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## Wandering shells: social media monitoring reveals the scale of exotic tortoise escapes in Poland

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Tortoises are among the most commonly kept exotic pets worldwide. However, they are often housed in inadequate fenced outdoor enclosures, which increases the risk of escape and potential introduction into the natural environment. The aim of this study was to assess the scale of this problem in Poland by analysing Facebook posts reporting missing and found tortoises. In total, 1,060 posts (532 concerning lost and 528 concerning found tortoises) published between 2010 and 2023 were collected. Ten species were identified, with the most frequently recorded being *Testudo horsfieldii* and *Testudo hermanni*. At least 43.5% of found individuals were in poor health, often exhibiting signs of carapace deformities, overgrown beaks and claws, as well as injuries such as fractures or open wounds. These findings underscore the need to raise public awareness and implement stricter control measures to prevent further introductions of non-native tortoise species into the Polish environment.

**Keywords:** alien species, terraristics, *Testudo* sp., social media, pets

Reptiles constitute one of the largest branches of the exotic pet trade, with species from the order Testudines playing a significant role (Bush et al., 2014; Auliya et al., 2016). Among more than 360 known species of turtles and tortoises, over 50% are currently threatened with extinction, and overexploitation of wild populations remains, along with habitat loss, one of the primary threats to their survival (Rhodin et al., 2018; Stanford et al., 2020). Approximately half of all Testudines species are involved in trade, many of them illegally (Luiselli et al., 2016; Sung & Fong, 2018).

Among Palearctic tortoises, three species: *Testudo hermanni*, *Testudo graeca* and *Testudo horsfieldii* are particularly exploited. In the last century, millions of individuals were exported from former Yugoslavia and the ex-Soviet republics to the United States and various European countries (Lee & Smith, 2010; Ljubicavljević et al., 2011). Such extensive harvesting led to significant population declines, in some cases resulting in population

collapse (Lambert, 1984; Ljubicavljević et al., 2011; Mandimbahasina et al., 2020). Nowadays, most tortoise species are captive-bred and/or are protected under the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES). This has contributed to a reduction in the capture of wild individuals, but not completely halted the practice (Theile et al., 2004). According to CITES data, nearly two million wild-caught individuals were traded between 1990 and 2000 (Luiselli et al., 2016). Despite regulatory frameworks, smuggling attempts into European countries, including Poland, persist (Kaleta & Szymańska, 2010). Currently, many captive tortoises from the genus *Testudo* are kept in outdoor enclosures, at least during the warmer months from spring to autumn (Bauer et al., 2019). Although this practice supports their welfare, it also increases the risk of escape into natural habitats. The extent and ecological consequences of such a phenomenon remain largely unknown.

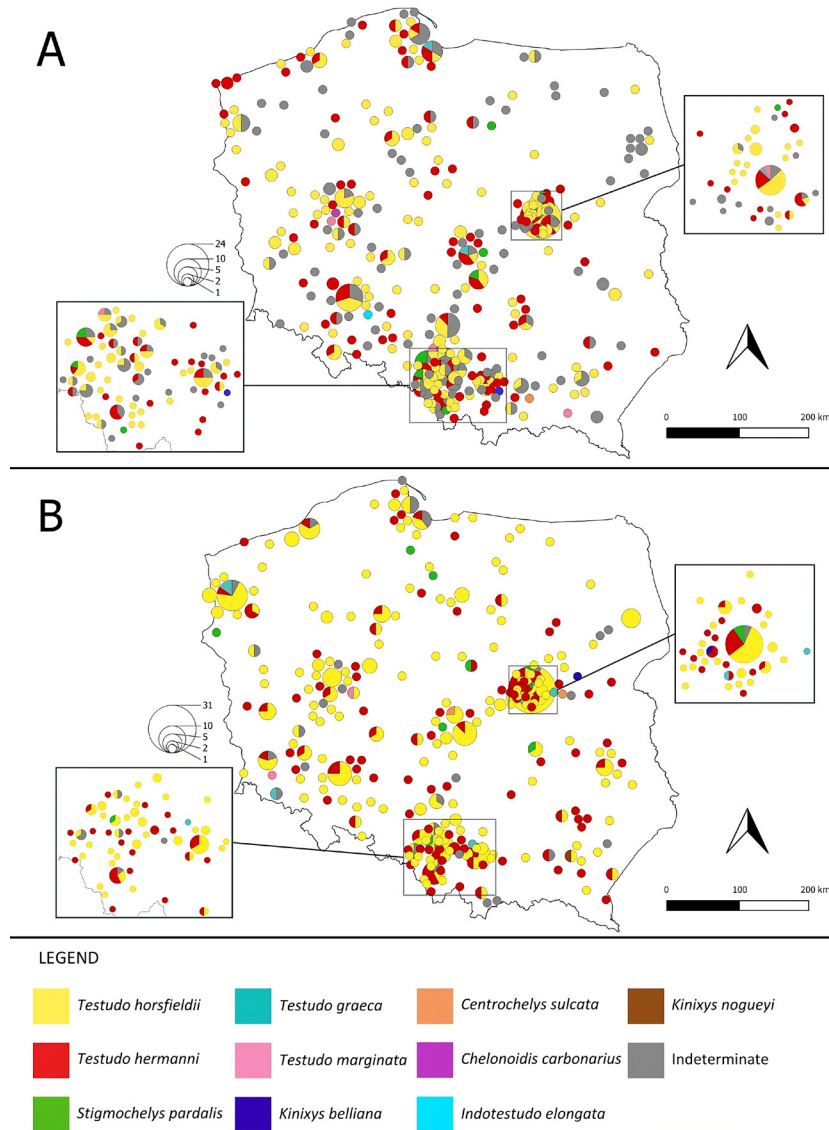
The aim of our study was to assess the scale of this issue by analysing Facebook posts reporting missing and found tortoises in Poland. Additionally, we discuss the potential threats posed by the presence of alien tortoise species in the natural environment of Poland, both to native ecosystems and to the tortoises themselves.

