Rapid Communication

New record of the non-native snapping turtle *Chelydra serpentina* (Linnaeus, 1758) in the wild of the Republic of Korea

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Abstract

Recent advances in transportation and expansion of the pet trade have increased the influx of non-native species into the Republic of Korea. Many of these non-native species have been introduced into the wild through release by humans. The introduction of non-native species can cause ecosystem disturbances, as well as a variety of social and economic problems. On 20 March 2019, a non-native turtle was found in a wet rice paddy and identified as a male snapping turtle, *Chelydra serpentina*. The carapace length and body weight of the specimen were 32.3 cm and 7.46 kg, respectively. The turtle was located underground, in a wet rice paddy and was hooked by tractors during plowing of the paddy. The closest reservoirs, where the turtle may have inhabited previously, were located between 300 m and 640 m from the discovery site. The four nearby reservoirs were surveyed, but no turtles were found. If the snapping turtle can survive in the wild of Korea, it would predate upon native species, thereby leading to negative impacts to the local ecosystem. Therefore, rapid responses, for example policy changes, are needed to reduce risk caused by the introduction of non-native turtles, including *Chelydra serpentina*.

Key words: invasive species, hibernation, rice paddy, Asia

Introduction

Recently, rapid growth in pet trade and use of long-distance transportation has accelerated the influx of non-native species into natural ecosystems (Williamson and Griffiths 1996; Lowe et al. 2000). In the Republic of Korea, there is an increasing trend in the reporting of abandoned pets, ending up in the wild (Oh and Hong 2007; Mun et al. 2013). Abandoned pets are regarded as the main cause of non-native species introductions in the Republic of Korea (National Institute of Ecology 2015). The introduction of non-native species can disturb ecosystems, and incur a variety of social and economic costs (Huxel 1999; Pimentel et al. 2005; Lovell et al. 2006; Shine 2010).

In the Republic of Korea, the legal import of reptiles has increased from 248 species to 304 species between 2011 and 2015 (National Institute of Ecology 2015). In recent field surveys 9 species, *Mauremys sinensis* (Gray, 1870), *Chrysemys picta bellii* (Schneider, 1783), *Graptemys ouachitensis* (Cagle, 1953), *G. pseudogeographica* (Gray, 1831) (*G. p. pseudogeographica* (Gray, 1831) and *G. p. kohni* (Baur, 1890)), *Pseudemys concinna* (Le Conte, 1830), *P. nelsoni* (Carr, 1938), *P. peninsulatris* (Carr, 1938), *P. rubriventris* (LeConte, 1830), *Trachemys scripta* (*T. s. elegans* (Wied-Neuwied, 1839), *T. s. scripta* (Thunberg, 1792), *T. s. troostii* (Holbrook, 1836)), of non-native turtles were detected in natural habitats in the Republic of Korea (National Institute of Ecology 2015; Lee et al. 2016; Koo et al. 2017). Surprisingly, *G. ouachitensis*, was observed despite the lack of official import records (Koo et al. 2017). Among these species, *Trachemys scripta elegans,* which was imported in the 1970s, has successful reproduced in natural habitats, and is now distributed throughout the country (Oh and Hong 2007; Song 2007; Kim et al. 2014; Koo et al. 2019).

Chelydra serpentina (Linnaeus, 1758) is one of the well-known non-native turtles that has been introduced into many countries in Asia (including Japan, China, Hong Kong, Singapore), Europe (Germany, Netherland, France, Spain) and South America (Mexico, Honduras, Costa Rica, Panama, Ecuador) through pet and food trade (Shiau et al. 2006; Parrott et al. 2009; de Magalhães and São-Pedro 2012) (see the data from www.gbif.org). Typically, *C. serpentina* can live for 25–30 years and reach up to 40 years (Aresco et al. 2006; Steyermark et al. 2008). The turtle can survive in most aquatic environments, such as rivers, reservoirs, ponds, and even coastal areas (Obst et al. 1988; Aresco and Gunzburger 2007; Steyermark et al. 2008). It can be a ferocious predator for native species due to its diverse diet (Aresco et al. 2006; Steyermark et al. 2008; Parrott et al. 2009).

Here, we report the occurrence of a non-native turtle *Chelydra serpentina* in the wild of the Republic of Korea.

