Molecular mechanisms of heatwave mortality in Pacific cod early life stages

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Context: Low Pacific cod recruitment estimates in Gulf of Alaska coincided with the 2014-16 & 2019 marine heatwaves.

Questions: How and why does warming affect early life stages of Pacific cod? Which genes and processes are sensitive to temperature, and is there potential to acclimatize or adapt?

LARVAL STUDY

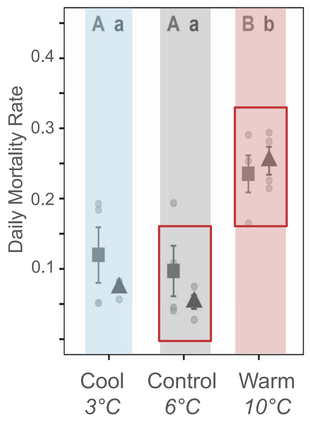
2-day old embryos from 1 female x 3 males reared in warm, acidified, cool, combined and control treatments, larvae sampled at ~6 mm (feeding stage, pre-flexion).

Data generated

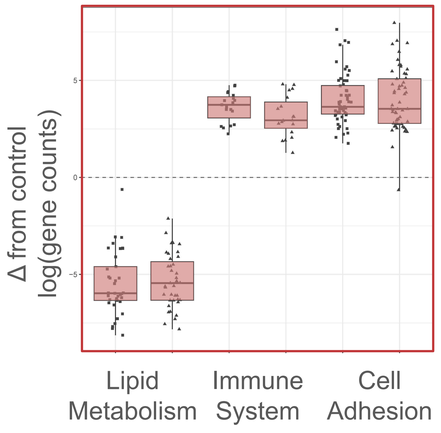
Gene expression of whole-body larvae (RNASeq)
n=11-14 / treatment

Mortality and growth rates and condition factors

Warming increased mortality rate

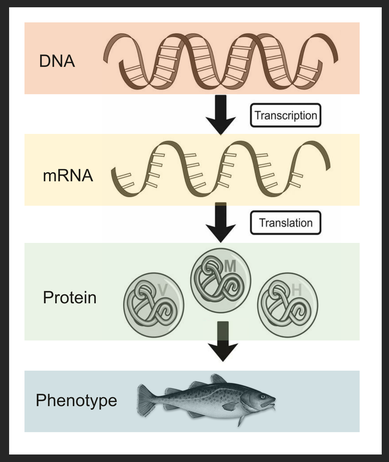


Warming altered larval gene expression



See the companion study:

Genome-to-phenome datasets reveal connections between genes and traits, enabling insights into mechanisms and adaptation.



Expression data reveal inflammation, lipid depletion or reallocation, and altered cell adhesion may be **mechanisms of larval mortality and poor juvenile condition during heatwaves**, likely decreasing Pacific cod recruitment in the Gulf of Alaska

We are exploring genes and genetic variation that might enable adaptation to warming alongside population structure

JUVENILE STUDY

Wild-caught juveniles were exposed to cold, cool, control, and warm temperatures for 6 weeks. Fish were tagged to collect per-individual data (n=40/temp).

Data generated

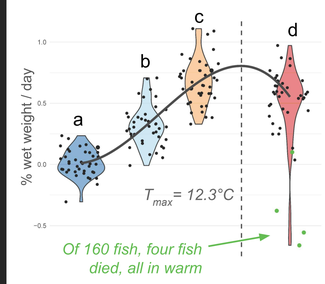
Whole-genome resequencing (3x depth, lcWGS)

Gene expression in livers (RNASeq)

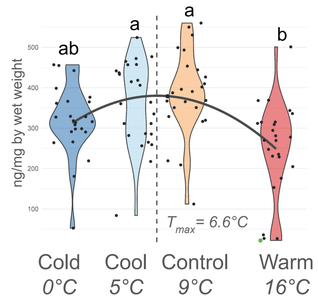
Liver lipid components

Growth rates, body & liver condition, survival

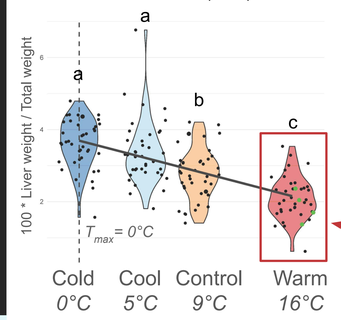
Growth rate



Total lipid content in liver



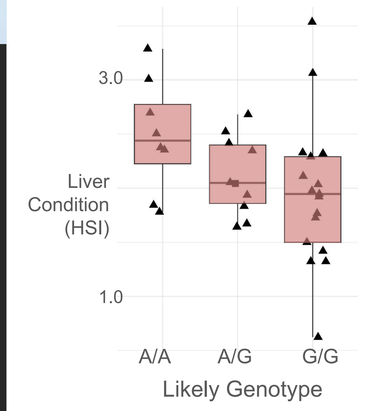
Liver condition (HSI)



Warming decreased juvenile growth, liver lipid content and liver and body condition

Wow, variability!

We used phenotype variability + genetic data to identify markers putatively associated with performance in Pacific cod juveniles exposed to warming



*Example marker for liver size in a gene coding for a **receptor for serotonin** (5-HT4) which regulates appetite*

Fish with A/A genotype had larger livers in warming

See my talk: