



On the keeled box turtle (*Cuora mouhotii*) from reforested land in Vietnam

The keeled box turtle (*Cuora mouhotii* Gray, 1862) is endangered (Ly *et al.* 2015, Das *et al.* 2016, Van *et al.* 2019) and native to Bangladesh, Bhutan, China, India, Laos, Myanmar, Thailand and Vietnam (Platt *et al.* 2018, Nguyen *et al.* 2011, 2020). First described in 1862 by Gray (Das *et al.* 2016), its numbers have declined by 50–80% in the past 75 years (Ahmed *et al.* 2020), particularly in China due to harvesting (Lau & Shi 2000). Other research has also shown that *C. mouhotii* is very rare in Myanmar and at risk in Laos (Stuart *et al.* 2001). In Vietnam, *C. mouhotii* has been found in the mountainous areas from North Central to Central Vietnam such as Cuc Phuong National Park, Nghe An, Ha Tinh and Quang Binh provinces (Van *et al.* 2019), as well as in the Truong Son mountains as far as Quang Nam province in Central Vietnam (Smith 1931, van Sang *et al.* 2012, Ziegler *et al.* 2014, Ly *et al.* 2015, Das *et al.* 2016). However, the population of *C. mouhotii* in Vietnam has also decreased significantly because of overexploitation and habitat destruction (Ly *et al.* 2015, Luiselli *et al.* 2016, Stenger *et al.* 2023).

In this paper, we report on the discovery, identification, habitat and dietary preferences of two *C. mouhotii* specimens, a male and a female, observed in a restored tropical rainforest in the Human Ecology Practical Area (HEPA) in Central Vietnam, a location where information about this endangered species is still limited. This discovery in a restored forest site reinforces the importance of the restoration and continued protection of habitats for the return, and further repopulation, of endangered species and for wildlife conservation generally.

The Human Ecology Practical Area (HEPA) is a forest protection area (18°25'N, 105°13'E, 110m a.s.l.) in Son Kim 1 commune, Huong Son district, Ha Tinh Province (HEPA, 2021). HEPA is a 500-ha forest site located in Central Vietnam and within the Northern

Annamites tropical rainforest region. In the Ha Tinh region, the average monthly atmospheric humidity varies from 70 to 85%, the average monthly temperature ranges from 24.5°C to 32.9°C year-round with the highest temperatures hitting 38.5–40.0 °C in June and July. The average annual rainfall is from 2500mm to 2650mm with 75% of the annual rainfall occurring in the rainy season from March to October (Dang 2018). HEPA is surrounded by national parks in the south, with the Vietnamese Vu Quang National Park and the Lao Nakai-Nam Theun National Park, being the closest. Previously a state forest, the site was heavily logged. Over the last two decades (2002–2022), it has been restored into a tropical secondary rainforest by the enormous and persistent reforestation and protection efforts of a small group of civil society members.

In the late morning of 15th November 2021, two HEPA forest rangers patrolled the forest to look for, confiscate and destroy illegal animal traps. They found two turtles stacked at the bottom of a deep hole (>1m deep) made by local farmers for harvesting the roots of a wild yam, *Dioscorea persimilis* (Dioscoreaceae). The turtles appeared to be wanting to escape from the bottom of the hole, which was about 30cm by 25cm. For the conservation and protection of the species, the exact location of the hole will not be revealed or mapped in this paper. The two forest rangers gently removed the two turtles from the hole with their hands and brought them to an empty water tank (about 5m long, 3m wide and 2m deep; henceforth referred to as the turtles' enclosure) in one of HEPA's eco-farm sites where they were housed for three weeks.

