Determining the Feasibility of Easing Marine Traffic in the Chinese White Dolphin Habitat in Hong Kong

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DETERMINING THE FEASIBILITY OF EASING MARINE TRAFFIC IN THE CHINESE WHITE DOLPHIN HABITAT IN HONG KONG

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Abstract

The Chinese white dolphin population in the Pearl River Estuary is currently facing a drastic population decline in part due to marine traffic. This project assessed the feasibility of easing the impact of marine traffic within the dolphins' habitat. By conducting direct observation of marine traffic and the Chinese white dolphin, surveying Hong Kong's general public, and interviewing related stakeholders, we were able to provide recommendations to aid in conservation efforts.

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This project's success would not have been possible without the help of many individuals. We would like to extend our deepest gratitude and appreciation to our project sponsor liaison, Michelle Luk, from the WWF. She was always willing to talk with us, answer our questions, and even traveled with us to various locations to act as our interpreter for multiple interviews with stakeholders. Samantha Lee, the Assistant Conservation Manager at WWF, was also very helpful in giving us feedback on our methods. WWF was a great sponsor and offered a welcoming environment in which to work.

The research and data collected is all thanks to those who completed our survey and took time out of their day to interview with us. The many people who completed our survey allowed us to get a better understanding as to how local people and tourists view the CWD and their opinions on possible solutions. Amy Knowlton, Research Scientist at the New England Aquarium, gave us information on the policies protecting the North Atlantic Right Whale. This information was the basis for our understanding of the possible ways we could help minimize the impact of marine traffic on the CWD. We are extremely thankful for Hong Kong DolphinWatch Co. Ltd, as they gave us the opportunity to observe the dolphins and allowed us to interview their employees. Specifically, Janet Walker of DolphinWatch gave us insight as to how much of an impact the CWD has on the environment. The fishermen and dolphin tour companies at Tai O gave us information as to how the dolphins affect various businesses.

Of course, this project would not have been possible at all if it were not for Worcester Polytechnic Institute and the Interdisciplinary and Global Studies Division for giving us the opportunity to study in Hong Kong. Our advisors, Professors McWeeny and Peet worked tirelessly to make sure our project fulfilled its full potential. Their timely responses, suggestions,

and feedback allowed us to make necessary changes to improve our project. Once again, we thank everyone who helped make our project possible.

Authorship

All sections of the report were edited and reviewed by each member of the team. The primary authors for each section are listed below using the initials of each member.

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Executive Summary

The development of human civilization has caused an improvement in the quality of life for some humans, but a decrease in the quality of life for many nonhuman animal species. Human development has caused many natural habitats to be dramatically altered. Hong Kong is a thriving region, but its advancement has caused the habitat of the Chinese white dolphin (CWD) to deteriorate. As the development of civilization continues, we must find a way to coexist with nature and all beings .

Over the past decade, the population of the CWD in Hong Kong's Pearl River Estuary has faced a 60% decrease. What was once a thriving coastal species is now threatened by constant marine traffic, bridge construction, pollution, and overfishing. All of these factors have a direct, negative impact on the habitat of the CWD. The World Wide Fund for Nature (WWF) Hong Kong has taken notice of this issue and has been working to promote conservation of the CWD.

The goal of this project was to determine the feasibility of easing marine traffic through the CWD habitat, which is contributing to the decline in the dolphin population. To achieve this goal, our objectives were to assess the current viewpoints of the Hong Kong public and different organizations towards the CWD, and study the marine traffic in the CWD habitat. All of these objectives were met by conducting research including interviews, a survey, and direct observation. We interviewed key stakeholders in Hong Kong to determine their willingness to alter their current practices in order to protect CWD habitats. We also surveyed residents and tourists in Tai O, various ferry ports, and universities around Hong Kong to gain an understanding of the general public's awareness of the problems faced by the CWD. Moreover,

we directly observed the type and number of vessels traveling through the dolphin habitat as well as the CWD's response to the vessels.

Through these methods, we have discovered that there is a lack of public awareness of the problems that are impacting the CWD population. However, the people of Hong Kong have shown that the CWD is an important species and symbol of their lives and culture. While boating companies seemed skeptical about changing their routes or reducing their speeds, we found that the general public was very willing to take routes that avoid the CWD habitat and even extend ferry routes that would take up to an hour longer to reach their destinations. Fishermen were also willing to relocate their fishing grounds or reduce their speed upon seeing a CWD. Overall, many individuals and some companies seem willing to take measures to help conserve the CWD.

The data we have gathered through our research was used to provide recommendations to the World Wide Fund for Nature about how to help preserve the CWD population. We believe that public awareness about the Chinese white dolphin is imperative in keeping the Pearl River Estuary's population from disappearing. Increasing awareness can be done through advertising or collaborating with universities and schools to educate students about the CWD's importance. Technology can also be utilized to create phone applications where people can learn facts about the CWD and where they are located. The WWF can also recommend that the Hong Kong Government implement a comprehensive educational program for fishermen and other companies about marine life and the CWD. Our findings can also be used by the WWF to urge the government to make policy changes in regards to marine traffic in the CWD habitat.

1. Introduction

Many marine species around the world are currently endangered or face the risk of becoming endangered (WWF, 2015b). Animals such as seals, whales, fish, sharks, and dolphins are being threatened daily by the actions of humans. In particular, marine mammals are susceptible to harm as a result of increased marine traffic. Industrialized coasts can be problematic for threatened and endangered marine mammals, as the need for resources escalates the competition between nature and humankind. If preventative measures are not taken, the population of these marine species will continue to fall and possibly lead to extinction, altering the local biodiversity and changing the marine environment.

As Hong Kong continues to grow, the environment for marine mammals becomes less favorable to inhabit. The Chinese white dolphin (CWD), an Indo-Pacific humpback dolphin which inhabits the Pearl River Estuary, is listed as Near Threatened on the IUCN Red List of Threatened Species 2015, has been facing a drastic 60% decline in its population within the last 13 years (WWF Hong Kong, 2015f; Hung, 2015; IUCN, 2015). The decrease in the dolphin population has been partly due to the deteriorating environmental conditions caused by many reasons such as marine traffic and water pollution within the CWD habitat. Moreover, the Hong Kong government has had challenges strictly enforcing rules and regulations to protect these mammals (Kao, 2016). However, non-governmental organizations such as the World Wide Fund for Nature (WWF), are trying to help threatened and endangered species and educate the public about their plight. If the decline in the CWD population is not addressed, this species is estimated to decrease in population size in Hong Kong by 74% after three generations (Karczmarski et al., 2015).

Globally, other species have been impacted by similar marine traffic problems. Like the CWD, the North Atlantic right whale (NARW) has been threatened by marine traffic and fishing (Kraus, 2005). Every year, there were at least three fatal collisions between the NARW and shipping vessels. Actions were taken by the New England Aquarium to protect the NARWs from further population decline. In 2008, marine vessel speeds were reduced and boating routes were changed to avoid the whale's habitat and decrease chances of collision. Since these methods have been implemented, there have been significantly fewer accidents with the NARW. In some locations, such as Australia, Indo-Pacific bottlenose dolphins live in a Marine Protected Area (MPA). This has helped minimize the number of accidents caused by marine vessels (Steckenreuter, Harcourt, and Möller, 2012). Studies have been carried out in these locations to analyze the impact of the newly established MPAs on the behavior of the dolphins and have yielded positive results.

Although there has been research conducted in other locations to identify the causes of the decline of various marine species, there has been little done to determine the impact that marine traffic has had on the CWD in Hong Kong's coastal waters. According to WWF Hong Kong's assistant conservation manager Samantha Lee, the government's environmental report for the Chek Lap Kok Airport expansion "failed to assess the cumulative environmental impact of the project and the Hong Kong-Zhuhai-Macao Bridge being built simultaneously" (Kao, 2014, paragraph 10). It is predicted that both the construction of the bridge and the possible third airport runway would negatively affect the CWD's habitat (Williams, 2015). Moreover, the government dictated that construction of the bridge must halt upon any sightings of CWDs (Environmental Protection Department, 2009). However, this alone protect the CWD from the effects of construction.

The goal of this project was to determine the feasibility of easing marine traffic that is contributing to the decline in the Chinese white dolphin population. To achieve our goal, we identified the current attitudes that different stakeholders and the public have towards the CWD through interviews and surveys. We also studied how marine traffic operates within the CWD habitat by using direct observation. Through this research, we were able to contribute to the WWF's effort to conserve the Pearl River Estuary's threatened CWD.

2. Background

To better understand the reasons for the population decline of the Chinese white dolphin (CWD), it is essential to gain a comprehensive idea of their habitat, their biology, threats to their environment, and what is currently being done to help them. In this chapter, we will discuss preservation efforts and studies that focus on the population decline of various marine species, and compare these to the situation of the CWD. Moreover, we will discuss the importance of involvement of various stakeholders in the Pearl River Estuary, as well as their effects on the CWD habitat.

2.1 Problems Facing Marine Habitats

Marine habitats are home to protozoa, marine invertebrates such as mollusks and corals, plankton and marine vertebrates like fishes, birds and mammals (Defenders of Wildlife, 2015). However, these diverse and unique habitats have also faced much destruction. Coastal areas, especially, have suffered due to their close proximity to human populations. These habitat losses have had far-reaching impacts on marine biodiversity.

The rapid growth of human populations has increased their impact on marine habitats. Cities and factories create waste products such as chemical effluent and pollution, which affect the living reefs and sea grasses (Greenpeace, 2015). Some factories illegally dispose of these harmful waste products in the ocean. These practices not only kill marine species but also dramatically affect the biodiversity of the whole marine ecosystem. Destructive fishing techniques such as pair trawling (see section 2.1.2) and poisoning destroy both marine habitats near the shore and in the deep sea. Moreover, the increase in tourism brings more vessels, such as ferries, motorboats, cruise ships, and private yachts into areas already being traveled by fishing boats and freight vessels, causing traffic congestion problems (Chan, 2014).

2.1.1 Marine Traffic in Endangered Species Habitats

The routes of marine vessels can sometimes interfere with the habitats and behaviors of marine mammals (WDC, 2016). Nowadays, many different types of marine vessels travel around the world for different purposes. Many vessels in the same area create underwater noise that is unnatural to the marine environment. Such changes in the acoustic environment may cause interruptions in the communication between marine mammals such as porpoises, sperm whales and dolphins that use sounds or echolocation as a means of communication (Discovery of Sound in the Sea, 2015). Noise from vessels can significantly affect the marine mammals' abilities to locate any predators or food. In shallow water, a vessel at a distance of 50 meters moving at 5 knots was found to decrease the communication range of the bottlenose dolphin by 26% (Jensen et al., 2009; Li et al., 2015). When the vessel increased its speed to 10 knots, the communication range was reduced by over 80%. In extreme cases, marine animals that utilize echolocation can be harmed by the noise from vessels (Wild Whales RSS, 2007). For example, the sound emitted by navy sonar is still at the pain threshold for animals 28 km away from the source of the noise, which can lead to trauma and death of animals.

Another problem for marine mammals is the speed at which vessels travel. The presence of high-speed vessels increases the chance of collisions with marine mammals because the animals do not have sufficient time to avoid the quickly approaching ship. The number of incidents is currently climbing as marine traffic congestion worsens. Fatal collisions of marine mammals are commonly caused by large, heavy cargo ships and cruise ships. One such incident involved a Blue whale that was struck dead by a ship in the Indian Ocean off the southern tip of Sri Lanka (Dailymail, 2012). This whale was fatally injured and died while sleeping in the middle of the shipping lane. Another recent incident occurred near Coney Island Beach in New York (Nature World News, 2015; Iacurci J., 2015). A minke whale was hit by a ship's propeller

and died from its injuries. The increasing number of these vessel collisions is a great threat to marine mammals. The North Atlantic Right Whale, for example, was victim to three collisions a year because ships were traveling at a speed too fast for the whales to avoid (A. Knowlton, personal communication, December 2, 2015). The marine mammals hit by the vessels are likely to die or suffer horrific injuries, which can dramatically affect the overall population of marine mammals in that area. In 2008, a regulation for a reduced speed of 10 knots went into effect for the entire East Coast of the United States in order to minimize the number of collisions between vessels and the North Atlantic Right Whale. This had a tremendous effect in lowering the frequency of collisions per year. However, speed limits alone were not effective in reducing the number of collisions that occurred with these animals. Although the East Coast is not a Marine Protected Area, vessels are now required to stay at least four miles (6.44 km) away from the migratory paths and habitats of the right whale. This distance has proven to have a positive impact on the whales; reducing both the number of collisions and the effects that noise has on these mammals.

2.1.2 Impact of Fishing on Endangered Marine Species

The negative impacts of human development have led to the decline of many marine species' populations (NOAA Fisheries, 2015). Human impact has increased due to rapid population growth, the need for more land, and significant developments in the technologies used in marine areas. Improvements in technology have resulted in larger and faster vessels as well as more advanced fishing equipment, which has reduced the fish stocks around the world significantly. Amy Knowlton (personal communication, December 2, 2015), head researcher in charge of the protection of the North Atlantic Right Whale at the New England Aquarium, explained how whales could become entangled within lobster gear (See Appendix B). She is

currently conducting research on different fishing gear that will be effective for fishing but will also break before causing serious damage to the whales.

Pair trawling is one of the fishing methods that has been threatening marine species around the world (WWF Hong Kong, 2015e; Greenpeace, 2015). It is carried out by two vessels, each towing one end of the fishing net so that the net is kept open. This method is used frequently within some fisheries due to its efficiency in catching fish. While a single vessel tends to scatter fish with its noise in shallow water, the two vessels operate together to herd fish into the net. When larger marine species such as whales or dolphins are captured in the net, they try to escape. A study conducted by the Whale and Dolphin Conservation Society (2015b) indicates that most of the whales and dolphins that have died due to fishing nets sustained horrific injuries while struggling to free themselves. Several cuts and abrasions to the skin were caused by the rope of the net. As the animals struggled, the fishing nets tightened, cutting deep through their flesh. This fishery practice dramatically affects marine species and can lead them to become endangered. However, as of December 31st, 2012, pair trawling was banned in the Hong Kong area in an effort to protect the marine ecosystem and allow the damaged seabed and depleted marine resources to recover (AFCD, 2016b). Since then, any CWD death was at the presence of fishing nets according to the stranded cases recorded by the Ocean Park Conservation Foundation (OPCF).

2.1.3 Preservation Efforts around the World

To reduce the decline in endangered and threatened populations around the world, there have been campaigns held by different organizations in support of these marine species. The U.S. National Oceanic and Atmospheric Administration (NOAA) has engaged in social movements and activities to set up regulations to protect various marine species (NOAA

Fisheries, 2015). They developed a unique program named 'Dolphin SMART' in partnership with the National Marine Fisheries Service, the Whale and Dolphin Conservation Organization and the dolphin ecology project team (WDC, 2015b). This program promotes responsible viewing and stewardship of dolphins in the region. The acronym SMART represents the basic viewing etiquette:

"Stay at least 50 yards away; [46 meters]

Move away slowly if the dolphins shows signs of disturbance;

Always put the vessel engine in neutral;

Refrain from swimming with, touching or feeding wild dolphins; and

Teach others to follow these practices" (WDC. 2015b, paragraph 3).

This program was first launched in the Florida Keys National Marine Sanctuary in 2007. Since then, it has spread throughout various organizations that promote dolphin conservation.

Marine Protected Areas (MPAs) have also been established to help with the conservation of endangered marine mammals (Hong Kong Dolphin Conservation Society, 2015). In Australia's marine park, the speed limit of vessels is 4 knots. They have also implemented many of the same rules that are followed by MPAs around the world. Such rules include banning the use of trawlers and prohibiting the capture of endangered marine species.

In locations around the globe, the designation of an MPA has given marine animals a safe habitat to nurse and feed without the threat of humans (Hong Kong Dolphin Conservation Society, 2015). The MPAs in Australia and Hawaii also require vessels to remain 100 yards (91 meters) away from endangered marine mammals, such as the Humpback whales (Steckenreuter, 2012; Miller, 2014).

Public advocacy has also been a vital tool used in the conservation of species (WWF, 2015c). In 2007, The Coca-Cola Company (2015) joined with WWF in support of polar bear conservation. The Arctic Home Campaign was launched in North America, and within two years it had spread to 17 different countries. The campaign had raised $3 million dollars that was used by WWF to preserve the polar bear's habitat. In this case, public advocacy was used to raise money for the protection of vital habitats and to bring awareness of a problem that would have soon led to the extinction of a species.

2.2 Threatened Marine Species in Hong Kong

Hong Kong is an increasingly developed area which has potentially caused many of its marine species to become endangered or threatened. Hong Kong is surrounded by estuarine and oceanic water that attracts many different species (WWF Hong Kong, 2015b). There are around 1,000 marine fish species, over 80 coral species, and two marine mammals (the Chinese white dolphin and the finless porpoise) in Hong Kong's marine biodiversity. However, the marine ecosystem has recently faced many risks that are significantly affecting the biodiversity. The fish population has dropped drastically due overfishing and insufficient regulation (AFCD, 2015a). The small number of Marine Protected Areas (less than 1.5% of Hong Kong's waters) worsens the situation due to lack of coverage and has put many marine species in Hong Kong at risk of being threatened or endangered.

Recent ongoing construction of the Hong Kong-Zhuhai-Macao Bridge (shown in the map below) and the plan to expand the Chek Lap Kok Airport will or has already influenced marine mammals' habitats directly. This development will dramatically affect the marine mammal population (Wanshel, 2015).

Figure 1: Hong Kong - Zhuhai - Macao Bridge (Carillo, 2013)

2.2.1 Chinese white dolphin

Chinese white dolphins (CWD) are one of the marine mammals in Hong Kong whose population is rapidly declining due to human activity. The CWD, also the Indo-Pacific Humpback Dolphin (*Sousa chinensis*), thrives in the waters of Southern China to those of Northern Australia (WDC, 2015a). The Pearl River Estuary population of the CWD is one of the most rare dolphin species due to their unique skin (WWF Hong Kong, 2015f). The only other dolphin to have a pink appearance in the world is the Amazon River Dolphin (WWF, 2015a). When young, the CWD are grey in color, but upon reaching adulthood they become pink. The pink color is a result of the close proximity of their blood vessels to the surface of their skin (Dolphins-World, 2014). The more active they are, the pinker they become. When a CWD dies, its skin shows its true white color due to lack of blood flow.

Figure 2: Chinese White Dolphin (Tam, 2015)

According to a line transect survey, the Pearl River Estuary's waters are home to the largest population of CWD, with 61 dolphins remaining in the Hong Kong area (Hung, 2015). However, this number is the result of a 60% decrease in the population over a span of 12 years.

2.2.2 Specific Areas Being Affected

The CWD's habitat in Hong Kong spans the coast of the Pearl River Estuary, which is also known as the Pearl River Delta Region (WWF Hong Kong, 2015a). In particular, they are located in the waters of West Lantau Island, near the Chek Lap Kok Airport and the village of Tai O. They are also found in the waters south of Lantau Island, including Fan Lau and the Soko Islands. They typically stay in warmer, shallow coastal areas; in water no deeper than 10 meters. The combination of fresh and saltwater as provided by the Pearl River Estuary is a delicate mix that fits the specific needs of the CWD. Therefore, they are unable to leave their habitat despite the abundance of marine traffic and development. The map in Figure 3 shows the areas where the CWD was spotted in the Hong Kong region during 2014.

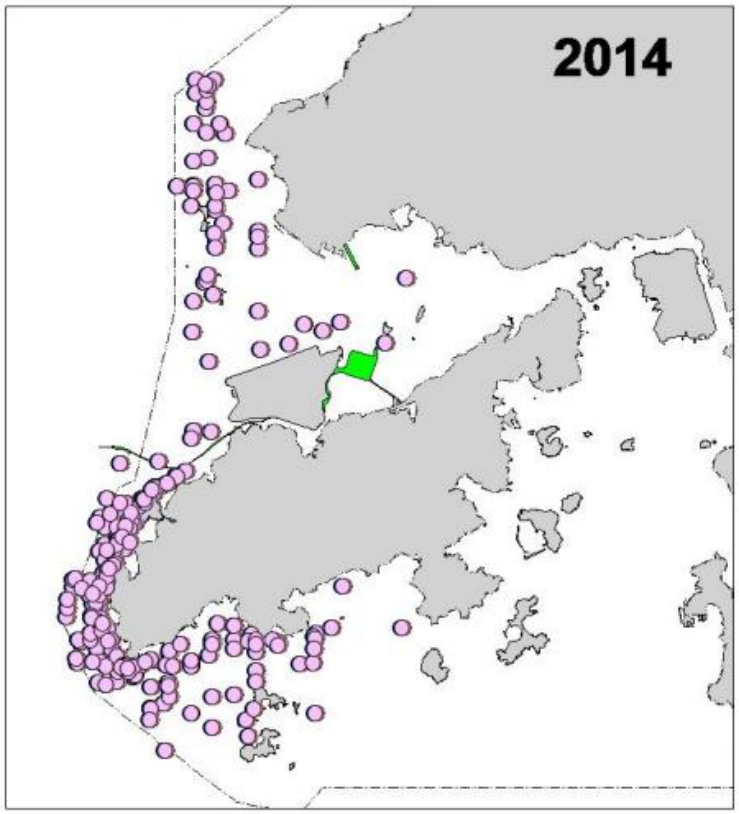

Figure 3: Distribution of Chinese white dolphin sightings (2014) (AFCD, 2015b)

2.2.3 Feeding Areas

The CWD's feeding areas are most threatened because they tend to feed near the coast (WWF Hong Kong, 2015e). They prey on various types of crustaceans and fish, including sardines, mullet, and mackerel. These can all be found along the coast of Hong Kong. Due to shortages in their food supply, CWD have been so desperate to get food that they temporarily beach themselves if they see fish close to the shore (Whale facts, 2015). Though they feed individually like most marine mammals, they hunt as a group using echolocation (MarineBio Conservation Society, 2013). This can be problematic because boats and ferries travel at speeds that create a frequency similar to that of a dolphin's echolocation, as explained in section 2.1.1.

2.2.4 Nursing Areas

Nursing areas of the CWD are of great concern because young dolphins are more susceptible to harm through pollution and boat collisions than mature dolphins (WWF, 2015e). A study done on two groups of CWD in the Pearl River Estuary found that more CWD calves (infants) were found around the west and northwest shore of Lantau Island, compared to the rest of their habitat (Dungan, et al, 2012). This same study also noted that in other dolphin species, nursing mothers and their calves prefer to stay closer to shore. One possibility as to why this occurs is because a majority of the food CWD eat is found closer to the shore. This provides easier access to food for the nursing mothers. A study on the Wild Bottlenose Dolphin newborns notes how young dolphins breathe more frequently than their adult counterparts (Mann & Smuts, 1999). This is true for other dolphin species, including the CWD. Their increased breathing frequency means that they surface more, thus heightening their risk of being injured by a traveling boat.

The shore of the west and northwest areas of Lantau are greatly impacted by development. This development has increased the amount of toxins in the waters of the CWD habitat. As mentioned above, the nursing mothers eat within these toxic waters. The toxins are transferred to the dolphin calves by their mother's milk, causing many defects. The increased amount in toxins within calves is also leading to a higher death rate for younger dolphins, indicating that dolphins in that area are more susceptible to harm.

2.2.5 Migration Patterns

The CWD does not seem to have a set migration pattern, though a slight fluctuation in their numbers can be seen throughout the year (Canales, 2015). CWDs prefer to stay in tropical and warm waters along the coast. In general, CWDs throughout Chinese coastal waters

(including Fujian, Taiwan and Guangxi provinces) tend to stay in their habitats year round, with a slight decrease in population size during the colder months. When the water temperature rises again, the population size slightly increases. A study done on the CWD off the coast of Taiwan has closely monitored the dolphins to see if there is a migration pattern (Wang & Yang, 2011). The result of the study was that there is no seasonal migration pattern. Because CWD usually remain in the same habitat year round, it is easier to notice the decrease in their population size.

2.3 Decline in Chinese white dolphin Population

The effects of Hong Kong's industrialized society have directly impacted the rapid decrease in the CWD population (WWF Hong Kong, 2015e). In 2003, Hong Kong's CWD population had 158 dolphins, but in 2015, merely 12 years later, the population had shrunk to 61 dolphins (Han, 2013; Hung, 2015).

One of the reasons for the drastic decline is Hong Kong's rapid development. Where the Chek Lap Kok Airport stands today was once a part of the dolphin's habitat. Land reclamation in general has destroyed much of the CWD's habitat. Land reclamation is the creation of land in bodies of water, and has taken place in numerous sections of the Pearl River Estuary (OECD Glossary of Statistical Terms, 2001). According to an article in the *South China Morning Post*, the dolphins are in "an area affected by reclamation work for the Hong Kong-Zhuhai-Macao Bridge and, imminently, by the construction of a third airport runway" (Mok, 2015, paragraph 7). This bridge, which will connect Lantau to Macao is being constructed right through the dolphin's habitat (Hung, 2013). According to the Hong Kong Dolphin Conservation Society, "The mammal has difficulties foraging for food and communicating with its kin using ultrasonic sound waves because of the noise from the bridge project" (Enyo, 2015, paragraph 5).

The Hong Kong-Zhuhai-Macao Bridge website has a page dedicated to the CWD explaining certain precautions the government is taking to minimize the effect on CWD (HZMB, 2010). However, construction in their habitat will affect them regardless (Environmental Protection Department, 2009). Because the bridge is not yet complete, ferries are still the most popular way to travel between Hong Kong, Macao, and Zhuhai. Hong Kong SAR has many islands, making ferries the quickest way to get from one island to another. This also causes distress to the dolphins because the ferries increase water pollution and the chance of a collision. Additionally, fishing boats and the equipment being used in construction for the bridge all contribute to water and underwater noise pollution, thus affecting the CWD. As determined by the Ocean Park Conservation Foundation, the leading causes of death in CWD in Hong Kong are fishing entanglement, boat trauma, and infection from pollution (OPCF Hong Kong, 2015). If the number of CWD continues to decrease, they will go extinct in this region.

2.4 Stakeholders and Their Effects

A number of stakeholders, including the government, the public, non-governmental organizations, and private organizations such as ferry companies, have had lasting negative effects on the survival of the CWD. Over the past century, land reclamation in Hong Kong has been decreasing the habitat of the CWD (WWF Hong Kong, 2015e). Future reclamation and construction plans show no indication of the government changing their focus away from development in order to protect the threatened species (Han, 2013). The large number of vessels in the waters around Hong Kong also hinders the protection efforts for the CWD. Cargo ships pollute the water with their fuel, while speed boats and high-speed ferries give marine mammals little time to react and avoid them (Vidal, 2009). However, the problem facing the CWD has been recognized by various organizations such as the WWF and the Hong Kong Dolphin

Conservation Society (WWF Hong Kong, 2015c). These organizations are working together with the government and other stakeholders to find a middle ground where all can continue their businesses while protecting the threatened CWD.

2.4.1 Government regulations

Currently, the CWD population in the Pearl River Estuary is classified as near threatened and is protected in Hong Kong (WWF Hong Kong, 2015d). However, the government of Hong Kong has not made moves to legally protect various habitats of the CWD that are seen as necessary for the survival of the dolphins. Additionally, the Hong Kong government has recently been pushing for land reclamation due to limited area within the territory. There are plans for reclaiming over 1,400 hectares of land within the next ten years (Enyo, 2015). These reclamation plans include the expansion of the Hong Kong International Airport to incorporate a third runway. This 650 hectare project includes a vital portion of the CWD's habitat. After complaints by the World Wide Fund for Nature and the Hong Kong Dolphin Conservation Society, the government offered to designate a dolphin sanctuary near Lantau Island after the airport reclamation project is concluded in 2023. Additionally, the government has already designated the Sha Chau and Lung Kwu Chau Marine Park near North Lantau Island for the Chinese white dolphin (WWF Hong Kong, 2015d).

