



Impacts of Diseases to Wild Fish Populations and the Exacerbating Effects of Temperature

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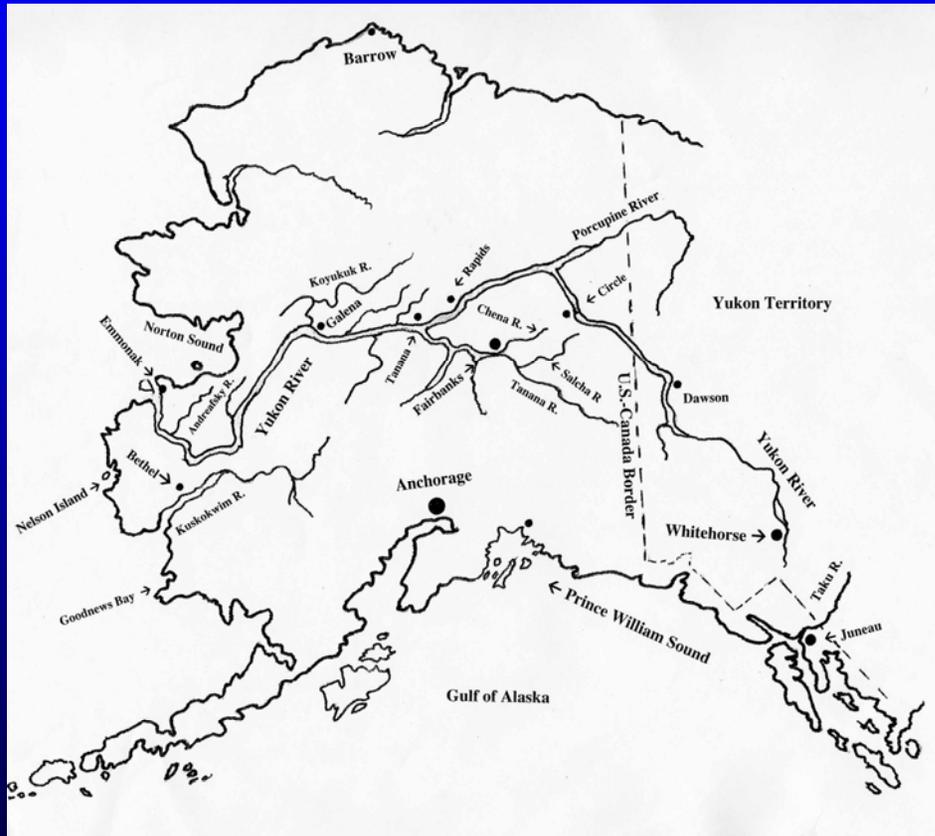
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Ichthyophonus in Yukon King Salmon

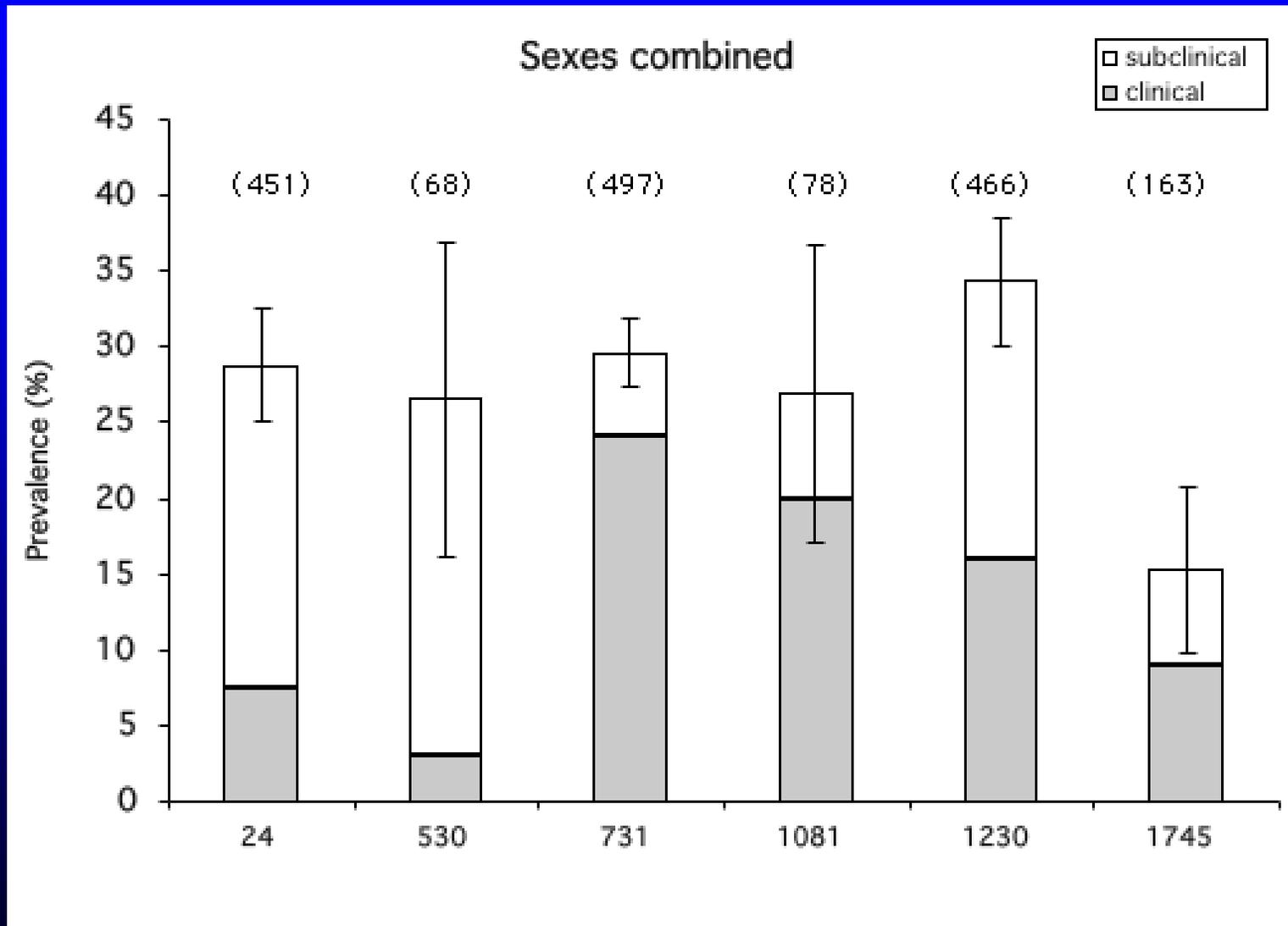
- Mid 1980's
- Off-odor, improper drying, unusable product
- Diagnosed



A monitoring study was initiated to investigate the effect of *Ichthyophonus* on the health of adult king salmon.

