Sharks found to exhibit altered swimming behavior when exposed to more acidic water

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Great white shark

(Phys.org) —A pair of researchers with the University of Gothenburg, in Sweden, has found that at least one kind of shark exhibits odd swimming behavior when in water that is more acidic than normal. In their paper published in the journal *Biology Letters*, Leon Green and Fredrik Jutfelt describe how they exposed captive sharks to water with increased acidity to simulate natural levels expected over the next century as global warming causes the world's oceans to become more acidic, and what they found by doing so.

Scientists know that some organisms that live in the ocean are adversely impacted by increased ocean acidification—coral reefs are just one example. But until now, little has been known about the impact it might have on sharks and rays—creatures with bone made of cartilage. To learn more, the research pair obtained 20 captive spotted catsharks and put them into individual water tanks—in some of the tanks, the pH level was equal to water in the oceans, about 8.1—others were put into tanks where the water pH level was as low as 7.7 (the predicted natural level by 2100). The sharks in all the tanks were monitored for four weeks to see what impact the acidic water may have on them.

The researchers found that the metabolism for all of the sharks remained normal, though they did find more bicarbonate and sodium ions in the blood of those swimming in the more acidic water. They noted also that the increased acidity did not appear to cause any damage to the bones or teeth of the sharks. The one area where they did find a difference was in swimming patterns. Under normal conditions, at night, the sharks swim for a moment or two, then stop for a short time, then swim again. The sharks in the acidic water swam longer and because of that had fewer swimming spurts while swimming at night—a clear deviation from their normal swimming behavior.

The researcher's don't know why the sharks swam longer, but suggest it might be due to the higher ion concentrations impacting their brains, or more simply, they might have simply kept swimming in the hope of finding less acidic water. In either case, it's not clear what it might mean for sharks in the ocean if they were to alter their swimming patterns in similar fashion over long periods of time. The extra expended energy might necessitate more food intake, for example, causing sharks to become more aggressive.

More information: Elevated carbon dioxide alters the plasma composition and behaviour of a shark, *Biol. Lett.* September 2014 vol. 10 no. 9 20140538, DOI: 10.1098/rsbl.2014.0538

Abstract
Increased carbon emissions from fossil fuels are increasing the pCO2 of

the ocean surface waters in a process called ocean acidification. Elevated water pCO2 can induce physiological and behavioural effects in teleost fishes, although there appear to be large differences in sensitivity between species. There is currently no information available on the possible responses to future ocean acidification in elasmobranch fishes. We exposed small-spotted catsharks (Scyliorhinus canicula) to either control conditions or a year 2100 scenario of 990 μatm pCO2 for four weeks. We did not detect treatment effects on growth, resting metabolic rate, aerobic scope, skin denticle ultrastructure or skin denticle morphology. However, we found that the elevated pCO2 group buffered internal acidosis via Graphic accumulation with an associated increase in Na+, indicating that the blood chemistry remained altered despite the long acclimation period. The elevated pCO2 group also exhibited a shift in their nocturnal swimming pattern from a pattern of many starts and stops to more continuous swimming. Although CO2-exposed teleost fishes can display reduced behavioural asymmetry (lateralization), the CO2-exposed sharks showed increased lateralization. These behavioural effects may suggest that elasmobranch neurophysiology is affected by CO2, as in some teleosts, or that the sharks detect CO2 as a constant stressor, which leads to altered behaviour. The potential direct effects of ocean acidification should henceforth be considered when assessing future anthropogenic effects on sharks.

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