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Dice Snake (*Natrix tessellata*) in the Baltic Sea Drainage Basin (Karvinsko District in Silesia, Czech Republic)

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Abstract. We report on scattered distributional records and a prospering population of the dice snake (*Natrix tessellata*) from Silesia in the northeast of the Czech Republic. Only a few unconfirmed records and documented sightings have existed from Silesia untill now. A recently discovered population at Havířov, Silesia, represents the first documentation of a reproducing population of *N. tessellata* in the Baltic Sea Drainage area. It is located approximately 145 km straight line from the nearest confirmed population near Brno, southeastern Czech Republic, which is a locality within the Black Sea drainage. There are several factors that characterize the population near Havířov: 1) the population inhabits a still water system made of ponds, unlike most other river dwelling populations in the Czech Republic; 2) the aquatic habitat is a pond network that drains into the Baltic Sea; 3) the pond system is under heavy anthropogenic influence. The edge of these reservoirs are formed by mullock chips from nearby coal minning activities. In this report we summarize all literature records and verbal information about observations of *N. tessellata* in Silesia and nearby Poland that indicate its wider distribution in the Baltic Sea Drainage Basin than was previously perceived, pointing toward a natural occurrence of *N. tessellata* in this area.

Key words. *Natrix tessellata*, distribution, anthropogenic habitat, Baltic Sea Drainage Basin (BSDB), Silesia, Czech Republic, Poland

Introduction

Natrix tessellata is a semiaquatic snake with a large distribution, extending from central Europe to northern Egypt and east as far as northwestern China (Gruschwitz et al. 1999, Baha El Din 2006). The northernmost western and central European populations, considered relicts of a postglacial warm period (Atlantikum, see Lenz et al. 2008, Wikipedia 2010), are reported from Germany and the Czech Republic (Gruschwitz et al. 1999). *N. tessellata* belongs to the rarest reptiles in the Czech Republic and is a law-protected species, filed in the category of nationally critically endangered species. In the atlas of Czech reptiles, Mikátová et al. (2001) summarized the known distribution and biology of *N. tessellata* in the Czech Republic. They included also records from atypical biotopes in the context of known Czech habitats and extralimital sites in reference to the presumed autochthonous distribution of *N. tessellata* in this country. The atlas-record from Silesia, the northwestern province of the Czech Republic, was based on the discovery of two specimens in 1997 by Vlček (1998) and was classified as such an extralimital record. By 2009 still only fragment data were known about *N. tessellata* from Silesia. However, in 2009 a stable and reproducing population was found (Vlček et al. 2010). In this report we summarize the published as well as new and unpublished data about the occurrence of *N. tessellata* in Czech Silesia. Furthermore, we formulate preliminary conclusions resulting from observations, which are atypical for this species.

Material and Methods

An inventory of all published and unpublished data about *Natrix tessellata* in Czech Silesia was conducted since its discovery in 1997 (Vlček 1998). Data of different quality and evidence have been collected. Moreover, during the past twelve years the senior author was searching the region for a stable, reproducing population of *N. tessellata*. Field search to record *N. tessellata* was conducted either visually by walking through potentially suitable biotopes , or the search was focused on sites, where fishermen reported on having seen „water snakes". Field work lasted from May to August.

Study Area

Silesia (Schlesien, Slezsko, Śląsk) is a historical region, extending from Poland into Czech Republic and partly into Germany (Fig. 1). Up until 1742 whole Silesia belonged to the territory of the Czech Crown with the capital Wroclaw. Thereafter, Silesia was divided into several parts of variable size (Czech Silesia, Prussian Silesia, Polish Silesia, Austrian Silesia). The relief of Silesia constitutes mainly lowland. For example, the Silesian Lowland covers most of Polish Silesia through which Odra River, the principal Silesian river flows. It rises in northern Moravia (Czech Republic) and flows through western Poland, constituting a 187 km long border between Poland and Germany. Finally, Odra River empties into the Baltic Sea north of the polish town Szczecin (Stettin). The Odra is the second longest river in Poland

Fig. 1. Map of the Odra River Basin (yellowish area, BSDB) and the greater area of Silesia. Indicated are also fossil and recent records of *N. tessellata* in Silesia (Czech Republic and Poland) and Northern Moravia (Czech Republic). Black dots = recent records (confirmed), white dots = recent records (unconfirmed) , 1 = fossil record from Mladeč Caves in Northern Movia (Morava River Basin, Black Sea DB), 2 = fossil record from Zabia Cave (Poland), star = unconfirmed record of *N. tessellata* from Bečva River, Morava River Basin, Black Sea DB, Northern Moravia, currently the nearest locality to the records in Silesia. Modified with permission by NorthNorthWest and the GNU Free Documentation License, Version 1.2.

with a total lenght of 854 km, of which 112 km are in the Czech Republic and 742 km in Poland (Fig. 1).

The region of Czech Silesia encompasses an area of 5525.51 km² in the northeast of the country and borders Poland (Fig. 2A). Its highest point is Praděd with 1491 m a.s.l.. Its lowest site is at Kopytov with 193 m a.s.l., which is north of Bohumín town, where Odra River leaves the Czech territory. The principal tributaries to the Odra watershed (Odra River Basin) in the Czech Republic are Opava, Moravice, Olše and Ostravice. The climate of Czech Silesia is mild, as a result of its geographical location that allows the exchange of inland and coastal climates. Altitude above sea level has the determining influence on the distribution of average annual temperatures. The warmest areas are the surroundings of Opava, the Ostrava Mining Basin, the northeastern part of Moravian Gate, Javornicko and Osoblažsko, where the annual average temperatures range from 8–9 °C.

The Czech Republic is often called the roof of Europe, as rivers originating from there flow into three different seas: the Black Sea, the Northern Sea and the Baltic Sea. Czech territory is also very variable concerning zoogeographic aspects: large parts belong to the Hercynicum, smaller ones to the Panonicum, Carpaticum and the smallest part to the Polonicum (Culek 1996). A variable relief and associtated favorable microclimatic conditions enabled amphibians and reptiles to reach also the highest sites in this area (cp. Zavadil 1993). This, the regional high species richness, partly strict geographic border and limited exchange of animals and plants between neighboring zoogeographic regions and, mostly, insufficient field research has yielded many surprises in recent times. This report discusses one such surprise discovery.

