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RISKS OF ACCIDENTAL INTRODUCTIONS OF VENOMOUS SNAKES INTO CITIES AND SEMI-URBAN AREAS IN SERBIA: REVIEW OF MEDIA-PUBLISHED CASES BETWEEN 2017 AND 2025

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ABSTRACT. In the past decade, multiple incidents have been documented involving the presence of venomous snakes in urban regions of Serbia, where these animals are typically absent. We analyzed the confirmed cases in major cities such as Belgrade, Novi Sad, Niš, Kragujevac, and Kraljevo, along with occurrences in smaller towns. The snake species involved was the nose-horned viper (*Vipera ammodytes*), which often "hitchhikes" vehicles returning from nature; the alternative – escaped captives – was highly improbable. These incidents most often ended with no bites to humans. Public reactions usually included fear and panic. Successful interventions by experts from faculties, institutes, or local snake handlers prevented bites or the establishment of breeding populations in urban areas. We addressed the ecological impacts of habitat disruption/urbanization, shifts in biodiversity, and interactions between humans and wildlife. Ongoing monitoring, public education, and establishment of educated communal services and response protocols are essential to reduce risks to both humans and these protected reptiles.

Keywords: Accidental introduction, urban area, venomous snakes

INTRODUCTION

Serbia is home to three species of venomous snakes: the nose-horned viper (*Vipera ammodytes*), the European adder (*Vipera berus*), and the rare meadow viper (*Vipera ursinii*) (TOMOVIĆ *et al*., 2019). These snakes are typically confined to natural habitats such as hills, mountains, and rural landscapes; they are not indigenous to densely populated (sub)urban environments (*ibid.*). In urban areas, non-venomous snakes (e.g. *Natrix* sp., *Zamenis*

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longissimus or *Dolischophis caspius*) are occasionally encountered, but venomous species are generally absent under normal conditions. All snake species in Serbia are strictly protected by law, except the nose-horned viper, which is "only" protected (ANONYMOUS 2010a, b, 2016). This means that snakes and their habitats must not be disturbed or destroyed (ANONYMOUS, 2016; ANONYMOUS, 2021a). The fines were prescribed for hurting or killing all protected wild species in Serbia, including snakes (ANONYMOUS, 2010c). Unfortunately, laypeople are usually not informed of the protection status of wild species in Serbia or the fines.

In recent years, the media reported on several incidents that brought venomous snakes into large city centers in Serbia. Such events raise concerns about public safety and awareness, and about the potential ecological implications of introducing a top predator into a non-native habitat. They also underscore the interface of human-wildlife interactions in an era of increasing urbanization and mobility.

This article reviews the cases of venomous snakes appearing in Serbian towns and cities documented between 2017 and 2025. We examined the confirmed reports from media and official sources, identified the snake species and their origins, described the typical scenarios that might have led to their urban appearance, and discussed the responses by authorities and communities. In addition, we analyzed the broader ecological context – how habitat disruption and climate conditions may contribute to such incidents – and considered the implications for biodiversity and urban ecosystem dynamics. By treating these case reports as observational data, we aimed to derive patterns and lessons that can inform future wildlife management and public health strategies in Serbia and similar regions.

METHODS

We searched for information on venomous snakes' presence in Serbian urban areas between 2017 and 2025. Data were collected from news articles, governmental and institutional reports, expert commentary, and the e-mails sent to the Serbian Herpetological Society (SHS). Keywords used in online searches included combinations of "poskok", "otrovnica" ("nose-horned viper" and "venomous snake" in Serbian), and city names (e.g., Belgrade, Novi Sad, Niš, Kragujevac, Kraljevo, etc.). We focused on the confirmed sightings or captures of venomous snakes within city limits or densely populated towns, excluding cases that occurred in rural settings and the sightings of non-venomous species. The manner/tone of such media reports will be the subject of another analysis. Relevant ecological information (e.g., snake habitat preferences, protective laws, climate data) was gathered to contextualize the incidents.

