The Establishment and Management of Nature Reserves: Crucial Support for the Recovery of the Yangtze Finless Porpoise Population

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Abstract: The Yangtze finless porpoise (*Neophocaena asiaeorientalis asiaeorientalis*) is distributed in the main stream of the middle and lower reaches of the Yangtze River, as well as in Dongting and Poyang lakes. Currently, the most crucial conservation approach involves the establishment and management of both *in-situ* and *ex-situ* nature reserves. Since the 1990s, seven nature reserves have been established in the middle and lower reaches of the Yangtze River, covering nearly one-third of its main stream. Additionally, two nature reserves, one in the Dongting Lake and another in the Poyang Lake, have been set up; and three *ex-situ* nature reserves have been established in three oxbows respectively in Hunan, Hubei, and Anhui provinces. Through measures such as improving the ecological environment quality within the reserves, regulating human activities, and conducting continuous monitoring, the finless porpoise population showed a slight increase in 2022 for the first time. The *ex-situ* population has continued to grow, with four individuals being released back into the main stream of the Yangtze River after undergoing reintroduction training in 2023. Based on the population development lasting for over three decades, and predictions of future ecological changes, orderly establishment and scientific management of nature reserves have played a key role in and will remain an important basis for the sustaining growth of the finless porpoise population.

Keywords: The Yangtze finless porpoise, nature reserve, *ex-situ* nature reserve, population development, species conservation

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UNESCO's Fifth World Congress of Biosphere Reserves (WCBR) will be held in Hangzhou, China in September 2025. The development of the UNESCO Man and the Biosphere Programme (MAB) Strategy and Action Plan will be an important topic for discussion at the conference. The last MAB Strategy (2015–2025) was released in 2016 on the fourth WCBR in Lima, Peru. As the MAB Programme has evolved, biosphere reserves have become its principal means of implementation (UNESCO, 2017). In China's Yangtze River, ten reserves have been established for the Yangtze finless porpoise (*Neophocaena asiaeorientalis asiaeorientalis*), across Hunan, Hubei, Jiangxi, Anhui, and Jiangsu provinces. These include natural reserves within their native habitat and ex-situ nature reserves created in oxbows. As of mid-2025, six nature reserves have been adopted as members of the China Biosphere Reserve Network (China National Committee for Man and the Biosphere Programme, 2024). The establishment, management, and consistent monitoring of these reserves have provided crucial support for the conservation and recovery of the finless porpoise population.

In the main stream of the middle and lower reaches of the Yangtze River, and the waters of the Dongting and Poyang lakes, the porpoise population has halted its decline and is slowly recovering, increasing from 1,012 individuals in the year of 2017 to 1,249 in the year of 2022. The population in *ex-situ* reserves has reached around 150 individuals and continues to grow sustainably; more importantly, four individuals from the Tian'e Zhou (Swan islet) *ex-situ* population have been rewilded and released into the main stream of the Yangtze River (Qiu et al., 2023; Hao et al., 2024a). Initially, these nature reserves effectively covered key distribution zones for the porpoise (Chen & Hua, 1989; Wang, 1989), providing essential protection for these critical habitats. The stable maintenance of natural ecological conditions, such as sandbars and river estuaries within the reserves, has promoted stable porpoise distributions (Wang & Wang, 2015). Fisheries management, particularly the implementation of the Ten-year Fishing Ban Policy, has effectively protected the porpoise's food resources (Mei et al., 2020). Patrols and real-time acoustic and visual monitoring have significantly enhanced the management and control of illegal activities within the reserves (Wang et al., 2021; Wang et al., 2025a). Management based on genetic diversity and population regulation within *ex-situ* reserves has fostered the stable development of the *ex-situ* conserved populations (Hao et al., 2024b; Tang et al., 2025). In summary, the establishment and continuously improved management of reserves have effectively promoted the recovery of the natural porpoise population and the development of *ex-situ* populations.

This essay summarizes the vital role of the construction and management of finless porpoise reserves over the past 30 years in promoting ecological environmental protection and porpoise conservation within these reserves. It also addresses major existing and emerging challenges and proposes potential solutions. This review aims to provide a reference for the planning, establishment, and management of finless porpoise reserves.