Results

Published Reports and Verbal Statements

Most records of *Natrix tessellata* from Czech Silesia. presented herewith are unconfirmed observations. Follow does a numerical list of all records corresponding to the numbered locations displayed on the map (Fig. 2A). Data marked with a star (*) are not mapped in the Czech Atlas of Reptiles (Mikátová et al. 2001, Fig. 3A).

1) According Polášek (1988)*, herpetologist J. Šuhaj observed one *N. tessellata* near the bank of the fishpond Nový Stav, 202 m a.s.l. near Bohumínsko (Bohumin). It concerns an adult individual of approximately 80 cm total length,.

2) M. Míček cit. in Foral (1994) mentioned the presence of *N. tessellata* from the Opava River system, near fishpond Štěpán at Bobrovníky (210 m a.s.l.). Two more persons have observed this species at this fishpond (Pavelková 2008*, Kubačka 2009 pers. comm.)*.

3) Vlček (1998) published the sampling of two *N. tessellata* in 1997. The snakes were found at the Sušanka Brook (252 m a.s.l.) on the northern border of Havířov town in Karvinsko district. These records found subsequently entry into the Czech atlas of reptiles (Mikátová et al. 2001, see blue dot in Fig. 3A)

4) J. Smola (1998 pers. comm.)* , a zooologist familiar with local reptiles, reported that his father recognized *N. tessellata* from photos as the species he hasobserved at Lučina River near Havířov (247 m a.s.l.) up until the first half of the 1970s. He correctly distinguised *N. tessellata* from syntopic grass snake (*N. natrix*) as the species with the prominent dorsal spots, pointed head and unmarked neck, compared to the practically non-spotted, but neck-marked *N. natrix* (Figs. 4 and 5).

5) In 1973, zoologist B. Lojkásek (1998 pers. comm.)* observed *N. tessellata* along Ostravice River near Bezruč Bridge in Ostravice (395 m a.s.l.).

6) Zoologist J. Stalmach (1999 pers. comm.)* found *N. tessellata* near Kopytov (region of Bohumín, 193 m a.s.l.). He observed the species at localities along the

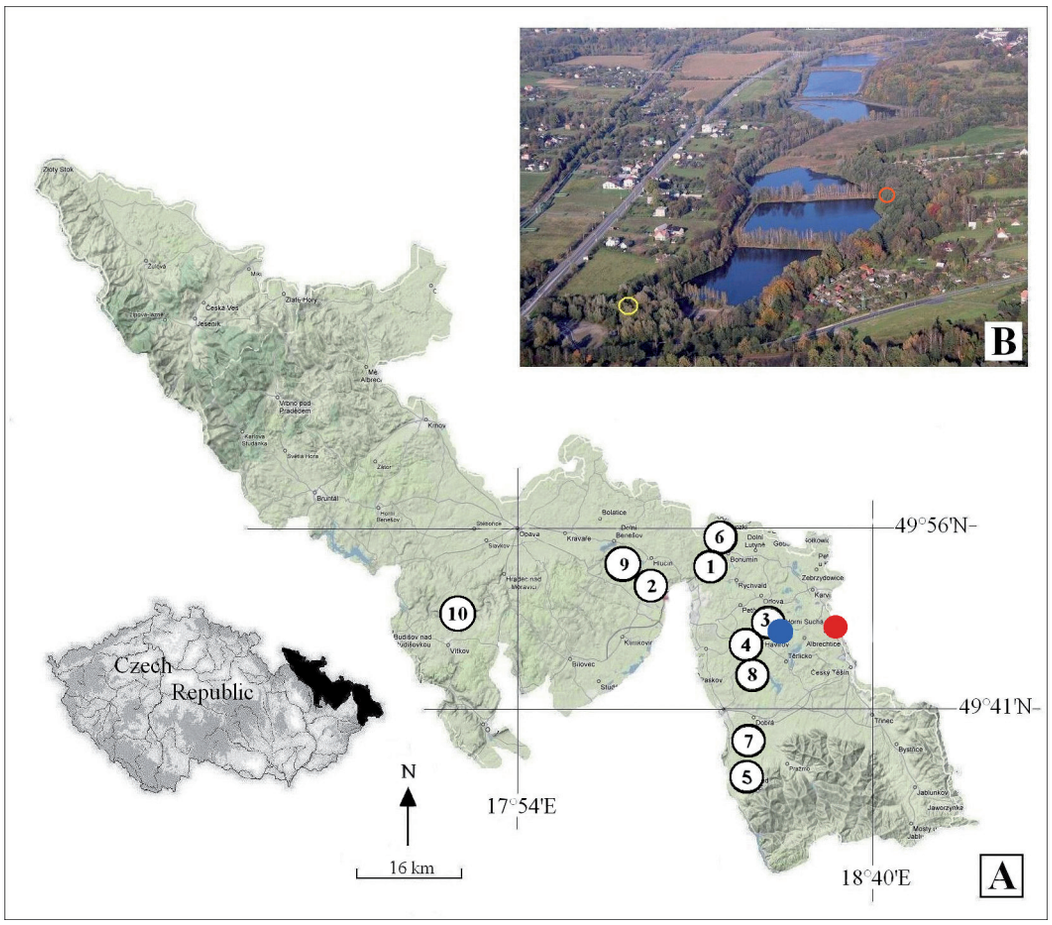

Fig. 2. *Natrix tessellata* in Silesia. A: Map of Czech Silesia (Czech Republic) showing sites of confirmed and anecdotal observations of *N. tessellata*. White dots with numbers 1–10 (see results), blue dot = population at Havířov town, red dot = photographed individual in Polish Silesia (Vlček et al. 2010). B: Aerial photo of Sušanka reservoirs, Havířov town, Karvinsko, Czech Silesia. Yellow circle = initial discovery of *N. tessellata* (record 3 in the results) along the Sušanka Brook next to pond P1. Red circle = putative hiberanculum, see text. Photo: Michal Polák

border between the Czech Republic and Poland at the confluence of Olše and Odra rivers.

