

Rapid Communication**New report of an alligator snapping turtle (*Macrochelys temminckii* Troost, 1835) introduced into the wild in the Republic of Korea**Kyo Soung Koo¹, Seoung-Min Park², Jae Hyeok Choi² and Ha-Cheol Sung^{3,*}¹Department of Life Sciences and Division of EcoScience, Ewha Womans University, 07804 Seoul, Republic of Korea²School of Biological of Sciences and Biotechnology, Chonnam National University, 61186 Gwangju, Republic of Korea³Department of Biological Sciences, Chonnam National University, 61186 Gwangju, Republic of Korea

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OPEN ACCESS**Abstract**

Alligator snapping turtles (*Macrochelys temminckii* Troost, 1835), Chelydridae, is native to the United States and is popular as a pet in many countries despite its large size and inclusions in CITES (Appendix III). On October 15, 2019, an alligator snapping turtle was found at the bottom of a stream in Gwangju, Republic of Korea. The turtle measured 310 mm in carapace length and weighed 7.6 kg. We presumed the shortest distance moved by this turtle was 1.54 km by stream or 1.26 km by land. This is the third record of an alligator snapping turtle in Korea. The first was reported in 2011 and the second in 2014. These repeated sightings of alligator snapping turtles suggest that more individuals are likely to be found in the wild in the Republic of Korea. We highlight the management problems of non-native species, including the alligator snapping turtle, starting with a lack of monitoring species that are imported into the country to inadequate surveys undertaken in the wild across the country.

Key words: reptile, Chelydridae, freshwater turtle, exotic species, CITES**Introduction**

Since the early 2000s there has been an increase in the international trade of wildlife for pest control (Shanmuganathan et al. 2010), food (Kang et al. 2019), and for the pet trade (Auliya et al. 2016; Sung and Fong 2018; Koo et al. 2020a). In general, non-native species are not adapted to the new environment they are introduced into. However, if a non-native species can survive and adapt, they can act as competitors and predators on native species (Savidge 1987; Cadi and Joly 2003). Non-native species can also carry parasites (Mihalca 2015), and facilitate the spread of diseases (Weitzman et al. 2019) into new environments. In addition, the social and economic costs of controlling introduced species are huge (Huxel 1999; Pimentel et al. 2005; Lovell et al. 2006; Shine 2010).

Reptiles are the most popular taxonomic group in the international pet trade (Shiau et al. 2006; Lee et al. 2016; Sung and Fong 2018). The expansion of pet markets and the demand by people have led to the rapid

increase in international trade of reptiles (Sung and Fong 2018; Koo et al. 2020a). Moreover, non-native turtles are imported and released for religious purposes in Asian countries (Shiau et al. 2006; Sung and Fong 2018).

According to a recent study, the number of non-native species imported into the Republic of Korea increased 2.8 times, from 1,109 species in 2011 to 3,096 species by 2015 (National Institute of Ecology 2015). In 2015, 21 amphibian and 305 reptile species were imported into the country (National Institute of Ecology 2015). However, 677 species, more than twice that in 2015, were confirmed for trade in only 25 South Korean online pet shops in 2019 (Koo et al. 2020a). Fourteen species of non-native turtles have been observed in the wild in the Republic of Korea, including the red-eared slider (*Trachemys scripta elegans* Wied-Neuwied, 1839), river cooter (*Pseudemys concinna* Le Conte, 1830), Ouachita map turtle (*Graptemys ouachitensis* Cagle, 1953), and the common snapping turtle (*Chelydra serpentina* Linnaeus, 1758) (Lee et al. 2016; Koo et al. 2017, 2020b, c; Park et al. 2020). *Graptemys ouachitensis* was not included in the official import list but was found in a public park (National Institute of Ecology 2015; Koo et al. 2017). The red-eared slider competes for basking spots (Jo et al. 2017), and even shares habitats and breeding sites with native turtles (Koo et al. 2019). In addition, river cooters that are sold in hundreds of large malls and online pet shops in the Republic of Korea are found nationwide in the wild (Koo et al. 2020a, c). In 2019, nesting (fertilized but fail to hatch) of a river cooter was confirmed in a public park in Korea (*unpublished data*).

In this paper, we report a non-native turtle, found in the wild and provide an important direction and base for the management of non-native turtles in Korea.

