The Impact of High IQ On the Lives of Killer Whales

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Abstract. Orcinus Orca, which is the largest species in the family of Delphinidae, and the only species in the genus of Orcinus, has always been an apex predator thanks to its high intelligence. They are found in almost every ocean in the world. Different location decides the characteristics of each social group. Orcas are highly socialized and have various behaviors and distinct cultures and traditions in different associations. This research mainly concluded and analyzed the effects in two aspects brought by its outstanding intelligence such as more complex and variable hunting strategies that widen its menu range and specific cultures that bring different languages and traditions. It also introduced the negative influences of captivity on wild orcas's bodies and mental states. It is necessary to pay attention to captive orca's physical and psychological health and this kind of industry which is harmful to animals should be regulated. Humans should not only prevent harmful industry but also keep a favorable marine ecosystem to protect orcas.

Keywords: Hunting strategies, Social, Captivity.

1. Introduction

Orcinus Orca is in the class of Mammalia, order of Cetacea and family Delphinidae. They are in the same family with dolphins instead of sharks which is in the class called Chondrichthyes. Thus, orcas breathe by their lungs rather than gills. Their maximum body size can reach 9.0m in males and 7.7m in females [1]. Orcas have a high level of intelligence in the Animalia. This brings them a rich variety of lifestyles including both socializing and hunting aspects. This research introduced the conclusion that the final strategy is generally the best strategy obtained under the influence of many factors. The location of habitats decides the weather conditions and the species of prey. These can directly affect their hunting plan. For example, extreme climate can create obstacles to predation and even migration. Large areas of ice require orcas to hold their breath for a long time. Species of prey are also important as their habitats and life habits should be considered before generating hunting strategies [2]. Different preys need different techniques, and those unique skills are often taught by the female leader of an association because of their matriarchal society, and it will be passed on to the younger generation as a tradition. The predation range is changing with the social group characteristics as well. Distinct population composition decides the depth of activities. Adult-only social groups are more likely to choose deeper areas [3]. According to the distribution of three main social groups of southern residential orca near British Columbia, they have some group-differentiated water zones [4]. Even though Orcinus Orca nearly has no natural enemy in the ocean, human factors are influencing them by polluting the ocean and also captivity for human entertainment activities. This endangers their physical health and has irreversible effects on their mental state, resulting in the phenomenon that a captive orca's average life expectancy is much shorter than wild orcas [5].

2. Hunting

2.1. Region

High intelligence brings rich activities and culture to orcas, so its impact can be simply divided into two aspects, hunting and socializing. For hunting, orca's hunting strategy has always been changing and there are 4 main factors directly related to their distinct strategies. Firstly, the location of habitats influences a lot, different locations provide different environmental conditions such as various temperatures, topography, etc. Some typical orca communities are located around several

specific countries. In this study, Norway and New Zealand are examples for detailed analysis. Orcas in the northern part of the Norwegian Atlantic have a special strategy because humans there depend on fisheries. As a result, these killer whale groups follow the fishing fleets to explore new ways of hunting. As the huge net that drags for lots of herrings is rising, there are always some of them accidentally fall back into the ocean. And as the number of fish is too large, even if just part of the fish drops out, it can be helpful to Orca's hunting. Also, in the Atlantic, orcas often need to hunt their prey on the ice floe. Their strategy is to line up and then swim underneath the floe with prey, usually some sea lions. They create waves to break the floating ice or let the sea lion slide off the ice into the sea. In the seas around New Zealand, orcas have other strategies as New Zealand has a disparate environment with the poles. Some pods of orca will hunt the seals or sea lions on the shore. This kind of hunting requires skills, otherwise, the orcas could easily be stranded and put at risk. In their matriarchal society, those skills are often taught by the leader of that pod, usually the oldest female orca of the pod to the oldest female in the next generation [2].