From the same areas, the booklet „Bohumín zajímavě (Anonymous 2004)" noted the occurrence of *N. tessellata* for the alluvial plain of Odra River from Old Bohumín to its confluence with Olše River. This publication, however, is not zoologically oriented, and hence, not a serious source of herpetological data, but nonetheless, the mentioning of *N. tessellata* there might not be coincidential.

7) Lojkásek (2008 pers. comm.)* reported the finding of a dead individual on the road between Raškovice and Skalice u Frýdku Místku near the Morávka River, 353 m a.s.l., in 1976. This individual is preserved at the Faculty of Science of the University of Ostrava. It shows sign of injuries, but the locality label yields no further details (Fig. 6).

8) J. Smola (2009 pers. comm.)* presented repeatedly observations from unnamed workers of the Odra River Basin, who reported of seeing *N. tessellata* at the Špluchovský Brook near the village Špluchov (284 m a.s.l.).

9) Zoologist J. Kubačka (2009 pers. comm.)* reported unconfirmed observations of *N. tessellata* from the Koutsko-Zábřežské meadows in the area of Kouty near the village Zábřeh u Hlučína (227 m a.s.l.).

10) J. Kubačka (2009 pers. comm.)* reported an unconfirmed observation of *N. tessellata* by a forest worker from the Moravice River, nearby the settlement Vendelín, in the proximity of the village Radkov (367 m a.s.l.). Also reptile expert V. Gvoždík (2009 pers. comm.)* mentioned the unconfirmed occurrence of *N. tessellata* from this river in Opavsko (circa 260 m a.s.l.) without further details.

11) Jančar (2010 pers. comm.), a local fisherman, reported to the first author that he has seen heavily spotted watersnakes already in 1955 around the ponds at Havířov, evidently representing *N. tessellata* (see blue dot in Fig. 2A).

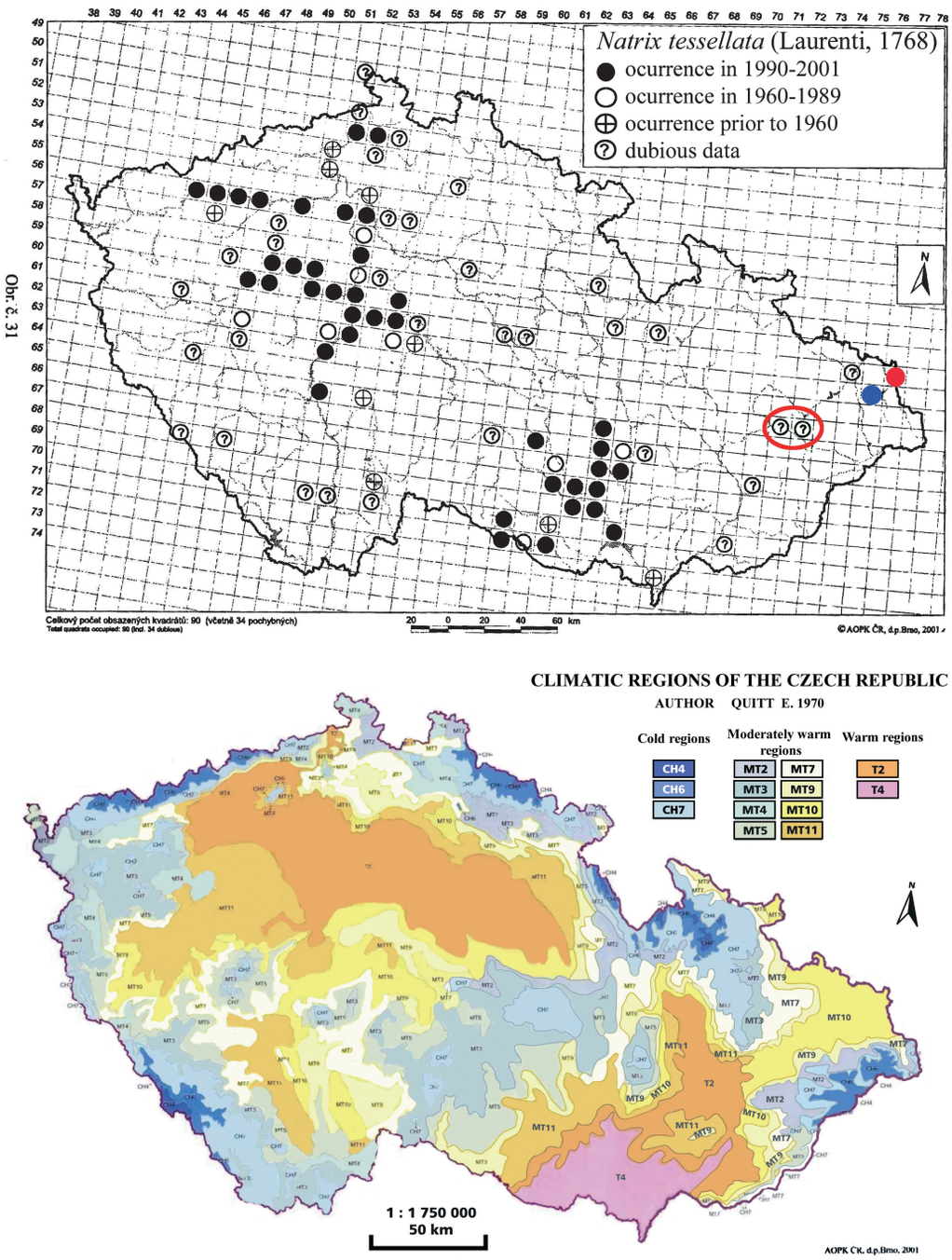

Fig. 3. Distribution of *N. tessellata* in the Czech Republic within the context of climatic characteristics. Above: Map complemented with the new records from Silesia region. Blue dot = reproducing population at Havířov Czech Silesia, red dot = photographed specimen from Polish Silesia (Vlček et al. 2010). Below: Climatic regions of the Czech Republic (Quitt 1970). With permission adapted after Mikátová et al. (2001).