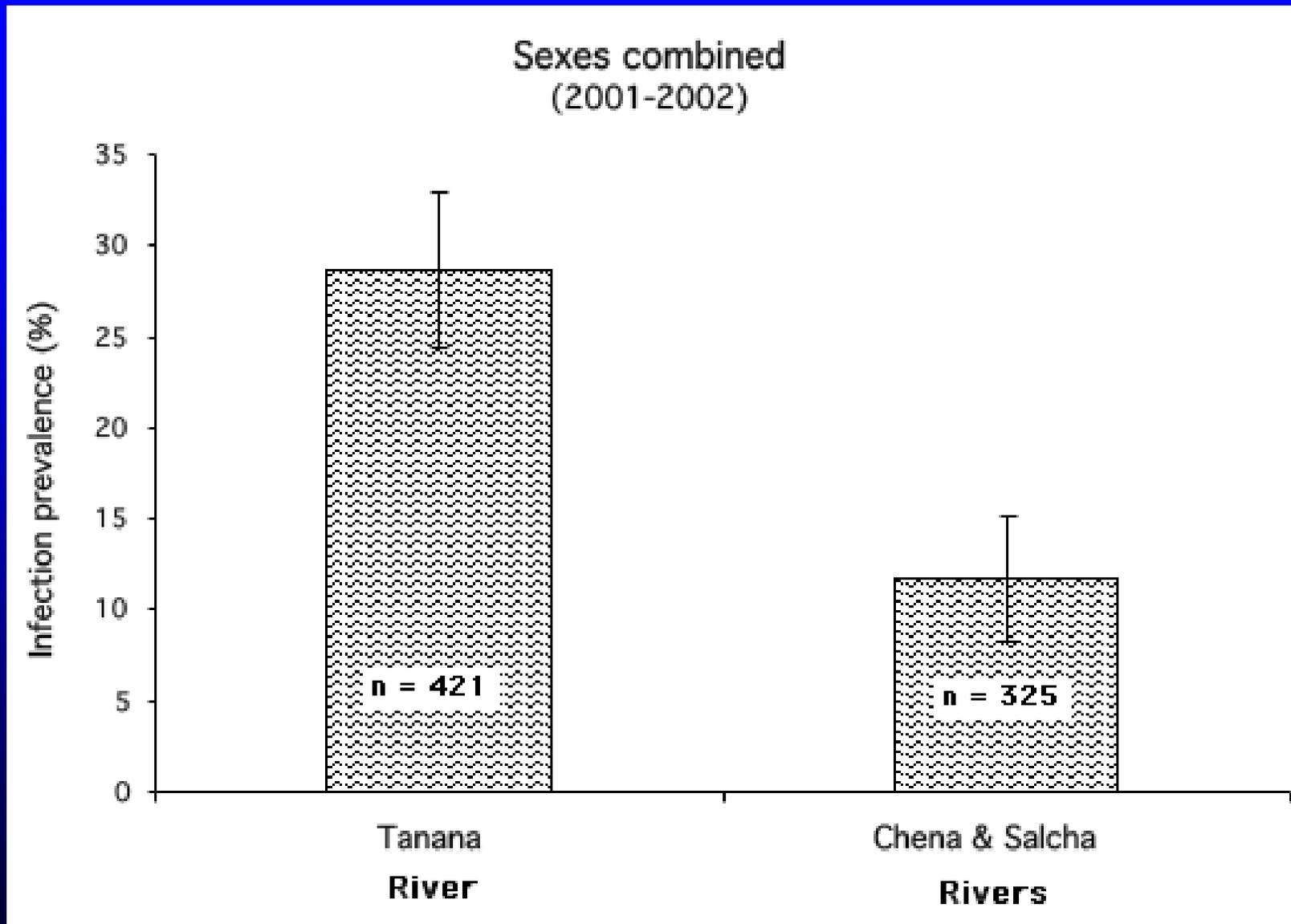


Prevalence of *Ichthyophonus* in Yukon Chinook



- Kocan, R.M., P.K. Hershberger, and J. Winton. 2004. Ichthyophoniasis: An Emerging Disease of Chinook Salmon (*Oncorhynchus tshawytscha*) in the Yukon River. *Journal of Aquatic Animal Health* 16: 58-72.

Prevalence of *Ichthyophonus* in Spawning Streams

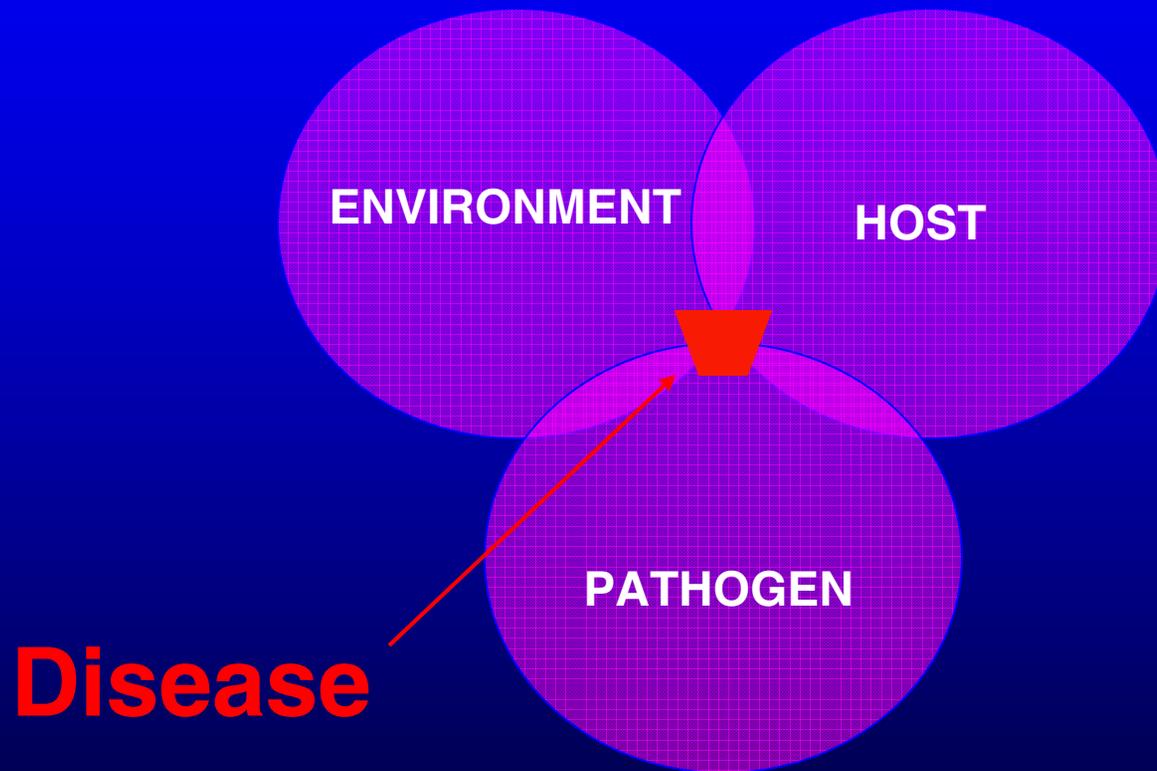


- Kocan, R.M., P.K. Hershberger. 2006. Differences in *Ichthyophonus* prevalence and infection severity between upper Yukon and Tanana River Chinook salmon, *Oncorhynchus tshawytscha* (Walbaum), stocks. *Journal of Fish Diseases* 29: 497-503.