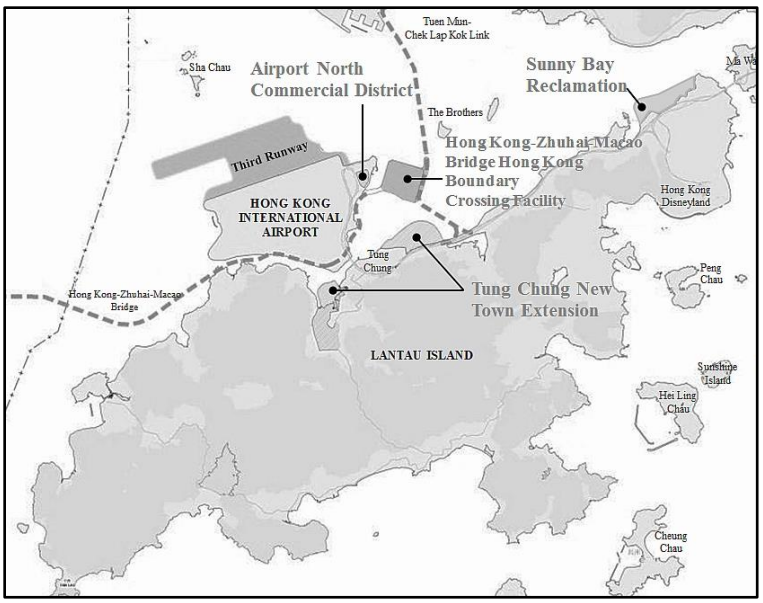

Figure 4: Conceptual Plan of Land Reclamation (Hong Kong SAR Government, 2014)

The construction of the Hong Kong-Zhuhai-Macao Bridge is also considered to be a major factor in the reduced dolphin population (WWF Hong Kong, 2015e; Jefferson, Hung, and Würsig, 2009). The Hong Kong government must soon make a decision about how much it values the CWD with respect to various construction and expansion projects before the species no longer remains in the Pearl River Estuary. However, they do recognize there is a problem affecting the CWD and has been taking some steps, such as designating marine parks, to protect the remaining dolphin population (Chan, 2014). It remains to be determined if these efforts are sufficient and whether additional measures may be needed.

2.4.2 Commercial Impacts

Many shipping and ferry companies use the waters around Hong Kong for transporting goods and making profit with little thought of their effect on the dolphin population. Because Hong Kong is primarily surrounded by water, it has many ferries, including high-speed ferries, to provide transportation to surrounding islands as well as to Macao and other parts of Mainland China. Trade vessels are also common in the territory, ranging from ocean-cargo vessels to river-

passenger vessels (Marine Traffic, 2015). Hong Kong residents also add personal vessels to the waters around Hong Kong (Marine Department, 2015). Moreover, Hong Kong's fishing industry is comprised of 4,000 vessels (AFCD, 2015a). All of these vessels in Hong Kong's waters create a very busy marine environment for the Chinese white dolphin.

There are about 800 trips per day from the different types of vessels in the CWD habitat, which spans about 31 km along Lantau's western and southern waters (Marine Traffic, 2015). This can be compared to the North Atlantic Right whale's habitat where there are about 450 trips per day over a coastline that spans 380 km (Marine Traffic, 2016). These vessels have different purposes such as fishing, tourism, public transport and trade, ranging from large cruise ships to small speed boats. Cargo ships are an important fixture in Hong Kong and can be classified as general cargo vessels, tankers, dry bulk carriers, multi-purpose vessels, or reefer ships. These ships burn large amounts of fuel, which is made worse by the fact that many are powered by bunker fuel, which contains high levels of sulfur (Marine Insight, 2010; Vidal, 2009).

Smaller ships in Hong Kong's waters include fishing vessels, privately-owned speed boats, and dolphin-watching boats (Marine Traffic, 2015). These vessels are not monitored by the Marine Department, and their routes are not available online. Fishing vessels in Hong Kong are usually less than 15 meters long and are either trawlers, liners or gill netters (AFCD, 2015a). Fishing vessels can be dangerous to local marine wildlife because the animals are likely to follow the boats in hopes of an easy meal and can become trapped in the netting (Ng and Leung, 2003). According to the Ocean Park Conservation Foundation, fishing vessels are one of the largest contributors to cetacean deaths (OPCF Hong Kong, 2015)

Every day, there are about 300 to 400 passenger and recreational vessel trips depending on the time of year (Marine Traffic, 2015). This vessel type makes up a large percentage of the

total number of vessels around Hong Kong. Over a normal 30-day period, high speed craft and passenger vessels make up 34% of the total vessels arriving in this area. The larger tour boats and dolphin-watching boats are normally between 20 to 30 meters in length and reach speeds between 10-20 knots (Iboats, Inc., 2015). The smaller, high-speed vessels are usually about 7-8 meters long and have an average cruising speed of 24 knots.

High speed ferries are also popular in Hong Kong. They can reach a high speed ranging between 35 and 50 knots and are generally 25-45 meters long (Marine Traffic, 2015). While these vessels are convenient for tourists and commuters, they cannot quickly maneuver and have been involved in four accidents with various objects, such as other boats and the breakwater in Macao's harbor, in the past four years (Chan, 2015; The Guardian, 2015). The objects that were hit were visible and quite large. If these were hit then they have the potential to hit dolphins, which are much smaller and harder to see. These boats also disrupt marine species due to their high speeds and their associated underwater noise. The waters surrounding Hong Kong have many different types of vessels, and each poses a new threat for the CWD.

2.5 Conservation Efforts

Non-government organizations, like WWF, have actively made efforts to protect the CWD. This organization is concerned about the CWD because these dolphins are a key factor in the biodiversity of Hong Kong's marine animals (WWF Hong Kong, 2015c). Within the Pearl River Estuary, the CWD are already considered threatened, meaning that their population is at an alarmingly low number and may disappear in certain areas.

2.5.1 Contributions of WWF Hong Kong

WWF has been conducting research and holding seminars in partnership with other scientific institutions to analyze the distribution, population and habitat of the CWD in order to raise awareness and preserve the species (Culik, 2010). They have also made a call to action, trying to get the attention of the Hong Kong government and asking for revisions of many governmental policies set in place to protect the CWD (WWF Hong Kong, 2015c). WWF has worked with other organizations, such as the Whale and Dolphin Conservation Society, in order to determine the current status of the CWD as well as make plans for future research. Moreover, they collaborated with South China Sea Fisheries Institute and Third Institute of Oceanography to further study the dolphins and their use of the Pearl River Estuary. This research is contributing to the different ways that CWD conservation activities can become more effective.

2.6 Preservation Efforts

Although non-governmental organizations have been working to protect the CWD, the efforts of the Hong Kong government to conserve the CWD have resulted in limited success (WWF Hong Kong, 2015e). Moreover, private companies such as ferry companies have been doing little to help with the conservation of the dolphin's habitat. The importance of protecting CWD habitats is not recognized by the government and thus many parts of the habitat are negatively affected. However, there are certain ordinances in effect to help with the preservation efforts of these marine mammals. The Wild Animals Protection Ordinance (WAPO) and the Protection of Endangered Species of Animals and Plants Ordinance (APO) both operate under Hong Kong's Agriculture, Fisheries, and Conservation Department (AFCD) to set rules and regulations for the protection of the dolphins (AFCD, 2015b; Hong Kong Dolphin Conservation Society, 2015). WAPO was enacted to prevent the harming, capturing, and killing of the CWD,

while APO forbids the selling and trading of the CWD. Moreover, an Environmental Impact Assessment requires all development projects that will affect the marine environment to supply a report indicating the effects that construction and the project itself will have on the CWD. A project proposing the construction of a liquefied natural gas receiving terminal on South Soko Island was terminated because the effects on the CWD habitat were determined to be too drastic. After WWF initiated a campaign against the project and collected over 20,000 signatures in support of the CWD, the project proponent took it into consideration and finally decided to withdraw the proposal (WWF Hong Kong, 2015i).

Despite the CWD's large natural habitat, there are only four Marine Protected Areas in Hong Kong waters where a speed limit of 10 knots is enforced and all use of fishing equipment is prohibited (Hong Kong Dolphin Conservation Society, 2015). Only the Sha Chau & Lung Kwu Chau Marine Park was designated to protect the CWD. The purple areas in the figure below are the Marine Protected Areas. While there are some regulations in place to help the CWD population, a lot more needs to be done before they can once again flourish.

Figure 5: Hong Kong Marine Parks (Environmental Protection Department, 2014)

2.6.1 Code of Conduct in Marine Habitats

Enforcing strict regulations in the habitats of the CWD can aid preservation efforts to be very effective (Conn & Silber, 2013). Vessel speed limits have been shown to minimize injuries and prevent fatalities upon collision. Moreover, slower speed limits allow vessels to spot marine mammals in time in order to prevent a collision. Marine Protected Areas in other parts of the world have also enforced rules for boats to stay at least 100 yards away from endangered marine mammals (Miller, 2014).

2.6.2 Raising Public Awareness

A key factor in the preservation of the CWD is gaining the public's support by raising awareness of the current decline in the dolphin's population. A poll conducted in 2007 by WWF Hong Kong asked Hong Kong citizens to pick an animal from a list of rare animals that they were most concerned about. Of the responses from the survey, roughly 50% were most concerned about the survival of the CWD (Cheung, 2007). This poll was also conducted in order

to raise the public awareness about the struggles of marine animals in Hong Kong's waters. However, only 6,800 citizens completed the poll. In contrast to Hong Kong's total population of 7.2 million, this number of concerned citizens is not sufficient to determine if there will be enough support to bring about any sort of change in policies. In another attempt to raise public awareness about the CWD, WWF entered a CWD named Ruby into the Miss Hong Kong beauty pageant (WWF Hong Kong, 2013). Although Ruby did not win, she gained about 60,000 signatures, indicating an increase in public awareness. As the CWD was the official mascot of the handover of Hong Kong from Great Britain to China in 1997, it is a key part of Hong Kong's culture and history (Canales, 2015).

2.7 Summary

The CWD's population decline is similar to other endangered marine species around the world in terms of the impacts from marine traffic. In the case of the North Atlantic Right whale, reduced speed and the rerouting of vessels proved to be effective in protecting the population. Similarly, the humpback whales in Australia and Hawaii have been preserved as a result of Marine Protected Areas where they can safely live. Yet in Hong Kong it is not yet clear if these methods or similar methods can be applied to the preservation efforts for the CWD. The next chapter describes the research methods we used to achieve our goal of determining the feasibility of easing the impact of the marine traffic through the Chinese white dolphin habitat in the Pearl River Estuary.

3. Methodology

The goal of this project was to determine the feasibility of easing the impact marine traffic has on the Chinese white dolphin (CWD) habitat, which may be causing a decline in their population in the Pearl River Estuary. Therefore, our objectives were to: 1) study how marine traffic operates in the CWD habitat 2) identify the current attitudes that stakeholders (government, ferry and shipping companies, ship owners, etc.). have toward the CWD, and 3) identify the current attitudes that the general public have towards the conservation of the CWD. In this chapter, we explain in detail the research methods we used to meet the different objectives.

3.1 Determine Overlap between Marine Traffic and CWD Habitat

We first determined where the majority of marine traffic within the CWD habitat was. The CWD is found in a very busy area of the Pearl River Estuary, but certain areas are impacted more than others. It was important to find out what specific locations of the CWD habitat overlapped with the marine traffic routes. The CWD habitat had been mapped by the AFCD, which included areas with higher CWD concentrations. We compared the map of the CWD habitat with the routes that vessels traveled in the waters around Hong Kong. Through direct observation and archival research, we determined which boats most frequently passed through the CWD habitat. To determine the vessel routes, we looked at various company websites and found the typical routes they use on a map of the Pearl River Estuary. We then mapped the most frequent routes on one map and compared it to the known dolphin habitat.

3.2 Study the Impact of Marine Traffic

Increased marine traffic is a major problem threatening the CWD. As discussed in our background, there have been incidents where a CWD was hit by a vessel and either died immediately or suffered horrific injuries. Therefore, it was important to determine the impact of marine traffic on the CWD's behavior and population. To determine the impact, we directly observed the vessels in the Pearl River Estuary and the CWD's behavior when interacting with the vessels.

3.2.1 Direct Observation of Vessels

To determine the amount of marine traffic traveling through the CWD habitat in Lantau Island's western and southern waters, we directly observed the types of vessels traveling in this region for 10 hours in Tai O (over a course of three days), 4 hours in Cheung Chau (in one day), and 4 hours on the Hong Kong DolphinWatch Ltd. tour boat (in one half-day tour) and determined the number of vessels per hour. In addition to the regularly scheduled vessels, direct observation guaranteed a variety of watercrafts to analyze. We used this information for the mapping method that was mentioned in section 3.1. To recognize the different types of vessels before we observed them, we studied the various vessels that were anticipated to be in Hong Kong waters. Each observation period documented the vessels that traveled during the hours of 10am – 3pm, and identified their travel routes to determine if any of the vessels were within the CWD's habitat range. Additionally, the direct observation of the number of vessels traveling through an area per hour in the region of CWD habitat gave us a general idea of the current marine traffic situation.

Figure 6: Map of Cheung Chau (Lazy Gala, 2016)

Observations took place throughout the course of several weeks, from the Fu Shan Viewing Point in Tai O, the Sai Wan Tin Hau Temple and Ng Hang Shek (Reclining Rock) on Cheung Chau Island, and off the coast of Tai O from the Tuen Mun-Tai O Ferry and a Hong Kong DolphinWatch Ltd. tour boat.

3.2.2 Direct Observation of Dolphins

Along with observing the vessels, we also directly observed the dolphins' behavior for 14 hours and how they interacted when vessels were nearby. We joined a dolphin watching tour boat to get as close as we could to the CWD. We also observed from the western coast of Lantau Island in Tai O. We did a preliminary observation from Fu Shan Viewing Point in Tai O to determine if there was enough visibility to observe the dolphins interacting with vessels.

Figure 7: Map of Tai O's Location on Lantau Island (Google, 2016)

We recorded the different behaviors of the CWD when different types of vessels and tour boats came within their range and documented which types of vessels CWD did or did not actively avoid. The boats' activities in the CWD habitat range were also noted. We used an observation protocol that we developed by reviewing WWF's dolphin observation protocol (see Appendix G1 for the protocol). These observations gave us essential information on the impact that vessels have on the CWD, the types of vessels in their habitat, and the types of vessel movements that affect the CWD's behavior the most.

3.3 Understand Current Attitudes towards CWDs and Their Conservation

We wanted to understand the attitudes of both the main stakeholders and the general public towards the Chinese white dolphin. This information helped indicate if changes in legislation, boating routes, and speed limits would be possible in the waters surrounding Hong Kong. Additionally, communicating with stakeholders and the community helped us determine Hong Kong's awareness of the difficulties facing the CWD.

3.3.1 Interviews with Stakeholders

To determine the willingness of stakeholders to change their current behaviors/activities in order to protect the CWD, we conducted interviews with: 1) tour boat companies, 2) fishermen, 3) ferry companies, 4) Hong Kong Government departments, 5)Non-Government Organizations (NGOs) and research facilities, and 6) shipping companies. These interviews were used to determine current boating practices in Hong Kong waters and indicated which types of boats have the most interaction with the CWD. The interviews were also used to determine the willingness of stakeholders to change their boating routes and traveling speeds in order to protect the dolphins. The interviewees were selected based on the five categories listed above. We contacted two dolphin-watch tour companies, two fishermen in Tai O, six ferry companies, two departments of the Hong Kong Government, three Non-Government Organizations and research facilities, and fourteen shipping companies. Within each category, at least one company or individual was interviewed, with the exception of the shipping companies, who either ignored our contact or refused to talk with us. Overall, we successfully interviewed three Non-Governmental Organizations, two fishermen, two dolphin watch companies, one government department, and one ferry company for a total of nine interviews. The information gathered through stakeholder interviews was used to make suggestions to the WWF about what solutions

to protect the CWD from boats may be possible. (See Appendices C1, D1, and E1 for interview protocols).

3.3.2 Survey of General Public

In addition to interviewing stakeholders, we also surveyed the general public. This survey was to determine the general level of the public's awareness about the CWD as well as their opinions on possible conservation efforts. A mix of tourists and local Hong Kong residents, including commuters, were surveyed to gain a broad understanding of public opinion. The survey was printed in both English and Chinese, which allowed a wider range of people to respond. We surveyed people on a Hong Kong DolphinWatch Ltd. tour boat to gather the opinions of people who have a more vested interest in the CWD. To gather the views of other Hong Kong residents whose actions directly affect the CWD, we conducted our survey in the village of Tai O on Lantau Island as well as at the Central Ferry Pier on Hong Kong Island and in Tuen Mun, as these are the main piers with vessels that travel through the CWD habitat. In order to gather the younger generation's opinions, we conducted the survey at both Hong Kong University and the City University of Hong Kong. Due to the Hong Kong public's willingness to talk with us, we completed 101 questionnaires. The survey also aimed to gauge how much people care about the well-being of the CWD. We determined the public's willingness to spend a longer duration on boat trips, which would be caused by extended boat routes and reduced speeds, as well as their willingness to pay more for boating tickets (see Appendix F1 for survey questionnaire). The additional surcharge would then be used as a donation towards the efforts of the CWD conservation. This information could show if there would be much public resistance to any changes in vessel regulations and practices.

3.4 Summary

The CWD population in the Pearl River Estuary is currently threatened by marine traffic, the construction of the Hong Kong-Zhuhai-Macao Bridge, water pollution, and many other human activities. If these threats continue, this population of the Chinese white dolphin will disappear. To determine the chances for preventing the further decline of the CWD in Hong Kong's waters, we conducted interviews with potential stakeholders in the area, surveyed the general public, and observed dolphin interactions with vessels. The next chapter presents and interprets the data we have collected.

4. Results

The goal of this project was to determine the feasibility of easing the dangers to the Chinese white dolphin (CWD) caused by marine traffic through the CWD habitat, which is contributing to the decline in their population in Hong Kong waters. To achieve this goal, our objectives were to identify the attitudes of stakeholders and the general public toward the CWD as well as determine how marine traffic operates and interacts with the CWD in their habitat. This chapter discusses our findings and connections between the results gathered by the various methods discussed in the previous chapter.

4.1 Current Attitudes of Stakeholders

Various stakeholders including ferry companies, relevant government officials, and dolphin conservation groups were interviewed to determine their attitudes towards the CWD as well as CWD conservation. This section takes a comprehensive look at the results gathered from the interviews and compares them to the opinions of the stakeholder's customers, the general public.

4.1.1 Attitudes of Ferry Companies

As ferries are the main form of transportation between the islands of Hong Kong and the surrounding areas, it was important to determine the opinions of ferry companies in regards to CWD conservation. Although we contacted six different ferry companies, we were only able to interview one ferry company. Our emails were not acknowledged by four companies, and one company declined to be interviewed. The company willing to interview with us owns 15 vessels and has a total of 146 sailings on weekdays and 132 sailings on weekends. This particular ferry company does not travel specifically through the CWD habitat so companies that are more

directly impacting the CWD may have responded differently; however, we believe their responses gave us a good starting point to determine the general response we would have received from other ferry companies regarding the CWD. For most of the questions we asked, such as their knowledge of problems facing CWD, importance of the CWD, and willingness to follow reduced speed limits, the ferry company gave neutral responses. The company answered with a three on every question that asked for a rating on a scale of one to five. Additionally, the ferry company did not respond to questions about whether they would be willing to take a longer route, if any route changes would affect the company image, and if customers would support a route change. The ambiguity of the responses is believed to be in part that the ferry company did not want to fully disclose their actual beliefs and attitudes regarding the CWD and their conservation. Doing so could affect their image politically and publicly. This makes it difficult to accurately predict how compliant they would be, should the government enforce compulsory legislation to reduce speeds in the CWD habitat.

The responses of the ferry company can be interpreted in many ways, ranging from neutral to negative. Because the company did not specifically object to route and speed limit changes, or give reasons why the changes would be harmful to their business, the responses can be interpreted as neutral. Due to the overall vagueness of the response from this company, we believe that if there were any legislative changes implemented about vessel operations in the CWD habitat, this ferry company would most likely follow the new rules, if they were compulsory. We hypothesize that the ferry company would not actively make changes to aid in the conservation of the CWD, but they would follow new laws. However, we must also acknowledge that all the other companies contacted either declined our interview or did not respond to emails. Due to the lack of response, these ferry companies may have more negative

views on CWD conservation. If ferry companies were shown support from their customers (see section 4.2.2 for opinions of the general public towards CWD conservation), they may be less opposed to following changed regulations imposed by the government. After the interview with this ferry company, we believe that other ferry companies would follow regulations set in place to help the CWD, if these changes were strictly enforced and did not affect their business or income negatively (see Appendix C2 for Interview Responses).

4.1.2 Attitudes of Shipping Companies

Cargo ships are one of the largest vessels that travel through the Pearl River Estuary and may affect the CWD due to their size, fuel, and underwater noise when traveling through their habitat. We contacted fourteen shipping companies for an interview and sent many follow-up emails and phone calls; however, we failed to interview any companies. A majority of the companies declined our interview request upon talking on the phone, while other companies ignored us. The lack of responses could be interpreted as a reflection of the company's attitudes towards the CWD and their conservation. Some companies were reluctant to speak with us, saying that their actions did not affect the CWD or have any correlation to the degradation of the population. Therefore, we decided to focus strictly on the direct observation of the cargo vessels from our viewing point in Tai O and on background knowledge we had about container ships. While conducting direct observation of marine traffic and the CWD, we were able to conclude that not many cargo vessels passed by the Tai O viewing point of the CWD habitat. Although we spotted some cargo vessels from the Fu Shan viewing point in Tai O, they stayed far off shore, away from where the dolphin sightings occurred. Additionally, cargo vessels travel at about 15 to 20 knots, which is much slower than most other marine traffic in the area. The underwater noise of container ships is at about 100 Hz, well below the dolphin hearing range of 40 to 160 kHz

(McKenna, 2012; Li et al, 2015). While the dolphins will be aware of the container ships, the underwater noise is not likely to substantially affect them. Being far away from the CWD habitat also means that the shipping vessels are not likely to collide with the dolphins. While we were not able to definitively conclude the opinions of shipping companies due to the lack of responses, we were able to determine that their container ships are not the largest threat to the CWD and their habitat.

4.1.3 Attitudes of Dolphin-Watch Companies

Dolphin-watching companies provided a different perspective than other types of companies because the success of their business depends on the conservation of the CWD. Two different dolphin-watching companies, Hong Kong DolphinWatch Ltd. and a local company in Tai O, were interviewed to gather their perspectives on the threats facing the CWD (see Appendices C3 and C4). Janet Walker from Hong Kong DolphinWatch Ltd. stated that the company was originally founded in order to raise awareness about the plight of the CWD in Hong Kong. Often the company will aid in research programs, cooperating with universities by allowing researchers to go on dolphin tours to help with their studies. The company displays information about the CWD on their vessel in addition to having an informational session at the beginning of their tours. The other dolphin-watching company we spoke to operates out of and is run by residents of Tai O, and offers people a chance to see the CWD by passing through its habitat. Unlike the Hong Kong DolphinWatch Ltd., this company does not display information about the CWD anywhere, nor do they educate their customers about the problems the CWD face. The Tai O dolphin-watching company could easily change this however, by distributing pamphlets about the CWD to their customers on their tours.

During the interviews, the two companies' representatives gave differing responses. For example, Hong Kong DolphinWatch believed that high vessel speed and underwater noise pollution affect and disturb the CWD. In contrast, the Tai O dolphin-watching company believed that vessel speed did not disturb the CWD and that if the underwater noise of vessels bothered the dolphins, the CWD would just move elsewhere. However, the Tai O company indicated they would be willing to decrease the speed of their vessels within the dolphin habitat mainly to avoid the CWD. This response indicates that the local tour companies need to be educated on the problems the CWD are currently facing. By becoming more educated on the CWD and their problems, local Tai O tour companies could increase their business. Because they are a locally run business, the schools of Hong Kong could be more compelled to go on field trips with them if they knew the operators could teach the students about the CWD and local marine habitats.

The two companies also agreed in some of their responses. Both believe that the CWD are very important to the environment. Janet Walker elaborated by discussing how the CWD are the main predators of their marine ecosystem, and that their health reflects the state of the ecosystem. An article written in *EcoHealth Journal* discussed this, saying how the health of Bottlenose Dolphins determines the health of the coastal marine habitats in which they reside (Wells, et al, 2004). As top-level predators, dolphins (both Bottlenose and Chinese white dolphins) consume high concentrations of contaminants. This is due to bioaccumulation. The higher an animal is on the food chain, the more contaminants they are exposed to, because they eat all the other animals that already have ingested many contaminants. Because of its status as a top predator, if the CWD is suffering from the amount of pollutants in the water, the entire ecosystem is contaminated.

Finally, the local Tai O dolphin-watching company stated that they would be willing to add a surcharge to their ticket prices that would be donated to CWD conservation efforts as long as the surcharge did not negatively affect business. The profits from Hong Kong DolphinWatch Ltd. are already donated to the Hong Kong Dolphin Conservation Society. Because the success of these two businesses depend on the survival of the CWD, they provided us with different attitudes toward CWD conservation than the other stakeholders interviewed. These dolphin-watching companies also provided us with useful insights about local knowledge of the CWD and willingness to participate in CWD conservation efforts.

4.1.4 Attitudes of Fishermen

The opinions of the fishermen in Tai O are especially valued as their vessel routes and fishing area directly overlap with the CWD habitat. The two fishermen whom we interviewed, both highly experienced with over thirty years in the profession, were not aware of the threats marine traffic had on the CWD, yet both agreed that the CWD is important as a species. One fisherman claimed that the CWD have become used to marine traffic and are not affected or harmed by the noise pollution boat engines create. They also believed that the CWD could hear a boat coming and avoid it regardless of the speed at which the vessel travels. Upon hearing this, we informed them of some of the problems marine traffic creates for the CWD (such as the noise pollution, affecting echolocation, etc.). After learning this, both fishermen stated that they would be willing to reduce their speed upon seeing a dolphin. They also believed other fishermen would be willing to do the same if they were informed of this, which indicates a need for education programs about the CWD. Dolphins are frequently seen when they are fishing, so reducing the boat's speed could affect the CWD in a positive way. As discussed previously, having a slower vessel speed would decrease the chances of a CWD being injured by the boat and also change

the frequency of the noise it creates underwater so as not to interfere with the dolphin's echolocation.

The fishermen also said they would be willing to change their fishing locations in order to avoid the CWD habitat, as the CWD compete with the fishermen for fish. If they were to fish in areas away from the dolphin habitat, the fishermen might have a larger catch. The dolphins would not follow them because the fishermen would be outside of their habitat and the salinity of the water would not be suitable for dolphins. The fishermen would also not object to having the CWD habitat become an MPA, as long as it would be possible to obtain fishing permits. Having fishermen be required to obtain permits would create the opportunity for an education program. In order to obtain a fishing permit, fishermen could be required to attend a CWD education course. This course would teach fishermen about the problems CWDs face and what they should do upon seeing one.

Although our information only comes from two fishermen, Tai O is a very small, tight-knit community with a population of less than 3,000 people. There is a strong network among the fishermen and the citizens in the village. We witnessed this on many occasions when walking through Tai O, as multiple fishermen would stop and chat with many of the vendors along the street, or would say hello to each other in passing. Because of this, we believe that a majority of the fishermen in Tai O would provide us with similar attitudes and would be willing to fish in different locations or reduce their speed, thus easing the threat marine traffic has on the CWD (see Appendix D2 for full interview responses).

