



SONAR



SONAR



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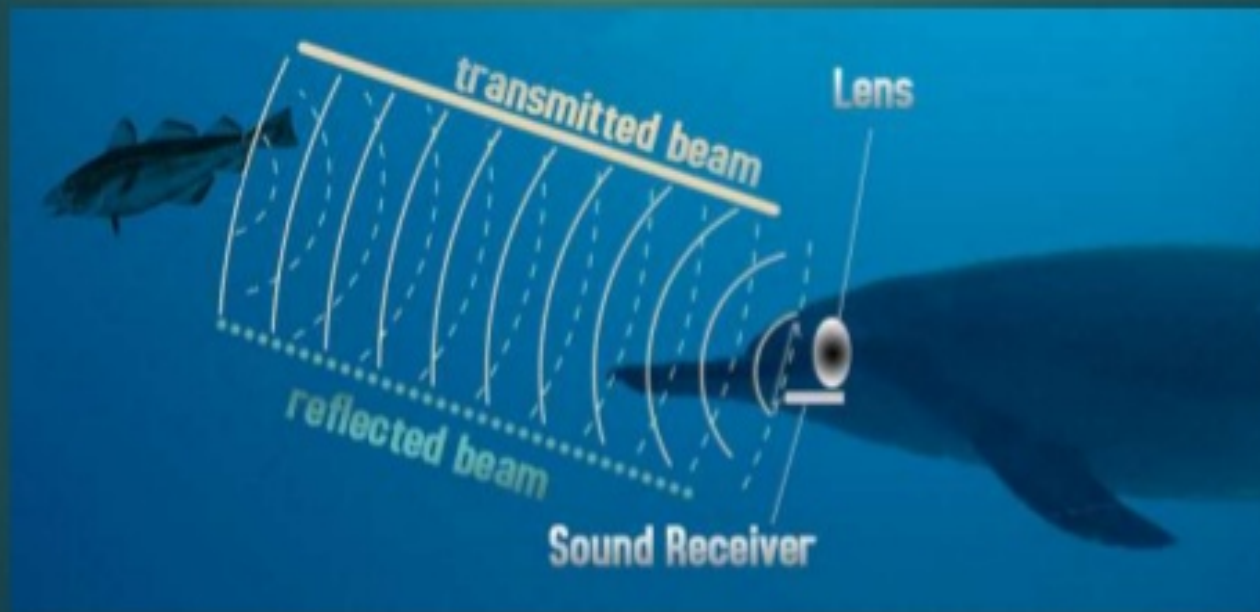
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introduction

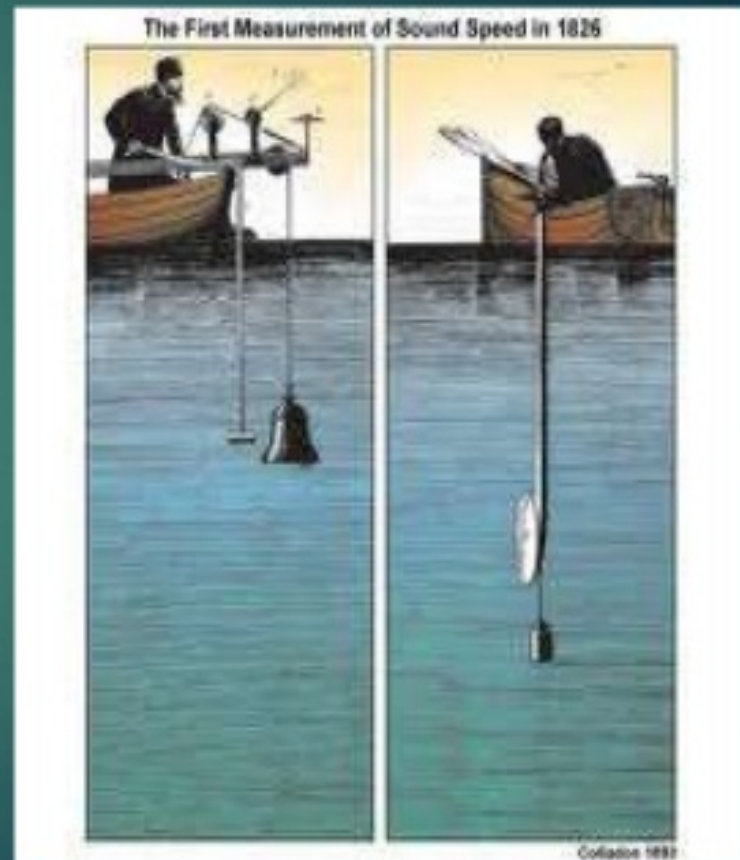
- ▶ Sonar ,which in itself originally an acronym for Sound Navigation And Ranging.
- ▶ It is a method of detecting , locating ,and determining the speed of objects through the use of reflected sound waves .
- ▶ A system using transmitted and reflected underwater sound waves to detect and locate submerged objects
- ▶ The acoustic frequencies used in sonar systems vary from very low (infrasonic) to extremely high (ultrasonic).

