E&S Lessons Learned from Projects

Tongling G3 Bridge Project: Biodiversity Good Practice

Background

Biodiversity encompasses the variety of life on Earth and is essential for the health of ecosystems, human well-being, and the global economy. The primary threats to biodiversity include habitat destruction, climate change, pollution, and the overexploitation of resources. Infrastructure development projects can significantly impact biodiversity through habitat alteration and fragmentation.

As a financial institution, NDB plays an important role in promoting biodiversity sustainability by effectively managing risks associated with its projects and capitalizing on opportunities. NDB requires its clients to implement measures to mitigate biodiversity impacts related to their projects, including adherence to the NDB's Environment and Social Framework (ESF) requirements for critical habitats.

This case study illustrates an approach and initiatives undertaken by NDB and its clients aimed at biodiversity protection. It showcases the practices adopted by an NDB's client to achieve the biodiversity protection objectives.

Project Overview

Anhui Tongling G3 Bridge Project entails construction of an 11.96 km road-rail bridge over the Yangtze River. This bridge features a single span supported by two piers, which are positioned on either bank of the river. This project is situated within the experimental zone of the Yangtze River Dolphin Natural Reserve (YRDNR), approximately 14.1 kilometers upstream from the buffer zone and 22.4 kilometers upstream from the core zone[1].

As the "Mother River" of China, the Yangtze River holds significant ecological, socio-economic, and cultural importance for the country. The YRDNR is dedicated to protecting three endangered species that are classified as Class-I nationally protected species, endemic to the Yangtze River,

Photo 1: An Overview of the G3 Bridge (Design View)

and listed as 'critically endangered' on the IUCN Red List[2]. These species include the Yangtze Finless Porpoise (*Neophocaena asiaeorientalis ssp. asiaeorientalis*), the Baiji (*Lipotes vexillifer,* functionally extincted), and the Chinese sturgeon (*Acipenser sinensis*). Additionally, the YRDNR is

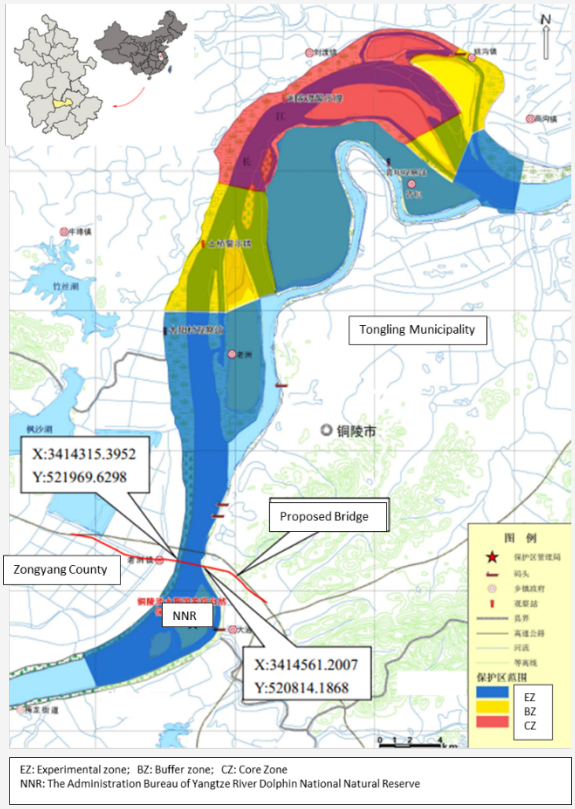
What are Critical Habitats?

Critical habitats are areas with high importance for biodiversity, including (a) highly threatened or unique ecosystem; (b) habitat important to Critically Endangered or Endangered species, as listed in the IUCN Red List of threatened species or under national law; (c) habitat important to endemic or restricted-ranges species; (d) habitat supporting globally or nationally significant concentrations of migratory or congregatory species; (e) ecological functions or characteristics that are needed to maintain the viability of the biodiversity features described above in (a) to (d).