4.1.5 Attitudes of the Government

The interviews with the Marine Department and the Agriculture, Fisheries and Conservation Department (AFCD) of the Hong Kong Government are discussed below. When

contacted, the Marine Department provided us with links to websites that elaborated on various rules and regulations regarding marine traffic in Hong Kong's waters. The most relevant of these regulations discussed the altered marine travel routes due to the construction of the third airport runway (Airport Authority Hong Kong, 2015).

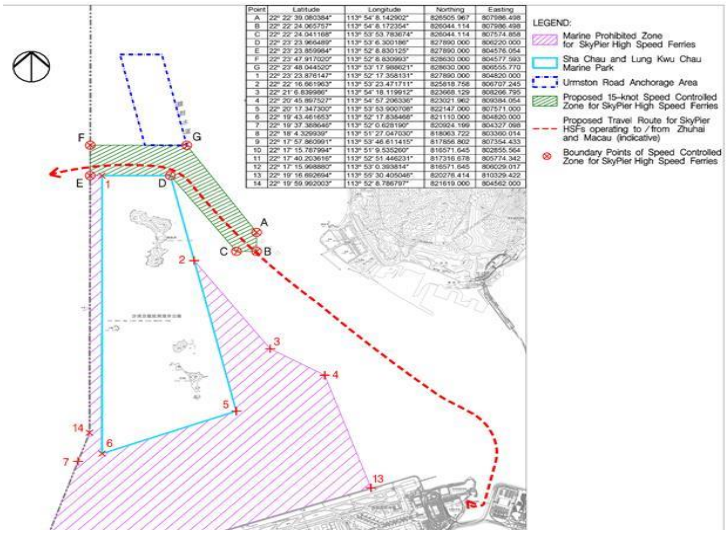

Figure 8: Marine Prohibited Zone for SkyPier HSFs (Airport Authority Hong Kong, 2015)

The high speed ferry route from the Hong Kong International Airport to Macao has been rerouted around the Sha Chau and Lung Kwu Chau Marine Park (indicated in blue), and there are speed restrictions in effect. When traveling through the area of high dolphin population density, the green striped section in the above figure, the High Speed Ferries (HSF) are required to follow a 15 knot speed restriction. The Marine Department requires all HSF using the new route to install GPS receivers/AIS (Automatic Identification System) transponders as well as provide the number and type of vessels taking the route on a monthly basis. If any regulation is disobeyed, the operator of the vessel is required to provide a reasonable explanation. However, when asked about reduced speed, Janet Walker of DolphinWatch described how reducing speed has been attempted before but has not been effective. When the Sha Chau and Lung Kwu Chau MPA was initially proposed, it covered a larger area but was decreased in size because several

ferry companies that traveled through the proposed MPA objected to the reduced speed limit. Therefore, she did not believe that a reduced speed limit would be acceptable for large companies in Hong Kong.

A recent article from the *South China Morning Post* (Kao, 2016) discussed the regulation of a strict 15-knot speed restriction and limitations of daily ferry traffic. An daily maximum of 99 vessels are allowed in the CWD habitat area, but some do not follow the reduced speed regulation. These regulations were enacted in order to reduce the environmental impact that would be caused by the new airport runway. However, many of the high-speed ferries travel at 19 knots, and government authorities have not taken any action, which creates a serious problem for the CWD habitat. Due to this recent problem, the Airport Authority stated that if captains feel they need to speed up to 19 knots, they will not issue a warning (Ng, 2016). A warning would only be issued if the vessel reached speeds greater than 19 knots. However, the Airport Authority's environmental permit issued by the Environmental Protection Agency requires all vessels to travel at or below 15 knots. In order to hold the ferry companies accountable for the reduced speed limit, the customers would need to hold the companies to higher standards. This could be possible with the installation of speedometers in the public area of ferries. A sign could be posted next to the speedometer explaining the maximum speed of 15 knots and the speedometer could emit a noise if the speed limit was not obeyed. This system would hold ferry operators more accountable. If the people care about the well-being of the CWD and are willing to follow a reduced speed, as our survey results indicate (see section 4.2.2), they must object to the current practices near the MPA. Without the general public’s support, we believe the government will continue to have a difficult time enforcing the reduced speed limits.

In our interview with the AFCD, the department indicated that they have a four-pronged conservation plan to protect the CWD and their habitat (see Appendix E4 for full transcript). The plan includes management, public education, research, and cross-boundary co-operation. AFCD also stated that they communicate with the public and stakeholders in a variety of ways, including a public hotline and corresponding committee. In their efforts to conserve the CWD, the AFCD has been monitoring the mammals continuously since 2001 and has been working towards the designation of more marine parks in Hong Kong's waters. They have also been communicating with experts, NGOs, and researchers in order to ensure the best plan for conserving the CWD in the future. The AFCD claimed that the department shares the same view as the general public of being concerned about the population decline and threats facing the CWD. In our general public survey, the public did seem concerned about the well-being of the species but they lacked knowledge about what exactly was impacting the dolphins (see section 4.2.1). This indicates that more communication between the AFCD and the general public is necessary to preserve the CWD. Through our interviews with the government, we found that both departments have a positive attitude towards CWD conservation, but they need updated enforcement policies.

4.1.6 Attitudes of Non-Government Organizations

In this section we discuss the relevant Non-Governmental Organizations' (NGOs) current attitudes and efforts to protect the CWD, and any studies that they have been conducting about the CWD habitat (see Appendices E2, E3, E4 for more information). The employees interviewed were involved with long-term monitoring of the CWD, facilitating public awareness campaigns, and running a stranding response team. Additionally, all three organizations had been contacted by the WWF or other organizations about CWD conservation and had provided specialized

knowledge, connections, or wrote joint signature letters. All of the NGOs interviewed had very similar responses to our questions regarding the CWD, marine regulations, and possible solutions.

When asked about what could be done to improve rules and regulations in regards to CWD conservation, one NGO had many ideas. They identified the main problems with the Environmental Impact Assessment (EIA) Ordinance, which currently aims to protect Hong Kong's natural environment from development projects. These problems include: 1. bias of consultants conducting EIAs, 2. inability to stop population decline once critical levels of the Event and Action plan are triggered, 3. low levels of compensation for the marine park after completion of construction, 4. lack of a comprehensive impact assessment for dolphin ecology when planning construction projects, and 5. ability of permits to be changed without public inspection through the Variation of Environmental Permits. To combat these problems, the organization suggested that a temporary stop be put on construction projects to allow the dolphins to recover. In the future, plans to aid the CWD and its habitat should be put into place during construction, not once construction is complete. Environmental consultants should be hired by someone other than the project proponents to perform a more comprehensive impact assessment. Public inspection should also be allowed before any Variation of Environmental Permits are issued. Another NGO believed in a more general sense that the rules and regulations needed to be updated to more current standards, and that more money needed to be allocated to enforcing all rules and regulations. The third organization wanted to see No Fishing zones in marine parks, core zones established that excluded boats, and shipping lane re-routing to avoid core CWD habitat areas.

These organizations were also asked their opinions about a reduced speed limit in the CWD habitat, and they responded favorably. One NGO stated that the scientific community believes speed reduction is an effective conservation method, while the other two believed that rerouting should occur in addition to speed reduction. All the organizations agreed that the citizens would be willing to accept the regulations if they were made aware of the problems facing the CWD and if the new rules were regularly enforced or incentivized.

Overall, in order to continue the conservation of the CWD in Hong Kong, the Non-Governmental Organizations believed that there needs to be a change in the priorities of the Hong Kong Government from development to conservation. The CWD has not been given sufficient time between construction projects to fully recover. Additionally, more MPAs should be established to give the population a larger protected area from the various construction projects. However, the organizations are skeptical that these changes can be implemented in Hong Kong's near future. They believe that the public and the vessel operators need to take more responsibility in protecting the dolphins on their own, as well as encouraging other companies to follow in suit. The Non-Government Organizations believed that without a shift to prioritizing CWD conservation, it is unlikely that new conservation measures will be implemented or enforced successfully.

4.2 Current Attitudes of General Public

The general public's opinions about what can be done to aid the CWD, including opinions of Hong Kong locals as well as tourists, are discussed below. It is imperative that the views of the public be understood in regards to the CWD and its conservation. Their attitudes about conservation and their willingness to change their behaviors to help the CWD are very important. This is because the public can provide support and power to non-governmental

organizations that attempt to push the government to pass legislation that will protect this threatened species. The public can also make it clear to ferry companies that they support slower speeds and longer routes for the relevant ferry trips.

4.2.1 Public Awareness of Chinese white dolphin

The amount of knowledge that Hong Kong's general public has about the CWD and the problems they currently face can have an impact on the willingness of all stakeholders to change their behavior to help conserve the CWD. The public's level of understanding can be used as an indicator for how willing stakeholders would be to support and comply with new legislation that could be enacted in order to protect the CWD. Our survey results included opinions from 101 members of the general public, 70 of whom were native to Hong Kong and 31 who were not.

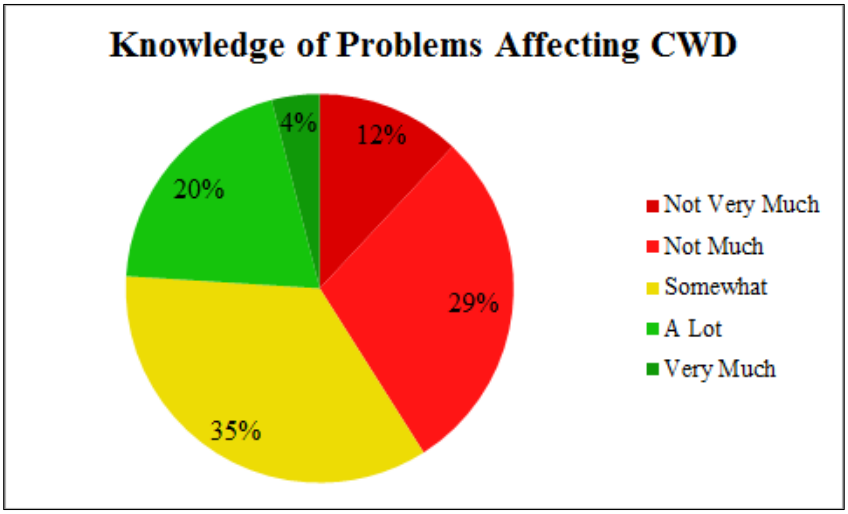

Figure 9: Knowledge of Problems Affecting CWD (n = 101)

We asked the public how much they knew about the problems the CWD currently faced. Figure 9 shows that roughly 24% of those we surveyed indicated they had a significant understanding of the problems the dolphins faced. Compared to the 41% of people who said they had almost no knowledge of the dolphins, this is a very small percentage. Additionally, 35% said

they had somewhat of an understanding of the problems which, through informal conversation, we determined to mean they were aware the dolphins were threatened but did not know the details of any specific threats.

We then separated these data by whether or not the answers were provided by someone native to Hong Kong or if they were "other" (tourists, international students, etc.).

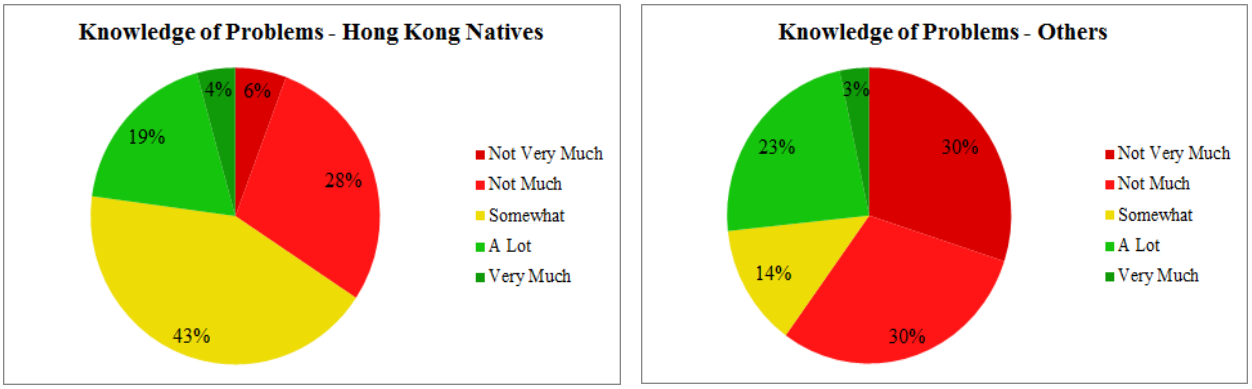

Figure 10: Knowledge of Problems - Hong Kong Natives (n = 70) Vs. Others (n = 31)

It is clear that the tourists know much less than the Hong Kong natives about the problems that the CWD currently face. The knowledge of Hong Kong Natives was split almost evenly between very aware of the problems, somewhat aware, and not aware with somewhat aware being the most common of the three categories. In contrast, most of the tourists (60%) did not know much about the problems. The tourists also tended to either have significant knowledge of the problems or no knowledge, with only 14% responding that they had general knowledge of the problem.

We asked what the respondent felt was the biggest problem that the CWD were facing. Figure 11 shows that most survey respondents (about 28%) believed that water pollution was the biggest threat to these mammals, along with development and land reclamation (about 20%). However, one of the largest response percentages was no response at all, indicating that a good portion of the public did not know about any problems that the CWD are currently facing.

Despite the fact that Figure 9 shows 41% of the people surveyed have little, if any knowledge of the CWD, Figure 11 shows that only 14% have no idea at all about their problems, as shown by the "No Response" section in the chart. This means that 27% of the people who indicated a specific problem for the CWD in Figure 11 claimed they had little knowledge about the CWD. We can infer that the 27% of people could only guess what may be an issue for the CWD.

According to the AFCD, habitat loss and disturbance, pollution, incidental entanglement in fishing gear, vessel collision, and depletion of food resources are the five biggest problems the CWD is currently facing. Comparing this to the answers given by the public, only about 70% of responses were of the categories listed by the AFCD. Furthermore, only a total of 10% of the survey respondents recognized vessel collision and depletion of food and resources as a problem. This shows that more of an effort needs to be done to educate the public about the CWD and the specific problems they face.

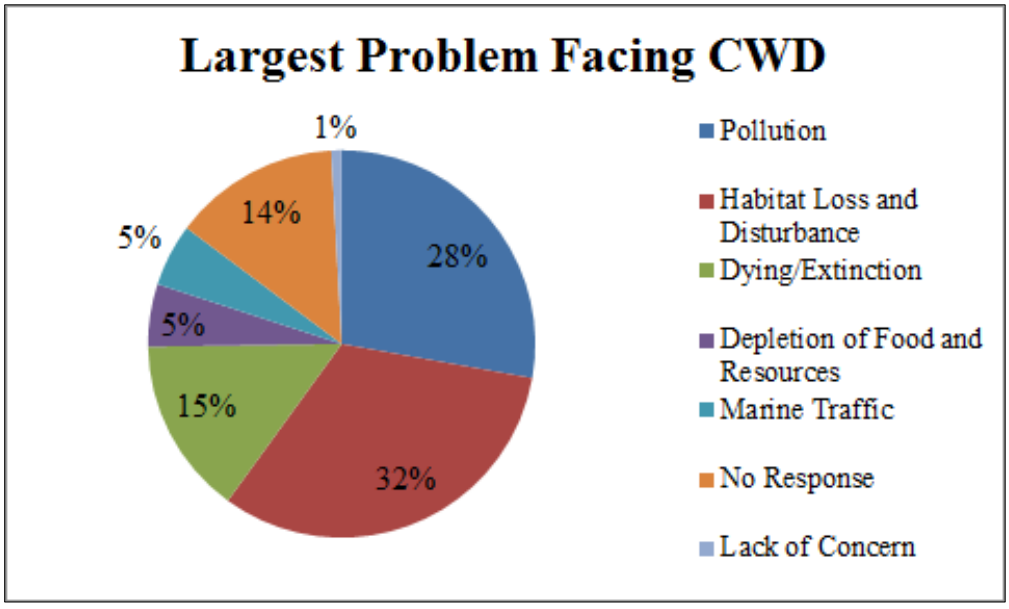

Figure 11: Largest Problem facing CWD (n = 101)

We also separated this data based on the demographic of the respondent.

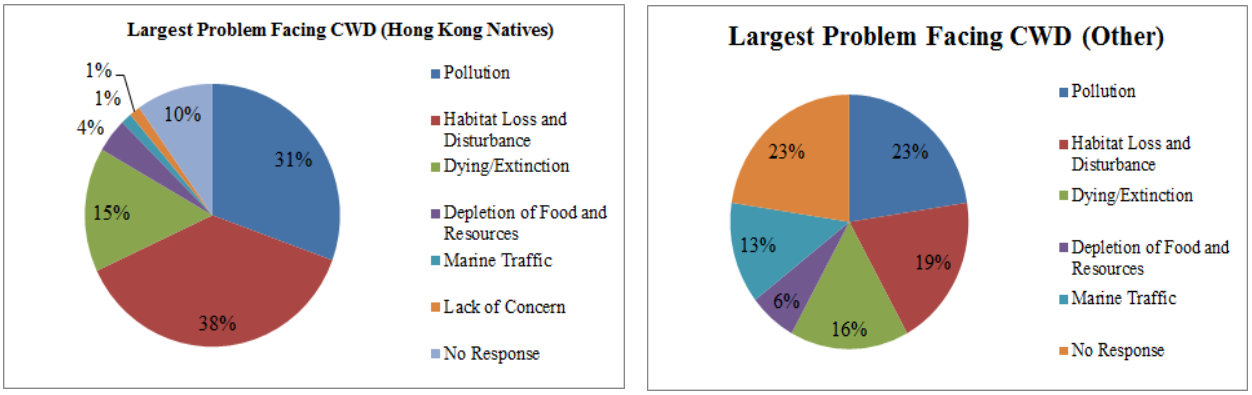

Figure 12: Largest Problem Facing CWD - Hong Kong Natives (n= 70) Vs. Others (n = 31)

The Hong Kong Natives believed that pollution, and habitat loss and disturbance were the biggest threats to the CWD. Interestingly enough, only 1% of Hong Kong Natives mentioned marine traffic to be an issue while nearly 13% of the Other category mentioned this. It is likely that the Hong Kong natives, like the stakeholders interviewed in Tai O, have the idea that the dolphins are used to the marine traffic, or do not think it is a problem because they themselves are used to the marine traffic. It is also clear that there is a larger gap of knowledge in the tourist demographic (as indicated by the lack of response), which is what was expected. Despite having little knowledge of the problems that the CWD are facing, many of our survey respondents did indicate that the dolphins were of importance to them, as shown in Figure 13.

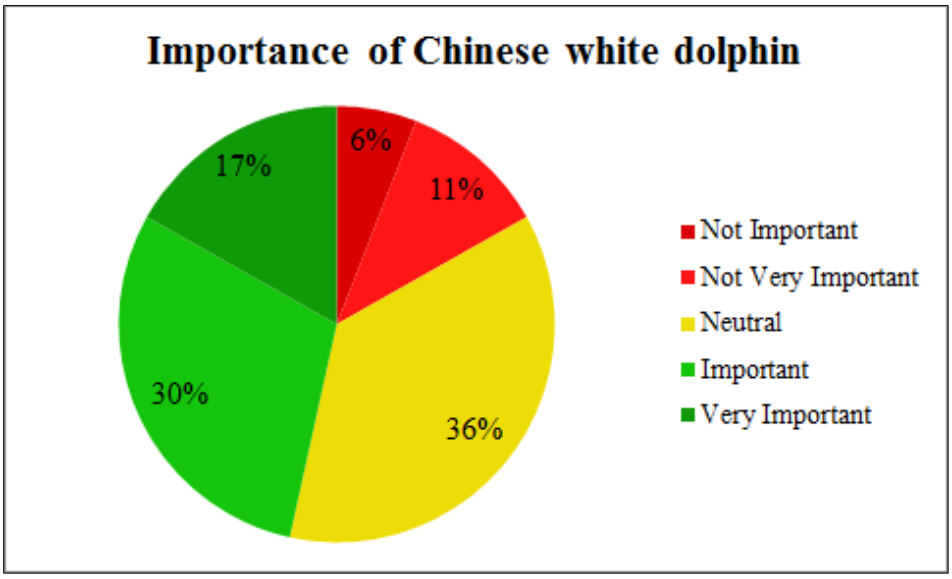

Figure 13: Importance of Chinese white dolphin (n = 101)

Figure 13 shows that approximately 47% of the people surveyed indicated that the dolphins were important or very important to them and 36% were neutral about the subject. About 17% stated that the dolphins were of little or no importance to them. If the dolphins are important to the people of Hong Kong, then they may be more willing to learn more about the factors impacting the CWD and be willing to contribute to conservation efforts.

4.2.2 Willingness to Change Vessel Route and Vessel Speed

Vessels traveling at high speeds through the CWD habitat can be fatal for the CWD. We aimed to determine how willing the public would be to have a longer trip at a slower speed, or following a different route, to minimize the collisions with CWD.

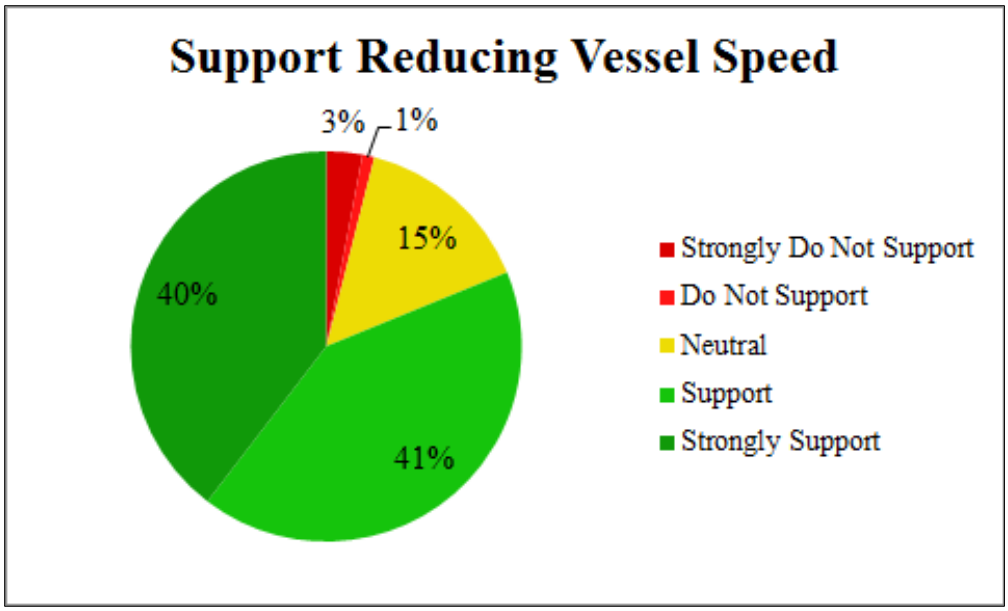

Figure 14: Percentage Who Support Reducing Speed (n= 101)

Figure 14 shows what percentage of the public we surveyed would support reducing the speed limit. The figure shows that about 81% of the public surveyed support or strongly support a reduced speed limit, while 15% were neutral and 4% opposed the idea.

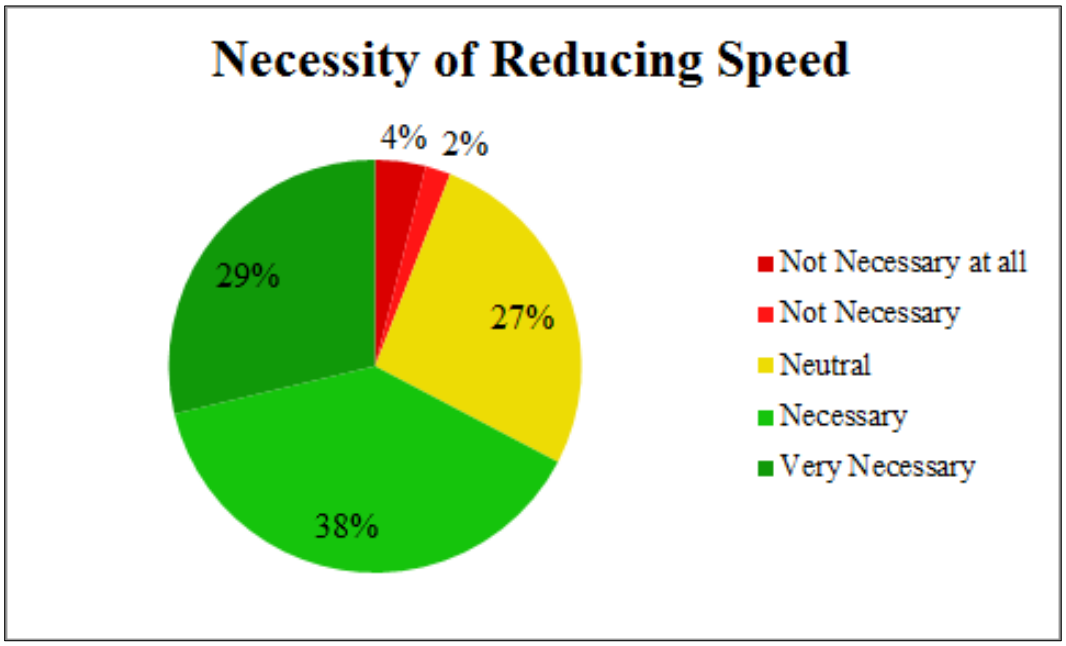

Figure 15: Necessity of Reducing Speed Limit (n = 101)

Figure 15 shows the public's opinions on the necessity of reducing the speed limit. Roughly 67% of the public surveyed believed it to be necessary or very necessary, and 6% of respondents were opposed. Based on these results a larger percentage of people are willing to follow a reduced speed than the percentage who believe that a reduced speed is necessary.

An outcome to reducing the speed limit of vessels would be a longer route. In our survey, we asked how supportive they would be of a longer route, how willing they would be to take the longer route and, if willing, how much longer they would be willing to increase their travel time (see Appendix F1).

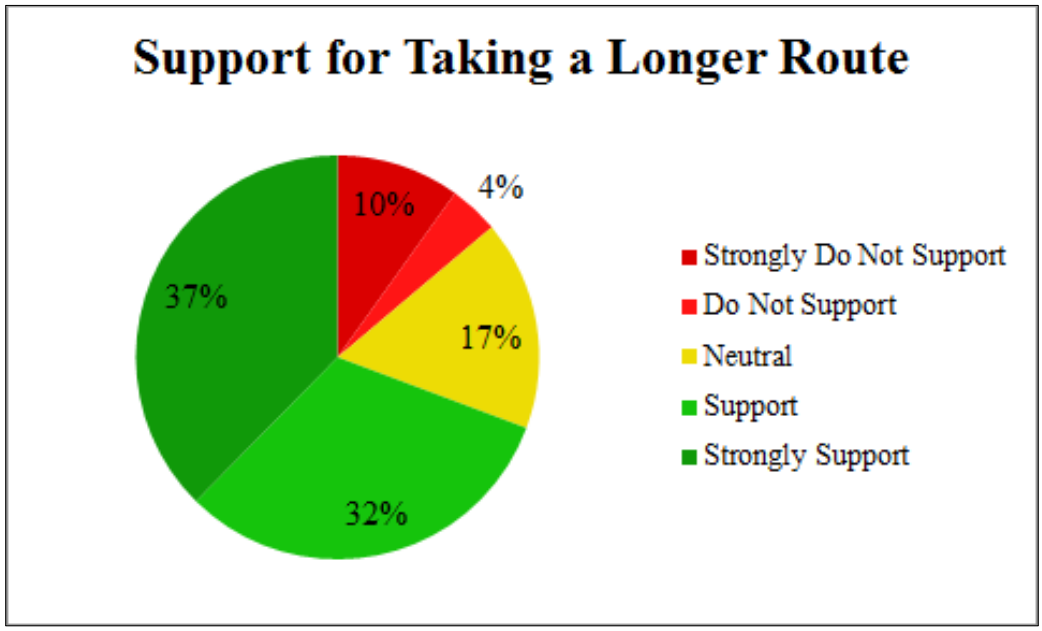

Figure 16: Support for Longer Route (n = 101)

Figure 16 shows the percentage of the public's responses on how supportive they would be of taking a longer route. The figure shows that 69% of the public surveyed support or strongly support taking a longer route and 14% were opposed. Overall, the majority of the public supported or was neutral to taking a longer route to avoid possible collisions with the CWD.

