

Burmese Peacock Softshell Turtle as a key species for the establishment of the Community-led Fish Conservation Areas along the Ayeyarwady River Basin in Myanmar

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Abstract

The Burmese Peacock Softshell Turtle (*Nilssononia formosa*, BPST), a Critically Endangered species, is endemic to Myanmar and primarily inhabits freshwater ecosystems, particularly rivers and wetlands. As an indicator species, the BPST reflects the health of freshwater habitats, which are crucial for the sustainability of capture fisheries resources. These fisheries are Myanmar's second most important resource after agriculture, providing essential fish-based products such as fish paste and fish sauce—key nutritional staples for the population. Additionally, capture fisheries offer vital subsistence livelihoods for landless communities, ensuring both food security and economic stability for marginalized groups. BPST conservation efforts contribute to the broader protection of freshwater fish populations. Since 2022, conservation initiatives have been underway in Myanmar, with live specimens recorded at multiple locations along the Ayeyarwady River basin. The Marine Science Association Myanmar (MSAM), in collaboration with the Fauna & Flora-Myanmar Program, is leading the BPST conservation project. MSAM is engaging with eleven identified communities along the Ayeyarwady River to establish Community-led Fish Conservation Areas—an approach aligned with the Other Effective Conservation Measure (OECM) framework, which emphasizes community-based conservation efforts. MSAM has facilitated the development of community-approved conservation maps and boundaries, securing formal agreements from local communities for the establishment of these conservation areas. Currently, management plans are being discussed in collaboration with the eleven communities and relevant stakeholders as part of the official designation process led by the Department of Fisheries. Once formally recognized, these Community-led Fish Conservation Areas will serve as a model conservation strategy for ensuring the long-term sustainability of Myanmar's freshwater capture fisheries.

Keywords: Burmese Peacock Softshell Turtle, OECM, Community-led Fish Conservation Area, sustainability, inland capture fisheries, Myanmar

Introduction

Inland capture fisheries are vital to Myanmar's food security, providing approximately 65% of the fish consumed nationwide, second only to rice as a staple food source [1]. These fisher-

ies also offer essential livelihoods and income opportunities for marginalized rural communities, particularly those residing near the country's extensive river systems [2]. However, these resources are experiencing considerable declines due to anthropo-

genic pressures such as overfishing and habitat degradation, as well as natural challenges like climate variability [3]. Ensuring the sustainability of inland capture fisheries is therefore crucial for Myanmar's economic stability and social well-being, especially for the grass-root communities.

Effective conservation strategies are necessary to protect these vital resources. One promising approach is the establishment of Community-led Fish Conservation Areas (CI-FCAs), a form of Other Effective Conservation Measures (OECMs). CI-FCAs are grounded in the interest, understanding and capacities of local communities, ensuring that resource users, those who directly depend on fisheries, play a central role in management. This user-based approach enhances effectiveness, as communities with a deep understanding of local ecosystems are more likely to implement sustainable practices [4]. Through active participation and collaboration with stakeholders, CI-FCAs can significantly contribute to the preservation of Myanmar's freshwater ecosystems.

Indicator species are organisms whose presence, absence, or abundance in a particular environment reflects specific environmental conditions, serving as vital tools in conservation planning. These species provide insights into the health of ecosystems, enabling conservationists to identify areas that require protection or restoration. By monitoring indicator species, scientists can detect changes in environmental quality, assess the effectiveness of management practices, and prioritize conservation efforts in regions where these species thrive. For instance, the presence of certain plant species can signify the quality of a habitat, guiding the selection of conservation areas [5]. Furthermore, selecting appropriate indicator species necessitates a scientific, data-driven approach that considers local ecology and traditional knowledge, ensuring that conservation strategies are both effective and culturally relevant [6]. Thus, the strategic use of indicator species is crucial for informed decision-making in the establishment and management of conservation areas.

The Burmese Peacock Softshell Turtle (*Nilssonia formosa*, BPST), endemic to Myanmar, serves as an indicator species for freshwater habitat health, making it valuable for conservation planning [7]. Identifying BPST habitats can guide the selection

of conservation areas, ensuring that CI-FCAs are established in ecologically significant locations [8]. By leveraging BPST distribution data, conservation efforts can be strategically directed, enhancing both biodiversity protection and fisheries sustainability. The establishment of CI-FCAs based on BPST presence can serve as a model conservation approach, promoting the long-term resilience of inland capture fisheries while improving the livelihoods of rural communities dependent on these resources.