Direct and Indirect Implications

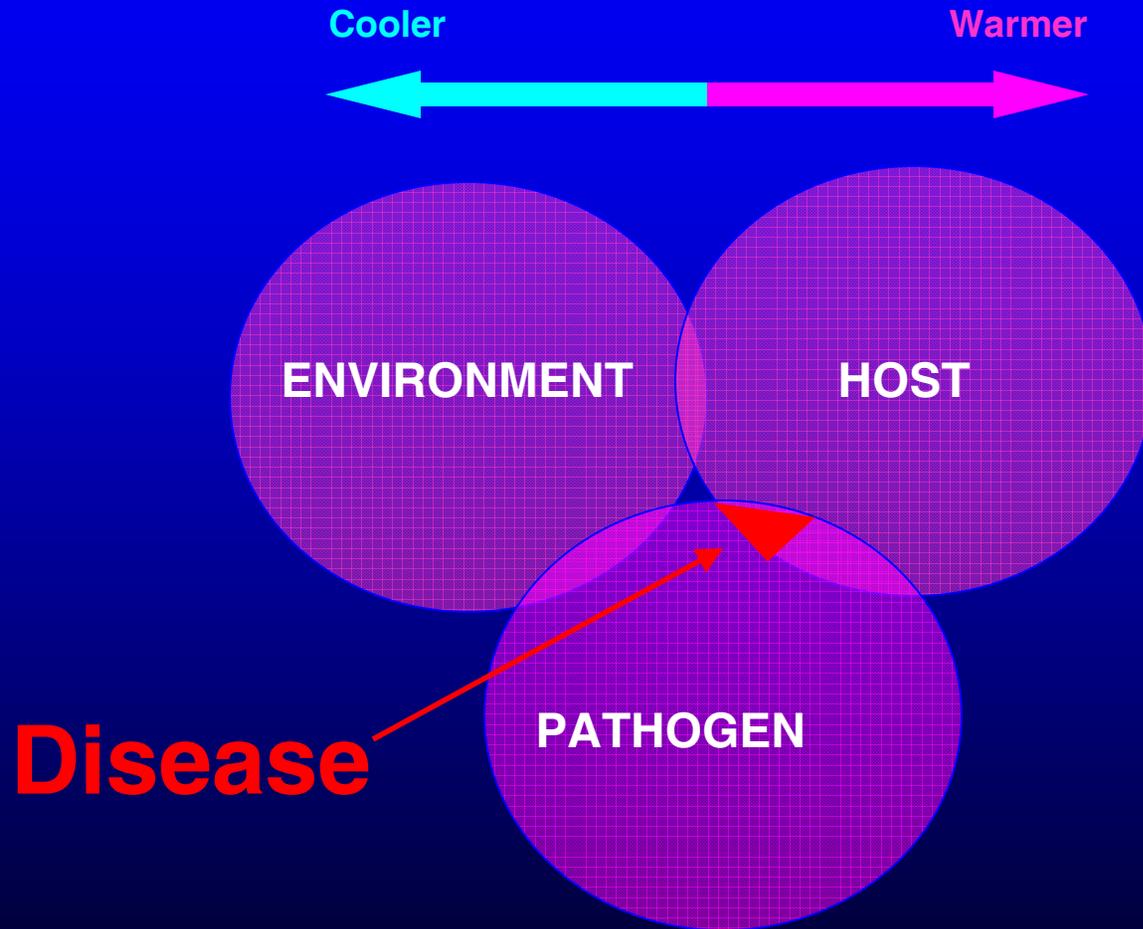


Causes of Disease in Wild Populations

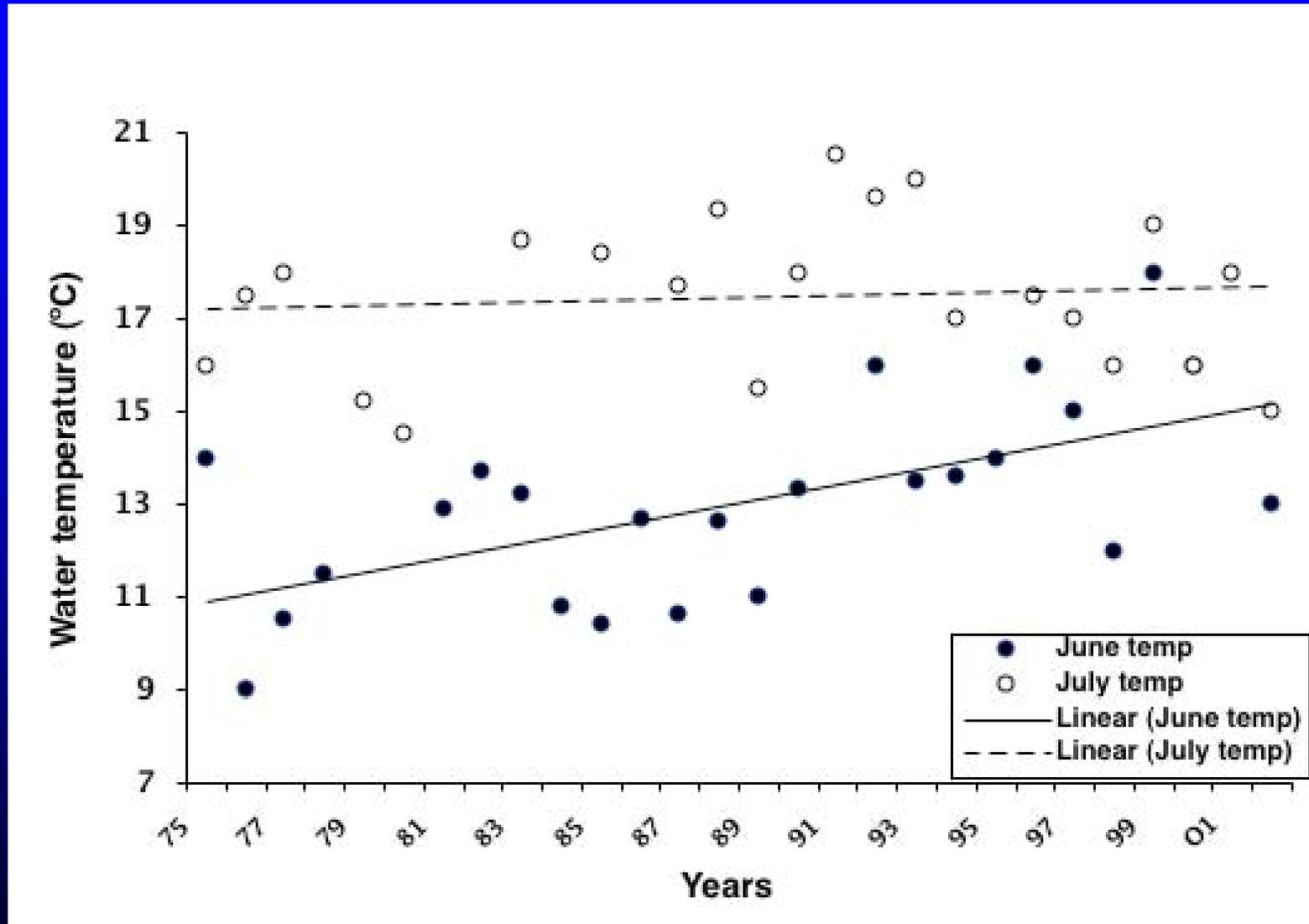


Causes of Disease in Wild Populations

Environmental Shifts



Mean Temperatures in the Lower Yukon River



- Kocan, R., P. Hershberger, G. Sanders, J. Winton. *Submitted*. Effects of temperature on disease progression and swimming stamina in *Ichthyophonus*-infected rainbow trout (*Oncorhynchus mykiss*) infected with *Ichthyophonus* sp. *Journal of Fish Diseases*.