When looking only at the respondents who used marine vessels, we found that there was not much variation in the amount of support for taking longer routes.

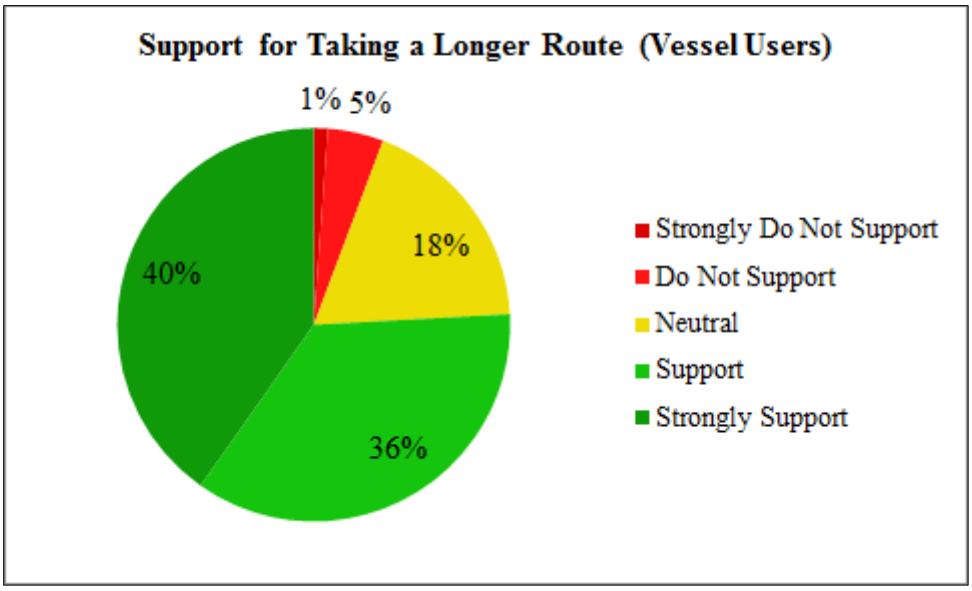

Figure 17: Support for Taking Longer Route- Vessel Users (n = 87)

Figure 17 shows that 76% of respondents claimed they supported longer routes if it would help conserve the CWD. This percentage is slightly more than that of the general public, implying that the people most likely to be affected by these changes would also be willing to support taking a longer route to benefit the conservation of the CWD.

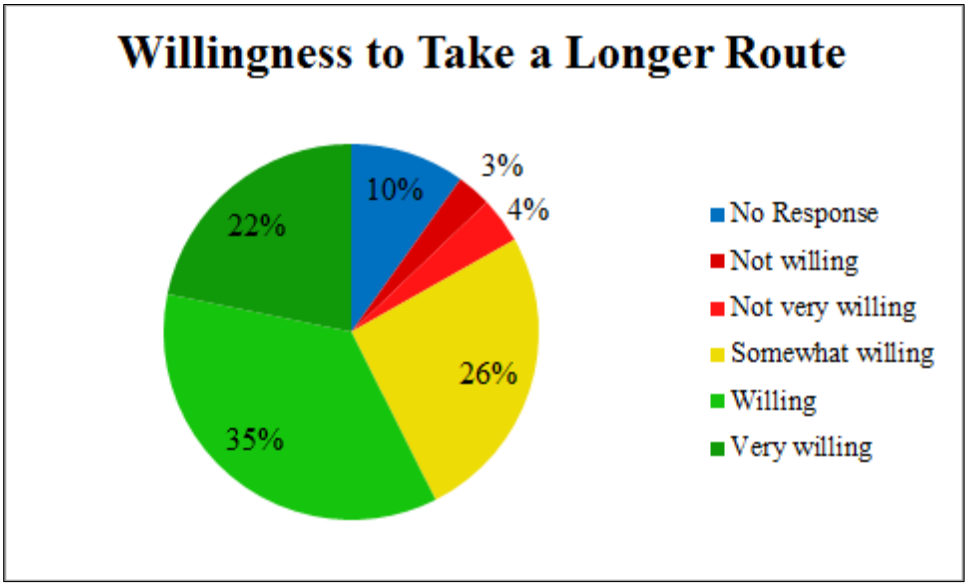

Figure 18: Willingness to take Longer Route (n = 101)

Figure 18 shows the general public's willingness to take a longer route when traveling by marine vessels. Out of all the responses, 57% indicated being willing to take a longer route, 26% indicated being somewhat willing, and only 7% were not willing to do so. We also noted 10% of the respondents gave no response at all, which indicates that few people were uncertain about the idea. Asking the public about their support for taking longer routes and their willingness to take longer routes may seem as though the same question is being presented. However, there is a difference between supporting an idea and actually being willing to commit to the idea and its results. In this case, about 94% of the public said that they would at least be somewhat supportive of longer routes for ferries. In contrast to that, only about 56% said that they would actually be willing to take these longer routes as a result of either a reduced speed or a different route that avoided the CWD habitat. There is a 38% difference in these two results and these public responses are subject to change if some of the related actions, such as speed reduction, are actually enforced. Due to the limited size of the survey sample, we cannot make generalizations about the entire Hong Kong public. However, we feel that because of the positive responses to reduced vessel speed and longer routes in our survey, there would be adequate public support for these changes. After the implementation of any new regulations, the public may have altered opinions, but currently they support changes that would help CWD conservation.

We also looked specifically at those who use or operate marine vessels.

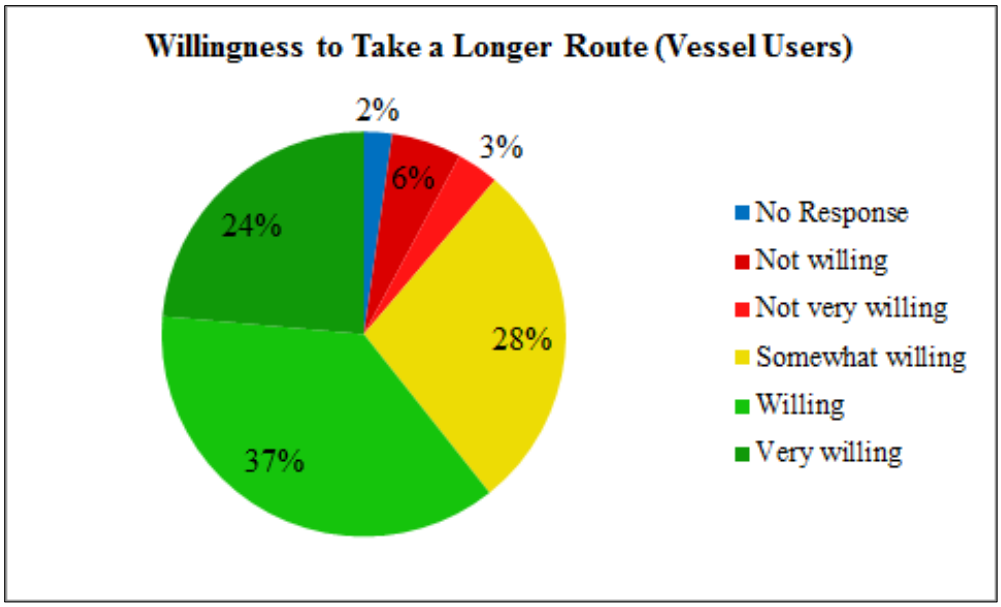

Figure 19: Vessel Users Willing to Take Longer Routes (n = 87)

Here, there is also very little variation in the percentages of those willing or very willing to take a longer route. There was a slight increase in the number of those willing or very willing, equating to 61%. There was also approximately a 3% increase over the general public in those somewhat willing to take a longer route.

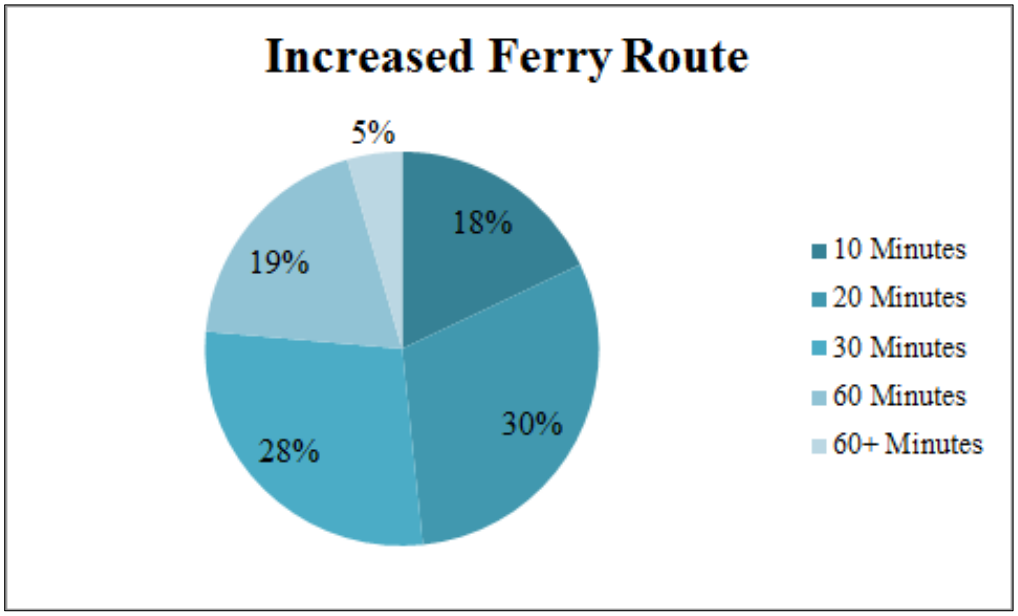

Figure 20: Increased Ferry Route Times (n = 101)

The majority of the people surveyed, about 58%, said they were willing to extend the ferry trip time for up to 20-30 minutes (see Figure 20). Almost 20% of the respondents indicated their willingness to increase their trip by more than 60 minutes. Combined with the positive responses to reduced speeds and altered routes, this result suggests that the public would be willing to change their behaviors in order to help conservation efforts for the CWD.

4.2.3 Willingness to Pay a Surcharge

Adding a surcharge to ticket prices for ferries and dolphin-watching tours in Hong Kong to donate to dolphin conservation efforts could be beneficial to helping the population of CWD in the Pearl River Estuary. To determine the public's support of the idea of a surcharge, we asked survey participants if they would support the idea of a surcharge, how willing they would be to pay the surcharge, and how much they would be willing to pay.

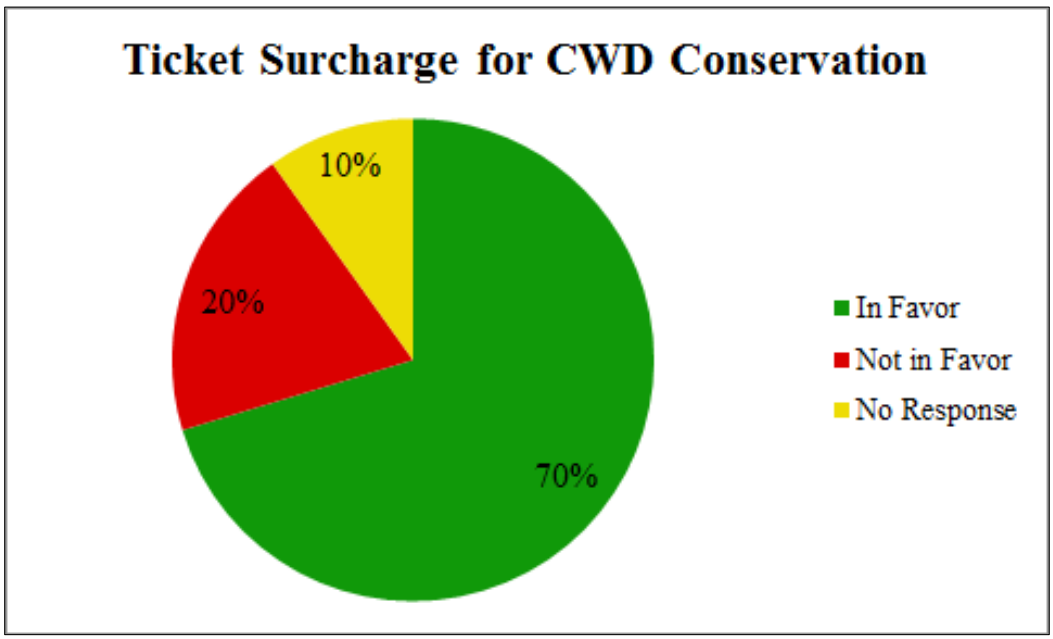

Figure 21: Ticket Surcharge for CWD Conservation

As seen in Figure 21 above, 70% of the survey respondents were in favor of a ticket surcharge that would be donated to CWD conservation efforts. Twenty percent of the

respondents were not in favor and 10% did not respond, which can be interpreted as either neutral or not in favor. Additionally, we asked how willing the public would be towards paying the surcharge.

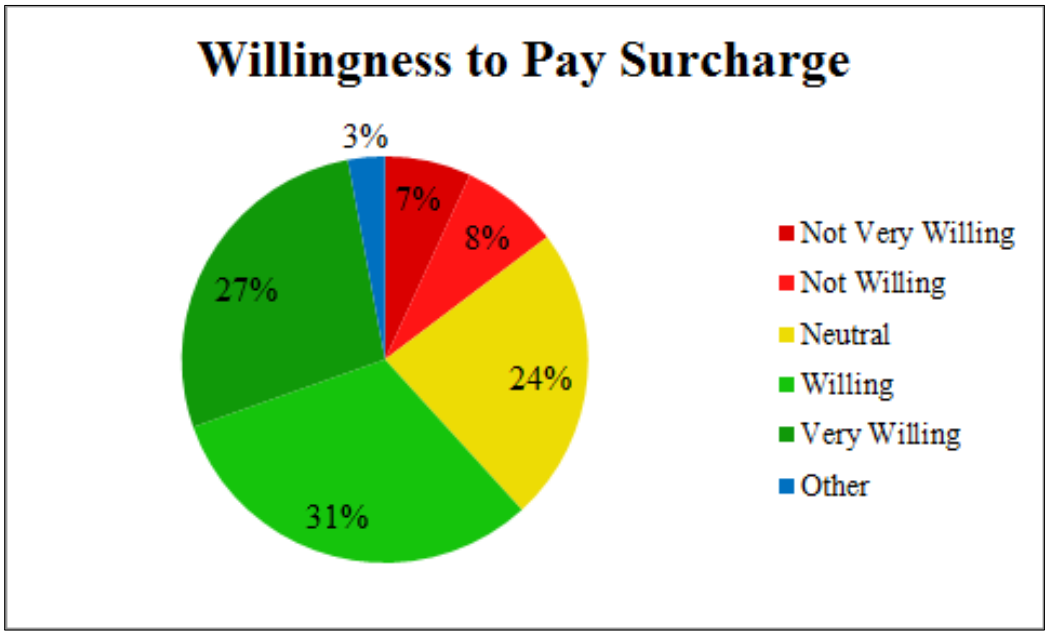

Figure 22: Willingness to Pay Surcharge

As predicted, a lower percentage (58%) of the public was willing or very willing to pay the surcharge than the percentage of the public (70%) who were in favor of the surcharge initially. About 24% of the respondents were neutral about paying the surcharge and 15% were opposed.

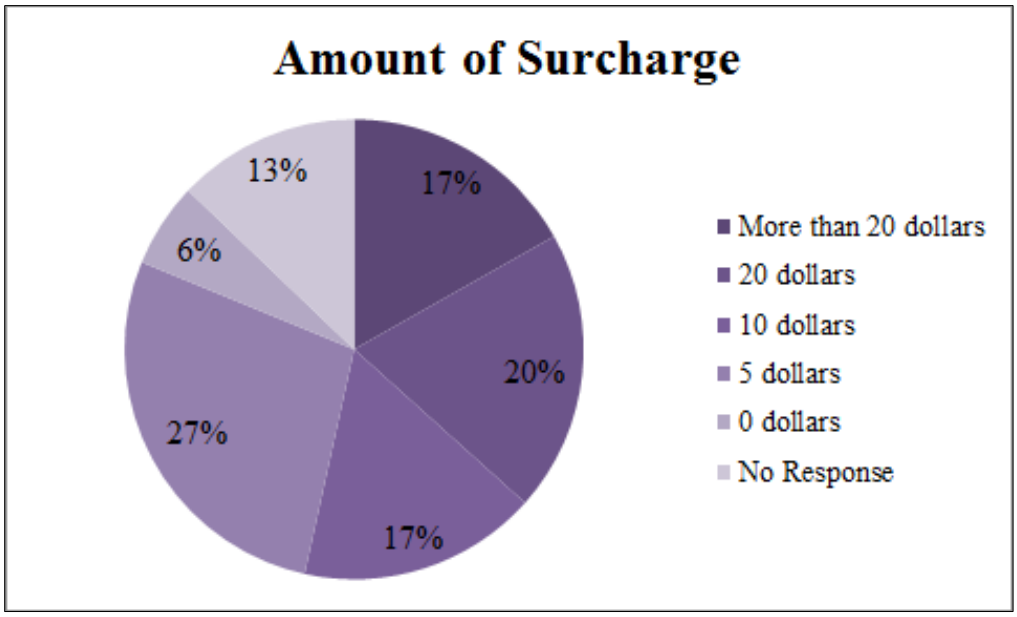

Figure 23: Amount of Surcharge

Figure 23 displays the amount of surcharge that the surveyed public would be willing to pay in addition to their ticket price. If the "No Response" category is understood as willing to pay zero Hong Kong dollars, then 19% of respondents would not pay a surcharge. This closely reflects the 15% of respondents from Figure 22 who were opposed to the surcharge. Through the survey, the public responded positively in their opinions of the CWD. These results indicated to us that the public is willing to alter their current behaviors to aid in CWD conservation.

4.3 Interaction between CWD and Marine Traffic

The direct observations we made in different locations gave us an idea of current marine traffic in Hong Kong waters and its impact on the CWD population as well as the CWD's behavior when interacting with the vessels. We observed the routes of the vessels seen from various observation points and recorded their routes on a map as seen below. These routes represent the most common vessel sightings but only include vessels with a set route. We then compared the vessel routes to the known habitat of the CWD.

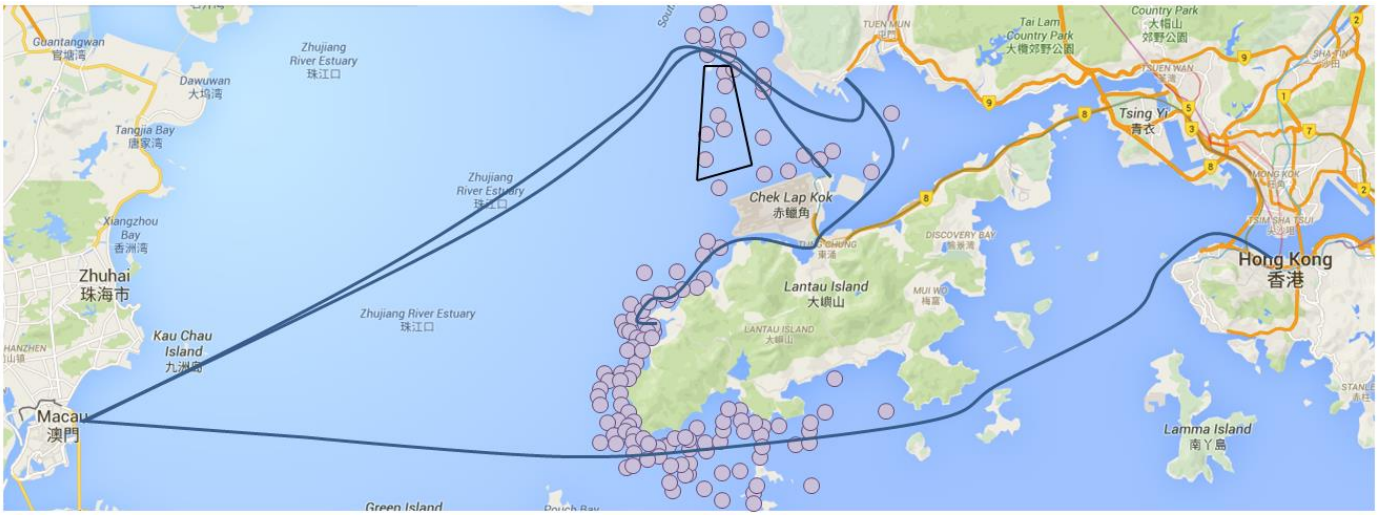

Figure 24: Ferry Routes Through the CWD Habitat

4.3.1 Marine Traffic in Tai O

From the viewing point we used in Tai O and while on the dolphin watch tour in the waters around Tai O, we observed the number of each type of vessel we saw traveling through this area of the CWD habitat (see Appendix G4 for completed data sheets). Figure 25 shows our view from our land-based observation point.

Figure 25: View from Land-based observation point, Tai O

The data presented in Figures 26, 27 and 28 are based on the land observations we completed over the course of three days.

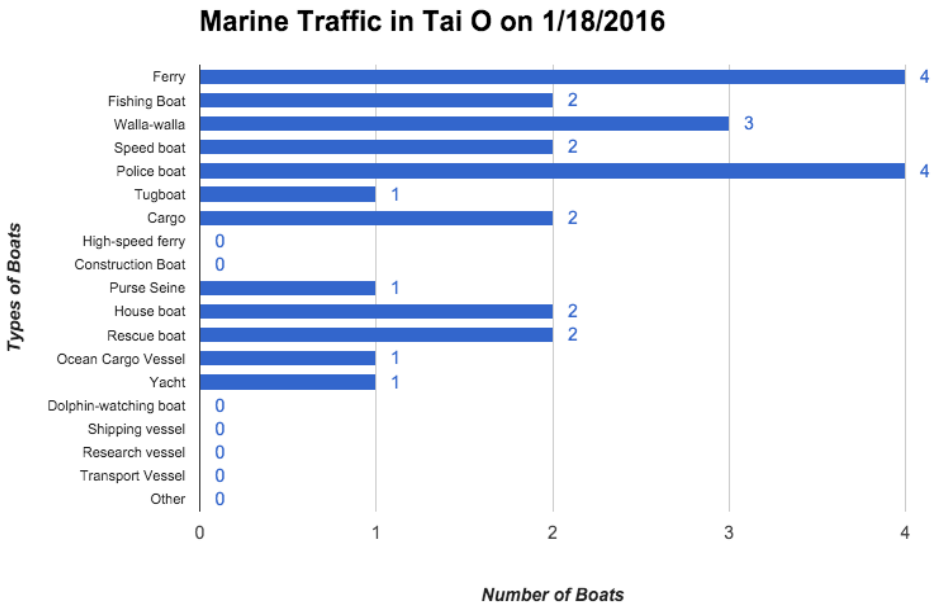

Figure 26: Marine Traffic in Tai O on 1/18/2016

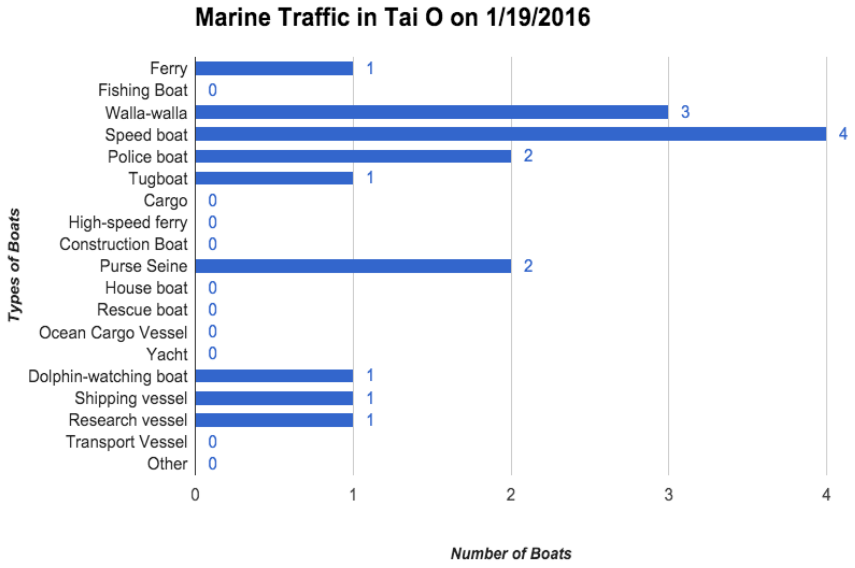

Figure 27: Marine Traffic in Tai O on 1/19/2016

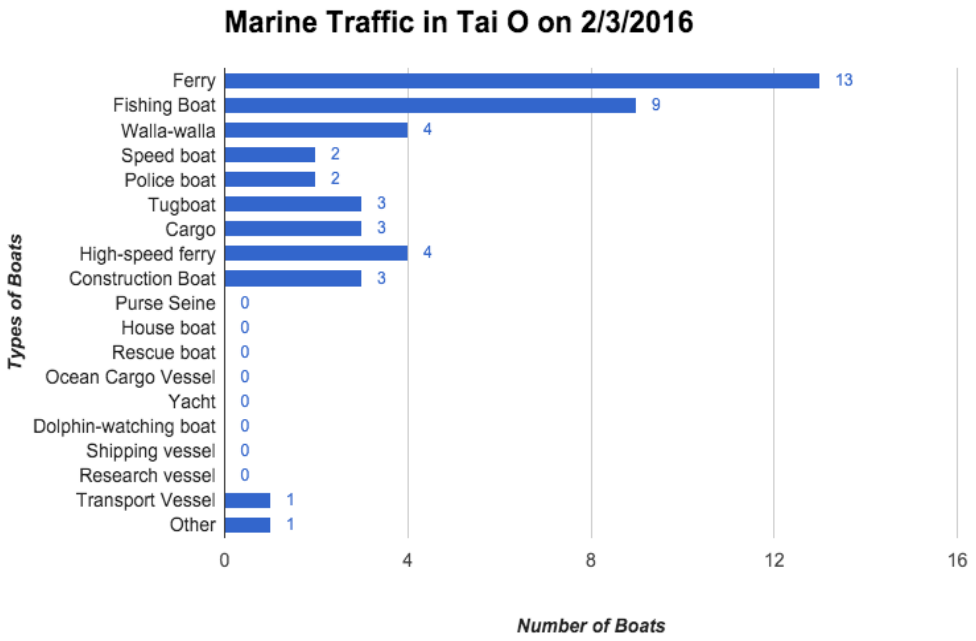

Figure 28: Marine Traffic in Tai O on 2/3/2016

Ferries were the most commonly spotted vessel because the ferry route from Tuen Mun to Tai O runs through the dolphin habitat in that location. Additionally, there were ferries seen bringing construction workers to the Hong Kong-Zhuhai-Macao bridge supports and stationary construction vessels off the coast of Lantau Island. The number of ferries varied largely depending on the day as a result of the construction schedule. Fishing boats were also common because the local residents of Tai O exited the Tai O Harbour, which is within sight of the viewing point. Walla-wallas were seen taking visitors on dolphin-watching tours in the area. The fishing boats and Walla-wallas operate when weather conditions are ideal. Moreover, the Walla-wallas operate depending on the number of customers they have, thus resulting in an unpredictable schedule.

