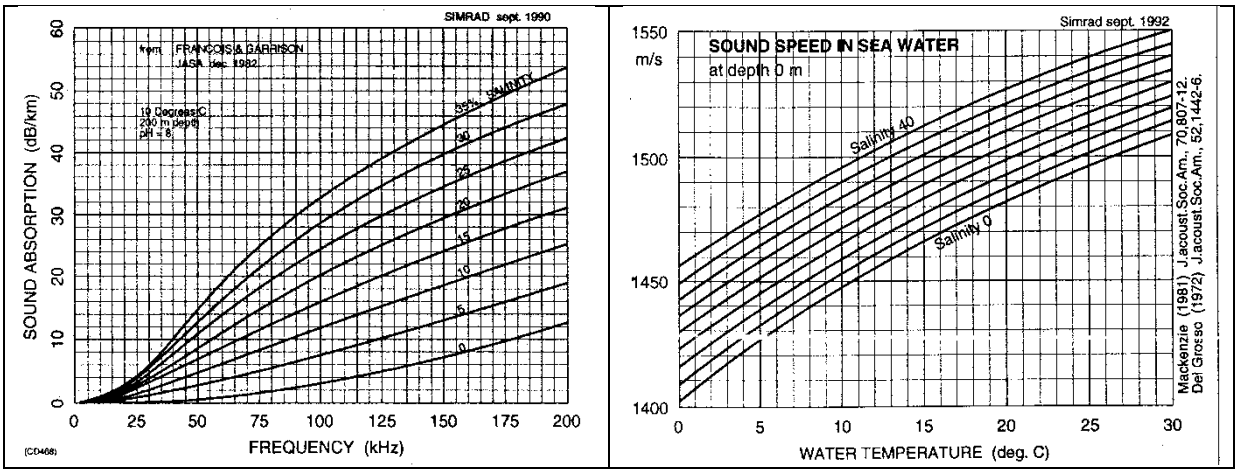
FISH538: Assignment 4 (optional)

1. (4) Bubble curtains are used as sound barriers to reduce noise from pile driving and to protect dolphins in a pen. Using the concept of acoustic impedance a) define the term using a(n) equation(s), and b) illustrate/describe how bubbles make a good sonic barrier.

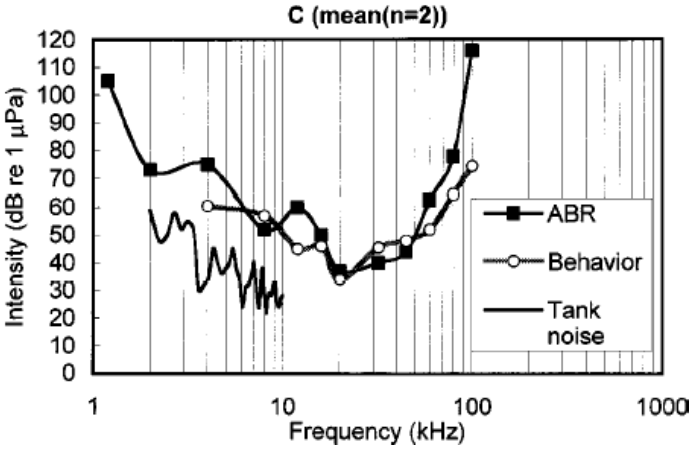
2. (4) You are enjoying a pleasant morning on your research vessel in the San Juan Islands and are dragging a calibrated hydrophone off your starboard quarter just for fun. How sensitive would your equipment need to be to receive a killer whale echolocation (center frequency 50 kHz) signal with a source level of 150 dB re 1 µPa at a 750 m range?