NDB ESF Requirements for Critical Habitats

According to NDB's ESF requirements, the clients "do not implement project activities in areas of critical habitats, unless: (a) there are no measurable adverse impacts on the critical habitat that could impair its ability to function; (b) there is no reduction in the population of any recognized endangered or critically endangered species; and (c) any lesser impacts are mitigated.

home to eleven other 'critically endangered' species, including the critically endangered Chinese alligator (*Alligator sinensis*), Yangtze giant softshell turtle (*Rafetus swinhoei*) and Siberian crane (*Leucogeranus leucogeranus*). Among these species, the Yangtze Finless Porpoise (referred to as the Porpoise) is the primary focus of conservation efforts, given its notable presence in the YRDNR.



Graph 1: Location of the project site and the YRDNR

The biodiversity impacts of the project are considered substantial and include several critical aspects during both construction and operational phases.

Here are the detailed impacts during construction:

1. *Loss and Change of Aquatic Habitats*: The construction of temporary docks, cofferdams, and other underwater structures will lead to the loss or alteration of aquatic habitats. This may disrupt the natural environment and affect the survival of aquatic species of the YRDNR.
2. *Impacts on Aquatic Animal Distribution and Migration*: Underwater construction activities, such as drilling, generate noise that may disrupt the distribution and migration of aquatic animals, particularly the Porpoise. These disruptions are significant as the Porpoise relies on echolocation for navigation, foraging, and communication, which are essential for their survival.
3. *Impacts on Yangtze Finless Porpoise*:
   - *Mechanical Damage or Death*: Construction activities may pose a risk of mechanical damage by vessel engines or death to the Porpoise.
   - *Reduced Population*: Negative impacts on fishery resources due to the project may lead to a reduction in the Porpoise's population as they rely on these resources for food.
   - *Disturbances to Feeding and Breeding Activities*: Nighttime lighting at the construction site can disturb the feeding and breeding habits of the Porpoise.
   - *Migration Disturbances*: Vessel congestion and construction-related underwater noise may hinder the Porpoise's passage through the project area, potentially altering their migratory corridors.
4. *Impacts on Habitat and Endangered Species Due to Water Quality Deterioration*: Accidental release or diffusion emissions from vessels can degrade water quality, impacting the habitats and endangered species within the YRDNR.
5. *Exacerbated Damage or Injury of Endangered Species During Rescue Activities*: In the event of rescue activities being conducted inappropriately, this may lead to further damage or injury to endangered species.

During the operational phase of the project, several significant impacts may emerge affecting critical habitats and aquatic biological resources within the YRDNR, as well as the local porpoise population. These potential impacts include the following:

1. *Change of Habitat and Hydraulic Conditions*: The presence of the bridge can alter natural habitat configurations and hydraulic conditions, which may affect water flow and sediment transport, leading to changes in the ecosystem.

2. *Water Quality-Related Impacts*: The operational activities associated with the bridge may negatively affect water quality, which can have detrimental effects on the endangered porpoise species, impacting their migration, feeding, and breeding activities.
3. *Potential Cumulative Impacts*: Together with the existing bridge, the new bridge may contribute to cumulative impacts on aquatic animals, further stressing their populations and habitats.
4. *Accidental Release of Dangerous Goods*: There is a risk of accidental releases of hazardous materials from the bridge, which could harm habitats and aquatic animals, exacerbating existing environmental challenges.

In summary, the project requires comprehensive planning and the implementation of effective mitigation measures to reduce the impacts on the YRDNR and the Porpoise's population. It is essential to address potential biodiversity impacts and risks to safeguard the ecological integrity of the Yangtze River and to ensure the survival of the Porpoise, which depends on this crucial ecosystem.