2.2. Species of preys

Prey species vary from group to group, and this becomes a determining factor in hunting strategy. A research of New Zealand orca represented that there are 24 species of prey in the orca menu with 10 types only found in New Zealand water [3]. Foraging preys, especially in shallow water areas has the greatest number of distinct strategies. For hunting prey at the bottom of the reef and coral crevices such as rays, orcas need to have good observations skill as rays are more flexible and have a similar body color to the reef. Orca predation includes sharks as well. A drone pilot filmed a video with several orcas at Hartenbos Beach and river mouth, Mossel Bay, South Africa, on 16 May 2022. The pilot observed five orcas around that area of water in 40 minutes [5].



Figure 1. The pictures recorded the complete process of the orca group hunting a white shark, by the drone pilot's camera [5]

In figure 1, the white shark has already died in figure 1(b) and there is obvious blood in the water in figure 1 (c). These pictures show the way orcas hunt great white sharks. They will roll the shark first to change its body into a specific position that can lead to tonic immobility. They may bite into

the shark's abdomen directly. This also corresponds to the type of wounds found on white shark carcasses: missing liver which may be caused by the buoyancy or was eaten, and bite marks on pectoral fins and torn pectoral girdles. This video also provides reference material for white sharks' evasive behavior. Same as many other marine animals do when they meet a predator, the shark was circling orcas to keep them within sight. However, this strategy may not work for orcas as they are social animals who always hunt in groups [5].

This case not only represents the hunting strategy of orca but also brings relative data for its effect. Some shreds of evidence show that surrounding white sharks fled that region and stayed in another area for more than 7 weeks. The first evidence is from some beach-based observers, they saw sharks move in different directions to flee and hide. Shark cage diving operators also bring a graph of the number of shark encounters during trips and flights. In Figure 2, it is significant that the number of sharks suddenly became zero after the predation and the first shark went back on the first of July. This case of an orca group hunting a shark can be seen as a specialized hunting behavior as white sharks are usually not on most of the orca's menu. However, if the situation of cultural transmission between different orca associations happens, there might be a huge influence on the shark population, especially around the area of Mossel Bay [5-7].

