"E	1 1	-	-
35	Dj	Bratovoiești	13 X 2018	44°08'12.23"N, 23°53'50.21"E	1	-	-
36	Dj	Rojiște	13 X 2018, 4 X 2014	44°04'42.33"N, 23°55'58.69"E	2 1	-	-
37	Dj	Măceșu de Jos	13 X 2018 20 X 2019	43°52'49.20"N, 23°42'15.91"E	1 1	-	-
38	Dj	Maglavit	14 X 2018	44°01'29.78"N, 23°05'25.95"E	1	-	-
39	Dj	Tâmburești	14 X 2017	44°01'50.66"N, 23°56'04.04"E	2	-	-

Caspian Whipsnake distribution in Romania

Table 1 (continued). *Dolichophis caspius* distribution records in southern Romania. Asterisks (*) indicate previous records. County abbreviations: Mh = Mehedinți County, Gr = Giurgiu County, Cl = Călărași County, Tr = Teleorman County, Ot = Olt County, Dj = Dolj County, Il = Ialomița County.

No.	County	Locality	Date(s)	Geographic coordinates	Road-killed	Human killed	Alive
40	Dj	Murta	14 X 2017	43°58'42.86"N, 23°56'38.08"E	1	-	-
41	Dj	Toceni	14 X 2017	43°57'18.22"N, 23°56'40.57"E	1	-	-
42	Dj	Sadova / Căciulătești	14 X 2017	43°55'22.73"N, 23°57'09.75"E	1	-	-
43	Dj	Bechet to the harbour	14 X 2017	43°46'02.70"N, 23°57'30.91"E	1	-	-
44	Dj	Sadova	2 V 2014	43°54'37.18"N, 23°56'32.94"E	1	-	-
45	Dj	Lișteva	3 X 2015	43°50'32.23"N, 23°55'51.40"E	1	-	-
46	Dj	Dobroești / Toceni	14 X 2013	43°58'06.44"N, 23°56'39.17"E	1	-	-
47	Dj	Badoși	4 X 2014	44°08'29.93"N, 23°53'38.35"E	2	-	-
48	Dj	Rojiște S	4 X 2014	44°02'53.85"N, 23°56'10.46"E	1	-	-
49	Dj	Poiana Mare	5 X 2014	43°54'38.13"N, 23°03'51.85"E	2	-	-
50	Dj	Calafat	5 X 2014	43°58'45.62"N, 22°56'33.71"E	2	-	-
51	Dj	Zăval	30 VIII 2019	43°50'27.58"N, 23°50'57.37"E	1	-	-
52	Dj	Desa	29 IX 2019	43°52'47.14"N, 23°01'50.80"E	1	-	-
53	Il	Țândărei	28 VIII 2018	44°38'44.96"N, 27°41'06.00"E	1	-	-
54	Il	Țândărei / Mihail Kogălniceanu	25 VIII 2019	44°39'11.49"N, 27°42'29.19"E	1	-	-
55	Il	Buliga West	30 VIII 2019	44°21'09.69"N, 27°47'07.46"E	-	-	1

The new records confirm the association of *D. caspius* with the loess walls of the Danube meadow (e.g., Ferenți et al. 2011; Covaciu-Marcov et al. 2012a). Most observations were made in areas with loess walls, both along the Danube meadow and its main tributaries (Jiu, Olt, Argeș). Along the Danube, loess walls have southern exposure; while along the Jiu (Fig. 3) and Olt Rivers they have western exposure, with southern oriented meadows, and along the Argeș River they are exposed to the north. Only some localities, such as Măceșu de Jos, are devoid of loess walls, with a plain relief and an indistinguishable boundary between the meadow and its neighboring terraces. In such cases, agricultural lands surrounding the roads were used by *D. caspius*, as is found in other parts of its distribution area (e.g., Ioannidis and Bousbouras 1997; Arslan et al. 2018; Sahin and Afsar 2018). Thus, the loess walls are confirmed to be favorable habitats for *D. caspius* (e.g., Korsós et al. 2002; Bellaagh et al. 2008), but some individuals persist even in flat habitats.