Project Planning

Prior to construction, the project design alternatives have been extensively assessed and optimized, taking environmental, social, economic, and technical considerations into account. Key actions implemented to minimize the biodiversity impacts include:

1. *Single-Span Bridge Design*: The design features a single-span bridge with no piers in the middle of the river, which helps to minimize disturbances to the protected habitats.
2. *Jack-Down Method for Pier Drilling*: The pier-free mid-river single-span structure not only minimizes habitat occupation but also offers sufficient width to reduce vibrations and noises generated by construction and operational traffic. This design helps alleviate disruptions to the migration corridors of the Porpoise.
4. *Establishment of Cofferdams*: Cofferdams will be constructed prior to underwater activities to create a dry working environment. This approach minimizes direct contact with water during the drilling process, thereby helping to reduce noise emissions and the impact on water quality during construction.
5. *Restricted Construction Window*: The construction window for underwater works is restricted to the dry season, specifically from October to next April. This scheduling avoids the breeding season of the Porpoise, thereby minimizing disturbances to their reproductive activities.
6. *Minimization of Construction Vessels*: To reduce impacts to the aquatic habitat, the project emphasizes the use of road transportation and innovative engineering techniques to limit the number of construction vessels needed.

These actions reflect the project's commitment to biodiversity stewardship and the protection of the YRDNR.

However, based on environmental and social due diligence, NDB has identified several significant gaps in relation to NDB ESF concerning the project's biodiversity impact assessment and management. These gaps include a lack of implementation capacity and resources, inadequate biodiversity impact assessments, and insufficient mitigation measures to ensure compliance with ESF requirements regarding critical habitats.

In response to these deficiencies, NDB collaborated closely with the project to address the challenges identified. External third-party biodiversity experts were engaged to conduct a supplementary biodiversity impact assessment, and practical mitigation measures were developed, resulting in the creation of an aquatic life conservation plan (ALCP, the plan). Furthermore, NDB and the project conducted extensive discussions regarding the implementation arrangements for this plan, with a particular focus on the allocation of appropriate technical expertise and funding to support effective execution.

The ALCP addresses both construction and operational biodiversity impacts and risks, encompassing the following key activities:

1. Assignment of a porpoise expert to the project environmental team.
2. Capacity building for all construction workers on the ALCP.
3. Engagement of third-party biodiversity consultants for ongoing noise monitoring and biodiversity assessment.
4. Compensation and offset for habitat loss through the restoration of river beaches located 2-3 km upstream and downstream of the pier construction sites, which were occupied by temporary farming activities.
5. Installation of noise-abatement devices on drilling machines to further reduce noise emissions from underwater construction activities.
6. The establishment of a Real-time Monitoring and Early Warning System for underwater noise and the Yangtze finless porpoise, to continuously monitor construction-induced underwater noise levels and porpoise distribution and migration patterns in real time, and to issue impact warnings and halt operations when risks to the Porpoise are detected, thereby minimizing potential harm.
7. Enhancement of the Porpoise's rescue system, including the establishment of a specific rescue fund, provision of rescue equipment at construction sites and within the YRDNR, and development of emergency rescue drills.
8. Implementation of navigation controls near pier construction sites to prevent vessel congestion.
9. Noise monitoring and modeling during operations to optimize traffic management on the bridge and navigation management on the river.
10. Information disclosure and public participation initiatives to raise awareness regarding biodiversity conservation.

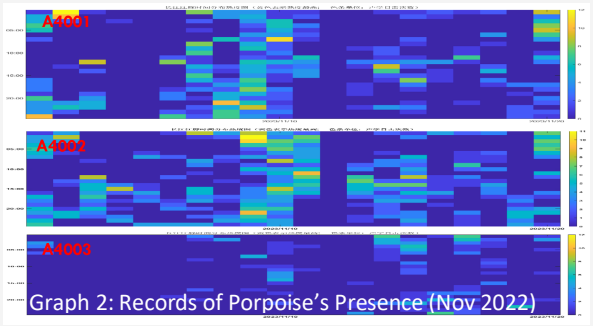
The ALCP is included in the project's environmental and social management plan for implementation.

Project Implementation

Following the approval of the project, the ALCP was officially implemented. In a strong commitment to preserving biodiversity and safeguarding the sensitive habitats within the site, the project diligently executed the actions outlined in the ALCP to ensure the effective management of the project impacts and conservation of local biodiversity.

All activities commenced with the critical step of allocating funds to support biodiversity initiatives. This financial support established a foundation for subsequent activities, facilitating the engagement of relevant experts and consultants for the planned monitoring and studies, as well as the procurement of essential equipment required for these studies.

