Harmonising Aviation Growth and Marine Biodiversity: HKIA's Innovative Approach

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Introduction

Prior to starting the Expansion of Hong Kong International Airport (HKIA) into a Three-Runway System (3RS) Project, the Airport Authority Hong Kong (AA) completed a comprehensive Environmental Impact Assessment (EIA), including assessment of impacts on nature and ecology. The 3RS Project involved substantial new land formation into the marine environment and the EIA demonstrated that with innovative construction approaches and a range of control and mitigation measures in place, the residual environmental impacts were found to be acceptable. A key mitigation was the designation of a new marine park adjacent to the expanded airport to help offset marine habitat lost to reclamation; the 2,400-hectare North Lantau Marine Park was established in November 2024 and links with two existing marine parks to form a 4,570-hectare combined marine protected area in waters near HKIA.

In addition to the statutory mitigation requirements from the 3RS Project EIA and environmental permit, AA also committed to a range of voluntary, beyond statutory initiatives as part of a Marine Ecology and Fisheries Enhancement Strategy (MEFES). This strategy incorporated a range of nature-positive initiatives aimed at further enhancing marine ecology and fisheries resources in Hong Kong's western waters. **This article provides an overview of HKIA's biodiversity strategy, specific enhancement initiatives implemented under the MEFES, lessons learned and reflections on balancing large-scale airport development with nature positive solutions.**

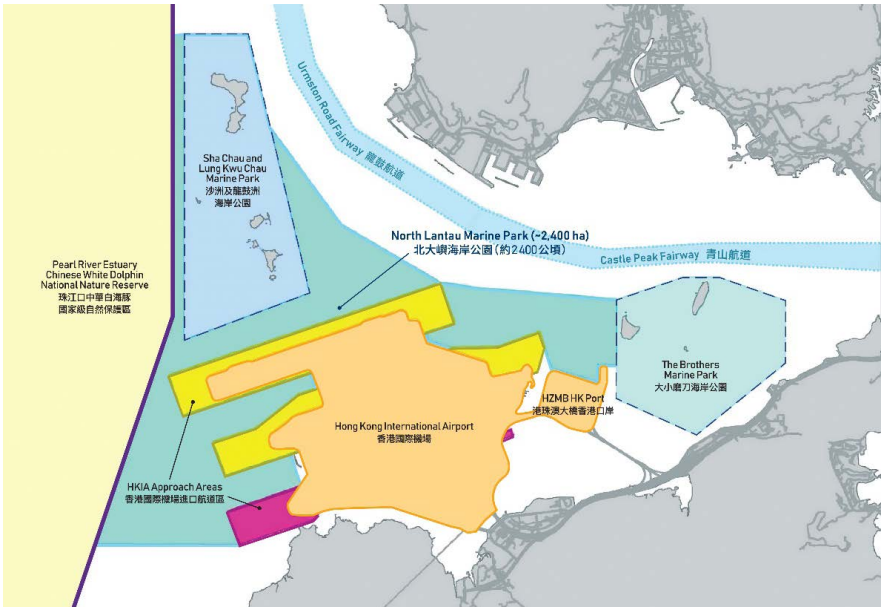

FIGURE 1: Designated North Lantau Marine Park linking with two existing marine parks.

HKIA's Biodiversity Strategy

HKIA is located north of Lantau Island in western Hong Kong waters and is surrounded by a range of marine and terrestrial habitats that are home to several species of significant ecological value. Nature and biodiversity are key considerations for AA, and through our MEFES commitments our biodiversity initiatives are intended to enhance the marine environment for the benefit of marine ecology, including for Chinese White Dolphins, an iconic species in waters near HKIA. Initiatives are also intended to enhance fisheries resources, providing support to fishing communities as well as encouraging more sustainable fishing operations. The following are some of our nature-positive initiatives under the MEFES.

Establishment of Enhancement Funds

In accordance with the 3RS environmental permit, AA established the Marine Ecology Enhancement Fund (MEEF) and Fisheries Enhancement Fund (FEF) in 2016, which are independent funds set up with the aim of enhancing the marine environment, ecology and fisheries resources. AA has injected a total of HK$400 million into the MEEF and FEF, with about HK$96 million granted from the funds to support marine ecology and fisheries projects since 2016.