Materials and results

On 15 October 2019, a non-native turtle was found underwater in a stream (35°10'44.44"N; 127°00'31.07"E, a.s.l. 99 m) in Gwangju, Republic of Korea (Figure 1). We identified the turtle as an alligator snapping turtle (*Macrochelys temminckii* Troost, 1835) based on the shape of the dorsal scales, three keels on the carapace, triangular head shape, reddish and moving worm-like tongue, and cross shape and small size of the ventral plate (Shi 2013) (Figure 2). The morphological measurement of this male turtle is presented in Table 1.

The turtle was found in the middle of Pungam Stream that flows from the Wonhyo valley to Lake Gwangju (Figure 3). This stream is nearly 9 km in length, with a width of approximately 10 m. Several small dams have been built along the Pungam Stream. The Pungam Stream was crystal clear and it was possible to check the state of the bottom without any equipment (Figure 3). The bottom of the stream was composed of rocks, stones, and sand. The turtle was found 1 m underwater in the middle of the stream

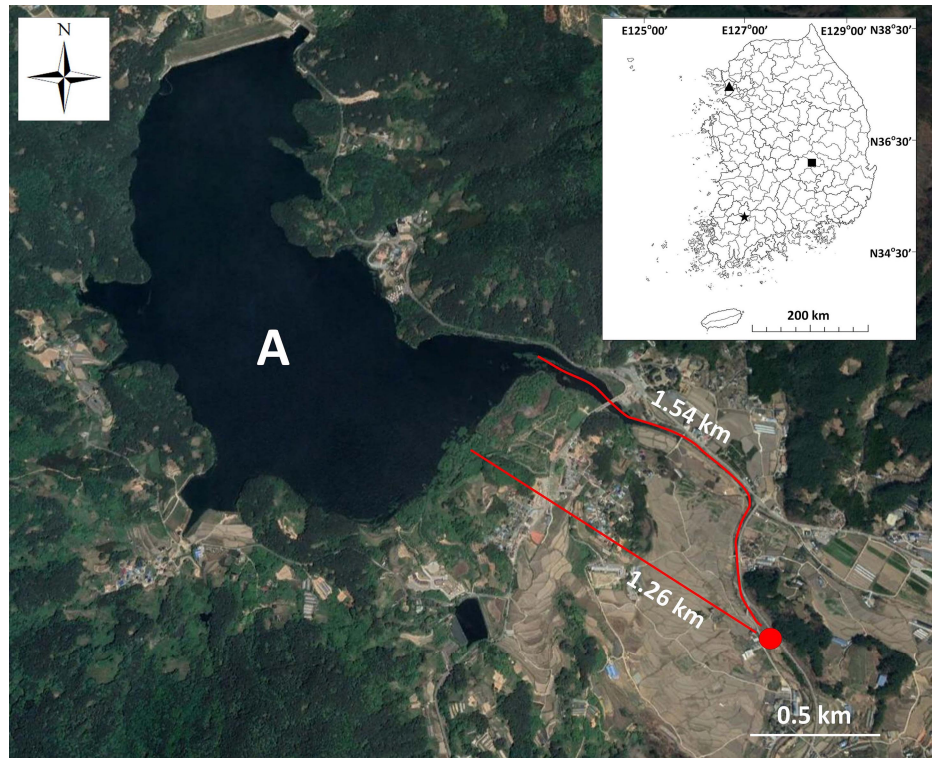


Figure 1. The site (red dot) where an alligator snapping turtle (*Macrochelys temminckii*) was discovered in Gwangju, Republic of Korea. The colored lines indicate the shortest possible routes to the site of discovery from the reservoir (red line: via stream, white line: directly). The star (this study), the square (May 11, 2011 in Gumi), and the triangle (January 1, 2014 in Bupyeong) in the map inset indicate all the locations from where the alligator snapping turtles has been reported from in the Republic of Korea.



Figure 2. The alligator snapping turtle (*Macrochelys temminckii*) found in the wild in the Republic of Korea. Photograph by Kyo Soung Koo.

near the dam (Figure 3). When the turtle was found, it was not moving but appeared to be foraging as the turtle had its mouth open, using its tongue as bait for hunting.

Table 1. Morphological measurement of the turtle, *Macrochelys temminckii*, an introduced species that was found in the wild in Gwangju, Republic of Korea.

