Cultural evolution of close-range killer whale calls

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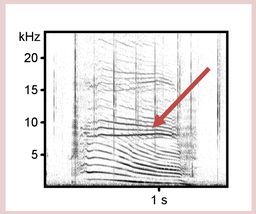
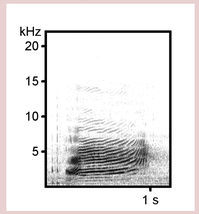
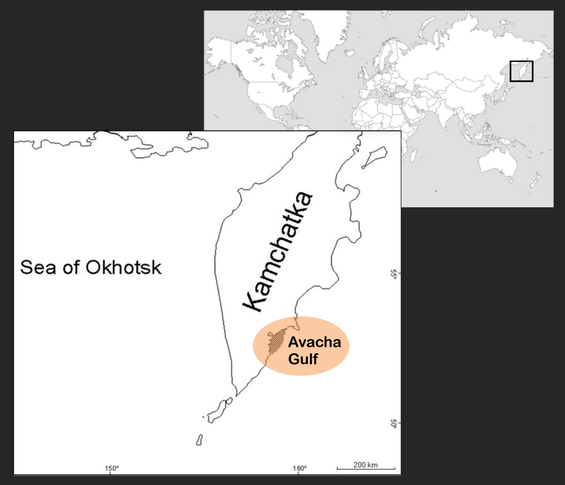
Introduction

- Resident (fish-eating) killer whales in the North Pacific live in stable matrilineal groups (matrilines).
- Each matriline has a repertoire of stereotyped calls – a vocal dialect.
- Vocal dialects are transmitted across generations through vocal learning and change with time as matrilines diverge and their social bonds fade.
- There are two main types of killer whale calls:

Biphonic	Monophonic
Contains an overlapping high-frequency component 	**Without** an overlapping high-frequency component 
Long-range calls – they are **louder**	**Close-range calls** – they are **quieter**
Mixed-directional - may provide information on the orientation of a caller	**Do not** have this feature
Are more common when **more than one pod** is present in the area	Dominated the vocalizations when a **single pod** was present
Are highly stereotyped and group-specific	Less stereotyped **Less studied**

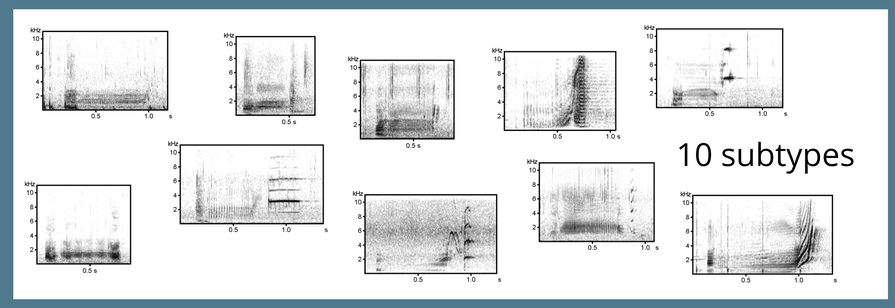
- These differences suggest that close-range and long-range calls can have different functions and follow different trajectories of cultural evolution.



Location of the Avacha Gulf (Russian Far East), where the data was recorded

Results

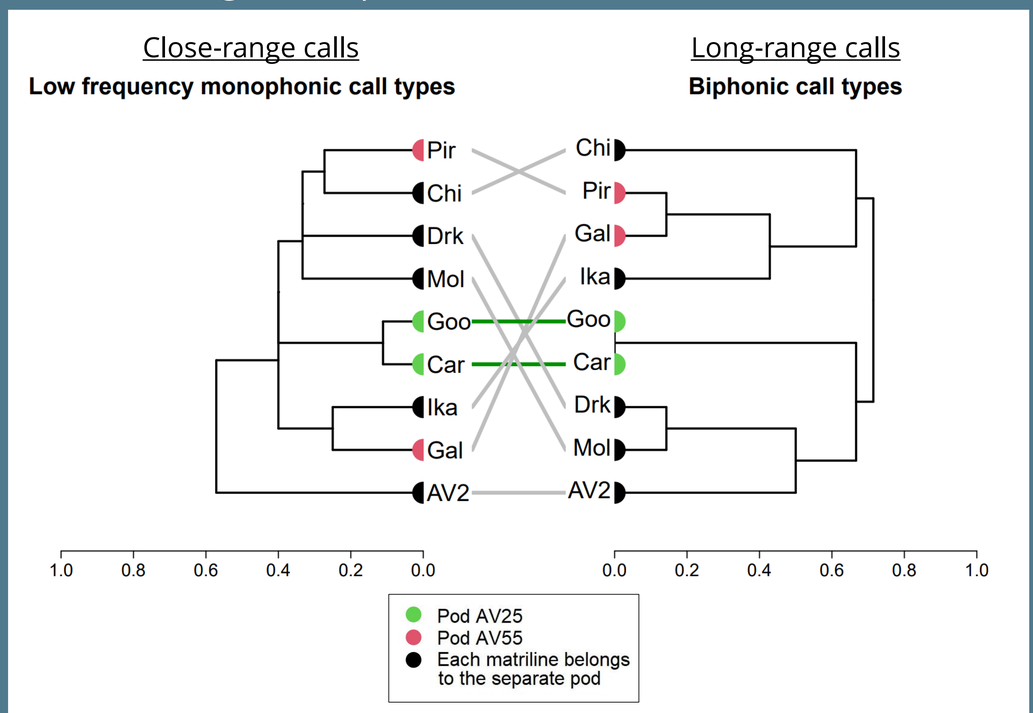
1) The new classification of **K12** was created:



2) We used literature data describing the matrilineal repertoires from previous studies

Filatova, O. A., Ivkovich, T. V., Guzeev, M. A., Burdin, A. M., & Hoyt, E. (2017). Social complexity and cultural transmission of dialects in killer whales. *Behaviour*, *154*(2), 171-194.

1 + **2** = Similarity dendrograms of the long-range and close-range call repertoires of 9 matrilines were created:



Comparison result - similarity patterns are different:

- Most matrilines that have similar repertoires of long-range calls have very different repertoires of close-range calls and vice versa.
- The repertoire of close-range calls were more homogeneous and less clustered with a smoother gradient of repertoire similarities between matrilines.

Aims

To test the hypothesis of the existence of differences between the trajectories of cultural evolution of close-range and long-range killer whale calls (fish-eating ecotype) in the Northwest Pacific (Kamchatka, Avacha Gulf), we:

1. Created a more detailed classification of **K12** call type - very common close-range call type in Avacha Gulf clan.
2. Compared the repertoires of close-range and long-range calls of a few matrilines from the same clan of fish-eating killer whales.

Methodology

- We analyzed more than 16 hours of recordings of resident killer whales sounds, recorded during 13 seasons from 2005 to 2022 in Avacha Gulf (Eastern Kamchatka, Russia).
- Spectrogram images were made with Avisoft SASLab Pro software.
- Auditory and visual classification by distinctive structural characteristics.
- To compare the repertoires, the similarity index was calculated:

$$\frac{2(N_c + N_s)}{R_1 + R_2}$$

N_C – total number of call types shared
N_S – total number of subtypes shared
R_1 and R_2 – repertoire sizes (call types plus subtypes) of two pods

Conclusion

- We found that similarity patterns were different for close-range and long-range calls.
- These differences suggest that close-range and long-range calls can follow different trajectories of cultural evolution.

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