

Communication

Confirmed Wild Reproduction and Distribution Records of *Palea steindachneri* in Northern Vietnam, with Notes on Sympatric *Pelodiscus* sp. in Dam-Impacted Habitats

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Abstract

Previous studies have consistently reported the detrimental impact of dam construction on natural populations of softshell turtles across East and Southeast Asia, with particularly severe effects on large-bodied species. The Wattle-necked Softshell Turtle (*Palea steindachneri*), a large-sized and Critically Endangered member of the family Trionychidae, remains poorly documented throughout much of its native range in Southeast Asia. In this study, we present new field data from the Đà River basin in northern Vietnam, encompassing areas both upstream and downstream of the Sơn La Dam. Data were obtained through a combination of direct field observations, camera trap monitoring, and semi-structured interviews with local fishers and traders. Two individuals of *P. steindachneri*—including a juvenile—were recorded, providing the first confirmed evidence of ongoing natural reproduction in the region. Additionally, we documented 102 individuals of *Pelodiscus* sp., encompassing all life stages and indicating a stable, reproducing local population. Despite overlapping in macrohabitat use along the river, the two species were spatially segregated, with a minimum interspecific distance of 8.2 km, suggesting broad sympatry without syntopy, potentially due to microhabitat partitioning. These findings underscore the persistence and likely reproductive viability of *P. steindachneri* in modified riverine systems affected by dams, and have broader conservation implications for other threatened taxa with similar ecologies, such as *Rafetus swinhoei*. Urgent conservation actions, including habitat protection, community-based monitoring, and strengthened regulation of the wildlife trade, are essential to ensure the survival of remaining wild populations.

Keywords: softshell turtle; endangered species; dam; south-east Asia

1. Introduction

Asian turtles represent one of the most critically threatened groups of vertebrates worldwide, with more than 80% of species currently at risk of extinction [1,2]. This alarming



Academic Editor: Antoni Margalida

Received: 23 May 2025

Revised: 20 June 2025

Accepted: 23 June 2025

Published: 27 June 2025

Citation: Le Duc, O.; Trong, M.N.; Leprince, B.; Minh, H.H.; Van, H.T.; Van, S.H.; Luiselli, L. Confirmed Wild Reproduction and Distribution Records of *Palea steindachneri* in Northern Vietnam, with Notes on Sympatric *Pelodiscus* sp. in Dam-Impacted Habitats. *Conservation* **2025**, *5*, 32. <https://doi.org/10.3390/conservation5030032>

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status is primarily attributed to habitat destruction, environmental pollution, overexploitation, and illegal wildlife trade, as documented by the IUCN Red List [1,2]. In Southeast Asia, the development of large-scale hydroelectric projects and dam construction along major river systems constitutes a particularly significant threat to freshwater turtle populations. In the context of Thailand, Thirakhupt and Van Dijk [3] observed that, within the initial 50–80 km downstream from large dams, water temperatures are notably lower and levels of dissolved oxygen are reduced relative to undisturbed riverine conditions. Furthermore, the periodic release of water from dams intensifies riverbed erosion, resulting in the degradation of sandbank habitats essential for riverine turtle species. Dams also impede or diminish the movement and connectivity of aquatic animal populations. Consequently, the ecological dynamics downstream of dams may be profoundly altered, posing substantial challenges to the persistence of affected turtle species.

Despite their critical conservation status, there remains a significant gap in our understanding of Asian turtle distribution and ecology in the wild [4], hindering effective conservation planning and management [5,6]. This is particularly evident in the case of the large-bodied Asian softshell turtles (Trionychidae), which are highly elusive and among the most critically threatened taxa in Asia [7–10]. Accordingly, the development of effective conservation strategies requires a significantly enhanced understanding of the local distribution and ecology of these species, as well as the identification and verification of sites supporting wild reproduction. Published data remain so limited that, for several species, there are instances of gaps exceeding two decades in documentation of their continued presence within certain countries (e.g., *Chitra chitra* in Thailand [11]). One such poorly studied species is the Wattle-necked Softshell Turtle (*Palea steindachneri*), which remains understudied across much of its range [8].