New Documented Records

History of Discovery: Overall, the only certain records of *Natrix tessellata* from Czech Silesia up until 2009 were the two specimens from Sušanka Brook near Havířov (Vlček 1998). Both specimens were females, with one of them gravid. During the subsequent three years, *N. tessellata* was observed twice more at this brook (Vlček, unpubl. data). These sightings indicated that a stable population may exist in the general area of the Sušanka reservoir. But the surprise came not until several years later, on the 10 May 2009, when local fishermen informed the first author about a large number of watersnakes. On the same day, the first author confirmed, that the reservoir is indeed inhabited by a reproducing population of *N. tessellata*, yielding different size classes of individuals. Meanwhile, the Sušanka reservoir at Havířov has been visited by all the authors and a max-

Fig. 4. A composite image of grass snake *Natrix natrix* from the Sušanka reservoirs, Havířov, Czech Silesia, demonstrating the nearly lack of dorsal spots, compared to the syntopic heavily spotted *N. tessellata* (see Fig. 5). Photo: Petr Vlček.

Fig. 5. Composite image of a typical yellowish and a contrastingly spotted color morph of *N. tessellata* from Sušanka reservoirs, Havířov, Czech Silesia. Photos: Petr Vlček & Konrad Mebert.

imum of 33 adult *N. tessellata* were counted on a single morning, 19 June 2010.

Ponds of Sušanka Reservoirs: The newly discovered population of *Natrix tessellata* at the Sušanka reservoir is situated on the northern periphery of Havířov (49°47'N, 18°25'E, 252 m a.s.l.), adjacent to the site of its first detection along the Sušanka Brook (record 3, Fig. 2B.). The Sušanka reservoir is a system of seven open water ponds (P1–P7, see Fig. 2B), whereby P4 contains little water as of 2010, and is being progressively grown over by reed grass. The ponds were used for sediment deposit and retreatment of water from the bituminous coal mines. The surface of the study area is circa 22.5 ha (1500 × 170 m).

Geomorphologically, the study area appertains to the Ostrava Mining Basin, the most widespread coal deposits in the Czech Republic. It is a densely populated

Fig. 6. Preserved *N. tessellata* from Morávka River found DOR between Raškovice and Skalice (record 7). No exact locality data. Collection of Faculty of Science at the University of Ostrava. Photo: Jiří Kupka.

(777–1443 persons/km²) and urbanized area of the Ostravsko-Karvinsko district. North of the reservoir flows the Sušanka Brook in southern direction and after 1.5 km merges with the Lučina River near Havířov. It is fed by some smaller brooks, and meanders through heavily settled and agricultured areas. The local mining operations cause frequent fly-ash precipitation and sludge beds of coal deposits. As a consequence, the brook has a very low water quality in its lower reach. The bed of the brook is mainly rocky to muddy. Near its confluence with the Lučina river, the Sušanka Brook is channelized, practically blocking the self-cleaning ability of the brook. The brook is ecologically destabilized and the entire area requires some effective measures of rehabilitation to improve the natural situation (Prymus 1992). The impact of deep mining and industry on the environment is very noticable in the whole region of Ostravsko-Karvinsko. There are sedimentary waste piles and mullock from coal-mines, including different accumulations of material and dumps (Pavelková 2008).

N. tessellata have been observed in all but one pond (P7). The highest density was perceived in P5 and P2. Even though there is some variation in the topomorphology among the ponds, other environmental aspects including climate and prey availabilty appear to render a generally suitable condition for most ponds to attract and enable a large population of *N. tessellata*. Hence, P2 is briefly described as a representative example of the habitat at the Sušanka reservoir.

Pond 2 (P2) has an approximative quadrate shape of 130 × 130 m (Figs. 2B, 6). Its banks were built on mullock (rocky waste material, mostly coal chips, obtained from mining activities). The bank stretches along a 45 degree

Fig. 7. Pond P2 of Sušanka reservoirs, Havířov in Karvinsko (Czech Silesia, Czech Republic), where the reproducing population of *N. tessellata* was discovered in 2009. The embankment of the pond provides subterranean cavities ideal for shelters, in particular under the pipes visible on the left side. Photos: Petr Vlček.

Fig. 8. A gravid female *N. tessellata* absorbs the heat on the reservoir bank. The dark mullock, built from mining activities, is an optimal substratum for the dice snakes at Havířov, not only providing suitable shelter, but also enabling thermoregulation on a rapidly heating surface. Photo: Petr Vlček.

slope and an approximately 3–10 m width (Fig. 7). Its distance from Sušanka Brook is circa 15–30 m. Mullock is the principal structure material of all ponds in the reservoirs of Sušanka. Mullock substratum is variable in its form, consisting of large dust particles, rocks of different sizes to large, dark and sharp-edged rocks (Fig. 8). Banks of P2 is partly overgrown with herbacious vegetation and a few trees with typical woody plants of the genera *Alnus, Salix,* and *Betula*. Other bank zones are more open, often with a barren character. *N. tessellata* has been found in both situations, but was detected most frequently in areas of little vegetation, where solar insulation appears to be sufficient for thermoregulatory activities. There are only a few shallow areas along the pond, mainly along its northern and western side. The entire area of the Sušanka reservoirs is frequented by fishermen.

***Polish Silesia*:** The dice snake *Natrix tessellata* was previously not confirmed to exist in Poland in historical periods (Juszczyk 1987, Najbar 1995, Gruschwitz et al. 1999, Berger 2000, Głowaciński & Rafiński 2003). Its first documented occurrence on Polish territory stems from the lower reach of Olše River (241 m a.s.l.), approximately 9.5 km straight line and northeast from the populations at Havířov (Vlček et al. 2010, red dot in Figs. 2A, 3A). A 2-hour search for *N. tessellata* near the Polish site along the Olse River and the ponds of Pogwizdow was conducted by the senior and the last author on 23 June 2010. Even though suitable habitat was detected, in particular along the river, only six grass snakes *N. natrix* could be found.

