Gervais’ Beaked Whale (*Mesoplodon europaeus*)

Auditory Evoked Potential (AEP) Hearing Measurements

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Abstract

Several mass strandings of beaked whales have recently been correlated with military exercises involving mid-frequency sonar, highlighting unknowns regarding hearing sensitivity in these species. We report the hearing abilities of a stranded juvenile beaked whale (*Mesoplodon europaeus*) measured with auditory evoked potentials (AEPs). The beaked whale’s modulation rate transfer function (MRTF) measured with a 40 kHz carrier showed responses up to an 1800 Hz amplitude modulation (AM) rate. The MRTF was strongest at the 1000 Hz and 1200 Hz AM rates. The envelope following response (EFR) input-output functions were non-linear. The beaked whale was most sensitive to high frequency signals between 40-80 kHz, but produced smaller evoked potentials to 5 kHz, the lowest frequency tested. The testing method using a jawphone in water was ground-truthed with AEP measurements of three bottlenose dolphins, for which behavioral audiograms had been previously measured. The beaked whale hearing range and sensitivity are similar to other odontocetes that have been measured.

A single, 181 kg juvenile male beaked whale (*Mesoplodon europaeus*; HBOI-Mo-01402) live-stranded ocean-side near the south edge of St. Lucie Inlet, FL on July 20, 2004. The whale was transported to Harbor Branch Oceanographic Institution, where it was maintained in an above-ground pool (approximate 1.5 m depth).

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AEP Measurements

- **Electrodes**:
  - **Jawphone**:

Sound Presentation:

- Sounds were presented with a jawphone into the animal’s mouth at the surface.

Evoked Potentials: Evoked potentials were recorded from surface suction cup silver chloride electrodes.

**Modulation Rate Transfer Function (MRTF)**

- Beaked whale modulation rate transfer function measured with a 40 kHz carrier tone at 130 dB re 1 uPa at various amplitude modulation rates.
  - The MRTF took approximately 2 minutes to measure.
  - Largest EFRs from 600-1200 Hz AM rates

**AEP Input-Output Functions**

Beaked whale input-output functions of evoked potential level as a function of stimulus sound pressure level (SPL). Carrier tones were amplitude modulated at 1200 Hz. The responses are non-linear.

**Beaked Whale AEP Audiogram**

- The AEP audiogram is presented as the lowest sound pressure levels (SPLs) for which an evoked potential could be detected at each test frequency, because of the non-linear nature of the input-output functions.

Ground-Truthing Against Known Behavioral Thresholds

To test how closely the setup using a jawphone and AEP measurements match behavioral hearing estimates, the same setup and technique were used to measure hearing in three bottlenose dolphins (*Tursiops truncatus*) for which behavioral audiograms had been previously collected at SPAWR.

- **AEP audiogram measured from Blue (BLU) in pool.**

Conclusions

- The beaked whale AEP audiogram is similar to other odontocetes, with sensitive high-frequency hearing, and decreasing sensitivity to low frequencies.
- AEPs are useful for making rapid hearing assessments of stranded marine mammals.