Eco-Enhancement of HKIA's Seawalls

There are around 13 km of new seawall around the newly formed land. An opportunity was identified to modify the seawall structure to attract a greater diversity of marine flora and fauna. Several types of eco-enhanced concrete blocks were designed for different sections of the seawall, with over 500 blocks now installed. Eco-blocks feature rough surfaces, pits, holes, and rock pool features that facilitate the colonization of epifauna, increase microhabitat complexity, and provide protection and refuge for marine organisms. Post-installation monitoring surveys have shown that the number of sessile species (such as barnacles and mussels) and mobile species (such as limpets and crabs) on the eco-blocks is higher than on general seawall blocks nearby. This initiative has successfully increased microhabitat complexity and provided habitats for intertidal organisms.

FIGURE 2: Eco-enhanced vertical seawall blocks

FIGURE 3: Eco-enhanced blocks to be deployed on sloping seawall.

FIGURE 4: Bivalves in the water retention basin in a deployed rock-pool eco block.

FIGURE 5: Artificial Reef (AR) units from pilot trial.

FIGURE 6: Scale up deployment of AR units.

Artificial Reef (AR) Deployment

As well as enhancing existing seawall structures, AA also looked into potential benefits of deploying ARs in waters around HKIA. In 2021, AAHK deployed 100 artificial reef (AR) units in waters to the west of HKIA's South Runway as a pilot trial. The purpose of this deployment was to investigate ecological and fisheries value of ARs and one-year of post-deployment monitoring revealed a significantly higher abundance and coverage of mobile and colonization species on the deployed AR units. Encouraged by these positive results, AAHK is now carrying out a scaled-up AR deployment, with 500 additional AR units being deployed in restricted waters to the west of HKIA's Centre Runway. The ARs are designed with roughened surfaces to simulate the texture of natural reefs and can provide shelter for marine fauna, including fish (some released as part of AA's restocking efforts).

Shellfish Reef (SR) Deployment

In partnership with an NGO and a local university, AA investigated the value of deploying shellfish reefs (SRs) along parts of the airport seawall's subtidal zone in 2021. A pilot deployment using limestone along short sections of the seawall toe was initiated, with recycled oyster shells (collected from hotels and restaurants across Hong Kong for reuse) and live oysters sourced from nearby oyster farms added to the limestone base. The SR pilot proved cost-effective and proved the viability and effectiveness of SRs on new seawalls. Post-deployment monitoring identified good biodiversity benefits, including recording over five times higher species richness on the SR sections compared to at the start of the deployment. Given the success of the pilot SR deployment, a scaled-up SR deployment along a half kilometer section of the North Runway seawall was completed in September 2024. Monitoring is currently underway, and initial findings again show marked biodiversity benefits.

FIGURE 7: Bags of oysters being deployed to shellfish reef.

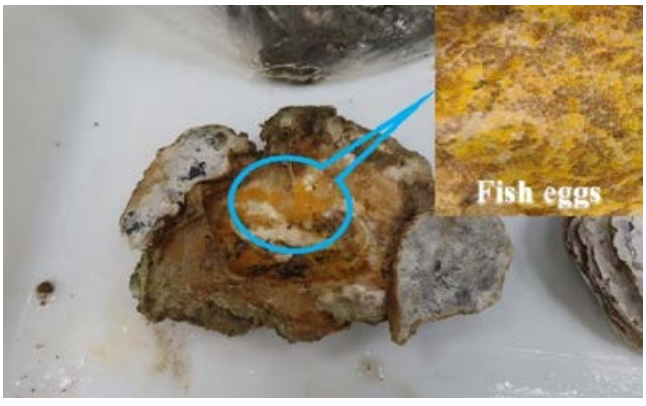

FIGURE 8: Fish eggs growing on oyster shells.

FIGURE 9: Release of fish fingerlings.