1. The Establishment of the Reserves Facilitates the Balance between Ecological Environment Protection and Socioeconomic Development

The middle and lower reaches of the Yangtze River, especially the lower sections, flow through provinces and municipalities that are economically highly developed, where the conflict between resource utilization/development and resource conservation is particularly acute. During the establishment of the reserves, the central and local governments, involved research institutions and conservation departments generally placed significant emphasis on coordinating the ecological service functions with the socioeconomic service functions of these reserves.

The earliest established reserves were in the Shishou and Xinluo sections of Hubei Province, both located in the Jingzhou section of the Yangtze River. The primary characteristic of the Jingzhou section is its complicatedly winding river channel, featuring abundant sandbars and gentle banks within the river channel. These characteristics create diverse current conditions, with numerous eddy zones, slow-flow areas, and confluence zones. Small fish, the primary prey of finless porpoises, favor these waters. Since porpoises have a relatively limited ability to cope with strong currents, these areas are their main distribution and habitat zones (Chen & Hua, 1989; Cui et al., 1999). Two reserves were established in the Anhui section, namely the Anqing and Tongling sections. These sections also fea-

Fig. 1. Two Yangtze finless porpoises in the *ex-situ* reserve situated at the Tian'e Zhou Oxbow (Swan islet), Shishou, Hubei. (Photo by the Hubei Changjiang Tian'e Zhou Baiji National Nature Reserve)

ture river channels rich in sandbars and riverside beach, where sandbars split the natural river channel into two or even multiple branches. Typically, one branch is deep and fast-flowing, suitable for transportation and shipping, while others are often shallower with slower currents, ideal for porpoise foraging and inhabiting. Thus, developing transportation and shipping can coexist with providing suitable waters for porpoise distribution and habitat (Chen et al., 2024a). The most typical example is the Zhenjiang reserve in the Jiangsu section. Its south branch is a navigation channel, while the north branch is non-navigable and was consequently designated as a reserve—currently the only non-navigable main stream reserve (Li et al., 2024).

Early established reserves were often designated to cover nearly 100 kilometers or even longer, mainly because the role of transportation and shipping in socioeconomic activities was less prominent initially. Thus, the delineation process prioritized ecological and species protection. The most recently established reserve is the Nanjing reserve in the Jiangsu section. Although located within the territory of Nanjing City, its initial location was not in the main urban area but rather about 50 kilometers upstream of the Nanjing Yangtze River Bridge (Chen et al., 2024b). Although this section is an important shipping channel, it contains two sandbars with excellent natural environmental conditions, and the northern bank consisted of undeveloped natural riverbanks with very natural shoreline and wetland conditions. The designation of this reserve can be taken as a classic case of balancing natural ecological protection with socioeconomic development.

2. Ecological Environmental Protection and Fish Resource Conservation Promote Recovery of Porpoise Populations in Reserves

The natural habitat of the finless porpoise has specific ecological characteristics, such as the presence of sandbars, branching channels, gentle slopes with slow

currents, mudflats, and vegetation (Wang & Wang, 2015). The long-term stability of these features often conflicts with socioeconomic activities like the operation of large water conservancy projects, hydraulic facility construction, waterway regulation, and port construction. For instance, water released from reservoirs with reduced sediment can lead to sandbar erosion or even disappearance; long, gentle slopes may collapse and be scoured into steep banks; hydraulic construction can cause large mudflat areas to degrade into dry land, with riparian vegetation replaced by terrestrial plants, eliminating spawning grounds for small fish; waterway regulation and port construction can significantly lower water levels in some branches, harden long stretches of sediment banks and riverbeds, occupy river ways, and increase persistent underwater noise (Zhao et al., 2013; Han et al., 2025; Xu et al., 2025).

When the reserves were first established, the number and scale of these water-related projects were relatively smaller, and their impact on porpoises was primarily direct harm during the construction, rather than long-term impact on the porpoise's habitat. Currently, such projects, though relatively bigger in scale, are generally averted from the core and buffer zones of the reserves, and hence their long-term negative effects to the habitats are, to some extent, mitigated. Even in experimental zones, the project scale and mitigation measures during construction must undergo thorough technological verification to minimize adverse effects on the porpoise's habitat (Wang & Wang, 2015). Furthermore, the recent large-scale removal of scattered, disorderly, and polluting docks and berths within reserves has, to some extent, reduced direct shoreline occupation and increased the range of near-shore habitats for porpoises (Xu et al., 2025). These countermeasures and policy enforcement to some extent have mitigated the negative impacts on porpoise habitats from the continuous operation of the related large water conservancy hubs and the increasing number and scale of the involved water conservancy and waterway regulation projects in the reserves (Han et al., 2025).