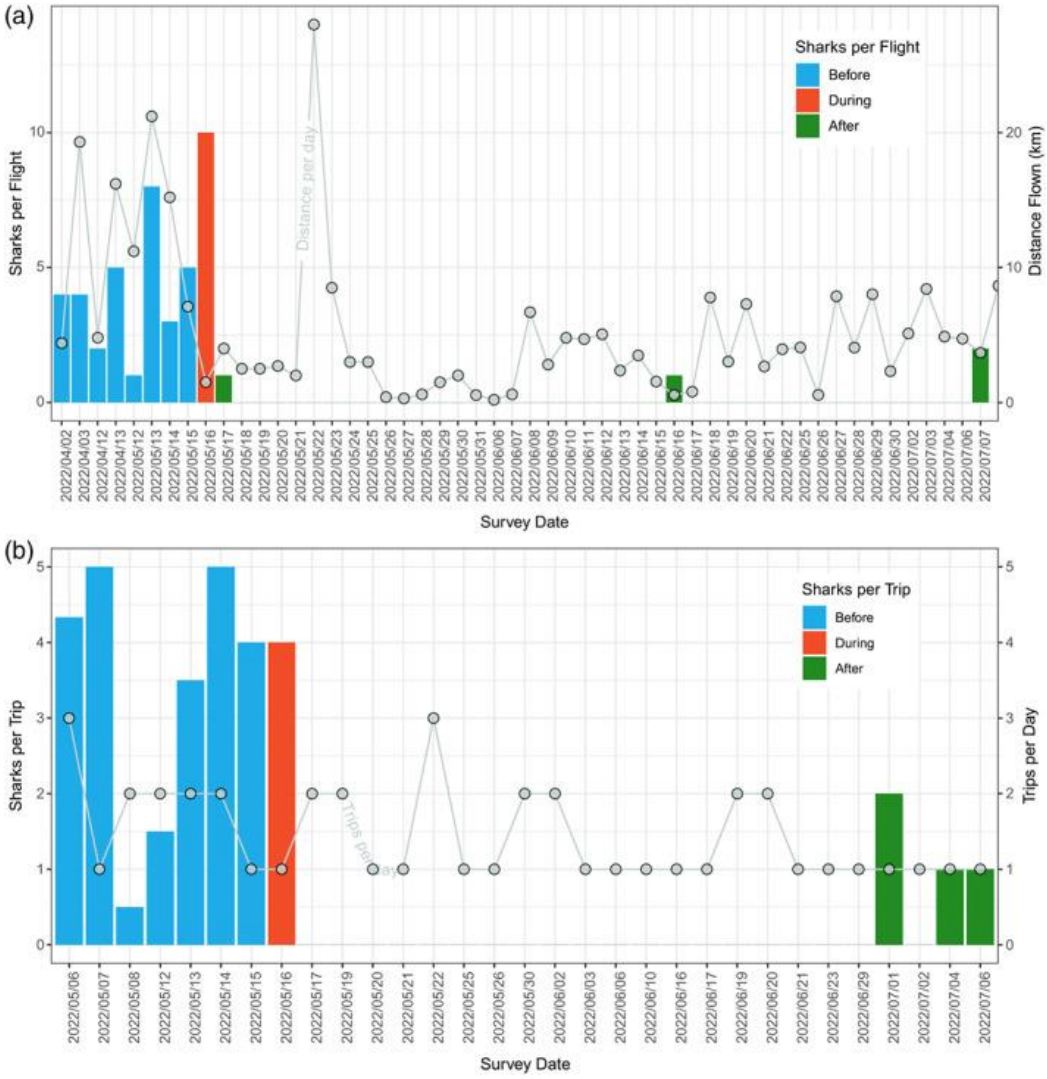


Figure 2. The encounter number of sharks per fight and per trip between 2nd April to 7th July [5]

2.3. Types of Orca

Transient orca and resident orca are distinct in many aspects of orca's life. The number of each pod could be the most obvious one as transient orca pods always consisted of about 3-6 orcas.

However, resident orca pods might have about 30 orcas or even more. They seem to avoid each other as we do not have any record of interaction between them. The exact number of each pod is not only affected by the types of orca, the water depth and sea surface temperature also influence it[3].

This figure 3 shows the seasonal encounter rate (ER) for orca sightings between September 2000 and April 2010 in the Hauraki Gulf, New Zealand. It presents the phenomenon that days with cooler weather had a higher encounter rate.