A key factor in the establishment of CI-FCA is the behavior change of relevant stakeholders. Research suggests that conducting a series of behavior change interventions can significantly enhance conservation efforts [9]. Globally, behavior change initiatives play a crucial role in achieving positive outcomes in conservation projects [10].

This project funded by Prince Bernard Nature Fund-PBD, United States Freshwater and Wildlife Service-USFWS, Rain Forst Trust-RFT, and Darwin-initiative have the common objective for the designation of conservation areas based on the key species and managed sustainability by local communities along the Ayeyarwady, Sittaung and Indawgyi basin in Myanmar. The Marine Science Association Myanmar (MSAM) and the Fauna & Flora-Myanmar Program are leading the project to meet the goal of the community-based fish conservation area designation based on the BPST conservation.

Project location

The project was implemented along the Ayeyarwady River system in Myanmar (Fig. 1), a vital lifeline for the country, supporting agriculture, fisheries, drinking water supply, transportation, and regional development [11]. The river is home to several endemic and threatened species, i.e. Burmese Peacock Softshell Turtle, Irrawaddy Dolphin, making its conservation crucial for biodiversity. Among its many contributions, the Ayeyarwady River system plays a particularly significant role in sustaining inland capture fisheries, about 388 fish species residing along the Ayeyarwady River system [12], which serve as a primary livelihood for the communities living along its banks. The project began in Indawgyi in 2022, in the upper Ayeyarwady River basin of Kachin State. In the following years, it expanded to the middle section of the Ayeyarwady River basin.

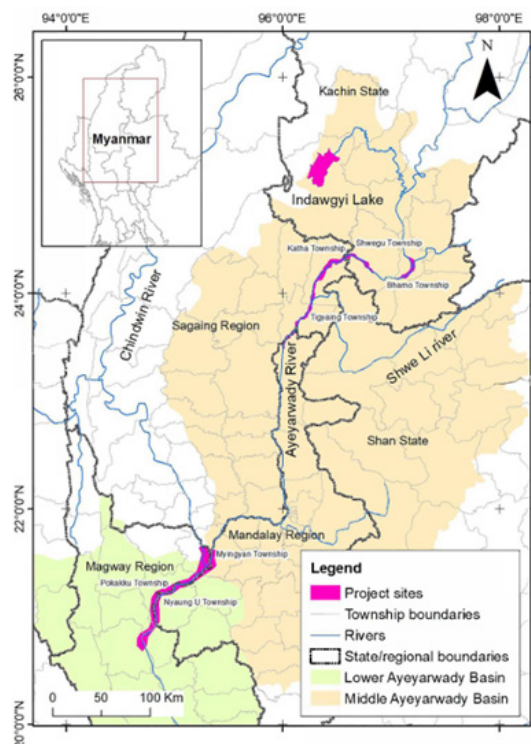


Figure 1: Project location (credit to Myo Myint Aung, Fauna & Flora-Myanmar)

Materials and Methods

This project was implemented using a community-based conservation approach, integrating local ecological knowledge (LEK) to enhance the effectiveness of species monitoring and habitat protection [13, 14]. To identify potential habitats of the Burmese Peacock Softshell Turtle (*Nilssonina formosa*, BPST) along the Ayeyarwady River system, project staff conducted Knowledge-Attitude-Behavior (KAB) surveys, a widely used tool for assessing local perceptions and conservation willingness [15].

Following habitat identification, the project team engaged in community consultations in the potential BPST habitats to evaluate the willingness of local residents to support BPST conservation efforts, and threats survey. Interested individuals were selected based on their experience in local fisheries and prior knowledge of turtle nesting sites [16]. These community members received training in species identification, tracking methods, and standardized documentation of nesting activity [17].

A structured communication system was established between the trained community monitors and the project team to facilitate timely data collection and reporting [18]. Villagers conducted regular patrols and monitoring within their designated con-

servation zones. Upon detecting turtle tracks or other signs of BPST activity, they promptly reported their observations to the project team. In response, conservation staff provided guidance on monitoring protocols and site management strategies, ensuring the protection of nesting habitats and the long-term viability of BPST populations [19]. The discovered nesting sites were covered with iron fences and place water bucket in the fences for the newly hatched turtles.

A series of behavior change awareness-raising events were conducted within project communities, including school children. The project produced awareness-raising pamphlets and distributed in the projects. The establishment process of the Community-led Fish Conservation Area (Cl-FCA) followed the framework outlined by Louri (2020) [20].