However, with the continuous operation of the related large water conservancy hubs and the increasing number and scale of the involved water conservancy and waterway regulation projects, their indirect negative impacts, particularly those on porpoise habitats and food resources, have become increasingly apparent (Han et al., 2025).

Reduction in fish resources due to overfishing is among the primary reasons for the continued decline in the porpoise population. Furthermore, illegal fishing activities also incur direct harm to porpoise individuals (Wang, 2009). The Ten-year Fishing Ban initiated in 2021 has provided a historical opportunity for protecting and even restoring fish resources within the reserves. Firstly, traditional fishing grounds, now free from fishing activities, have become foraging and even habitat areas for porpoises. Secondly, with fishing disturbance ceased, fish distribution and movement have become more regular, aligning better with porpoise predation behaviors. Thirdly, the increasing abundance of fish resources and the stabilization of fish community structure provide richer food sources for porpoises, conducive to their reproduction and growth. Monitoring shows significant recovery of fish resources throughout the basin since the ban began.

3. Systematic Daily Patrols Contribute to the Reduction in Stranding Risks and Human-Induced Mortality

Natural climate change has led to persistently low water levels and rapid water recession. Such adverse situation plus the increasing disturbance from shipping, and the more frequently encountering of residual fishing hooks, lines, and nets increase the risks of porpoises becoming trapped in shallow waters, calves being separated from their mothers due to the failure in their acoustic sensing and communication, and accidental injuries or even deaths from entanglement. (Wang et al., 2020; Wang et al., 2021; Liu et al., 2020; Yang et al., 2025; Wang et al., 2025b).

In recent years, incidents of porpoises being trapped in shallow areas due to sudden drops in water levels have occurred occasionally in waters like the Poyang Lake, sometimes involving groups of individuals. In 2022, the Institute of Hydrobiology, Chinese Academy of Sciences, and other organizations successfully rescued over 100 porpoises from shallow sand pits in the Poyang Lake and relocated them to the water channel connecting the Poyang Lake and the Yangtze River. This success is largely attributed to daily patrols and an early warning system based on real-time acoustic and visual monitoring, which detected the trapped group in time and accurately predicted the development of the situation.

Porpoises are highly sensitive to underwater noise, especially during the calf-rearing season from April to July, when mothers

and calves rely entirely on acoustic signals for communication and bonding (Li et al., 2007), such as for nursing and accompanying swimming (Chen et al., 2018). Shipping noise propagates effectively underwater, particularly in narrow river channels, and can mask the acoustic signals between mothers and calves, leading to separation. Once separated from its mother, a calf lacking the ability to identify underwater objects effectively cannot obtain nutrition, and may even fail to swim in strong currents, hence ultimately would suffer drowning, stranding, or death. Patrols can detect stranded calves in time, buying time to remove them from dangerous waters and attempt reunions with their mothers.

Although large-scale fishing operations are prohibited, recreational fishing activities and residual nets, lines, and hooks in the water still pose serious threats to porpoise movement and survival. Porpoises prefer to inhabit nearshore areas and shallow waters around sandbars. Since the Ten-year Fishing Ban, porpoise's activity in these areas has increased as large-scale fishing operations have completely withdrawn, and the abundance of small fish is highly attractive. Consequently, residual nets, lines, and hooks in these areas can easily entangle porpoises, causing severe injury or even death. Patrols can often find entangled porpoises relatively quicker. Collaborating with fisheries management departments and research institutions, they can capture the porpoise and remove the entangled materials, winning precious time for successful rescue. In recent years, several cases of injured porpoises caused by residual nets, lines, and hooks have occurred in areas like Dongting Lake in Hunan, Poyang Lake in Jiangxi, and the Nanjing section of Yangtze River in Jiangsu Province. Some individuals were successfully rescued after timely sighted.

