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## First natural history observations of the Critically Endangered Wattle-necked softshell turtle *Palea steindachneri* in its native range

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The Wattle-necked softshell turtle *Palea steindachneri* is poorly understood in its natural habitat, despite being highly productive in farms and commonly observed in the turtle trade. Field observations conducted in Vietnam's Pu Mat National Park represent the inaugural instance of direct, in-the-wild natural history documentation for the species within its native habitat. In contrast, prior research relied on interview data gathered from local communities. The species was found in slow-moving water in a sandy stream, consistent with previous information from community interview data. The limited range and its frequent appearance in the food and traditional medicine trade have led to the species' classification as Critically Endangered by the IUCN Red List.

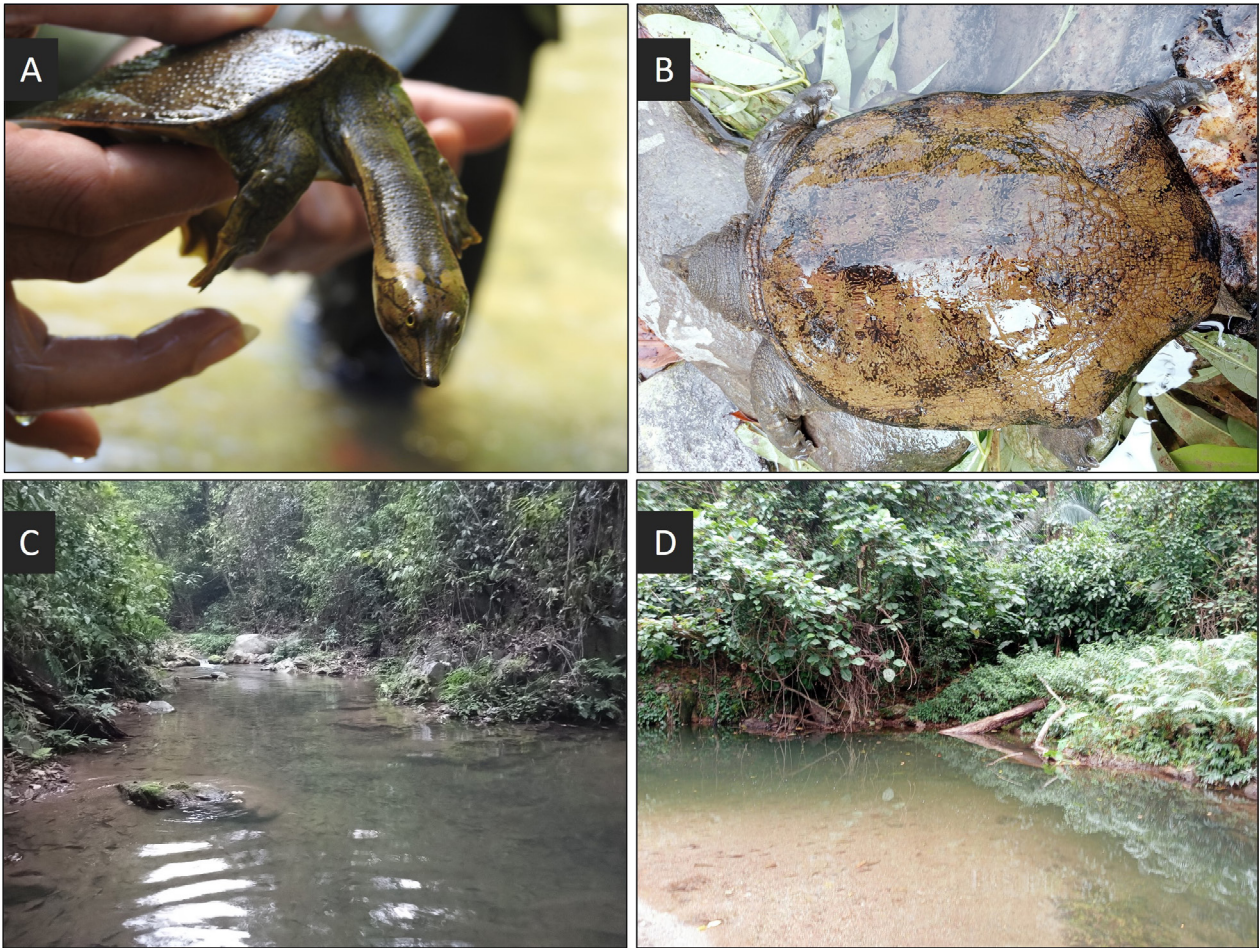
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The natural history and ecology of the Wattle-necked softshell turtle *Palea steindachneri* remains poorly understood throughout its entire range (Le Duc et al., 2020a). While the species is native to Vietnam, Laos and China, all prior data regarding its natural history have stemmed from local communities, lacking verification through field observations (Fong et al., 2021; Le Duc et al., 2020a; Markus, 2011; Zuklin et al., 2021; Ducotterd et al., 2022). Notably, there have been no confirmed field observations in its native range to date. However, there have been recorded observations of the species in the wild in Hawaii, USA, which lies outside its native range (Radford, 2011). The majority of knowledge on the species has been obtained through farming, turtle trade, genetics, diseases in captivity, and consumption (Ernst & Bogadek, 2005; Gaillard et al., 2017; Han et al., 2017; Le Duc et al., 2020a; Tang et al., 1997; Tong et al., 2009). The species is highly productive in farms, which has led to extensive farming in China and Vietnam, and it is commonly observed in the turtle trade but is not easily seen in the wild (Haitao et

