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**Dialects and Vocal Learning in Resident Killer
Whales**

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Introduction

The killer whale, *Orcinus orca*, is a highly intelligent marine mammal which displays both cultural and vocal attributes long considered to be the sole preserve of humans but which are now increasingly being shown to exist within the animal kingdom, particularly with respect to cetaceans (Filatova *et al.*, 2007 and Whitehead *et al.*, 2004). Killer whales have their own distinct culture which differs between clans. They also display distinct dialects and are capable of vocal learning.

Killer whales are split into three distinct ecotypes according to factors which include physiology (fin shape, saddle patch etc), diet, family relationships and vocalisations (Filatova *et al.*, 2007 and Killer Whale.org: <http://www.killerwhale.org/index2.html>). The three ecotypes are resident killer whales, transient killer whales and offshore killer whales. The cultures and discrete call types of these three ecotypes differ enormously, with resident killer whales using vocalisation more extensively than transient and offshore killer whales which tend to be somewhat quieter (Centre for Whale Research: <http://www.whaleresearch.com/research.html> and Killer Whale.org: <http://www.killerwhale.org/index2.html>).

Resident killer whales are the most studied in terms of vocalisation, in part as they are easy for researchers to locate and identify, but also due to their use of dialects and the family structure they exhibit. Resident killer whales live in matriarchal family groups called the matriline, which is based around one female or matriarch and between one to four generations of her offspring (Deecke *et al.*, 2000). It is interesting to note that the sons of the matriarch, not only her daughters, live with their mother their entire lives with dialect shown to be an important contributing factor in the prevention of inbreeding (Filatova *et al.*, 2007).

The matriarch and her family socialise and live in a pod with other killer whales with whom they are related, therefore they share the same vocalisations. Pods that share vocalisations, and in particular call types, with other pods can be said to be part of a wider clan (Filatova *et al.*, 2007). Clans in turn reside within a larger community which may travel together. Different communities such as the northern and southern resident killer whales of the Northeast Pacific are genetically distinct and do not mix or mate with each other, despite the fact that their territories may overlap (Whitehead *et al.*, 2004). These communities also have very different dialects and vocalisations (Centre for Whale Research: <http://www.whaleresearch.com/research.html>)

Resident killer whales clans therefore have their own dialects and culture. In addition they are capable of vocal learning and transmission of that culture through vocalisation. This is demonstrated in three recent research papers written by Foote *et al.*, (2006), Deecke *et al.*, (2000) and Filatova *et al.*, (2007).

Material and Methods

Each of Foote *et al.*, (2006), Deecke *et al.*, (2000) and Filatova *et al.*, (2007) used similar methods to monitor the killer whales that were part of their study. Hydrophones were used to record underwater vocalisations made by the whales. Filatova *et al.*, (2007) used only boat based sound recordings, with Foote *et al.*, (2006) and Deecke *et al.*, (2000) using both land based and boat based sound recordings.

Discussion

Dialects and Culture

Clans of resident killer whales have their own culture, dialects and vocal traditions which are passed down through the generations, both within the pod and vertically within the matriline. Killer whale calves learn their vocalisations and call types primarily from their mother and immediate family but also from the other members of the pod in which they live (Filatova *et al.*, 2007 and Killer Whale. org: <http://www.killerwhale.org/index2.html>). It has even been shown that killer whale calves go through a learning phase of babbling in a remarkably similar way to a human child, and must practise their vocalisations until they can match the vocalisations of the adults within their pod (Foote *et al.*, 2006). Within the same pod different matriline of killer whales may display very subtle differences in their shared call types which indicates that the majority of a calves education and vocal learning comes specifically from its mother and immediate family (Deecke *et al.*, 2000 and Filatova *et al.*, 2007). This is not unexpected given the very strong lifelong bond that exists between a resident mother and her offspring.

Very few mammals other than humans possess a distinct culture and have different dialects (Whitehead *et al.*, 2004) and arguments have often been put forward to try and disprove the existence of culture and dialects within the animal kingdom. One argument is that geographical isolation can account for differences in behaviour; and that what looks like a culture is merely genetic variation at play (Filatova *et al.*, 2007 and Foote *et al.*, 2006). This is a more persuasive argument in terms of land mammals, but it does not readily apply to communities of resident killer whales where the situation is rather more complex.

