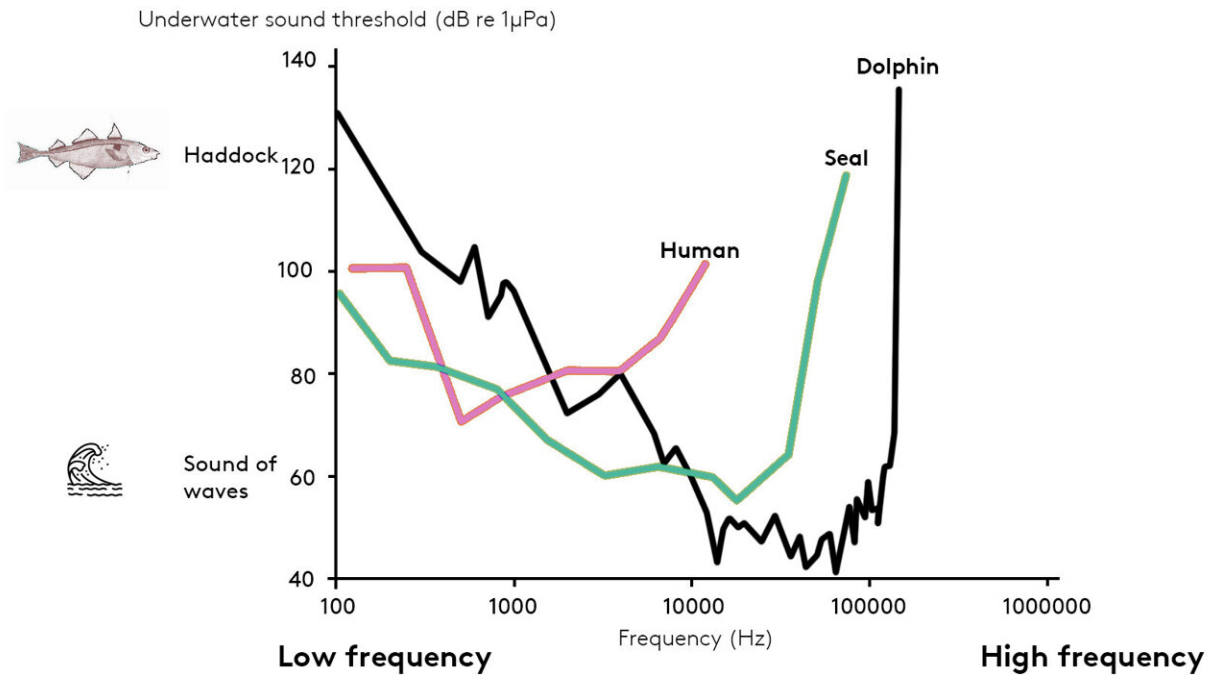


# Human or seal? Who has the best underwater hearing?

May 24 2022, by Birgitte Svennevig



Infographic comparing human, seal, dolphin hearing under water. Credit: University of Southern Denmark

Millions of years ago, all mammals lived on land, but at some point, several species left land and evolved to a life in the sea: think of seals and whales, which today are adapted to life under water.

The rest who remained on land have similarly adapted to a life on land, and it can hardly come as a surprise that we humans today hear better on land than under water—which is the conclusion from a group of scientists in a new study. But the study also reveals surprising news about human hearing.

Jakob Christensen-Dalsgaard is an expert in animal hearing, and in his laboratory at University of Southern Denmark, he tirelessly throws himself into hearing studies of animals such as cormorants, geckos, frogs, crocodiles—and now also humans.

## **Decades of hearing tests**

Since the 1950s, several different attempts have been made to measure human hearing under water. The US military, for example, has had an interest in understanding how divers are affected by underwater explosions, and in general, the hearing tests have been very different.

Some subjects have been tested with diving equipment on, others with neoprene caps and still others with air-filled diving masks—all of which can affect the test subjects' hearing.

"But common to all these scientific studies is that they all find hearing thresholds that are higher than the thresholds we have found in our new study," Christensen-Dalsgaard says.



Human and seal underwater. Credit: University of Southern Denmark

## **We hear as well as seals under water**

In the new study, in which 7 people participated, the average hearing threshold of 71 dB (3.5 mPa) is at 500 Hz.

"It is 26 dB lower than hypothesized in previous studies, so we must conclude that humans hear significantly better under water than previously reported by science. In fact, the threshold at 500 Hz is in line with how well animals such as cormorants and seals hear under water," says Jakob Christensen-Dalsgaard.

Worth noting in this context is that seals and dolphins—unlike us—can hear very [loud sounds](#) under water—sounds that humans cannot hear.

The previous studies hypothesized that the [human ear](#) under water works

by so-called bone conduction; that is, that the [sound waves](#) vibrate the skull. That hypothesis would fit the high hearing thresholds found in previous studies.

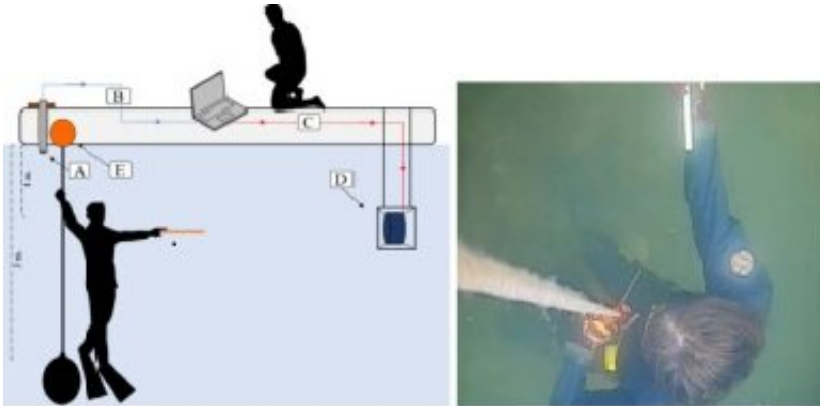


Illustration of how the hearing tests were conducted. Credit: Jakob Christensen-Dalsgaard, University of Southern Denmark.

"But we believe that resonance in the enclosed air in the middle ear amplifies the sound and makes the ear more sensitive. We have also shown this in previous studies of cormorants, turtles, and frogs," explains Jakob Christensen-Dalsgaard

"You should not expect to be able to jump into the sea and orient yourself perfectly using only your sense of hearing," says Jakob Christensen-Dalsgaard, "sense of hearing is not just about being able to pick up a sound. It is also about determining the direction of the sound—and this is very difficult for a person underwater."

"In air we can determine the sound direction within a few degrees, but in water there is an up to 90 degrees error margin. This is not so strange, because we are trained to react to the small time differences between the

ears, which are due to the speed of sound in air. In water, the speed of sound is four times greater, and the time differences are much smaller," Jakob Christensen-Dalsgaard explains, concluding that "the results tell us that humans have a reduced ability to determine the direction of sounds under water, thus confirming that human [hearing](#) is not adapted to work well under [water](#)."

The work is published in the journal *Hearing Research*.

**More information:** K. Sørensen et al, Is human underwater hearing mediated by bone conduction?, *Hearing Research* (2022). [DOI: 10.1016/j.heares.2022.108484](#)

Provided by University of Southern Denmark

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