

# Classification of *Kogia* spp. echolocation clicks and temporal trends at Hawai'i Island

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## **Abstract:**

The cryptic species of the genus *Kogia*, including the dwarf sperm whale (*K. sima*) and the pygmy sperm whale (*K. breviceps*), are known primarily from strandings and rare sightings throughout the world's tropical and temperate oceans. Their low profile and quiet behavior at the surface make them very difficult to observe in any but the most calm sea conditions. However, recent recordings of signals from wild and captive animals reveal that they echolocate at high frequencies (peak frequencies > 100 kHz), which makes passive acoustic monitoring (PAM) a possibility.

For successful PAM a species must be distinguishable from other species based solely on acoustic characteristics, and sufficient recordings must be made to confidently identify those characteristics. We sought to increase the sample of *Kogia* clicks collected in the wild by deploying a High-frequency Acoustic Recording Package (HARP) sampling at 320 kHz off the Big Island of Hawai'i in the fall of 2014. In this area *Kogia* spp. (primarily *K. sima*) have been sighted with regularity, and no other species that make high-frequency clicks are known to occur. This recording produced a sample of more than 5000 high-frequency clicks from 98 encounters, identified through a combination manual/automated click detection process. Comparison of these clicks to other recordings of *Kogia* and other species with similar high-frequency clicks (e.g. Dall's porpoise, harbor porpoise) show that inter-click interval and click duration can be used to distinguish the *Kogia* spp. from species in other genera. Consistent click characters across encounters and rare sightings of *K. breviceps* in the region suggest our recordings are from *K. sima*, though available data and analyses to date do not allow for absolute determination of species identification.

Examination of *Kogia* clicks recorded at 320 kHz sample rate suggest that it is possible to detect this species using 200 kHz sample rate data from HARPS due to an aliasing feature, which is the most common sample rate used with HARPs. Examination of multiple years of HARP data from the Kona site reveal regular occurrence in this region, with clusters of acoustic encounters occurring on average every two weeks.

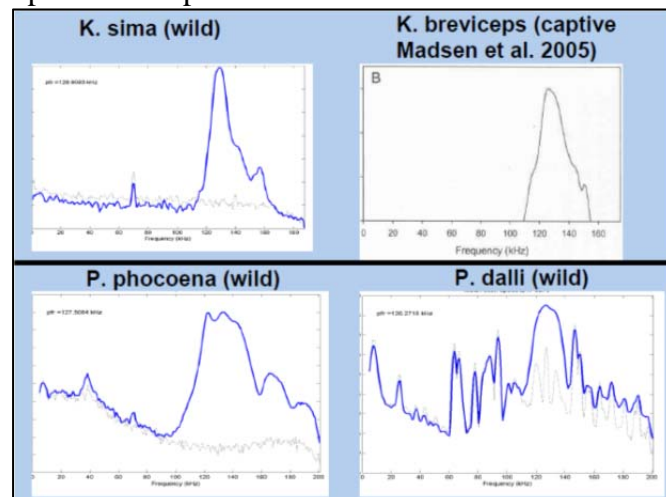
## Presentation Summary:

- Very little is known about the two *Kogia* species beyond what can be learned from stranded animals. There is even less known about their acoustics because of the high frequencies of their echolocation clicks.
- Recordings are gradually being made that facilitate characterization of the two species' calls, particularly opportunistic, high frequency recordings in the wild and captivity (rehabilitated animals). Also available are calls from HARP data from regions where there are no other species that make similar calls (e.g. Gulf of Mexico, Hawai'i, etc.), sampled at 320 kHz or aliased in data sampled at 200 kHz. Here recordings from multiple sources are compared to illustrate the possibility of acoustically distinguishing *Kogia spp.* from other species with high frequency clicks, primarily Dall's and harbor porpoise.
- Please note: this is a VERY SMALL data set, presenting valuable information, but with limited power to draw conclusions. Also, this data set should NOT be used to distinguish the two porpoise species. Please see published references for more information, such as Kyhn LA, Tougaard J, Beedholm K, Jensen FH, Ashe E, et al. (2013) Clicking in a Killer Whale Habitat: Narrow-Band, High-Frequency Biosonar Clicks of Harbour Porpoise (*Phocoena phocoena*) and Dall's Porpoise (*Phocoenoides dalli*). PLoS ONE 8(5): e63763. doi:10.1371/journal.pone.0063763.
- Neither peak frequencies nor spectral shape can be used to distinguish the two *Kogia* species or to separate them from porpoise living in the same region based on this limited data set.