	Measurement
Carapace straight length (mm)	310.5
Plastron length (mm)	246.7
Tail length (mm)	166.1
Body weight (kg)	7.6



Figure 3. The small dam in the Pungam Stream where the alligator snapping turtle (*Macrochelys temminckii*) was found. The red circle indicates the location of the turtle. Photograph by Kyo Soung Koo.

We estimated possible routes traveled by the turtle based on the location where the individual was discovered and the surrounding habitats (Figure 1). The shortest possible routes from Lake Gwangju to the discovery location were approximately 1.54 km using streams or 1.26 km by land (Figure 1). We transferred the alligator snapping turtle to the Yeongsan River Basin Environmental Office that manages non-native species in Korea.

Discussion

Alligator snapping turtles AST tend to stay within core sites, but can make significant long-distance movements (27–30 km in 3 years based on Wickham 1922). Moreover, they have been reported to move 6.8 km in six days (Sloan and Taylor 1987) and the maximum distance moved in two months has been reported as 16 km (Riedle et al. 2006). The alligator snapping turtle found in our study was in a stream that is 9 km long, and the entire range of the stream might be an area of activity for the turtle.

On May 11, 2011, the first recorded discovery of an alligator snapping turtle in the wild was reported in Gumi, Korea (Figure 1). However, only

two details were reported – the length of nose to tip of tail was 80 cm and that it was found in a small stream (<http://m.tknews.kr/2483>). The second report of this turtle was recorded on January 1st, 2014, in Bupyeong (37°30'33.08"N; 126°43'49.39"E, a.s.l. 12 m), Incheon, Korea (Figure 1). The turtle, nearly 50 cm in body length, was found at the bottom of a retention basin when it was drained for dredging (<http://www.incheontoday.com/news/articleView.html?idxno=26546>). As in the first record, the turtle was reported by the press and there was no additional information.

The United States Fish and Wildlife Service (USFWS) has considered the alligator snapping turtle need to be listed as endangered or threatened (but still under review), because of unregulated harvesting of the species, habitat loss, pollution, pesticide accumulation and population decrease (<https://www.fws.gov/>). Moreover, the International Union for Conservation of Nature (IUCN) has included this turtle in the Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES) Appendix III to protect them internationally (<https://www.cites.org/eng/app/appendices.php>). In Korea, after the alligator snapping turtle was included in the Appendix III of the CITES, import of this species was prohibited. However, the species is still traded in online pet shops and between persons (Koo et al. 2020a). Ironically, even though this turtle is a threatened species and protected by law from many states in the USA, they are popular pets in other countries, including Korea (Shiau et al. 2006; Sy 2015; Koo et al. 2020a).

Alligator snapping turtles spend most of their life underwater, and typically do not surface bask but instead thermos-regulate by controlling their depth in the water column (Riedle et al. 2006; Fitzgerald and Nelson 2011). Female turtles come out of the water only for breeding (Howey and Dinkelacker 2009). Therefore, these ecological traits make the survey and capture of alligator snapping turtle difficult (Zappalorti 1976). In Korea, field surveys for non-native turtles focus only on moving or basking turtles, and do not use traps (NIER 2012). This limited survey method is not effective in finding all freshwater turtle species, especially snapping turtles. While we report on only the third sighting of an alligator snapping turtle in the Republic of Korea, considering that the species is still traded in online and offline markets, more turtles are likely to be found in the wild.

Mauremys reevesii, the only native semi-aquatic turtle in the Republic of Korea, is rapidly decreasing in number due to habitat destruction, illegal capture, and competition with exotic species (Lovich et al. 2011; NIBR 2011). Unfortunately, this endangered native turtle also lives in Pungam Stream where the alligator snapping turtle was found. Alligator snapping turtles use a variety of native animals as food, including invertebrates, turtles, insects, nutrias, squirrels, snakes, and birds (Elsley 2006) and small individuals may act as competitors with *M. reevesii*. Predation on other turtles by alligator snapping turtles is well known and in some cases the consumption of these is greater than that of the other food items (Elsley

2006). Alligator snapping turtles are very likely to use *M. reevesii* as a food source. We suggest that non-native turtles, including alligator snapping turtle, should be managed to protect this endangered turtle in Korea.

Ecological, social, and economic problems caused by non-native species are becoming a global issue. Obviously, these problems will grow with the expansion of pet markets. The introduction of non-native species disturbs the environments and ecosystems that they are introduced into, but methods to control them result in another ethical problem. Nevertheless, the most effective solution to prevent the problems caused by non-native species is to block their artificial or natural introduction.

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