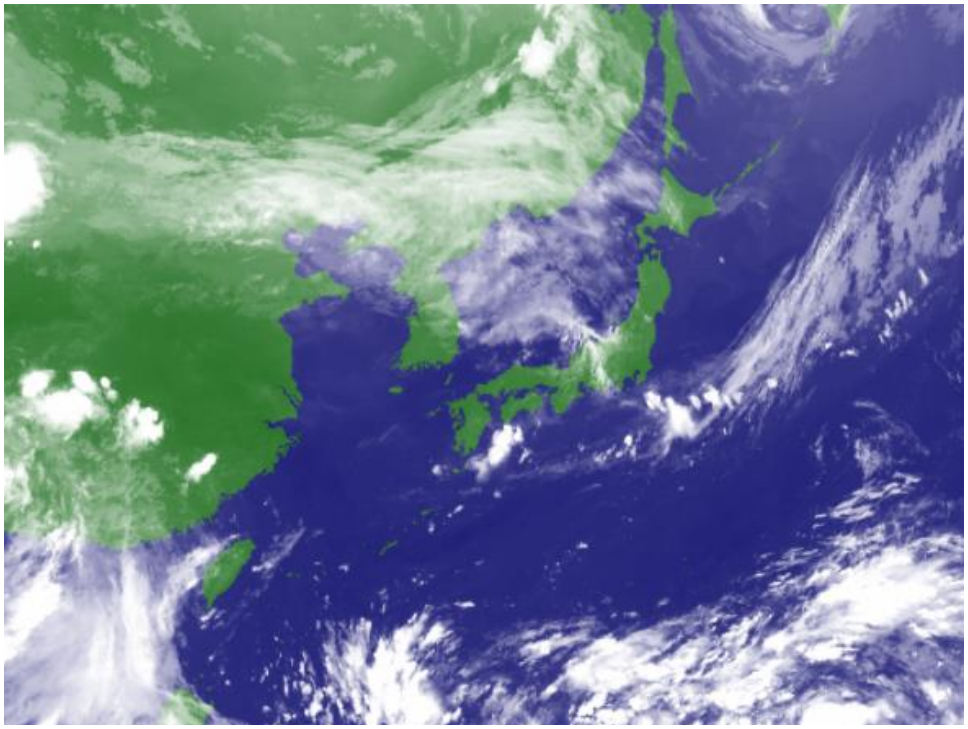
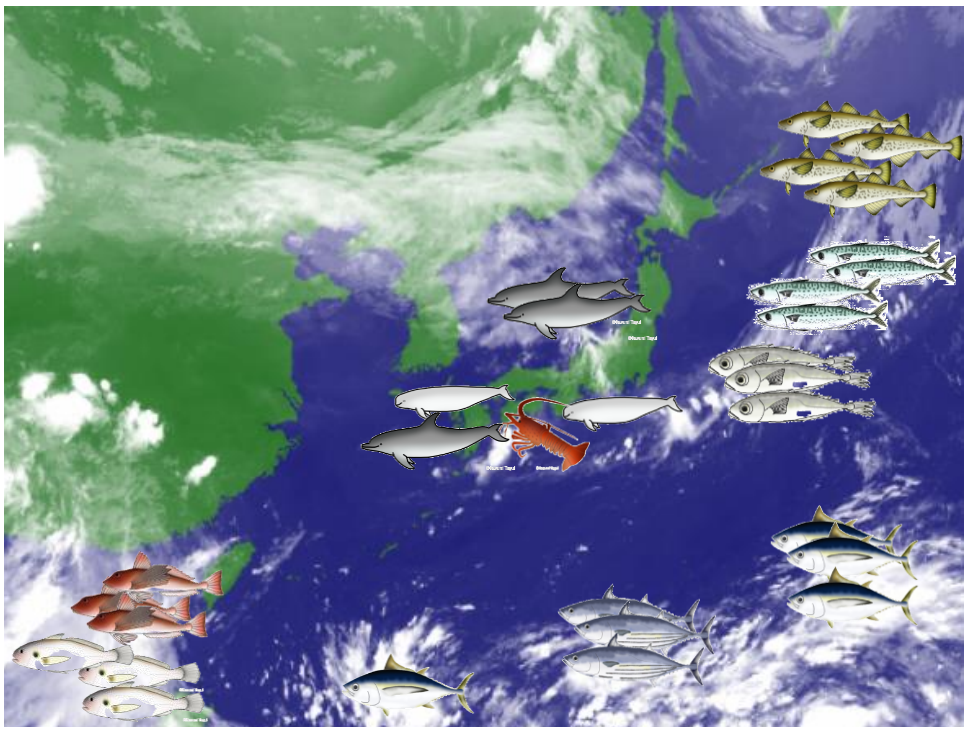
May 14, Cebu, Philippine

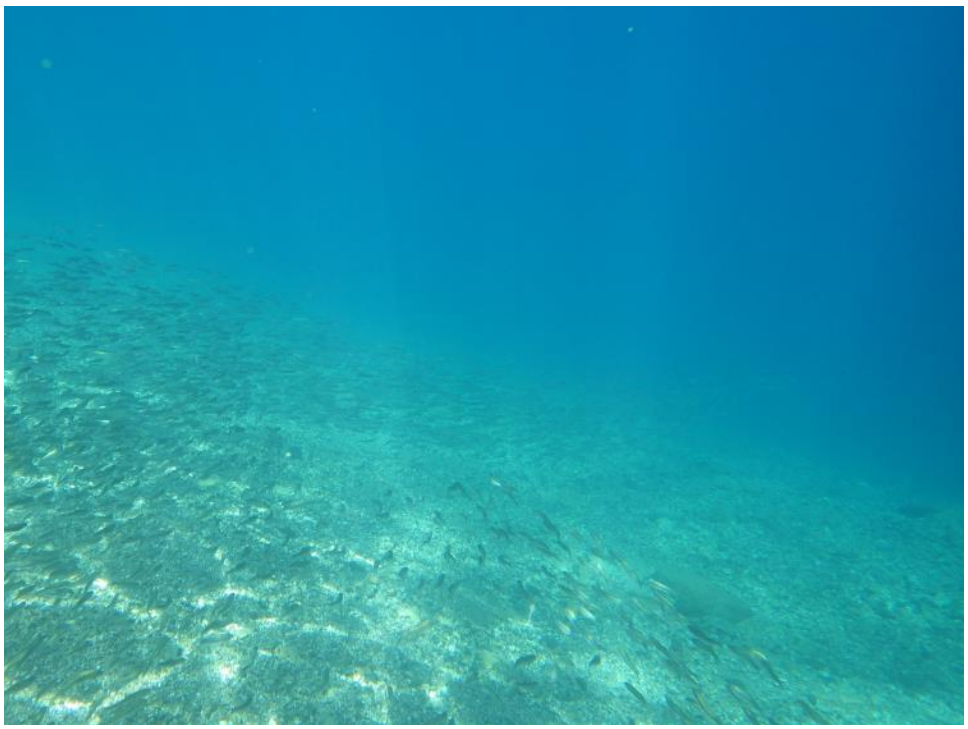
Application of bioacoustics in marine conservation

