Carpe solis – sunbathing fish defy the laws of nature

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Credit: Linnéuniversitetet

That sunbathing may require a refreshing swim to avoid overheating is a

vacation experience shared by many. It has been assumed that this cooling effect of water prevents fish from reaping the rewards of sunbathing available to animals in terrestrial environments. New evidence on behavior of carp, published in the Royal Society journal Proceedings B,challenges this paradigm. Sunbathing fish can become warmer than the surrounding water and the gain in body temperature enables the fish to grow faster, the study shows.

That sun basking is widespread and important for cold blooded animals such as snakes, lizards, and insects in terrestrial environments is well established. However, it has been generally believed that fish and other aquatic animals cannot increase their body temperature by basking because of the thermal properties of water. The results from the study of sunbathing carp points to a paradigm shift.

The researchers from Linnaeus University in Sweden set out to investigate the possibility for heat gain during sun basking for fish. By first using physical models (dummy fish), they showed that objects that are submerged in water and exposed to light can in fact become warmer than the surrounding water. Next, the authors studied free ranging carp (Cyprinus carpio) equipped with data loggers that monitored vertical movements and temperatures to quantify basking behavior and its consequences in live fish. Carp attained temperatures that were higher than water when they basked at the surface under sunny conditions. Fish that became warmer during basking also grew faster, thus demonstrating that sunbathing can bring fitness benefits.

Another key finding was that the advantages associated with sunbathing are not equally available to and utilized by all fish. Darker individuals became warmer during basking compared to paler individuals. Individuals with a bold personality also had a higher temperature gain compared to shy individuals. Different behaviors, appearances and strategies are favorable under different conditions, and variability among

individuals may enable populations and species to cope with life in an ever changing world.

The discovery that fish can regulate their body temperature by sunbathing is intriguing and can have profound scientific and practical implications. "That the temperature gain during basking translates into faster growth underscores the ecological and evolutionary importance of this behavior. We anticipate that these results will contribute to improved biomass production and fish welfare in aquaculture", say lead author and doctorate student Oscar Nordahl.

That fish can do what was previously thought impossible has other important consequences, in that sunbathing has potential to influence spatial and temporal distributions of fish. This, in turn, has implications for commercial fisheries and can improve models concerning biodiversity responses to ongoing climate change, according to the authors.

More information: Oscar Nordahl et al. Sun-basking fish benefit from body temperatures that are higher than ambient water, *Proceedings of the Royal Society B: Biological Sciences* (2018). DOI: 10.1098/rspb.2018.0639

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