al., 2008; Le Duc et al., 2020a). While Le Duc et al. (2020a) claimed the species is carnivores, Marchetti & Engstrom (2016) believe it is omnivorous. Respondents from local communities report that the species mostly inhabits slow moving water bodies in sandy streams and rarely enters rivers or large water bodies such as lakes or reservoirs (Le Duc et al., 2020a; 2020b). Interviews with farmers who farm *P. steindachneri* in Vietnam revealed that the species can grow up to 45 kg in weight or 450 mm in carapace length, recorded in captivity, and they lay up to 28 eggs per clutch, intermittently between the months of March and July, and can produce 4–5 clutches per year (Le Duc et al., 2020a; Pham, pers. com.). In captivity, the species hibernates from November to February while it does not do so in Hawaii (Le Duc et al., 2020a; Radford, 2011). Due to its limited range and frequent appearance in the food and traditional medicine trade, the species was recently reassessed as Critically Endangered by the IUCN (Fong et al., 2021). In this study, we present the first natural history observations of the species from its native range through field data collected by Save Vietnam's Wildlife (SVW)'s anti-poaching team (a local NGO in Vietnam that focuses on the protection and rehabilitation of wildlife in the country) and a survey conducted using aquatic traps in Pu Mat National Park (PMNP) in the central Annamite mountain range of Vietnam.

Starting from 2018, the alliance between SVW's 16 anti-poaching teams and PMNP's 74 rangers has been conducting patrols across the entire PMNP while employing SMART (Spatial Monitoring and Reporting Tool) to monitor and record forest violations and wildlife observations. During one of these patrols on 22 September 2020, VVD, one of the authors of this paper, observed a juvenile *P. steindachneri* (Fig. 1a) near a sand bank of Chat stream at an elevation of 203 m a.s.l. Chat stream is one of the main streams in PMNP. The water body was estimated to be 1000 cm in length, 300 cm in width, and 200 cm in depth at the time he captured the individual (Fig. 1c). The co-ordinates of the discovery have not been disclosed for the safety of the animals.