Materials and results

On 20 March 2019, a non-native turtle was found and captured in Songdang-ri, Nonsan-si, Chungcheongnam-do, Republic of Korea (36°16′48.56″N; 127°7′6.47″E, 43 m a.s.l.). Based on the shape of the dorsal shell, head, and tail, the specimen was identified as a male *Chelydra serpentina* (Shi 2013). The length and weight of the adult turtle were 32.3 cm (straight carapace length) and 7.46 kg (measured after euthanasia), respectively. The turtle was located underground, in the middle of a wet rice paddy (Figure 1) and was hurt by a tractor during plowing. The turtle was badly injured, a part from the beak to the front of the eye was cut off, and the carapace was broken by a tractor (Figure 2). Moreover, completely healed wounds (evidenced by distorted original shape) were found near this year's fresh wounds (Figure 2). The farmer, who caught the turtle, endowed

Figure 1. The site where the *Chelydra serpentina* specimen was discovered. The turtle was found underground in a wet rice paddy in Nonsan-si, Chungnam, Republic of Korea. Photo by Kyo Soung Koo.

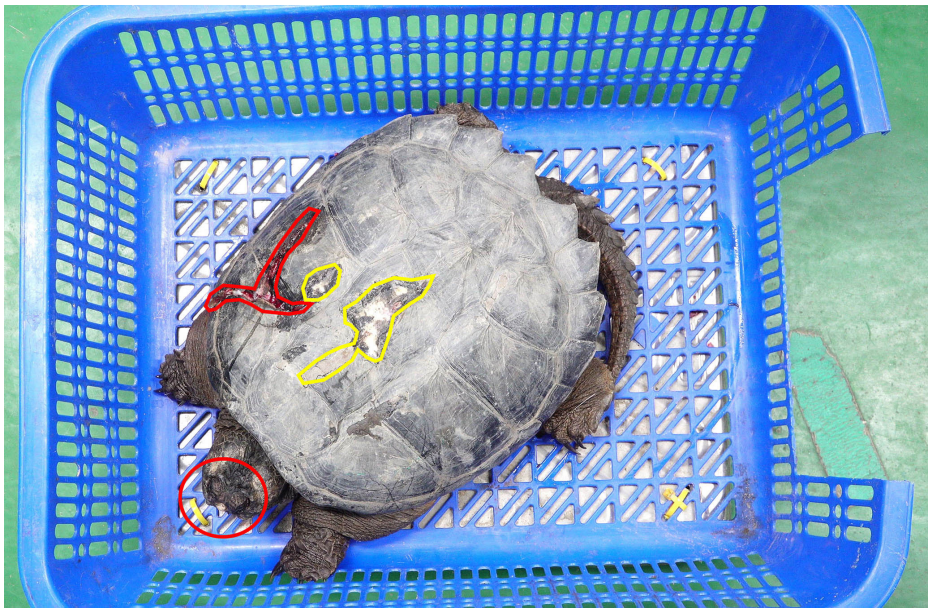

Figure 2. Male *Chelydra serpentina* specimen described in the present study. The beak and the carapace of the turtle were severely damaged by the tractor. The red (in 2019) and yellow (previously) polygons indicated the scars. Photo by Joon-Seok Lee.

the specimen to the Chungnam Wildlife Rescue Center (Yeasan-Gun), where it was euthanized.

The discovery site and surrounding environment were surveyed on 2 April 2019, after checking the potential habitats for the turtle through Google map. We speculated that the turtle might have inhabited the closest reservoirs that were either 370 m north, 550 m northeast, 330 m southeast, or 640 m southwest from where the turtle was found (Figure 3). Considering the previous reports of the species' movement ability (e.g., Obbard and Brooks 1980), it is possible that the turtle traveled from these reservoirs.