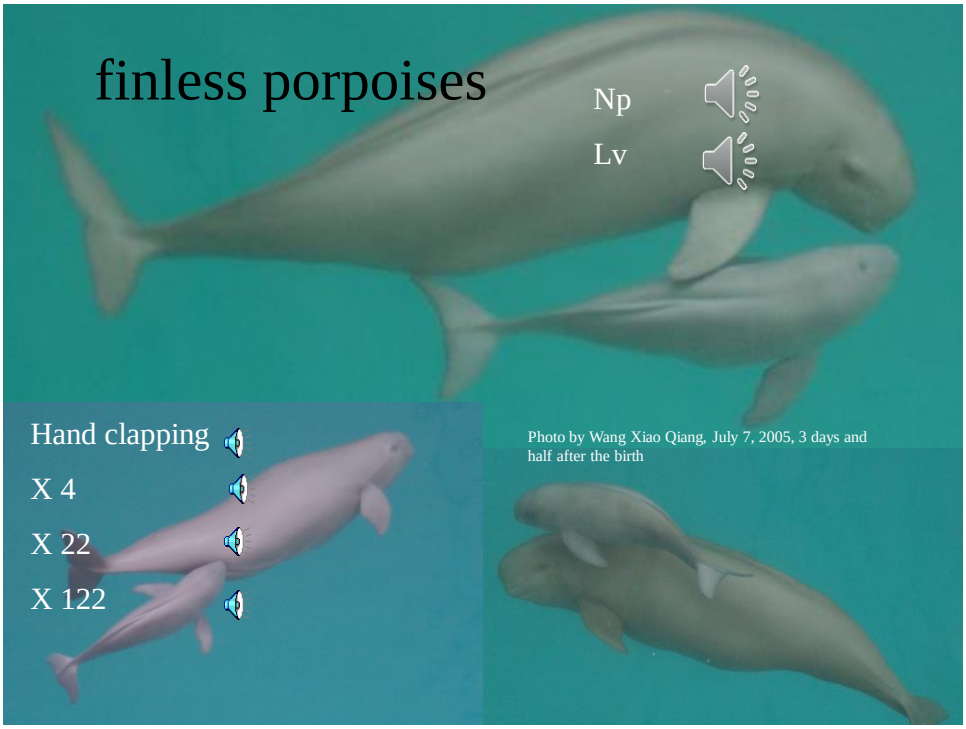
Tomonari Akamatsu (Fisheries Research Agency, Japan)