The Wattle-necked Softshell Turtle is a large-sized (up to 450 mm of carapace length, [12], threatened Trionychidae species distributed across Vietnam, Laos, and China [13], with introduced populations established in Hawaii, Mauritius, and Réunion [13,14]. *P. steindachneri* exhibits a broad geographic range that overlaps with several other softshell turtle species, including the Critically Endangered *Rafetus swinhoei* [9,15] and smaller congeners of the genus *Pelodiscus*, whose taxonomic delineation remains unresolved [16–18] and whose ecological characteristics are still poorly understood [4,19]. Although it is widely bred in commercial farms in China and Vietnam [8,20], wild populations are rare and the species is listed as Critically Endangered (CR) on the IUCN Red List [21]. Wild individuals are currently protected under Vietnamese law (Category IIB, Decree No. 84/2021/ND-CP) and are nationally protected wild animal (Category II) in China.

Despite its acknowledged status as a CR species, the ecological knowledge of *P. steindachneri* within its native range remains severely limited—a situation that, as reported above, is characteristic of South-East Asian turtle species more broadly [4]. Indeed, only a handful of records from Vietnam have been documented in recent years, including three instances of individuals caught by fishers in the Red River in Bac Giang and Lao Cai provinces [4] and a direct observation in the wild at Pu Mat National Park [22].

In this study, we present new data on the distribution of *P. steindachneri* in northern Vietnam, including the confirmation evidence of its reproduction in the wild despite the severe environmental alterations caused by hydroelectric development and other anthropogenic disturbances [23]. We also present data on the distribution and age structure—specifically, the number of adults in comparison to subadults and juveniles—of sympatric populations of *Pelodiscus*. In the latter case, and pending a more stable taxonomic consensus regarding the *Pelodiscus sinensis* “species complex”, all observed individuals in this study are provisionally classified as *Pelodiscus* sp. However, according to [13], these individuals would

be assigned to *Pelodiscus variegatus*. Our results highlight the species' capacity to persist and reproduce under changing environmental conditions, offering critical insights into the potential for conservation and management of not only *P. steindachneri* and *Pelodiscus*, but also other potentially co-occurring Trionychidae species.

2. Materials and Methods

We carried out the field study along the Đà River, which flows from China into the Red River system in Vietnam [9]. The primary focus area was in Sơn La Province, upstream of the Sơn La hydroelectric dam [24]. The hydrological conditions of this region have been notably affected by the construction and operation of the Sơn La dam [23], leading to significant changes in water levels and seasonal imbalances, particularly during the dry season (Appendix A Table A1). The position of the various dams within the studied territory is shown in Figure 1.

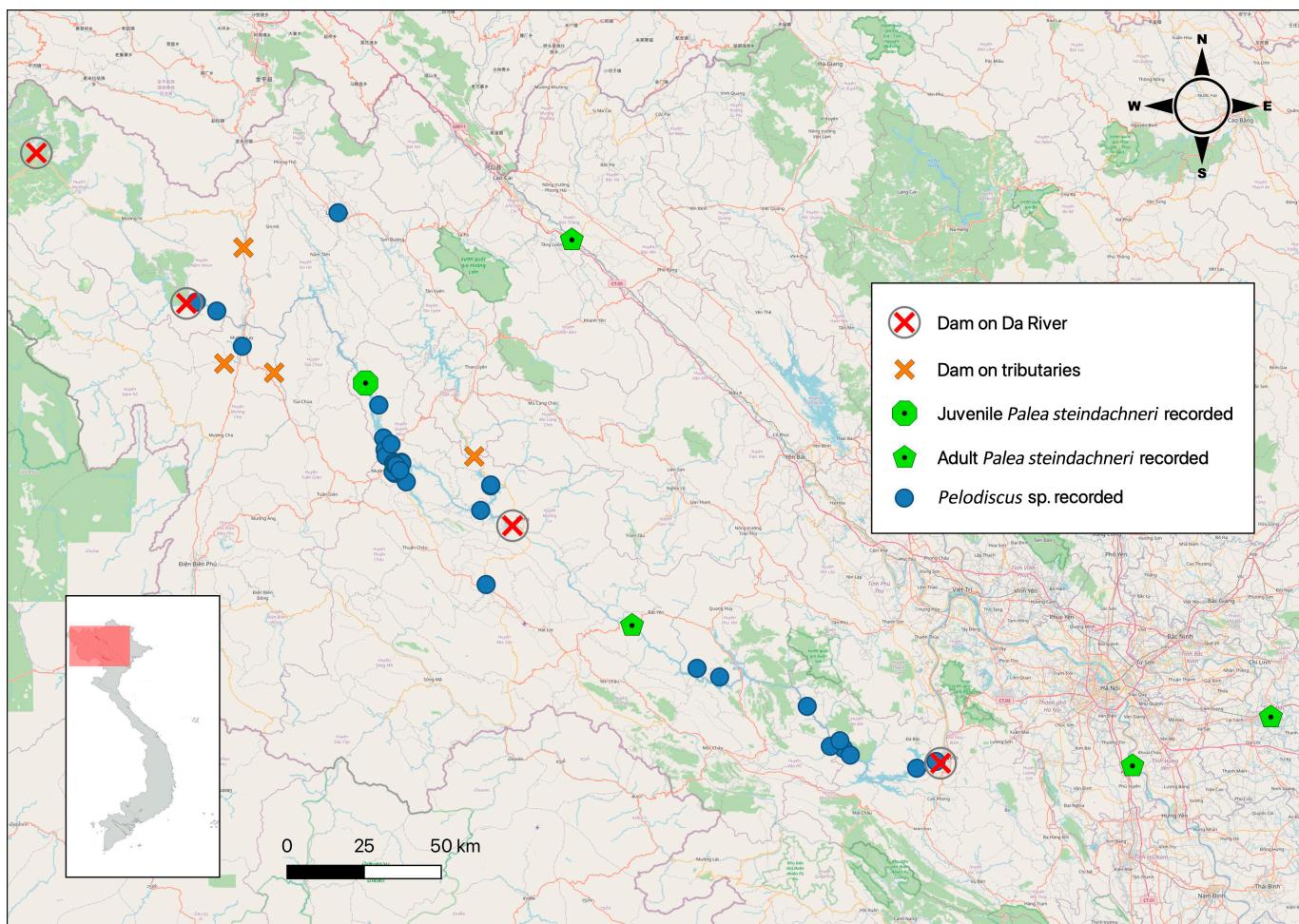


Figure 1. Map of northern Vietnam showing the position of the hydroelectric dams on the Da River and its tributaries, and the distribution records of *Palea steindachneri* and *Pelodiscus* sp. obtained during the 2025 and previous surveys. The location of the study area within Vietnam is illustrated in the inset of the figure.

The general features of the Da river are presented in Figure 2. Based on our observations during the study, the average water level drop was approximately 25 m between Pac Ma dam and Lai Chau dam, 12 m between Lai Chau dam and Son La dam, and 20 m between Son La dam and Hoa Binh dam. However, these values can vary considerably depending on interannual hydrological conditions. Due to these substantial fluctuations

in water levels, aquatic emergent vegetation was nearly absent from the study area. Only terrestrial vegetation established on the upper banks during periods of high water may persist over time. Vegetation that emerges during low water periods is unlikely to survive subsequent rises in water levels. Exposed sandy or bare ground is observed only when water levels recede.



Figure 2. Photos of the Da river in northern Vietnam.

The primary field research was conducted over a continuous 76-day period, from 6 March to 21 May 2025; additionally, data from previous surveys (2019–2024) undertaken by our team in northern Vietnam were incorporated into this study. This timeframe for the primary field research was selected to coincide with the beginning of the dry season, when water levels typically decrease, which is critical for enhancing the chances of observing freshwater turtle activity in the wild (Appendix A Figure A1).

