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Different shades of snake: Peculiar coloration in an urban population of the Grass Snake, *Natrix natrix* (Linnaeus, 1758)

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Grass snakes *Natrix natrix* (Linnaeus, 1758) are natricine snakes widely distributed in mainland Europe, ranging from Scandinavia to southern Italy (Beebee & Griffiths 2000). Individuals of *N. natrix* are usually olive-grey, greenish, or even steel-grey with various dark blotches and sometimes light stripes (Speybroeck et al. 2016). They are characterized with a half-moon yellow collar behind the head, which has been proven to have an aposematic role in deterring predators (Madsen 1987). Melanism in natricines is quite common; either as sporadic occurrences within populations (Mollov 2012) and even as a regularly occurring morph (Ajtić et al. 2013). Melanistic individuals of *N. natrix* have been reported around the region, from Bulgaria (Mollov 2012), Bosnia and Herzegovina (Bašić & Zimić 2016), Croatia (Zadravec & Lauš 2011) and Montenegro (Gvozdenović & Schweiger 2014), but, so far, no such reports have been made from Serbia.

Study site

In Belgrade, Serbia, there is an urban population of grass snakes around the banks of the Danube river (44° 49'56" N, 20° 30'15" E). At this locality, *N. natrix* is sympatric with another natricine snake, *Natrix tessellata*, along with larger colubrid snakes, *Zamenis longissimus* and *Dolichophis caspius.* The proximity of the Danube river, along with the swampy embankment around the bridge, is proving to be an ideal habitat for these semiaquatic snakes as there is an abundance of food and sites for basking, egg laying and hibernation. However, being so close to the city roads and local settlements places an extremely high anthropogenic pressure on this population.

Results

During the ongoing ecological and behavioral studies at this locality, apart from the usual, green colored individuals with yellow collars, individuals of the subspecies *N. n. persa* (Kindler et al. 2013) are commonly caught at this locality (17% of captured individuals, unpublished data). One interesting fact to point out is that many of the snakes caught lack the bright yellow, white or orange half-moon collars and instead have black spots behind the head. Melanistic individuals have also been caught several times (Fig 1.).

