REPTILES & AMPHIBIANS

Evidence of Free-living Common Snapping Turtles (*Chelydra serpentina*) in Hong Kong in the iNaturalist Application

Matthew Mo and Elouise Mo

Sydney, New South Wales, Australia (matthew.sk.mo@gmail.com)

The Common Snapping Turtle (*Chelydra serpentina*) is a large freshwater chelonian (carapace length 25–47 cm) native to the eastern and central United States of America and Canada. In its native range, the Common Snapping Turtle is listed by the International Union for Conservation of Nature as Least Concern (van Dijk 2012) but it is susceptible to localized population declines in urban wetlands from road mortality (Piczak et al. 2019). Meanwhile, introduced populations of Common Snapping Turtles have been established in Japan (Kobayashi et al. 2006a, 2006b), and sightings of free-living individuals have been spasmodically recorded in the western United States of America, Italy, China, Taiwan, and South Korea (Chen et al. 2000; van Dijk 2012; Koo et al. 2020). Like other reptiles, turtles are transported to countries outside of their native range to supply the international pet trade, which sometimes results in individuals either escaping or being released (Stringham and Lockwood 2018; Mantintsilili et al. 2022). Furthermore, some people release captive animals as part of religious acts believed to build spiritual merit (Agoramoorthy and Hsu 2005; Ng and Lim 2010). Turtles also are considered a delicacy in many Asian countries, implicating both turtle farming and imports of live turtles collected from the wild as sources to supply this demand in restaurants (Lau and Haitao 2000; Shiping et al. 2006).

Hong Kong is a special administrative region of China with a dense human population, in which members of the public can purchase exotic reptiles, including turtles, to keep as pets. Exotic reptiles are traded at markets such as the popular Tung Choi Street in Mong Kok, Hong Kong's largest pet market (Sung et al. 2021a; Dufour et al. 2022), as well as through online selling (Sung and Fong 2018). The release of exotic pets has been linked to the establishment of introduced species of reptiles that include the Red-eared Slider (*Trachemys scripta elegans*) (Lau et al. 2000; Sung et al. 2021b), the Chinese Striped-necked Turtle (*Mauremys sinensis*) (Sung et al. 2021b), Tokay Gecko (*Gekko gecko*) (Romer 1951), Brook's House Gecko (*Hemidactylus brookii*) (Romer 1977), and Chinese Water Dragon (*Physignathus cocincinus*) (Mo 2019a). Additional emerging reports document other species such as Green Iguanas (*Iguana iguana*) found as free-living individuals (van den Burg et al. 2020; Mo and Mo 2022a) and other chelonians native to North America, believed to be Yellow-belled Sliders (*Trachemys scripta scripta*) or River Cooters (*Pseudemys concinna*) (Mo 2019b). During 2016, on a visit to Hong Kong, we sampled 21 pet shops and found 12 that sold live reptiles, three of which sold juvenile Common Snapping Turtles (Fig. 1).

iNaturalist is a community-science initiative jointly managed by the California Academy of Sciences and the National Geographic Society (2023), which has been increasingly beneficial for species detections outside native ranges (Werenkraut et al. 2020; Mesaglio and Callaghan 2021; Mo and Mo 2022a, 2022b). The iNaturalist application collates

Figure 1. Juvenile Common Snapping Turtles (*Chelydra serpentina*) in the front of a pet shop on Tung Choi Street, Mong Kok, Hong Kong. Photograph by Matthew Mo.

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spatiotemporal data on organisms or evidence of their presence (e.g., tracks, nests, or sloughed skins) through crowdsourcing observations from registered application users. Reported observations typically are accompanied by at least one photograph, which is scrutinized by other application users who provide suggested species identification. Where identification at the species level is not possible, application users identify organisms to the closest possible taxonomic rank (e.g., to family or genus). The application applies a data-quality assessment in which observations are classified as verifiable if the organism is free-living (not a captive animal or cultivated plant or fungus) and the following minimal data are provided: photograph(s) or audio recording(s), information on observation date, latitude, and longitude. Verifiable observations attain "research grade" status when a majority of at least three application users agree on the identity of the species.

We searched the iNaturalist application for evidence of Common Snapping Turtles living in the wild in Hong Kong as of 1 February 2023. This search resulted in eight verifiable observations of the species in Hong Kong from eight separate application users (Table 1). All eight observations were research grade; however, we believe two observations to be the same individual encountered by separate observers based on the database reports containing the same observation date, similar location, and each observer's photograph showing the same physical setting. We contacted all observers to verify the locations of each turtle, which resulted in four observers returning contact and two of them advising us of an additional five Common Snapping Turtles found in two other locations (Table 2).

