

# No Eco in Ecotoxicology without Context: Alterations in Population Age Structure, Dynamics and Spatial interactions.

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# John Cairns Jr. before ecotoxicology

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- My Initial interest in the research of John Cairns was as an ecologist working on **protozoan community structure** in the field and with experimental microcosms
- I worked on the population biology, genetics and evolution of the *Paramecium aurelia* species complex.
- John took a protozoan genetics course as a graduate student from my Thesis advisor, John R. Preer Jr.



# The influence of working with Protists

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- Protists, especially ciliates, exist as dynamic populations in dynamic communities, with a variety of life-history strategies.
- It was apparent that the work of G. F. Guase (1934) **were laboratory artifacts** with little importance to populations of Paramecium and their predators in the field.
- **The ecological context is vital to understand the dynamics**



# Context in Ecotoxicology

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- **The Myth of the Most Sensitive Species-1985.**  
Often overlooked paper in regards to Species sensitivity distributions and setting Aquatic Life Criteria.
- Microcosms and other constructed systems can provide interactions and indirect effects
- **Developing a Field of Landscape Ecotoxicology. (with -B. R. Niederlehner)-1996.** The field as reality and landscape as context.



# Context in Ecotoxicology

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- Context of effects in **population structure and dynamics**
- Context of effects in a **Landscape Scale**
- **Infectious disease and invasives** as a confounder.



# Context in Ecotoxicology

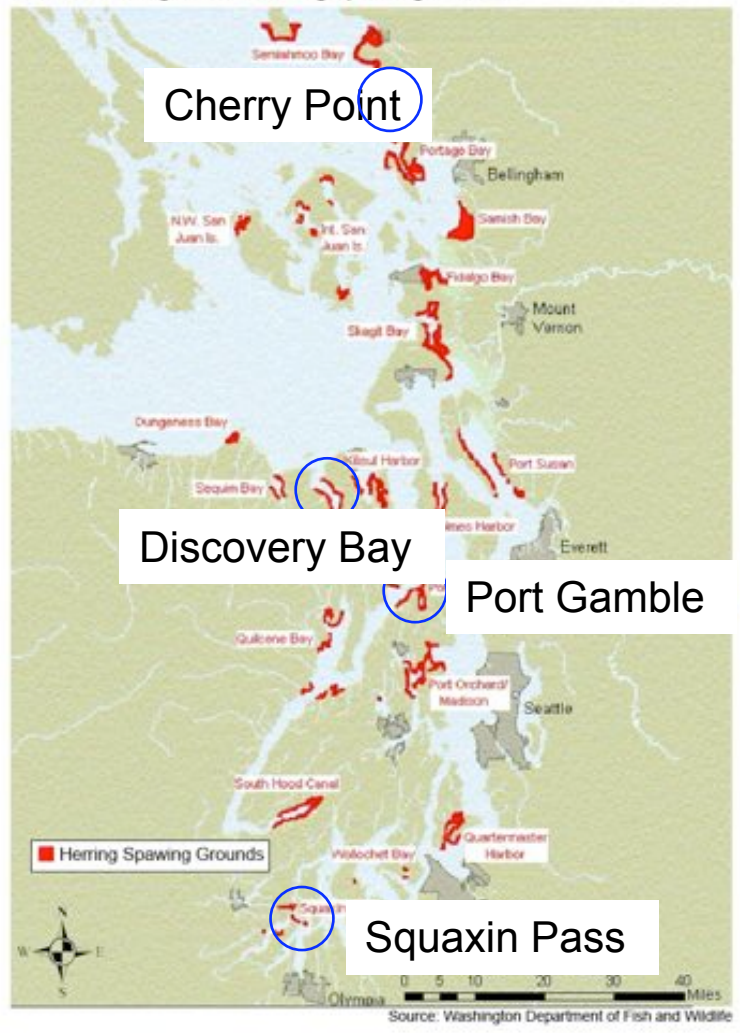
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- Pacific Herring in Puget Sound
- Infectious disease in endangered species, Whirling Disease in Rio Grande Cutthroat Trout