Discussion and Conclusions

The newly discovered population of *Natrix tessellata* at Havířov in the Karvinsko District of Silesia, Czech Republic, and adjacent Poland was a surprise, since the herpetofauna of these two countries appeared to be well documented with relatively recent national publications (Juszczyk 1987, Najbar 1995, Berger 2000, Mikátová et al. 2001). The reproducing population at the Sušanka reservoirs has a few attributes that sets it apart from other populations in the Czech Republic or middle Europe from north or east of the Alps (sensu Gruschwitz et al. 1999, Mikátová et al. 2001).

1) It is the first documented occurrence of *N. tessellata* from the Baltic Sea Drainage Basin (BSDB), which is connected via the Odra River system.

2) This population is not related to the fluvial river phenomenon with its microclimatically beneficial slope habitat, which are normally populated by *N. tessellata* in the Czech Repbulic. Moreover, this locality is situated in the Polonicum biogeographical subprovince, whose climate is colder than at similar altitudes in the Hercinian subprovince (Culek 1996). However, comparing the distribution of *N. tessellata* with the climate map by Quitt (1970) of the Czech Republic (Figs. 3B) shows, that the population at Havířov (or Czech Silesia *sensu lato*) inhabit a moderately warm region termed MT10. This climate is even slightly warmer than in the region of MT9 in northern Moravia, Czech Republic, which provides sufficient good conditions for currently surviving populations of *N. tessellata*.

The distribution of *N. tessellata* in the Czech Republic closely corresponds with the distribution of the thermo-

philic eastern green lizard (*Lacerta viridis*). Both these species occur syntopically in the fluvial river phenomenon (Mikátová et al. 2001). However, *L. viridis* does not occur in Silesia today. On the other hand, the historical occurrence of *L. viridis* in Ustroň town in southern Poland is very interesting in this regard (Juszczyk 1987). These records are in relative close proximity to *N. tessellata* in Havířov and the Polish record at Pogwizdow with a straight line distance of only 27 km, respectively 17 km. This indicates a regional warmer climate at least in the recent past, and hence, the historical occurrence of *L. viridis* in Czech Silesia, including the area of northern Moravia, appears to be very probable in this context (Hudeček & Šuhaj 1993).

Fig. 9. View of potential hibernaculum at pond P2. Yellow dot: one *N. tessellata* was observed on 1 April 2010. See also yellow dot in Figure 2 for an aerial image of the same hibernation site. Red dot: site of three balls of snakes acc. a verbal report, April 2009, possibly representing mating balls of *N. tessellata* (or/and *N. natrix*). Photo: Petr Vlček

Fig. 10. Closer view of potential hibernaculum from Figure 9, where one *N. tessellata* was observed in front of it (insert). The snake was found on 1 April 2010 at 18 C temperature. Another seven specimens were found on the same day at the northern shore of the same pond. A first inspection at the same site on 26 March 2010 (21 C) has not yielded any *N. tessellata*, but four *Lacerta agilis* and one *N. natrix*. Photo: Petr Vlček

Fig. 11. Bank of mullock and ovipostion site. Eggs were uncovered (see also insert). Photo: Petr Vlček

3) *N. tessellata* reproduces, hibernates,hunts, and hence thrives, in the Ostrava Mining Basin all year in a predominant anthropogenic biotope of still waters in contrast to the naturally sloped habitat of most other populations of Czech *N. tessellata* (see above). These reservoirs are built a few metres higher than the water surface of the adjacent brook. The snakes lay their eggs and also hibernate (Fig. 9 and 10) in subterranean cavities in the bank and under the pipes, which are laid over the mullock (Figs. 11). The local anthropogenic habitat probably is preferred over the natural Sušanka Brook, which is regulated, flanked by fully shading trees, and markedly contaminated. The ponds, on the contrary, render relatively clear water, sufficient fish diet, and sparsely vegetated slopes along the ponds. Such slopes produce a beneficial microclimatic environment, as they promote rapidly elevating temperatures required for physiologically essential aspects of the life history of *N. tessellata* (hibernation, mating, spermatogenesis, embryogenesis, digestion, growth, ecdysis, oviposition).

4) The autochthonous origin of the population at Havířov in the BSDB was questionable and appeared to be unlikely at a first glance, because of the large air-distances of 145 km farther southeast to the nearest confirmed natural population on Svratka River near Brno and of 50 km to the two potential records from the Bečva River (1: near villages Kamenec u Skaličky, 49°31‘59.60“N, 17°47‘31.23“E; and 2: Hustopeče nad Bečvou, bridge between Choryně / Hustopeče nad Bečvou 49°30‘06.41“N, 17°54‘22.37“E). The records from the Bečva River are noted as questionable in Mikátová et al. (2001), but after contacting the observer (V. Přikryl), we conclude that his knowledge about the local herpetofauna appeared reliable and the local habitat was perceived as suitable for *N. tessellata* after a short visit by one of the authors (VZ). Subsequently, we received a document from the 90s in which V. Přikryl lists a total of 12 *N. tessellata* with locality data that he has observed in that same re-

gion between 1963 and 1992. This region may have been the source from where *N. tessellata* migrated north to colonize the Havířov area in recent times (decades). However, both, Svratka and Bečva rivers, belong to the Black Sea drainage area and are too far (longer routes than the air-distances mentioned above) for a migratory individual or a group of *N. tessellata* to reach the Silesia sites within their lifetime. This should be also viewed in regards to the known small seasonal home ranges and relatively short distances of movements of only a few hundred meters of individual *N. tessellata* (e.g. Lenz & Gruschwitz 1993, Bendel 1997, Neumann & Mebert 2011, Conelli et al. 2011, Velenský et al. 2011). Hence, the records from the Svratka and Bečva rivers are unlikely sources for *N. tessellata* at Havířov and the BSDB. The same reasoning accounts also for a potential but unlikely migration between other recently discoverd sites in the general Silesia area, such as the preserved *N. tessellata* form the Morávka River or the one from the Polish site (Vlček et al. 2010). For example, if an individual *N. tessellata* from the Sušanka resevoirs at Havířov would have migrated to Morávka River, it had been crawling and swimming 33 km downstream, from the Sušanka Brook into the Lučina River, then up the Ostravice River, and finally into the Morávka River. Even a longer distance would be required to reach the Polish site of *N. tessellata*, as individuls would have to wander over 60 km along the ponds of Sušanka, down the Sušanka Brook, then the Lučina River, the Ostravice River, the Odra River, and finally into the Olše River. These unlikely scenarios could leave us with the suspicion that the *N. tessellata* from the Sušanka resevoirs at Havířov are the progeny of introduced specimens in the recent past and thus would seem to support their allochthonous state. However, on a closer look, there are several points that are in support of a natural occurrence of *N. tessellata* in southern Silesia, the Czech Republic and adjacent areas of Poland, which are subsequently listed.

First, 11 accounts of published and unpublished records of *N. tessellata* in Silesia, though of qualitatively different evidence, starting with the anonymous verbal information from fishermen to the observations by biologists to the documented preserved specimen, is nontheless a relatively high number of independent reports,

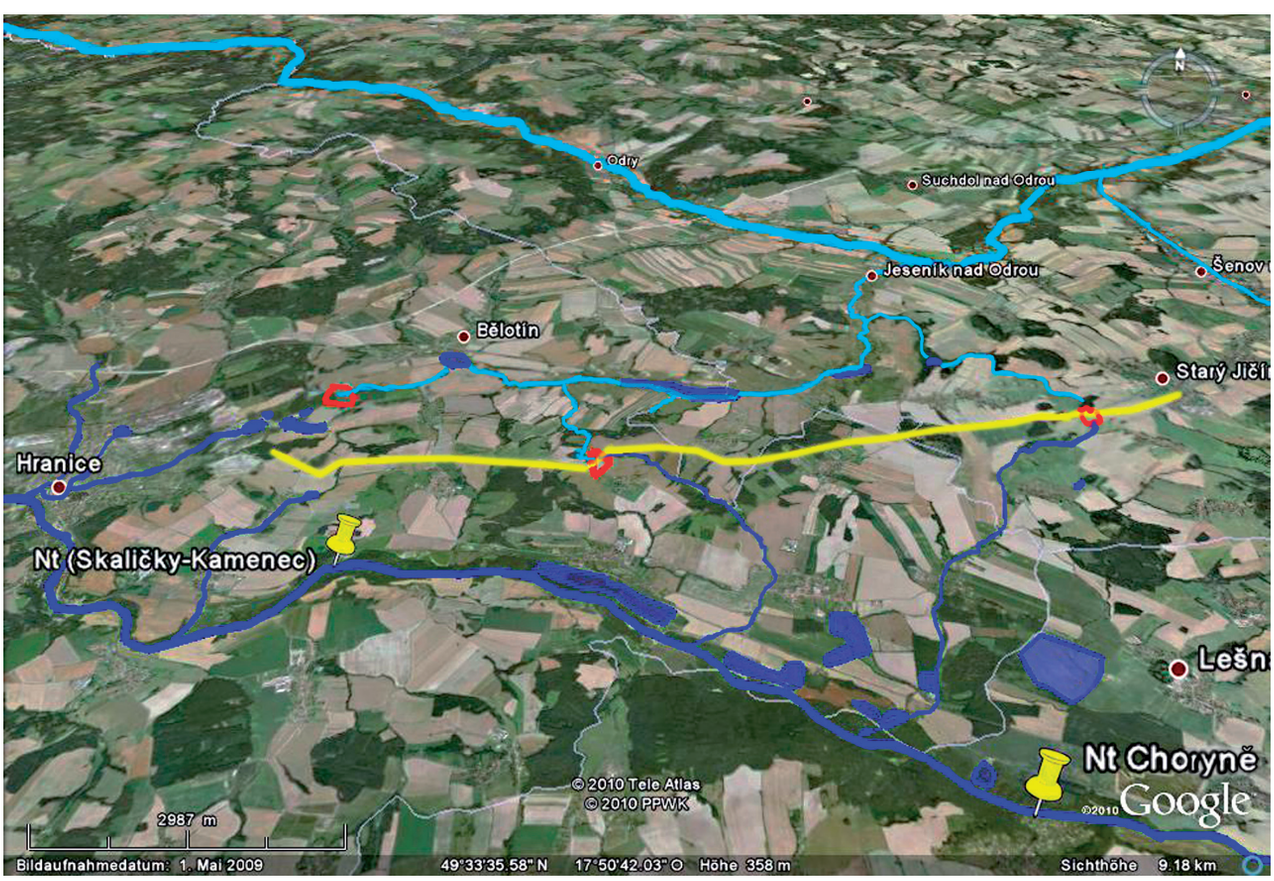

Fig. 12. Proximity between the Baltic Sea and the Black Sea Drainages in northeastern Czech Republic, displaying potential routes for *N. tessellata* to migrate from the Becva River (dark blue, bold) of the Black Sea Drainage Basin into the Odra River system (light blue, bold) of the Baltic Sea Drainage Basin. Dark and light blue lines are corresponding tributaries to the two river systems and represent putative corridors between the systems. Ponds are shown as dark blue circle patches. The yellow line approximates the dividing ridge, and the red areas represent the passes between tributaries for the two river systems, respectively. Yellow thumbnails are two anecdotal, but reliable records of *N. tessellata* (see text).

and sites as well, for being just accidental. However, even though introduction can be very successful in *N. tessellata* (e.g. Mebert 1993, Lenz et al. 2008), it appears very unlikely that anecdotal reports of *N. tessellata* from more than five different sites by unrelated persons point all to the same species.

Second, the credible verbal information from locals (point 11 in Results) corroborate the hypothesis of an autochthonous origin of *N. tessellata* from Havířov. Jančar (2010 pers. comm.), who well distinguishes the two local *Natrix* species, observed *N. tessellata* at the Sušanka reservoirs from his childhood on (1955–1958) continually to 2010. He reported a noticeable decrease of snakes over the decades.

Third, even though the Silesia records are located north of the Carpathian Mountains, supposedly a natural topographic barrier for the northward expansion during cooler climates, the mountain range in fact only borders the far eastern part of the Czech Republic and its Silesia area. To the west of the Havířov population of *N. tessellata* and all other unconfirmed regional records rise the Jeseniky Mountains, another natural barrier. However, in between these mountain ranges lies a lowland corridor, extending from the Silesian *N. tessellata* records south to the next known populations near Brno. This corridor rarely rises above 300 m a.s.l., and thus, conforms to all other Silesia records, which lie between 193 and 395 m a.s.l. This altitudinal zone corresponds to the habitat altitude of *N. tessellata* in middle European populations (Ivanov 1997b, Mikátová et al. 2001).

Indeed, the two anecdotal records from Bečva River (Black Sea Drainage) are very near to the dividing ridge over to the Baltic Sea Drainage Basin (BSDB). A closer look reveals, the proximity between the Baltic and the Black Sea drainages, and thus, providing potential migratory routes for *N. tessellata* across the drainage dividing range (see Fig. 12). First, the anecdotal record from between the villages Kamenec and Skaličky is only 7 km upstream from a tributary at the town Hranice. Smaller tributaries lead form that confluence through Hranice and northeast of it to a pond system at 290 m a.s.l. (Fig. 12). From there only 500 m air-distance lead to an area at approx. 326 m a.s.l., which is part of the dividing ridge between the Baltic and the Black Sea drainages. The dividing ridge is another 500 m away from the first tributary of the Odra River system (BSDB), which is within the reach of individual movements of *N. tessellata* (see exampels in Mebert 2011). Second, 4.7 km upstream of that same record enters a tributary that leads slightly uphill through the village Hustopeče and another 3.7 km up to a small area at 360 m a.s.l. north of a small settlement named Hranické Loučky. This area is also part of the dividing ridge of the two drainages, with only 30 m distance separating two small brooks/canals of the Black Sea and Baltic Sea drainages. Third, the record from the bridge between Choryně and Hustopeče is only 2.5 km upstream from a tributary entrance that leads through two small villages up to an area at 330 m a.s.l. just west of Janovice. From there, the next small brook/canal leading into the BSDB is only 600 m away. Hence, this is another pass between the Black Sea and Baltic Sea drainages that, considering the distances, is within the range of annual movements for *N. tessellata* (see examples in Mebert 2011).

Even though the low lying landscape between Brno and Havířov has been drastically changed for agricultural purposes over the last decades to centuries, and the passes between the Black Sea and Baltic Sea drainages described above barely provide suitable conditions for *N. tessellata* today, potentially favorable conditions with connecting aquatic systems may have existed in the historic past or earlier in the warmer Atlantikum period approximately 6000 to 10,000 BP (Böhme 1989, Wikipedia 2010), allowing for an expansion of *N. tessellata* from central Czech Republic north into the Silesia region. The Silesia populations of *N. tessellata* may represent a relict population from a warmer period of the present postglacial period (Atlantikum).

Similar arguments are proposed for the northern, isolated populations in Germany (Obst & Strasser 2011), Ukraine (Kotenko et al. 2011), and Russia (Litvinov et al. 2011). There is a rich fossil record of *N. tessellata* from the Lower Pleistocene (Lower Biharian) from the Mladeč Caves near the Olomouc city, Czech Republic (Fig. 1). It shows that the range of this species was farther to the north in the Lower Pleistocene and possibly could have reached also the northern boundaries of the Czech Republic (Ivanov 1997a). This presumption indirectly supports the occurrence of *N. cf. tessellata* from the same aged locality at Zabia Cave (near Podlesice) in Polish Silesia (Ivanov 1997b), which is only 105 km northeast from Olše River (Fig. 1).

Fourth, the climatic maps (see point 2 in the Discussion above and Fig. 3) show that there is a moderately warm corridor (at least level MT10) connecting Brno with Havířov. Hence, the regional climate appears sufficiently suitable for the expansion of *N. tessellata* from the southern Czech Republic into Silesia with subsequent formation of populations such as the one at Havířov.

Fifth, many *N. tessellata* from Havířov have a yellow tone in their dorsal color (Fig. 8) unlike the more grayish to olive individuals from elsewhere in the Czech Republic (e.g. Velenský et al. 2011). This might be a sign for an independent, introduced population. However, dorsal color may change over a few generations in response to local selective pressures. Such a marked visual difference, thus, reflects rather current or recent isolation than a different origin.

Finally, all the arguments listed and explained above suggest that *N. tessellata* in Czech Silesia dates back to an autochthonous origin. But only a genetic comparison of the three metapopulations in the Czech Republic, from the Black Sea, the Northern Sea, and now also the BSDB, and other populations farther south could resolve this issue. Such a genetic comparison is currently in the planing stages by two of the authors above (DJ & KM).

In the light of these recent findings, the previously unconfirmed records will require a thorough revision and field visits to confirm or discard the presence of more sites with *N. tessellata* in Czech Silesia and nearby Poland in the years to come. We suppose that *N. tessellata* had a wider distribution, reaching even into Silesia in recent history (the last 2000 years), when aquatic systems were more open, as wood was cut due to their need of firewood by the local villagers and farmers. The aquatic system became closed and shadowed as a consequence of decreased clearing of adjoining forests during the past 100 years, as other energy (heating) resources than wood were exploited. On the basis of these facts, we preliminarily consider the occurrence of *N. tessellata* in Silesia as autochthonous. With the evaluations brought forward in this report, we suggest to subsequently develop a plan for measures to improve the living conditions for the dice snake in Czeck Silesia, as they are not only a critically endangerd species in the Czech Republic, but also constitute the sole representatives of this species in the Baltic Sea Drainage Basin.

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References

Anonymus (2004): Bohumín zajímavě. – Vydal městský úřad Bohumín v srpnu 2004 (druhé opravené vydání původní publikace z roku 2000) (in Czech).

Baha El Din, S. (2006): A Guide to the Reptiles and Amphibians of Egypt. – American University in Cairo Press, Egypt.

Bendel, P.(1997): Zur Physiologie, Morphometrie und Populationsökologie der Würfelnatter *Natrix tessellata* am Alpnachersee. – M.S. thesis, Zoological Museum, University of Zürich, Switzerland.

Berger, L. (2000): Płazy i gady Polski. Klucz do oznaczania. – Wydawnictwo Naukowe PWN, Warszawa, Poznań (in Polish).