To collect data on missing and found tortoises reported on Facebook, and to ensure data anonymisation, we followed the procedure described by Chowdhury et al. (2024) and Di Minin (2021), adapting it to the specific context of our study. Using various combinations of Polish keywords, we manually searched for relevant posts in groups focused on tortoises, in groups related to lost and found animals in major urban areas of Poland, as well as in Facebook's general search engine. We analysed posts published between 2004 and December 2023. Whenever possible, the following information was collected: species, date of the incident, date of the post, location, habitat type, health condition and whether the missing tortoise was eventually found. All images and user comments attached to the posts were systematically verified to eliminate potential species misidentifications. Cases without photos in tortoise-related groups were

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**Table 1.** Species list and number of exotic tortoises recorded in Poland. IUCN Red List Category: LC – Least Concern, VU – Vulnerable, EN – Endangered, CR – Critically Endangered.

Species	IUCN Red List Category	CITES Appendix	Number of lost individuals	Number of found individuals	Total
<i>Testudo horsfieldii</i>	VU	II	220	319	539
<i>Testudo hermanni</i>	VU	II	127	143	270
<i>Stigmochelys pardalis</i>	LC	II	8	11	19
<i>Testudo graeca</i>	VU	II	4	6	10
<i>Testudo marginata</i>	LC	II	5	3	8
<i>Kinixys belliana</i>	-	II	2	3	5
<i>Centrochelys sulcata</i>	EN	II	1	2	3
<i>Chelonoidis carbonaria</i>	-	II	1	1	2
<i>Kinixys nogueyi</i>	-	II	0	1	1
<i>Indotestudo elongata</i>	CR	II	1	0	1
Indeterminate	-	-	165	40	205



**Figure 1.** Map of Poland showing the localities of reported **A.** lost and **B.** found tortoises during 2010–2023.

categorised simply as “tortoises,” while posts without photos from other sources were excluded from analysis. Multiple posts referring to the same individual, published in different groups or by different users, were considered a single record. The current taxonomy was obtained from Uetz et al. (2025), and the species were classified according to the International Union for Conservation of Nature Red List and CITES appendices. To assess whether the number of posts increased proportionally to the growing number of Facebook users, we quantified the relationship between annual post counts and annual user numbers using Spearman’s rank correlation coefficient. Facebook user statistics were obtained from publicly available sources (sotrender.com and napoleoncat.com) for the years 2013–2023. The analysis was performed using PAST software version 4.08 (Hammer et al., 2001).

In total, 1,060 posts (532 posts on lost tortoises and 528 on found tortoises) shared between June 2010 and October 2023 were included in the dataset. The annual increase in posting was positively correlated with the increasing number of Facebook users in Poland (Spearman’s rho 0.96,  $p < 0.001$ ; Fig. S1 in supplementary materials). They included 1,063 tortoises (534 lost and 529 found individuals) belonging to 10 species (Table 1). The most frequent were *T. horsfieldii* (50.7%) and *T. hermanni* (25.4%), followed by *Stigmochelys pardalis* (1.8%), *T. graeca* (0.9%), *Testudo marginata* (0.7%), *Kinixys belliana* (0.5%), *Centrochelys sulcata* (0.3%), *Chelonoidis carbonarius* (0.2%), *Indotestudo elongata* (0.1%) and *Kinixys nogueyi* (0.1%). Indeterminate specimens accounted for 19.3% of all cases. All species are included in CITES Appendix II. According to the IUCN Red List, *I. elongata* is classified as Critically Endangered (CR), *C. sulcata* as Endangered (EN), *T. horsfieldii*, *T. hermanni* and *T. graeca* as Vulnerable (VU), *T. marginata* and *S. pardalis* as Least Concern (LC), and remaining as not evaluated (NE). Lost tortoises were reported from 320 localities ( $n = 502$ ) and found tortoises from 284 localities ( $n = 470$ ); in the remaining cases, location data were not specified. The largest concentrations were in Warsaw metropolitan area, the Upper Silesian urban area, and other cities (Fig. 1), reflecting the data collection method, which was biased toward urban areas. Tortoises were most frequently reported in urban environments, including backyard gardens, streets, allotments etc. (67.9% of found and 62.6% of lost tortoises). However, a relatively high share of posts concerned non-urban areas (21.3% of found and 32.0% of lost tortoises), such as forests, arable fields or meadows. The health condition of at least 43.5% of found tortoises was poor, with animals often showing signs of carapace deformation (such as rickets or pyramidal growth), overgrown beaks and claws, as well as fractures, open wounds and amputated limbs. Out of 534 lost tortoises, at least 205 were found and removed from the environment.

