

The first record of an invasive reptile species, *Pelomedusa* cf. *olivacea* (Schweigger, 1812) (Pelomedusidae, Testudines), in the wild of South Korea

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Abstract

Invasive species are of global conservation concern. South Korea is also facing the same challenge, especially, due to the growing pet trade. Herein, we report *Pelomedusa* cf. *olivacea* (Schweigger, 1812) from the wild in South Korea, where it has been imported as a pet. This is the first record of *Pelomedusa* in the Asian continent. In October 2019, we found an individual of this species beside Hongje Stream in Seoul. We recommend immediate control measures and strict monitoring of the pet trade to avoid the introduction of more invasive species.

Keywords

African Helmeted Turtle, Hongje Stream, *Mauremys reevesii*, pet trade, wildlife management

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Introduction

It has long been a practice to import animals from their natural territories for pet and food purposes; however, in recent years, importations of animals have increased worldwide (Lowe et al. 2000). It can be harmful to the native environment if somehow, either abandoned or released, those animals establish populations in the wild outside of their natural territory (Masin et al. 2014; Koo et al. 2017). Animals that are artificially or naturally introduced from abroad and exist outside their original habitats and geographic range are called invasive species (Koo et al. 2020a). Invasive species may cause various problems

such as disturbances and diseases in the native ecosystem (Huxel 1999; Jo et al. 2017; Nentwig et al. 2018). Therefore, proper management and measures of control are necessary, which may be expensive (Huxel 1999; Pimentel et al. 2005; Lovell et al. 2006; Shine 2010). The basis for managing an invasive species is to understand its distribution (Sillero et al. 2014). Thus, new data on occurrences of an invasive species very important for its management and this information must be continuously updated, especially in countries, like South Korea, which are considered global pet trade epicenters (Koo et al. 2020a).

In recent years, the number of imported exotic species has steadily increased in South Korea (NIE 2020). About 700 exotic species of herpetofauna alone have been reported in the online pet market in South Korea (Koo et al. 2020a). Among them the Testudines (110 species) comprise a large part of the imported pet animal list, only second to the Squamata (433 species). In addition, two out of the top 10 most sold species were found to be turtle species (Koo et al. 2020a). Accordingly, many invasive turtles have been already reported from the wild across the country (NIE 2020). To date, 14 invasive turtle species are reported in the wild of South Korea, and many are waiting in pet shops (Park et al. 2020; Park and Oh 2021; Koo et al. 2020a, 2020b, 2021; NIE 2020).

Herein, we report an additional invasive turtle species in the wild of South Korea. We discuss the potential of this species to invade the Korean environment and cite global examples. We also discuss the possible impacts on the native ecosystem, especially on *Mauremys reevesii* (Gray, 1831), an endangered native semi-aquatic turtle in

Korea. Finally, we recommend an immediate formulation of proper wildlife management policies, regular surveys, and strict control and regulation of the pet trade in South Korea and the rest of the world to avoid the expansion of more invasive species.

Methods

As a part of the National Biodiversity survey, we observed the herpetofaunal diversity of Hongje Stream, Seoul, South Korea, in October 2019. It is a national park and a place of high visitation by the public. The stream is 13.38 km long and is the source of the Pyeongchang Stream Valley in the southern part of Bukhan Mountain and is one of the tributaries of the Han River (Seodaemun-gu Office Hongje Stream 2022). A six-lane ring road extends over the stream throughout the densely populated Seodaemun-gu (Fig. 1B). During the survey, special attention was given to the place in the stream that is known as the turtle-rich area (Fig. 1C). On 6 October 2019, together with other species, we found an