Elevated Temperature Results in Increased Growth of *Ichthyophonus*

5 °C



10 °C



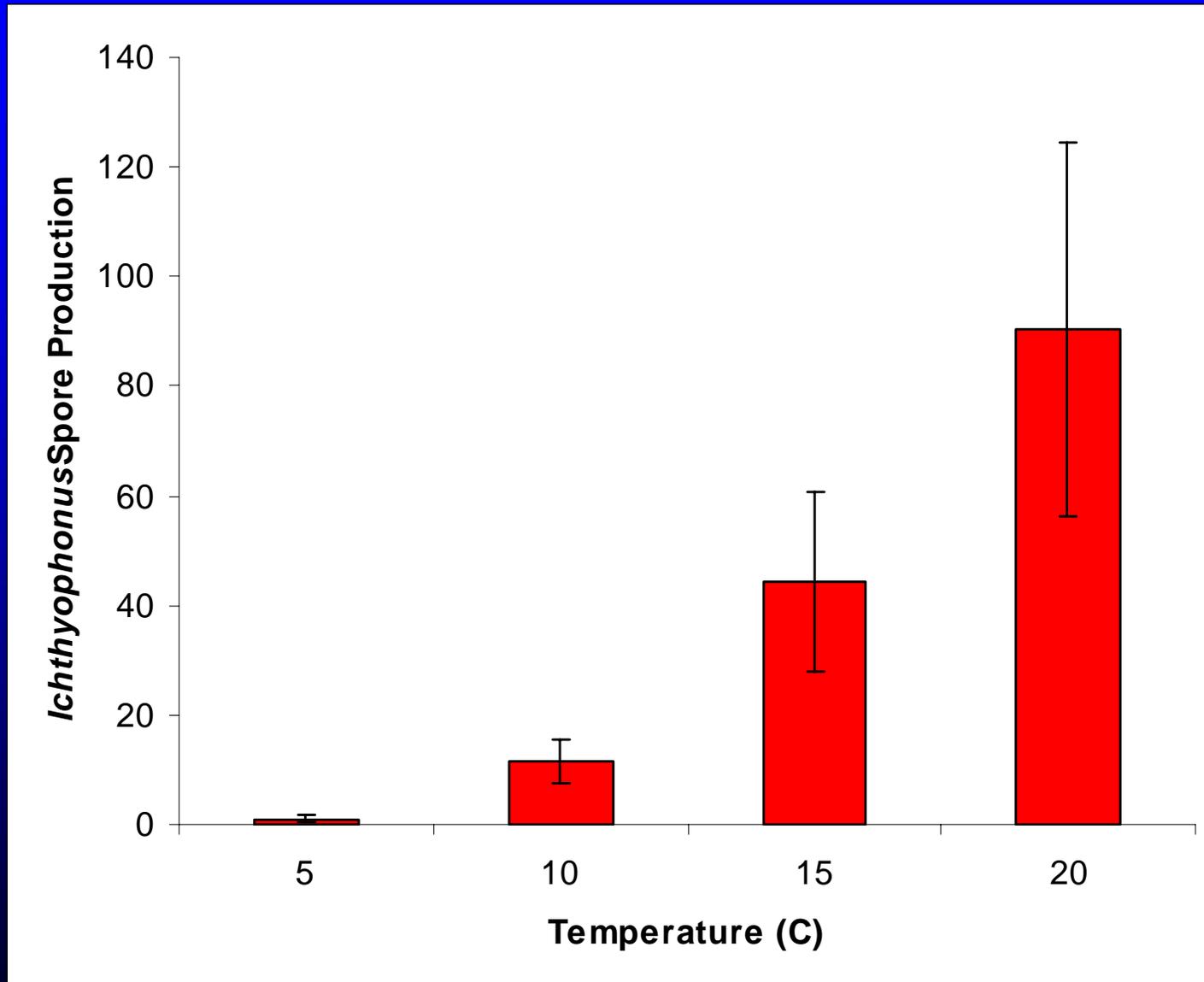
15 °C



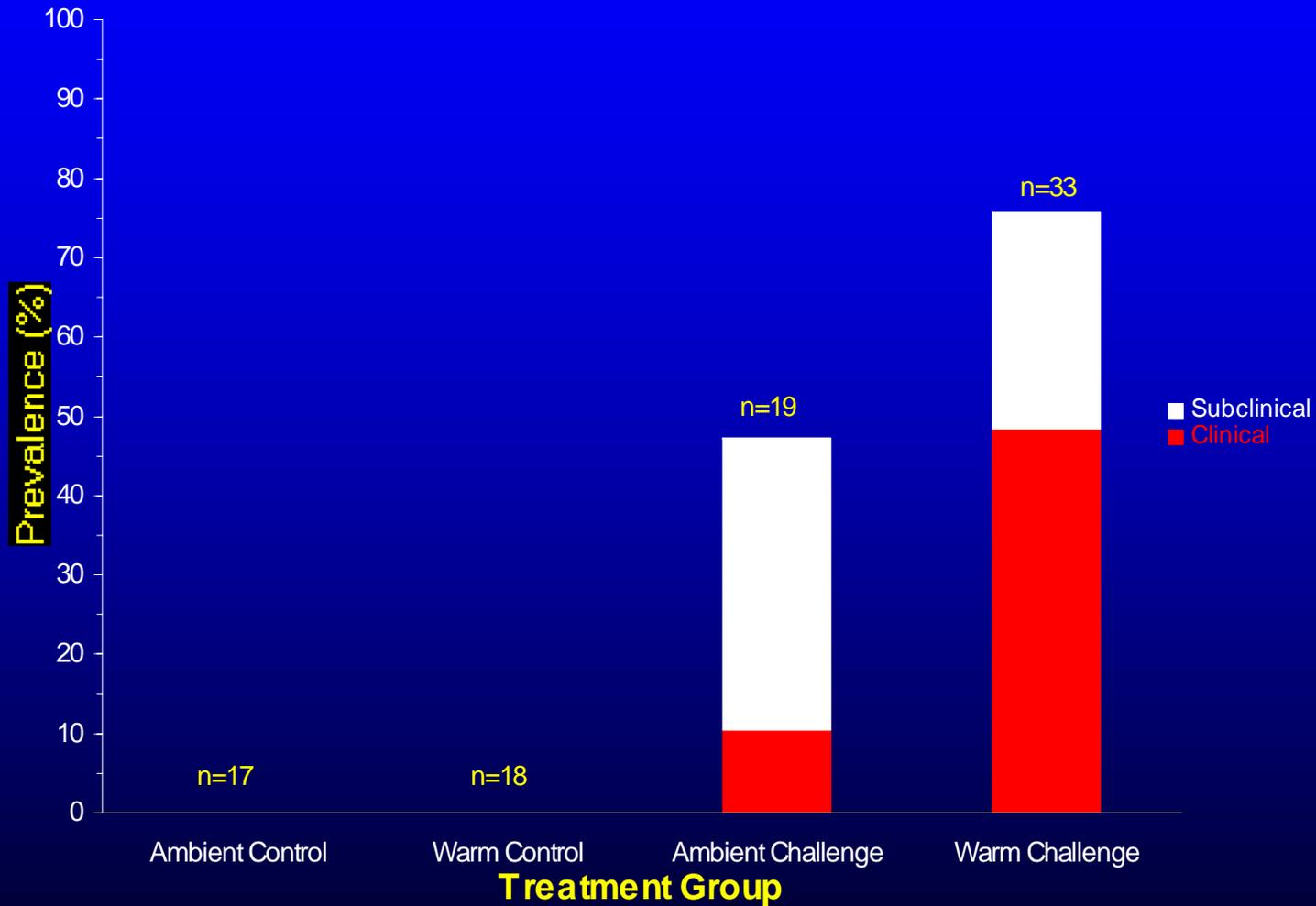
20 °C



Elevated Temperature Results in Increased Growth of *Ichthyophonus*

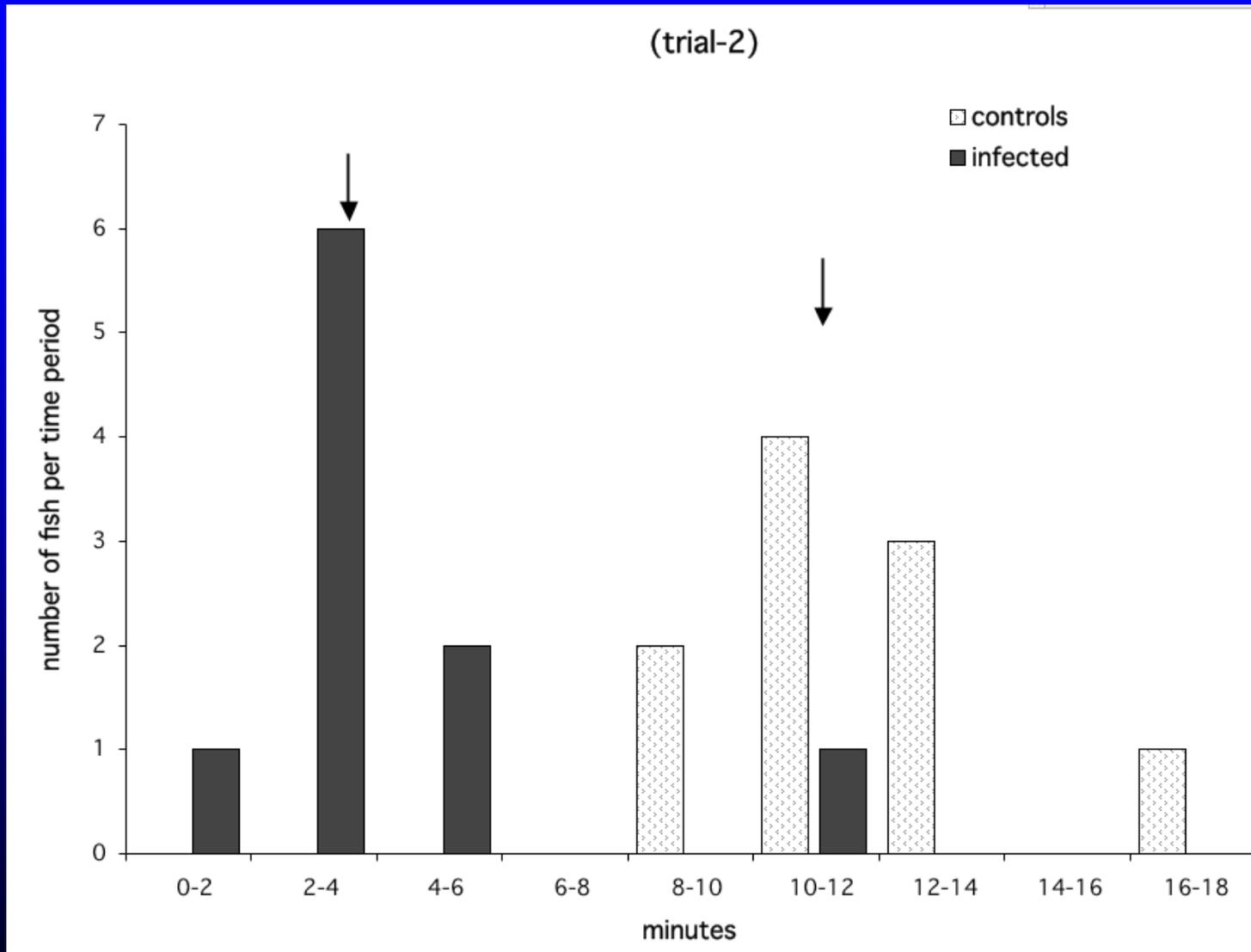


Elevated Temperatures Result in Increased Prevalences of Infection and Disease



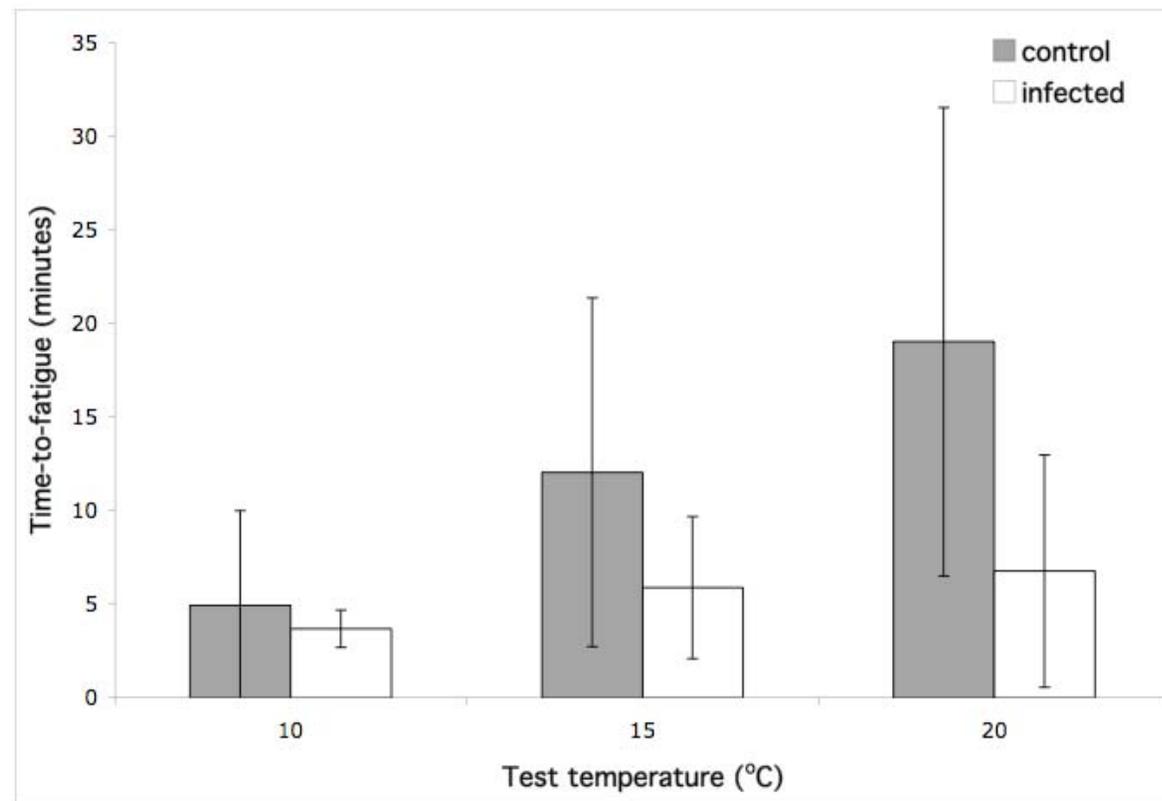
Halpenny, C.M., R.M. Kocan, J.R. Winton, J.A. Perry, and P.K. Hershberger. 2002. Elevated temperature exacerbates *Ichthyophonus* infections in buffalo sculpin. Fish Health Newsletter 30(2): 17-20.