Although there are clear genetic distinctions between communities of killer whales and between the differing ecotypes, there is no real geographical isolation (Whitehead *et al.*, 2004). When studying the resident killer whales of the Northeast Pacific it can be observed that the territory of one resident community may not only overlap with other resident communities but also with the territory of transient killer whales (Centre for Whale Research: <http://www.whaleresearch.com/research.html>). Therefore the whales have ample opportunity to interact and interbreed should they so wish, although in practice different communities are never seen together (Killer Whale. org: <http://www.killerwhale.org/index2.html>). Not only do culture and dialect exist within killer whale communities, it is believed that dialect plays a crucial role in preventing

interaction between differing communities and it also acts to prevent inbreeding within pods (Filatova *et al.*, 2007). Males breed with females of different clans but within the same community (Filatova *et al.*, 2007 and Killer Whale.org: <http://www.killerwhale.org/index2.html>). Therefore resident killer whales only mate with other whales who sound different from themselves and hence prevent inbreeding; but they will not mate with those whales that sound too different from themselves, for example a different community of resident killer whales, or transient killer whales. In doing this, the unique culture and vocalisations specific to a certain community of resident killer whales is preserved in a wider sense by phenotactics (Filatova *et al.*, 2007), whilst at the same time the whales do not mate too closely with other family members.

Much of the work done on the dialects of killer whales has been done on the resident killer whales of the Northeast Pacific . However an increasing body of research is being done in Russia, which corroborates the work done on the Northeast Pacific whales. Filatova *et al.*, (2007) studied the vocalisations of resident killer whales residing in a community in South Kamchatka in eastern Russia, in addition to the vocalisations of killer whales not part of this community. Within this community Filatova *et al.*, (2007) was able to identify three distinct clans of resident killer whales according to the differences in their vocalisations. Four main classes of discrete call types were able to be identified which were specific to the South Kamchatka residents and which were not used by other killer whales currently in the area (such as transients). While each clan displayed its own dialect, each of these classes of discrete calls displayed similarities of dialect between the clans. This would suggest that these differences in dialect are a cultural tradition displayed by all of the resident whales of this region and in this community.

Filatova *et al.*, (2007) found that there were four main classes of discrete calls within the community of South Kamchatka residents. Within these four main classes, two main categories of call types were identified: Biph calls and Moph calls. Biph calls have biphonic sounds; that is they have an overlapping high frequency element present. Moph class calls on the other hand do not have an overlapping high frequency element to them and were classified as monophonic sounds. Within the resident South Kamchatka community, 344 Biph class sounds were recorded which were roughly divided into 2 main classes; Biph 1 and Biph 2. Similarly Moph calls could also be separated into Moph 1 and Moph 2 classes, with Moph 1 calls being described as squeak like.

Within the clans of the South Kamchatka residents, and thus within each dialect, there were always two different call classes present, being Biph 1 calls and squeaky Moph 1 calls. All clans except one also used Biph 2 calls. No dialect used solely Biph or Moph calls and Filatova *et al.*, (2007) believe the Biph 1 and Moph 1 class calls are used for communication within the community. Biph 1 class calls were predominantly found to occur when there were many pods in the area. The less pods present the less Biph 1 class calls occurred. From this phenomena and from the unique structure of the calls, Filatova *et al.*, (2007) speculated that Biph 1 class calls,

with their overlapping high frequency, serve as a form of identification within the community. Resident killer whales may even have the capacity to identify between different matriline present in the area by virtue of the Biph 1 class calls used as each pod has its own type of variation on the basic Biph 1 call, with at least eight further subtypes being identifiable which could be specific to a particular matriline.

Filatova *et al.*, (2007) found that Moph 1 class calls were used quite differently from the Biph class calls, their occurrence not differing according to the number of pods in the area, but instead differing according to the type of activity the pods were engaged in at the time.

Filatova *et al.*, (2007) also found that just as with the Northeast Pacific residents (Deecke *et al.*, 2000), each dialect of the South Kamchatka residents has a specific form which is then applied to differing call classes. For example, within the same call class, one clan may use a very developed final element to the call but another clan may have a very weak or non-existent final element, with even more subtle variations existing between pods and matriline.

The work of Filatova *et al.*, (2007) in addition to previous work on Northeast Pacific killer whales strongly suggests that resident killer whales do indeed have culture and dialect. For a time questions did still remain as to whether killer whales were also capable of vocal learning. The earlier work of Deecke *et al.*, (2000) followed by Foote *et al.*, (2006) seem to confirm that vocal learning does indeed take place.

Vocal Learning

Deecke *et al.*, (2000) studied the structure of discrete calls types of two different matriline of northern resident killer whales in the Northeast Pacific, over a period of twelve to thirteen years. Unfortunately only two types of discrete call were studied. It was found that over the time period of the survey, only one of these discrete call types changed, the other remaining constant. Deecke *et al.*, (2000) were able to conclude that over time discrete call types may change within a matriline, with members of different matriline (within the same pod) matching the changes. Not all discrete calls may vary, but those that do change do so by virtue of cultural drift, indicating that vocal behaviour is learned not only vertically within a matriline but also horizontally between matriline within the same pod.