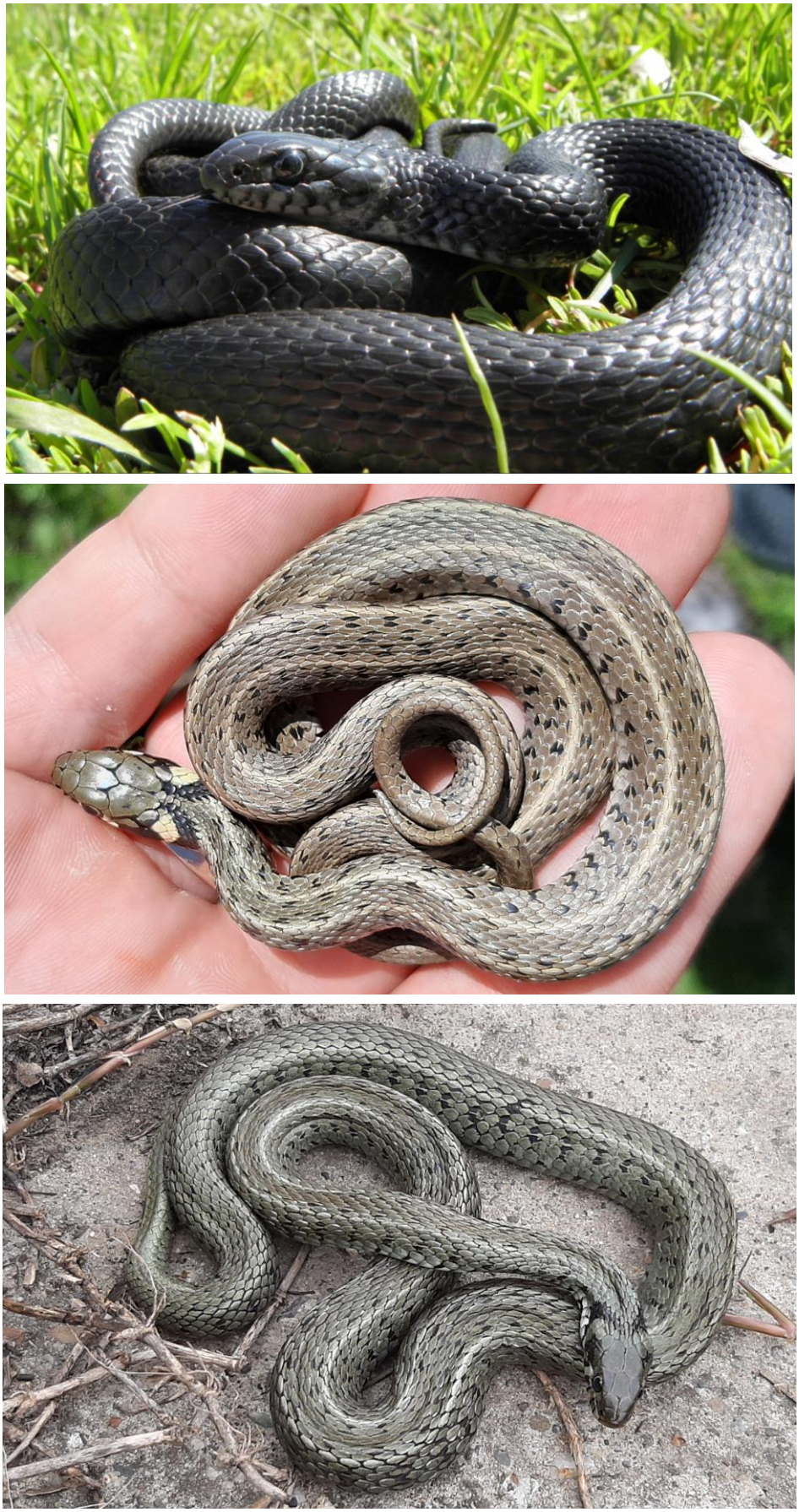

Figure 1. A melanistic individual (top) and an individual from the subspecies *N. n. persa* (middle). A common occurring individual with black spots behind the head (bottom) captured at the locality.