Ichthyophonus infections Negatively Impact Swimming Performance



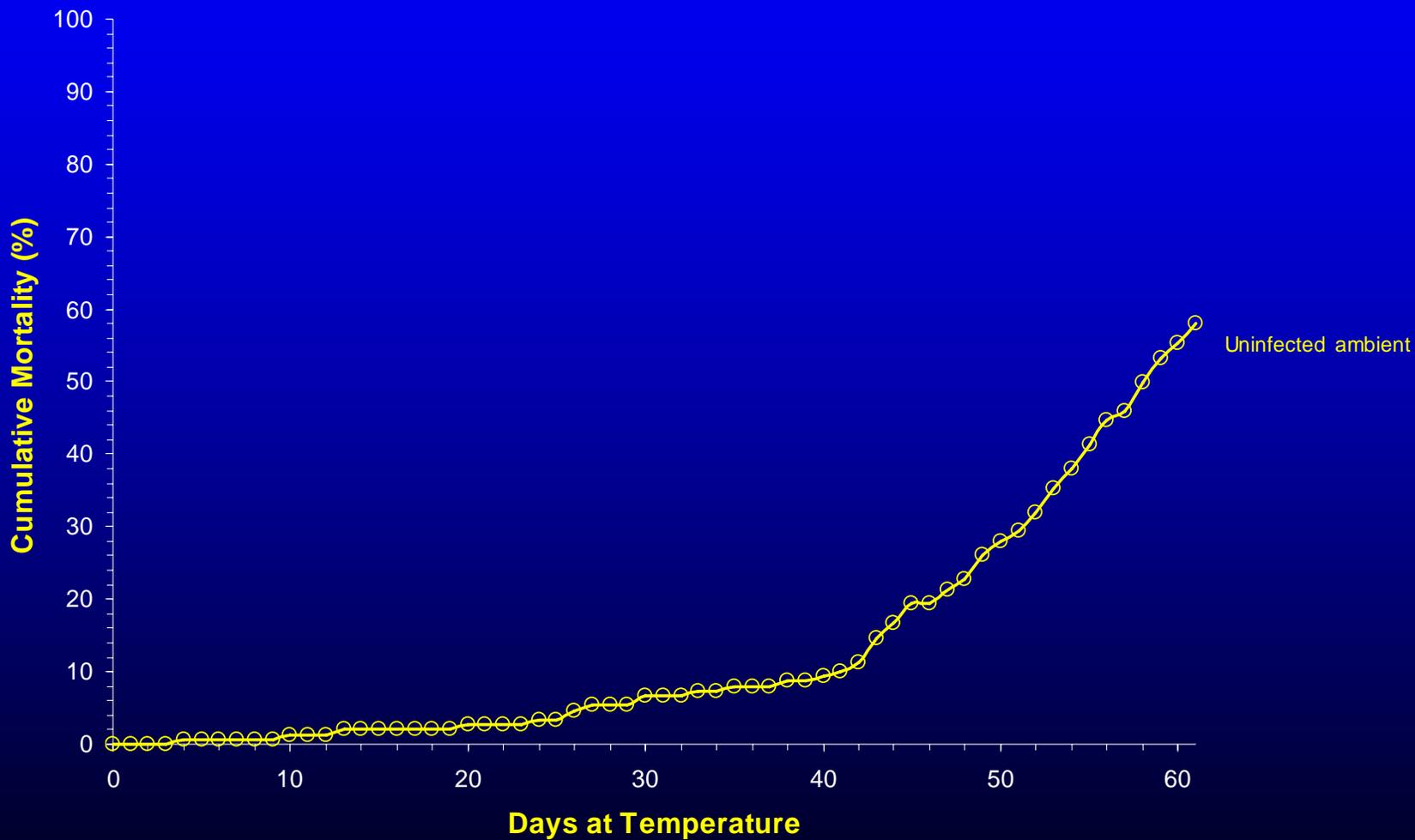
Kocan, R., S. LaPatra, J. Gregg, J. Winton, P. Hershberger. 2006. *Ichthyophonus*-induced cardiac damage: a mechanism for reduced swimming stamina in rainbow trout. *Journal of Fish Diseases* 29: 521-527.

Beneficial Effects of Elevated Temperature on Swimming Performance are Negated by *Ichthyophonus* Infections

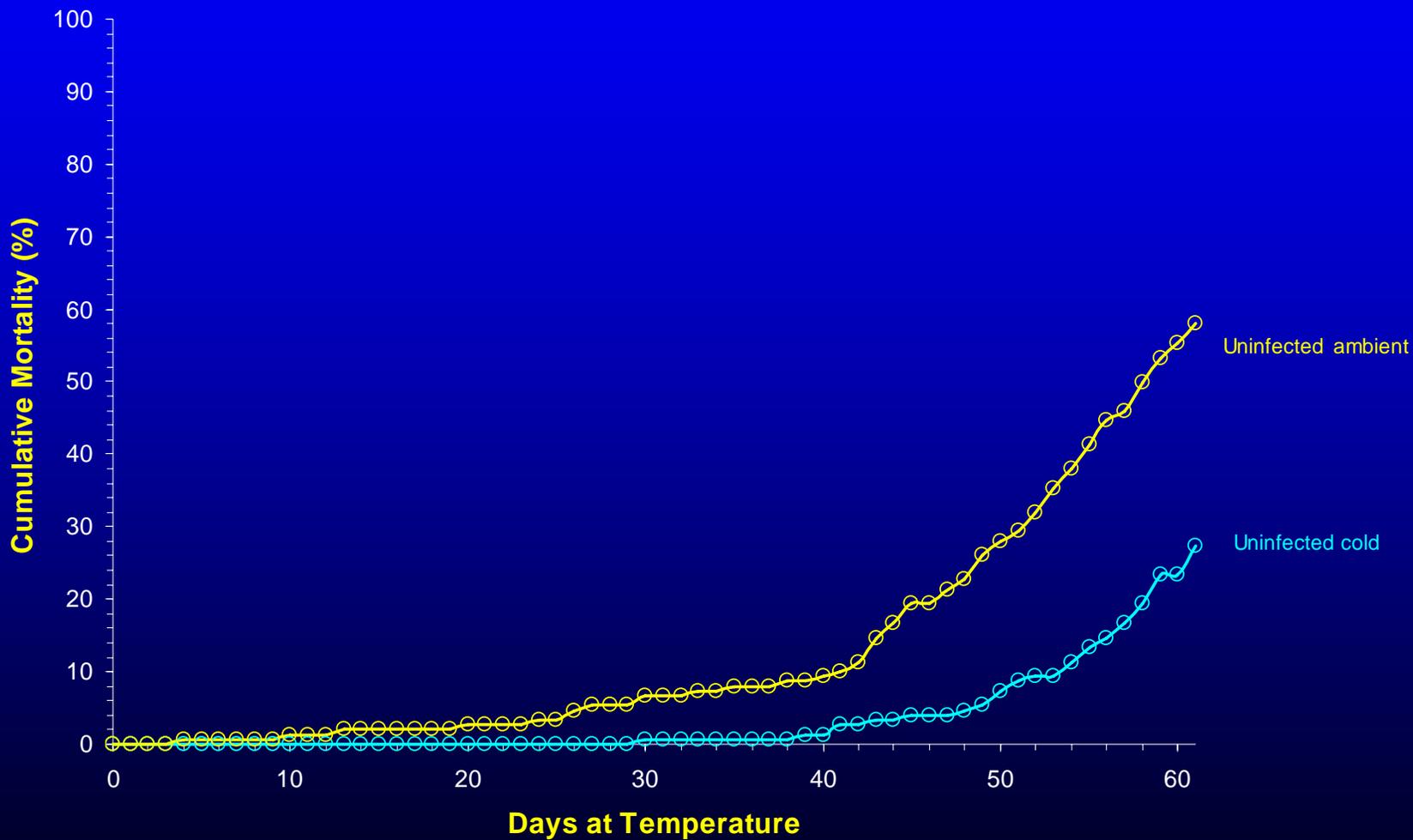


- Kocan, R., P. Hershberger, G. Sanders, J. Winton. *Submitted*. Effects of temperature on disease progression and swimming stamina in *Ichthyophonus*-infected rainbow trout (*Oncorhynchus mykiss*) infected with *Ichthyophonus* sp. *Journal of Fish Diseases*.