Foote *et al.*, (2006) also studied vocal learning but from a different angle, concentrating on two juvenile resident killer whales who were separated from their matriline at a young age, both between one and two years of age. The separation of a calf from its matriline is exceptionally unusual among resident killer whales, and thus offered a very unique opportunity for study. At the time of recording, one of the whales named Luna was aged approximately five years, the other named Springer was somewhat younger at two years of age. Both were recorded in an area outside the usual range of their pod and were not in the company of other killer whales at the time of recording. Foote *et al.*, (2006) found that both of these calves displayed vocal learning by using call types which differed significantly from that of the pod

and matriline into which they were born. Indeed Luna not only had a very different call type to its matriline, it also produced barks, mimicking the California sea lions which were in the vicinity. The variance in call type from the matriline was constant as Luna was recorded on more than one occasion, in addition Luna's matriline do not produce barks or mimic sea lions in the way Luna was demonstrated to do. The data on Springer was not so comprehensive or persuasive, although Springer also produced calls that were not typical of its matriline. It also must be remembered that Springer was only two years of age at the time of recording and had not been separated from its matriline for an extensive period of time. In comparison, Luna was significantly older at five years of age, and hence had more time to develop a more comprehensive repertoire of vocalisations. Both of these whales are very young, given a killer whale in the wild can live into its seventies or eighties (Centre for Whale Research: <http://www.whaleresearch.com/research.html>) so it would be expected that both Luna and Springer may undergo considerable vocal development both due to physical maturation and in terms of vocal learning.

Unlike birds, vocal learning has not regularly been observed with respect to mammals (Filatova *et al.*, 2007) therefore the work of both Deecke *et al.*, (2000) Foote *et al.*, (2006) was important in demonstrating that vocal learning does indeed take place within killer whale communities. There are two main arguments asserted against vocal learning taking place; the first is that genetic variation is affecting vocalisations, the second that vocalisation changes are due to physical maturation of the whales in question (Deecke *et al.*, 2000 and Foote *et al.*, 2006).

The argument that the ongoing process of physical maturation can account for the variation in the vocalisations of killer whales is not persuasive. The work of Foote *et al.*, (2006) is not useful in this context as both whales studied were physically immature, however the process of physical maturation does not account for the findings of Deecke *et al.*, (2000). The work of Deecke *et al.*, (2000) demonstrated that the rate of change between call types differed, something that would not happen if indeed the variation in call type was due to a physical maturation process where it would be expected that the rate of change of each call type would be affected equally. Genetic variation has also been cited as a reason for change in vocalisations but again Deecke *et al.*, (2000) were able to disprove this theory in relation to their study, as the years in which there was the most variation in terms of the call structure of the matriline, were the years in which the matriline membership remained static in terms of its composition. Similarly Foote *et al.*, (2006) studied two individuals not a group and was able to demonstrate vocal learning by each of these individuals, particularly in relation to the ability of mimicry which is an undoubted example of vocal learning taking place.

Conclusion

The work of Deecke *et al.*, (2000), Foote *et al.*, (2006) and Filatova *et al.*, (2007) show that resident killer whales have their own unique dialects and are capable of vocal learning and cultural transmission via their vocalisations. Calves learn their

vocalisations and call types not just by vertical transmission within the matriline, but also through horizontal transmission between members of the same pod, albeit from different matriline.

Filatova *et al.*, (2007) was able to demonstrate the remarkable ability of resident killer whales to use vocalisations as part of their culture, even being able to recognise different matriline by virtue of their dialect. As humans we live in a very different acoustic world to that of the killer whale and it would come as no surprise to find in years to come, that the dialects and communications of killer whales are far more sophisticated than we initially realised.

The work of Deecke *et al.*, (2000) and Foote *et al.*, (2006) was somewhat limited in terms of the number of whales and vocalisations studied but the work is of great value nonetheless. In particular, it would be interesting to follow up on the work of Foote *et al.*, (2006) and observe the changes in vocalisations of both Luna and Springer as they mature and develop.

Not only is this research important when studying the use of dialects, culture and learning with respect to resident killer whales, it is also important within a far broader context. Studies of this type serve to highlight the many ways in which killer whales are unique, by virtue of the complexity of their culture, vocal learning and social behaviour. Their family relationships, emotional requirements and cognitive abilities are undoubtedly complex, perhaps second only to humans (Whitehead *et al.*, 2004). For these reasons alone, surely it is time to seriously review the ethics and legality of keeping and breeding killer whales in captivity for use in amusement parks. This is perhaps best summed up in a quote by Jacques-Yves Cousteau, which although refers to dolphins, is no less relevant in relation to killer whales: "There is about as much educational benefit to be gained in studying dolphins in captivity as there would be studying mankind by only observing prisoners held in solitary confinement."

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Primary

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Secondary

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