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Effects of climate change on the viability of the Devils Hole Pupfish

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Effects of Climate Change on the Viability of the Devils Hole Pupfish
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Abstract

Devils Hole is a unique pupfish habitat in the Mojave. C. diabolis is a critically endangered pupfish species that is only found in Devils Hole. The population contained just 38 individuals in 2006. The current population is estimated at 120 individuals. Most breeding takes place on the shelf at the bottom center of the photograph. Our investigation includes measuring resting aerobic metabolic activity based on oxygen consumption at various temperatures. Due to the endangered nature of C. diabolis, we use a possible hybrid fish of C. diabolis and its closest relative, C. nevadensis mionectes for testing purposes. The basis of our experiments is flow-through respirometry. We place the fish in a clear plastic chamber that has water pulled through it by a peristaltic device and a series of tubes. An electrode that senses changes in oxygen pressure takes measurements before the fish enters the chamber to establish a baseline and then continually measures the oxygen pressure over a course of 2-5 hours to determine how much oxygen the fish requires at rest. After determining how much oxygen the fish consumed at rest at various temperatures, we chart those data to determine which temperatures are stressful for the fish in an acute setting. By using fish that are acclimated to different temperatures, we can determine just how much oxygen C. diabolis uses at various temperatures above and below the temperatures found in Devils Hole. Flow-through respirometry, we determine oxygen consumption as a function of temperature and mass. By controlling the temperature of the water in an aquarium, we can determine just how much oxygen C. diabolis uses at various temperatures above and below the temperatures found in Devils Hole.

Preliminary data show unusual oxygen consumption patterns for 33°C acclimated fish.

As water temperature increases, the oxygen demand of fish increases and the oxygen capacity of water decreases. This means the fish need more oxygen but there’s less of it available.

Cyprinodon diabolis is a critically endangered pupfish species that is only found in Devils Hole. The population contained just 38 individuals in 2006. The current population is estimated at 120 individuals. Most breeding takes place on the shelf at the bottom center of the photograph.

The breeding shelf is the only portion of Devils Hole that is exposed to the surrounding environment and the water temp changes as the season changes. The above graph demonstrates that at temperatures between 25 and 31°C, the mass-specific metabolic rate decreases, as expected; however, at 34°C, the rate is essentially flat, indicating that as mass increases, the fish struggle to meet oxygen needs.

Methods

C. diabolis likely lives above its ideal temperature range.

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