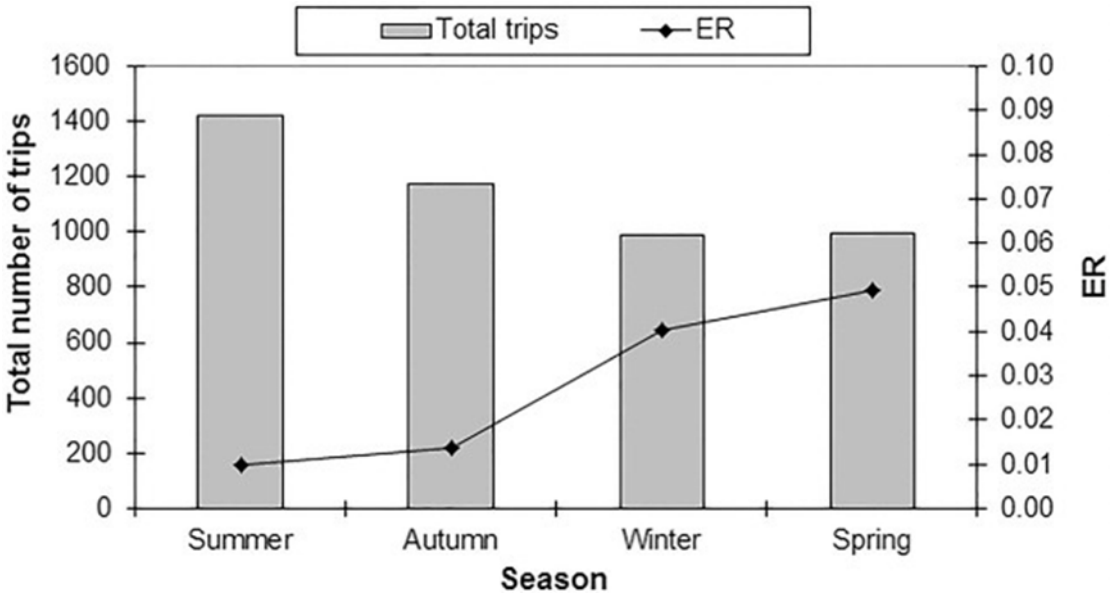


Figure 3. The changing of encounter rate in different season [3]

According to Figure 4, orcas were usually located in water with temperatures from 12.8 to 23.6 degrees Celsius. The results of seasonal occurrence with different sea surface temperatures vary significantly as the difference of log-transformed sea surface temperature between Autumn and Winter and reach about 3 degrees Celsius.

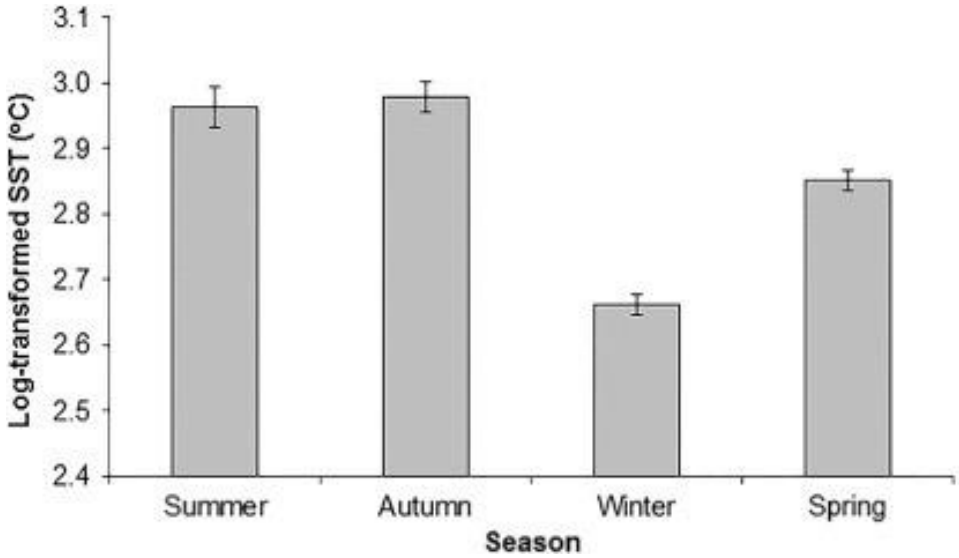


Figure 4. The Log-transformed sea surface temperature [3].

In relation to water depth, there is no obvious seasonal difference in water depth. However, the orca group composition does affect the depth of their activities. Figure 5 represents that groups with both adult and immature orcas are more likely to be observed in a lower depth.