1. To see aquatic animals by listening







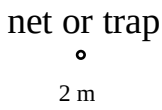


Finding finless porpoise: Level 1

Finding finless porpoise: Level 2

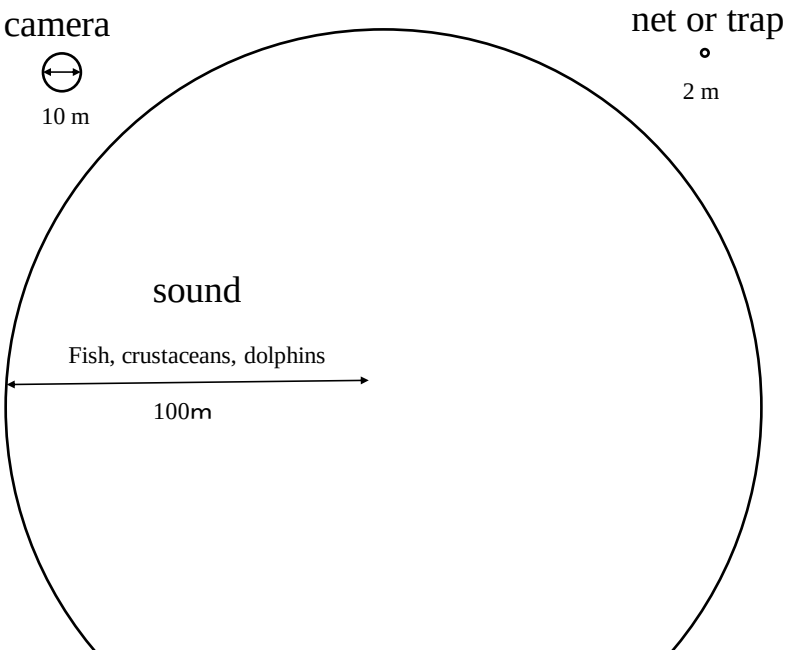
Finding finless porpoise: Level 3

Detection range

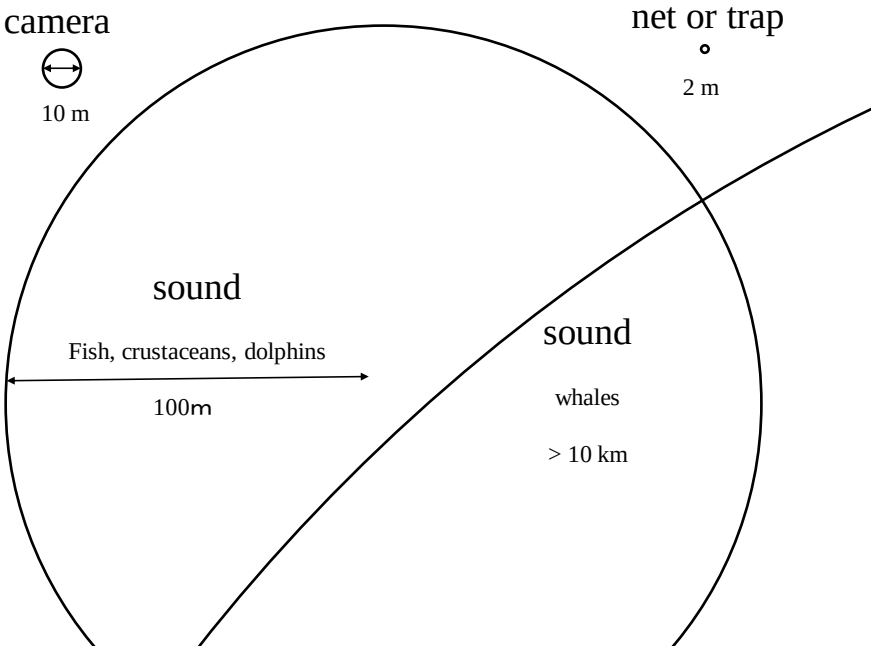


Detection range

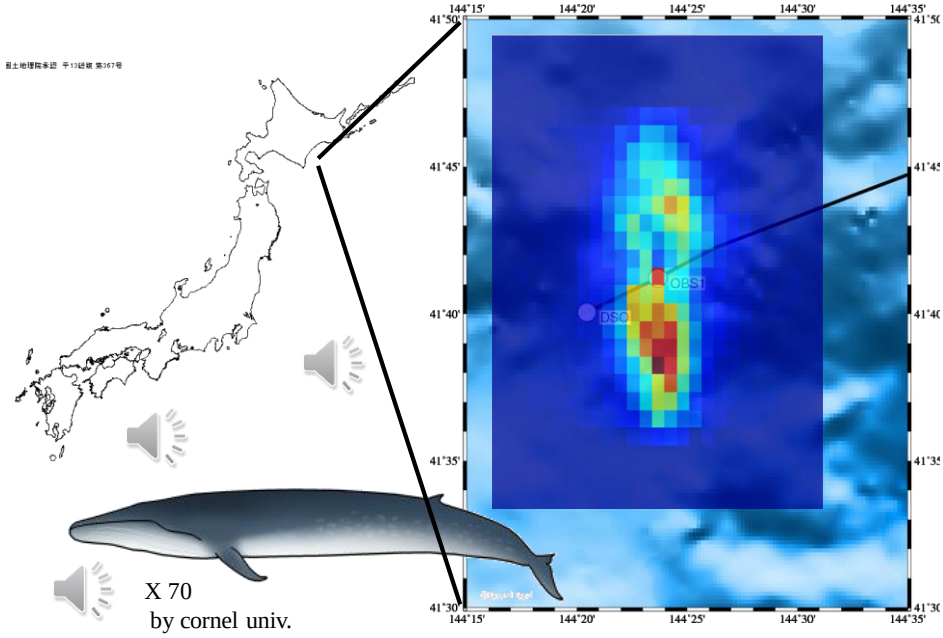
Detection range



Detection range

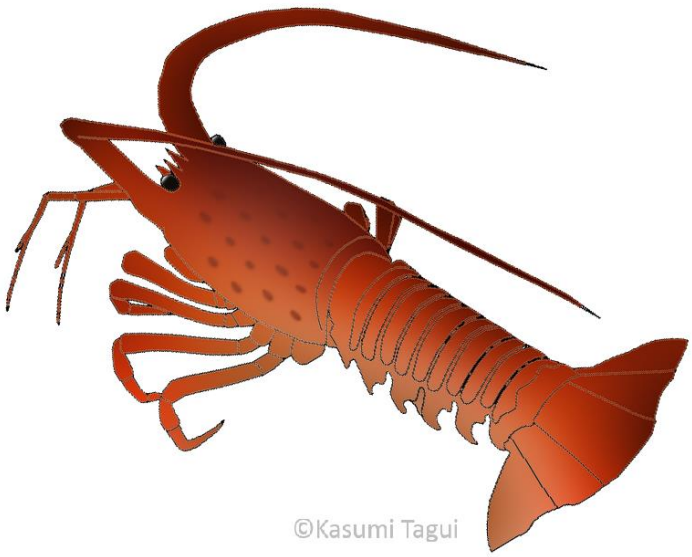


Detection range of fin whale calls



2. Sound of aquatic animals

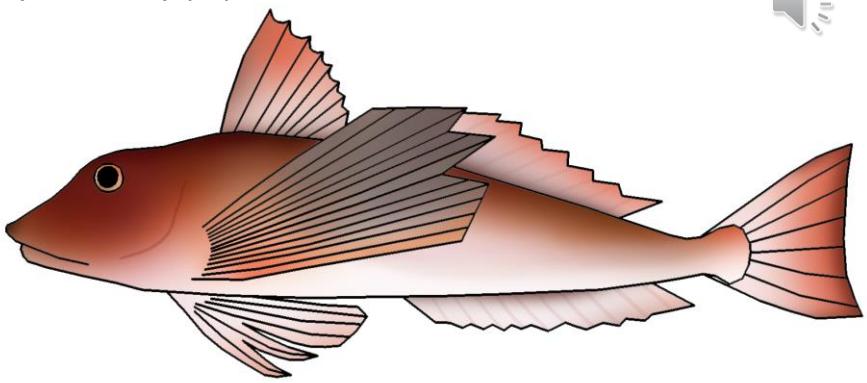
What is this?