The earliest known sighting was of a live Common Snapping Turtle that was captured on fishing tackle at the Aberdeen Reservoirs in Aberdeen Country Park, Southern District, on 25 February 2018 (iNaturalist record identity 9989066; Fig. 2). The observer described the size of this turtle as approximately 34 cm in carapace length and advised that it was removed from the wild after it was caught (H.T.

Table 1. Reports of free-living Common Snapping Turtles *Chelydra serpentina* in Hong Kong lodged in the iNaturalist application. Record identities are as assigned by the iNaturalist application. Record nos. 11861957 and 11969837 were probably observations of the same individual by different observers based on the reported observations containing the same observation date, similar location, and each observer's photograph showing the same physical setting. Observers chose not to disclose the exact locations of observations for record nos. 85627066 and 101324383 (those observations are not shown spatially in Fig. 3).

Record identity	Observation date	Observation details	Locality	Latitude, longitude (public positional accuracy in m)
9989066	25 Feb 2018	Live individual captured on fishing tackle from one of the reservoirs	Aberdeen Country Park, Southern District	22.25478°N, 114.1618°E (251)
11861957	29 Apr 2018*	Live individual photographed in a clear water body	Plover Cove Country Park, North District	22.50494°N, 114.2444°E (15)
11969837	29 Apr 2018*	Live individual photographed in a clear water body	Plover Cove Country Park, North District	22.50378°N, 114.2452°E (600)
19149694	22 Dec 2018	Dead individual photographed in a clear water canal	Ho Chung, Sai Kung District	22.35448°N, 114.2456°E (18)
38212761	1 Feb 2020	Live individual photographed in a clear water body	Sai Kung West Country Park, Sai Kung District	22.42185°N, 114.3120°E (18903)
85627066	4 Jul 2021	Live individual photographed in a clear water body	Exact location obscured but known to be in the Southern District	Geographical coordinates displayed in application denatured by 30 km
101324383	16 Nov 2021	Live individual photographed in a clear water body	Lantau Island, Islands District	Geographical coordinates displayed in application denatured by 30 km
133906158	3 Sep 2022	Live individual photographed in a clear water body partially retreated beneath aquatic vegetation	Yuen Long, Yuen Long District	22.46587°N, 114.01684°E (5)

Table 2. Additional sightings of free-living Common Snapping Turtles (*Chelydra serpentina*) in Hong Kong based on personal communications with iNaturalist-application users.

Source	Observation details	Locality
H.T. Cheng, pers. comm. This application user had lodged the observation 9989066 (see Table 1)	Four live individuals captured on fishing tackle at different times. The observer believed each individual differed in size, inferring them to be separate individuals.	Tai Tam Tuk Reservoir, Tai Tam Country Park, Southern District
Tse Chung Yi, pers. comm. This application user had lodged the observation 19149694 (see Table 1)	One live individual photographed in a clear water stream	Mount Parker, Tai Tam Country Park, Southern District

Figure 2. A Common Snapping Turtle (*Chelydra serpentina*) after being caught on fishing tackle in Aberdeen Country Park, Southern District, Hong Kong (iNaturalist record identity 9989066). Photograph by H.T. Cheng.

Cheng, pers. comm). One other database report documented a Common Snapping Turtle in the Southern District, which was observed on 4 July 2021 (iNaturalist record identity 85627066; Table 1). Although this observer did not disclose the exact location, the photograph they uploaded to the iNaturalist application showed a live individual inhabiting a clear body of water.

The additional reports of Common Snapping Turtles that were not lodged in the iNaturalist application were also from the Southern District (Table 2). These were four live individuals of different sizes in the Tai Tam Tuk Reservoir that were observed at different times (H.T. Cheng, pers. comm) and one live individual that was found in a clearwater stream on Mount Parker (Tse Chung Yi, pers. comm). Both of these locations are situated within the Tai Tam Country Park, approximately 4 km east of Aberdeen Country Park (Fig. 3).

We considered two database reports of Common Snapping Turtles in Plover Cove Country Park, North District, to be observations of the same individual (iNaturalist record identities 11861957 and 11969837; Table 1). Both database reports record the observation date as 29 April 2018 and depict a live turtle of the same appearance in a clearwater body that has a strikingly similar physical setting in photographs by both observers (Fig. 4).