High Speed Ferries were not often seen from the Tai O viewing point, which was most likely due to visibility restrictions. When the High Speed Ferries were spotted, they were

traveling on the horizon line, far from the western shore of Lantau Island. At this location, the High Speed Ferries were not within the CWD habitat, as the dolphins tend to stick to the coastline. However, High Speed Ferry routes do intersect the dolphin habitats at other locations around Lantau Island when the vessels travel closer to the shore (as seen in the map in section 4.3). The police vessels seen traveling through the dolphin habitat also moved extremely quickly at an estimated speed of 30 knots. The police vessels remained close to the shore of Lantau Island when traveling by the viewing point and would pass by our field of view in about one minute. From our vantage point, we could clearly hear the motor of the police vessels, which implied that they also created a large amount of underwater noise pollution.

Cargo vessels were also seen in the distance from the viewing point still within the CWD habitat, but they were not traveling near the Sha Chau and Lung Kwu Chau MPA. Both river trade and ocean cargo vessels were seen due to the proximity to the Pearl River Estuary, a common shipping route. Although the cargo vessels were very large, they moved very slowly, at about 15-20 knots. This led us to believe that the dolphins would have ample time to avoid the large, slow-moving vessels.

Construction vessels could be seen moving between sections of the Hong Kong-Zhuhai-Macao Bridge, which is currently under construction. However, these vessels did not move at high speeds and are required by the government to reduce their speed to 10 knots if they have any dolphin sightings. Overall, the traffic passing through the dolphin habitat was not constant, but the area was busy. The speed of vessels traveling directly through the CWD habitat ranged from idle to about 30 knots. The high speed ferries seen off in the distance are known to travel at speeds between 35 and 50 knots. Due to the speed and number of vessels in the area, there is most likely significant noise pollution affecting the dolphins.

Based on our direct observations during the dolphin watch tour, we noted the various types of vessels that were in the CWD habitat near Tai O (see Appendix G5). The figure below shows the different types of vessels that travelled through the habitat during the four hour observation period.

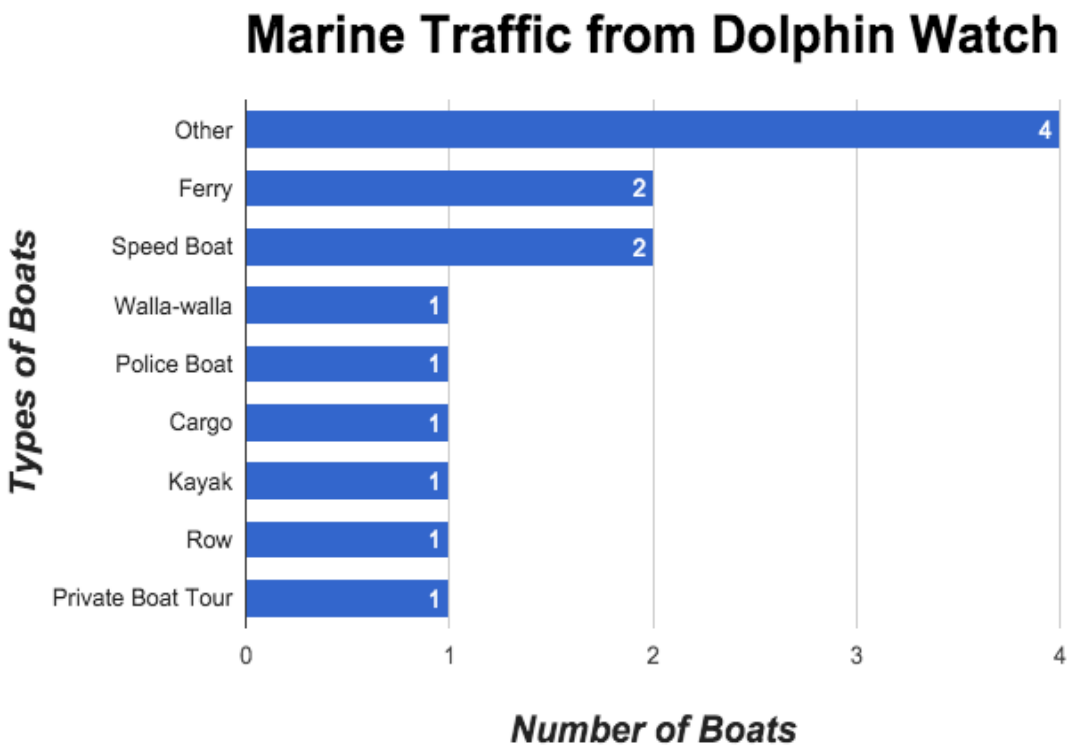

Figure 29: Marine Traffic viewed from Hong Kong Dolphin Watch Vessel

The most common vessels to travel in the CWD habitat in Tai O were unidentifiable (labeled "Other"), followed by ferries. The boats labeled "Other" were no bigger than the dolphin watch tour boat and had no interaction with the CWD that were present at that time. The cargo vessels noted were also in the distance, far from the CWD that were spotted. Figure 30 shows the CWD we spotted and how far they were from the coast and marine vessels. This data clearly supports the notion that there is heavy marine traffic within the CWD habitat and that policies such as speed reduction or rerouting of vessels must be implemented to ease its impacts.

Figure 30: CWD viewed from Hong Kong Dolphin Watch Vessel

4.3.2 Marine Traffic in Cheung Chau Island area

Cheung Chau Island is home to the Cheung Chau Ferry terminal and harbor, which is a very popular location for vessels of all types. Direct observation for a total of four hours was done there to collect data on the types of marine vessels that pass through the CWD habitat along the southeastern Lantau Island area. The marine vessels traveling from the port on the west coast of Cheung Chau Island pass beside the southern coast of Lantau Island, directly through the CWD habitat, which is why both of our observation points were along the western part of Cheung Chau. Three hours of direct observation were conducted at Sai Wan Tin Hau Temple, overlooking the west part of the coast.

Figure 31: View from Sai Wan Tin Hau Observation point

There were a total of 144 marine vessels that passed through the area during the observation period. Figure 32 shows that a large number of these vessels were high speed ferries. As stated previously, high speed ferries pose a big threat to CWD because of the speeds at which they travel. With such a large number of high speed ferries leaving the port of Cheung Chau, the CWD habitat would be greatly affected. We recorded whether the ferries were heading towards or away from the CWD habitat and found that about 40% were moving towards the habitat. We also noted that speed boats were second in terms of the number observed. However, the speed boats in Cheung Chau stayed near the shoreline of the island, and thus would not travel through the CWD habitat.

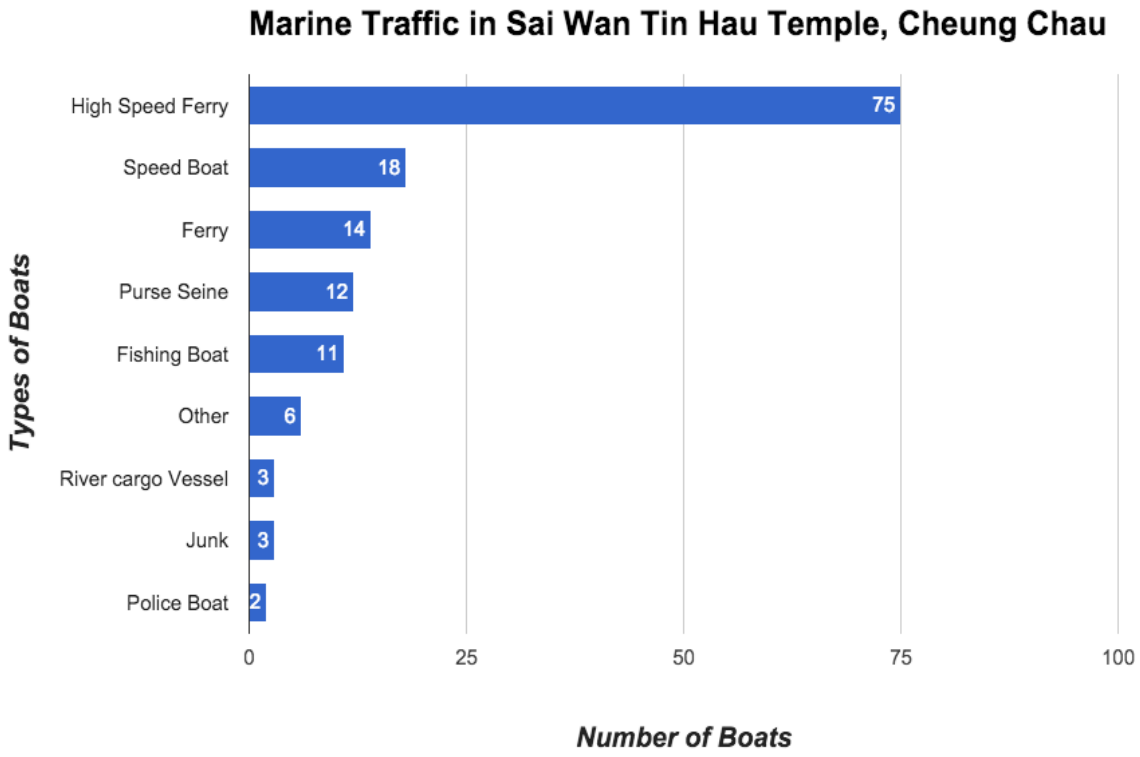

Figure 32: Marine Traffic Recorded from Sai Wan Tin Hau Observation Point

The fourth hour of observation was done at Ng Hang Shek, also known as Reclining Rock, on the same day as the previous Cheung Chau observation. From this viewpoint, we were able to see off of the southwest coast of the island. A total of 29 vessels were recorded, most of which were High Speed Ferries. Additionally about 46% of the High Speed Ferries were headed in the direction of the CWD habitat. The complete distribution of vessels can be seen in Figure 33. Speed boats, once again, were the second most commonly observed boat.

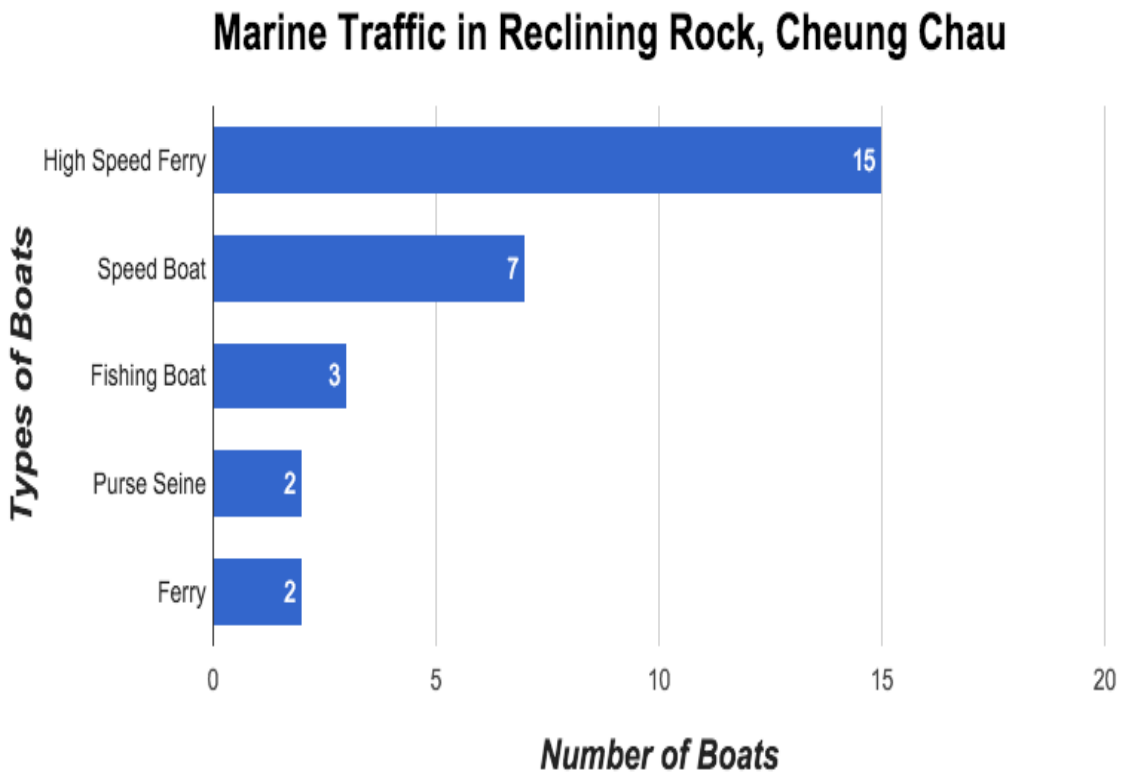

Figure 33: Marine Traffic viewed from Reclining Rock (Ng Hang Shek) Observation Point

Due to timing and weather limitations, we were unable to make another trip to Cheung Chau. However, most of the boats we observed have a clear schedule, and it can be inferred that roughly the same number of boats travel with the same frequency every day. Based on our observation in Cheung Chau, it is clear that the main threat to the southern part of the CWD habitat is high speed ferries and speed boats. Both types of boats travel at high speeds and can injure or kill a dolphin through collision. There is also a high frequency at which these boats travel. In the four hours that we observed from Cheung Chau, there were 90 High Speed Ferries that traveled through its waters. The New World First Ferry company alone makes 84 trips a day between the Central Ferry Pier and Cheung Chau (New World First Ferry Services, 2016). As stated previously, High Speed Ferries are a threat to the CWD, and based on our data, it can be seen that there is a large number of them traveling through the CWD habitat daily. Although

slightly less than half of the HSF recorded were heading into the CWD habitat, the other HSF were seen heading the opposite direction, indicating that they had just traveled through the habitat. While High speed ferries can operate at 15 knots, the design of the vessels makes traveling at slow speeds less comfortable for the passengers and a longer route with a consistent higher speed would be more feasible for this type of vessel. Our direct observation from Cheung Chau allowed us to study the high amount of marine traffic traveling to the CWD habitat from other locations around Hong Kong.

4.3.3 Interaction Between Vessels and CWD

The observations we made while on the dolphin watch tour yielded valuable data on how the CWD interact with various types of vessels. Much of the interaction that took place was with the dolphin watch tour boat itself. The responses of the dolphins were either neutral or positive, as they would swim close (within 10 meters) to the boat for as long as 11 minutes at a time (see Appendix G5).

Figure 34: Dolphin Interaction with Vessels

The dolphins also exhibited a wide range of behaviors, the most common of which was quiet surfacing. The tour boat also engaged in behaviors that actively sought out the dolphins. When dolphins were spotted, the tour boat would follow the dolphin, either traveling in parallel to the dolphin or directly towards it, a behavior known as “head on.” The boat would also get as

close as five meters to a dolphin. However, the boat would be idling when this close in range. The only other vessel to interact with the CWD was a private tour boat, which stayed in the area for 20 minutes. This particular vessel followed the dolphins directly and remained idle once they were within a distance of approximately 10 meters from the dolphins.

The AFCD has created a voluntary code of conduct for dolphin watching tours (AFCD, 2016a). The dolphin watch tour that we participated in tried to remain in compliance with these rules. However, there were a few rules that were infringed upon. Following the dolphins "head on" as the tour boat sometimes did is prohibited by the code of conduct. Moreover, the AFCD only allows for one dolphin watching tour boat to be within 500 meters of a group of dolphins. During our observation period, another dolphin watching vessel was also within 10 meters of the dolphins. Neither that boat nor the dolphin-watch tour that we were on made an effort to move away and obey the 500 meter rule. Currently there are no penalties for refusing to follow the AFCD's code of conduct for dolphin watching activities. Dolphin watching tour vessels have the most interaction with the CWD as they actively seek them out. Strict enforcement of this code of conduct, along with penalties such as fines for breaking these rules, is needed in order to ensure the protection of the CWD.

Despite having successfully collected this data, there were many limitations to our direct observation from the dolphin watch tour boat. The tour boat was costly and taking more than one trip would have been expensive. The weather was also often not conducive for dolphin watching and many trips were cancelled. Moreover, we were only able to observe for four hours, which might not have been long enough to effectively determine how the dolphins usually interact with boats.

4.4 Summary

Through the completion of our objectives, we have gained an understanding of the views of the general public towards the CWD and how they can influence the willingness of stakeholders to participate in CWD conservation efforts. Two of our objectives were to study the public's and stakeholder's opinions on the CWD. The data that we have collected shows positive results in terms of the public's perceptions of the CWD. Although they lack specific knowledge in regards to the problems the CWD currently face, they are willing to change their behaviors in order to support the CWD and their conservation. While some stakeholders were neutral or slightly skeptical about the idea of slowing marine traffic down within the CWD habitat, we believe that the data we collected on the general public's attitudes could help persuade stakeholders that change is possible. Although unpredictable and poor weather prevented us from going to Tai O and Cheung Chau for further observations of marine vessels, the data we collected indicates a high concentration of marine traffic in the CWD habitat, completing our objective of studying the marine traffic within the habitat. The next chapter will provide recommendations that we have for stakeholders and our sponsor, WWF Hong Kong.

5. Conclusions and Recommendations

This chapter summarizes our conclusions and recommendations based on the analysis of our data. Our recommendations were based on our conclusions and background research and are targeted at all stakeholders involved in the conservation of the Chinese white dolphin.

5.1 Conclusions

Based on our findings and research, we were able to draw out the recommendations for stakeholders, the government, and Non-Governmental Organizations. The CWD is a threatened species in Hong Kong and their population has been declining drastically. The general public has some, but not much knowledge of the problems the CWD face; however the majority of the public are willing to participate in protecting the CWD. Many marine vessels contribute to the decline of the CWD by traveling at high speeds within the CWD habitat. Fishermen and private tour companies are mostly willing to adjust routes and speeds to minimize their impact on the CWD. Ferry and shipping companies may be less willing to voluntarily make route and speed adjustments and would need legislation enacted to make changes in their current practices. The Hong Kong Government is aware of the problems affecting the CWD and has been implementing programs to help with dolphin conservation, but it needs assistance from companies and the public to make the programs successful.

5.2 Recommendation for Stakeholders

It is important that we recommend feasible solutions to stakeholders, such as ferry companies, as their business activities have a direct impact on the habitat of the CWD. We believe that the following recommendations should be implemented:

- Tour boats and Ferry companies should add a small surcharge of about 10 HKD on ticket prices to be donated to CWD conservation efforts and research organizations.
- High Speed Ferries should redirect their routes to avoid the core CWD habitats.
- All stakeholders should reduce the speed of their vessels to between 10 and 15 knots either within the core CWD habitat or upon seeing a CWD.
- CWD tour boats should remain in compliance with the AFCD's code of conduct for dolphin watching activities.

5.3 Recommendation for the Hong Kong SAR Government

The Hong Kong SAR Government has the potential to have a great role in lessening the impact marine traffic has on the CWD. The following is what we believe the government could do:

- Implement a mandatory education program about the CWD for anyone requesting a permit to fish in MPAs. This program would teach local fishermen about the CWD and how the species is impacted by marine traffic and teach them what measures should be taken if they see a CWD.
- Create a 15 knot speed limit within the core CWD habitats and implement a system to ensure no vessels go above the speed limit by displaying the speedometer to the passengers.

5.4 Recommendation for Our Sponsor

The WWF Hong Kong has played a big role in marine conservation, and it is our hope that the following recommendations can aid them in their current conservation efforts of the CWD.

- Increase public awareness by:

    - Advertising the importance of the CWD in the MTR and other public venues.
    - Teaching children about the CWD in schools. This can also be done by funding field trips for the students to visit Tai O where they can go on a dolphin-watch tour led by a local company that has been educated about the CWD.
    - Collaborating with local universities to promote awareness and inform people what they can do to help the CWD.
- Collaborate with private tour companies to have a ticket surcharge donated to CWD conservation efforts.
- Develop a phone application that allows users to see where dolphin habitats are and learn facts about the dolphin, which also gives users the opportunity to aid in the CWD conservation.

5.5 Summary

Through our research, we assessed the feasibility of decreasing the impact of marine traffic on the CWD in Hong Kong's waters. We hope that WWF Hong Kong can use our findings to advocate with the government and other relevant stakeholders to help reduce the impact of marine traffic on CWD. We believe that these recommendations will aid in easing the dangers of marine traffic contributing to the decline in the Chinese white dolphin population. By increasing the public's awareness of the problems the CWD face, we hope that they understand the CWD's importance and actively support their conservation. It is our hope that through accordance with our recommendations, marine traffic will have less of an impact on the dolphin's habitat and the population of the CWD will increase over the next few years; continuing to flourish in the Pearl River Estuary.

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Appendix A: Sponsor Description

The WWF (World Wide Fund for Nature), formerly the World Wildlife Fund, is a global non-profit organization that was founded in 1961 (WWF Hong Kong, 2015g). As an organization, the WWF strives to stop the degradation of the planet's natural environment and build a future in which humans live in harmony with nature, by conserving the world's biological diversity, ensuring that the use of renewable natural resources is sustainable, and promoting the reduction of pollution and wasteful consumption.

WWF Hong Kong (2015g) was inaugurated into the World Wide Fund for Nature in 1981. There are currently 90 employees in the Hong Kong branch. This branch is run by an executive council, with Edward Ho as the Chairman. The Hong Kong branch of WWF, as well as the organization globally, is supported by donations. These donations come from individuals, Hong Kong's corporate sector, and the community through public events. In addition, WWF is supported by the Panda Shop online store and through membership (WWF Hong Kong, 2015h). In Hong Kong, the WWF is focused mainly on conservation and education. Other chapters of the WWF (in different locations) have worked with communities to help protect various species of dolphins, including the Irrawaddy Dolphin in Southeast Asia. WWF has been known to spread awareness about endangered species, which is what is being done by WWF Hong Kong for the Chinese white dolphin (CWD).

WWF Hong Kong (2015b) has been actively seeking to protect the CWD in recent years after a dramatic decline in the species' population. In addition to WWF Hong Kong, other organizations have identified the Chinese white dolphin as an important species to protect and have been striving towards that goal. Some of these groups include: the Hong Kong Dolphin Conservation Society, Hong Kong DolphinWatch Ltd., and the Agriculture, Fisheries and

Conservation Department (Hong Kong Dolphin Conservation Society, 2015) . These groups are able to provide a full scope of the problem as they have been involved in the conservation initiative since its start. Our sponsor at WWF has firsthand knowledge of the stakeholders involved in the problem as well as details that are often not reported on in research journals.

Appendix B: Interview Transcript with Amy Knowlton

Interview Transcript: Interview by Telephone 4:14 - 4:38 pm December 2, 2015 Tech Suite 112A

Amy: Hello

Giselle: Hello Ms. Knowlton

Giselle: I just wanted to introduce everyone in the group *greetings exchanged*

Giselle: We just have a few questions that we wanted to ask you. Professor Peet and Professor McWeeny had mentioned you to be a good resource. First of all, can you describe some of the work you've done with the Right Whales?

Amy: Focused on studying North Atlantic Right Whale, about 500 left in the population. They are impacted by vessel strikes and fishing gear entanglements. In the 90's when vessel strikes were happening frequently, studied marine policy and focused on shipping policies to understand international maritime organization about how ships are regulated in the ocean. Hosted workshop in 1997 for stakeholders (shipping companies, researches, etc.) to talk about the issue and ways to address it. This went on for a few years. In 2001, submitted recommendation to national marine fishing services to make these recommendations into regulations. These regulations included reduced speed of 10 knots or less and rerouting measures whenever feasible. These two approaches have been put in place and drastically reduced the number of impacts.

Also focused on entanglement levels (frequency and severity). Severity has been showing an increase. The ropes removed show clear patterns that smaller whale species/younger whales are in lower strength breaking ropes.

Office at New England Aquarium also curates photo IDs for Right Whale to monitor the population.

Giselle: In terms of reducing boat speed, how many whales were affected before the reduction?

Amy: (Paper will be sent), average of 2-3 per year. The reduced speed regulation went into effect in 2008 (there was a 5 year clause that if the rule didn't make a difference, they would go back to original rules), however, the rule proved to be effective.

Giselle: When you were studying the Right Whale, did you notice any changes in terms of their behavior towards marine traffic?

Amy: There was a reduction in the number of strikes/mortality, no good sense of behavior around vessels, reduced speed allows for better chance of escaping vessel. No studies were done to specifically investigate the behavior of the Right Whale with marine traffic.

Caitlin: When working on the speed reductions, what were the reactions of stakeholders?

Amy: Stakeholders were not too happy about speed restrictions initially. The most concerned groups were fishery companies and the Port Authority. In order to not single out a particular port, the speed restriction was applied to all of the east coast. This is also helpful because the whales will migrate along the entire coast instead of staying up north. Currently, there have been no major pushbacks to get rid of rules.

Giselle: What was the impact of the boats and vessels within the Right Whale habitat?

Amy: Ships are now 4-5 miles away from the habitat, reduces noise impacts (hard to measure)

Giselle: You mentioned the speed changes and the re-routings. Have you noticed any people that do not follow these laws?

Amy: Yes, national fishery service monitors through AIS (transmitting device). This allows them to monitor vessel names and speeds. It is required that all vessels have this transmitting device. The NFS can issue violation notices to the ships (fines can be issued if rules violated more than once) however over time, violation of rules has gone.

Yejee: Could you tell us how the noise problem can be handled?

Amy: I did not specifically investigate this, but people are currently trying to understand how whales communicate over great noise levels. There are ways to build ships to reduce sound output (changes to propeller or hull) efforts by international maritime organization, in addition to noise, seismic noise from offshore construction and drilling (these noises are louder than ship noises)

Giselle: That’s all the questions that we have for you, thank you so much for talking with us and giving us some very helpful information.

Amy: Dr. McWeeny sent literature on the Chinese White Dolphin. What will you be doing there?

Giselle: *description of project along with problem statement and objectives*

Amy: I believe it is important to find a way to coexist with the animals. If you have any additional questions, feel free to call me again. Good luck! Good-bye, have a good day.

Giselle: Good-bye, have a good day.

Appendix C1: Interview Protocol for Companies

We are Worcester Polytechnic Institute students and we are conducting the following interview for a school project. Thank you for your time and help.
我們是來自 Worcester Polytechnic Institute 的學生，現正進行一項問卷調查。盼望您能撥冗接受此項調查，謝謝您的幫忙。

Instructions: This interview investigates various companies' awareness of the Chinese White Dolphins and willingness towards helping their conservation. Please read each question and provide an answer by circling a number, checking a box, or writing in the comments section to the right of corresponding questions. This interview's responses will be kept anonymous, Please answer each question as honestly as possible.

Demographic		
1	Occupation:	
	Work experience in the field:	
Company Background		
2	Please tell us about your company	Comments:
	How many vessels does your company own?	
	How many trips per day does each vessel take?	
	How many different routes do your vessels take? What areas do your boats travel through? (please mark on map)	
	During what times of the day do your vessels operate?	
	How frequently do the vessels pass through the Western and Southern waters of Lantau?	
	Will the number of trips you take per day be affected by the Hong Kong – Zhuhai – Macao bridge once it is built?	