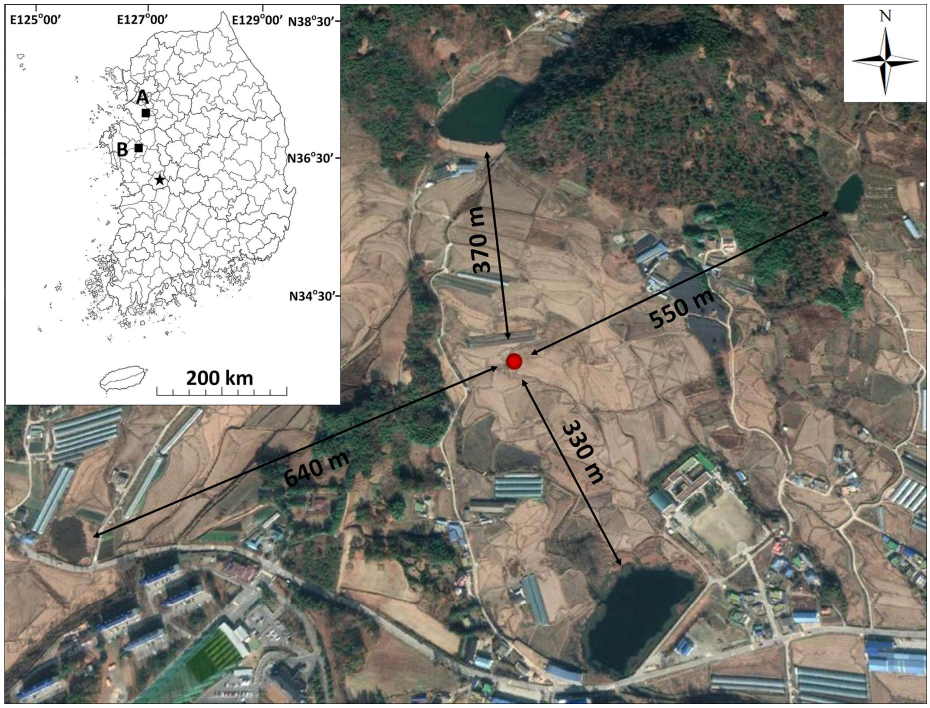

Figure 3. Locations of *Chelydra serpentina* reported in the Republic of Korea: black star (red circle) in 2019, and two black squares (A) Hwaseong on 22 May 2014, B) Yesan on 26 June 2014. Arrows indicate possible migration routes from nearby reservoirs to the discovery site.

At least, 2–3 researchers surveyed these potential habitats by walking and observing but failed to find additional *C. serpentina* individuals.

According to the discoverer, the snapping turtle was found in 2018 for the first time. It was found hiding under the ground of rice paddy, near the location where it was found in 2019. The turtle was collected, but it escaped subsequently.

Two cases of *C. serpentina* were recorded in May 22 and June 26 in 2014 from Hwaseong and Yesan (Figure 3), respectively (See the National Institute of Ecology 2014). The two turtles were found in the water of an artificial channel near rice paddy. Based on the body condition of the two turtles, researchers presumed that the turtles survived in the wild for years.

C. serpentina has been reported to breed successfully in personal zoo (called "Turtle Land") (National Institute of Ecology 2014). The zoo is located at one of the coldest areas in the republic of Korea (National Institute of Ecology 2014). On 9 September 2012, 11 eggs were hatched in the outdoor environment of the zoo (National Institute of Ecology 2014).

Discussion

The three cases (including our report) of distribution in the wild and the breeding in personal zoo indicate that *Chelydra serpentina* could survive and adapt to Korea's natural environment and climate. Field surveys covering the whole country are necessary to confirm the status of this non-native turtle in the wild. Moreover, it is urgent to establish control strategies, before non-native species adapt and spread.

Native turtles hibernate in winter and spring in Korea (Lee et al. 2012). It is possible that *C. serpentina* was hibernating in the rice paddy, especially considering the time and place in which it was found. Moreover, the turtle was found in the same place in 2018. This finding provided evidence that *C. serpentina* may survive the winter in Republic of Korea.

Generally, non-native turtles, including *C. serpentina*, cause problems to native ecosystems by predation and competition with native species (Parrott et al. 2009), and spread parasites to native species (Ishida et al. 2011). In addition, it is expected that the establishment of introduced turtles is enhanced under global warming (Parrott et al. 2009).

Chelydra serpentina is a popular turtle sold in most online pet shops in the Republic of Korea (Koo 2020, *unpublished data*). The species has a record of being officially imported in 2015, but it is unknown when the turtle was first imported in Korea. Because there are no accurate records of imports if the pets are not endangered species, listed in CITES or causing ecosystem disturbances, the pet imports may lead to indiscriminate influx of non-native species, and their introduction into the wild. To manage potential problems, we suggest that pet imports are sufficiently controlled, and each imported individual is registered and tracked. This is the first step to prevent additional invasions by non-native species in the Republic of Korea, through the international pet trade.

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References

Aresco MJ, Gunzburger MS (2007) Ecology and morphology of *Chelydra serpentina* in northwestern Florida. *Southeastern Naturalist* 6: 435–449, https://doi.org/10.1656/1528-7092(2007)6[435:EAMOCS]2.0.CO;2

Aresco MJ, Ewert MA, Gunzburger MS, Heinrich GL, Meylan PA (2006) *Chelydra serpentina*-snapping turtle. In: Meylan PA (ed), Biology and Conservation of Florida Turtles. Chelonian Research Monographs 3, Chelonian Research Foundation, pp 44–57

de Magalhães ALB, São-Pedro VA (2012) Illegal trade on non-native amphibians and reptiles in southeast Brazil: the status of e-commerce. *Phyllomedusa: Journal of Herpetology* 11: 155–160, https://doi.org/10.11606/issn.2316-9079.v11i2p155-160

Huxel GR (1999) Rapid displacement of native species by invasive species: effects of hybridization. *Biological Conservation* 89: 143–152, https://doi.org/10.1016/S0006-3207(98)00153-0

