Effects of Intra-Annual Sea Surface Temperatures on Parasite Abundance in Puget Sound

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Introduction

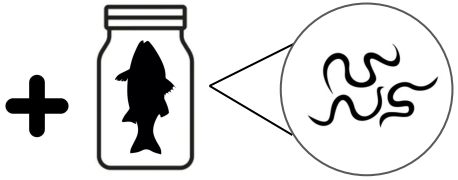
The abundance of parasites with 3+ hosts in the Puget Sound has declined over the past century. This decline is significantly correlated with increasing average annual sea surface temperatures (SSTs) caused by climate change. However, this decline could also be caused by SST variations **within a single year,** such as short-term temperature spikes or increasingly warm summers or winters.

Is parasite abundance correlated with intra-annual SST variation?

And if so, are intra-annual variables better predictors of decline than annual average SST?

Methods

Monthly SST data
Race Rocks Lighthouse,
British Columbia



Data from parasitological dissections
of fluid-preserved fishes
8 fish species, 85 parasite species

1921-2019 **Puget Sound**

Model: Generalized Linear Mixed-Effects Model with a negative binomial distribution

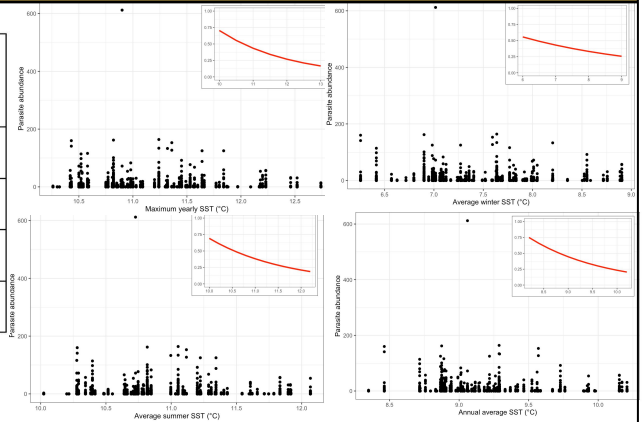
- Test parasite abundance correlation with 4 SST variables:

avg. summer SST
maximum yearly SST
avg. winter SST
annual average SST

Results

Temperature Variable	% Decline per 1 °C Increase	P-value
Maximum yearly SST	38%	4.76e-05
Average summer SST	45%	0.0123
Average winter SST	23%	3.3e-05
Average annual SST	48%	<2e-16

Table 1. Relationship of temperature variables to parasite abundance. The middle column shows percent decline in parasite abundance observed per 1 °C increase in each SST variable.



Figures 2-5. The downwards slope of the regression lines in each graph shows a negative correlation for all four variables.

All four variables tested were significantly negatively correlated with parasite abundance. Average annual SST was the strongest predictor of parasite decline, followed closely by average summer SST.

Discussion

While these results can't determine causation, they suggest that parasite abundance in the Puget Sound may be declining due to a **combination** of short- and long-term SST increases. Increasingly warm summers may be especially bad for parasites, likely because many parasite species undergo key life cycle stages during this season.

Conclusion

The abundance of 3+ host parasites in Puget Sound is **significantly negatively correlated** with increases in several intra-annual SST variables. However, annual average SST remains the strongest predictor of parasite decline. As both annual and intra-annual SST metrics increase with climate change, parasites will likely be affected in complex ways.