4. Application of Real-Time Acoustic-Visual Monitoring and Early Warning Systems Enhances Surveillance Efficiency

Finless porpoises are vocal animals; monitoring their sounds can detect their presence and underwater activities (Li et al., 2022; Wang et al., 2025a; Yang et al., 2025). In key habitat areas, such as the Yangtze section below the Gezhouba Dam in Yichang, the mouth of the Poyang Lake in Jiujiang, and the side water channel north of Hechangzhou Island in Zhenjiang, porpoises are consistently present year-round. Deploying passive acoustic monitoring devices in these areas allows for 24/7 monitoring of porpoise acoustic signals, identifying their presence and underwater foraging behaviors, and providing timely understanding of porpoise activities and group sizes in these important habitats (Duan et al., 2023). Significant changes in porpoise behavior in these waters, such as reduced frequency of appearance, diminished group sizes, or shortened daily residence times, may indicate alterations in ecological conditions or appearance of human activities adversely affecting the porpoises, necessitating on-site investigation and continued attention to the porpoise groups in the areas (Wang et al., 2021).

Bridge construction, waterway regulation, and water conservancy projects are increasingly frequent in the middle and lower reaches and the waters of Dongting and Poyang lakes. Some projects involve high-intensity construction, wide-ranging impacts, and long durations. Traditional visual surveys for monitoring porpoises in these construction zones are limited, as they cannot cover 24 hours and are less efficient. Deploying acoustic monitoring and early warning platforms near construction sites overcomes these limitations, enabling real-time, 24/7 monitoring. The information gathered is promptly relayed to construction site managers and supervisors, buying time for enhancing close-range observation and adjusting construction intensity to protect porpoises in the construction area and mitigate impacts (Wang et al., 2025a).

Furthermore, the real-time acoustic monitoring platforms deployed in key habitat areas can also issue warnings to ship captains, providing ample time for them to increase vigilance, reduce speed to avoid collisions with porpoises, and take appropriate evasive actions when mother-calf pairs are detected.

5. Reintroducing *Ex-situ* Porpoises into the Yangtze Mainstream Offers an Innovative Approach to Population Recovery

In recent years, the *ex-situ* population in the Tian'e Zhou Oxbow in Shishou, Hubei has continued to grow, nearing or even likely exceeding the environmental carrying capacity of this enclosed water body (Tang et al., 2025). There-

Fig. 2. Transferring the finless porpoises from the rewilding training waters in the Yangtze River to a releasing site. (Photo by the Hubei Changjiang Xinluo Section Baiji National Nature Reserve)

fore, relocating some individuals to other *ex-situ* reserves and artificial environments, or introducing them to the main stream of Yangtze River is necessary to promote healthy, sustainable population development and significantly reduce risks faced by this *ex-situ* population, such as prolonged extremely low water levels and water quality deterioration. Relocating some individuals of *ex-situ* population into the main stream of the Yangtze River is conducive to gradually promoting the recovery of local populations in the river.

Given the significant differences in water flow velocity, abundance of small fish resources, shipping intensity, and underwater noise levels between the *ex-situ* reserves and the natural Yangtze main stream environment, the porpoises scheduled for release underwent a two-year rewilding training program before being released into the main stream of the Yangtze River. This training aimed to help them adapt to the flowing water environment, lower density of small fish resources, frequent shipping traffic, and stronger underwater noise in the Yangtze. Monitoring results from the two-year rewilding training indicated that these released porpoises adapted well to the changes in habitat. After being released into the main stream, they integrated into existing natural groups within a short period, suggesting that individuals bred in *ex-situ* populations can serve as an important supplementary resource for reintroduction into the Yangtze River (Qiu et al., 2023). This transition of *ex-situ* conservation from primarily "preserving the species" to also serving as a "source for replenishment" marks the complete integration of *ex-situ* and *in-situ* conservation strategies.

Conclusion

The finless porpoise population has shown a positive trend of halting decline and beginning a slow recovery that is closely related to the establishment and management of natural reserves, the prohibition and control of key human activities, and the application of new monitoring technologies.