A lobster

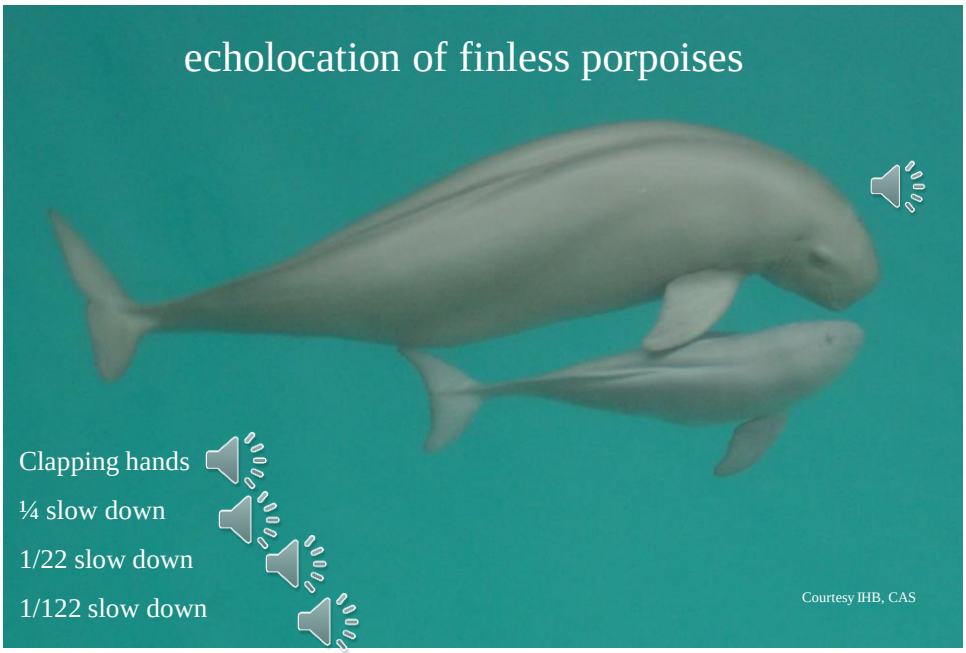
What is this?

Why should they (we) use sounds in the water?



A gurnard

What is this sound?



?

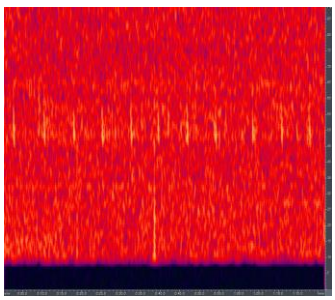
http://www.aquabio.com/sousa-chinensis.html

?

normal

x20

Very low frequency communication of fin whales

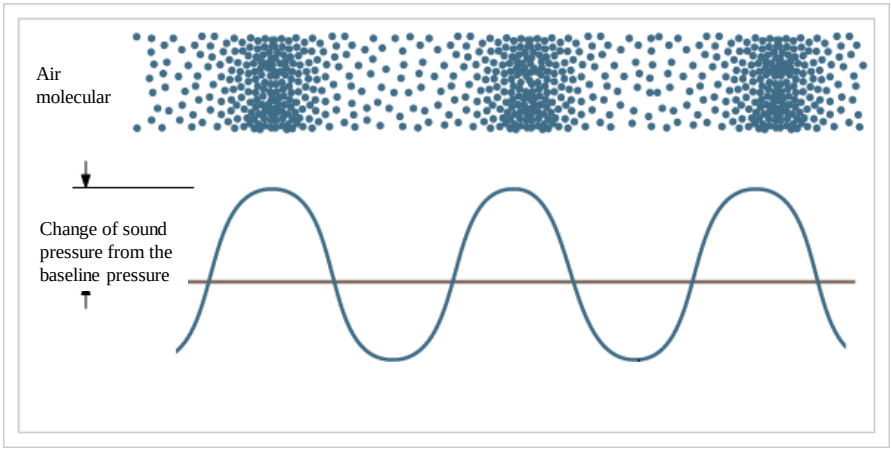


50Hz

< 81 seconds >

3. Basics of acoustics

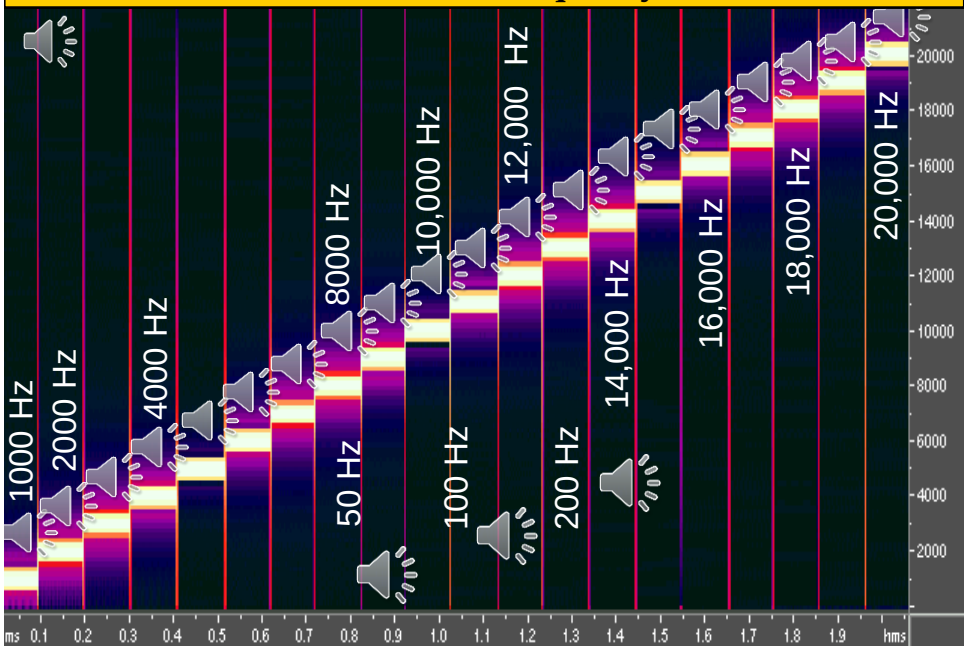
What is sound?