Böhme, W. (1989): Klimafaktoren und Artenrückgang am Beispiel mitteleuropäischer . Eidechsen (Reptilia: Lacertidae). – Schr.-R.f. Landschaftspflege u. Naturschutz **29**: 195–202.

Conelli, A.E., Nembrini, M. & K. Mebert (2011): Different habitat use of dice snakes, *Natrix tessellata*, among three populations in Ticino Canton, Switzerland – A radiotelemetry study Mertensiella **18**: 100–116.

Culek, M. (1996) (Ed.): Biogeografické členění České Republiky. – Enigma, Praha.

Foral, I. (1994): Inventarizační Průzkum PR Štěpán. – M.S. thesis, deposited at AOPK ČR Ostrava (in Czech).

Głowaciński, Z. & J. Rafiński (2003): Atlas Płazów i Gadów Polski. Status,Rozmieszczenie, Ochtona. – Inspekcja Ochrony Środowiska / Instytut Ochrony Przyrody PAN / Bibl. Monitoringu Przyrody, Warszawa and Kraków, Poland.

Gruschwitz, M., Lenz, S., Mebert, K. & V. Laňka (1999): *Natrix tessellata* (Laurenti, 1768) – Würfelnatter. – In: Böhme, W. (Ed.): Handbuch der Amphibien und Reptilien Europas **Band 3**/II Schlangen (Serpentes) II:. – AULA-Verlag, Wiesbaden, Germany.

Hudeček, J. & J. Šuhaj (1993): Ještěrka zelená. Sporné druhy v batrachofauně a herpetofauně severní Moravy a Slezska. – Vlastivěd. Listy **19**: 40–41 (in Czech).

Ivanov, M. (1997a): Hadi Evropského Kenozoika. – M.S. (disertační práce), Masarykova Univerzita, Brno, Czech Republic.

Ivanov, M. (1997b): Old Biharian reptiles of Zabia Cave (Poland). – Acta Zool. Cracov. (Kraków, Poland) **40**(2): 249–267.

Juszczyk, W. (1987): Płazy i Gady Krajowe, **część 3–gady**. – Wydawnictwo Państwowe Naukowe Warszawa, Poland (in Polish).

Kotenko, T.I., Shaitan, S.V., Starkov, V.G. & O.I. Zinenko (2011): The northern range limit of the dice snake, *Natrix tessellata*, in Ukraine and the Don River Basin in Russia. – Mertensiella **18**: 311–324.

Lenz, S. & M. Gruschwitz (1993): Zur Autökologie der Würfelnatter, *Natrix t. tessellata* (Laurenti 1768) (Reptilia: Serpentes: Colubridae) in Deutschland. – Mertensiella **3**:235–252.

Lenz, S., Mebert, K. & J. Hill (2008): Die Würfelnatter: Reptil des Jahres 2009. – In: Die Würfelnatter, Reptil des Jahres, Aktionsbroschüre. – DGHT, Rheinbach, Germany.

Litvinov, N., Bakiev, A. & K. Mebert (2011): Thermobiology and microclimate of the dice snake at its northern range limit in Russia. – Mertensiella **18**: 330–336.

Mebert, K. (1993): Untersuchung zur Morphologie und Taxonomie der Würfelnatter *Natrix tessellata* (Laurenti 1768) in der Schweiz und im südlichen Alpenraum. – M.S. thesis, Zoological Museum, University of Zürich, Switzerland.

Mebert, K. (Ed.) (2011): The Dice Snake, *Natrix tessellata*: Biology, Distribution and Conservation of a Palaearctic Species. – Mertensiella **18**, DGHT, Rheinbach, Germany.

Mikátová, B., Zavadil V. & V. Laňka (2001): Dice Snake – *Natrix tessellata* (Laurenti, 1768). – In: Mikátová, B., Vlašín, M. & V. Zavadil (Eds.): Atlas of the Distribution of Reptiles in the Czech Republic. – AOPK ČR, Brno-Praha, Czech Republic: 140–151 (in Czech and English).

Najbar, B. (1995): Płazy i Gady Polski. – Wyższa Szkoła Inżynierska, Zielona Góra, (in Polish).

Neumann, C. & K. Mebert (2011): Migration behavior of endangered dice snakes (*Natrix tessellata*) at the River Nahe, Germany. – Mertensiella **18**: 39–48.

Obst, F.-J. & P. Strasser (2011): Das Sächsische Vorkommen der Würfelnatter im Elbtal bei Meissen. – Mertensiella **18**: 58–70.

Pavelková, L. (2008): Ochrana přírody a krajiny na Ostravsku, Bakalářská práce, Univerzita Palackého v Olomouci, Přírodovědecká Fakulta, Katedra Geografie, Olomouc (in Czech).

Polášek, Z. (1988): Předběžná informace o průzkumu obojživelníků a plazů v okrese Karviná. – Hyla, Karvinské mládí č. **28**: 3–10 (in Czech).

Prymus, Z. (1992): Hodnocení vlivu navrhované výstavby obchodního centra v mokřadní lokalitě Havířov-kruhový objezd na životní prostředí. Compiled by: Výrobně-obchodní družstvo INTERECO, 735 95 Bystřice nad Olší, 15th June 1992 (in Czech).

Quitt, E. (1970): Mapa Klimatických Oblastí ČSSR. – Geografický ústav ČSAV Brno, Kartografie, Praha (in Czech).

Velenský, M., Velenský, P. & K. Mebert (2011): Ecology and ethology of dice snakes, *Natrix tessellata*, in the city district Troja, Prague. – Mertensiella **18**: 157–176.

Vlček, P. (1998): Dva nálezy užovky podplamaté ve Slezsku (eng: Two records of dice snakes in Silesia). – Živa, Praha **46**(2): 85 (in Czech).

Vlček, P., Najbar, B. & D. Jablonski (2010): First records of the dice snake (*Natrix tessellata*) from the north-eastern part of the Czech Republic and Poland. – Herpetology Notes **3**: 23–26.

Wikipedia (2010): Atlantikum. – Available at: http://de.wikipedia.org/w/index.php?oldid=71584232

Zavadil, V. (1993): Vertikale Verbreitung der Amphibien in der Tschechoslowakei. –Salamandra **28**: 202–222 (in German with Czech summary).

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