Ishida A, Iwao H, Hinoue M, Abe S, Kobayashi R, Asakawa M (2011) Internal parasites obtained from two alien turtles, *Trachemys scripta* (Emydidae) and *Chelydra serpentina* (Chelydridae), in Japan. *Bulletin of the Biogeographical Society of Japan* 66(2011): 1–6

Kim SH, Lee HHM, Kim DE, Lee DH, Hwang IC, Lee CW, Kim HM, Lee HJ, Kim MJ, Kim DK, Song HY, Park EJ, Kim JM (2014) Information on alien species on Korea. National Institute of Ecology, Republic of Korea, 175 pp

Koo KS, Kwon S, Do MS, Kim S (2017) Distribution characteristics of exotic turtles in Korean Wild - based on Gangwon-do and Gyeongsangnam-do-. *Korean Journal Ecology and Environment* 50: 286–294, https://doi.org/10.11614/KSL.2017.50.3.286

Koo KS, Beak HJ, Kim SH, Jang HJ, Kim DI, Sung HC (2019) First Report on the natural movement of introduced Turtle, *Trachemys scripta elegans*. *Korean Journal Ecology and Environment* 52: 9–12, https://doi.org/10.11614/KSL.2019.52.1.009

Lee JH, Jang HJ, Suh JH (2012) Ecological guide book of herpetofauna in Korea. National Institute of Environmental Research, Incheon, South Korea, 256 pp

Lee DH, Kim YC, Chang MH, Kim S, Kim D, Kil J (2016) Current status and management of alien turtles in Korea. *Journal of Environmental Impact Assessment* 25: 319–332, https://doi.org/10.14249/eia.2016.25.5.319

Lovell SJ, Stone SF, Fernandez L (2006) The economic impacts of aquatic invasive species: a review of the literature. *Agricultural and Resource Economics Review* 35: 195–208, https://doi.org/10.1017/S1068280500010157

Lowe S, Browne M, Boudjelas S, DePoorter M (2000) 100 of the world's worst invasive alien species: a selection from the global invasive species database (Vol. 12). Auckland: Invasive Species Specialist Group, 12 pp

Mun S, Nam KH, Kim CG, Chun YJ, Lee HW, Kil JH, Lee JC (2013) Suggestions for the improvement of the invasive alien species management in Korea comparative analysis of the legal framework for invasive alien species between Japan and Korea. *Environmental Policy* 6: 35–54, https://doi.org/10.15301/jepa.2013.06.21.2.35

National Institute of Ecology (2014) Ecological studies of alien species (I). Ministry of Environment, Republic of Korea, 101 pp

National Institute of Ecology (2015) Nationwide survey of nonnative species in Korea (I). Ministry of Environment, Republic of Korea, 342 pp

Obbard ME, Brooks RJ (1980) Nesting migrations of the snapping turtle (*Chelydra serpentina*). *Herpetologica* 36(2): 158–162

Obst FJ, Richter K, Jacob U (1988) Atlas of reptiles and amphibians for the terrarium. Neptune, 830 pp

Oh HS, Hong CE (2007) Current conditions of habitat for *Rana catesbeiana* and *Trachemys scripta elegans* imported to Jeju-do, including proposed management plans. *Korean Journal of Environment and Ecology* 21(4): 311–317

Parrott D, Roy S, Baker R, Cannon R, Eyre D, Hill M, Wagner M, Preston C, Roy H, Beckmann B, Copp GH (2009) Horizon scanning for new invasive non-native animal species in England, Natural England, Sheffield, United Kingdom, 111 pp

Pimentel D, Zuniga R, Morrison D (2005) Update on the environmental and economic costs associated with alien-invasive species in the United States. *Ecological Economics* 52: 273–288, https://doi.org/10.1016/j.ecolecon.2004.10.002

Shi H (2013) Identification manual for the conservation of turtles in China. Encyclopedia of China publishing house, China, 174 pp

Shiau TW, Hou PC, Wu SH, Tu MC (2006) A survey on alien pet reptiles in Taiwan. *Taiwania* 51(2): 71–80

Shine R (2010) The ecological impact of invasive cane toads (*Bufo marinus*) in Australia. The *Quarterly Review of Biology* 85: 253–291, https://doi.org/10.1086/655116

Song JY (2007) Current status and distribution of reptiles in the Republic of Korea. *Korean Journal of Environmental Biology* 25(2): 124–138

Steyermark AC, Finkler MS, Brooks RJ, Gibbons W (2008) Biology of the snapping turtle (*Chelydra serpentina*). The Johns Hopkins University Press, Baltimore, 240 pp

Williamson M, Griffiths B (1996) Biological invasions. Springer Science & Business Media. London, England, 244 pp