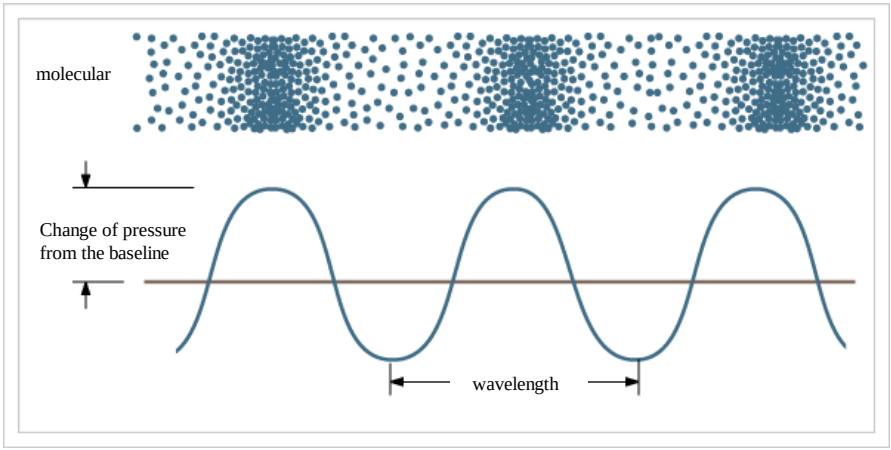


http://www.soundproofingcompany.com/soundproofing101/what-is-sound/

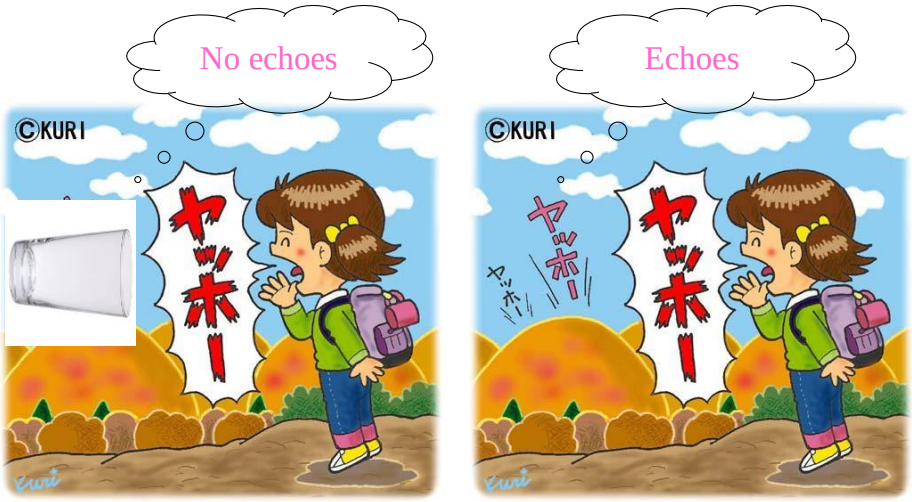
Frequency and wavelength

Listen each frequency

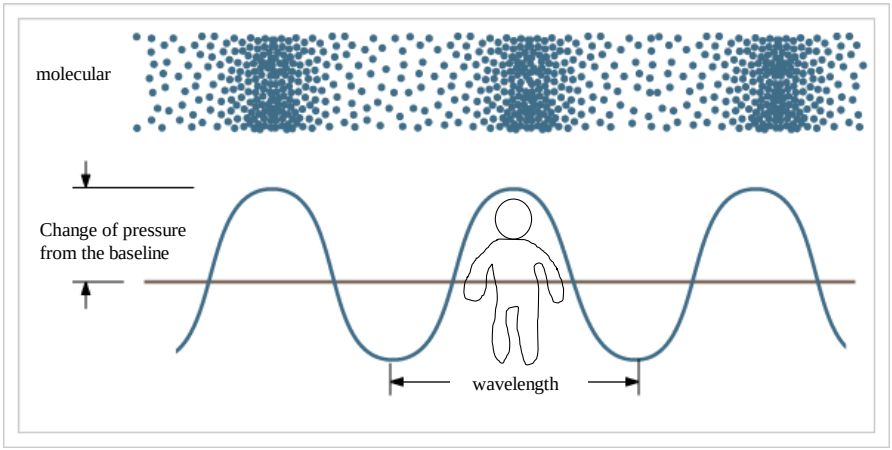




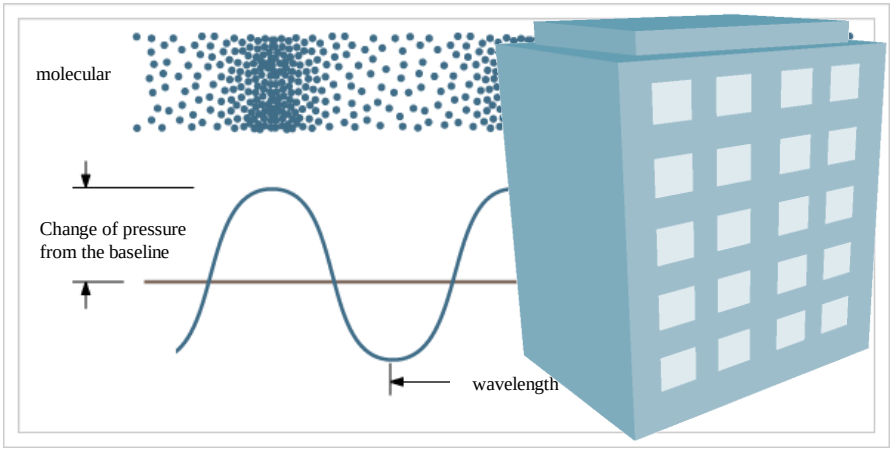
http://www.soundproofingcompany.com/soundproofing101/what-is-sound/