To our knowledge, this is the first study to demonstrate such a large-scale, contemporary, albeit often short-term, occurrence of alien tortoises in the Central European environment. The scope of these findings extends well beyond anecdotal reports and citizen science records,

such as those from iNaturalist (Šíroký & Moravec, 2015; iNaturalist, 2025). The marked increase in posts in recent years is likely linked to the growing number of Facebook users and the platform’s popularity, which simultaneously highlights the potential of social media as a tool in wildlife research (Kolenda et al., 2021; Chowdhury et al., 2024). In the Polish literature, reports concerning tortoises also remain scarce. Between 2000 and 2016, a total of 12 individuals representing four species were captured at seven locations within the Zielona Góra district (Najbar et al., 2017). Gryz & Krauze-Gryz (2021) documented severely damaged *Testudo* sp. remains found along a railway embankment in Rogów (central Poland) in 2015.

Most cases recorded in this study were escapes from insufficiently secured outdoor enclosures or occurred during walks. However, intentional releases also take place. Already during World War II, large numbers of tortoises were transported to Poland from Southern Europe, and for several years after the war, they were still being found in various parts of the country (Młynarski, 1960; Tuszyńska, 2010; Szarota, 1978). Furthermore, Młynarski (1966) noted that tortoises became increasingly common in Poland as tourists brought them back from the Balkan Peninsula, and many individuals were regularly observed in the wild. Another introduction attempt was documented by Brzeziecki (2022), who described the release of an unknown number of tortoises, likely *T. hermanni* or *T. graeca*, into arable fields near Przybysławice (southern Poland) in the mid-20<sup>th</sup> century. Many of these individuals likely perished quickly due to Poland’s harsh winters. However, with ongoing climate change, and the increasing practice of overwintering tortoises in outdoor enclosures, their survival in the wild for multiple years now seems plausible (Bauer et al., 2019).

Introducing captive-bred tortoises into Central Europe, where no native tortoise species occur, appears to pose minimal risk to local ecosystems. First, a significant proportion of lost tortoises are recovered relatively quickly. Second, their population density remains low, unlike that of *Trachemys scripta*, which is capable of establishing large populations in aquatic habitats (e.g. Standfuss et al., 2016; Trzópek & Kaczmarski, 2021). So far, only isolated cases of tortoise breeding outside captivity have been reported (e.g. in the Netherlands; Brouwer & Bruekers, 2019). Nevertheless, tortoises may serve as vectors of parasites and zoonotic bacteria such as *Salmonella*, *Mycobacterium*, *Citrobacter* and *Escherichia coli*, posing a potential threat to native fauna (Nowak-Chmura, 2014; Rom et al., 2018; Goławska et al., 2019; Casalino et al., 2021; Hossain & Heo, 2021).

Cases of physical injuries observed in tortoises illustrate the risks these animals face in the wild. Furthermore, many of the found individuals were in poor condition, showing signs such as dehydration, beak overgrowth or pyramidal carapace growth. These symptoms likely reflect inadequate captive care, despite reported improvements in husbandry practices in recent decades (Bauer et al., 2019). However, the possible impact of long-term exposure to natural conditions cannot be ruled out.

Fortunately, most recovered tortoises are handed over to NGOs/adoption centres, where they receive proper veterinary care and are eventually rehomed with people knowledgeable about their needs. Unfortunately, others remain with the people who found them. They are often unfamiliar with tortoise care. According to analysed Facebook posts, they feed them cat food, prioritise fruits and vegetables in tortoise diets, and keep them on inappropriate surfaces such as bare floors.

In conclusion, both unintentional escapes from outdoor enclosures and deliberate releases, combined with the poor condition of many recovered tortoises, indicate a high level of owner irresponsibility and a widespread lack of knowledge about these animals, which directly threatens their welfare. Our study and literature review did not reveal any major negative impacts of tortoises on native ecosystems in Poland; however, the introduction of non-native pathogens remains a potential risk. As all observed species are covered under the CITES convention and require registration, we recommend the implementation of mandatory tortoise tagging, which would facilitate the identification of escaped individuals and their owners, as well as the establishment of a nationwide database of microchipped tortoises to support effective monitoring and enforcement. Simultaneously, educational efforts targeted at tortoise keepers should be intensified to improve husbandry practices and animal welfare.

#### Author contributions

Krzysztof Kolenda conceived the idea. Adriana Kościńska, Ada Krasieńska and Ash Wilczek collected data, all authors analysed data, Adriana Kościńska made figures and tables. Krzysztof Kolenda, Adriana Kościńska, Ada Krasieńska and Ash Wilczek wrote the manuscript. All authors read and approved the final version of this manuscript.

#### Data accessibility

Data used in this study are available in the supplementary materials.

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