Two database reports address Common Snapping Turtles in the Sai Kung District (Table 1). The first observation was of a dead individual found in a clearwater stream adjacent to a residential area in Ho Chung on 22 December 2018 (iNaturalist record identity 19149694; Fig. 5). The observer that reported this individual and one other observer we contacted were both aware of regularly occurring releases of animals, including Common Snapping Turtles, as religious acts at this location (Tse Chung Yi and H.T. Cheng, pers. comm). The second database report in the Sai Kung District was of a live turtle observed in a clearwater body in the Sai Kung West

Figure 3. Locations of community reports of free-living Common Snapping Turtles (*Chelydra serpentina*) in Hong Kong. Reports without exact locations (i.e., geographical coordinates displayed in the iNaturalist application that were denatured by 30 km) are not shown.

Figure 4. A Common Snapping Turtle (*Chelydra serpentina*) in clear water in Plover Cove Country Park, North District, Hong Kong (iNaturalist record identity 11969837). Photograph by Jan Ho.

Country Park on 1 February 2020 (iNaturalist record identity 38212761).

The sole database report of a Common Snapping Turtle in the Islands District was a live individual found in a clear-water stream at an undisclosed location on Lantau Island on 16 November 2021 (iNaturalist record identity 101324383; Table 1). The observer described the size of this turtle as approximately 30 cm in carapace length and advised that it was subsequently removed and rehomed as a pet (Chiu Yui Hong, pers. comm).

The most recent database report of a Common Snapping Turtle in Hong Kong was also the sole record of the species from the Yuen Long District (iNaturalist record identity 133906158; Table 1). This individual, observed on 3 September 2022, was recorded from one of the many clearwater bodies in Yuen Long, where it was partially hidden behind aquatic vegetation.

Based on the seven unique sightings of Common Snapping Turtles lodged in the iNaturalist application and the five additional sightings gained from observers, we know of at least 12 unique individuals that have existed in the wild in Hong Kong. These sightings, in five administrative districts, were mainly distributed from the eastern New Territories to Hong Kong Island (Fig. 3). Notably, the sightings with known dates have occurred within a four-year period from February 2018 to September 2022. Although no evidence from these data indicates that any self-sustaining populations exist, these sightings should not be treated as benign. The establishment of the Common Snapping Turtle as an introduced species in Japan (Kobayashi et al. 2006a, 2006b) highlights the potentially high risk of introduced populations becoming established in other parts of eastern Asia. Furthermore, establishment risk for this species has been evaluated as serious in other regions in the Eastern Hemisphere (Kopecký et al. 2013). Although the species generally has low recruitment where it has been studied due to nest and juvenile predation and vehicle collisions (Piczak et al. 2019), each female individual can produce from 20 to 75 eggs per year (Iverson et al. 1997) and can hold sperm for several years to use in favorable breeding conditions (Galbraith et al. 1993). These are factors that can enable population establishment, especially if the limitations to individual survival in the native range are not present (Yasukawa 2002; Kobayashi et al. 2006b). The Common Snapping Turtle also is a long-lived species, with a potential life expectancy to 50 years (Golet and Haines 2000), which means that escaped or released individuals could persist in extralimital environments for such lengths of time.

Figure 5. A dead Common Snapping Turtle (*Chelydra serpentina*) (iNaturalist record identity 19149694) (left) and the stream in Ho Chung, Sai Kung District, Hong Kong, where it was recorded (right). Photographs by Tse Chung Yi.

The release of exotic pets is a well-documented pathway for the establishment of introduced species (Filz et al. 2018; Maceda-Veiga et al. 2019). Past research has shown that establishment success in chelonians is more closely associated with the number of separate release events than the number of individuals traded (Pasmans et al. 2017). We consider the Common Snapping Turtle to be a species likely to be discarded by pet owners in Hong Kong based on the low likelihood of the large body sizes attained by adults (Iverson et al. 1997) being compatible with the small residential living spaces that are typical of the region (Ho et al. 2008). Our communications with observers also indicated that a degree of religious practices involving the release of live animals (see also Agoramoorthy and Hsu 2005) has contributed to Common Snapping Turtles occurring as free-living animals in Hong Kong. Although the sample size of these observations is small, they signal a potentially regular pathway for introduction similar to that involving discarded pets. Despite the positive emotions associated with liberating live animals, these practices have potential animal-welfare issues if environments are unsuitable. Furthermore, the biosecurity implications extend beyond the possibility of species establishing populations, in that pathogens may be introduced into recipient water bodies even if released animals themselves do not survive (Johnson and Speare 2003; Schloegel et al. 2009; Lafuente et al. 2013; Demkowska-Kutrzepa et al. 2018). Public education may improve community awareness of these matters and deter people from engaging in these practices.

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