Hong Kong Offshore LNG Terminal Project, Marine Conservation Enhancement Fund

Completion Report – MCEF21109

Health assessment goes in the air: applicability of unmanned aerial vehicle for collecting biological health data of residential cetaceans in Hong Kong waters

Executive Summary and Way Forward

The objectives of this project were to develop a new set of technical protocols and unmanned aerial vehicle (UAV) sampling tools for vessel survey on free-ranging cetaceans, to investigate the feasibility of UAV as a remote sensing technology to collect biological health data in free-ranging cetaceans, to characterise the microbiomes in blow samples collected from free-ranging cetaceans using UAV, and to correlate health conditions and pathological findings with body condition index in stranded cetaceans.

Vessel survey has been conducted by researchers worldwide to study free-ranging aquatic animals including cetaceans. Conventionally, photos and videos are taken from the vessel, which provide a visual documentation of the animals from a horizontal aspect. Other non-invasive methods like acoustic monitoring or environmental DNA collection from the sea are also practiced to answer specific research questions like occurrence and distribution of elusive species. In Hong Kong, the resident cetaceans (particularly the Indo-Pacific humpback dolphins) are routinely encountered in the Lantau waters. Vast resources have been allocated on distribution and abundance monitoring, however little is known about their health or wellbeing except from postmortem investigation on stranded individuals, which is highly opportunistic and only represents a single timepoint of a fraction of the entire population. With reference to studies on large whales overseas, this project aimed to utilise UAV to collect biological health data, both visually and microbiologically, in free-ranging cetaceans.

Vessel surveys on free-ranging cetaceans were routinely conducted in Lantau waters, where vessel-based photographs were taken to identify individual dolphins via characteristic features on their dorsal fin and body surface (which is a standard technique practiced worldwide). Whenever feasible, UAV was launched at a fixed and safe altitude to capture footages from a perpendicular angle such that the body façade (i.e., body length and width) can be measured on extracted still images to calculate the body condition index. Synchronised timestamps and manual notetaking facilitated matching the UAV-based measurements to the photo-identification records. Vessel surveys and body façade measurements were conducted repeatedly and longitudinally, if a dolphin was resighted across different survey dates, any change of body condition and visual health could be tracked. Throughout the project, 37 vessel surveys have been conducted, yielding over 90,000 vessel-based photos and over 4 hours 20 minutes of UAV-based footage have been acquired. Photo-identification was able to differentiate 167 individual humpback dolphins (adding to a sum of 383 photo-identified individuals in our database established since 2020), in which 51 of them were resighted for over 3 times. Body façade measurement was performed on 163 still images extracted from UAV-based footages, and were matched to 97 individual humpback dolphins in the longitudinal visual health tracking catalogue of the project team.

One notable subject was a female Indo-Pacific humpback dolphin the project team first encountered in April 2020 and subsequently resighted for over 20 times until January 2024. The dolphin appeared nutritionally well and healthy in general, with only minor rake marks and pox-like lesions noted occasionally (both resolved naturally). In December 2024, a stranded dolphin underwent postmortem investigation by Ocean Park Conservation Foundation Hong Kong and the project team. The dolphin was identified as HK004 in the project team's database. Postmortem CT and gross necropsy determined the animal had just given birth and was lactating. The cause of death was due to peracute underwater entrapment related to fishery interaction. For this case, we have documented its visual health profile by vessel survey in conjunction with UAV-based monitoring. Its body condition index was above the average of its age class, which was coherent with its reproductive success before its unfortunate death. This demonstrated the use of remote sensing technique (i.e., vessel-based photography and UAV-based videography) in longitudinal health assessment of vulnerable aquatic wildlife for better understanding of their biological condition and ultimately their urged conservation.

In addition, UAV was used in attempt to collect blow samples from free-ranging cetaceans. Cetaceans are marine mammals that surface to sea surface for breathing. Upon exhalation, a burst of vapour (i.e., blow) is released over their blowhole. Like COVID nasal swab in humans, the blow can be collected and analysed for microbial composition to reflect the respiratory health of the individual. This method has been reported on large whales that exhale in very large volume, resulting in very large blows for collection and analysis. However, for small cetaceans like our resident species, their blows are much smaller, and their swimming pattern is much more random, making blow collection very challenging. In this project, different collection protocols and setups were tested and optimised to accommodate the small blow volume and undesirable movement of the blow collection device upon flight. After multiple trials, a setup with satisfactory stabilisation has been developed, and was employed for blow collection at the sea. Despite numerous diligent attempts made, the small blow volume and unpredictable surfacing pattern of free-ranging small cetaceans yet to allow successful collection of sufficient blow sample for downstream analysis. Nonetheless, the technicality in the design of the blow sample collector to tackle undesirable rotatory movement upon sudden change in flight direction especially associated with approaching surfacing small cetaceans has been accomplished, and we anticipate success in blow collection upon further trials with larger group size encounter.

Overall, with the support of the Marine Conservation Enhancement Fund, the project has achieved most of the objectives, providing effective technical protocols and UAV sampling tools to collect biological health data in free-ranging cetaceans, including various epidermal conditions and body condition indexes, which are closely related to their biological health and can be correlated with postmortem findings in stranded cetaceans. Project findings on visual health assessment on free-ranging cetaceans have been presented in public seminars, outreach talks, and international conferences, and will soon be published as manuscript in academic journal. The project has successfully demonstrated technical protocols that can be applied in visual health assessment on small cetaceans worldwide, and offered valuable insights for future remote sensing projects on non-invasive health surveillance of aquatic wildlife.