Results

The first live BPST specimen was recorded in Indawgyi on July 22, 2022. In total, five specimens were documented in Indawgyi that year. The number of recorded species increased to 22 in 2023 and 24 in 2024. Among these, two were consumed in 2022, one in 2023, and two in 2024 (see Table 1 and Figure 2).

Table 1: Burmese Peacock Softshell Turtle records

Year	Live	Consumed	Total
2022	3	2	5
2023	21	1	22
2024	21	3	24

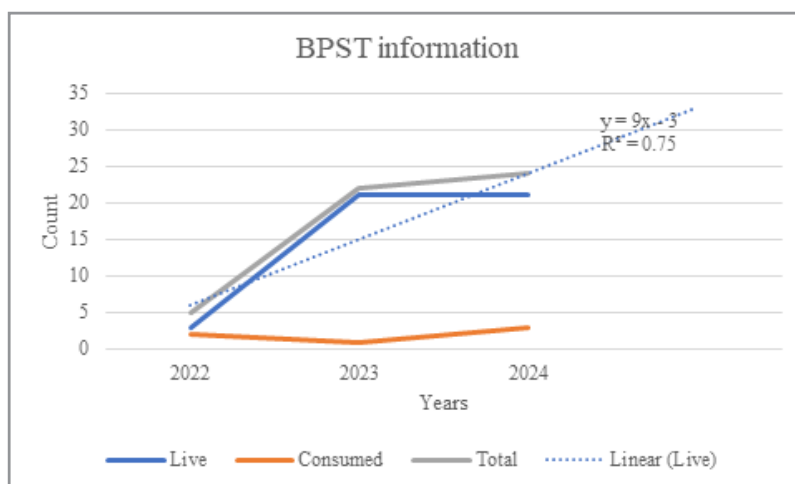


Figure 2: BPST records

The first BPST nesting site in Indawgyi was recorded on October 15, 2022. A total of 12 nesting sites were documented along the banks of Indawgyi Lake that year, with the project successfully protecting five of them. The recorded egg counts per nest were 17, 18, 18, 20, and 23, totaling 96 eggs.

The first BPST hatchlings were observed on June 11, 2023, the morning after a night of heavy rain. A total of 15 live hatchlings were recorded from one nesting site, along with three unhatched

eggs. Hatchlings from the remaining four sites were not observed or recorded. The collected eggs diameter of 3.6 cm. The hatchlings had an average weight of 19 grams, average length of 5.0 cm and a width of 4.6 cm. The surface soil temperature recorded of the hatching nest was about 31.6 °C.

In 2023, 910BPST nesting sites were recorded, and 9 were successfully protected. By 2024, the number of recorded and protected sites had increased to 16 (see Table 2 and Figure 3).

Table 2: Burmese Peacock Softshell Turtle nesting site records

Year	Nests	Protected
2022	12	5
2023	10	9
2024	16	16

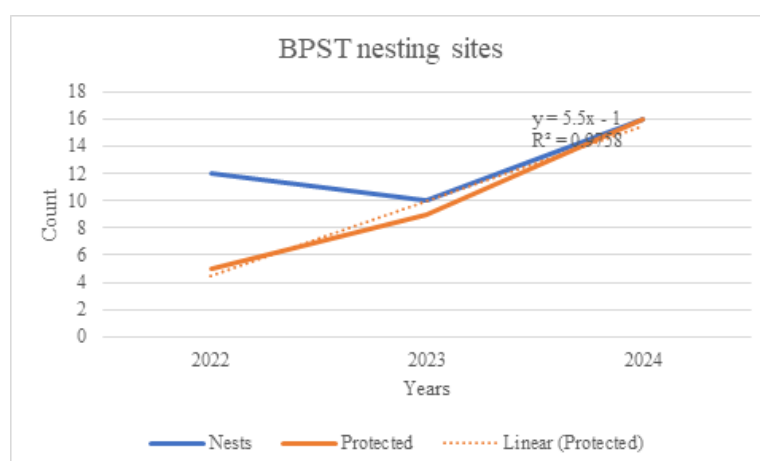


Figure 3: BPST Nesting Sites Records

In the first year of the project, poaching was identified as a major threat. By 2024, climate change-related weather issues had emerged as an additional challenge. BPST turtles typically hatch in June, but in 2024, heavy rainfall during the nesting season caused significant damage. Nesting sites were eroded, and many nests were either destroyed or became rotten due to prolonged inundation and excessive moisture.

In response to BPST conservation records, the project collaborated with nearby communities to establish Community-led Fish Conservation Areas (CI-FCAs) along the Ayeyarwady River basin. Eleven communities agreed to the establishment of CI-FCAs and formalized their commitment by signing agreements (Figure 4). The project is currently developing a management plan as part of the official designation process.