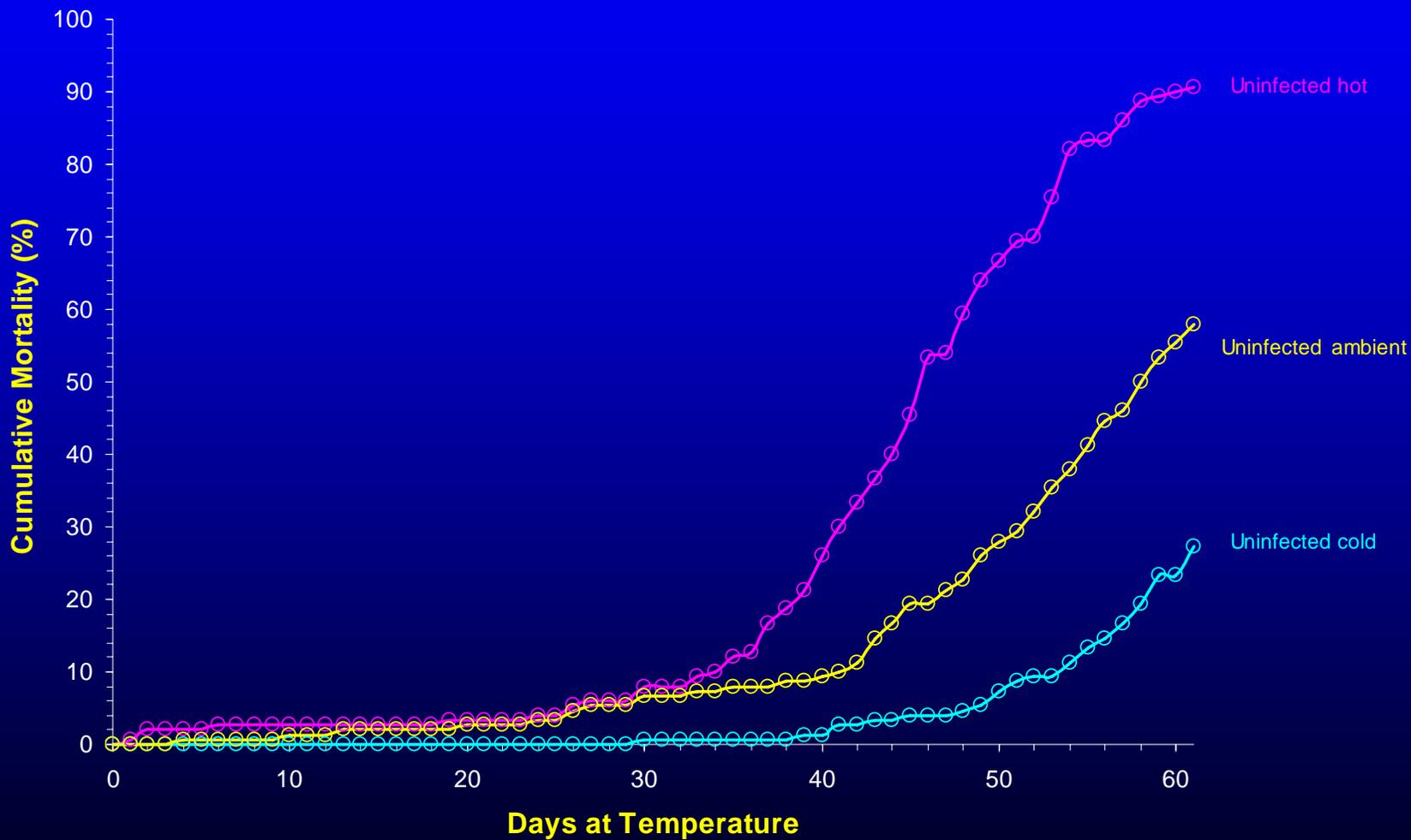
Elevated Temperature Results in Decreased Time-to-Death among Fasted Individuals



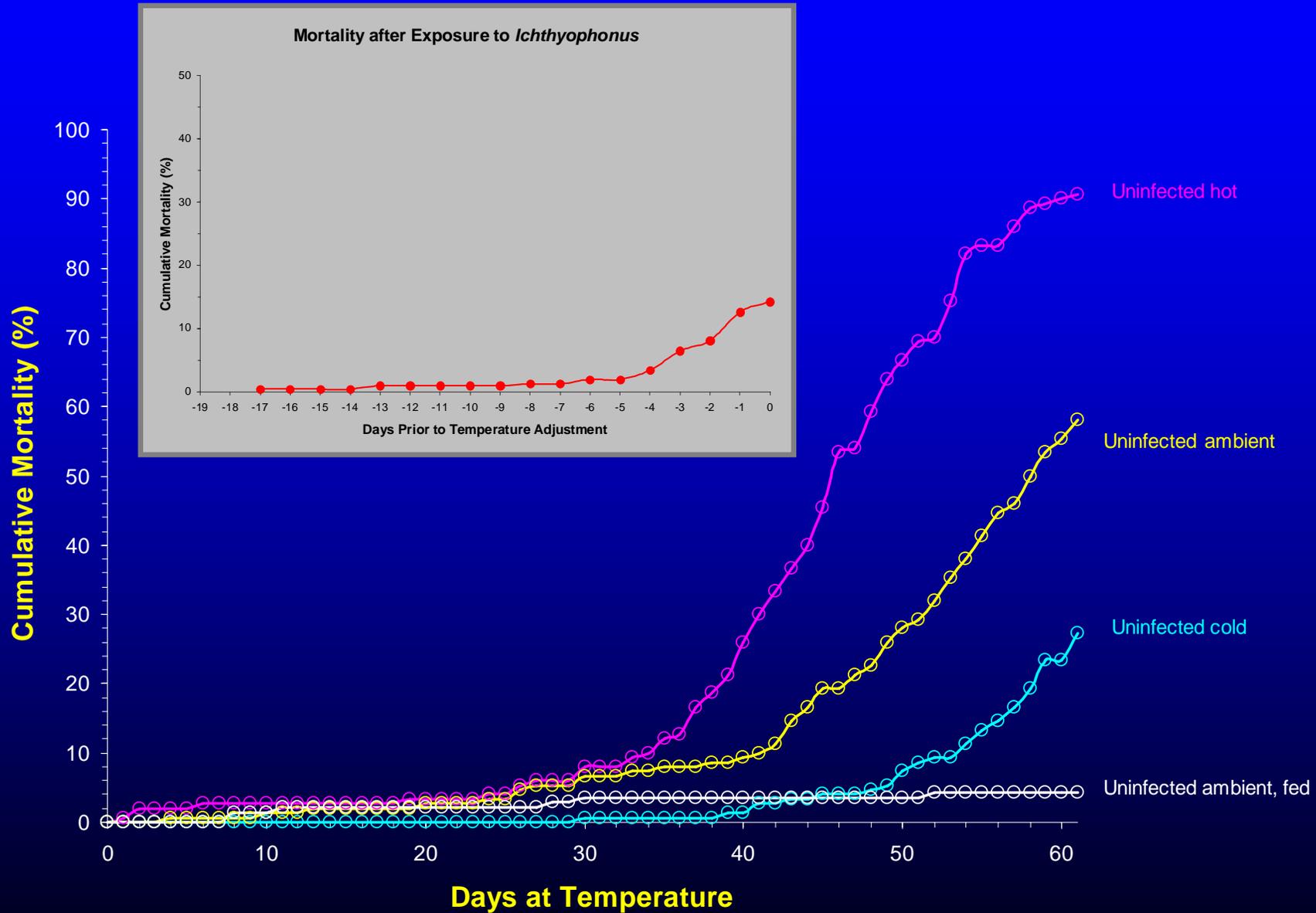
Elevated Temperature Results in Decreased Time-to-Death among Fasted Individuals