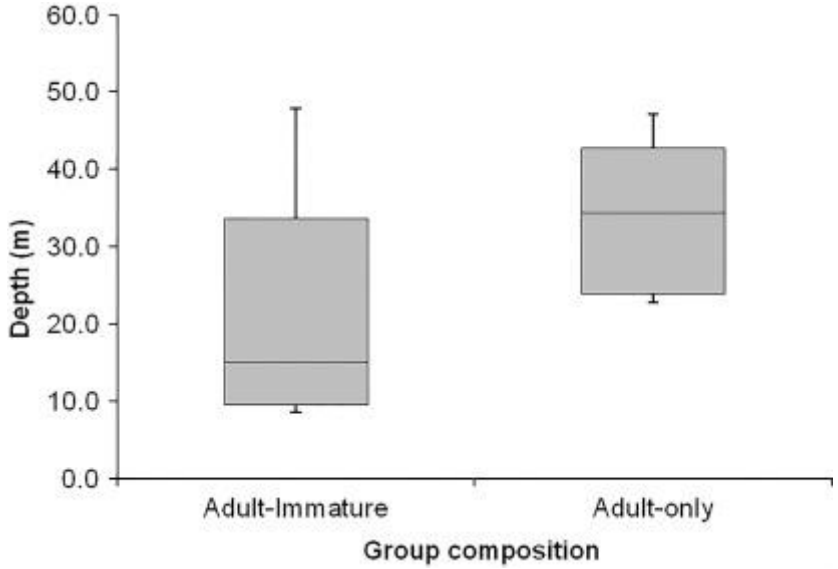


Figure 5. Difference of water depth that orca groups choose between adult and immature groups and adult-only groups [3]

This transient--resident classification method is not the only way. Still in the New Zealand water, the population there are observed to be composed of at least 3 sub-populations (North-only; South-only; Both) which is related to their geographic distribution [2]. In this way of sorting, the association indices of both sides are much less than others. This might be because migration of a community requires an all-round consideration as the destination may not be suitable.

2.4. Social aspect

Because of their high intelligence, Orcinus orca has their own social life. Some behaviors such as sharing food can even help to raise the association indices. At the same time, to avoid the situation of depopulation in sub-population groups, the sex ratio is always similar in each of the associations [8]. Rich social life represents a highly structured social system. As the ecosystem is changing, cetaceans often modify their distribution pattern to reduce the reductions in population and other effects from social structure. Research observed the distribution patterns of southern resident Orcinus orca. In the inshore waters of Washington and British Columbia which is the main habitat for southern resident killer whales in Summer, there are 3 distinct pods of orcas. The result of the research about summer distribution and variation in the sighting density indicates the specialization that some areas are almost used by certain individual pods. Thus different pods will live in distinct habitat conditions, creating variable behaviors to face different risks and finally influencing the mortality rate [4].

The southern resident orca population consists of 3 long-tern matrilineally related pods, figure 6 clearly shows the Kernel density distribution for each group. In the aspect of space use, even though all of them have a huge distribution in the Haro Strait, the J group seems to be more concentrated in the northern part which is near the Boundary Pass than others, and the L group shows the greatest variation as its density in the Strait of Juan de Fuca is much higher than J and K group. K group does not have extensive use of surrounding water [4].

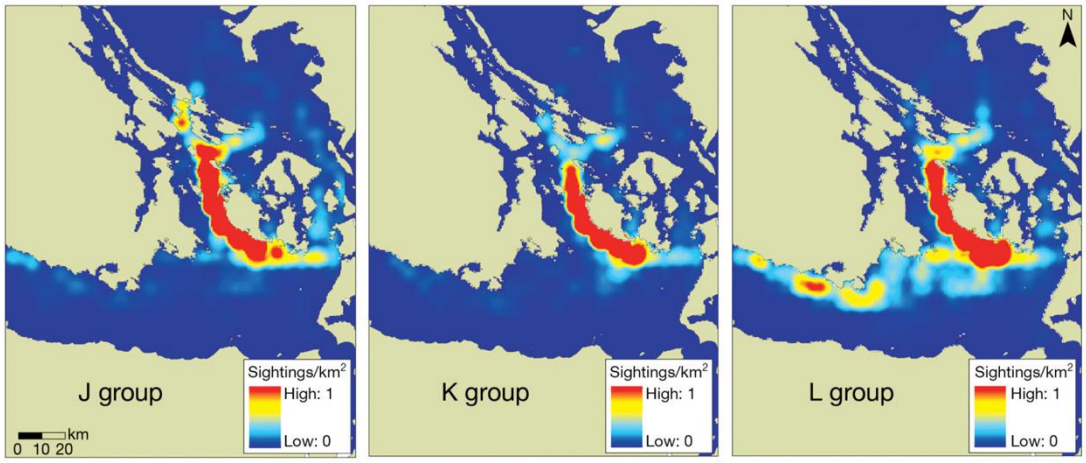


Figure 6. Density of sighting for J,K,L each group [4].