	What are your future plans for the company (for example, how many additional routes do you plan to have in the next 5-10 years, how many vessels to you plan to add, etc.)?	
Awareness of Chinese White Dolphin Conservation		
3	On a scale of 1 to 5 how much do you know about the problems that the Chinese White Dolphin is currently facing (please specify the problem)? 1 2 3 4 5 Not very much Very much	
	On a scale of 1 to 5, do you agree that high vessel speed is one of the factors to pose a disturbance towards the travelling or other activities of the Chinese White Dolphin? 1 2 3 4 5 Do not agree Strongly agree	
	On a scale of 1 to 5, do you agree that marine traffic creates underwater noise pollution that affects the Chinese White Dolphin? 1 2 3 4 5 Do not agree Strongly agree	
4	On a scale of 1 to 5, how important is the Chinese White Dolphin to you? 1 2 3 4 5 Not very much Very much	
5	On a scale of 1 to 5, how often have you seen a Chinese White Dolphin while operating your vessel (if you have personally operated the vessels or know the situation)? 1 2 3 4 5 Not very often Very often	
	How close was your vessel to the spotted Chinese White Dolphins? ☐< 500 m ☐500 m – 1 km ☐> 1 km	

	Do you often encounter Chinese White Dolphins following your vessels (if applicable)?	
6	On a scale of 1 to 5, how important is the Chinese White Dolphin to the environment? 1 2 3 4 5 Not very much Very much	
	On a scale of 1 to 5, how important is the Chinese White Dolphin to the success of your company? 1 2 3 4 5 Not very much Very much	
Willingness to aid in Chinese White Dolphin Conservation		
7	What are your thoughts on taking a longer route to your destination/to fish (seasonally, during the productive seasons in summer or periodically, during the peak periods) in order to avoid core habitats of Chinese White Dolphin?	Comments:
	On a scale of 1 to 5, how willing would you be to take a longer route if it is voluntary? 1 2 3 4 5 Not willing Very willing If it is compulsory? 1 2 3 4 5 Not willing Very willing	
	On a scale of 1 to 5, do you think a longer route for dolphin conservation (example: occasionally) would further improve the image of your company? 1 2 3 4 5 Do not agree Strongly agree	

	On a scale of 1 to 5, do you think a changed route for dolphin conservation (example: occasionally) would further improve the image of your company? 1 2 3 4 5 Do not agree Strongly agree	
	If willing, by how much longer are you willing to increase the time of your trips? ☐10 minutes ☐20 minutes ☐30 minutes ☐1 hour ☐more than an hour	
	On a scale of 1 to 5, do you think creating a longer or different route for dolphin conservation would be a long process upon the management team's decision? 1 2 3 4 5 Do not agree Strongly agree	
	On a scale of 1 to 5, do you think a longer or different route for dolphin conservation would reduce the company's gross profits significantly? (example: less cost effective) 1 2 3 4 5 Do not agree Strongly agree	
	On a scale of 1 to 5, do you think a longer or different route for dolphin conservation would be supported by the customers? (if applicable) 1 2 3 4 5 Do not agree Strongly agree	
8	What are your thoughts on reducing speed limits for all vessels in order to help the Chinese White Dolphin?	Comments:
	On a scale of 1 to 5, do you think reducing speed for dolphin conservation would be supported by the customers? (if applicable) 1 2 3 4 5 Do not agree Strongly agree	

	On a scale of 1 to 5, do you think reducing speed for dolphin conservation would improve the image of your company? 1 2 3 4 5 Do not agree Strongly agree	
	On a scale of 1 to 5, do you think reducing speed for dolphin conservation would reduce the company's gross profit significantly? (example: less cost effective) 1 2 3 4 5 Do not agree Strongly agree	
	On a scale of 1 to 5, how willing would you be to follow reduced speed limits within the dolphin habitat if it were voluntary? 1 2 3 4 5 Not willing Very willing If it were compulsory? 1 2 3 4 5 Not willing Very willing	
	On a scale of 1 to 5, do you think posting information about Chinese White Dolphin on your company's vessels would further improve the image of your company? 1 2 3 4 5 Do not agree Strongly agree	
	On a scale of 1 to 5, do you think reducing speed for dolphin conservation would be a long process for the management team? 1 2 3 4 5 Do not agree Strongly agree	
	Overall, do you think reducing speed of vessels is feasible in the dolphin habitat? Why or why not?	Comments:

9	What are your thoughts on adding a surcharge to fares and donating that portion to the Chinese White Dolphin conservation effort?	Comments:
	On a scale of 1 to 5, how willing would you be to add this surcharge? 1 2 3 4 5 Not willing Very willing	
10	Would you be interested to know the results of the overall survey? ☐Yes ☐No	

Thank you for participating in this interview.

Day after Interview:
Email a thank you note.
Dear ___,
We deeply appreciate you taking the time to meet with us. Talking with you was a pleasure. We now have a better understanding of _____. (if person was interested in learning our results) Once our research is complete, we will send you a copy of our results. Should we have any further questions, would it be possible to speak with you again? We look forward to keeping in contact with you.

Sincerely,
Amanda Agdeppa, Caitlin Burner, Yejee Choi, and Giselle Verbera

Appendix C2: Interview with Ferry Company

Occupation: Corporate Communications, over 5 years' experience
Vessels: 15 vessels, 146 sailings on weekdays, 132 sailings on weekends
Routes:

Awareness of Chinese White Dolphin Conservation:
Knowledge of Problems: 3
High Speed Vessels disturbing CWD: 3
Marine Traffic creates underwater noise pollution: 3
Importance of CWD to company: 3
Importance of CWD to environment: 3
Importance of CWD to success of company: 3
Thoughts on taking a longer route to avoid core CWD habitats: Depends on the ferry license devised by the Transport Department

Willingness to aid in Chinese White Dolphin Conservation:
Reducing speed supported by customers: 3
Reducing speed improving company image: 3
Reducing speed hurting company's gross profit: 3
Willingness to follow reduced speed limits: 3
If posting information about CWD would improve company image: 3
Reducing speed a long process for management team: 3
Is reducing speed feasible?: Neutral
Opinion on adding a surcharge: Neutral
Willingness to add surcharge: 3

Appendix C3: Interview with Hong Kong Dolphinwatch Ltd.

Occupation: Tour Guide

Work Experience in Field: Started in 1997 (approximately 18.5 years). Saw an ad in the newspaper for Japanese/English speaker and applied for position. Knew a little about the CWD due to handover in 1997.

Company background: Company founded with the intention of raising awareness about the CWD. It would also be good for the local economy. The company depends on tourism for subsidization. The company also willingly cooperates with many research programs and organizations.

Vessels: 1 boat, operates Wednesday, Friday, and Sunday, one trip per day that lasts about half the day

Routes: Main route from Tung Chung to Tai O and stays fairly near the coast. The other route is in the northern CWD habitat near the MPA (but currently it is rarely taken)

Number of trips per day affected by Hong Kong-Zhuhai-Macao bridge: No

Awareness of Chinese White Dolphin Conservation
Knowledge of Problems: 5
Vessel speed affecting CWD: 5
Marine traffic creating underwater noise pollution: 5
Importance of CWD to company: 5
Frequency of CWD sightings: 5
Distance from vessel to CWD: >500 m

Importance of CWD to environment: 5 ,CWD are very important to the environment as they are the main predators. Predators are a good indication of the state of the environment because they're at the top of the food chain. For example, the dolphins are very affected by the heavy metal toxins. This is because the prey they eat are also affected by the toxins. The effects that the bottom of the food change experience are concentrated as you move up the food chain to the top predator. Moreover, the top predators are good indicators of the ecosystem. If the top predators lack food, then everything else in the food chain lacks food.

Importance of CWD to the success of company: 5

Thoughts on reduced speed limit: Reducing the speed has been tried before in the MPA. However it was not effective. Some of the ferry routes cut through the MPA and the companies refused to follow the reduced speed. In response to this, the government cut out a chunk of the MPA to accommodate the ferry routes.

Posting information about CWD improve company image: The company has always given out pamphlets for tours to raise awareness about the problems the CWD are facing. In the first 3-4 years of operation, they also handed out surveys/petitions for the government about the CWD conservation.

Is reducing speed of vessels is feasible?: I do not think it is feasible for big companies, especially the ferries that run between HK and China. However, HK specific companies may able to change.

Appendix C4: Interview with Tai O Dolphin-watching Company

Experience in field: 15 years
Vessels: 3, 3-10 trips per day around Tai O from 10:30-17:00
Routes: Always passing through Western and Southern Lantau waters
Number of trips per day affected by Hong Kong-Zhuhai-Macao Bridge: No

Awareness of Chinese White Dolphin Conservation
Knowledge of problems: No problem
High vessel speed causing a disturbance to CWD: 1
Marine traffic causes underwater noise pollution: 1, Dolphins will move away
Importance of CWD to company: 5
Frequency of CWD sightings: very variable
Distance between vessel and CWD: <500 m
Frequency of CWD following vessel: Depends
Importance of CWD to the environment: 5
Importance of CWD to success of company: 5

Willingness to aid in Chinese White Dolphin Conservation
Willing to take longer route to avoid core habitats: Sometimes, yes.
Willingness to take longer route if voluntary: 5
Taking a longer route would improve image of company: 3
Willing to follow reduced speed limit if voluntary: 4
Posting information about CWD would improve image of company: 4
Thoughts on adding a surcharge that would be donated to CWD conservation efforts: If it does not impact business, then it is good.
Willingness to add surcharge: 3

Appendix D1: Interview Protocol for Boat Owners

We are Worcester Polytechnic Institute students and we are conducting the following interview for a school project. Thank you for your time and help.
我們是來自 Worcester Polytechnic Institute 的學生，現正進行一項問卷調查。盼望您能撥冗接受此項調查，謝謝您的幫忙。

Instructions: This interview investigates the boat owner's awareness and willingness towards conserving the Chinese White Dolphins. Please read each question and provide an answer by circling a number, checking a box, or writing in the comments section to the right of corresponding questions. The answers to this interview are anonymous, so please answer each question as honestly as possible.

背景：此問卷研究船隻持有人對保育中華白海豚的意識和意願。請閱讀每一條問題，及以圈出數字、在方格內標記號或書寫在意見部分提供答案。此問卷是不記名的，請儘量如實地回答每一條問題。

Demographic個人資料		
1	Occupation (職業):	
	Work experience in the field (在此行業的工作經驗):	
Personal Background個人背景		
2	Please tell us about yourself 請介紹自己	Comments: 意見:
	How long have you owned your boat? 你擁有了自己的船隻有多久?	
	Do other people co-own the boat with you? 你有否與別人一起共同擁有船隻?	
	What type of boat do you own? 你擁有的船隻是什麼種類的?	
	How often do you use your boat? 你有多經常使用你的船隻?	
	What do you use your boat for? 你用你的船隻來做什麼?	

	Where are the most common areas you travel with your boat? (please mark on map) 你通常在哪裡使用你的船隻?(請在地圖上畫上記號)	
	On average, what speed do you operate your boat at? 你會以平均什麼速度來行駛你的船隻呢?	
	Do you use your boat for recreation, or is it for travel? 你會使用你的船隻來作娛樂或旅遊用途嗎?	
	Is your boat used in place of the ferry? 你會把你的船隻接載客人去目的地嗎?	
Awareness of Chinese White Dolphin Conservation **對保育中華白海豚的意識**		
3	On a scale of 1 to 5 how much do you know about the problems that the Chinese White Dolphins are currently facing? 依5, 4, 3, 2, 1 給分(以5為最高分)，你認為你有多認識現時中華白海豚所面對的問題呢? 1 2 3 4 5 Not very much 非常不認識 Very much 非常認識	
	On a scale of 1 to 5, do you agree that vessel speed is one of the factors to pose a disturbance towards the travelling or other activities of the Chinese White Dolphins? 依5, 4, 3, 2, 1 給分(以5為最高分)，你是否同意船速是其中一個影響中華白海豚游動或**進行**其他活動的因素呢? 1 2 3 4 5 Do not agree 非常不同意 Strongly agree 非常同意	

	On a scale of 1 to 5, do you agree that busy marine traffic is one of the factors that affect the Chinese White Dolphins by creating underwater noise pollution? 依5, 4, 3, 2, 1 給分(以5為最高分)，你是否同意海上忙碌的交通造成的**海底**噪音**污染**是其中一個影響中華白海豚的因素呢**?** 1 2 3 4 5 Do not agree Strongly agree 非常不同意 非常同意	
4	On a scale of 1 to 5, how important is the Chinese White Dolphin to you? 依5, 4, 3, 2, 1 給分(以5為最高分)，你認為中華白海豚對你來說有多重要? 1 2 3 4 5 Not very much Very much 非常不重要 非常重要	
5	On a scale of 1 to 5, how often have you seen a Chinese White Dolphin while operating your vessel? 依5, 4, 3, 2, 1 給分(以5為最高分)，當你在駕駛你的船隻時，你有多經常見中華白海豚呢? 1 2 3 4 5 Not very often Very often 非常不常見 非常常見	
	How close was your vessel to the Chinese White Dolphin? 你的船隻與中華白海豚有多接近(距離)?	Comments: 意見：
	Do you often encounter Chinese White Dolphins following your vessels? 你有多經常見中華白海豚跟隨著你的船隻?	Comments: 意見：
6	On a scale of 1 to 5, how important is the Chinese White Dolphin to the environment? 依5, 4, 3, 2, 1 給分(以5為最高分)，你認為中華白海豚對生態環境來說有多重要? 1 2 3 4 5 Not very much Very much 非常不重要 非常重要	

Willingness to aid in Chinese White Dolphin Conservation		
7	What are your thoughts on taking a longer route to your destination/to fish (seasonally, during the productive seasons in summer or periodically, during the peak periods) in order to avoid core habitats of Chinese White Dolphin? 為了避免阻礙中華白海豚的日常生活，可能需要使用較長的路線才能到達你的目的地(季節性，夏天的旺季或定期，繁忙時間)，你對此安排有什麼意見?	Comments: 意見:
	On a scale of 1 to 5, how willing would you be to alter or change where you normally visit (if it coincides with dolphin habitat)? 依5,4,3,2,1 給分(以5為最高分)，如船隻以往的行駛路線與中華白海豚的棲息處相同，你有多願意改變船隻以往的行駛路線? 1 2 3 4 5 Not willing Very willing 非常不願意 非常願意	
	On a scale of 1 to 5, how willing would you be to take a longer route if it is voluntary? 依5,4,3,2,1 給分(以5為最高分)，如是自願性的，你有多願意使用較長的路線才能到達你的目的地? 1 2 3 4 5 Not willing Very willing 非常不願意 非常願意 If it is compulsory? 如是必須的? 1 2 3 4 5 Not willing Very willing 非常不願意 非常願意	
	If willing, by how much longer are you willing to increase the time of your trips? 如果你願意使用較長的路線才能到達你的目的地，你會願意增加多少時間? ☐10 minutes **十分鐘** ☐20 minutes**二十分鐘** ☐30 minutes **三十分鐘** ☐1 hour**一小時** ☐more than an hour**多於一小時**	

<table>
<tr><td rowspan="5">8</td><td>What are your thoughts on reducing speed limits for all vessels in order to help the Chinese White Dolphin?

為了幫助中華白海豚，你對所有船隻減速行駛有什麼意見?</td><td>Comments:

意見：</td></tr>
<tr><td colspan="2">On a scale of 1 to 5, how willing would you be to follow reduced speed limits within the dolphin habitat if it were voluntary?
依5,4,3,2,1 給分(以5為最高分)，如自願選擇，你有多願意在中華白海豚的棲息處跟隨這些減速限制?

1 2 3 4 5

Not willing Very willing
非常不願意 非常願意
If it is compulsory? 是必須的?

1 2 3 4 5
Not willing Very willing
非常不願意 非常願意</td></tr>
<tr><td colspan="2">On a scale of 1 to 5, do you think reducing speed for dolphin conservation would decrease the amount you traveled in your boat?
依5,4,3,2,1 給分(以5為最高分)，你認為為了保育中華白海豚而減速會否減少你使用你的船隻嗎?
1 2 3 4 5

Do not agree Strongly agree
非常不同意 非常同意</td></tr>
<tr><td>Overall, do you think reducing speed of vessels near the Chinese White Dolphin habitat is feasible?
總的來說，你認為船隻減速行駛可行嗎?</td><td>Comments:
意見：</td></tr>
<tr><td>9</td><td>Have you ever operated your boat in the Sha Chau and Lung Kwu Chau Marine Park?
你有否曾在指定海洋保護區駕駛你的船隻?</td><td>Comments:
意見：</td></tr>
</table>

	If yes, would you be willing to see other areas around Lantau Island become designated MPAs? 如有，你會否願意看到大嶼山附近的地區成為指定海洋保護區?	
	What are your thoughts about MPAs? Do you believe MPAs are an effective way to preserve marine habitats? 你對海洋保護區有什麼意見?	Comments: 意見：
10	Would you be interested to know the results of the overall survey? 你會否有興趣知道這次問卷調查整體的結果?	Comments 意見：

Thank you for participating in this interview.

謝謝你的參與

Day after Interview:
Email a thank you note.
Dear ___,
We deeply appreciate you taking the time to meet with us. Talking with you was a pleasure. We now have a better understanding of _____. (if person was interested in learning our results) Once our research is complete, we will send you a copy of our results. Should we have any further questions, would it be possible to speak with you again? We look forward to keeping in contact with you.

Sincerely,
Amanda Agdeppa, Caitlin Burner, Yejee Choi, and Giselle Verbera

Appendix D2: Interviews with Boat Owners

Interview 1:
Occupation: Fisherman
Experience in the Field: 30 years
Boat: Owned for 20 years, fishing/speed boat, used 5 times a week for fishing
Locations of Travel in boat: Fan Lau, Tai O
Average boat speed: 20 knots
Boat used in place of ferry: No

Awareness of Chinese White Dolphin Conservation:
Knowledge of Problems: 5
Importance of CWD to individual: 1
Frequency of CWD sightings: 4
Distance between boat and CWD: 100 meters
Frequency of CWD following vessel: 20%
Importance of CWD to environment: 4

Willingness to aid in Chinese White Dolphin Conservation:
Taking a longer route to avoid core habitat: No objections
Willingness to alter normal route/locations visited: 5
Willing to take longer route if voluntary: 5
Willing to take longer route if compulsory: N/A, we do not know/cannot tell where dolphins are
Thoughts on reducing vessel speed: Accept the idea, but there is no big difference.
Willing to follow reduced speed limit if voluntary: 5
Is reducing speed of vessels near the CWD habitat feasible: Ok
Operated vessel in Sha Chau and Lung Kwu Chau Marine Park: Yes, he had a fishing permit in the past so he would fish inside the park
Thoughts on MPAs? Are MPAs effective in preserving marine habitats?: Fishing is not allowed, but if it is allowed, MPA is ok.

Interview 2:
Occupation: Fishermen
Experience in the Field: 35 years
Boat: Owned for 20 years, fishing vessel, used about 3 times a week for fishing or recreation
Locations of Travel in boat: Tai O, Lung Kwu Chau, Soko Islands
Average boat speed: 20-30 knots
Boat used in place of ferry: Yes

Awareness of Chinese White Dolphin Conservation:
Knowledge of Problems: 5
Vessel speed affecting CWD: 3
Marine Traffic affecting CWD through noise pollution: 1 (they are used to it)
Importance of CWD to individual: 3
Frequency of CWD sightings: 4
Distance between boat and CWD: 50 meters
Frequency of CWD following vessel: 30%
Importance of CWD to environment: 3

Willingness to aid in Chinese White Dolphin Conservation:
Taking a longer route to avoid core habitat: Agree, keep distance from the dolphins
Willingness to alter normal route/locations visited: 5 (not good for fishing, avoid net/gear entanglement)
Willing to take longer route if voluntary: 5
Willing to take longer route if compulsory: 1
How much longer are you willing to increase the time of trips: 3 min due to close distance of Tai O to open water
Thoughts on reducing vessel speed: At dolphin's presence
Willing to follow reduced speed limit if voluntary: 5
Reducing speed would decrease the amount the boat is used: 1
Is reducing speed of vessels near the CWD habitat feasible: No, it is difficult because 10 knots is very slow
Operated vessel in Sha Chau and Lung Kwu Chau Marine Park: Yes
Would you be willing to see more MPAs around Lantau Island?: No
Thoughts on MPAs? Are MPAs effective in preserving marine habitats?: No fishing is allowed which is nonsense for fishermen.

Appendix E1: Interview Questionnaire for the Government and Non-Government Organizations

We are Worcester Polytechnic Institute students and we are conducting the following interview for a school project. Thank you for your time and help.
我們是來自 Worcester Polytechnic Institute 的學生，現正進行一項問卷調查。盼望您能撥冗接受此項調查，謝謝您的幫忙。

Instructions: This interview investigates the government's awareness and willingness towards conserving the Chinese White Dolphins. Please read each question and provide an answer by circling a number, checking a box, or writing in the Comments section to the right of corresponding questions. This interview's responses are anonymous. Please answer each question as honestly as possible.

Demographic		
1	Occupation:	
	Work experience in the field:	
Personal Background		
2	Please tell us about yourself	Comments:
	How long have you worked in your department?	
	Tell us about your involvement with the Chinese White Dolphin so far?	

Awareness of Chinese White Dolphin Conservation		
4	On a scale of 1 to 5, how important do you think the Chinese White Dolphins are? 1 2 3 4 5 Not very much Very much	
6	On a scale of 1 to 5, how important is the Chinese White Dolphin to the environment? 1 2 3 4 5 Not very much Very much	
Willingness to aid in Chinese White Dolphin Conservation		
7	How many times have WWF and/or other private or non-government organizations contacted you about concerns about the Chinese White Dolphin? How did you address their concerns?	Comments:
8	On a scale of 1 to 5, how effective do you think the current rules and regulations regarding marine parks are in protecting the Chinese White Dolphins? 1 2 3 4 5 Not very effective Very effective	
	Do you have any suggestions for how rules and regulations could be improved to conserve Chinese White Dolphins?	Comments:
	What monitoring systems have been implemented to see if regulations are being followed?	

9	What are your thoughts on reducing speed limits for all vessels within the dolphin habitat in order to help the Chinese White Dolphins?	Comments:
	Do you think that citizens will obey this regulation or agree to follow it?	
10	Do you think that there needs to be a change of any sort to help conserve the remaining population of the Chinese White Dolphins?	Comments:
11	What do you think about posing more measures in alleviating impacts from marine traffic to Chinese White Dolphins in Hong Kong? E.g. speed restriction zone, no-go zone, re-routing	Comments:
	How likely do you think that these measures could be successfully implemented in Hong Kong? What do you think would need to happen for it to be successful?	

Thank you for participating in this interview.

<u>Day after Interview:</u>
Email a thank you note.
Dear ___,
We deeply appreciate you taking the time to meet with us. Talking with you was a pleasure. We now have a better understanding of _____. (if person was interested in learning our results) Once our research is complete, we will send you a copy of our results. Should we have any further questions, would it be possible to speak with you again? We look forward to keeping in contact with you.

Sincerely,
Amanda Agdeppa, Caitlin Burner, Yejee Choi, and Giselle Verbera

Appendix E2: Interview with Non-Government Organization (1)

Occupation: Research assistant and committee member

Involvement with CWD: Collecting field data of CWD in Hong Kong from boat survey, land-based and aerial observation (few days per week) in order monitor the ecology, status, abundance, distribution and individual home range of the dolphins in long-term. Raising public awareness of CWD through public and school seminars, exhibitions, publications and dolphin-watching trips.

Awareness of Chinese White Dolphin Conservation:
Importance to organization: 5
Importance to environment: 5

Willingness to aid in Chinese White Dolphin Conservation:
Have you been contacted by WWF or other organizations about the CWD: Yes, provided specialized knowledge on dolphin conservation eg. how dolphins threatened by construction work and marine traffic etc. Sometimes wrote joint signatures letter about the common concerns on dolphin conservation and submitted to corresponding departments.

Effectiveness of Marine Parks: 2

Suggestions for improving rules and regulations: One of the existing regulations protecting dolphins in HK is the EIA Ordinance. It helps to avoid, minimize and control the adverse impact on dolphins of designated project through the application of the environmental impact assessment process and the environmental permit system. However, the major problems of the current EIA mechanism include:

1. Environmental consultants conducting EIAs are paid by project proponents, thus the independence of EIAs is doubtable;
2. Event and Action Plan for the post-construction dolphin monitoring could not meet the purpose of controlling the significant downward trend of dolphin numbers after triggering the action level or limited level;
3. Compensation for dolphin i.e. marine park after construction work;
4. Cumulative impact assessment for dolphin ecology is not comprehensive enough as it contains only general qualitative synopsis and some proposed developments are being left out for impact assessment;
5. Project proponents are able to apply the Variation of Environmental Permits that issued by director of EPD without public inspection over and over again to change the terms of the permits which can be unfavorable for protecting dolphins.

Our suggestions are as below:

1. A statutory authority should hire its own environmental consultants to conduct EIAs so that the dolphin impact assessment could be independent from the project proponents;
2. Additional mitigation measures such as controlling or temporarily stopping relevant construction activity for the recovery of the dolphin habitat should be taken into deep consideration but not mere paper talk;
3. Compensations for dolphin habitat should be done before or during construction period;
4. Cumulative impact assessment should be done in a quantitative manner, such as using comprehensive habitat modeling or population viability analysis to contemplate the cumulative ecological impacts on dolphins; while all other existing, committed and proposed developments should be assessed for the cumulative impact assessment;
5. Public inspection should be allowed before the Variation of Environmental Permits being issued.

Monitoring systems implemented to ensure regulations are obeyed: Environmental Monitoring and Audit Manual is implemented to ensure compliance with the recommendations in the EIA study, to assess the effectiveness of the recommended mitigation measures and to identify any further need for additional mitigation measures or remedial action.

Thoughts on reducing vessel speed in CWD habitat: The higher speed is the vessel, the higher frequency it produces. Reducing speed limit to 10 knots that applied to all marine parks in Hong Kong will lower down the risk of vessel collision. However, marine traffic impact to dolphins is not limited to high speed. Low frequency of underwater sound and high intensity of vessels within the dolphin habitat can greatly affect the foraging abilities and displace dolphins away from their favorable area. Therefore, reducing speed limits is good for dolphins but re-routing vessel traffic esp. high-speed ferry from dolphin habitat will be much more effective to protect them.

Will citizens obey new regulations?: Education and public awareness will help the citizens to involve in dolphin conservation and follow the regulations.

Any changes to help conserve the CWD population: The marine construction work in dolphin habitat is too frequent these years without effective mitigation measures for their impacts to dolphins. The government should establish more marine protected areas to enhance the carrying capacity of dolphins in Hong Kong waters before those construction work. Besides, EPD should take precautionary principle into account when assessing the impacts to dolphins and not issue the Environmental Permit without careful consideration.

Additional measures in alleviating impacts of marine traffic: Marine traffic has been posing a great threat to dolphins and there is the need for more measures including speed restriction zone esp. in dolphin hotspots for dolphin-watching vessels and other high-speed vessels, no-go zone in core habitats and re-routing esp. high-speed ferries and high-intensity construction boats.

Could these measures be successfully implemented in Hong Kong?: It is not likely that the measures will be implemented in the near future. Vessel operators need to bear the corporate social responsibility to protect the dolphins on top of doing their own business. The government needs to speed up in conducting the marine traffic impact assessment and starting the legislation procedure as well as urging the vessel operators to reduce the impact to dolphins.

Appendix E3: Interview with Non-Government Organization (2)

Occupation: Ph.D. Candidate

Involvement with CWD: I have been participating in field research in several countries on marine mammals. I have also been demonstrating some classroom and field based courses. I am now conducting my own research on Chinese White Dolphin. I have been participating in stranding response team; participating in several researches on Chinese White Dolphin in Pearl River Delta where 2 of them are mainly conducted by myself.

Awareness of Chinese White Dolphin Conservation:

Importance to organization: 5

Importance to environment: 4

Willingness to aid in Chinese White Dolphin Conservation:

Have you been contacted by WWF or other organizations about the CWD: About 5 times. Usually not me in person but my team as a whole where I am involved in responding to their questions / concerns. I applied my scientific experiences and knowledge / information from my connections to provide them with my scientific comments and my concerns about what they suggest or propose.

Effectiveness of Marine Parks: 2

Suggestions for improving rules and regulations: First, the current rules and regulations are outdated and needed to be revised with updated scientific information and standards. Second, the resources allocated for management and enforcement of these rules and regulations need to be increased in a great proportion and monitored to make sure the objectives of the regulations are met effectively.

Monitoring systems implemented to ensure regulations are obeyed: There are routine check-ups and management by the government. The government has also constant and ad-hoc suggestions or comments on the regulations received from their expert panel. Responses from public are sometimes considered by the management authority.

Thoughts on reducing vessel speed in CWD habitat: The definition of the dolphin's habitat and the effectiveness of speed limit as conservation tool in practice have to been agreed within the scientific community as well as the government. I believe this tool is effective and needed in the case of Chinese White Dolphin in Pearl River Delta.

Will citizens obey new regulations?: Certainly most will agree with the regulation but following or not depends very much on how the implementation will be introduced and enforced.

Any changes to help conserve the CWD population: Yes. I think there is enough information and resources to do way much better to the conservation of the dolphins then it is. What have to be changed are the process to make the best informed decision by the management authority and the allocation of the dispersed resources currently available to the conservation community.

Additional measures in alleviating impacts of marine traffic: I think it is essential for these measures to be put in place asap.

Could these measures be successfully implemented in Hong Kong?: With the experiences from other countries it would be optimistic but I am afraid the local authority has to make a big change before those experiences can be followed. The big change is to prioritize the need of conserving Chinese White Dolphin over the difficulties to achieve so.

Appendix E4: Interview with Non-Government Organization (3)

Occupation: Assistant Manager, Scientific Projects

Involvement with CWD: Our company provides funding to CWD researchers in Asia, with a main focus in the CWD in Chinese waters and especially to the population in the Pearl River Estuary. We have been investigating marine mammal stranding in HK since May 2006.

Awareness of Chinese white dolphin Conservation:
Importance to organization: 5
Importance to environment: 5

Willingness to aid in Chinese white dolphin Conservation:
Have you been contacted by WWF or other organizations about the CWD: We meet with WWF team from time to time in various occasions and initiatives. Their concerns are not directly to us but to the government.

Effectiveness of Marine Parks: 2

Suggestions for improving rules and regulations: No fishing within marine parks, setting up core zones to exclude boats entering, shipping lane re-routing to avoid key CWD habitat.

Monitoring systems implemented to ensure regulations are obeyed: AFCD has a team to patrol the marine parks from Mon-Sun (?) from 9-5 only. There can be stronger patrolling other than these periods.

Thoughts on reducing vessel speed in CWD habitat: Could be helpful, but need enforcement and also reduce number of boats entering that area will be beneficial too.

Will citizens obey new regulations?: Maybe, but it needs enforcement or incentives, or better understanding on their actions taken.

Any changes to help conserve the CWD population: Yes.

Additional measures in alleviating impacts of marine traffic: Agree.

Could these measures be successfully implemented in Hong Kong?: Need a better consultation with the sea-users and solicit their support.

Appendix E5: Interview with Hong Kong Government

Involvement with CWD: The Agriculture, Fisheries and Conservation Department (AFCD) implemented the Conservation Programme for the Chinese white dolphin (CWD) in Hong Kong since 2001. As identified by local studies on CWD biology and ecology, the major threats to the dolphins in Hong Kong includes habitat loss and disturbance, pollution, incidental entanglement in fishing gear, vessel collision and depletion of food resources. Upon review of the available information pertaining to the species and the human factors threatening their long term viability, a four-pronged conservation plan was devised for protecting the dolphins and their habitats in Hong Kong. The four-pronged approach comprises: (a) management, (b) public education, (c) research, and (d) cross-boundary co-operation.

Willingness to aid in Chinese white dolphin Conservation:
Have you been contacted by WWF or other organizations about the CWD: AFCD communicates and liaises with the public and all stakeholders on issues about CWD through different platforms such as public hotline, corresponding committee and working groups, etc.

Suggestions for improving rules and regulations and monitoring systems implemented: There are four marine parks and one marine reserve designated so far in Hong Kong, in which Sha Chau and Lung Kwu Chau Marine Park was designated for the protection of CWD and their habitats. AFCD has uninterruptedly monitored the marine mammals in Hong Kong since 2001, which indicated the continuous utilization of Sha Chau and Lung Kwu Chau Marine Park area by CWD. There are plans to designate new marine parks for conservation of CWD.
On protection of marine resources and ecosystem, the Legislative Council passed the legislative amendments to ban trawling in Hong Kong waters with effect from 31 December 2012. The trawl ban will go a long way in enhancing the food resources and habitats of CWD in Hong Kong.

Thoughts on reducing vessel speed in CWD habitat: Vessel speed is restricted within the marine parks area under the Marine Parks Ordinance (Cap. 476). With respect to the dolphin watching activities, AFCD produces and promotes the code of conduct for dolphin watching. The vessel operators are advised to follow the code of conduct, including to maintain the vessel at low speed during dolphin watching, in order to minimize the disturbance to the CWD. AFCD will continue to seek for practicable measures to reduce the potential threats by marine traffic on local CWD.

Any changes to help conserve the CWD population: AFCD shares the same view with the general public on concern of the observed downward trends in abundance and other potential threats on CWD. On top of the Conservation Programme for CWD, AFCD continues to communicate and seek advice from experts and advisory bodies, and to collaborate with NGOs and researchers, for better conservation measures on CWD. We will continue to do our best within the government ambit in order to help ensure the long term viability of Hong Kong dolphins.

Appendix F1: Public Survey Questionnaire

Public Survey Questionnaire

Instructions: This survey investigates the public's awareness and willingness towards conserving the Chinese White Dolphins. Please read each question and provide an answer by circling a number, checking a box, or writing in the Comments section to the right of the corresponding questions. These survey responses are anonymous. Please answer each question as honestly as possible.

背景：此問卷研究公眾對保育中華白海豚的意識和願意性。請閱讀每一條問題，及以圈出數字、在方格內標記號或書寫在意見部分提供答案。此問卷是不記名的，請儘量如實地回答每一條問題。

Demographic (個人資料)		
1	Age (年齡)：	
	Are you a tourist? (你是遊客嗎?) ☐Yes**是** ☐No**否**	
	Occupation (職業)：	
Awareness of Chinese White Dolphin Conservation (對保育中華白海豚的意識)		
2	On a scale of 1 to 5 (with 5 being very much) how much do you know about the problems that the dolphins are currently facing? 依5,4,3,2,1 給分(以5為最高分)，你認為你有多認識現時中華白海豚所面對的問題呢? 1 Not very much 非常不認識 — 2 — 3 — 4 — 5 Very much 非常認識	
	Please specify what you think is the most serious problem that the Chinese White Dolphins are facing: 請具體說明中華白海豚現正面對最嚴重的威脅:	
3	On a scale of 1 to 5, how important is the Chinese White Dolphin to you? 依5,4,3,2,1 給分(以5為最高分)，你認為中華白海豚對你來說有多重要? 1 Not important 非常不重要 — 2 — 3 — 4 — 5 Very important 非常重要	
Concerned factors and willingness towards Chinese White Dolphin Conservation		
4	What routes do you take when you take the ferry (Specify starting and ending location)? 你選擇的路線的起點站和終點站為何?	Comments: 意見：
	What kind of vessel do you travel in (check all that apply)? 你會使用以下哪種船? ☐High Speed Ferry **高速快船** ☐Ferry **渡輪** ☐Fishing boat **漁船** ☐Personal boat **私人船** ☐Cruise Ship **遊輪** ☐Tour Boat **觀光船** ☐N/A (if checked, skip to Question 6) **不適用 (請跳到第六題)**	

5	On a scale of 1 to 5, would you support taking a longer route to help avoid the Chinese White Dolphin habitat? 依5,4,3,2,1 給分(以5為最高分)，為了避免阻礙中華白海豚的日常生活，你會否支持使用較長的路線才能到達你的目的地? 1 2 3 4 5 Not support 非常不支持 Strongly support 非常支持
	On a scale of 1 to 5, how willing would you be to take a longer route? 依5,4,3,2,1 給分(以5為最高分)，你有多願意使用較長的路線才能到達你的目的地？ 1 2 3 4 5 Not willing 非常不願意 Very willing 非常願意
	If willing, by how much longer are you willing to increase the time of your trips? 如果你願意使用較長的路線才能到達你的目的地，你會願意增加多少時間? ☐10 minutes **十分鐘** ☐20 minutes **二十分鐘** ☐30 minutes **三十分鐘** ☐1 hour **一小時** ☐more than an hour **多於一小時**
6	On a scale of 1 to 5, would you support reducing the speed limit to help the population of the Chinese White Dolphin? 依5,4,3,2,1 給分(以5為最高分)，為了幫助中華白海豚，你會否支持船隻減速行駛? 1 2 3 4 5 Not support 非常不支持 Strongly support 非常支持
	On a scale of 1 to 5, do you think reducing speed for dolphin conservation is necessary? 依5,4,3,2,1 給分(以5為最高分)，你認為船隻減速行駛對保育中華白海豚是必須的嗎? 1 2 3 4 5 Do not agree 非常不同意 Strongly agree 非常同意
	Overall, would you have a problem if the speed limits were reduced? 總的來說，你認為船隻減速行駛可行嗎? ☐Yes**是** ☐No**否**
	Do you believe it would be a good idea to add a modest surcharge to fares and to donate that portion of the fare to the Chinese White Dolphin conservation effort? 你認為徵收少許船票以外的附加費作中華白海豚保育用途是件好事嗎? ☐Yes**是** ☐No**否**
	On a scale of 1 to 5, how willing would you be to pay this surcharge? 依5,4,3,2,1 給分(以5為最高分)，你有多願意付這附加費? 1 2 3 4 5 Not willing 非常不願意 Very willing 非常願意
	Please check the surcharge amount you would be willing to pay (all that apply). 你願意付多少上述的附加費? ☐$0 ☐$5 ☐$10 ☐$20 ☐more than $20 多於$20

Thank you for taking this survey
謝謝你的參與

Appendix F2: Survey of General Public Results

Survey Number	Location surveyed	Date	Age	Hong Kong Native	Occupation	Knowledge of Problems (1-5)	Worst Problem	Importance (1-5)	Routes Taken	Vessel Type	Longer Route (1-5)	Willing to take longer route (1-5)	How much longer (min)	Reduced speed (1-5)	Reducing speed Necessary? (1-5)	Problem with reduced speed	Add surcharge?	Willing to pay surcharge?	Amount surcharge
1	Central Ferry Pier	1/26/16	--	Y	Technical Consultant	3	--	3	--	HSF, FE	3	3	30	3	3	--	--	5	--
2	Central Ferry Pier	1/26/16	17	Y	Student (minor, results not used)	3	--	4		HSF, FE	4	4	60	4	4	--	--	--	
3	Central Ferry Pier	1/26/16	21	Y	Student	3	--	4	--	FE	4	3	20	4	3	--	--	4	
4	Central Ferry Pier	1/26/16	36	Y	--	3	--	3	--	HSF	5	5	60	5	5	--	--	4	
5	Central Ferry Pier	1/26/16	30	Y	Delivery Boy	2	--	5	--	TB	5	5	60+	5	5	--	--	5	
6	Central Ferry Pier	1/28/16	20	N	Student	3	Low Reproduction Rates	1	HK to Macao	HSF	2	1	--	2	3	--	N	1	
7	Central Ferry Pier	1/28/16	21	N	Student	1	Boats/ Ferries	1	HK to Macao	HSF, FE, PB, CS	3	3	30	3	3	Y	--	3	--
8	Central Ferry Pier	1/28/16	20	N	Student	4	Boats/ Ferries	3	--	HSF, FE	4	4	20	4	4	N	--	3	
9	Central Ferry Pier	1/28/16	20	N	Student	4	Boats/ Ferries	1	HK to Macao	HSF	4	4	10	4	4	N	Y	2	
10	Central Ferry Pier	1/28/16	20	N	Student	2	Boats/ Ferries	2	HK to Macao	HSF	4	3	30	3	3	N	Y	4	--
11	Central Ferry Pier	1/28/16	20	N	Student	4	Dying/ Endangered/ Extinction	2	HK to Macao	HSF	3	3	30	--	--	--	--	--	--
12	Central Ferry Pier	1/28/16	20	N	Student	4	--	2	HK to Macao, Central to TST	HSF, FE	3	1	10	5	3	--	--	3	
13	Tai O	1/30/16	--	N	--	2	--	5	--	FE	5	3	60	5	5	Y	Y	5	$20+

14	Tai O	1/30/16	43	N	Housewife	5	Development/ Land Reclamation/Loss of Habitat	5	Cheung Chau	FE	5	5	60	5	5	Y	Y	5	$20+
15	Tai O	1/30/16	28	N	Designer	1	--	4	Sheung Wan	HSF	5	5	60	5	5	Y	Y	5	$20
16	Central Ferry Pier	1/30/16	45	Y	Sales	4	Development/ Land Reclamation/ Loss of Habitat, Water Pollution	4	Central to TST, Wanchai	HSF, FE, TB	4	4	60	4	4	Y	Y	3	$20+
17	Tai O	1/30/16	--	Y	Engineer	2	--	1	Central	FE	5	5	60	5	5	Y	Y	5	$10
18	Tai O	1/30/16	49	Y	Teacher	1	Water Pollution	3	Tung Chung to Tai O	HSP	5	4	30	5	5	Y	Y	5	$20
19	Tai O	1/30/16	47	Y	Accountant	1	--	1	N/A	N/A	--	2	30	4	3	Y	Y	3	$20
20	Tai O	1/30/16	40	N	Editor	2	--	3	--	HSF, FE	3	3	10	3	3	N	N	1	$0
21	Tai O	1/30/16	62	Y	Housewife	2	--	2	Tuen Mun to Tai O	FE	5	5	60	5	5	Y	Y	5	$20
22	Tuen Mun	1/30/16	32	N	Helper	2	Dying/ Endangered/ Extinction	5	N/A	N/A	5	4	30	5	5	N	Y	4	$20+
23	Tai O	1/30/16	24	N	Student	2	Water Pollution	4	Central to TST, Wanchai	FE	5	5	30	5	5	N	Y	4	$10
24	Dolphin Watch Boat	1/31/16	34	N	Human Resources	2	Development/Land Reclamation/Loss of Habitat	3	N/A	FE, TB	5	5	60	5	5	N	Y	5	$20+
25	Dolphin Watch Boat	1/31/16	21	N	Student	2	Development/Land Reclamation/Loss of Habitat	5	N/A	TB	5	5	60+	5	5	N	Y	5	$20+
26	Dolphin Watch Boat	1/31/16	67	N	Retired	4	Water Pollution	4	Central to TST	FE, TB	5	5	10	5	5	N	Y	5	$5
27	Dolphin Watch Boat	1/31/16	29	Y	Kindergarten Teacher	4	Water Pollution	5	Central to TST	FE, PB, TB	4	4	20	4	4	N	Y	3	$5
28	Dolphin Watch Boat	1/31/16	34	N	Account Manager	4	Development/ Land Reclamation/Loss of Habitat	4	Central to TST	FE, TB	2	1	--	4	4	N	N	1	$0
29	Dolphin Watch Boat	1/31/16	21	Y	Manager	5	Water Pollution	3	N/A	TB	3	3	20	3	3	N	Y	3	$20+
30	Dolphin Watch Boat	1/31/16	21	Y	Editor	3	Lack of Concern, Pollution, Development/ Land Reclamation/Loss of Habitat	5	N/A	TB	5	5	60	5	5	N	Y	5	$20
31	Dolphin Watch Boat	1/31/16	35	Y	Physiotherapist	1	Water Pollution	3	--	TB	4	4	30	4	4	N	Y	4	$10

32	Dolphin Watch Boat	1/31/16	58	N	Retiree	2	Development/ Land Reclamation/Loss of Habitat	4	Central to TST	FE,TB	5	4	10	4	4	N	Y	4	$5
33	Dolphin Watch Boat	1/31/16	40	--	Businessman	3	Dying/ Endangered/ Extinction	3	--	TB	3	--	--	--	--	--	--	--	--
34	Dolphin Watch Boat	1/31/16	31	N	Engineer	3	Water Pollution	3	N/A	TB	5	5	30	4	4	N	Y	5	$10
35	Dolphin Watch Boat	1/31/16	39	N	Surgeon	1	Water Pollution, Development/ Land Reclamation/Loss of Habitat	3	--	TB	3	4	20	5	4	N	N	4	$5
36	Dolphin Watch Boat	1/31/16	26	Y	Journalist	5	Development/Land Reclamation/Loss of Habitat	5	Central to TST, Islands, Shengwan to Macau	HSF, FE, TB, PB	5	5	30	5	5	N	Y	5	$20+
37	Dolphin Watch Boat	1/31/16	40+	Y	Banker	3	Development/ Land Reclamation/ Loss of Habitat, Dying Endangered/ Extinction	5	--	HSF, TB	4	3	20	3	3	N	Y	5	$20+
38	Dolphin Watch Boat	1/31/16	32	N	Beautician	2	Water Pollution	5	Tung Chung	FE, TB	3	3	10	4	4	Y	Y	2	$20
39	Dolphin Watch Boat	1/31/16	28	Y	--	3	Water Pollution	3	HK to Macao, Central to TST	HSF, FE, TB	5	5	60	5	3	N	Y	5	$20
40	Dolphin Watch Boat	1/31/16	35	Y	Journalist	2	Water Pollution	4	HK to Macao	TB, HSF, FE	5	5	20	5	4	N	Y	5	$20+
41	Dolphin Watch Boat	1/31/16	39	Y	--	3	Water Pollution	3	Central to TST	TB	5	4	30	5	3	Y	Y	3	$20
42	Dolphin Watch Boat	1/31/16	42	N	Project Manager	3	Water Pollution	4	Tung Chung to Tai O	TB	2	2	20	4	4	Y	Y	4	$20
43	Dolphin Watch Boat	1/31/16	--	Y	Journalist	4	Water Pollution	3	--	TB	4	3	20	4	3	Y	Y	5	$20+
44	Dolphin Watch Boat	1/31/16	28	Y	--	2	Water Pollution	2	--	TB	5	4	60	4	4	N	Y	4	$10
45	Dolphin Watch Boat	1/31/16	25	N	Writer	3	Overfishing	4	All within Hong Kong	HSF, FE, TB	4	4	20	4	4	N	Y	4	$20
46	HKU	2/1/16	18	Y	Student	3	Development/Land Reclamation/Loss of Habitat	4	--	HSF, FE	4	3	30	4	4	Y	Y	4	$20

47	HKU	2/1/16	21	Y	Student	3	Development/Land Reclamation/Loss of Habitat, Water Pollution	4	Aberdeen to Lamma Island	FE, FB	5	4	30	5	5	Y	Y	4	$5
48	HKU	2/1/16	21	N	Student	1	--	1	--	Cs	--	3	10	3	3	N	N	1	$0
49	HKU	2/1/16	20	N	Student	1	Water Pollution	3	HK to Macau	Fe	4	3	10	4	4	N	N	3	$5
50	HKU	2/1/16	--	Y	--	3	Development/Land Reclamation/Loss of Habitat	3	N/A	TB	5	4	60	5	5	Y	Y	5	$20
51	HKU	2/1/16	30	Y	Researcher	3	Dying/ Endangered/ Extinction	4	Central to TST	FE	4	4	30	4	5	Y	Y	5	$10
52	HKU	2/1/16	21	N	Student	1	--	2	--	FE	3	2	20	3	5	Y	Y	5	$20+
53	HKU	2/1/16	--	Y	IT	3	Dying/ Endangered/ Extinction	4	--	TB	2	3	20	4	4	N	Y	2	$5
54	HKU	2/1/16	25	Y	Admin	2	Development/Land Reclamation/Loss of Habitat	3	Central to TST	FE	4	3	20	3	3	Y	Y	3	$5
55	HKU	2/1/16	29	Y	HKU Staff Officer	2	Development/Land Reclamation/Loss of Habitat	3	HK to Macau	HSF	3	3	20	3	2	N	Y	4	$10
56	HKU	2/1/16	24	Y	Student	2	Water Pollution	2	--	FE	4	4	20	4	4	Y	N	2	$5
57	HKU	2/1/16	23	Y	Student	2	Water Pollution	3	Central to TST	FE, TB	3	2	10	3	4	Y	N	1	$0
58	HKU	2/1/16	31	Y	IT, Finance	3	Development/ Land Reclamation/ Loss of Habitat, Water Pollution, Noise Pollution	4	Central to TST	FE	4	4	20	4	4	Y	Y	4	$20+
59	HKU	2/1/16	22	Y	Student	3	Dying/ Endangered/ Extinction	5	--	FE	5	5	60+	5	5	Y	Y	5	$20+
60	HKU	2/1/16	30	Y	Research Officer	4	Development/Land Reclamation/Loss of Habitat	4	Park Island to Central	Fe	4	4	20	4	4	N	Y	4	$10
61	HKU	2/1/16	18	Y	Student	4	Development/Land Reclamation/Loss of Habitat	4	N/A	HSF, FE	5	4	30	4	4	Y	Y	4	$5
62	HKU	2/1/16	20	N	Student	1	Dying/ Endangered/ Extinction	5	N/A	N/A	5	4	30	5	5	N	Y	3	$20
63	CityU	2/15/16	18	Y	Student	3	Overfishing	5	N/A	N/A	--	--	--	4	5	Y	N	2	$5
64	CityU	2/15/16	18	Y	Student	2	Development/Land Reclamation/Loss of Habitat, Water Pollution	2	N/A	N/A	4	4	60	4	4	Y	Y	4	$20
65	CityU	2/15/16	18	Y	Student	2	Water Pollution	3	N/A	N/A	--	--	--	4	3	Y	Y	2	$20
66	CityU	2/15/16	18	Y	Student	2	Dying/ Endangered/ Extinction	2	HK to Macao	FE, TB	5	5	30	4	4	Y	Y	5	$20
67	CityU	2/15/16	20	Y	Student	3	Development/Land Reclamation/Loss of Habitat	5	Central to Cheung Chau	FE	5	4	30	5	4	Y	Y	5	$20

68	CityU	2/15/16	18	Y	Student	4	Development/Land Reclamation/Loss of Habitat	3	N/A	N/A	--	--	--	4	4	Y	N	3	$5
69	CityU	2/15/16	21	Y	Student	4	Development/ Land Reclamation/ Loss of Habitat, Water Pollution	4	Central to TST	FE	4	4	20	5	4	Y	N	3	$10
70	CityU	2/15/16	25	Y	Student	2	Development/Land Reclamation/Loss of Habitat, Water Pollution	3	N/A	N/A	--	--	--	5	5	Y	Y	4	$5
71	CityU	2/15/16	22	Y	Student	3	Noise Pollution, Water Pollution	4	Central to TST	FE	5	5	30	5	5	Y	Y	5	$20+
72	CityU	2/15/16	23	Y	Student	2	Water Pollution	3	Wan Chai to TST	FE	4	4	10	3	3	N	N	3	$5
73	CityU	2/15/16	21	Y	Student	3	Dying/ Endangered/ Extinction	4	Central to Cheung Chau	FE	4	4	20	4	4	N	Y	3	$5
74	CityU	2/15/16	21	Y	Student	4	Water Pollution	3	Central to TST	FE	4	4	30	4	4	Y	Y	4	$20+
75	CityU	2/15/16	20	Y	Student	3	Water Pollution, Boats/Ferries	4	Outside HK, fishing vessel	FB	4	3	60	4	3	Y	Y	3	$10
76	CityU	2/15/16	23	Y	Student	4	Development/Land Reclamation/Loss of Habitat	3	N/A	N/A	--	--	--	4	4	Y	Y	3	$5
77	CityU	2/15/16	19	Y	Student	3	Development/Land Reclamation/Loss of Habitat	4	--	N/A	--	--	--	5	5	Y	Y	4	$20
78	CityU	2/15/16	30	Y	Student	5	Overfishing	5	N/A	FE	3	--	--	--	--	--	--	--	--
79	CityU	2/15/16	19	Y	Student	3	Development/Land Reclamation/Loss of Habitat	5	Pier	TB	5	5	60+	5	4	Y	N	5	$20+
80	CityU	2/15/16	20	Y	Student	3	Water Pollution	4	Central to TST	FE	4	3	10	4	4	Y	Y	4	$5
81	CityU	2/15/16	21	Y	Student	4	Development/Land Reclamation/Loss of Habitat	3	Central to TST	FE	4	4	20	4	4	N	Y	4	$10
82	CityU	2/15/16	19	Y	Student	2	Development/Land Reclamation/Loss of Habitat	3	Central to TST	FE	4	4	20	4	3	Y	Y	4	$5
83	CityU	2/15/16	19	Y	Student	3	Water Pollution	3	Central to Cheung Chau	FE	4	4	20	5	4	Y	Y	4	$10
84	CityU	2/15/16	20	Y	Student	2	Dying/ Endangered/ Extinction	3	Central to TST	FE	5	4	20	5	4	Y	Y	4	$10
85	CityU	2/15/16	20	Y	Student	4	Development/Land Reclamation/Loss of Habitat	5	HK to Macao	HSF, FE	5	5	60	5	5	Y	Y	$5	$20
86	CityU	2/15/16	22	Y	Student	2	Dying/ Endangered/ Extinction	3	N/A	TB	5	4	60	5	4	Y	Y	4	$5
87	CityU	2/15/16	19	Y	Student	3	Development/Land Reclamation/Loss of Habitat, Water Pollution	4	Central to TST	FE	4	4	30	4	5	Y	N	4	$5
88	CityU	2/15/16	21	Y	Student	2	Overfishing	3	-	N/A	-	-	-	4	3	Y	N	4	$10

89	CityU	2/15/16	21	Y	Student	2	Development/ Land Reclamation/ Loss of Habitat, Dying/ Endangered/ Extinction, Water Pollution	2	-	-	3	3	10	4	3	Y	Y	3	$5
90	CityU	2/15/16	36	Y	Researcher	3	Dying/ Endangered/ Extinction	4	N/A	-	5	5	30	5	N/A	N	Y	5	$5
91	CityU	2/15/16	-	N	-	4	Dying/ Endangered/ Extinction	3	N/A	N/A	-	-	-	4	3	N	Y	4	$10
92	CityU	2/15/16	20	N	Student	1	--	3	-	TB	4	3	60	4	3	Y	Y	3	$20
93	CityU	2/15/16	19	Y	Student	3	Development/ Land Reclamation/ Loss of Habitat, Water Pollution	4	Wan Chai to TST	TB	5	4	20	5	4	Y	Y	3	$10
94	CityU	2/15/16	23	Y	Student (PhD)	1	Dying/ Endangered/ Extinction	2	Central to TST	FE	5	5	10	5	3	N	N	1	$0
95	CityU	2/15/16	22	N	Student	1	Dying/ Endangered/ Extinction	3	Central to TST	--	5	4	20	4	3	N	N	1	$0
96	CityU	2/15/16	21	Y	Student	3	--	4	Central to TST	HSF, FE	3	3	20	3	3	Y	N	3	$5
97	CityU	2/15/16	21	Y	Student	2	Dying/ Endangered/ Extinction	3	Central to TST	FE	3	3	10	3	3	Y	N	2	$5
98	CityU	2/15/16	21	Y	Student	3	Development/Land Reclamation/Loss of Habitat	4	Central to TST	FE, CS, TB	4	3	30	5	4	Y	Y	3	$5
99	CityU	2/15/16	21	Y	Student	4	Development/ Land Reclamation/ Loss of Habitat, Water Pollution, Noise Pollution	3	Central to TST	FE	4	4	20	4	4	Y	Y	4	$10
100	CityU	2/15/16	21	Y	Student	4	Development/ Land Reclamation/ Loss of Habitat, Dying/ Endangered/ Extinction	3	Wan Chai to TST	FE	4	4	10	5	5	Y	N	3	$5
101	CityU	2/15/16	20	Y	Student	3	Development/Land Reclamation/Loss of Habitat	4	Central/Wan Chai to TST	FE	5	3	30	5	5	Y	Y	4	$5
102	CityU	2/15/16	20	Y	Student	3	Water Pollution	4	TST to Central	FE	3	3	10	3	2	Y	N	2	$5

Appendix G1: Direct Observation Protocol off the Coast of Lantau

In order to successfully observe the CWDs from both land and sea, we must use observation sheets and guidelines based off of those created by the WWF. There are two charts that must be filled out simultaneously (see below). The observer (or observers) must write their initials, the date, the start and end time of the observation period (including AM or PM), the sea state, and visibility. If it is possible to see farther than 1km offshore or from a vessel and if the sea state is a 1 or 2 on the Beaufort Sea State scale, then direct observation can be conducted (see Appendix I for Beaufort Sea State scale).