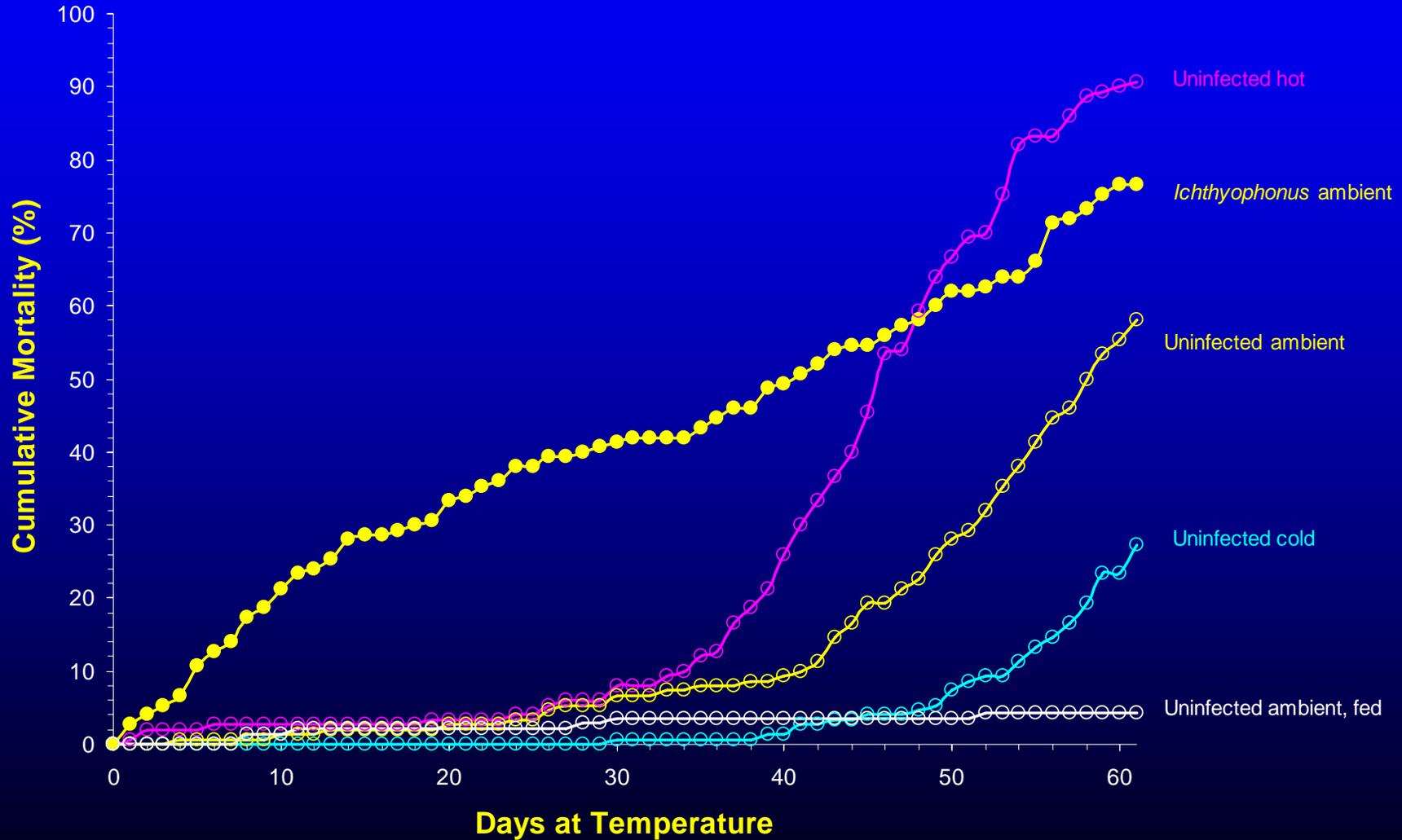
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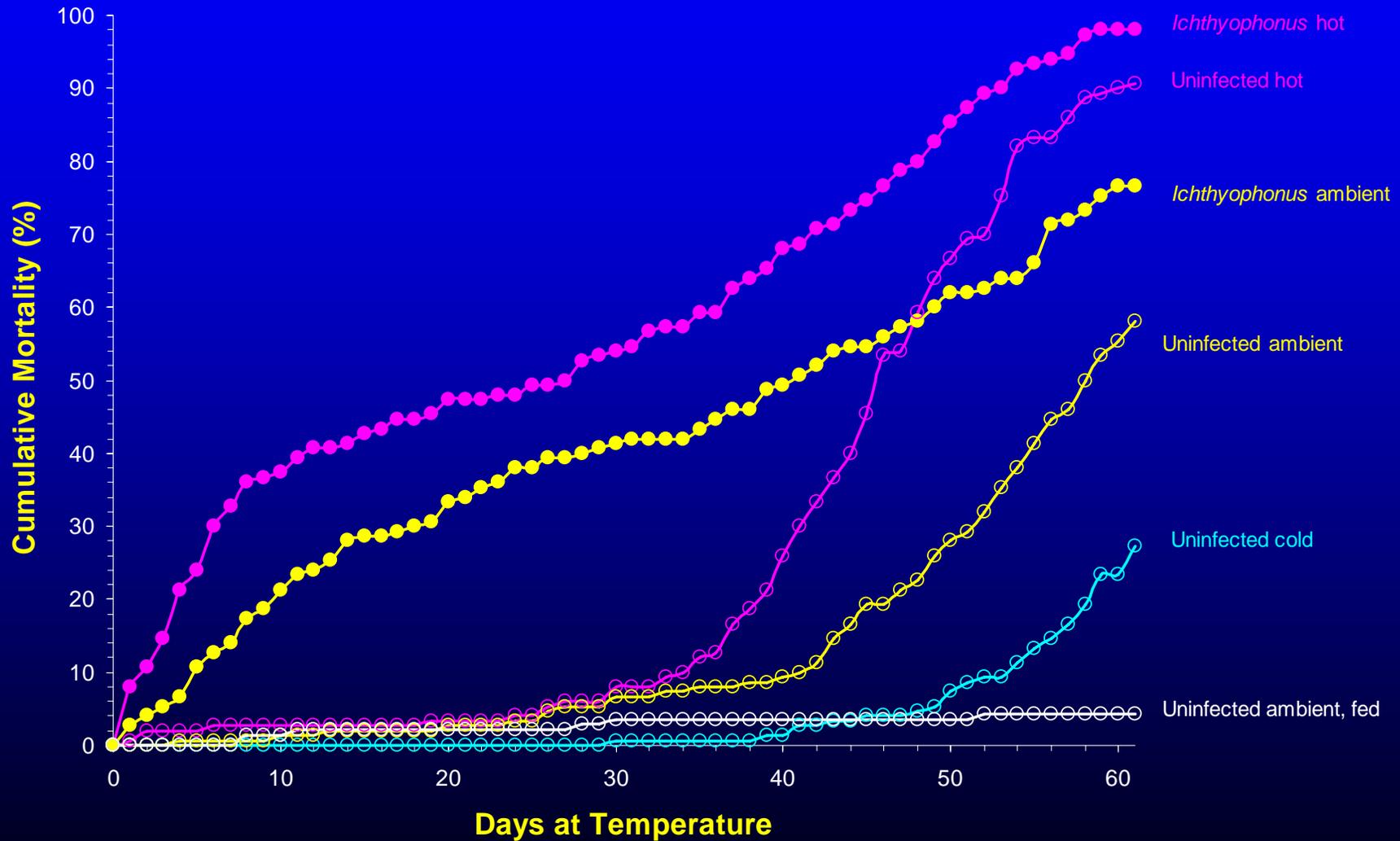
Elevated Temperature Results in Decreased Time-to-Death among Fasted Individuals



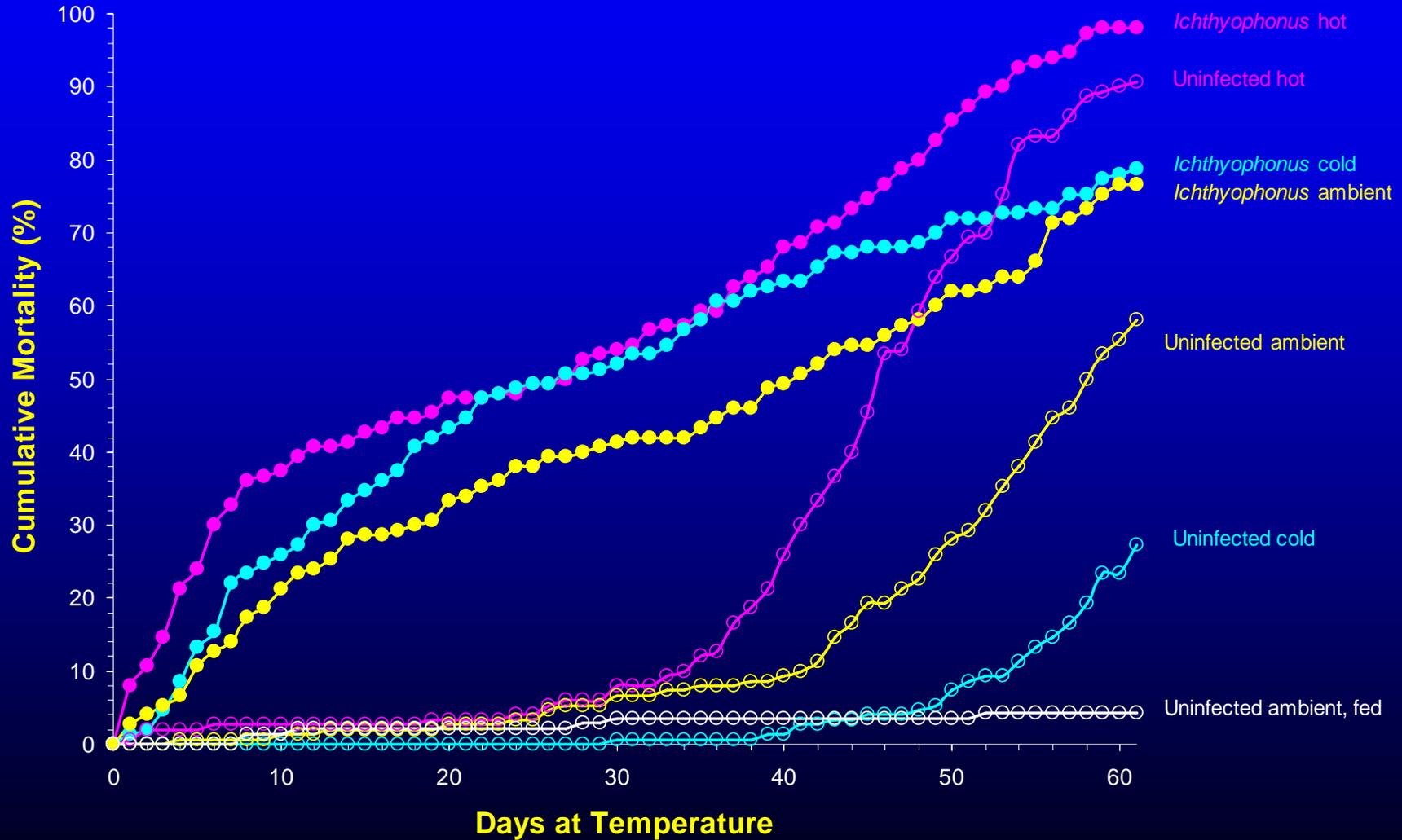
Combined Effects of Temperature and *Ichthyophonus* on Fasted Herring