RESULTS

In October 2022, a live nose-horned viper was discovered on a busy street (Bulevar despota Stefana) in the heart of Belgrade, a location far from this species' natural habitat (RADOSAVLJEVIĆ, 2022a, b). Wildlife experts noted that venomous snake species "should not be found in Belgrade, especially not in the strict city center", indicating the unusual nature of the sighting. The half-meter viper was safely captured by the city's animal control service and transferred to the Belgrade Zoo where it was kept until nature protection authorities decided whether to release it back into a suitable wild habitat. How a nose-horned viper ended up in downtown Belgrade prompted speculation: biologists suggested it was most likely transported inadvertently, or it was brought by someone to be kept as a pet and was later released/escaped. This specimen was an older female, possibly seeking winter shelter at the time of capture (late autumn). The incident marked one of the first confirmed venomous snake in central Belgrade in recent history.

In Serbia's second-largest city, Novi Sad (the capital of the Vojvodina Province), people found a nose-horned viper in a city park on November 2, 2024 (ANONYMOUS, 2024a). This was reported by e-mail to the SHS and published in the local news (ANONYMOUS, 2024b). The viper was killed (Fig. 1), and another, larger snake (app. 1 m long) managed to escape into the sewage system. The viper was observed by local children. "Since it was small", the people supposed there were more of them, i.e. an entire litter. The first news report ended with a statement, "All services we called claimed that this is not within their jurisdiction" (*ibid*.). However, later during the day, people from "Zelenilo" (public greenery) were observed removing dry leaves and cleaning the park from debris. Experts from the Institute for Nature Conservation of the Vojvodina Province have also come to search the park, and they talked to local people. On November 8, the Public Broadcasting Service of Vojvodina (Bjelić Čabrilo RTV, 2019) wrote about the snake and published a part of their conversation with the first author, who explained where the snake could have come from (ANONYMOUS, 2024b; ANONYMOUS, 2024c).

Figure 1. The viper killed in the park in Novi Sad
(Photo provided by Petković, 2024.).

In Vojvodina, there is only one record of the nose-horned viper in nature, from the village Kusić near Bela Crkva, app. 130 km from Novi Sad (DŽUKIĆ *et al*., 2005); hence, this viper was also probably brought incidentally by some vehicle. Vojvodina province does host small isolated populations of the European adder (on the Fruška Gora Mountain, Vršačke planine hills, and near the Obedska bara wetland), those are in remote areas, and they could not have naturally reached the cities (MUDRINIĆ, 2019; TOMOVIĆ *et al*., 2019; ANONYMOU, 2023a).

The city of Niš, located near the natural nose-horned viper habitat (TOMOVIĆ *et al*., 2019), also experienced a few incidents involving venomous snakes venturing into urbanized zones. On May 2, 2022, customers at the mall on the outskirts of Niš were stunned to find a nose-horned viper on the parking lot in front of a store (ISAILOVIĆ, 2022). The mall's security immediately contacted the local non-governmental animal protection organization, whose members are trained to handle wild animals, including venomous snakes. The viper was later released into a suitable natural habitat outside the city. Investigations into this mall incident revealed a clear cause: the snake's appearance coincided with the holidays, during which many residents had picnic outings in the nearby Sićevačka and Jelašnička klisura gorges – areas known as the natural habitat of nose-horned vipers. Around the same time, another supposed nose-horned viper encounter was recorded in a semi-urban neighborhood in Niš: a 33-year-old

resident reported being bitten by a snake in his yard (TOROVIĆ, 2022). Unfortunately, not many details are available, so we cannot speculate further.

Serbia's fourth-largest city, Kragujevac, saw at least two notable venomous snake incidents in the past decade. The first occurred in May 2017 at the factory yard on the city outskirts (ANONYMOUS, 2017a; RADIŠIĆ, 2017). As a group of workers were leaving at shift's end, they spotted a snake near one of the gates. Unaware it was venomous, one worker attempted to pick it up by the tail, at which point the snake – supposed to be a common European adder (*Vipera berus*) – bit him on the forearm (ANONYMOUS, 2017b). The snake escaped into nearby vegetation after the bite. Like in many other cases, the snake was misidentified: *Vipera berus* is not native to the vicinity of Kragujevac. The surroundings of this city are inhabited only by the nose-horned viper. Medical doctors responded swiftly: the 38-year-old man was given antiviperine serum and other necessary treatment at the hospital, and he recovered without life-threatening complications. The second incident took place in May 2022 in downtown Kragujevac: a nose-horned viper was found entwined in the wheel well of a car parked between the Hotel Kragujevac and a residential building in the city center (PETROVIĆ, 2022). A resident discovered the half-meter viper wedged between the tire and hubcap of her parked car, intermittently poking its head out. Removing this snake proved challenging: it remained stuck inside the wheel for over 24 hours, and none of the city services claimed responsibility for handling snakes. The municipal Zoohygiene department admitted they are only equipped to deal with stray dogs and lack trained personnel for snake capture. Eventually, the car owner had to seek help from a local snake handler, who managed to pull the viper out by the tail after considerable effort. Once extracted, the viper was released outside the city. Again, the incident raised an important administrative issue: it prompted public discussion in Kragujevac about which authorities are responsible for humane snake removal and relocation, since the existing city services were not prepared to respond.