### ○ Peak Frequency examples

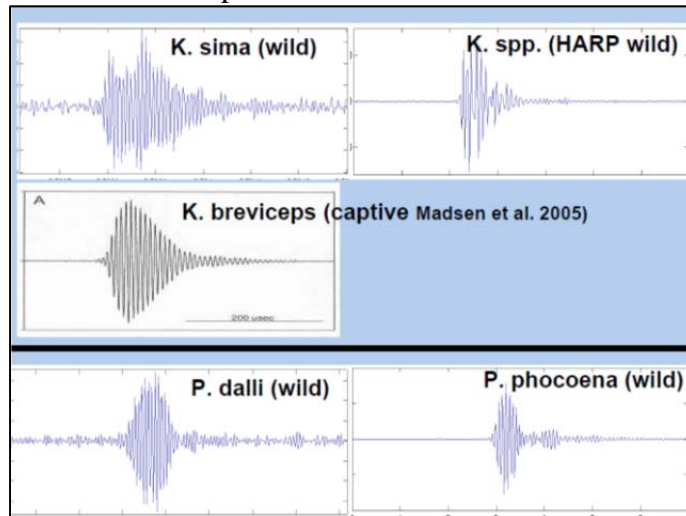
Species	Peak Frequency (kHz)
<i>K. Sima (wild)</i>	129
<i>K. Breviceps (captive, Madsen et al. 2005)</i>	130
<i>P. Dalli (wild)</i>	126
<i>P. Phocoena (wild)</i>	127

### ○ Spectra examples



- Waveform is not a clear distinguishing feature based on this data set.

- Waveform examples:

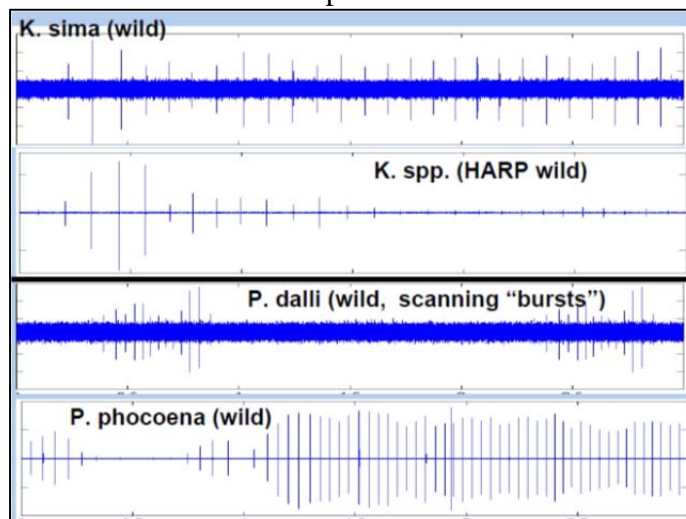


- Click duration may prove to be useful for distinguishing the *Kogia* species from the porpoise species, and inter-click-interval is likely to be characteristic.

- Click duration and inter-click-interval examples:

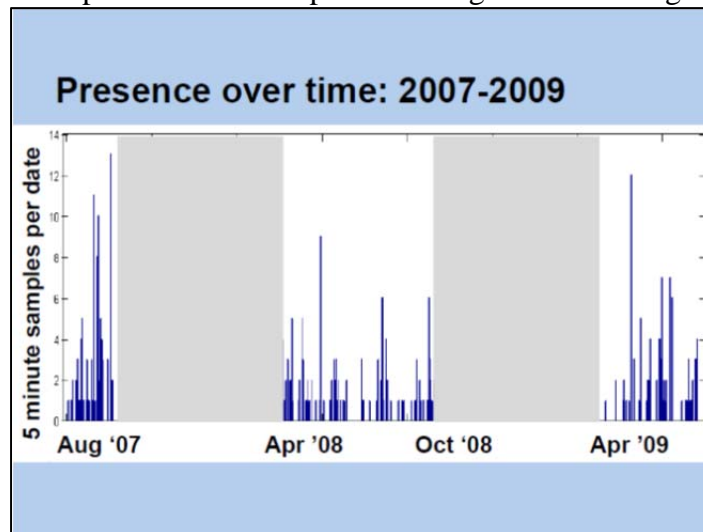
Species	Click duration (us)	Inter-click-interval (ms)
<i>K. sima</i> (wild)	110	118
<i>K. spp.</i> (HARP wild)	68	108
<i>K. breviceps</i> (captive Madsen et al. 2005)	120	-
<i>P. dalli</i> (wild)	55	71
<i>P. phocoena</i> (wild)	99	73

- Inter-click-interval examples



- Long-term passive acoustic monitoring off Hawai'i Island reveals consistent presence over years and likely over seasons, and is the first long-term monitoring effort based on detections of healthy, wild animals. Based on visual surveys these are likely only *K. sima* (see Baird RW, Webster DL, Aschettino JM, Schorr GS, McSweeney DJ. (2013) Odontocete Cetaceans Around the Main Hawaiian Islands: Habitat Use and Relative Abundance from Small-Boat Sighting Surveys. Aquatic Mammals 39(3), 253-269, DOI 10.1578/AM.39.3.2013.253.)

- Example time series of presence August 2007 – August 2009



- Example time series of presence in spring-fall months