Two complementary methodologies were employed: (i) the use of 71 camera traps, including 50 floating camera traps (set as described in [25]) placed on the surface of the Đà River and 21 stationary camera traps installed at locations identified as potential turtle nesting/basking habitats, all situated upstream of the Sơn La dam; and (ii) the direct observation of individuals in the field or in fishers' catches, supplemented by face-to-face semi-structured interviews with local wildlife traders and fishers to document turtle captures [4,15]. Floating camera traps were deployed randomly across a vast area, and their number was significantly lower than what would be required to reliably estimate the

quantitative abundance of the target species, as is typically achieved in more controlled, experimental camera trap studies. Consequently, their primary function in this study was to increase the likelihood of detecting the presence of turtle species within the area, rather than to provide accurate estimates of their population density.

We defined as potential nesting or basking sites those quiet areas, relatively far from human activities, with a slope of less than 30° and with soil soft enough for a turtle to dig to lay its eggs. Concurrently, daily surveys were conducted at the Quỳnh Nhài harbor, where researchers met with local traders at approximately 2:00 PM each day from March to May 2025 to document turtles either captured by fishers or acquired by traders within the study area. These surveys took the form of semi-structured interviews, during which the following questions were asked: (1) How many turtles do you purchase annually? (2) What species are they? (3) What is the peak season for turtle purchases? (4) From whom do you obtain them? (5) What is the maximum size of turtles you acquire? (6) Have you encountered rare or unusual turtle species? (7) Do you possess any photographs of these turtles? Additionally, traders were asked to provide their phone numbers, Zalo accounts, or Facebook pages, and were encouraged to share any photographs of turtles caught or bought in the region. Overall, we conducted interviews with 505 fishers (203 in 2019, 90 in 2024, and 212 in 2025) at 10 traders (all in 2025).

When any turtle specimens were observed, their size classifications were assigned based on the following criteria: individuals were designated as juveniles if born within the current year, as subadults if older than one year and weighing ≤ 1.5 kg, and as adults if sexually mature and weighing ≥ 1.5 kg. These three age categories were employed because they could be reliably and unambiguously assigned to specimens, including cases in which only photographic evidence provided by fishers was available.

To calculate the distances between occurrences of the two species, the GPS coordinates of *P. steindachneri* and *Pelodiscus* sp. records were imported into QGIS (version 3.36). The “Distance Matrix” function, available under Vector → Analysis Tools, was then employed to compute pairwise distances between the points.

3. Results

3.1. *Palea steindachneri*

The distribution of the sightings of *P. steindachneri* at the study area is shown in Figure 1. Two individuals of this species were recorded during the study period (Figure 3), providing new evidence of the species’ presence in the Đà River system around the Sơn La Dam. On 18 January 2025, a fisher reported catching an adult *P. steindachneri* (estimated weight: 12 kg) downstream from the Sơn La Dam. The individual was captured using a hook long line and subsequently sold for VND 2.5 million (EUR ~90) to a wildlife trader based in Quỳnh Nhài town. Two images from the provided video documentation of this turtle are shown in Figure 3A,B. On 20 March 2025, a newborn *P. steindachneri* was caught by another fisher upstream from the Sơn La Dam using a maze funnel trap (Figure 3C,D). This individual was sold for VND 150,000 (EUR ~5) to a trader at the Quỳnh Nhài harbor. This juvenile turtle was captured upstream of the dam (Figure 1), providing direct evidence of a breeding, and potentially viable, population of *P. steindachneri* within this section of the Đà River. The recent (2022–2025) confirmed records of wild *P. steindachneri* in northern Vietnam are shown in Figure 1 (this figure also includes previous records from our research team).



Figure 3. *Palea steindachneri* adult (A,B) and juvenile (C,D) caught by fishers on the Da River during this study.

3.2. *Pelodiscus* sp.

The distribution map of *Pelodiscus* sp. occurrences in the wild within the study area is presented in Figure 1. The distribution of *Pelodiscus* sp. records indicates a widespread and well-dispersed presence throughout the Da River basin (Figure 1). At the study area, from 2019 to 2025, we recorded 102 *Pelodiscus* sp., including 46 adults, 30 subadults, and 26 juveniles, thus showing that also this latter species does reproduce in the wild along the Đà River and that it is likely locally abundant (Figure 4). Among these specimens, we also recorded three juveniles by two different floating camera traps on 28 March 2025, 20 April 2025, and 12 May 2025 (Appendix A Figure A1).



Figure 4. Differently aged individuals of *Pelodiscus* sp. recorded along the Da River in North Vietnam.

Each *Palea* individual was observed at a minimum distance of 8.2 km from the nearest recorded sighting of *Pelodiscus* sp. The mean distance between occurrences of the two species was much higher: 82.27 km (standard deviation = 54.38 km; median = 77.8 km).

4. Discussion

Our study provides novel data on the distribution and apparent abundance—as indicated by the number of individuals observed—of *P. steindachneri* and *Pelodiscus* sp. in northern Vietnam. Concerning *P. steindachneri*, the documentation of a juvenile individual upstream of the Son La Dam represents the first direct evidence of natural reproduction in the wild in this region, whereas three adults were already documented in the Red River basin by [4]. It is possible that a viable breeding population of *P. steindachneri* may occur in the Đà River basin, despite the significant environmental disruptions caused by hydroelectric infrastructure, altered hydrological regimes, and ongoing human activity. However, this hypothesis requires validation through further research. Nonetheless, this finding is noteworthy, considering that dams are widely recognized for their substantial negative impact on free-ranging turtle populations [26] in different ecological scenarios, such as in the Amazonian South America [27], North America [28–30], and Australia [31, 32], other than Asia [3, 9]. If considered jointly with previous reports of *P. steindachneri* in Vietnam [4, 22], our results build upon these isolated records by demonstrating that reproduction is occurring, even in degraded habitats, highlighting the species' resilience. However, the low number of recorded individuals and the context of their capture—both caught and sold by fishers—indicate that *P. steindachneri* is probably rare and remains highly vulnerable to exploitation and trade. Our records underscore the urgent need for enhanced protection measures, including habitat conservation, stricter enforcement of wildlife trade

regulations, and the development of community-based monitoring programs to reduce fishing pressures in critical areas.

Notably, we also confirmed the presence and natural reproduction of another softshell turtle species, *Pelodiscus* sp. (identified by some taxonomic authorities as *P. variegatus* or as *P. sinensis* under a more traditional classification) [16]. Our records of this species' presence are both numerous and widely dispersed throughout the Da River system, indicating that it is undoubtedly widespread. Moreover, the observation of over 100 individuals with multiple methods (camera traps, inspection of fishers' catches, etc.), including dozen subadults and juveniles, suggests that this species is locally abundant and actively reproducing in the area. The low number of individuals detected by the camera traps should not be interpreted as evidence of low population density, as the number of traps deployed was greatly insufficient relative to the vast size of the surveyed area. The primary objective of using camera traps in this context was to increase the likelihood of detecting the presence of turtle species potentially inhabiting the region, rather than to provide a reliable estimate of their population density.

Given its apparent abundance and the extensive availability of suitable habitat within the Đà River basin, this taxon does not currently appear to be threatened in northern Vietnam. However, ongoing habitat degradation, increasing pollution, and human disturbance may pose significant risks to the long-term viability of certain wild populations, and a careful monitoring should therefore be carried out.

From an ecological standpoint, both species were documented occupying the same habitat type along the main river channel. However, the minimum recorded distance between individuals of the two species was substantial (about 8 km). It is important to note that this value likely overestimates the actual distance, as the methodology employed did not permit comprehensive sampling across the entire riverine stretch between the two observation points. These findings suggest that, while the two species are broadly sympatric, they may not be syntopic. It is plausible that interspecific differences in micro-habitat preferences—such as variations in bank structure and riverbed characteristics (e.g., current velocity, abundance of emergent vegetation)—may contribute to spatial segregation and reduce interspecific competition, particularly when individuals of both species exhibit comparable body sizes (e.g., juvenile *P. steindachneri* and subadult *Pelodiscus* sp.). However, further empirical research is required to test this hypothesis as nothing is known on the microhabitat selection/use of these species. This proposition is consistent with previous ecological studies, which have shown that microhabitat partitioning in turtles represents the primary axis of resource differentiation in approximately 80% of documented cases globally, followed by dietary differentiation in nearly 70% of cases, while macrohabitat use and temporal activity patterns play comparatively minor roles [33]. Regarding the dietary niche dimension, *P. steindachneri* individuals introduced to the Hawaiian Islands have been documented consuming a diverse range of food items, including vegetation, seeds, insects, and various introduced species such as snails, prawns, and clams [14]. Stable isotope analyses of carbon and nitrogen indicate that the diet of this species in Hawaii is primarily composed of fish and snails [12], consistent with the dietary preferences observed in captive individuals from Vietnam [8]. Similarly, species within the genus *Pelodiscus* exhibit a generalist feeding strategy, consuming a wide variety of food sources, including plant material (e.g., algae, sedges, duckweed), fish, amphibians (e.g., frogs), crustaceans (e.g., shrimps), mollusks (e.g., pond snails, trumpet snails, clams), a diverse array of insects (e.g., butterflies, flies, mosquitoes, mantises, mayflies, aquatic and ground beetles, stink bugs), and annelids (e.g., earthworms) [34]. Given the substantial dietary overlap and the fact that *P. steindachneri* attains significantly larger body sizes than *Pelodiscus* species, it is

plausible that interspecific competition for food may occur, particularly between *Pelodiscus* adults and *Palea* juveniles and subadults.

The coexistence and continued reproduction of two distinct softshell turtle species in a region significantly modified by dam construction suggests that ecological conditions may remain suitable possibly also for *Rafetus swinhoei*—a nearly extinct sympatric species exhibiting comparable ecological and reproductive traits [9,15,28,35]. Given that *R. swinhoei*'s historical distribution has been substantially impacted by dam development [9], our findings may have important implications for its potential persistence in the wild. Concerning *P. steindachneri*, future research should prioritize locating nesting sites, assessing reproductive success, and identifying key threats across the species' remaining range in Vietnam.

Author Contributions: Conceptualization, L.L.; methodology, L.L. and O.L.D.; formal analysis, L.L.; investigation, O.L.D., M.N.T., B.L., H.H.M., H.T.V., and S.H.V.; resources, B.L.; data curation, O.L.D.; writing—original draft preparation, L.L.; writing—review and editing, all authors; supervision, L.L. and S.H.V.; project administration, O.L.D.; funding acquisition, B.L. All authors have read and agreed to the published version of the manuscript.

Funding: The field surveys were funded by Turtle Sanctuary and Conservation Center NGO (TSCC), Paris, France. The acquisition of camera traps was thankfully supported by Le Pal Zoo, Dompierre sur Besbre 03290, France (funds to TSCC).

Institutional Review Board Statement: The study was conducted according to the guidelines of the Declaration of Helsinki, and the ethical approval for the protocol was supplied by the Board of Directors of the Institute for Development, Ecology, Conservation & Cooperation (ID ECC protocol: 01/13/03/2024; released on 13 March 2024).

Informed Consent Statement: Verbal informed consent was obtained from the participants. All participants were thoroughly informed about the scope of the study, and the relevant governmental permits were presented to them prior to the administration of any questionnaires.

Data Availability Statement: Data will be provided from the corresponding author after reasonable request.

Acknowledgments: We would like to thank the Vietnam National University of Forestry for granting the necessary permit to conduct the field surveys (Research permit: 906/UBND-NC) and the Son La Provincial People Committee for supporting the research permit and their logistic assistance. Three anonymous referees substantially improved the submitted draft.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

Table A1. Inventory of hydroelectric dams on the Đà River in Vietnam, including the initial dams constructed on its tributaries. Sources: <https://seho.vn/tintuc/khai-thac-va-van-hanh-thuy-dien-nam-na-3/>; <https://www.thuydienhoabinh.vn/wp-content/uploads/2021/08/Quy-trinh-van-hanh-ho-chua-TDHB.pdf>; <https://hqbc.vn/gioi-thieu/thong-so-cong-trinh-62.html>; https://cdm.unfccc.int/ProgrammeOfActivities/cpa_db/JFIU537LC1B92NSP8WXY4OVG0ZMH6Q/view [36].