Kraljevo, a city in central Serbia in the Ibar River valley, experienced an unusual surge of snake sightings in the summer of 2024 (ANONYMOUS, 2024d). This town is also comparatively near the nose-horned viper's natural habitat (TOMOVIĆ *et al*., 2019). During an intense heat wave in June 2024, several nose-horned vipers were seen in Kraljevo city center, causing panic among residents. This was a highly abnormal situation – "an invasion of snakes, including some of the most dangerous species, even in the heart of town", as reported by national media (MILOVIĆ, 2024). It was noted that this was not the first occurrence that year: a month earlier, in May, an "enormous" nose-horned viper had also been spotted in the city. In response, the local snake catcher was overwhelmed with calls from frightened citizens. He captured several snakes in the city during that period, including a "capital" specimen of nose-horned viper on an upper floor of a residential building (MILOVIĆ, 2024). No bites were reported in the Kraljevo incidents. By late June, as weather patterns normalized, the wave of urban snake encounters in Kraljevo subsided.

Several smaller communities in Serbia also reported venomous snake encounters. One striking case happened in Užice in April 2024. Užice lies in the western hilly region of Serbia and near the Đetinja River gorge, an area within the nose-horned viper range (TOMOVIĆ *et al*., 2019). A local snake handler was called to intervene when a viper was spotted in the center of Užice, near the river quay outside a pet shop. The viper slithered from under a car toward the pet store entrance and raised the alarm. The local snake handler arrived and swiftly caught the snake. The snake was returned to a wild area outside Užice (GLIGORIJEVIĆ, 2024). Even earlier in spring, on March 4, 2021, a female nose-horned viper was observed on the quay along the Đetinja River in Užice. The local Facebook page warned their followers to be careful and reminded us all that "we are their guests" (ANONYMOUS, 2021b). In April 2025, people also saw and filmed a large specimen of *V. ammodytes* at the quay in Užice (A.B., 2025).

Early 2024 also saw "one of the most venomous snakes on our soil allegedly seen in Pančevo" (a nose-horned viper sighting reported on social media in February), and a large water snake observed near Niš in the same week. In the Pančevo case, a photograph of a nose-horned

viper in a city park caused a stir online. We doubted that it appeared in Pančevo, as that is not its terrain or habitat, and if it did occur, it was "likely via transported wood or by hiding in a vehicle's wheel". No physical capture was made in that instance, so it remains an unconfirmed sighting (SIMIĆ, 2024).

In August 2017, the SHS received an email from Smederevska Palanka: people spotted a nose-horned viper in a street that had been under construction for several weeks and masses of gravel were unloaded there (Fig. 2).

Figure 2. The nose-horned viper observed in Smederevska Palanka city center (Photo provided by Marković, 2017.)

Other small-town incidents typically involved snakes entering yards or homes on the outskirts (where urban meets rural). For example, the media noted an increase in snake encounters in Leskovac in 2021, including some bites, attributable to hot weather and overgrown lots (though these were peripheral areas, not the town center). In a village near Svilajnac in central Serbia, a teenager was bitten by a nose-horned viper in 2023 and successfully treated at the hospital in Kragujevac (ANONYMOUS, 2023b).

In all the presented cases, there was no evidence that accidentally introduced snakes established persistent populations in urban locations. The snakes were either captured and removed to the wild (or to a Zoo) or they fled back out of the immediate area. The incidents were isolated surprises rather than signs of a broader range expansion into cities.