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**Figure 1.** *Palea steindachneri* found by chance in the forest stream by VVD **A.** and by trapping **B.** Habitat where VVD captured the juvenile *P. steindachneri* **C.** and location where subadult one was trapped **D.**

The second observation occurred serendipitously during a survey conducted using 20 funnel aquatic traps (sized at 40 x 80cm). This survey was originally undertaken to locate Big-headed turtles *Platysternon megacephalum* and determine suitable release sites for the 120 rescued individuals currently housed at the PMNP rescue centre (SVW, unpub. data). The traps were set from 22–28 April 2023, with a total of 1321.87 trapping hours and were set in the afternoon along a ~ 5 km stream length. The locations of the traps were changed every morning. The trapping hours were calculated using the formula  $H = RT - ST$  (where H represents hours, RT is the trap removal time, and ST is the trap setting up time). All 20 traps were set for an average of 9 hours per day before being moved to other locations. Chicken intestines were used as bait. While no *P. megacephalum* were found, a sub-adult male *P. steindachneri* (weighing 2330 g, carapace length (CL) 27.5 cm, carapace width (CW) 23.6 cm) (Fig. 1b) and an adult female Four-eyed turtle *Sacalia quadriocellata* (weighing 253 g, CL 12.8 cm, CW 11.4 cm) were found in the traps. The *P. steindachneri* was caught on 27 April 2023 at an elevation of 283 m a.s.l. The water body where the *P. steindachneri* was trapped was an estimated 170 cm wide, 300 cm long, and 110 cm deep with a submerged sandbank (Fig. 1d). The trapping effort for the *P. steindachneri* was 0.000757 individual/hour/trap (see Pham et al., 2018 for further

detail on trapping method). All turtles were unharmed and released to the same location after basic measurements were taken using a tape measure for carapace length and carapace width and photos were taken.

*Palea steindachneri* is known for its high productivity in captivity, with females capable of laying a substantial number of eggs (Le duc et al., 2020a; Pham, pers. com.). However, despite this high reproductive potential, the species seems to exhibit a low survival rate, resulting in low population density even in areas where hunting threats are absent. This was exemplified by Radford's (2011) study, which conducted trapping efforts for 24 days but only managed to capture three *P. steindachneri* individuals.

Throughout the trapping period, the team also captured several species of fish and crab by chance, these were tentatively identified by relevant regional experts based on photos we provided. The captured species, included *Pterocryptis cochinchinensis*, *Tachysurus* sp., *Tracacichthys taeniatus*, *Bardodes semifasciolatus*, *Sarcocheilichthys nigripinnis*, *Onychostoma* sp., *Coreoperca* sp., *Hemibagrus* sp. and crabs (*Indochinamon* sp.) that could potentially serve as prey for *P. steindachneri*, as they coexist in the same stream. Further research on the diet of *P. steindachneri* should be conducted, as the available information on the species' diet only comes from captive specimens that are

primarily fed on fish (mainly *Hypophthalmichthys* ssp.) as their main food source, with earthworms and snails (*Achatina fulica*) provided as supplementary food (Le Duc et al., 2020a). However, studies conducted on the species in Kauai (USA), where *P. steindachneri* is non-native, have discovered a variety of items in the species' fecal matter, including rocks, hair, styrofoam, plastic, vegetation, seeds, insects, and introduced species of snails, prawns, and clams (Engstrom et al., 2009). This suggests that the species may have an omnivorous diet, but further research is needed to better understand its feeding habits in its native range.

In both our observations, *P. steindachneri* was found in a stream in a tropical evergreen forest with vines, ferns, grasses, forest banana and a complex forest structure with small to large trees on the sides of the stream. In both instances, the turtle was submerged in slow-moving water in the deeper and wider section of the stream. These findings are consistent with the information provided by local communities during interviews (Le Duc et al., 2020b), which stated that the species mostly lives in small water bodies in sandy streams and rarely enters a river or a large water body such as lakes or reservoirs. However, Ducotterd et al. (2022), based on interview information, argued that the species is also found in large river systems. Hence, our findings represent the first time this species has been recorded in the wild in its native range by scientists. The location where the species was found is about nearly 20 km away from the nearest human settlement. This location is considered as a safe zone of PMNP as a result of the effort of SVW and PMNP to stop poaching in the PMNP (SVW, unpub.data)

The discovery of a juvenile individual offers hope for the survival of the species in PMNP as it is indicative of a breeding population and relatively recent recruitment. Conducting surveys to gather information on the population size, distribution, and threats to *P. steindachneri* is crucial for conservation efforts in its native range. This information will help to develop and implement effective conservation strategies to protect the species and their habitats globally.

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