In accordance with the requirements of the ALCP and to leverage the importance of specialized knowledge, an experienced fresh-water porpoise expert was appointed to the E&S team. This expert played a pivotal role in advising biodiversity conservation strategies, conducting technical training, monitoring the implementation of ALCP actions, and ensuring that all actions were aligned with the objectives of the ALCP.



Graph 2: Records of Porpoise's Presence (Nov 2022)

A dedicated hydro-biodiversity consultant team was engaged to conduct continuous noise and porpoise monitoring at three key locations: the pier site, 900 meters upstream, and 750 meters downstream (the existing bridge). They installed advanced underwater noise monitoring equipment to collect data on noise levels and determine if the maximum allowable threshold of 180 dBA is exceeded [3], which informs construction activities.

Combined with visual monitoring, porpoise tracking and recording were conducted using a

passive acoustic positioning system integrated into the noise monitoring equipment, which detects and alerts the approach of the Porpoise. Aquatic biodiversity and habitat surveys are conducted biannually during both dry and wet seasons by a leading research team in China, specializing in aquatic biology and conservation. Three sampling sections have been established at the site, as well as both upstream and downstream, focusing on phytoplankton, wetland plants, benthic organisms, and fishery resources. Each section comprises three sampling points to effectively monitor aquatic ecological indicators along this river segment.

Photo 2: Porpoise rescue drill conducted in 2022

Recognizing that effective biodiversity management requires support from all project staff, including general contractors and subcontractors, the client organized a series of capacity-building training sessions. These sessions provided detailed information on protected species, their behavior patterns, and the requirements for reporting sightings. Additionally, targeted training focused on the specific actions outlined in the ALCP, ensuring that all relevant staff were well-acquainted with the plan's objectives and methodologies, fostering a cohesive implementation approach. For example, porpoise rescue capabilities were enhanced through specialized animal rescue training, which covered sighting report procedures, protocols for engaging experts, and emergency response techniques, enabling staff to respond promptly and effectively to incidents. Real-time rescue drills were conducted annually.

To comply with noise control requirements for the construction project, the EPC contractor utilized low-noise and low-vibration equipment, decreased the overall intensity of construction activities, and ensured careful handling of materials during loading and unloading to minimize noise emissions at the source. Construction vessel management was conducted with strict oversight to minimize navigation times and volumes. Additionally, measures were implemented to mitigate nighttime light pollution, including the installation of lampshades on outdoor lighting fixtures and the creation of 14 welding operation shields to contain welding arc light.

Additionally, to leverage local knowledge and resources, the client actively collaborated with the administration center of the YRDNR to share monitoring data, patrol coverage, and rescue resources. Approximately 150 former fishermen and porpoise enthusiasts formed the Yangtze Finless Porpoise Conservation Committee, which conducts regular river patrols to deter illegal fishing activities and promote public awareness campaigns in the region.

Moreover, the client worked closely with the Maritime Bureau during the project construction phase. Through coordinated efforts, they effectively regulated vessel speeds in the river segment upstream and downstream of the project area, mitigating the impact of cumulative noise emissions from vessels on the aquatic environment.

However, the originally designed riverbank restoration at the northern pier site was deemed impractical. The construction standards for large bridges require concrete embankments upstream and downstream for stability, which precludes restoration at the bridge site. The project is now exploring alternatives for habitat restoration, such as restoring river segments in other critical areas for protected species or releasing specific fish fry essential to the river porpoise's food chain. This plan will be finalized in consultation with experts and the YRDNR.

Results and Outcomes

Impacts

The implementation of the underwater noise monitoring and early warning system focused on porpoise activities has established a robust management framework that included the project, the contractors, and construction supervision agencies. This system facilitated real-

time SMS alerts (over the phone) based on the distribution patterns of the Porpoise and potential underwater noise threats, allowing for necessary adjustments to construction operations.

Long-term monitoring results indicated that construction-generated noise has localized impacts on porpoise distribution. Specifically, there were fewer daytime sightings in construction sections compared to nighttime intervals during construction pauses, which aligns with expectations. However, monitoring at upstream and downstream sites shows no significant changes in porpoise distribution patterns. Notably, the Porpoise consistently reoccupies construction sections during nighttime non-working periods, suggesting that impacts are spatially and temporally limited.