イラストさんぽ http://67977865.at.webry.info/



http://www.soundproofingcompany.com/soundproofing101/what-is-sound/



http://www.soundproofingcompany.com/soundproofing101/what-is-sound/

$\lambda = v/f$

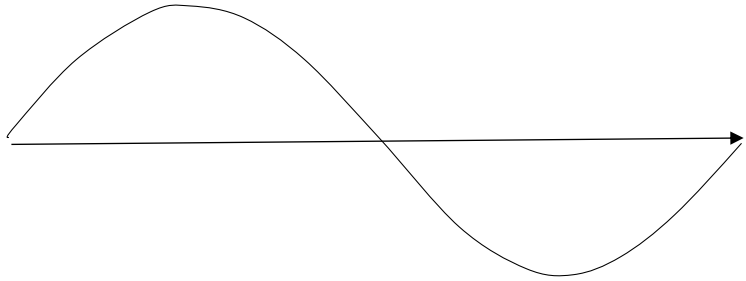
$v = 1500 m/s$

$f = 4 MHz$

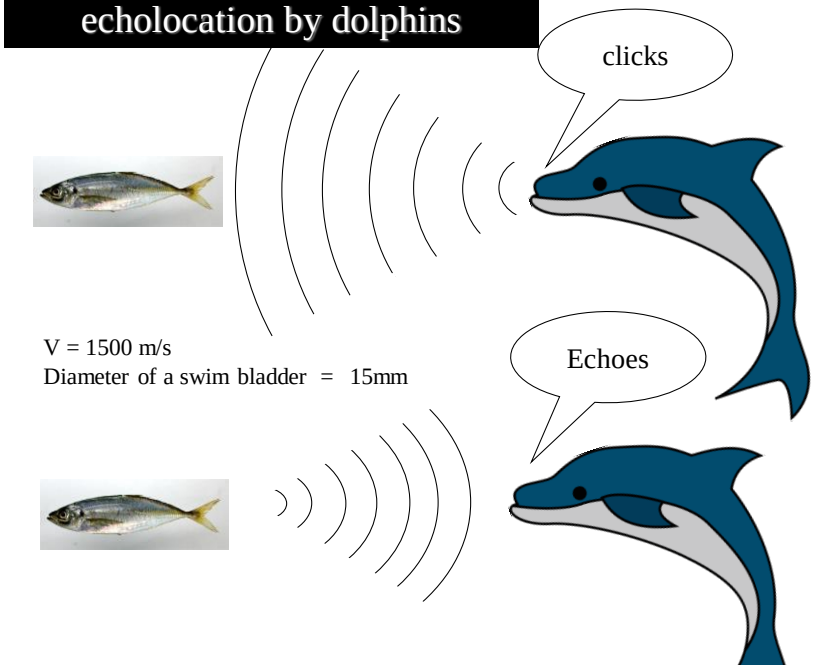
$\lambda = 0.375 mm$

Wavelength λ（m） ＝ sound velocity (m/s) / frequency (Hz)

$$\lambda = v/f$$



Calculate the frequency of echolocation by dolphins



Wavelength (m)

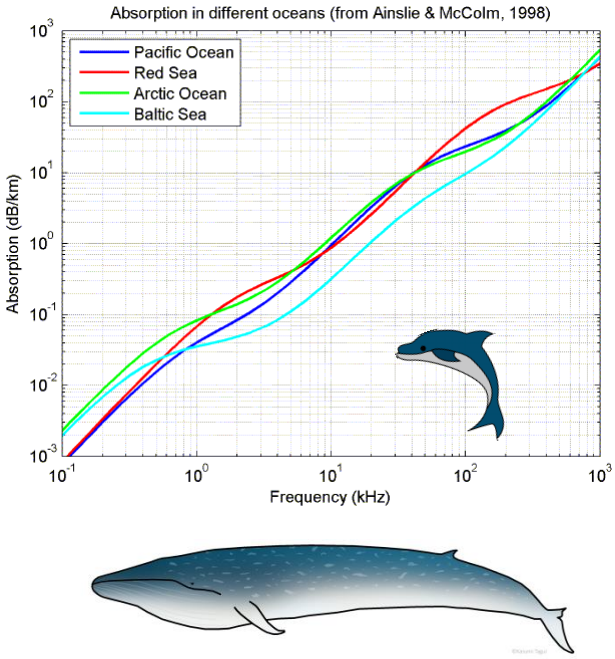
7.5 *0.015* *0.0003*

200 *100,000* *5,000,000*

Frequency (Hz)