Dam	River	Province	LAT	LONG	Construction Date	Capacity (MW)	Reservoir Capacity (m ³)	High (m)	Length (m)
Hoa Binh	Da River	Hoa Binh	20.808110	105.326619	1994–2012	1920	9.8 billion	128	970
Son La	Da River	Son La	21.496458	103.996610	2005–2012	2400	9.3 billion	138	1000
Huoi Quang	Nam Mu	Lai Chau	21.696632	103.877913	2006–2016	520	184 mil	104	267
Trung Thu	Nam Muc	Dien Bien	21.938172	103.256023	2014–2016	29.6	30.7 mil	39	50
Nam Na 3	Nam Na	Lai Chau	22.298428	103.160793	2014–2018	30	34.25 mil	37.5	220
Nam He	Nam He	Dien Bien	21.964770	103.101122	2010–2014	16	10.8 mil	55.5	207.5
Lai Chau	Da River	Lai Chau	22.137730	102.983801	2011–2016	1200	1.2 billion	137	613
Pac Ma	Da River	Lai Chau	22.570238	102.517356	2016–2019	140	N/A	N/A	450

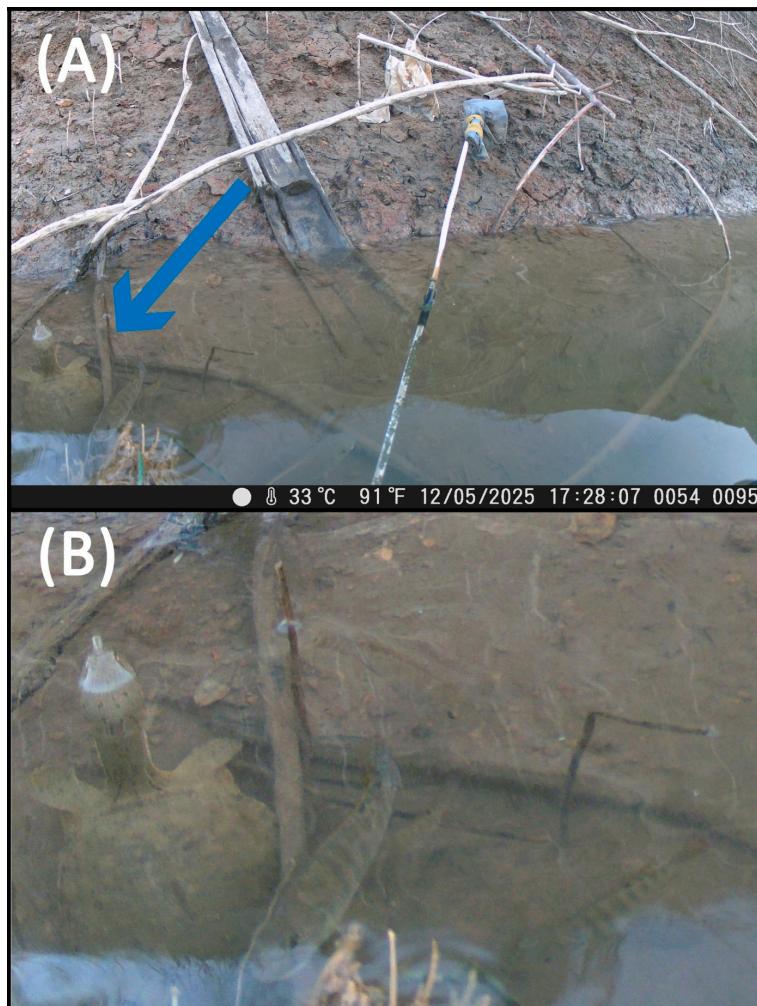


Figure A1. A juvenile softshell turtle (*Pelodiscus* sp.) recorded with a floating camera trap on the Da River (A) and zoom on the juvenile softshell turtle (B).

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