history

- ▶ We know that some animals (dolphins and bats) have use sound as a medium of communication and objects detection for millions of years

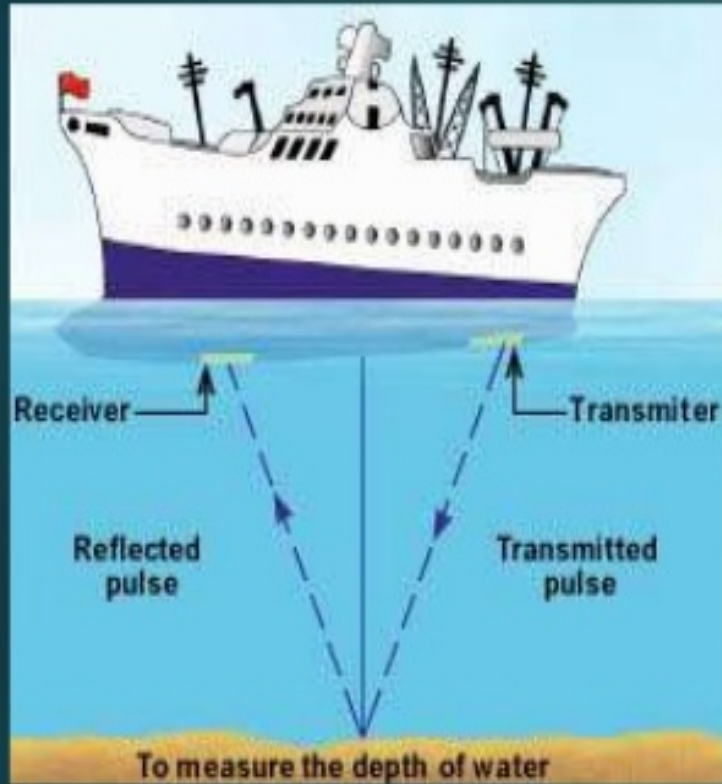


- ▶ But use of the sound by humans in the water is initially recorded by **Leonardo da Vinci** in 1490: a tube inserted into the water was said to be used to detect vessels by placing an ear to the tube.
- ▶ Sonar was first patented by Lewis Richardson and German physicist Alexander Behm in 1913.



Sonar

- ▶ Sonar is a device that is used to detect underwater objects using sound waves.
- ▶ In this system a sound pulse is generated and sent underwater through a transmitter.
- ▶ sound waves are reflected by the underwater object which are received at receiver.
- ▶ The time taken by sound wave to come back is recorded.
- ▶ And by knowing the speed of sound wave in water the distance can be easily calculated by formula.
- ▶ $\text{Distance} = \text{speed} \times \text{time}$



