

# Surprising hearing talents in cormorants

April 1 2020

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Many aquatic animals like frogs and turtles spend a big part of their lives under water and have adapted to this condition in various ways, one being that they have excellent hearing under water.

A new study shows that the same goes for a diving bird, the great

cormorant.

This is surprising because the great cormorant spends most of its time out of the water. It is the first time we see such extensive [hearing](#) adaptations in an animal that does not spend most of its time under water, says biologist Jakob Christensen-Dalsgaard, of University of Southern Denmark.

## **Human noise is a problem for animals at sea**

Researchers are increasingly paying attention to the living conditions of animals living in or near the oceans.

Oceans are no longer the quiet habitats they used to be. Human activities produce noise—examples are ship traffic, fishing and windmill constructions, and this noise may pose a threat to the oceans' animals.

"We need more knowledge about how [animals](#) are affected by this noise—does it impair their hearing or their hunting and fishing abilities? We have studied the effect on whales for some time now, but we don't know very much about diving [birds](#). There are many vulnerable animal species living or foraging at sea, that may be negatively affected by [human noise](#)," says Jakob Christensen-Dalsgaard.

## **Listening for fish?**

"Even though the great cormorant is not an aquatic animal, it does frequently visit the water columns, so it makes sense that it, too, has adapted its ears for hearing under water," Christensen-Dalsgaard says about the new study.

Whereas the great cormorant spends about 30 seconds foraging under

water in active pursuit of prey, approximately 150 other species of diving birds spend up to several minutes in pursuit of fish and squid.

Foraging under water is challenging for the sensory apparatus of the birds, however, and for most birds, their visual acuity under water is no better than that of humans. So, the birds may use other sensory modalities.

## **We know very little about birds' hearing under water**

Apart from a few behavioral studies, the hearing of birds under water is unknown.

Previously, researchers from University of Southern Denmark, have documented that great cormorants and gentoo penguins respond to sound under water, but this is the first study of the physiology of underwater hearing in any bird.

The study shows that the cormorant ear has been specialized for underwater hearing.

## **How was the study done?**

To study hearing of the cormorant in air and under water the scientists measured auditory evoked responses and neural activity in response to airborne and underwater sound in anesthetized birds.

The neural responses to airborne and underwater sounds were measured using electrodes under the skin. In this way, the scientists could measure hearing thresholds to sound in air and under water.

Thresholds in water and air proved to be similar, with almost the same

sensitivity to sound pressure in the two media. This is surprising, because similar sound pressures in air and water means that the threshold sound intensity (the energy radiated by the sound wave) is much lower in water, so the ear is more sensitive to underwater than to airborne sound.

## **The cost: Stiffer and heavier eardrums**

"We found anatomical changes in the ear structures compared to terrestrial birds. These changes may explain the good sensitivity to underwater sound. The adaptations also may provide better protection of the eardrums from the [water](#) pressure," says Jakob Christensen-Dalsgaard.

But there is—as always in nature—a cost to these benefits:

Their hearing in air is not as sensitive as in many other birds. Their eardrums are stiffer and heavier.

## **How has the ear adapted?**

The cormorant eardrum shows large vibrations in response to underwater sound, so the sensitivity likely is mediated by the eardrum and middle ear.

Underwater eardrum vibrations and anatomical features of the cormorant ear are similar to features found in turtles and aquatic frogs, that also appear to be specialized for underwater hearing.

The data suggest convergent modifications of the tympanic ear in these three distantly related species, and similar modifications may be found in other diving birds.

**More information:** Ole Næsbye Larsen et al, Amphibious hearing in a diving bird, the great cormorant (*Phalacrocorax carbo sinensis*), *The Journal of Experimental Biology* (2020). [DOI: 10.1242/jeb.217265](https://doi.org/10.1242/jeb.217265)

Provided by University of Southern Denmark

Citation: Surprising hearing talents in cormorants (2020, April 1) retrieved 5 May 2024 from <https://phys.org/news/2020-04-talents-cormorants.html>

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