Many photographs of the turtles and their immediate habitat were taken and sent directly to the HEPA board and biodiversity scientists for identifying the species and to seek conservation advice. It was observed that the turtles' carapaces were each 16–17cm long, had three large, raised ridges and were serrated on the back end. The turtles' plastron had different variations of brown colour ranging from light brown, grey to dark

Plate 27

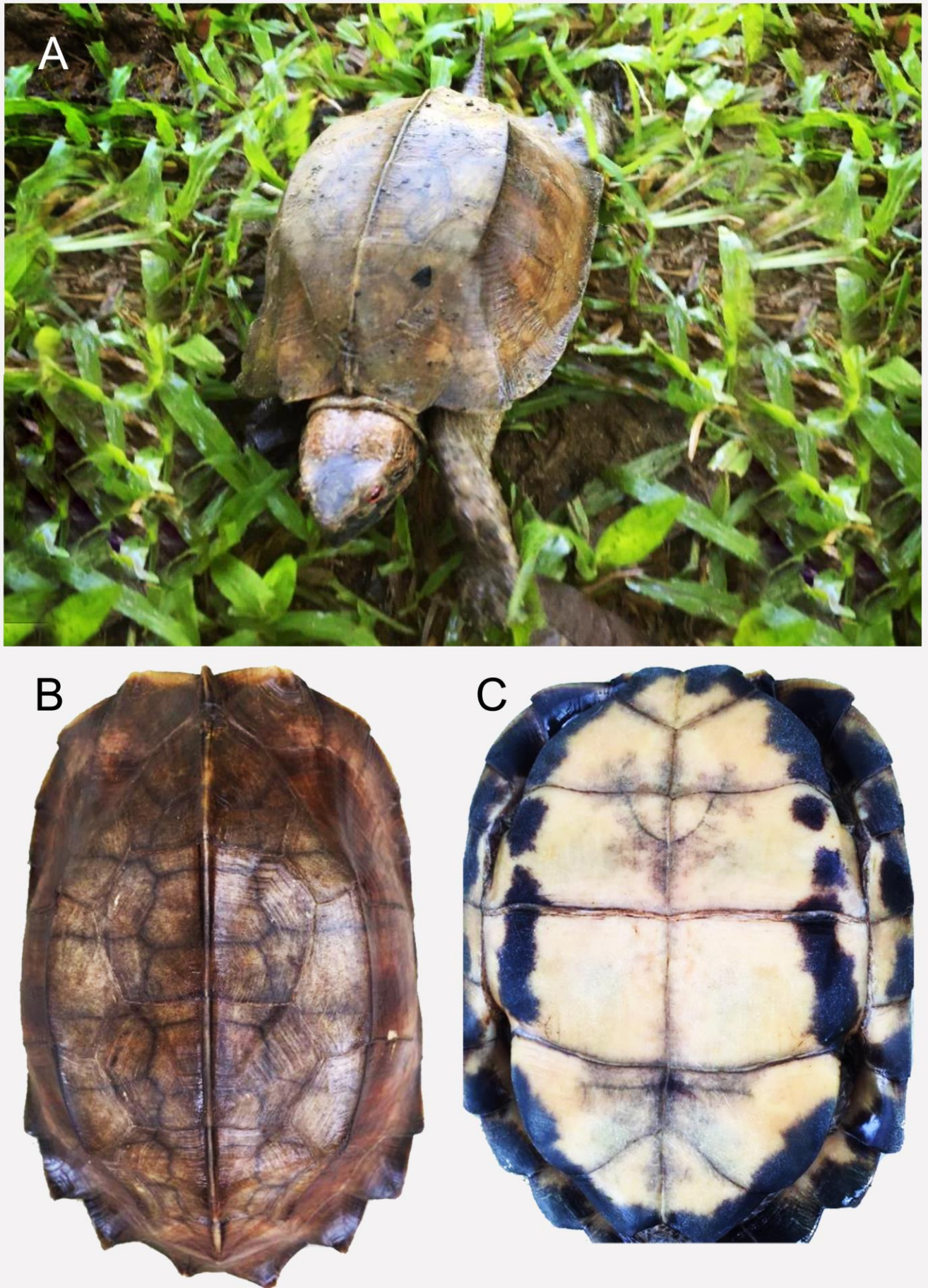


Figure 1. *Cuora mouhotii* found in the HEPA forest, Ha Tinh Province, Central Vietnam: (A) dorsolateral, (B) dorsal, and (C) ventral views of the body; © Photo: Nguyen & Le Tran 2021)

Plate 28



Figure 2. *Cuora mouhotii* with (A) red eyes (female) and (B) black eyes (male); © Photo: V. Le Tran 2021

brown and grey (Fig. 1). The turtles' feet were only lightly webbed, suggesting a terrestrial lifestyle as opposed to an aquatic one. Each finger had sharp nails. The skin of their feet looked like horny scales but was soft, and the colour of skin ranged from light brown to dark brown. Based on these observations, the turtles were identified to be *C. mouhotii*, which is an endangered species. Based on the sexual dimorphism in eye colouration (World Land Trust 2022, Thai National Parks 2023), one turtle was female and the other was male (Fig. 2).

As the turtles were healthy and did not require any veterinary intervention, they could be returned to their natural habitat after three to five days of captivity. However, caution was taken against releasing them back to where they were found for fear of poachers. Hence, their caretakers modified the environment of their enclosure to mimic their natural habitat of small limestone caves and rock crevices in karst forest (Ziegler *et al.* 2014, Das *et al.* 2016). They were eventually released in an area of forest with a similar natural habitat but closer to the geographical centre of HEPA. The pair of *C. mouhotii* had a strong preference for eating earthworms, and only consumed a little of the fruits and vegetables that were offered to them when captive. This is a different finding from Xiao *et al.* (2017) who observed an omnivorous diet of *C. mouhotii* comprising a wide range of vegetation and fallen fruits in their natural environment. We hypothesise that this preference stems from higher activity levels with the change of seasons from winter (when they were discovered) to summer (when Xiao *et al.*'s observations were made).

In Southeast Asia and in Vietnam, wild animals are at high risk of becoming extinct, due to factors such as poverty-driven harvesting of bush meat, inadequate infrastructure, weak governance of protected areas and uncontrolled wildlife trade (Sodhi *et al.* 2004, Duckworth *et al.* 2012, Sandalj *et al.* 2016). Nineteen surveys have shown that 3,442 specimens of *C. mouhotii*, *C. galbinifrons*, and *C. picturata* were exploited commercially in cities such as Hanoi, Da Nang, Buon Me Thuot, and Ho Chi Minh (Van *et al.* 2019). Other research has shown that *C. mouhotii* has decreased due to local consumption as food, use in traditional medicine, and as pets (Hendrie 2000, Stuart & Timmins 2000, Cheung & Dudgeon 2006). Wildlife conservation acts and protocols are extremely important for the protection of *C. mouhotii*.

Our discovery of *C. mouhotii* at the end of 2021, about two decades after the HEPA site had been restored from a degraded forest to a lush secondary tropical rainforest, highlights the significance and potential of forest restoration for the recovery of wildlife populations. Continued support needs to be provided for the protection of restored forests and their wildlife against illegal loggers, hunters and poachers. This was evidenced in the decision agreed by the biodiversity scientists that the release of *C. mouhotii* back into the wild should be in an area of forest that is frequently and easily monitored by HEPA forest managers. Ranger patrols are necessary for protecting forests and wildlife against incursions from poachers, and more capacity-building can be done for forest rangers to empower them in the important role they play in nature conservation (Khac *et al.* 2021).

While only a male and female pair of *C. mouhotii* were found in HEPA at the end of 2021, there is potential for the HEPA forest to become a site for the restoration of a population of this endangered species. Like these two turtle specimens, other turtles could have also made their way to the HEPA forest from neighbouring national parks, or from having escaped from local smugglers. There is also the potential for this species to breed in HEPA. Therefore, utmost care should be taken in the management and protection of the forest if this potential is to be fulfilled. There needs to be continued efforts by forest rangers in patrolling the forest, and public education for the local community about the preciousness of the HEPA forest as a habitat for the preservation of wildlife.

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