Offspring growth rate from experiments testing for local adaptation in thermal TGP

Website: https://www.bco-dmo.org/dataset/704653
Data Type: experimental
Version: 1
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Project

» Beyond maternal effects: Transgenerational plasticity in thermal performance (ThermalTGP)

Contributors	Affiliation	Role
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Abstract

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Coverage

Spatial Extent: **N**:42.0863 **E**:-71.3514 **S**:32.385 **W**:-80.2723
Temporal Extent: 2014 - 2014

Dataset Description

Offspring growth rate from experiment to test for local adaptation in thermal TGP.

Acquisition Description

We caught wild juvenile sheepshead minnows (Cyprinodon variegatus) from South Carolina (SC), Maryland (MD) and Connecticut (CT) in 2014. All fish were transferred to acclimation aquaria at 24 deg C at the NOAA Fisheries Science Center, Santa Cruz, California. Daily care followed standard protocols (Cripe et al. 2009, Salinas and Munch 2012), including ad libitum feeding of TetraMin flakes (Tetra Holding, Blacksburg, VA, USA). Salinity was maintained at 20 ppt, but was reduced to 10 ppt for two days prior to egg collection. The photoperiod was 14L:10D. Each day we changed 10% of the total volume of water.

For the experiments of thermal transgenerational plasticity, all eggs were divided in half and transferred to either same temperature with parent or different temperature with parent: for example, if we collected eggs from 26 deg C parents, then a half of eggs were at 26 deg C and another half of eggs were at 32 deg C. Upon hatching we randomly selected up to four larvae from each treatment group. We measured standard body length from photographs of the fish obtained with a Canon 40D digital camera with Image J (Rasband 2016). At the end of the experiment, we measured wet-mass, and then removed and weighted the testes and gonad.

Processing Description

Growth rate was calculated as the difference in length at 8 or 9 weeks after hatching and length at 2 weeks post-hatching divided by time because growth was linear over this period. We calculated gonadosomatic indecies (GSI: 100x gonad mass/total mass).

BCO-DMO Data Processing Notes:

- reformatted column names to comply with BCO-DMO standards

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Related Publications

Cripe, G. M., Hemmer, B. L., Goodman, L. R., & Vennari, J. C. (2008). Development of a Methodology for Successful Multigeneration Life-Cycle Testing of the Estuarine Sheepshead Minnow, Cyprinodon variegatus. Archives of Environmental Contamination and Toxicology, 56(3), 500–508. doi:10.1007/s00244-008-9204-8 [details]

Rasband, W. S. (1997). ImageJ. US National Institutes of Health, Bethesda, MD, USA. [details]

Salinas, S., & Munch, S. B. (2011). Thermal legacies: transgenerational effects of temperature on growth in a vertebrate. Ecology Letters, 15(2), 159–163. doi:10.1111/j.1461-0248.2011.01721.x [details]

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Parameters

Parameter	Description	Units
population	Code for the origin of sampled population;: 1 - South Carolina; 2 - Maryland; 3 - Connecticut	unitless
p_temp	Parent temperature	celsius
o_temp	Offspring temperature	celsius
t_day	Date of parental exposure on new temperature (26C or 32C) from 24C	unitless
pf_length	Mean length in parents	millimeters
growth_rate	Mean growth rate	millimeters per day
st_dev	Standard deviation of growth rate	unitless

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Instruments

Dataset-specific Instrument Name	Canon 40D digital camera with Image J
Generic Instrument Name	Camera
Dataset-specific Description	Photographs used to determine fish body length
Generic Instrument Description	All types of photographic equipment including stills, video, film and digital systems.

Dataset-specific Instrument Name	Aquarium
Generic Instrument Name	Aquarium
Dataset-specific Description	Used to acclimate juvenile sheepshead minnows
Generic Instrument Description	Aquarium - a vivarium consisting of at least one transparent side in which water-dwelling plants or animals are kept

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Deployments

Mangel_2014

Website	https://www.bco-dmo.org/deployment/704753
Platform	shoreside Eastern United States
Start Date	2014-07-01
End Date	2014-09-30
Description	Estuaries in South Carolina, Maryland, and Connecticut

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Project Information

Beyond maternal effects: Transgenerational plasticity in thermal performance

(ThermalTGP)

Coverage: Nearshore waters of Florida, South Carolina, Maryland, & Connecticut

Description from NSF award abstract: Many marine species are currently undergoing significant range shifts and exceedingly rapid changes in phenotype driven, potentially, by warming, ocean acidification, and human-induced evolution. Dramatic shifts in body size and maturation have been observed in many marine fishes worldwide. There is considerable debate over whether these changes are the result of rapid evolution or physiological responses to changes in environmental variables. Attempts to address these issues typically assume that thermal physiology is fixed or slow to evolve. Transgenerational plasticity (TGP) occurs when the environment experienced by the parents directly translates, without any changes in DNA sequences, into significant changes in offspring. TGP in thermal performance provides a mechanism for a rapid response to climate change that has, to date, been demonstrated only in terrestrial plants. This project will provide the first test of thermal TGP in marine systems and will explore its implications for forecasting responses to human-induced evolution and climate change. First, the PIs will test for thermal TGP in four taxonomically distinct fishes. Then, using sheepshead minnows as a model, they will study the dependence of transgenerational responses on the predictability of the thermal environment and test whether disparate thermal environments select for different levels of TGP. With these data they will develop the first stochastic population model including TGP and use it to understand life history evolution and predict responses to climate change. The existence of thermal TGP poses a serious challenge to the idea that changes in thermal physiology are slow to evolve and can safely be ignored in modeling population responses to climate change or harvest selection. By extension, virtually all field estimates of heritability and physiological measurements will need to be reconsidered in light of thermal TGP, as will conclusions regarding rapid evolution in shifting environments. The research team has made significant contributions to theoretical and empirical work on the evolutionary, behavioral, and physiological ecology of growth in many different species and environments. Together, the team has substantial prior experience in all aspects of the proposed research and has worked together successfully for many years.

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Funding

Funding Source	Award
NSF Division of Ocean Sciences (NSF OCE)	OCE-1130483

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