## Estimated Auditory Bandwidths for Marine Mammals and Fish

| Functional Hearing Group | Estimated Functional Hearing Frequency Range* | Maximum Sensitivity Range or Peak Sensitivity* |
|---|---|---|
| **Low-Frequency Cetaceans** | | |
| All baleen whales | 7 Hz to 22 kHz | |
| **Mid-Frequency Cetaceans** | | |
| Odontocete species | 150 Hz to 160 kHz | |
| Killer whale | 50 Hz to 100 kHz | ~ 15 kHz |
| **High-Frequency Cetaceans** | | |
| Odontocete species | 200 Hz to 180 kHz | |
| Harbor porpoise | 200 Hz to 180 kHz | 16 to 140 kHz |
| **Pinnipeds in water** | | |
| All | 75 Hz to 75 kHz** | 700 Hz to 20 kHz |
| Steller sea lion | 500 Hz to 32 kHz*** | |
| **Pinnipeds in air** | | |
| All | 75 Hz to 30 kHz** | |
| **Fish** | | |
| | 20 Hz to 1000 Hz**** | |

The dominant frequencies from pile driving (impact or vibratory) are typically below 1,000 Hz. Thus, pile driving sounds are in the mid- to low-frequency range.

**Low-Frequency Cetaceans** - all mysticetes or baleen whales

**Mid-Frequency Cetaceans** - all odontocete species (dolphins, including Pacific white-sided dolphin, and porpoises) not included in the low or high frequency groups

**High-Frequency Cetaceans** - harbor and Dall's porpoise, river dolphins

**Pinnipeds in water** - seals, fur seals and sea lions

**Pinnipeds in air** - haul out sites

* Unless otherwise noted, source of estimated hearing ranges and maximum sensitivity ranges are from Southall et al. 2007, 73 FR 41318 - July 18, 2008, and 73 FR 60836 - October 14, 2008. Southall et al. (2007) designated these "functional hearing groups" for marine mammals and estimated the lower and upper frequencies of functional hearing of these groups. In general, animals are less sensitive to sounds at the outer edge of their functional range and most sensitive to sounds of frequences within a smaller range somewhere in the middle of their functional hearing range (73 FR 60836).

** These ranges are essentially based on data for phocid seals, which have the broadesty auditory bandwidths of the pinnepeds (Southall et al. 2007)

*** Source: NOAA Fisheries NMFS Memorandum Guidance on ESA-Listed Marine Mammal Consultations (available: http://www.wsdot.wa.gov/Environment/Biology/BA/default.htm#GuidMarineMamm)

**** Source: Hastings and Popper 2005 (http://www.dot.ca.gov/hq/env/bio/files/Effects_of_Sound_on_Fish23Aug05.pdf)

1 Hz = 0.001 kHz

1 kHz = 1000 Hz