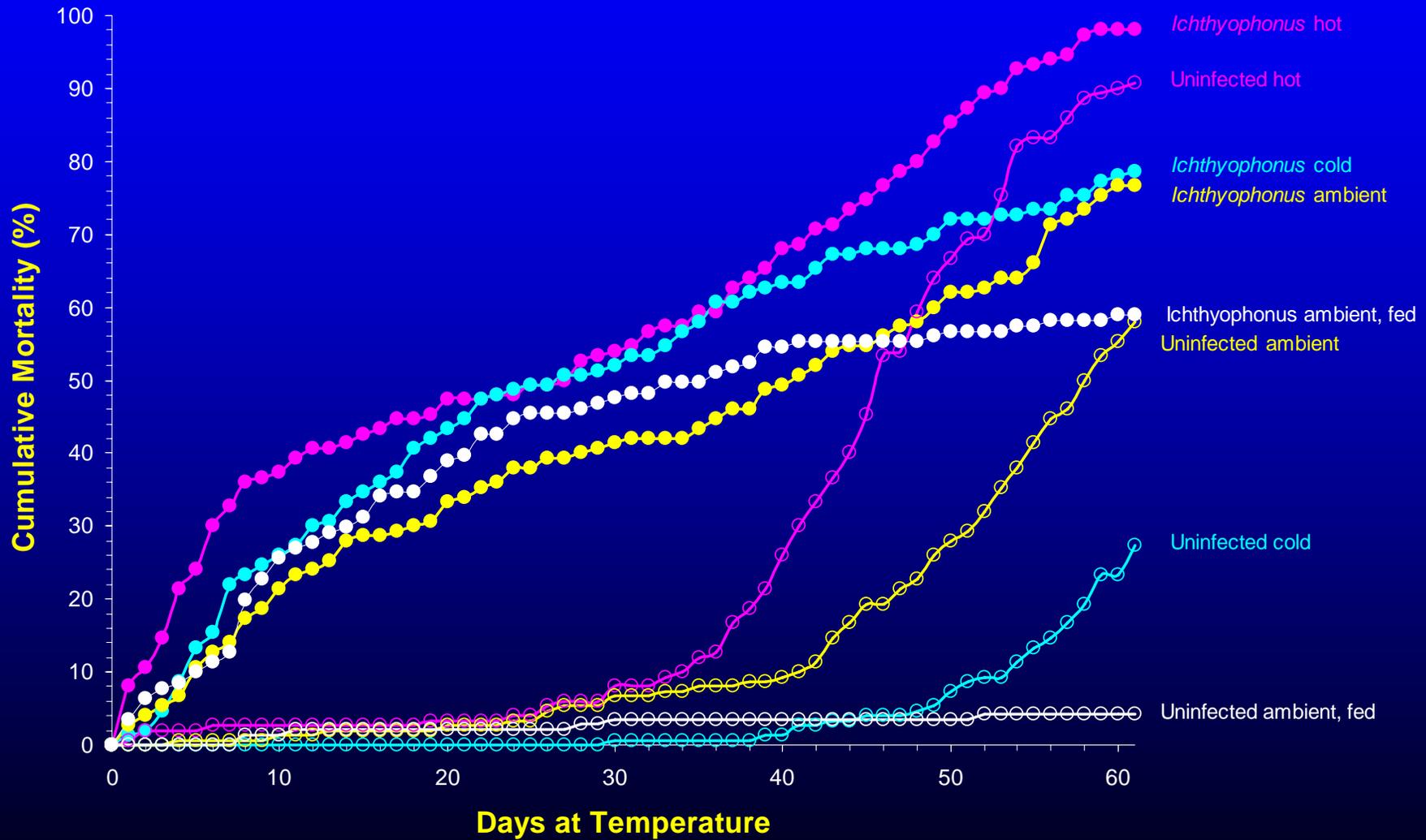
Combined Effects of Temperature and *Ichthyophonus* on Fasted Herring



Combined Effects of Temperature and *Ichthyophonus* on Fasted Herring

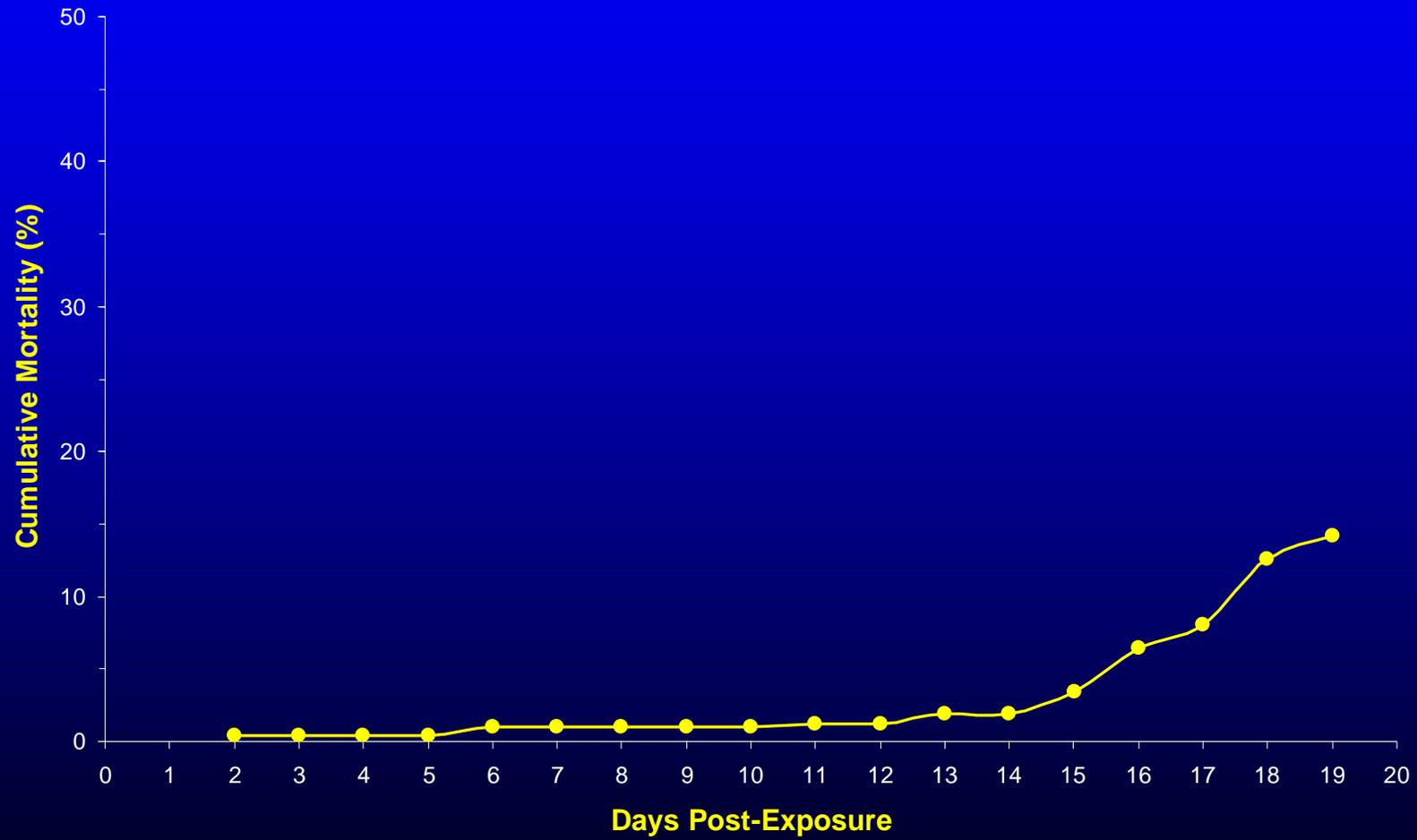


Combined Effects of Temperature and *Ichthyophonus* on Fasted Herring



What Happens if the Fish are Infected, but not yet Diseased?

Cumulative Mortality after Exposure to *Ichthyophonus*



Summary:

***Ichthyophonus* recently emerged and resulted in epizootic disease among Yukon River Chinook salmon**

***Ichthyophonus* Infections result in:**

- **Mortality**
- **Decreased swimming performance**

Elevated Temperatures result in:

- **Increased prevalences of *Ichthyophonus* infection and disease**
- **Increased growth of *Ichthyophonus***
- **Increased swimming performance among uninfected individuals that is negated by *Ichthyophonus* infections**
- **Decreased time-to-death among fasted individuals**



Acknowledgements

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