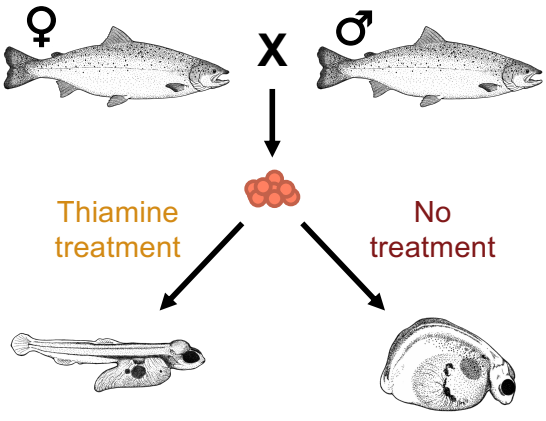
Evidence for genetic differences in thiamine deficiency outcomes in Lake Champlain Atlantic salmon (*Salmo salar*)

A summary of: Harder et al. 2020. Among-family variation in survival and gene expression uncovers adaptive genetic variation in a threatened fish, *Molecular Ecology*. Link to paper.

Background

Thiamine deficiency is an emerging conservation issue in vertebrates resulting from the inability to acquire or retain thiamine (vitamin B_1) and has been documented in aquatic ecosystems ranging from the Baltic Sea to the Laurentian Great Lakes. In Lake Champlain, eggs of stocked Atlantic salmon are treated with thiamine to mitigate otherwise high rates of juvenile mortality. Some research suggests that fish populations with diets naturally low in thiamine may have genetically adapted to low thiamine availability, reducing the probability of demographic loss in response to thiamine deficiency. We wanted to assess the potential for such a response in Lake Champlain salmon.

Methods



We randomly crossed 9 pairs of thiamine-deficient salmon and tracked mortality for the treated and untreated offspring of each pair. About 3 months post-fertilization, we sampled 2 treated and 2 untreated fry from each family for gene expression analysis.

Results

- Survival of untreated offspring varied among families, and ranged from 0-60%
- 1,446 genes were associated with differences in survival among families:

812 genes were strongly expressed (upregulated) in families with **poor survival**

Many of these genes were related to **physiological stress** responses

634 genes were strongly expressed (upregulated) in families with **high survival**

Many of these genes were related to **growth and development processes**

Conclusions

- Differences in gene expression patterns across families may be due to **genetic differences** in how genes are regulated in response to low thiamine availablilty
- The large number of genes identified in our study suggests that adaptation to low available thiamine (or perhaps thiaminase consumption) is highly polygenic, **involving many different genes**
- Our results also suggest that the **genetic variation** required for adaptation is **already present** in Lake Champlain

Project contributors

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