Post-construction monitoring confirmed a rapid restoration of normal distribution patterns in the construction area. Additionally, porpoise migration behaviors throughout the bridge area continued without interruption, with both upstream and downstream movements remaining unaffected. These findings demonstrate that effective engineering design and implementation have successfully mitigated potential noise escalation risks. The proactive management system has ensured timely adjustments to noise intensity, ultimately preventing adverse effects on porpoise distribution and migratory behaviors during pier drilling and other construction activities.

During the dry season of the first construction year, cofferdams were successfully completed without any observed deterioration in water quality. Aquatic biodiversity and habitat surveys conducted over three consecutive years, covering 10 km upstream and downstream of the construction section, revealed significant seasonal variations in phytoplankton biomass and water quality parameters between wet and dry seasons. However, no notable differences in spatial distribution have been observed. These seasonal fluctuations, primarily influenced by hydrological conditions in the main river channel, are recognized as basin-wide phenomena.

Analysis indicates that project activities have minimal impacts on aquatic organisms. Triennial population surveys of the Yangtze porpoise across the entire reserve demonstrated stable distribution patterns and population numbers, with no statistically significant differences compared to pre-construction baselines. These findings confirm the effectiveness of the monitoring and protection measures implemented to mitigate potential disturbances, indicating that the project has exerted negligible impacts on the Porpoise within the reserve waters.

Photo 3: Porpoise sighting near the project site

Benefits

The project delivered biodiversity benefits, including enhanced capacity for biodiversity conservation management, increased awareness among staff and the community, strengthened stakeholder engagement, and broader socio-economic advantages associated with both the construction and operation of the project.

For example, the underwater noise monitoring and porpoise early warning system implemented in the project showcases advanced features and high technological sophistication. This system provides real-time protection and early warnings for key protected species during construction activities. As an innovative initiative marking its first application in water-related operations along the Yangtze River, it establishes an industry benchmark and offers a replicable, practical model for similar projects.

Additionally, this approach has resulted in an invention patent [4], which paves the way for broader application and technological advancements in future endeavors. This system not only enhances conservation efforts for the Porpoise but also contributes to the development of sustainable practices in aquatic construction.

During the execution of the ALCP, a range of comprehensive stakeholder engagement and

public awareness activities has been conducted, including community capacity-building and environmental outreach initiatives. Notably, activities such as "Civilized Practice, I Act – Building a Beautiful Suburban Ecology" and "Caring for Yangtze River Aquatic Animals, Building a Harmonious Suburban Home" have successfully engaged over 1,000 citizens. Coverage by prominent media outlets, including CCTV News, CGTN, Tongling Daily, and Tongling TV, has raised awareness of the remarkable ecological environment of the Yangtze River segment in Tongling, with particular emphasis on the G3 Bridge construction and porpoise protection efforts.

Challenges and Lessons Learned

Challenges

The project's biodiversity conservation efforts encountered several challenges, particularly in reconciling national system requirements with the ESF. The ESF outlines more specific requirements regarding biodiversity conservation and critical habitats, such as the mandate that there be no reduction in the population of protected species and that any negative impacts must be effectively mitigated. This alignment was critical for ensuring the project's effectiveness in promoting biodiversity.

Another significant hurdle was securing a commitment from the project developer. Their commitment was essential for prioritizing and allocating resources to biodiversity initiatives. Efforts were directed toward demonstrating the long-term benefits of biodiversity, thereby fostering a sense of ownership among key decision-makers.

Additionally, the project needed to allocate budgets for the ALCP. This investment was essential for ensuring the successful execution of all related activities.

Lessons Learned

The project revealed several key lessons for future biodiversity conservation efforts. A significant takeaway was recognizing the ALCP as a core component of project management, rather than a supplementary element. Integrating it into the project's framework, prioritizing capacity building and continuous learning, and equipping key implementation agencies with the skills needed for effective biodiversity strategy implementation.

Another crucial takeaway was the importance of extensive stakeholder engagement, highlighting that collaboration among the project, technical consultants, contractors and subcontractors, government agencies, YRDNR, NGOs, and local communities is essential for success.