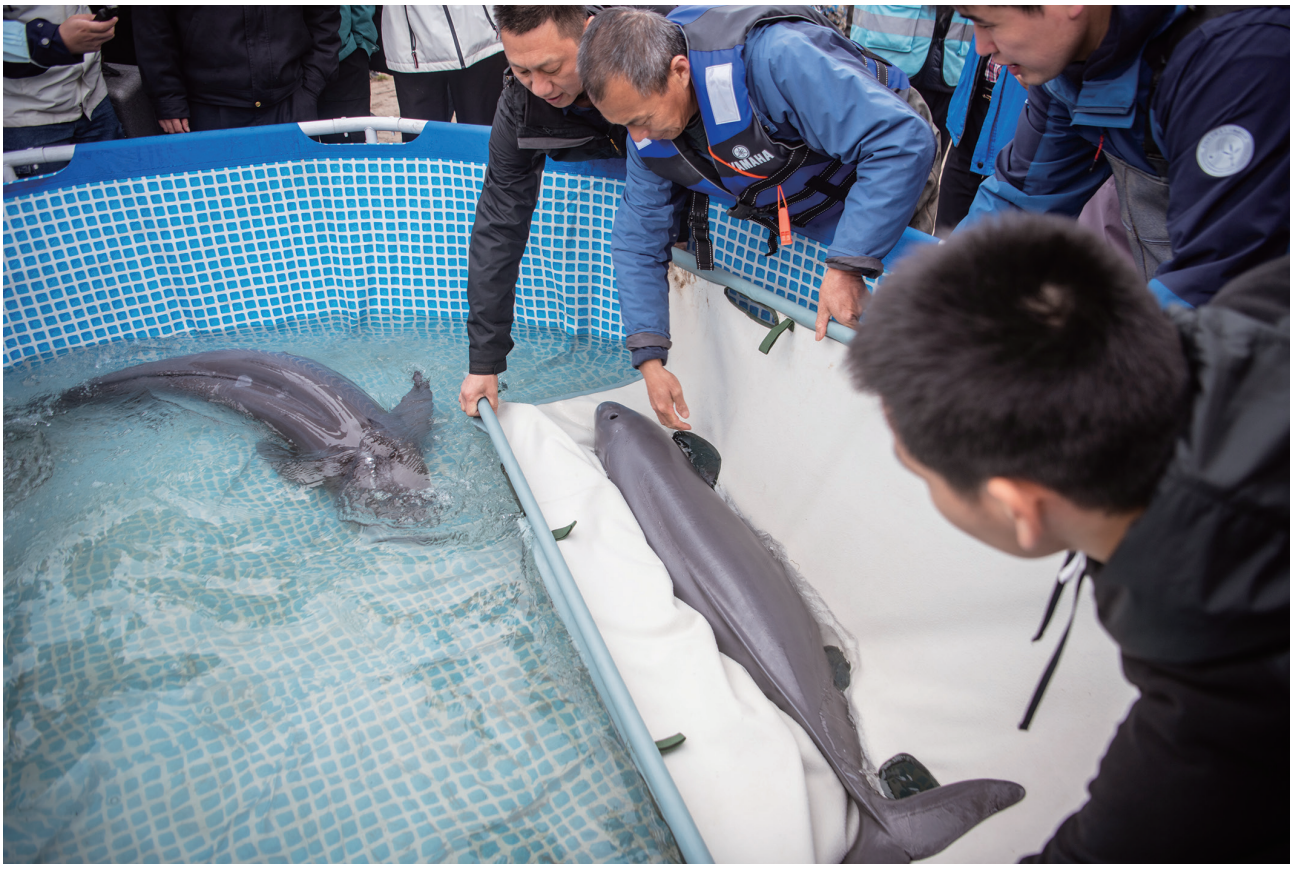

Fig. 3. A short relaxation of finless porpoises before being released to the Yangtze River. (Photo by WU Zhizun)

Nevertheless, significant threats persist currently and will continue in the foreseeable future. These include excessively lowered water levels resulting from extreme climate events, intensive shipping noise, and increased residual fishing gear. Proposed conservation countermeasures, such as restoring floodplains, restoring natural hydrological rhythms, averting key porpoise habitats from waterway and port planning, implementing vessel speed limits, and strengthening leisure fishing management, still require policy promotion and implementation. The protection of the Yangtze finless porpoise is inseparable from the overall ecological conservation of the Yangtze River; only integrated protection can achieve long-term conservation goals. Within this framework, nature reserves, as vital components of the Man and the Biosphere Programme and Framework, will continue to play a pivotal supporting role.

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