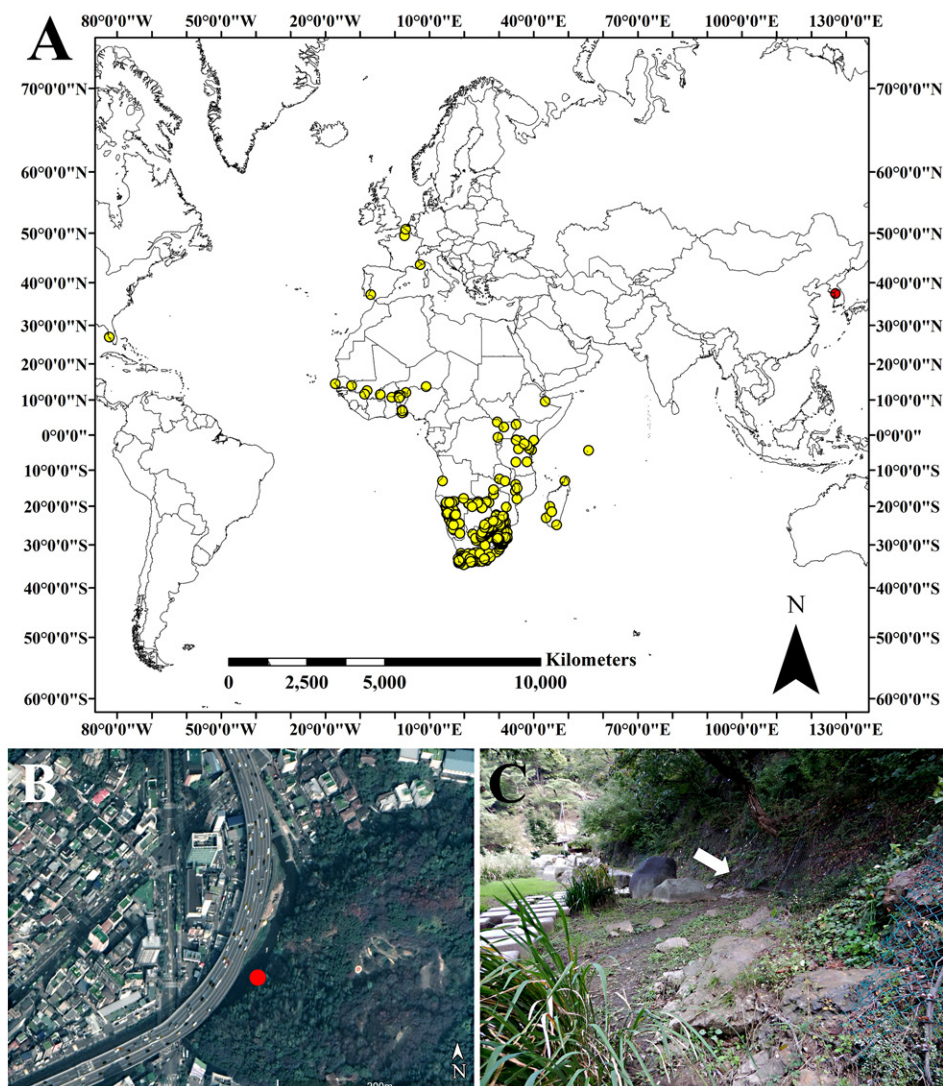


Figure 1. Global distribution of the genus and new record locality of the species. **A.** Distribution range of the genus *Pelomedusa* worldwide (retrieved from GBIF 2022). The red circle indicates the location of the new record of *P. cf. olivacea* (Schweigger, 1812). **B.** Satellite image of the study area; the red circle indicates the location of the new record of *P. cf. olivacea*. **C.** The microhabitat of present observation.

unidentified turtle species at that site. We found *Pseudemys concinna* (Le Conte, 1830) and *Pelodiscus maackii* (Brandt, 1858) resting on a rock, while the unidentified turtle was moving into the forest along the rockfall prevention wire mesh next to the stream trail (Fig. 1C). As the team was not comprised of turtle experts and the study was not designed to collect the samples, we took photographs and released the unidentified species at the same place where they were observed. After the fieldwork, we identified the turtle species by comparing the photographs and information with the existing literature, field guides, and expert opinions (Petzold et al. 2014; Spawls et al. 2018).

Results

Pelomedusa cf. *olivacea* (Schweigger, 1812)

Figure 2

Observation. SOUTH KOREA – Seoul • Hongje Stream: Hongje stream artificial waterfall; 37°34'49.98"N, 126°56'14.27"E; 32 m alt.; 06.X.2019; Choong-Ho Ham. obs.; rockfall prevention wire mesh.

