Hibernation-like Behaviour in Antarctic Fish - on Ice for Winter

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Scientists from the University of Birmingham and the British Antarctic Survey have discovered an Antarctic fish species that adopts a winter survival strategy similar to hibernation. Reporting this week in the journal PLoS ONE, the online journal from the Public Library of Science, they reveal that the Antarctic 'cod' Notothenia coriiceps effectively 'puts itself on ice' to survive the long Antarctic winter.

The study showed that the fish activate a seasonal 'switch' in ecological strategy - going from one that maximises feeding and growth in summer to another that minimises the energetic cost of living during the long Antarctic winter. The research demonstrates that at least some fish species can enter a dormant state, similar to hibernation that is not temperature driven and presumably provides seasonal energetic benefits. Scientists already know that Antarctic fish have very low metabolic rates and blood 'antifreeze' proteins that allow them to live in near-freezing waters. This study demonstrates that Antarctic fish - which already live 'life in the 'slow lane' with extremely low rates of growth, metabolism and swimming activity - can in fact further depress these metabolic processes in winter.

Project leader Dr Stuart Egginton from the University of Birmingham's Medical School, says, 'These results are very exciting as they show for the first time a continuous record of how fish adjust their lifestyle over a whole year. That we were able to collect these data in one of the world's most inhospitable habitats was a real bonus, as it allowed us to test the current ideas about what drives seasonality in animals - and proved them to be wrong: fish do not just follow immediate cues, but regulate their activity as a compromise between conflicting needs. The challenge is now to determine whether animals living in extreme environments can adjust their strategy to cope with climate change'

Lead author Dr Hamish Campbell, formerly at the University of Birmingham, but now at University of Queensland, Australia said, "Hibernation is a pretty complex subject. Fish are generally incapable of suppressing their metabolic rate independently of temperature. Therefore, winter dormancy in fish is typically directly proportional to decreasing water temperatures. The interesting thing about these Antarctic cod is that their metabolic rates are reduced in winter even though the seawater temperature doesn't decrease much. It seems unlikely that the small winter reductions in water temperature that do occur are causing the measured decrease in metabolism. However, there are big seasonal changes in light levels, with 24 hour light during summer followed by months of winter darkness - so the decrease in light during winter may be driving the reduction in metabolic rates."

Dr Keiron Fraser from British Antarctic Survey says, "This is our first insight into how these fish live in winter. We have, for the first time in the Antarctic, used cutting edge technologies combining tracking of free swimming fish in the wild and heart rate monitors to allow us to investigate just how these animals cope in winter with living in near freezing water and almost complete darkness for months on end. It appears they utilise the short Antarctic summers to gain sufficient energy from feeding to tide them over in winter. The hibernation-like state they enter in winter is presumably a mechanism for reducing their energy requirements to the bare minimum. The interesting question we still have to answer is why these fish greatly reduce feeding in winter when food is still available."

Why these fish chose to adopt this hibernation-like strategy during winter is currently unclear, but it presumably provides energetic benefits. The traditional views of hibernation are being challenged constantly. This study introduces a new group of animals that appear to utilise a hibernation-like strategy that allows them to survive during the long winters in one of the harshest environments on Earth.

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Notes for editors

Pictures (stills and video) are available from the BAS Press Office.

The paper: Hibernation in an Antarctic fish: on ice for winter by Hamish A Campbell, Keiron P P Fraser, Charles M Bishop, Lloyd Peck and Stuart Egginton is published this week in PLoS ONE 3(3): e1743. doi:10.1371/journal.pone.0001743 http://www.plosone.org/doi/pone.0001743

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The collaborative research is part of the British Antarctic Survey (BAS) Antarctic Funding Initiative (AFI), which promotes wider participation in Antarctic research by UK universities and other research organisations. AFI encourages field-based research carried out in the normal BAS operating area and using the unique logistic capabilities of the Survey.

The 'Antarctic Cod' (Notothenia coriiceps) became isolated from its warmer water cousins around 30 million years ago when the Antarctic circumpolar current was formed. The olive-coloured fish has a broad head and a narrow body. Whilst scientists know that it has a glycoprotein antifreeze in its blood and it maintains a very low heart rate of less than 10 beats per minute, very little is known about its behaviour or how it evolved to live in Antarctica's extreme environment.

The Cambridge-based British Antarctic Survey (BAS) is a world leader in research into global environmental issues. With an annual budget of around £40 million, five Antarctic Research Stations, two Royal Research Ships and five aircraft BAS undertakes an interdisciplinary research programme and plays an active and influential role in Antarctic affairs. BAS has joint research projects with over 40 UK universities and has more than 120 national and international collaborations. It is a component of the Natural Environment Research Council. More information about the work of the Survey can be found at: www.antarctica.ac.uk

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