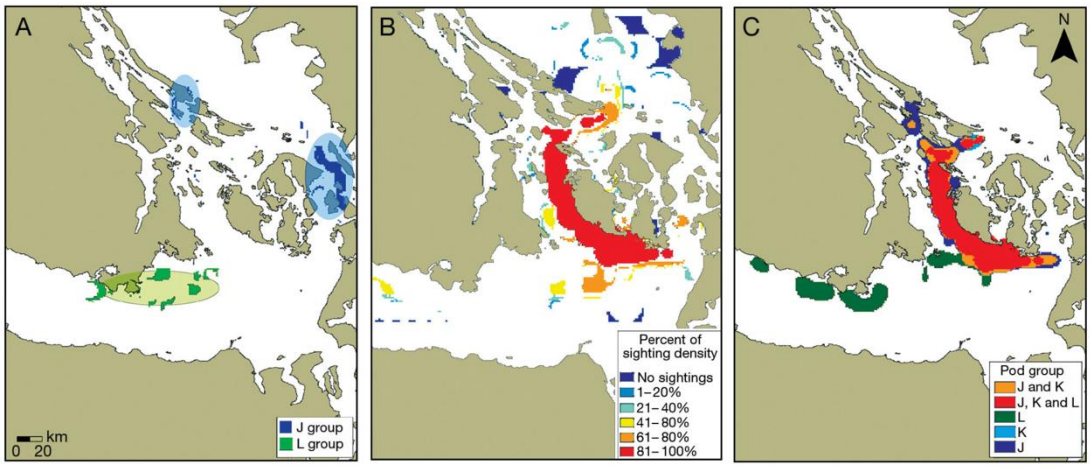


Figure 7. The distribution of only one group (A) and all three groups (C) with the sighting density shown in (B) [4]

From figure 7(B), it is significant that the Haro Strait is the highest-density area. In figure 7(A), the specialized areas are shown, the L pod has the widest activity range from the Haro Strait which reached. Figure 7(C) shows the complete pods distribution. However, this is the result for Summer. The changing weather conditions may bring a new distribution of these southern resident orca pods. Also, the prey availability such as herring distribution changing through different seasons may affect the pods' location. Another research found that the connection level of social network became higher [8].

Orcinus orca also have their language system in distinct association. It was recorded that orca has group-differentiated vocal dialects with some unique call types which may be non-genetically and related to their traditions. The way to transmit dialects is supposed to be imitation as it cannot be explained by environmental or genetic factors. Research shows that the tested orca correctly copied all of the trained sounds. The visual examination presents a similar result to the acoustic features [9].

2.5. Captivity

Orcinus orca in captivity are always facing amounts of harmful effects such as abnormal behaviors and higher morbidity and mortality rates caused by infectious diseases. Orcas are social animals, thus they have the requirements for social life [5]. An orca called Kandu V who was a captive orca at the Sea World of California, died because its artery at the upper jaw was severed. The reason for this wound is the conflict between orcas from different association backgrounds. Besides the social factors, captured orca's teeth are also always in an unhealthy status. During the training, steel gates are used to separate them. However, it is common for them to bite the metal bars and concrete corners of the

pool. This leads to the result that the pulp of some teeth is exposed. The reaction of its immune system is inflammation and the treatment which is usually used is called 'pulpotomy', by using a drill. Orcas present to be refused, but without this therapy, they will be easily infected by potentially life-threatening bacteremia, sepsis and more related diseases. According to observation, an abnormal bending of the dorsal fin (Fig. 8) is almost only found in captive orcas as well. 100% of captive adult male orcas have collapsed dorsal fins, and 1% in the wild have the same symptom(See Figure 8)[10].



