

### ***Topic Summary***

Killer whales (*Orcinus orca*) are incredibly fascinating in the way they have their own 'language' - a set of taught vocalizations that consist of whistles, clicks and burst-pulsed signals that are used in short range echolocation and long range communication (Janik 2009). These sounds originate in a sound producing organ in the nasal passage that allows for the transmittance of sound waves through wide ranges of distance in water (Janik 2009). These structural auditory organs allow for the visualization of sound for orcas, and information such as location, species, relation, and association (to pods, subgroups or other) to be identified (Ford 1991). Passage of this signal from an origin (or signaller) to an intended receiver allows for the exchange of vocalizations associated with orca communication.

Researchers and marine scientists have found innovative, non-invasive methods of recording and observing orcas in context based settings while they make these sounds - such as hunting, migration, transportation, sociality, and parental care. One of the most notable methods is the use of hydrophones and quiet-tracking vessels to catch both video and audio of orcas while they interact with their environment and other individuals. Other study methodologies include, sonar tagging; auditory recording; and a combination of visual and audio tracking that allows for the identification of sound to be traced to a singular orca (Janik 2009). Use of audio mapping is then analysed to see the similarity of calls down matrilineal lines, and across populations through what is called horizontal cultural transmission (Riesch et al 2006).

The first big discovery in the realm of orca bioacoustics was the possibility of 'language' in orcas being taught down matrilineal lines, rather than what was previously assumed to be vocalizations due to genetics. Researchers such as Reisinger et al (2017), Riesch et al (2006) and Samarra (2015) created studies exploring how the passage of information was predominantly vocal, and that these vocal signals were similar in matrilineal units of 2-3 generations. Reisinger's publication studied kinship and division of orca clans down to pods, and then sub groups down to the matrilineal unit - where most basal learning occurred. Resch's publication studied specific call patterns showing indication of relatedness and proximate association to other orcas, and how the greater an orca's call repertoire, the more stable they are within a pod or clan. This idea was only furthered by Samarra's publication on specialization in calls directly correlating to specialization in diet and foraging behaviour.

The discoveries that showed the range of specialization and association of different orcas was based on the discoveries of Ford (1991), and Miller (2000). Both Ford and Miller allowed for the discovery of both the methodology of study that is widely used in marine bioacoustic study today. Ford's discovery of distinction between call types, the classification of calls, and the creation of a database of orca acoustic recordings allowed for Miller's postulation on

multi-directionality and movement cueing in orca signalling. Janik (2009) then synthesized this information and allowed for the processes of acoustic signalling from an anatomical perspective of all delphinids to be widely accessible to new researchers to build a deeper understanding of cetacean communication.

Researchers and studies such as Riesch & Deecke (2011), Miller & Bain (2000), Filatova et al (2012) and Miller et al (2004) have found that the presence of dialectic separation in orcas after studying the foundation texts of Ford and team, and discovered what horizontal cultural transmission is, and how it affects different populations of orcas. The variations between generations and association of calls due to joint predation events and passing mating events allowed for dialectic differences to be identified due to differences between a matriline as its progeny. This also developed the idea of ecotypes, and how ecological isolation results in isolation and internal transmission of cultural and social skills that develop the overall specialisation of an orca's call repertoire (Riesch & Deecke 2011).

However, despite the ground breaking research done by marine biologists and orca behaviour specialists, there is little known about the relation of resident versus transient communication, and how transmission language occurs in highly migratory species - as seen in Riesch & Deecke (2011), Reisinger et al (2017), and Ford (1991).

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