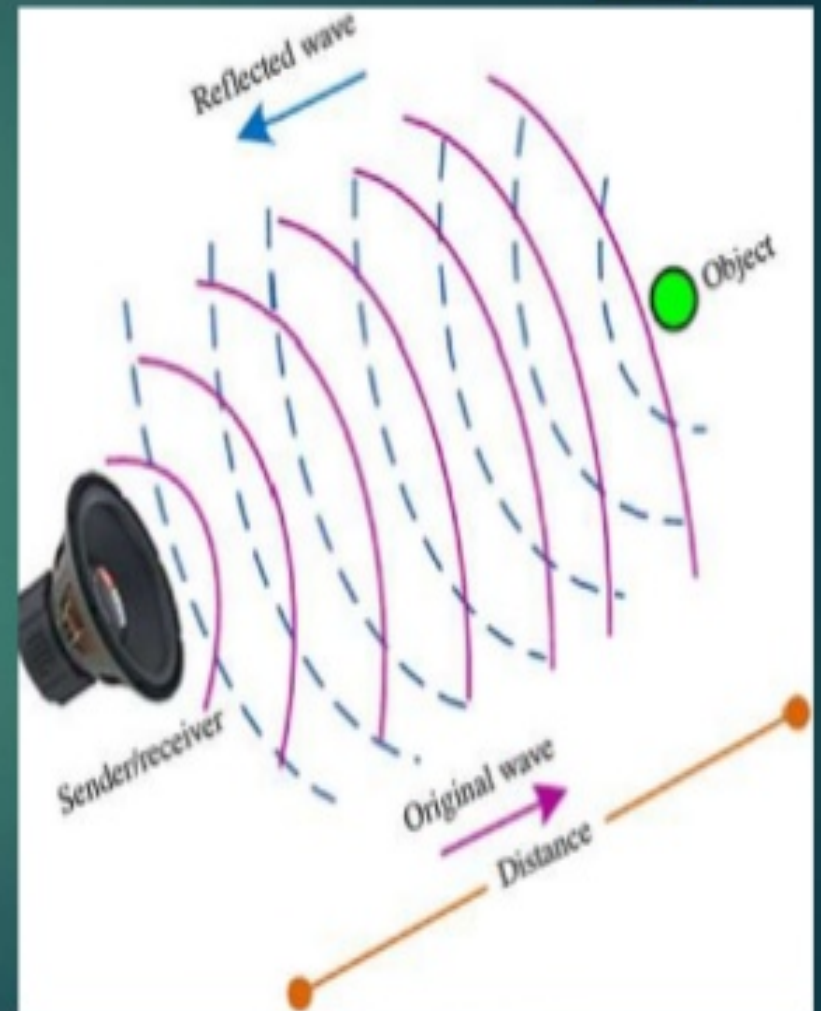
Type of sonar


sonar is of two types:


