Living without oxygen is not that easy

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Shallow lakes and ponds in Northern Europe often become anoxic for several months every winter due to ice coverage. The only fish that survives in these waters is the crucian carp (*Carassius carassius*) -- the wild cousin of the goldfish (*C. auratus*). The crucian carp is arguably the most anoxia-tolerant fish species. Among vertebrates, its anoxia tolerance is only matched by that of some North American freshwater turtles. However, unlike turtles, the crucian carp remains active during anoxia. The key adaptation allowing a high level of glycolytic ATP production in anoxia is its ability to convert lactate to ethanol and keeping enormous stores of glycogen. Still, when faced with hypoxia, the crucian carp has a remarkable ability to remodel it gills, resulting in a 7 fold increase in the respiratory surface area, which of course boosts its capacity for oxygen uptake. Thus, if it can avoid anoxia it will do so. Indeed, it appears to suffer memory loss and brain damage in anoxia or upon reoxygenation, and we are seeing very major rearrangements in its brain transcriptome.