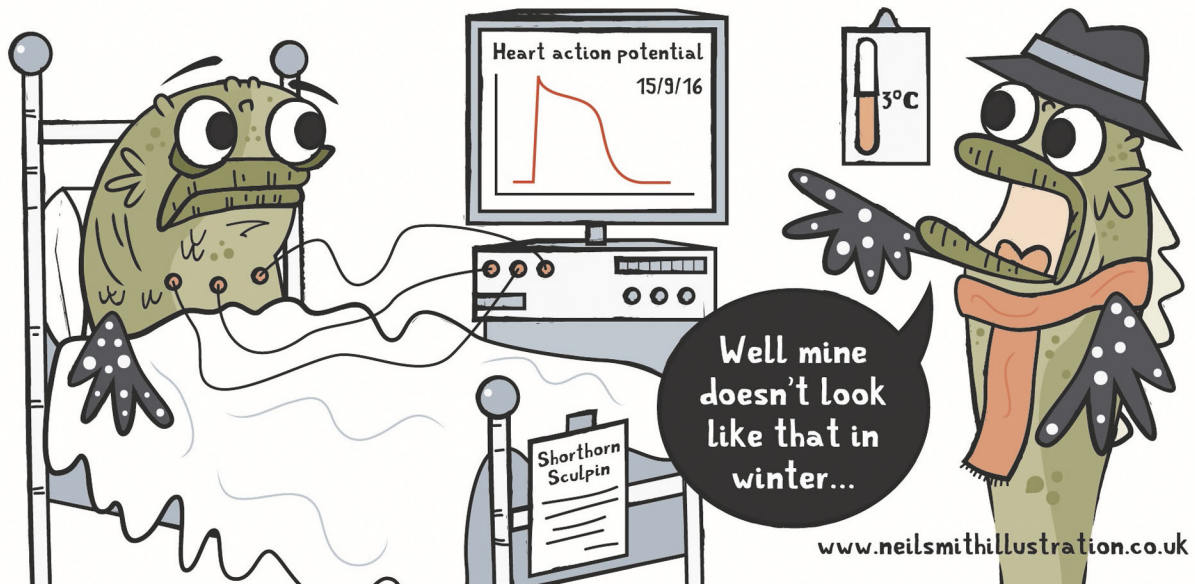


INSIDE JEB

Fake winter doesn't modify sculpin hearts as much as the real thing



For every cold blooded (ectothermic) creature that depends on the surroundings for its body temperature there's a Goldilocks point where the temperature is just right. Too hot and metabolism runs too fast; too cold and animals can't react fast enough. Creatures on land or in the air have the luxury of finding shade or sun to keep their body temperatures in harmony, but fish have to go with the flow, and this can affect their hearts dramatically. 'Acute cooling causes a decrease in heart rhythm and cardiac output', says Tatiana Filatova, from Lomonosov Moscow State University, Russia. However, most studies investigating the effects of winter temperatures on fish hearts are conducted on captive animals that were chilled for only a few weeks. So, Filatova and Denis Abramochkin also from Lomonosov Moscow State University, with Holly Shiels from The University of Manchester, UK, decided to find out how the hearts of true winter fish compared

with those of lab-based fish that had experienced an artificial winter.

Catching shorthorn sculpin (*Myoxocephalus scorpio*) that had adapted naturally to summer (~12°C) and winter (~2°C) conditions in their Arctic Circle waters, the team then chilled some of the summer fish to 3°C for 6 weeks to simulate winter before measuring the essential electrical currents that drive heart beats. Sure enough, the hearts of the two sets of winter fish differed from the summer fish; both groups of winter fish had a shorter action potential (electric signal that drives heart contraction) than the summer fish. However, when the team compared the hearts of the two groups of cold fish, the duration of the action potential in the hearts of the natural winter fish was significantly shorter than that of the fake winter fish. The team suspects that the fish that had overwintered naturally had more ion channels in their muscle cells, to compensate for the effects

of being at low temperatures by increasing the volume of ions flowing into and out of the tissue, which shortens the action potential.

So it seems that the hearts of fish that have merely been chilled in the lab do not go through the full range of physiological changes experienced by fish during genuine winter, and the team outlines other seasonal factors – daylight, sea ice and activity – which could contribute to the dramatic difference between the hearts of genuine winter sculpin and lab-based imposters.

10.1242/jeb.210609

Filatova, T. S., Abramochkin, D. V. and Shiels, H. A. (2019). Thermal acclimation and seasonal acclimatization: a comparative study of cardiac response to prolonged temperature change in shorthorn sculpin. *J. Exp. Biol.* **222**, jeb 202242. doi:10.1242/jeb.202242

Kathryn Knight
kathryn.knight@biologists.com