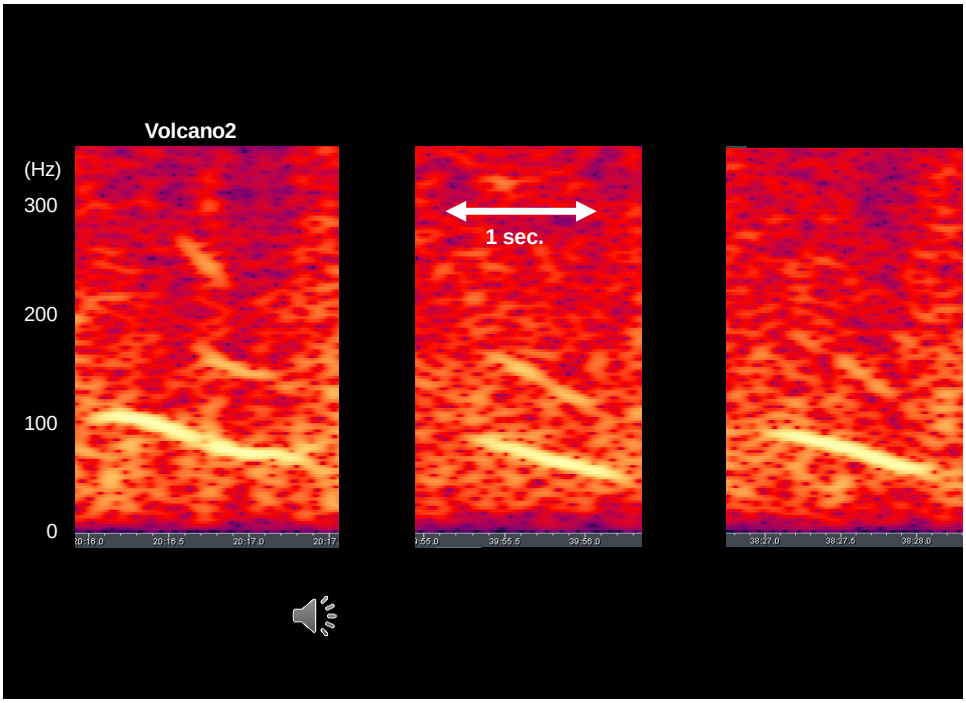
4. Tricks of sound

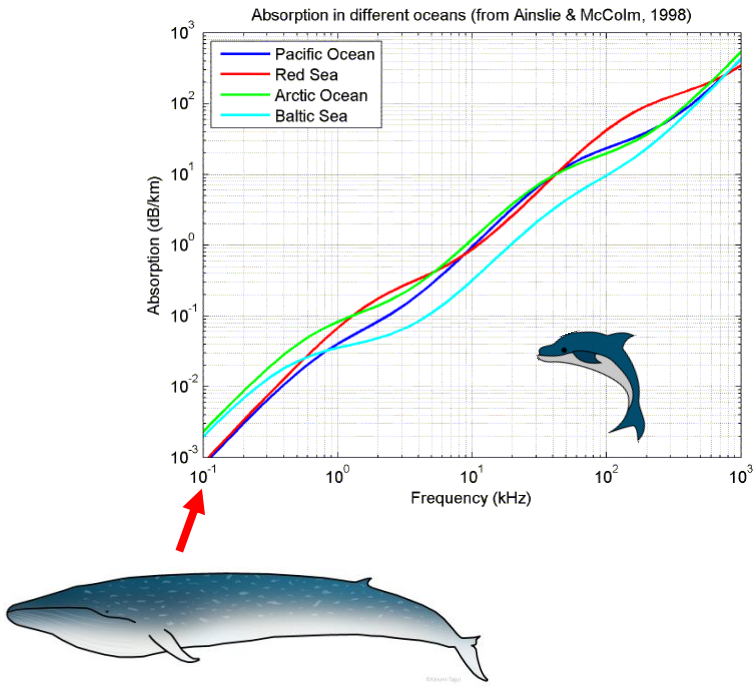
absorption


Absorption in different oceans (from Ainslie & McColm, 1998)
Pacific Ocean
Red Sea
Arctic Ocean
Baltic Sea
Absorption (dB/km)
Frequency (kHz)

How about the frequency of baleen whales?

Photo: Sabrina Brando

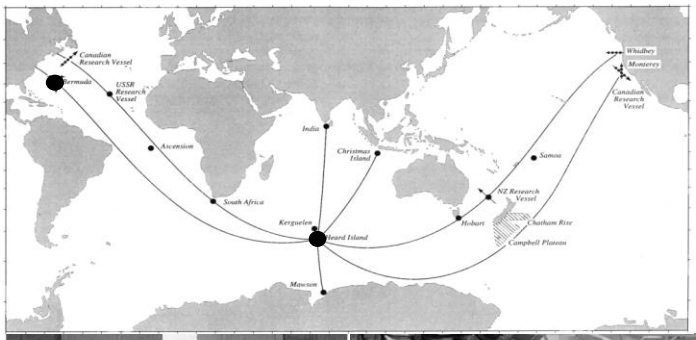

Volcano2
(Hz)
300
200
100
0
1 sec.



Human have been listening underwater low frequency sounds.

Any examples?

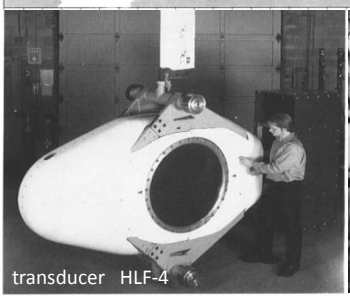
Munk et al. (1994) The Heard Island feasibility test, J. Acoust. Soc. Am. 96(4), 2330-2342



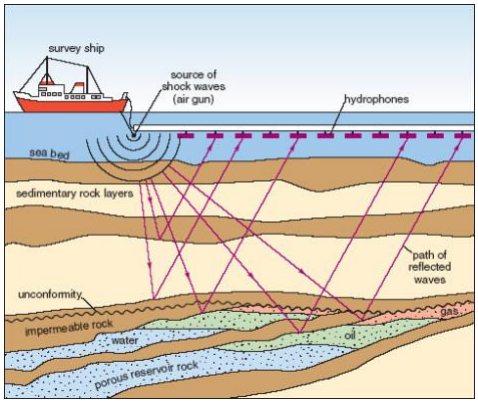
f=57 Hz

SL=206 dB re 1uPa

220dB by 5 TR

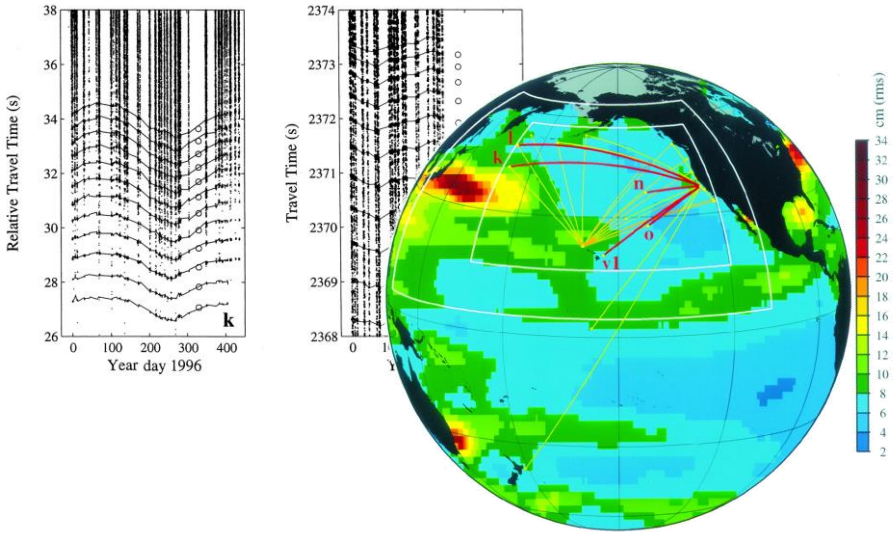


Air gun



https://mininginmalawi.com/2013/12/06/considerations-related-to-seismic-surveying-in-lake-malawi-dave-kienzler-fulbright-clinton-fellow-in-malawis-ministry-of-mining/

ATOC (Acoustic Thermometry of Ocean Climate)



Science 28 Aug 1998: Vol. 281, Issue 5381, pp. 1327-1332

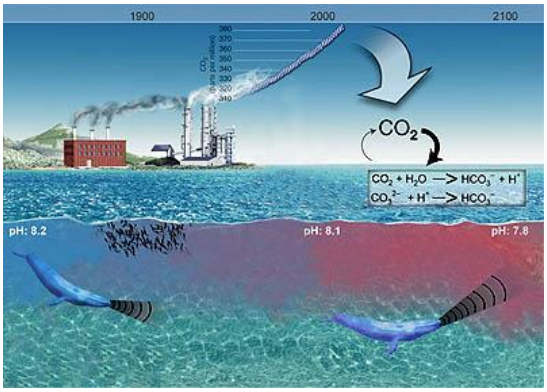
Global warming : good or bad for whales?

