Predicting the invasion success of zebra and quagga mussels

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The Problem

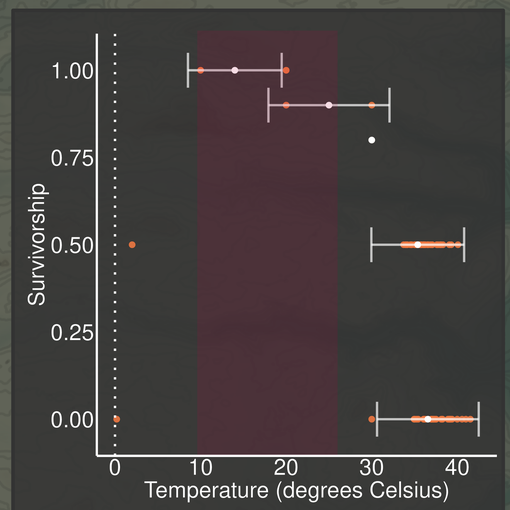
Zebra and quagga mussels (*Dreissena polymorpha* and *D. rostriformis bugensis*) are a pressing threat to freshwater biodiversity in North America. These invaders have spread from the Great Lakes across the continent via boats and downstream dispersal.

Predicting the spread of dreissenid mussels is a major priority for conservation. [1]

Here we present a mechanistic niche model that uses response curves extracted from the literature to compare against a suite of environmental data for the lakes of the Okanagan Valley in BC, Canada.

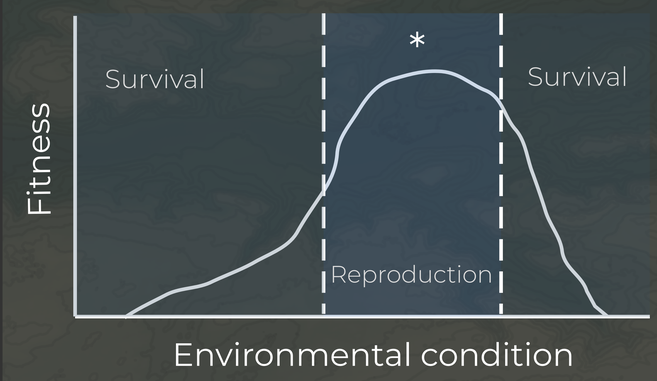
Six key variables were identified as contributing to dreissenid mussel establishment success:

Variable	Environmental data
Depth	Bathymetry
Calcium availability	$CaCO_3$ conc.
Substrate size	Foreshore inventory
Food availability	Chlorophyll-a conc.
Temperature	Epilimnion and hypolimnion temperature profiles
Salinity	Not included, inland lake.



Temperature response curve for zebra mussels, extracted from the literature. Purple band represents the area identified in the literature where growth is possible.

The $CaCO_3$/epilimnion temperature niche space for sites in Skaha Lake between 2017 and 2021. Yellow and purple bands indicate areas where growth and shell maintenance are possible.



To tie together the environmental data and the physiology of the mussels, experimental response data will be gathered from the literature and used to fit response curves using Bayesian Markov Chain Monte Carlo (MCMC) random sampling. [2]

Fitness optima where survival and reproduction can occur will be estimated from the performance curves and evaluated against a suite of environmental data collected for the lakes of the Okanagan Valley.

Euclidean distances from the optima for each point of environmental data will be calculated, producing a total distance from the niche centroid [3].

This total distance represents a useful metric to evaluate establishment risk and is an important step forward in our ability to evaluate the invasion dynamics of these mussels at a lake-by-lake, river-by-river scale.

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This research was conducted on the unceded traditional territories of the xʷməθkʷəy̓əm (Musqueam), Sḵwx̱wú7mesh (Squamish), Sel̓íl̓witulh (Tsleil-Waututh), Kwikwetlem (kwikwəƛ̓əm), and Katzie Nations, and involves the unceded traditional territories of the Sylix (Okanagan) peoples.

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