- ▶ Active sonar
- ▶ Passive sonar

Active sonar

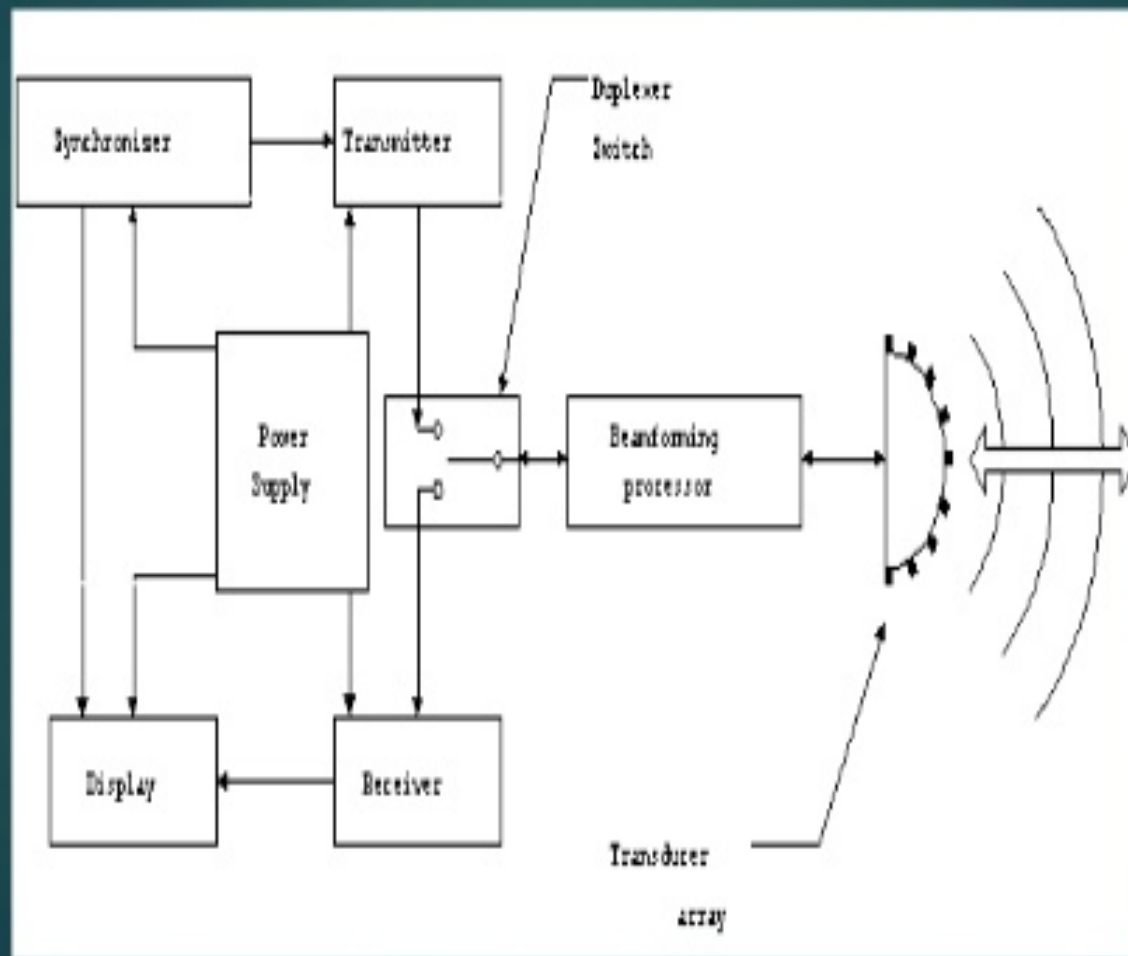
- ▶ Active sonar uses sound transmitter and receiver . And there are 3 modes of operation :
- ▶ Monostatic mode
- ▶ Bistatic mode
- ▶ Multistatic mode



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- ▶ Monostatic mode : when the transmitter and receiver are at the same place.
 - ▶ Bistatic mode : when the transmitter and receiver are separated by some distance.
 - ▶ Multistatic mode : When more transmitters (or more receivers) are used, again spatially separated.

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- ▶ Most sonars are used monostatically with the same array often being used for transmission and reception.
 - ▶ Active sonar creates a pulse of sound, often called a "ping", and then listens for reflections (echo) of the pulse.
 - ▶ This pulse of sound is generally created electronically using a sonar projector consisting of a signal generator, power amplifier and electro-acoustic transducer/array.
 - ▶ To measure the distance to an object, the time from transmission of a pulse to reception is measured and converted into a range by knowing the speed of sound.
 - ▶ To measure the bearing, several hydrophones are used, and the set measures the relative arrival time to each.