Figure 4: Community-Agreed CI-FCA

Discussion

This research is the first research to save the endangered species BPST and to use this indicator species for the establishment of Community-led Fish Conservation Area (CI-FCA) for the benefit of threatened biodiversity and well-being of dependent stakeholders. Using the indicator species is common practice in the conservation area establishment. The crucial of this CI-FCA establishment is behavior change of the stakeholders. The behavior change through the close communication with the stakeholders and organize awareness-raising programs are useful tools of the effectiveness of the behavior change.

The threat noted in the first year was poaching. The community did not understand the projects' objective and the important role of indicator species to the aquatic ecosystem. The traditional practice is the turtle eggs were collected and sold in the market or family consumption.

The documentation of *Nilssonina formosa* Burmese Peacock Softshell Turtle (BPST) specimens in Indawgyi since 2022 provides valuable insights into population trends, nesting success, and conservation challenges. The increase in recorded individuals from five in 2022 to 22 in 2023 and 24 in 2024 suggests improved monitoring efforts and potentially a recovering population. However, the continued consumption of individuals, two in 2022, one in 2023, and two in 2024, indicates that poaching and local exploitation remain persistent threats, necessitating strengthened law enforcement and community engagement in conservation efforts.

The establishment of BPST nesting sites in Indawgyi further highlights the ecological significance of this region. The first nesting site was recorded in October 2022, with a total of 12 nesting sites documented along the banks of Indawgyi Lake that year. However, only five of these sites were successfully protect-

ed, emphasizing the need for more effective nest monitoring and protection strategies. The recorded clutch sizes, ranging from 17 to 23 eggs per nest (totaling 96 eggs), align with the reproductive output reported for other freshwater turtle species [21].

Hatching success in BPST populations appears to be influenced by environmental conditions. The first observed hatchlings on June 11, 2023, coincided with a night of heavy rainfall, suggesting a potential link between precipitation and hatching timing. However, while 15 hatchlings were successfully recorded from one nest, no hatchlings were observed from the remaining four nests, raising concerns about nest viability, predation, or environmental stressors. The dimensions of collected eggs (3.6 cm diameter) and hatchlings (5.0 cm length, 4.6 cm width, 19 grams) are comparable to known BPST morphometric data, further validating species identification.

Climate change-related weather variability emerged as a significant threat in 2024. Heavy rainfall during the nesting season led to erosion of nesting sites, with some nests being destroyed or suffering from prolonged inundation, leading to egg rot. These findings align with previous studies indicating that excessive moisture can negatively impact turtle embryonic development and hatching success [22]. Such climate-related threats underscore the need for adaptive management strategies, such as elevating nest sites or implementing artificial incubation programs.

In response to conservation challenges, the project-initiated community-based conservation efforts, leading to the establishment of Community-led Fish Conservation Areas (CI-FCAs) along the Ayeyarwady River basin. The participation of eleven communities in signing conservation agreements signifies a growing local commitment to BPST protection. The development of a management plan for CI-FCA designation is a crucial step toward long-term conservation sustainability, as community-driven initiatives have been shown to enhance local stewardship and reduce anthropogenic threats to endangered species [23].

Overall, the results indicate progress in BPST conservation through increased monitoring, protection of nesting sites, and community engagement. However, ongoing challenges, including poaching and climate-related threats, highlight the need for continuous adaptive management, policy support, and further research to ensure the species' long-term survival.

Conclusion

This study represents a pioneering effort to conserve the endangered Burmese Peacock Softshell Turtle (*Nilssonina formosa*, BPST) while leveraging it as an indicator species for the establishment of Community-led Fish Conservation Areas (CI-FCAs). The findings highlight the importance of stakeholder behavior change, achieved through continuous engagement and awareness-raising programs, in ensuring the success of conservation initiatives. While the increase in recorded BPST individuals from 2022 to 2024 suggests positive conservation outcomes, persistent threats such as poaching and climate change-induced habitat degradation underscore the need for sustained intervention. The documentation of nesting success and hatching patterns provides crucial insights into BPST reproductive ecology, with evidence linking extreme weather events to nest failure. The successful establishment of CI-FCAs, supported by eleven local

communities, demonstrates the potential of community-driven conservation models in safeguarding aquatic biodiversity. Moving forward, strengthening law enforcement, enhancing nest protection strategies, and integrating climate-adaptive management approaches will be essential for ensuring the long-term survival of BPST and the broader aquatic ecosystem.

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