Identification. The observed turtle individual was identified by close examination of the photographs and comparison of its morphology with original descriptions of relevant known species. The identification was also confirmed by experts. Overall, the turtle was dark brown (Fig. 2A). The neck was long and in a defensive posture, bent and folded to the right, but it did not fully push inside. The plastron had no hinge, and the midseam and joint of each scute were generally yellow. This set of characteristics indicated that the individual belongs to the genus *Pelomedusa* Wagler, 1830. In addition to the generic characteristics, there were two small barbels below the chin (Fig. 2B, red circle). The gular and anal scutes of the plastron were black, and the center of the other scutes was brown, while the outer edges were black. The shape of the pectoral scutes was triangular and did not touch the plastral midline (Fig. 2C). Thus, we identified the individual as the African Helmeted Turtle, *Pelomedusa* cf. *olivacea* (Schweigger, 1812).

Discussion

The report of *Pelomedusa* cf. *olivacea* from South Korea is very important as it is the first record of this genus in Asian countries. The genus *Pelomedusa* is generally considered invasive in various countries, and it already has invaded Europe and America, beyond its natural distribution range on the African continent (Fig. 1). However, it is one of two extant genera of the family Pelomedusidae. The most important character to divide these genera is whether a hinge is present on the plastron (*Pelomedusa* without a hinge and *Pelusios* Wagner, 1930 with a hinge in the front section of the plastron; Spawls et al. 2018). The individual we observed in the Hongje Stream did not have a hinge on the plastron and, thus, it belongs to *Pelomedusa*.

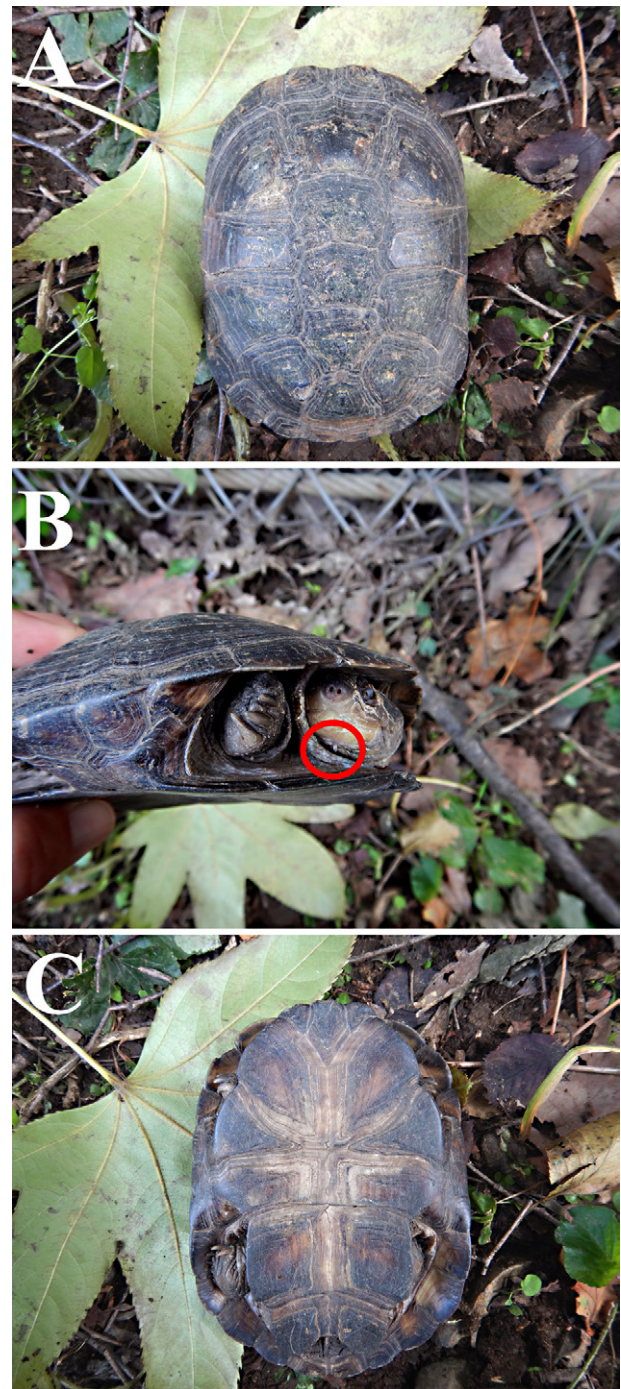


Figure 2. *Pelomedusa* cf. *olivacea* (Schweigger, 1812). **A.** Dorsal view. **B.** Frontal view, showing barbel below chin (circled). **C.** Ventral view.