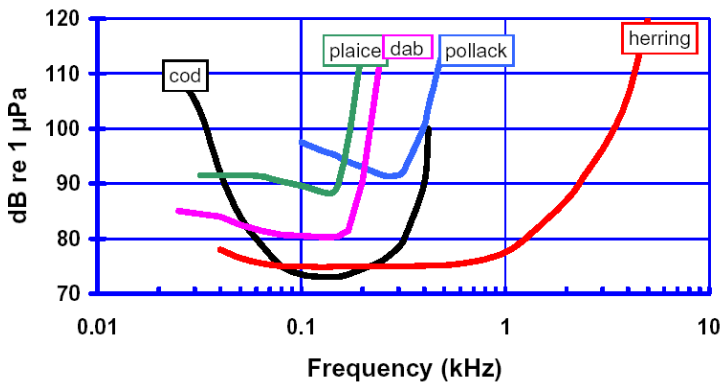
Make sure to state environmental assumptions used in solving the question.

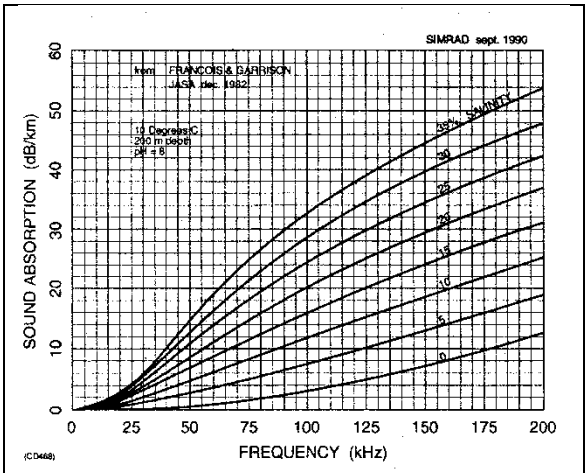
3. (6) Your NSF research proposal objective is to document the effect of killer whale feeding on fish using the research vessel 'Tridens.' You are concerned that mechanical noise from the vessel will cause avoidance by fish and/or whales. Using data extracted from the figures below, calculate the maximum distance at which a) herring and b) killer whales will detect the vessel. If the reaction threshold by herring is 30 dB above detection, c) what is the expected reaction distance of herring? Below 1 kHz, assume killer whale hearing threshold remains constant and that sound attenuation can be ignored.

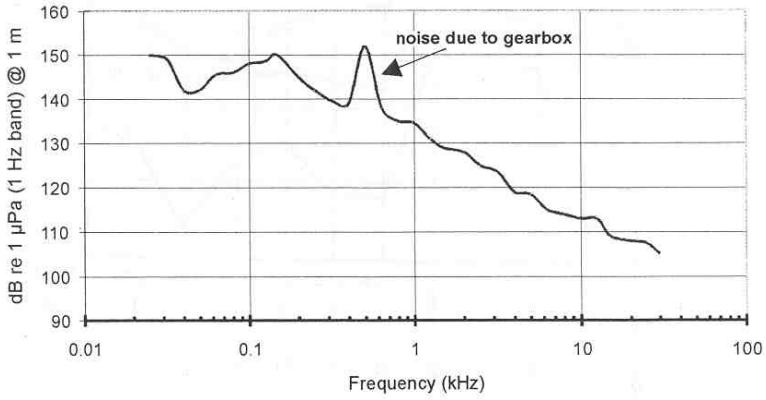
Killer whale hearing threshold



Fish hearing thresholds







4. (6) A colleague at IRD (Institut de recherche pour le développement) in France is working on a project at La Reunion Island (off eastern Africa) where sharks have begun to attack surfers. The science team wants to tag sharks with active acoustic tags. For many reasons, it is preferable to place the tags inside the sharks, but it is unknown if an internal placement will significantly reduce the detection range of the tags, and that sharks with internal tags would not be detected at distances comparable to those with external tags.

   a) Outline the analytic steps and show the equations that you would use to calculate detection ranges of sharks with external tags compared to those with internal tags.
   b) List 2 sets of measurements (1 field, 1 laboratory) that are needed to verify your calculations in part a.

   Bonus (1): What do you think would be the largest source of signal attenuation and why?