GEOPHYSICAL RESEARCH LETTERS, VOL. 35, L19601, doi:10.1029/2008GL034913, 2008

Click Here for Full Article

Unanticipated consequences of ocean acidification: A noisier oc at lower pH

Keith C. Hester,[1] Edward T. Peltzer,[1] William J. Kirkwood,[1] and Peter G. Brewer[1]



http://www.mbari.org/news/news_releases/2008/co2-sound/co2-sound-release.html

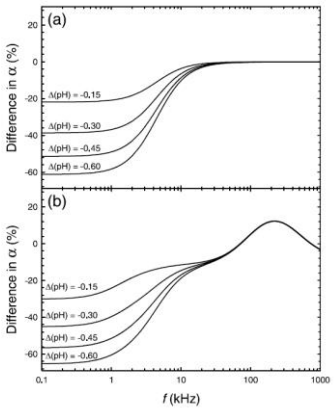
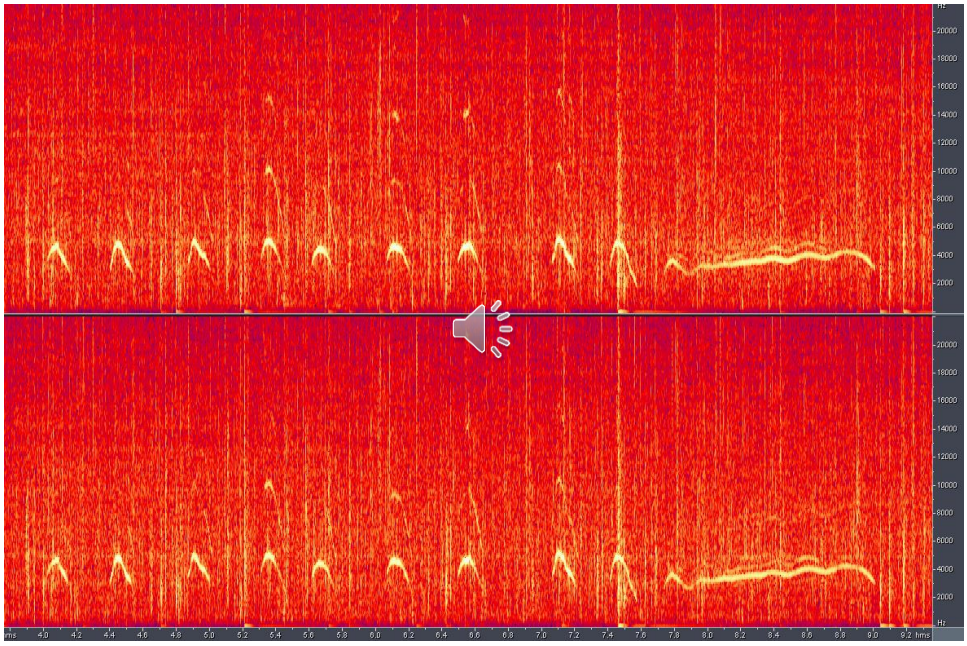


Figure 3. Percent difference in sound absorptivity in seawater between 0.01 to 1000 kHz for (a) a decrease in pH from 0.15 to 0.6 and (b) lower pH accompanied with a 3°C increase (initial conditions: S = 35, T = 12°C, pH = 8.1, D = 0.05 m).

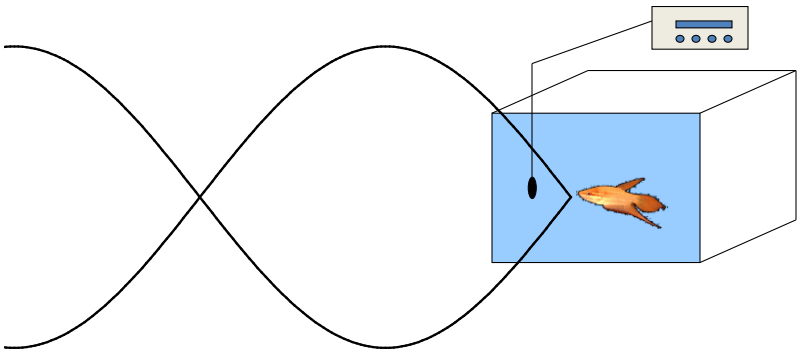
Gap and mirror

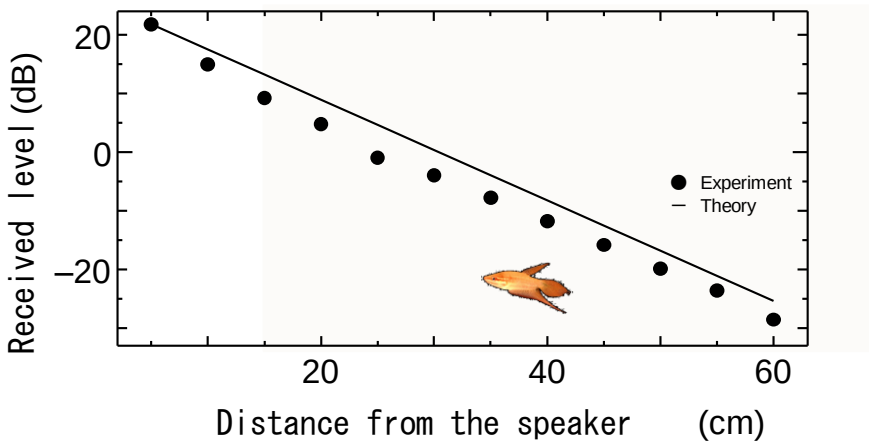

Tragedy in a kitchen


Photo by Surasak Thongsukdee



λ > depth





Akamatsu et al. 2002

Hide and communicate; a quiet window hypothesis (Lugli 2010)