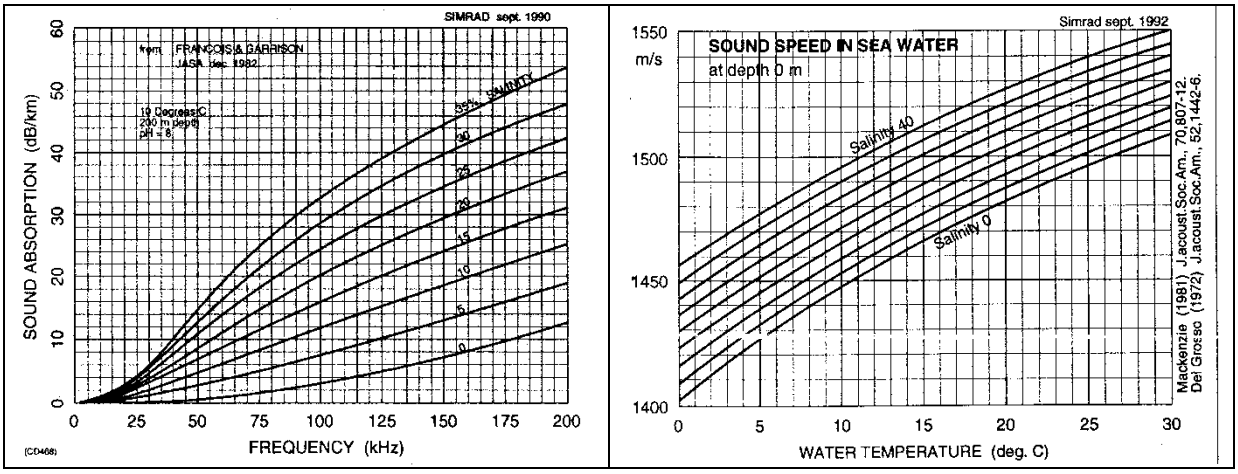
FISH 538: Practice Problems for Midterm

1. (4) You have just been contracted by the Bonneville Power Administration to map trajectories of individual Chinook salmon (*Oncorhynchus tshawytscha)* as they migrate downstream towards a fish bypass at a hydroelectric dam in the Columbia River. Target tracking is the combination of successive echoes from a single target in three dimensions. You don't want to double track any fish so sampling will be from the bypass upriver. Your boat travels upstream at 3.5 knots over ground. The fish are moving toward the dam at 1.35 knots. You have a 7 degree transducer (between half power points). The entrance to the dam bypass is at 41 m depth. What is the minimum ping rate required to get at least 5 echoes to form a track from a Chinook approaching the bypass? Include one or more diagrams to illustrate your calculations.

2. (3) 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 questions.

3. (4) In an effort to reduce noise at depth in a 200 kHz data set, an unnamed laboratory subtracted 20 dB from echo integral values from 70 m depth to the bottom (100m).

   a) What term in the sonar equation was violated?

   b) Plot the original term and the modified term after the subtraction in a graph.

   c) How were Sa values affected in the modified data set?

Answers:

1. Net speed of targets and boat: 1.35 knots downstream + 3.5 knots upstream = 4.85 knots

   Convert knots to m/s = (4.85 kn x 1852 m/kn)/3600 s = 2.495 m/s = 2.5 m/s

   Beam swath: $\tan\left(\frac{\theta}{2}\right) = \frac{x}{41} = 2.5$ 2x = 5 m

   To get 5 pings (assuming a ping on each edge of the beam) = 2 pings/s (i.e. Hz)

2. Environmental Conditions (arbitrarily chosen): 10^{o}C, 35 ppt

   So, α = 14 dB/km = 0.014 dB /m; c = 1488 m/s

   RL = SL – TL

   = SL – 20 log (r) - α r

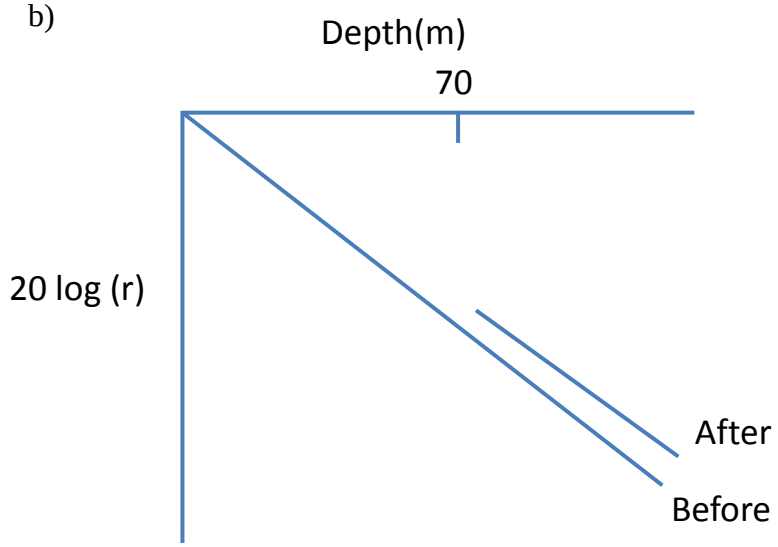
   = 150 - 20 log (750) – (0.014) (750)

   = 150 – 57.5 – 10.5

   = 82 dB re 1μPa

3. a) Spreading loss 20 log (r), Transmission loss due to spreading

   b)



   c) decreased in depths >70 m