The genus *Pelomedusa* was thought to be monotypic (Gasperetti et al. 1993) until Petzold et al. (2014) found unexpected cryptic diversity through molecular phylogenetic studies. Petzold et al. (2014) reported over 10 species within what was considered a single species, *P. subrufa* (Bonnaterre, 1789). They suggested a species delimitation through regional and geographic distribution of the genetically diverged populations (Petzold et al. 2014). We could use neither geographic distribution nor molecular data to identify our specimen because this observed animal is far from its native range in Africa (Fig. 1A) and no genetic material was collected. However, the

morphological classification of the genus *Pelomedusa* based only on the shape of the pectoral scutes of the plastron is available (Petzold et al. 2014), and we found the shape of pectoral scutes triangular and did not touch the plastral midline on our observed individual; these characters indicate a close morphological affinity to *P. cf. olivacea* (Schweigger, 1812). This species is distributed in Benin, Burkina Faso, Niger, Nigeria, and Senegal (Uetz et al. 2022). As it is well established that *Pelomedusa* shows high cryptic diversity (Petzold et al. 2014), we cautiously identify the observed animal as *P. cf. olivacea* pending further taxonomic work and confirmation.

The report of this species in the wild of South Korea indicates the need for setting proper management policies, knowing possible transits, and evaluating probable impacts on the native ecosystems. Although apparently, it is very difficult for this species to travel continental distances (Africa to Asia), this report from South Korea was not surprising. Previous reports in Europe (Bugter et al. 2011; Ferri et al. 2021; GBIF 2022; Fig. 1A), and the predicted possibility of invasion in America (Fujisaki et al. 2010), shows the potential of *Pelomedusa* species to spread around the world through the pet trade. South Korea is already recognized as one of the world epicenters of the pet trade, and reported the existence of this species in the animal market (Koo et al. 2020a).

However, reports of pet animals in the wild, which are more evident in urban and populated areas, indicate human interference and the poor management by the authorities (Koo et al. 2017; Park et al. 2020; Koo et al. 2020b; Koo et al. 2021). Despite having regular reports of non-native species in the wild (Fujisaki et al. 2010; Koo et al. 2017, 2021; Jablonski et al. 2018; Park et al. 2020), the pet trade is increasing worldwide (Nijman et al. 2012; Sung and Fong 2018; Marshall et al. 2020), including in South Korea (Koo et al. 2020a, 2020b). Although all alien species might not equally harm the ecosystem (Lowe et al. 2000), we urge immediate surveys and management action for *P. cf. olivacea* in the wild of South Korea, considering its mobility and capability for spread (Boycott and Bourquin 2008).

Especially, the introduction of this African helmeted turtle species in the wild may intensify the challenge for *Mauremys reevesii* (Gray, 1831), a native semi-aquatic endangered turtle species in South Korea. It is already evident that the population of *M. reevesii* is rapidly decreasing due to competition with exotic species, illegal capture, and habitat destruction (Lovich et al. 2011). Given the similarity in habitat preferences (Boycott and Bourquin 2008), the newly recorded invasive species in this study could be one of the most potential threats for *M. reevesii* in the near future. Thus, we recommend immediate surveys for evaluating the actual wild population status, formulating a management plan, and controlling *P. cf. olivacea*. Furthermore, we also urge regular monitoring and regulation of the pet trade to avoid the introduction of more invasive species in the native ecosystems.

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Authors' Contributions

Conceptualization: MMR, S-MP, H-CS. Data curation: MMR. Funding acquisition: H-CS. Investigation: C-HH, MMR, S-MP. Methodology: C-HH. Supervision: H-CS. Visualization: MMR, S-MP. Writing – original draft: S-MP, MMR. Writing – review and editing: S-MP, MMR, C-HH, H-CS.

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