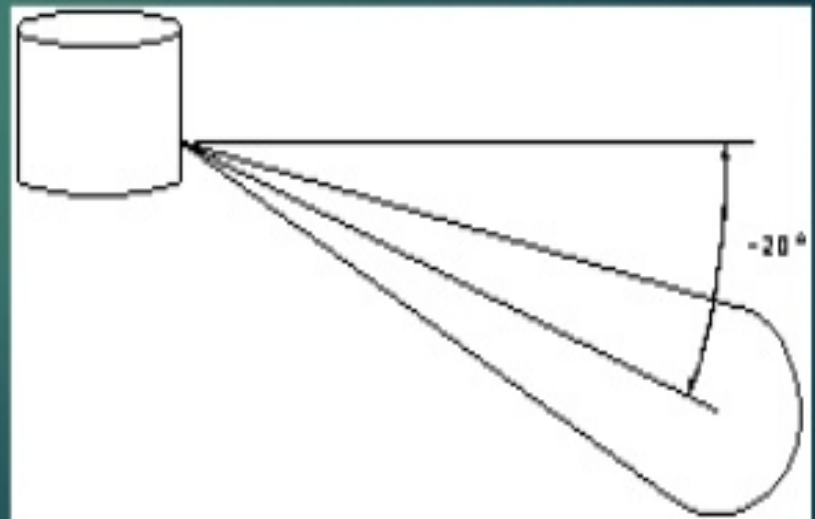
Block diagram of an active sonar





Functional components

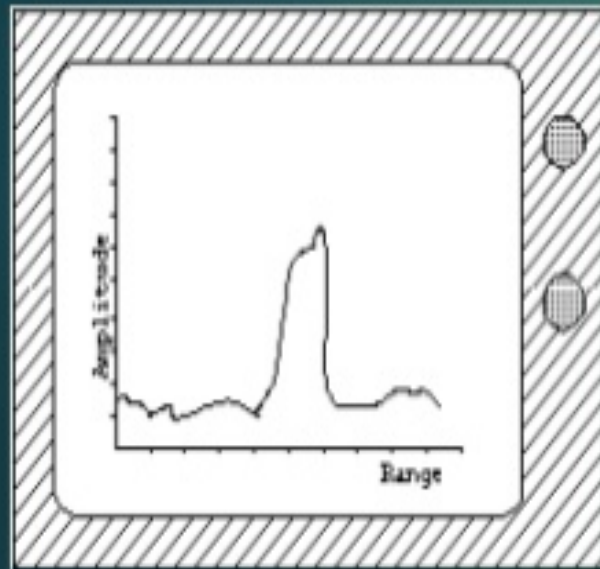
- ▶ Transmitter : The transmitter generates the outgoing pulse. It determines pulse width, pulse repetition frequency, modulation and carrier frequency.
- ▶ Transducer array : The individual transducers are simple elements with little or no directionality. They are arranged in an array to improve the directivity index, which improves the figure-of-merit by noise reduction.
- ▶ The array of transducers reduces the beamwidth in the horizontal direction, and is usually circular in order to give more or less complete coverage

Vertical beam of typical transducer array.

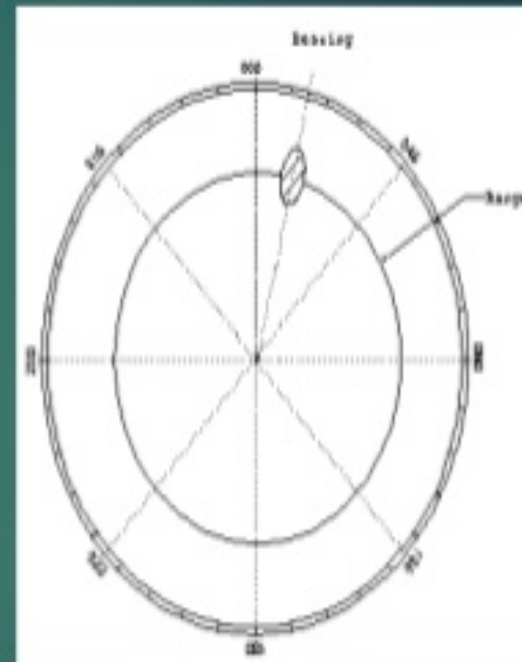


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- ▶ Duplexer switch : it is a switch that toggles between transmitter and receiver.
 - ▶ Synchroniser : Provides overall coordination and timing for the system. Reset the display for each new pulse in order to make range measurements.
 - ▶ Receiver : Collects the received energy. The receiver may also demodulate the return if frequency modulation is used on transmission

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- ▶ Display : Puts all of the detection information into a visual format. There are several types:
 - ▶ A-scan : the signal along a single beam for a portion of the listening cycle. A target appears as a raised section if it is in the beam.
 - ▶ PPI(plan position indicator) : A top-down (geographic view). The sonar system must sequentially search individual beams which are displayed in their true or relative form. The strength of the return is represented by the intensity on the display.