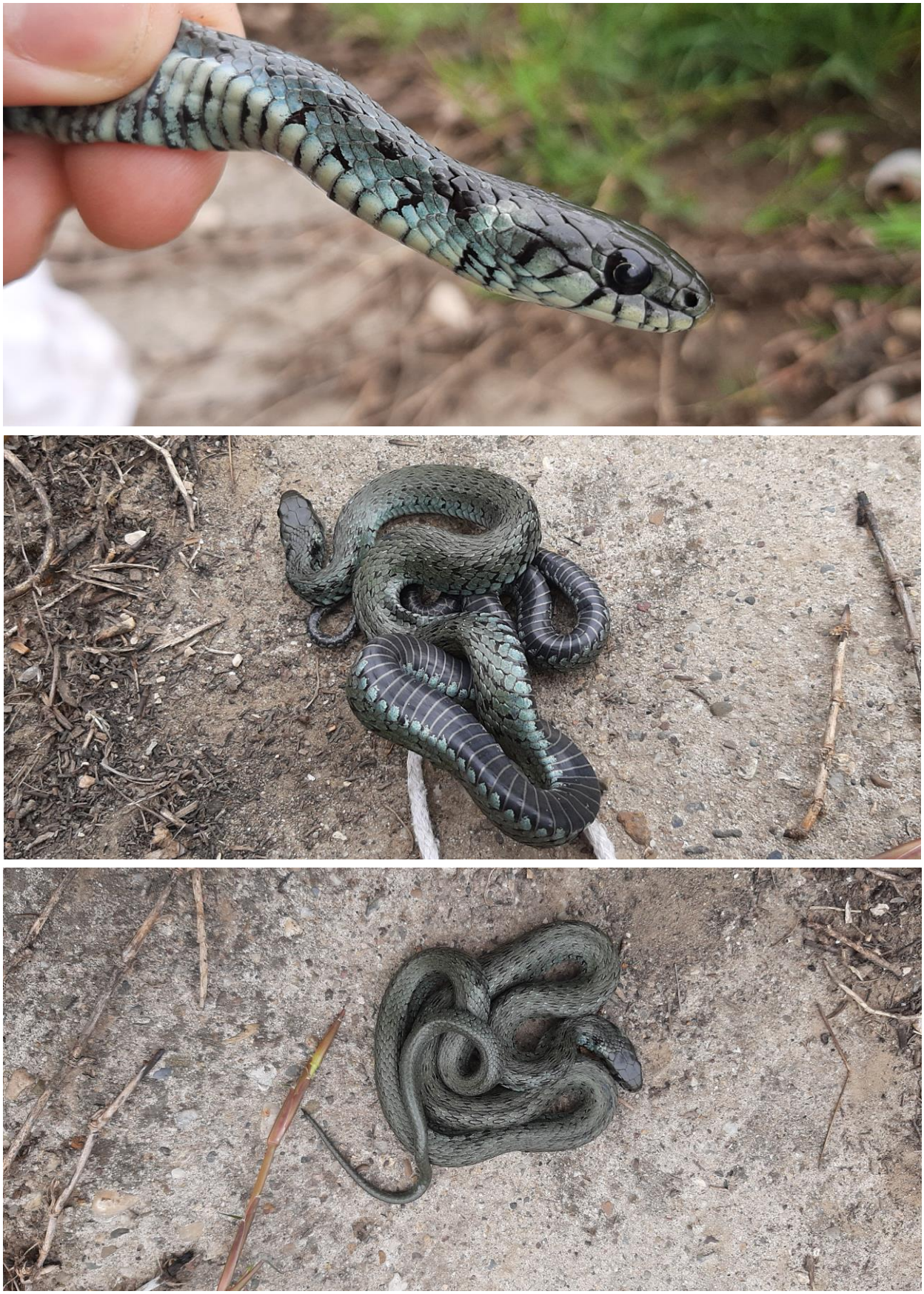

Figure 2. The adult female with a peculiar blue coloration. From the top to bottom: blue coloration present at the margin of the last row of dorsal scales and ventral scales. The white underside of the throat is clearly visible; Dorsal view of the individual; The ventral color switches from white to black towards the tail and the blue color intensifies.

One of the most interesting finds was an individual with a distinctive blue coloration (Fig 2). The snake was an adult female, measuring snout-to-vent length 733 mm, total length 885 mm and weighing 190 grams. The dorsal color was dark green with black dots in an irregular blotched pattern, with no bright half-moon collar present behind the head. The ventral coloration was white around the throat, with a blue hue around the edges of the ventral scales. The color intensifies towards the ends of the tail, going from white to completely black, with intense blue coloration around the edges of ventral scales. There was not any ventral pattern present in stark contrast with the usually present irregular blotches of black.

Discussion

In many reptile species, one of the most important targets of natural selection are color and pattern of individuals (Allen et al. 2013; Olsson et al. 2013). In turn, the plethora of present color and patterns occurring in a population of one species implies the significance of that trait. More precisely, color and pattern surely play an important role as an antipredator mechanism (Isaac & Gregory 2013). This could well be the case with this population; a certain type of predator pressure may shape color and patterns of this snake population, such as the lack of aposematic coloration and emergence of melanistic snakes. Melanistic snakes face certain disadvantages, presumably higher predation risk (Madsen 1987), but the color could be prevalent in populations where it facilitates certain advantages (Andrén & Nilson, 1981). On the other hand, although melanistic snakes may seem conspicuous, some research does not support that predators detect melanistic snakes more than other morphs (Bittner 2003).

Impact of other traits such as the absence of ventral patterns and presence of bluish color is still unknown, and further studies are needed to explain this phenomenon. On the other hand, blue coloration has been reported in melanistic morphs from populations of *Thamnophis sirtalis* in Canada (Mooi et al. 2011).

Many possible factors contribute to the occurrence of melanistic morphs and may be related to gene flow, genetic drift and natural selection (King 2003). Undoubtedly, specific local evolutionary forces (Janzen et al. 2002; Mooi et al. 2011) play an important role in shaping color and pattern of individuals at this locality. Future research of reptile populations that thrive in urban environments is definitely needed in order to answer evolutionary questions that are arising.

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