FIGURE 10: Preparing for fish fry release.

Fish Fry Release

After consulting with local fishing industry representatives, AAHK has also released approximately 28,000 commercially important fish species in stages in the waters west of HKIA, primarily to assess the restocking potential for enhancing fisheries resources. Monitoring after each release has made use of underwater visual and acoustic telemetry survey techniques, and these have shown that fish species are present within and near the release sites for an extended period after release. AAHK is currently planning to conduct a further restocking of approximately 50,000 fish fry, again within the restricted waters of HKIA, to tie in with Mainland China's National Fish Releasing Day on 6 June 2025.

Stakeholder Engagement

Successful implementation of various voluntary measures has required specialist knowledge and thorough understanding of the local marine environment. AA has engaged numerous stakeholders, including expert consultants, various government authorities, NGOs, fishing community representatives, and academic institutions, during both the development and implementation of enhancement measures. Regular engagement with external stakeholders has helped to ensure successful implementation. Details of all of our enhancement initiatives are also regularly shared with stakeholders through AAHK's Sustainability Reporting, the 3RS Project website, and at regular meetings with many stakeholders.

Demonstrating Success before Scaling Up

Post-deployment monitoring is a key feature of our enhancement initiatives and has in all cases shown that our pilot initiatives have been successful. For example, the AR pilot was successful in promoting the growth of mobile and sessile species, with hard coral and fish species observed inhabiting the ARs during monitoring. Similarly, findings from SR monitoring indicate significant biodiversity benefits, with over five times higher species richness recorded at the SRs compared to project onset. Demonstrated value at the pilot stage has paved the way for substantial scale-up and positive outcomes reinforce the value of the enhancement initiatives in promoting marine biodiversity and fisheries resources.

Innovation and Social Benefit

The ARs and SRs were designed with innovative features to promote the settlement of marine organisms and to provide shelter for marine flora and fauna. The use of recycled shells for SR deployment is a cost-effective and environmentally friendly approach with waste reduction benefit and additional benefits of creating further habitats for colonisation by other species. As well as enhancing marine biodiversity, these initiatives in many cases also have a strong social benefit, for example involving ongoing engagement with local communities such as fishers.

Lessons Learned

The implementation of these biodiversity-focused initiatives has provided valuable lessons for AA and other stakeholders – not least other project proponents considering large scale development with a footprint into the marine environment. Key lessons learned include the importance of regular and diverse stakeholder engagement, the value of pilot testing to assess the real-world viability of initiatives before committing to much larger (and more costly) scale-ups, and the importance of ongoing monitoring to evaluate the effectiveness of each of the enhancement measures being implemented. Other airports or large-scale developments with a significant ecological footprint may learn from AA's experiences:

1. **Engaging Stakeholders Early and Often**: Involve government authorities, NGOs, academic institutes, and local communities in the planning and implementation of biodiversity initiatives to ensure their success.
2. **Pilot Testing Initiatives**: Conduct pilot tests to assess the feasibility and effectiveness of proposed enhancement measures before implementing more costly scale ups.
3. **Monitoring and Adaptation**: Implement robust monitoring programs to evaluate the outcomes of biodiversity initiatives and adapt strategies as needed based on monitoring results.
4. **Promoting Innovation**: Explore innovative solutions when considering various initiatives, such as use of recycled materials and eco-enhancements to existing structures, to enhance biodiversity and promote sustainability.

Conclusion

The 3RS Project at HKIA has provided an opportunity for AA to implement a comprehensive and ambitious MEFES, going well beyond statutory requirements. Through initiatives such as eco-enhanced seawalls, artificial reef / shellfish reef deployments, and fish fry releases, AA has demonstrated the value of exploring and implementing voluntary nature-positive solutions in enhancing marine biodiversity and fisheries resources. There are valuable lessons and insights for other airport expansion initiatives or large-scale developments that may encroach into marine or terrestrial habitats. Making a long-term commitment to the MEFES has been highly important to our project success — large-scale development can be done hand in hand with taking a proactive approach on finding and implementing meaningful nature-positive solutions.