DISCUSSION

The documented incidents of venomous snakes in Serbian cities over the last eight years reveal several recurring themes and implications.

The "stowaway" scenario: all confirmed urban encounters with nose-horned vipers were traced back to inadvertent human-mediated transport. The typical scenario involved a snake hiding in a vehicle (car chassis, engine bay, hubcap) or cargo (firewood, gravel, etc.) in its natural habitat, then being unwittingly carried into the city. Upon arrival, the snake emerges in an entirely unfamiliar urban environment and is disoriented and confused, trying to find a new hiding place or to escape. In a minority of cases, intentional but illicit human action was suspected (someone capturing a wild snake out of curiosity and later releasing or losing it in the city). The Belgrade incident was speculated to have possibly resulted from an individual dumping an unwanted "pet" viper (RADOSAVLJEVIĆ, 2022a), but there was no direct evidence of any deliberate release in the cases we reviewed. Our findings align with broader patterns

observed internationally, where small animals sometimes hitchhike cars, cargo shipments, or nursery plant deliveries into cities, leading to surprise appearances far from their home range (BOMFORD *et al*., 2009; ADAMAPOULOU and LEGAKIS, 2016).

Urbanisation: numerous cities have spread widely during the last decades, and urban zones have penetrated certain previously "wild" areas, some of which naturally housed venomous snakes (the surroundings of Kragujevac, Kraljevo, Užice etc.). In short, having brutally invaded the habitats of wild species, we inevitably came into contact with some of them in what is left of their homes. As a confirmation of this scenario, there is a report from the outskirts of Zagreb, the capital of the neighboring Croatia, of European adders that persisted in the now-urbanized area (ZADRAVEC, 2019). Venomous snake species are more sensitive to disturbance, and their true cohabitation with dense urban (or agricultural, sacred, etc.) settings is rare, except in some tropical countries (BARHADIYA *et al*., 2024; OJHA *et al*., 2025). In contrast to their venomous relatives, non-venomous snakes can adapt to living in (sub)urban, human-dominated environments. Habitat fragmentation and destruction strongly affect wild species and cause dramatic decreases in biodiversity worldwide (BRUM *et al*., 2023; TAN *et al*., 2023). However, sometimes, reptiles benefit to some extent from urban infrastructure (LETTOOF *et al*., 2023), and e.g. from rodents that accompany human settlements (*ibid*.). Certain non-venomous snake species, e.g. *Natrix* sp. and *Zamenis longissimus*, can even thrive in/around man-made structures (MÉSZÁROS *et al*., 2024; MAJOR *et al*., 2025).

The urban ecology of reptiles is still not adequately investigated (BRUM *et al*., 2022). From a biodiversity perspective, the one-off introduction of a venomous snake into a city has a limited direct impact on the urban ecosystem. There is no evidence that the snakes in the reviewed incidents established breeding populations; thus, they did not become invasive or permanently alter the urban fauna. On the other hand, the risk to humans and pets is a primary concern (NIKOLIĆ, 2025). A venomous snake loose in a city poses a potential danger if provoked – for example, if someone unknowingly steps near it or attempts to handle it, like in the Kragujevac factory. Fortunately, in the documented cases, no fatalities occurred, and bites were few. In general, fatalities following bites by venomous snakes in Serbia and the neighboring countries are extremely rare (NIKOLIĆ, 2020; NIKOLIĆ *et al*., 2021).

Urban expansion into snake-inhabited landscapes will increase human-snake interactions, even without any "introduction". In the countries inhabited by more species of snakes (in tropical and sub-tropical climates), the appearance of venomous snakes in urban surroundings is more serious than in Serbia and is reasonably more thoroughly addressed (e.g. BARHADIYA *et al*., 2024). In this sense, encounters with venomous snakes in Serbia – but also with misidentified non-venomous species – should already be used by the local authorities and educators to remind the public that all snakes are valuable constituents of ecosystems, that all are protected and should not be harmed. People should be aware that spring is the period when reptiles "wake" from their "winter dormancy" and start searching for food and mates – which makes them less cautious than usual. Appearance of increased numbers of snakes in spring is not an "invasion" as the media like to present it, but a completely natural phenomenon. People are advised to keep their yards clear of debris and mow their lawns regularly: in clear spaces, snakes are easier to spot and avoid. Numerous websites "advise" people to use some chemical products, e.g. baking soda, to keep the snakes away from their gardens. Others suggest using sulphur or naphthalene. For either of these, there is no proof of efficacy against snakes – quite the opposite (FERRARO, 1995). Such instructions may be more harmful than beneficial, leading the people to believe they "solved" their "snake problem" while the animals remain around the houses.