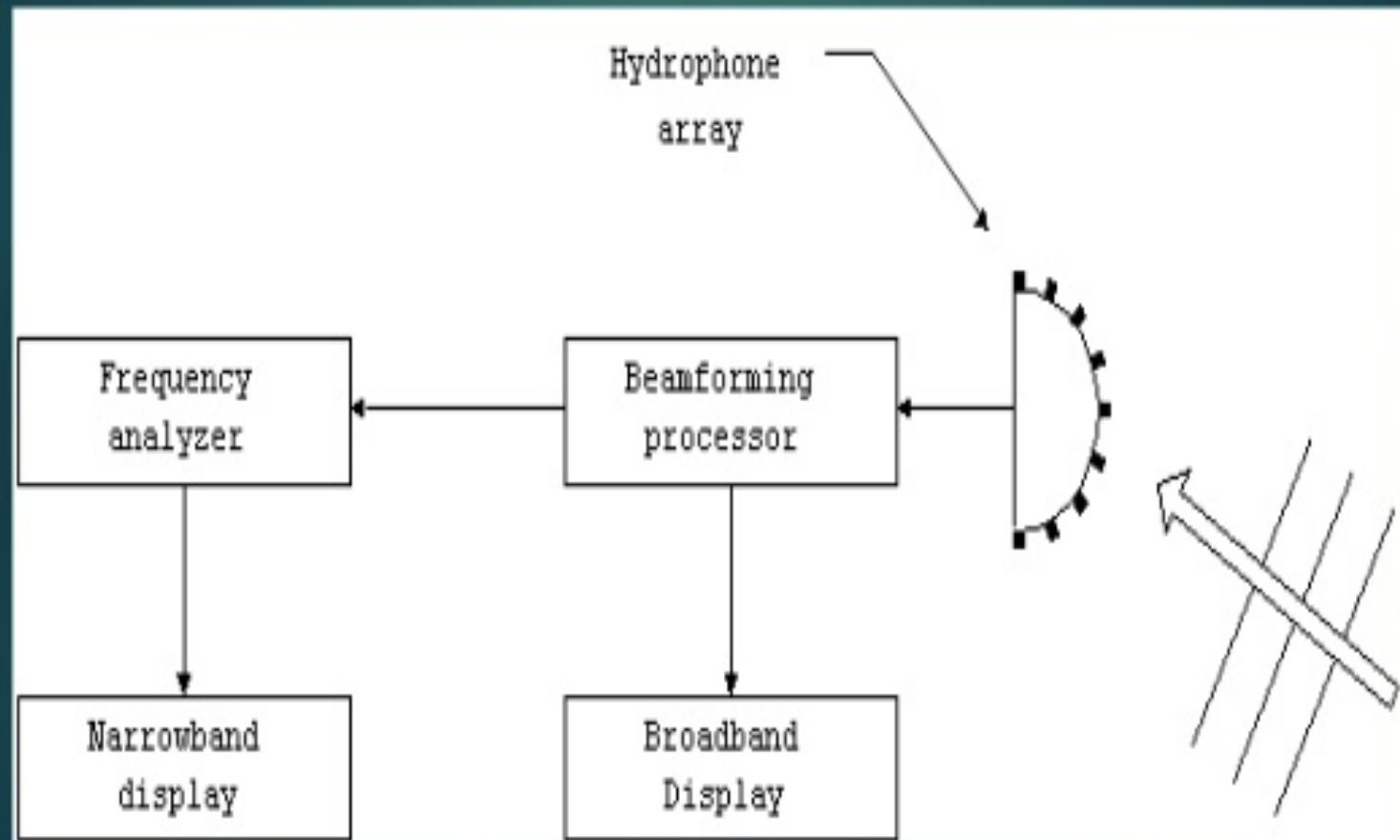


A – scan display



PPI display

Block diagram of passive sonar



application

- ▶ It is used to find the actual depth of the sea.
- ▶ Sonar systems are used to find lost ships and submarines.
- ▶ These are used in ocean surveillance systems.
- ▶ They are used by navy detect the locations of enemy submarines.
- ▶ They are used for under water security.

limitation

- ▶ It has an adverse effects on marine animals like dolphins and whales ,that also use sound waves for their navigation.
- ▶ It leads whales to painful and often fatal decompression sickness.
- ▶ The sonar systems generate lot of noise
- ▶ High intensity sonar sounds can create a small temporary shift in the hearing threshold of some fish

Thank you!