Figure 8. Comparison of dorsal fin between a captive orca(left) and a wild orca(right) [10]

With its skin, sunburn could be a serious problem. High levels of UV radiation can result in cataracts. Tanks of orcas are shallow and clear and have weak protection from the sun's rays. It may finally cause accidental injury to trainers. Another important factor that influences life expectancy is the food resources. Orcas in the wild do not eat dead animals in normal situations, but orcas in captivity are forced to eat frozen-thawed fish with limited species. Therefore, they are often facing the problem of vitamin deficiency [10].

3. Conclusion

Orcinus Orca is a highly intelligent species that needs open water and the company of their association. In their culture, there are multiple kinds of traditions and unique behaviors and languages. They are able to change their hunting strategies in different environmental conditions. The captivity of orca should be controlled as they are actually experiencing pain in both physical and mental states. It is hard to keep a healthy mental state if orcas are not living with their social group as they are typically social animals. Forcing them to live in cramped conditions and forcing them to train for performance is cruel and goes against their actual survival mode.

References

[1] John K.B. Ford, K - Killer Whale: Orcinus orca, Editor(s): William F. Perrin, Bernd Würsig, J.G.M. Thewissen, 2009, Encyclopedia of Marine Mammals (Second Edition), Academic Press, Pages 650-657, ISBN 9780123735539

[2] Rune Dietz, Audun H. Rikardsen, Martin Biuw, Lars Kleivane, Christina Lehmkuhl Noer, Dominique Stalder, Floris M. van Beest, Frank F. Rigét, Christian Sonne, Martin Hansen, Hanne Strager, Morten Tange Olsen.(2020) Migratory and diurnal activity of North Atlantic killer whales (Orcinus orca) off northern Norway. Journal of Experimental Marine Biology and Ecology. Volume 533, 151456, ISSN 0022-0981.

[3] K Hupman, IN Visser, E Martinez & KA Stockin (2015) Using platforms of opportunity to determine the occurrence and group characteristics of orca (Orcinus orca) in the Hauraki Gulf, New Zealand, New Zealand Journal of Marine and Freshwater Research, 49:1, 132-149

[4] Hauser DDW, Logsdon MG, Holmes EE, VanBlaricom GR, Osborne RW (2007) Summer distribution patterns of southern resident killer whales Orcinus orca: core areas and spatial segregation of social groups. Mar Ecol Prog Ser 351:301-310.

[5] Lori Marino, Naomi A. Rose, Ingrid N. Visser, Heather Rally, Hope Ferdowsian, Veronica Slootsky.(2020) The harmful effects of captivity and chronic stress on the well-being of orcas (Orcinus orca), Journal of Veterinary Behavior, Volume 35, Pages 69-82, ISSN 1558-7878

[6] Visser, I. (2000). Orca (orcinus orca) in New Zealand waters (Doctoral dissertation, ResearchSpace@ Auckland).

[7] Towner, A. V., Kock, A. A., Stopforth, C., Hurwitz, D., & Elwen, S. H. (2023). Direct observation of killer whales preying on white sharks and evidence of a flight response. Ecology, 104(1), e3875.

[8] Emma A. Foster, Daniel W. Franks, Lesley J. Morrell, Ken C. Balcomb, Kim M. Parsons, Astrid van Ginneken, Darren P. 2012, Croft, Social network correlates of food availability in an endangered population of killer whales, Orcinus orca, Animal Behaviour, Volume 83, Issue 3, Pages 731-736, ISSN 0003-3472

[9] José Z. Abramson, Mª Victoria Hernández-Lloreda, Lino García, Fernando Colmenares, Francisco Aboitiz, Josep Call (2018) Imitation of novel conspecific and human speech sounds in the killer whale (Orcinus orca). Proceedings of the Royal Society B: Biological Sciences.

[10] Jett, J., & Ventre, J. (2011). Keto and Tilikum express the stress of Orca captivity. The Orca Project, 21.