

DELTA SCIENCE FELLOW 2013



Ken Jeffries

Postdoctoral Fellow

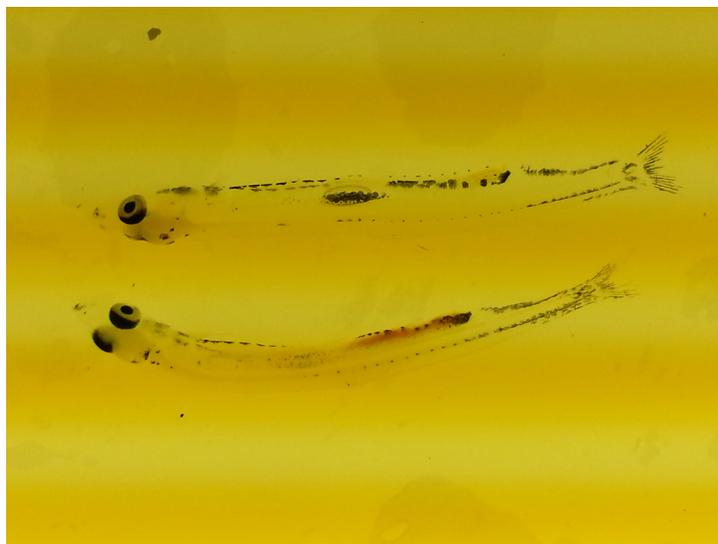
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WHY THIS RESEARCH MATTERS

In the Sacramento/San Joaquin Rivers Delta and San Francisco Bay region of California, two native fish species, the delta smelt and longfin smelt, are showing decreasing population trends while the non-native inland silverside fish is increasingly more abundant.

Identifying the temperature thresholds for these species could help determine the availability of suitable habitat (i.e., with appropriate temperature ranges) and aid in the development of conservation plans for the delta and longfin smelt.

Determining thermal tolerances of longfin smelt and inland silverside and develop biomarkers of thermal stress using new genomics technology



Ken Jeffries studied the thermal tolerance of native fishes, including these 50 day old larval delta smelt.
Courtesy photo

PROJECT

The project characterized the high water temperature tolerances for two species of fish found in the Bay-Delta system, the longfin smelt and inland silverside, using acute temperature exposure experiments. The Fellow used high-throughput sequencing technology to characterize the effects of water temperature on the expression of 44,000 genes (mRNA transcripts). Results were compared to patterns found in delta smelt, to determine common responses to temperature stress among the three species and develop quantitative molecular tools (qPCR assays) to comparatively assess their mechanisms of temperature tolerance.

RESULTS

Longfin smelt exhibited a pronounced cellular stress response after exposure to 20°C that was not observed in delta smelt. The stress response occurred at a temperature below those at which they can be periodically found in the wild, suggesting that these fish may routinely experience sublethal temperature stress in the Delta. This work has been published in a peer-reviewed scientific publication. The Fellow has submitted RNA sequence data for the delta smelt and longfin smelt to the National Center for Biotechnology Information Sequence Read Archive (accession number SRP064394).

MANAGEMENT APPLICATIONS

This study provided the first information on the thermal tolerance of longfin smelt. Based on their physiological responses, longfin smelt may be more susceptible to increases in temperature, as this species appears to be near its upper thermal limits with relatively little room to tolerate persistent drought or future climate warming in California. Longfin smelt may need to adjust either their behavior – seeking out deeper water during peak seasonal temperatures – or the phenology of their spawning or migration to the cooler saltwater environment; otherwise, periods of high water temperature could be detrimental to segments of this population as regions of the Delta will no longer provide suitable habitat.

With the delta smelt at a legitimate risk of extinction, longfin smelt could become a key indicator species of ecosystem health in the Delta, the epicenter of the debates surrounding water use in California. The information generated by this work is being used by Delta managers to understand the habitat requirements of these species during warm water temperature years, such as during drought.



Ken Jeffries conducted the smelt experiments at the UC Davis Fish Conservation and Culture Laboratory in Byron, CA. *Courtesy photo*

SELECT PUBLICATIONS AND PRESENTATIONS

Jeffries, K.M., Connon, R.E., Davis, B.E., Komoroske, L.M., Britton, M.T., Sommer, T., Todgham, A.E. and Fanguie, N.A., 2016. Effects of high temperatures on threatened estuarine fishes during periods of extreme drought. *Journal of Experimental Biology*, 219(11), pp.1705-1716.

Jeffries, K.M., Connon, R.E., Bjelde, B.E., Komoroske, L.M., Britton, M.T., Sommer, T., Todgham, A.E., Fanguie, N.A. 2015. The transcriptome-wide effects of high water temperature on two threatened California fishes. American Fisheries Society 145th Annual Meeting, Portland, OR, USA. [Poster Presentation], public/profession presentation, 3000 attendees, 2015-08-16

Bjelde, B.E., Jeffries, K.M., Komoroske, L.M., Todgham, A.E., Connon, R.E., Fanguie, N.A. 2015. Critical thermal limits and sensitivity in developing endangered California fishes. American Fisheries Society 145th Annual Meeting, Portland, OR, USA. [Poster Presentation]. public/profession presentation, 3000 attendees, 2015-08-16

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