For the Marine Traffic Datasheet, the observer must record all vessels that pass within 5 km of shore when observing on land or within a 100m radius of a dolphin-watching vessel when observing from sea. The observer will note the start and end time of the vessel within the specified ranges, along with the type, color, and behavior of the vessel. The start time of the vessel will be recorded when the vessel enters the observer's field of vision, if it is within 5 km of the shore. The end time will be recorded when the vessel is no longer within the observer's field of vision or when the vessel is no longer within 500m of the shoreline. These categories are described below in the datasheet.

If dolphins are present, then the observer will refer to the Dolphin-Vessel Interaction Datasheet. There, the number of CWDs present, a specific dolphin's behavior, the interaction the dolphins have with the vessels, the distance the boat is from the dolphins, and any notes that the observer wishes to take will be recorded. For the Dolphin-Vessel Interaction Datasheet, the observer will scan the waters within 500m of shore using 8x21 National Geographic brand

binoculars for a period of 10 minutes. If no dolphins are spotted, the observer will take a 10 minute break and will then resume scanning.

Appendix G2: Marine Traffic Observation Datasheet

Date: Observer: Sea State/Visibility: Start Time: End Time:

Boat Record #	Boat Type	No. (Color)	Travel Direction	Start Time	End Time	Boat Behavior	Dolphin Present (Y/N)	Land/Sea	Distance from observer	Comments

Boat Type: **W** (Walla-walla), **Y** (Yacht), **PV** (Police boat), **HSF** (High-speed ferry), **Fe** (Ferry), **DW** (Dolphin-watching boat), **RV** (Research vessel), **SB** (Speed boat), **PS** (Purse Seine), **O** (Other, specify in comments)
Boat Behavior: **T** (Travelling), **S** (Stationary), **DF** (Dolphin follow), **OP** (Operating)

Appendix G3: Dolphin-Vessel Interaction Observation Datasheet

Date: Observer: Sea State/Visibility: Start Time: End Time:

Boat Record #	Start Time	End Time	Boat Behavior	Number of Dolphin(s)	Distance from Dolphin(s) (m)	Dolphin Response	Dolphin Behavior	Land/Sea	Comments

Boat Type: **W** (Walla-walla), **Y** (Yacht), **PV** (Police boat), **HSF** (High-speed ferry), **Fe** (Ferry), **DW** (Dolphin-watching boat), **RV** (Research vessel), **SB** (Speed boat), **PS** (Purse Seine), **O** (Other, specify in comments)

Boat Behavior: **PB** (Pass-by), **ST** (Stationary), **PA** (Parallel), **FO** (Follow), **HO** (Head-on), **TH** (Through), **CO** (Corner), **OP** (Operating)

Dolphin response: **Att** (Attract), **Neu** (Neutral), **Avo** (Avoid)

Dolphin behavior: **Q** (Quiet Surface), **B** (Breach), **S** (Spy-hop), **F** (Fluke up), **P** (Porpoise), **TS** (Tail-slap), **HS** (Head-slap)

Appendix G4: Direct Observation from Fu Shan Viewing Point in Tai O

Tai O Marine Traffic Observation Datasheet

Date: 1/18/2016 **Observer**: AA, CB, YC, GV **Sea State/Visibility**: 1-2 / 1 **Start Time**: 10:00 **End Time**: 14:00

Boat Type	No. (Color)	Start Time	End Time	Boat Behavior	Dolphin Present (Y/N)	Land/Sea	Comments
Fe	green / white	10:04	10:06	T	N	land	
PS	black / white	10:13	10:19	T	N	land	
Y	white	10:15	10:22	T	N	land	
SB	yellow	10:15	10:17	T	N	land	
O	blue	10:20	10:26	T	N	land	house boat
O	blue	10:37	10:43	T	N	land	house boat
O	white / black	10:38	10:45	T	N	land	tugboat / cargo
PV	18/white	10:53	10:56	T	N	land	
O	yellow	10:56	10:57	T	N	land	rescue boat
O	blue	11:08	11:10	T	N	land	private fishing vessel
O	grey	11:09	11:12	T	N	land	cargo ship
Fe	blue / green / white, 500	11:10	11:15	T	N	land	
O	blue	11:40	11:43	T	N	land	fishing boat
Fe	green / white	11:53	11:56	T	N	land	
O	yellow	12:07	12:08	T	N	land	rescue boat
Fe	white	12:08	12:13	T	N	land	

SB	blue	12:32	12:36	T	N	land	
O	white/black/blue/red 5159	12:32	12:45	T	N	land	cargo boat
PV	white, 41	12:42	12:44	T	N	land	
PV	grey / black, 52	12:45	12:50	T	N	land	
PV	18	1:08	1:10	T	N	land	
W	blue / yellow	1:17	1:20	T	N	land	
O	blue	1:42	1:47	T	N	land	ocean cargo vessel
W	yellow	1:48	1:52	T	N	land	
W	green / yellow	1:48		T	N	land	

Date: 1/19/2016 **Observer**: AA,CB,YC,GV **Sea State/Visibility**: 2-3/ 2-3 **Start Time**: 10:40 **End Time**: 12:40

Boat Type	No. (Color)	Start Time	End Time	Boat Behavior	Dolphin Present (Y/N)	Land/Sea	Comments
DW	32166/white	10:40	10:57	T	N	land	
PS	tan/ black	10:42	10:51	T	N	land	
PV	52	10:45	10:50	T	N	land	
SB	blue	10:59	11:00	T	N	land	
W	green / yellow	10:59	11:02	T/S	N	land	
W	green / yellow	11:03	11:07	T/S	N	land	
PS	brown / tan	11:20		T	N	land	
SB	701712	11:24	11:25	T	N	land	
SB	green	11:26	11:28	T	N		
O	black	11:28	11:49	T	N	land	shipping vessel
O	black / red	11:29	11:40	T	N	land	tugboat
RV	white	11:42	11:44	T	N	land	
SB	brown / grey	11:42	11:44	T	N	land	
Fe	CKS A863	11:55	11:58	T	N	land	
PV	64	12:00	12:04	T	N	land	
W	blue	12:33	12:35	T	N	land	

Date: 2/3/2016 **Observer**: AA,CB,YC,GV **Sea State/Visibility**: 2-3/ 2-3 **Start Time**: 10:00 **End Time**: 14:00

Boat Type	No. (Color)	Start Time	End Time	Boat Behavior	Dolphin Present (Y/N)	Land/Sea	Comments
Fe	green / white	10:05	10:08	T	N	land	
Fe	white / black	10:05	10:13	T	N	land	
O		10:00		S	N	land	construction boat
Fe	white / black	10:08	10:12	T	N	land	
O	dark blue	10:09	10:11	T	N	land	cargo ship
O	red	10:14	10:30	T	N	land	cargo ship
Fe	black / white	10:15	10:17	T	N	land	
O	black	10:22	10:	T	N	land	fishing boat
HSF	white	10:23	10:29	T	N	land	
O	green / black	10:24	10:	T	N	land	fishing boat
Fe	blue / white	10:24	10:50	T	N	land	
HSF	white	10:29	10:50	T	N	land	
Fe	white/black	10:29	10:50	T	N	land	
HSF	--	10:41	10:50	T	N	land	
Fe	white	10:41	10:50	T	N	land	
O	black / white	10:48	10:52	T	N	land	tugboat
HSF	blue	10:49	10:55	T	N	land	
Fe	blue / white	10:56	11:03	T	N	land	
O	white / blue / black	11:05	11:06	T	N	land	tugboat

O	green	11:17	11:29	S	N	land	fishing boat
O	green	11:22	11:29	T			fishing boat
O	black	11:23	11:29	T			fishing boat
Fe	white / black	11:30	11:33	T			
O	white	11:30	11:33	T			fishing boat
W	orange / blue	11:31	11:33	T			
Fe	white / green	11:51	11:53	T	N	land	
Fe	blue / white	12:00	12:02	T			
W	green / orange	12:03	12:07	T			
O	white	12:05	12:28	T	N	land	cargo ship
Fe	white	12:08	12:10	T			
O	black / white / red	12:13	12:30	T	N		transport vessel
Fe	white / black	12:18	12:19	T	N		
SB	blue	12:22	12:25	T	N	land	
O	black	12:30	12:33	T	N	land	Fishing Boat
O	red	12:41	12:45	T	N	land	
O	white / black	12:46	12:55	T	N	land	tugboat
W	green / orange	12:54	1:00	T, S, DF	Y	land	
SB	blue	1:02	1:08	T	N	land	
O	white	1:07	1:13	T, S	N	land	construction boat
PV	gray / white, #60---	1:08	1:16	T	N	land	

O	black	1:20	1:24	T	N	land	fishing boat
O	black	1:21	1:26	T	N	land	fishing boat
O	black / white	1:24	1:29	T	N	land	construction boat
PV	gray, #18	1:30	1:35	T	N	land	
W	orange / blue	1:38	1:43	T, S, T	N	land	

Boat Type: **W** (Walla-walla), **Y** (Yacht), **PV** (Police boat), **HSF** (High-speed ferry), **Fe** (Ferry), **DW** (Dolphin-watching boat), **RV** (Research vessel), **SB** (Speed boat), **PS** (Purse Seine), **O** (Other, specify in comments)
Boat Behavior: **T** (Travelling), **S** (Stationary), **DF** (Dolphin follow), **OP** (Operating)

Dolphin-Vessel Interaction Observation Datasheet

Date: 2/3/2016 **Observer:** AA, CB, YC, GV **Sea State/Visibility:** 2-3/2-3 **Start Time:** 10:00 **End Time:** 14:00

Type of Boat	No. (Color)	Start Time	End Time	Boat Behavior	Boat Interaction with Dolphin (Y/N)	Number of Dolphin(s)	Distance from Dolphin(s) (m)	Dolphin Response	Dolphin Behavior	Land/ Sea	Comments
W	blue / orange	12:59	1:00	ST, HO	Y	2	~5m	Neu	Q	land	
none		1:08	1:09		N	2			Q	land	

Boat Type: **W** (Walla-walla), **Y** (Yacht), **PV** (Police boat), **HSF** (High-speed ferry), **Fe** (Ferry), **DW** (Dolphin-watching boat), **RV** (Research vessel), **SB** (Speed boat), **PS** (Purse Seine), **O** (Other, specify in comments)
Boat Behavior: **PB** (Pass-by), **ST** (Stationary), **PA** (Parallel), **FO** (Follow), **HO** (Head-on), **TH** (Through), **CO** (Corner), **OP** (Operating)
Dolphin response: **Att** (Attract), **Neu** (Neutral), **Avo** (Avoid)
Dolphin behavior: **Q** (Quiet Surface), **B** (Breach), **S** (Spy-hop), **F** (Fluke up), **P** (Porpoise), **TS** (Tail-slap), **HS** (Head-slap)

Appendix G5: Direct Observation from Dolphin Watch Vessel

Marine Traffic Observation Datasheet

Date: 1/31/2016 **Observer:** AA,CB,YC,GV **Sea State:** 2-3 **Visibility:** 2-3 **Start Time:** 11:28 **End Time:** 12:28

Boat Type	No. (Color)	Start Time	End Time	Boat Behavior	Dolphin Present (Y/N)	Land/Sea	Comments
O	black/ white	11:38	11:49	S	N	sea	cargo
O	black	11:41	11:49	S	N	sea	
Fe	blue/ white	11:41	11:49	OP, T	N	sea	
Fe	blue	11:42	11:46	OP, T	N	sea	
SB	blue	11:47	11:50	T	N	sea	
W	orange/ green	11:50	11:55	T	N	sea	
O	yellow	11:51	12:00	S	N	sea	kayak
O	white	11:51	12:00	S	N	sea	row
O	black	11:51	12:00	S	N	sea	
PV	black/ red	11:53	12:00	T	N	sea	
SB	black	11:58	12:10	T	N	sea	
	yellow	11:58	12:05		N	sea	
	blue	11:58	12:10	S	N	sea	
O	white and red 20936	12:15	12:30	T, then S	Y	sea	private boat tour

Boat Type: **W** (Walla-walla), **Y** (Yacht), **PV** (Police boat), **HSF** (High-speed ferry), **Fe** (Ferry), **DW** (Dolphin-watching boat), **RV** (Research vessel), **SB** (Speed boat), **PS** (Purse Seine), **O** (Other, specify in comments)
Boat Behavior: **T** (Travelling), **S** (Stationary), **DF** (Dolphin follow), **OP** (Operating)

Dolphin-Vessel Interaction Observation Datasheet

Date: 1/31/2016 **Observer:** AA ,CB, YC, GV **Sea State/Visibility:** 3 **Start Time:** 11:28 **End Time:** 12:40

Type of Boat	No. (Color)	Start Time	End Time	Boat Behavior	Boat Interaction with Dolphin (Y/N)	Number of Dolphins	Distance from Dolphin(s) (m)	Dolphin Response	Dolphin Behavior	Land / Sea	Comments
DW		11:28	11:35	PB	Y	3	50	Att	TS, Q	Sea	fishing boat present
DW		11:30	11:35	HO FO	Y	2	10	Att	S, Q	Sea	
DW		11:33	11:35	HO	Y	3	10	Att	Q	Sea	
DW		11:39	11:48	HO FO	Y	2	10	Neu	TS, Q	Sea	
DW		11:50	11:56	HO FO	Y	2	10	Att	Q, TS, F, D	Sea	
DW		11:56	12:00	HO FO	Y	3	10	Att	Q	Sea	
DW		12:00	12:05	HO FO	Y	4	10	Att	Q	Sea	
DW		12:05	12:10			5			Q	Sea	
DW		12:10	12:21	PA	Y	4	5	Att	Q, TS	Sea	one did a wiggle
O	c7029	12:21	12:40		Y					Sea	

Boat Type: **W** (Walla-walla), **Y** (Yacht), **PV** (Police boat), **HSF** (High-speed ferry), **Fe** (Ferry), **DW** (Dolphin-watching boat), **RV** (Research vessel), **SB** (Speed boat), **PS** (Purse Seine), **O** (Other, specify in comments)

Boat Behavior: **PB** (Pass-by), **ST** (Stationary), **PA** (Parallel), **FO** (Follow), **HO** (Head-on), **TH** (Through), **CO** (Corner), **OP** (Operating)

Dolphin response: **Att** (Attract), **Neu** (Neutral), **Avo** (Avoid)

Dolphin behavior: **Q** (Quiet Surface), **B** (Breach), **S** (Spy-hop), **F** (Fluke up), **P** (Porpoise), **TS** (Tail-slap), **HS** (Head-slap), **D** (dive)

Appendix G6: Direct Observation from Sai Wan Tin Hau Observation Point in Cheung Chau

Marine Traffic Observation Datasheet

Date: 2/12/2016 **Observer**: AA,CB,YC,GV **Sea State/Visibility**: 2-3/ 2-3 **Start Time**: 9:28 **End Time**: 12:28

Boat Type	No. (Color)	Start Time	End Time	Boat Behavior	Dolphin Present (Y/N)	Land/Sea	Comments
O	green	9:28	9:41	S, T	N	Land	fishing
HSF		9:28	9:29	T	N	Land	
PS		9:28	12:00	S	N	Land	
PS		9:28	9:34	T	N	Land	
SB	white	9:28	9:45	T	N	Land	
HSF	red/ black	9:30	9:33	T	N	Land	
O	blue	9:30	9:54	S, T	N	Land	river cargo vessel
O	red	9:31	12:00	S	N	Land	river cargo vessel
O	red	9:31	12:00	S	N	Land	river cargo vessel
HSF	red/ black	9:32	9:34	T	N	Land	in
HSF	red/ black	9:32	9:34	T	N	Land	out
O	orange/ green	9:33	9:35	T	N	Land	fishing
SB	Blue	9:33	10:41	S, T	N	Land	
PS	black/ white	9:34		S	N	Land	
HSF	blue	9:36	938	T	N	Land	out
HSF	white/ red	9:37	9:38	T	N	Land	in, turbojet
Fe	orange/ white /green	9:39	9:40	T	N	Land	out
HSF	yellow/ black	9:39	9:41	T	N	Land	out
HSF	white/blue	9:39		T	N	Land	out

PS	white/black	9:40		T	N	Land	
HSF	blue	9:42	9:45	T	N	Land	in
O	black/white	9:43		T	N	Land	like police but not its fishing coming in
Fe	white	9:43	9:48	T	N	Land	in
HSF	red/black	9:44	9:48	T	N	Land	in
O	black/green	9:45	10:01	T	N	Land	in
O	black/white	9:47	10:00	T	N	Land	out
HSF	red/white	9:48	9:52	T	N	Land	in, turbojet
HSF	blue	9:48	9:51	T	N	Land	out
O	blue/black	9:48	10:00	T	N	Land	in
O	white	9:52	9:56	T	N	Land	
HSF	red/white	9:53	9:56	T	N	Land	out, turbojet
HSF	red/white	10:02	10:04	T	N	Land	out, turbojet
O	blue	10:03	10:04	T	N	Land	fishing
O	blue	10:05	10:09	T	N	Land	out
HSF	red/black	10:07	10:10	T	N	Land	out, turbojet
Fe	white/black/ orange/green	10:09	10:12	T	N	Land	out
PS	black/red/ white	10:09		T, S	N	Land	
HSF	blue	10:12	10:15	T	N	Land	in
Fe	white/blue	10:13	10:16	T	N	Land	in
O	white black	10:14	10:17	T	N	Land	fishing, out
HSF	white orange	10:16	10:19	T	N	Land	in

HSF	red white	10:17	10:20	T	N	Land	in, turbojet
HSF	blue	10:19	10:22	T	N	Land	out
HSF	red white	10:20	10:23	t	N	Land	turbojet
HSF	red black	10:22	10:24	t	N	Land	turbojet, out
SB	gold, P41021C	10:24	10:25	t	N	Land	out
HSF	red white	10:24	10:27	t	N	Land	out
SB	green	10:27	10:32	t, s	N	Land	out
O	blue	10:28	10:31	t	N	Land	out, about to fall over
SB	red	10:30	10:30	t	N	Land	in, lobster fishing boat
O	red white black	10:31	10:34	T	N	Land	fishing, out
HSF	red white	10:31	10:34	T	N	Land	in, turbojet
HSF	red white	10:31	10:34	T	N	Land	out
SB	green	10:32	10:39	T	N	Land	out
PS	white black red	10:33	10:40	T, S	N	Land	
PS	white black red	10:34	10:40	T	N	Land	out
HSF	red black	10:35	10:38	T	N	Land	out
PS	red white black	10:35	10:40	T	N	Land	out
HSF	blue	10:36	10:39	T	N	Land	out
HSF	red white black	10:37	10:40	T	N	Land	out

O	yellow white black	10:37	10:44	T	N	Land	out
HSF	red, black	10:38	10:41	T	N	Land	out
HSF	red white	10:39	10:41	T	N	Land	out
SB	green	10:43		T	N	Land	out
PS	white, black, red	10:44		T	N	land	out
SB	blue red	10:44	10:45	T	N	Land	out
HSF	blue	10:44	10:47	T	N	Land	in
SB	p40751c, blue	10:46		T	N	land	out
HSF	white	10:46	10:49	T	N	Land	in
HSF	blue	10:46	10:48	T	N	Land	in
Fe	black white	10:46	10:55	T	N	Land	out
HSF	red, black	10:48	10:50	T	N	Land	in
O	black blue	10:48		T	N	Land	out, fishing
HSF	blue	10:49	10:52	T	N	Land	out
HSF	red white	10:51	10:54	T	N	Land	out, turbojet
HSF	white	10:52	10:53	T	N	Land	out
Fe	green black white	10:53	10:55	T	N	Land	out
HSF	white black	10:53	10:54	T	N	Land	in
HSF	red white black	10:54	10:58	T	N	Land	out, turbojet
O	white	10:54		T	N	Land	mysterious

Fe	grey white red	10:56	10:59	T	N	Land	out
HSF	red black	10:57	11:00	T	N	Land	out, turbojet
SB	black	10:57	11:00	T	N	Land	in
PS	2667 white black red	10:57		T	N	Land	out, guy tosses boxes overboard
Fe	white	10:59	11:02	T	N	Land	in, First Ferry
SB	blue	11:00	11;01	T	N	Land	in
HSF	red white	11:03	11:06	T	N	Land	in
SB	blue p4058c	11:04		T	N	Land	out
PS	black white	11:04		T	N	Land	out
SB	white	11:05	11:06	T	N	Land	out
HSF	red black	11:07	11:10	T	N	Land	out
HSF	white red	11:08		T	N	Land	out
O	teal white red black	11:10	11:16	T, S	N	Land	out, junk
HSF	white, orange	11:10	11:11	T	N	Land	in
HSF	red black	11:11	11:14	T	N	Land	in
HSF	blue	11:11	11:14	T	N	Land	in
SB	white, 707544	11:12		T	N	Land	in
HSF	red black	11:13	11:16	T	N	Land	in
Fe	white	11:15	11:16	T	N	Land	in
HSF	red black	11:16	11:20	T	N	Land	in
HSF	red	11:18	11:20	T	N	Land	in

	white						
HSF	blue	11:20	11:23	T	N	Land	out
SB	blue	11:21	11:24	T	N	Land	out
SB	blue	11:21	11:24	T	N	Land	out
Fe	white blue black	11:25	11:28	T	N	Land	out
HSF	red white	11:26	11:29	T	N	Land	out
HSF	red black	11:26	11:29	T	N	Land	out
HSF	red white	11:28	11:31	T	N	Land	in
HSF	blue	11:29	11:32	T	N	Land	in
HSF	yellow	11:30	11:31	T	N	Land	in
O		11:33		T, S	N	Land	in, junk
HSF	red white	11:33	11:36	T	N	Land	out
Fe	white black	11:35	11:40	T	N	Land	out
HSF	blue	11:36	11:39	T	N	Land	out
HSF	red white	11:36	11:40	T	N	Land	in
HSF	blue	11:39	11:42	T	N	Land	out
HSF	blue	11:39	11:42	T	N	Land	in
HSF	blue	11:41	11:44	T	N	Land	in
HSF	red white	11:41	11:44	T	N	Land	out
HSF	red black	11:49	11:52	T	N	Land	in
O	white blue	11:50		T	N	Land	out, fishing
HSF	red	11:50	11:53	T	N	Land	out

HSF	white	11:53	11:57	T	N	Land	out
FE	white	11:53	11:55	T	N	Land	out
HSF	red black	11:53	11:56	T	N	Land	out
HSF	blue	11:54	11:57	T	N	Land	out
Fe	white	11:54	11:57	T	N	Land	out
HSF	red white	11:55	11:58	T	N	Land	in
HSF	red white	11:56	11:59	T	N	Land	out
HSF	red white	11:56	11:59	T	N	Land	in
O	Periwinkle	11:58		T, S	N	Land	out
PS	red white black	11:59	12:07	T	N	Land	in
SB	green, p40897c	11:59	11:59	T	N	Land	out
Fe	white	11:59	12:03	T	N	Land	in
O	light blue	12:02	12:05	T	N	Land	in
PS	red black white	12:02	12:28	T, S	N	Land	in
SB	gold p40331c	12:04	12:05	T	N	Land	out
HSF	white	12:04	12:09	T	N	Land	in
HSF	red black	12:06	12:09	T	N	Land	out
HSF	red white	12:06	12:09	T	N	Land	out
PV	grey black	12:09	12:28	T	N	Land	in
O	green red	12:10	12:25	T	N	Land	in, junk
HSF	red white	12:25	12:28	T	N	Land	out

Boat Type: **W** (Walla-walla), **Y** (Yacht), **PV** (Police boat), **HSF** (High-speed ferry), **Fe** (Ferry), **DW** (Dolphin-watching boat), **RV** (Research vessel), **SB** (Speed boat), **PS** (Purse Seine), **O** (Other, specify in comments)

Boat Behavior: **T** (Travelling), **S** (Stationary), **DF** (Dolphin follow), **OP** (Operating)

Appendix G7: Direct Observation from Reclining Rock Observation Point in Cheung Chau

Marine Traffic Observation Datasheet

Date: 2/12/2016 **Observer:** AA,CB,YC,GV **Sea State/Visibility:** 2-3/ 2-3 **Start Time:** 2:48 **End Time:** 3:48

Boat Type	No. (Color)	Start Time	End Time	Boat Behavior	Dolphin Present (Y/N)	Land/Sea	Comments
HSF	white black	2:48		T	N	Land	in
HSF	blue	2:46	2:48	T	N	Land	out
PS	blue	2:48		S	N	Land	out
SB	blue	2:50	2:55	T	N	Land	out
SB	blue	2:51	2:55	T	N	Land	out
Fe	black white	2:52	3:01	T	N	Land	in
HSF	black white	2:52	2:55	T	N	Land	out
HSF	red black	2:54	2:55	T	N	Land	in
HSF	red white	2:56	2:57	T	N	Land	out
HSF	red white	2:58	2:59	T	N	Land	out
HSF	red white	2:58	2:59	T	N	Land	out
SB	green, P40879C	2:59	2:59	T	N	Land	in
HSF	red white	3:03	3:04	T	N	Land	in
HSF	red white	3:06	3:08	T	N	Land	in
HSF	red white	3:09	3:12	T	N	Land	out
PS		3:10	3:15	T	N	Land	in
HSF	white	3:14	3:17	T	N	Land	in

HSF	blue	3:17	3:20	T	N	Land	in
HSF	red white	3:19	3:20	T	N	Land	in
SB	blue	3:22	3:22	T	N	Land	in
O	black	3:22	3:30	T	N	Land	in, fishing
SB	green	3:23	3:24	T	N	Land	in
O	white black	3:27		T	N	Land	out, fishing
HSF	red black	3:31	3:34	T	N	Land	out
SB	red	3:37	3:38	T	N	Land	out
O	grey blue	3:38	3:41	T	N	Land	in, fishing
HSF	red white	3:39	3:41	T	N	Land	out
Fe	white	3:40	3:47	T	N	Land	out
SB	blue	3:42	3:48	T	N	Land	out

Boat Type: **W** (Walla-walla), **Y** (Yacht), **PV** (Police boat), **HSF** (High-speed ferry), **Fe** (Ferry), **DW** (Dolphin-watching boat), **RV** (Research vessel), **SB** (Speed boat), **PS** (Purse Seine), **O** (Other, specify in comments)

Boat Behavior: **T** (Travelling), **S** (Stationary), **DF** (Dolphin follow), **OP** (Operating)