Photo 4: Patrol of the project site

The project established alignment between project goals and environmental objectives, while EPC contractor implemented biodiversity-friendly practices. Technical consultants contributed their expertise to the development of innovative environmental strategies, and collaboration with government agencies ensured regulatory compliance.

Engaging local communities incorporated local perspectives into project plans, garnering support and enriching sustainable practices. Partnerships with NGOs and environmental organizations expanded resources and advocated for beneficial policy changes. This comprehensive engagement advanced biodiversity objectives and laid the groundwork for future conservation efforts.

Photo 5: ALCP training to contractor staff

The project organized multiple training sessions on aquatic biodiversity conservation, benefiting around 2,400 participants through 360 sessions integrated into daily operations. The project also established strong relationships with NGOs like the Yangtze River Ecological Protection Foundation and the Tongling Yangtze River Porpoise Conservation Association for public awareness campaigns.

The real-time early warning management technology implemented in this project effectively integrated construction management with species protection. This approach highlighted the significance of consulting experts and utilizing innovative technical solutions that are specifically tailored to the unique environmental characteristics and conservation needs of the site. By adopting such strategies in similar engineering projects, stakeholders can ensure that both construction objectives and ecological preservation efforts are effectively balanced, promoting sustainable development practices.

Conclusion

Biodiversity protection is a central pillar of the project, essential for both environmental health of the protected habitats and socio-economic well-being of local communities. By prioritizing biodiversity, the project has contributed to ecosystem protection and fostered a sustainable future for both nature and communities.

NDB has been instrumental in advancing this biodiversity agenda through financial support, technical expertise, and stakeholder partnerships. Its involvement has ensured adherence to the Bank's safeguard policies and enhanced the project's effectiveness and credibility while reinforcing the NDB's mission of promoting sustainable development.

Integrating biodiversity into operations and investment decisions is crucial for infrastructure projects. Project proponents and investment banks must embed biodiversity in decision-making. Early consideration of biodiversity helps identify environmental impacts and fosters compliance, while investment banks should prioritize funding environmentally responsible projects to drive industry adoption of best practices.

This integration ultimately ensures that project development aligns with environmental health, allowing both nature and human societies to thrive.

References:

[1] In China, natural protected areas are comprised of three types of zones: a core zone, a buffer zone, and an experimental zone, each with descending levels of ecological value and corresponding protection requirements.

[2] The IUCN Red List of Threatened Species is a comprehensive inventory that aims to assess the global conservation status of plant and animal species. Established in 1964, the IUCN Red List uses a set of criteria to evaluate the extinction risk of thousands of species and subspecies. The list provides valuable information on the population size, trends, and threats faced by species.

[3] According to the hearing threshold of Yangtze finless porpoises, when SELcuw reaches 179 dBa, it will cause a temporary shift in the hearing threshold. When SELcuw reaches 199 dBa, it will cause a permanent shift in the hearing threshold (*NMFS, 2000; NOAA, 2013*). NMFS 2000: *Taking and importing marine mammals; taking marine mammals incidental to construction and operation of offshore oil and gas facilities in the Beaufort Sea*. Federal Register, 2000, 65: 34014–34032. NOAA: 2013. I. 12-18-2013 ed, National Oceanic and Atmospheric Administration.

[4] ZL 2024 1 0252228.3, titled "Underwater Noise Early Warning System for Yangtze Finless Porpoise Conservation for Aquatic Construction Projects 发明专利：用于保护江豚的水体施工过程中的水下噪声预警系统"

Useful links:

- NDB ESF: https://www.ndb.int/projects/environment-and-social-sustainability/
- The IUCN Red List of Threatened Species: https://www.iucnredlist.org
- Convention on Biological Diversity: Kunming-Montreal Global Biodiversity Framework 2022: https://www.cbd.int/article/cop15-final-text-kunming-montreal-gbf-221222
- The United Nations Environment Program (UNEP) Biodiversity and Ecosystems Program: https://www.unep.org/topics/ocean-seas-and-coasts/regional-seas-programme/biodiversity-and-ecosystems