The data presented here extend the northern limit of the distribution of *D. caspius* along the Danube tributaries. Whipsnakes are xerophilous, influenced by temperature and precipitation, and so the future northward distribution could be facilitated by climate change (see Sahlean et al. 2014), and even hatching time depends regionally on temperature (Sahlean and Strugariu 2018). In south-western Romania, the last few decades were warmer and drier than longer term averages (Pravaliu et al. 2014), and *D. caspius* was mostly recorded in the regions of the country with a drier climate (Matei et al. 2016). The high

number of whipsnakes found could be a consequence of favorable climatic conditions that enabled an increase in the population growth rate. Moreover, *D. caspius* could already be at an advantage due to climate change, despite the high number of road-killed individuals. Nevertheless, until recently the Danube meadow was mostly covered by wet areas, lakes, or forests (probably except for the loess walls), which are now drained, deforested, and replaced with agricultural terrains (e.g., Licurici 2011; Benecke et al. 2013; Geacu et al. 2018). Thus, agriculture probably enlarged *D. caspius* habitats beyond the loess walls. This scenario is supported by previous records of this species in the agricultural areas of other regions as well (e.g., Ioannidis and Bousbouras 1997; Arslan et al. 2018; Sahin and Afsar 2018).

The high number of *D. caspius* records is not necessarily an indicator of favorable conditions, but



Fig. 3. *Dolichophis caspius* habitat in Jiu meadow, Romania.

clearly suggests a great human pressure in which snakes are disturbed by intensive agriculture and habitat alteration. In trying to avoid this impact, they move more often, more frequently falling victim to the increasing road traffic. Increased traffic intensity is known to increase road mortality (e.g., Jones et al. 2014; Miranda et al. 2017; Gonçalves et al. 2018), even if *D. caspius* is the fastest snake in Romania (Fuhn and Vancea 1961). In addition, the greater activity of herpetologists may have increased the number of records and observed road-killed individuals. Nevertheless, we have no prior information on the species status before the extensive alteration of the Danube meadow (e.g., Licurici 2011; Benecke et al. 2013; Geacu et al. 2018). *Dolichophis caspius* records based on road-killed individuals are not specific only to Romania (Covaciu-Marcov and David 2010; Ferenti et al. 2011; Covaciu-Marcov et al. 2012a; Sahlean et al. 2019), but are also commonly reported in other regions (e.g., Korsós et al. 2002; Krěmar et al. 2007; Kambourova-Ivanova et al. 2012; Mollov et al. 2013). Most of the whipsnakes found were killed on roads situated at the upper limit of the loess walls, just as previously indicated (Covaciu-Marcov et al. 2012a). Road-killed individuals were rarely recorded at the base of the loess walls, or in regions without loess walls.

In southern Romania, *D. caspius* has arrived only recently, at the end of its postglacial expansion (Nagy et al. 2010). It uses natural and restrictive, but also modified, habitats. Its protected status (O.U.G 57/2007, Monitorului Oficial al României, <http://www.monitoruloficial.ro/>) increases the importance of the regional biodiversity, where numerous relicts are present (e.g., Paşcovschi 1967; Ferenti and Covaciu-Marcov 2014; Covaciu-Marcov et al. 2017a, 2018). *Dolichophis caspius* is not the only southern species with its northern distribution limit in this region, but there are also other amphibian and reptile species in the same category (e.g., Covaciu-Marcov et al. 2012b; Cogălniceanu et al. 2013; Székely et al. 2013).

The records of *D. caspius*, especially road-killed individuals, have been increasing in recent years in Romania (e.g., Strugariu and Gherghel 2007; Covaciu-Marcov and David 2010; Sahlean et al. 2010; Ferenti et al. 2011; Covaciu-Marcov et al. 2012a; Iftime and Iftime 2015, 2017; Sahlean et al. 2019). The finding of numerous snakes is a consequence of what kills them, namely the road network development. The impact of roads on biodiversity is increasingly clear, including in Romania (e.g., Cicort-Lucaciu et al. 2012, 2016; Ciolan et al. 2017; Covaciu-Marcov et al. 2017c; Popovici and Ile 2018; Teodor et al. 2019). The proposal of speed reductions in regions populated by whipsnakes (Covaciu-Marcov et al. 2012a) is no longer feasible because, according to the new distribution records, the speed limits would need to be applied to hundreds of km of the roadway. If the protection of relicts strictly related to natural habitats is relatively facile, depending on the

conservation of the last remnants of initial habitats, then the conservation of a species (such as *D. caspius*) which recently arrived at its postglacial expansion (Nagy et al. 2010) and is probably influenced by the climatic changes (Sahlean et al. 2014) or even by some human impacts, is much more difficult. This difficulty is further compounded by the fact that this species could enter in conflict with the exact factors that favor it at the moment.

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