Climate/weather changes: Another important factor determining the distribution and behavior of snakes is the climate, i.e. environmental temperature (and precipitation, etc.). In the past decades, average temperatures have risen, especially during winter, so many snakes are active in periods we expect them to be "sleeping". Also, cities are warmer than natural surroundings, so these reptiles can find warm places that enable them to remain active when

they should not be (Pančevo in February: GLIGORIJEVIĆ, 2024). On the other hand, summers are becoming too warm (the case from Kraljevo in 2024), and reptiles seek refuge – which can include human-made structures. In regions of the world inhabited by many species of highly venomous snakes, serious analyses are performed in the sense of their range shifts resulting from climate change (MARTINEZ *et al*., 2024).

Public reaction and education: The cases of venomous snakes in the cities presented in the Serbian media highlighted one crucial problem: in most Serbian cities there is no trained communal unit capable of handling snakes. Only Belgrade has one, whose employees were properly educated by the herpetologists from the Institute for Nature Conservation of Serbia. There is a need for clear protocols and training for animal control units in all major cities, which may involve equipping teams with protective gear and having on-call experts, especially during the peaks of snake activity. Moreover, coordination with local hospitals is crucial so that if a venomous snake bite occurs, antivenom is readily available and medical staff are trained in snakebite management. To the best of our knowledge, in addition to the one in Niš, there is only one more registered NGO (also in the south of the country) whose members are trained to handle venomous snakes. In all other cases, snakes are removed from urban areas by the local "snake handlers", highly experienced volunteers, usually without formal education or engagement. This must be changed. In this sense, the first author designed a short course that was launched in 2024 at the University of Kragujevac, "Wildlife handler in specific circumstances" (2024).

Also, the media must be educated to objectively and rationally report about snake encounters (including venomous snake bites) and not to raise and spread panic using words like "horror", "panic", "enormous snake", etc., and photographs of exotic species (BOŠKOVIĆ, 2025) The situation is changing for the better, both among laypeople (many call the SHS to ask for advice), and media workers (they often contact experts), but more effort is needed to adequately educate the widest possible public. Expert input helps prevent panic and unnecessary snake killings by fearful individuals.

Herpetologists in Serbia universally advise that if a snake is spotted, the best course is to keep distance and call professionals. Improper handling not only endangers the person (via bites) but also the snake; panicked attempts to kill snakes can harm protected wildlife and are illegal in Serbia except in extreme self-defense cases. Conservationists and educators try to counter this by emphasizing the rarity of hazardous encounters and the ecological value of snakes. Experts highlight that venomous snakes are useful animals that should be protected and cared for help balance the narrative, turning an alarming event into an educational opportunity. Over the long term, improving public knowledge – such as how to distinguish common non-venomous snakes from vipers, and understanding snake behavior – will reduce panic and unnecessary snake killings, thereby benefiting urban biodiversity.

The Serbian legal framework already protects all native snake species: of the ten Serbian snakes, nine are strictly protected and the nose-horned viper is protected by law (ANONYMOUS, 2010a, b). However, laypeople can hardly find reliable information regarding these reptiles, i.e. educational sources are scarce. The members of the SHS contribute to educating people they contact, but that is not enough: formal educational programs and media coverage should be improved.

From a policy perspective, preventing accidental introductions is challenging – one cannot inspect every car or bundle of firewood for hidden snakes. However, raising awareness among travelers to high-risk rural/"wild" areas could prevent some perilous encounters (NIKOLIĆ *et al*., 2023; PAVIĆ and NIKOLIĆ, 2025). Additionally, continued enforcement against wildlife smuggling is relevant; although our focus is on accidental cases, the threat of exotic venomous snakes via the pet trade exists (DE HARO, 2018). Maintaining robust controls on exotic pet ownership and transport will help ensure Serbia's urban snake surprises are limited to native species and not something more perilous (ANONYMOUS, 2018).

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