# Pacific Herring in Puget Sound

Documented Puget Sound Herring Spawning Grounds



Entire Puget Sound as a habitat

At least two genetically distinct groups

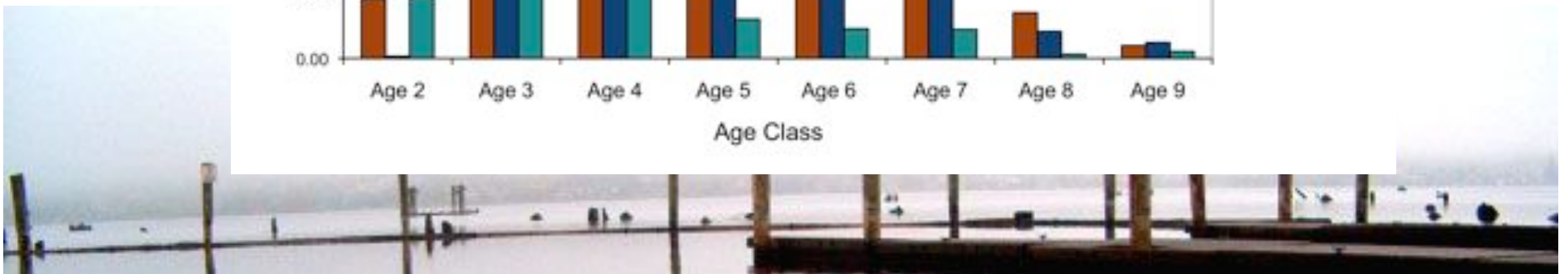
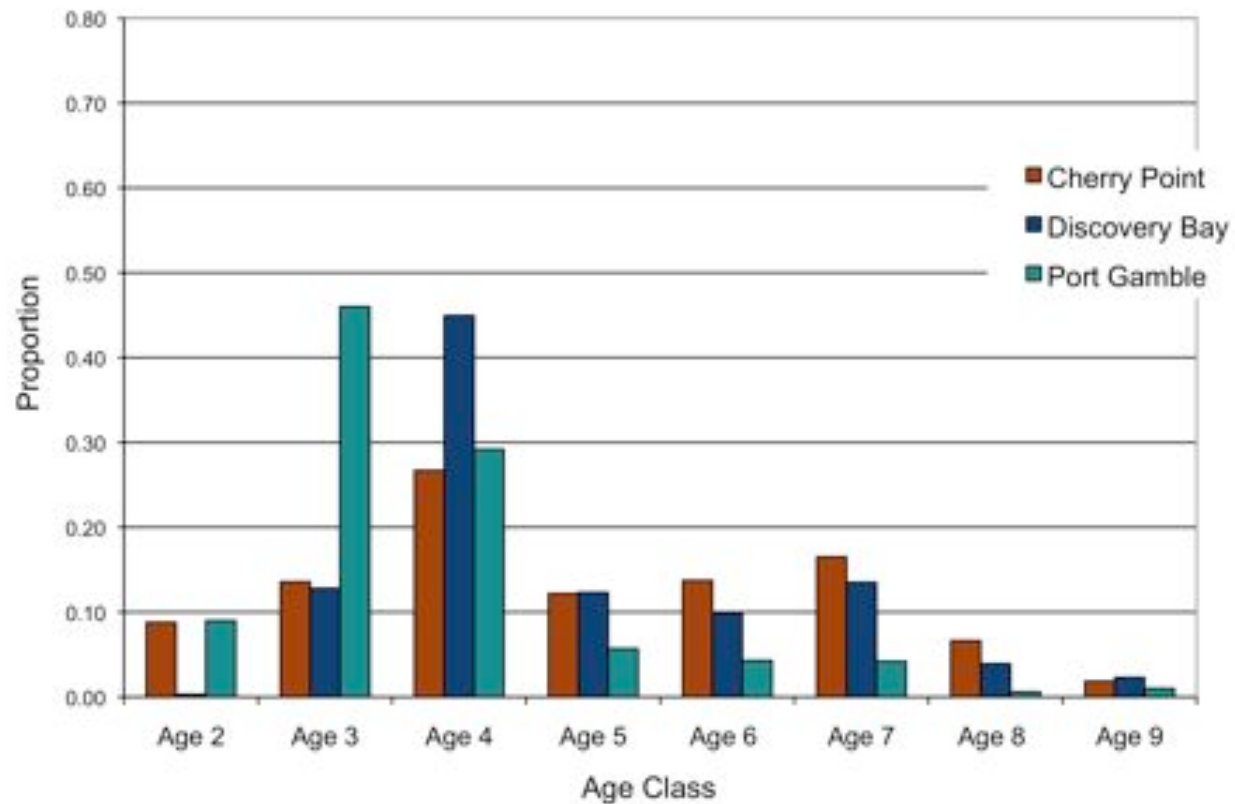
May be a patchy population is Southern Puget Sound

Cherry Point is an isolated breeding group from lower Puget sound Stocks

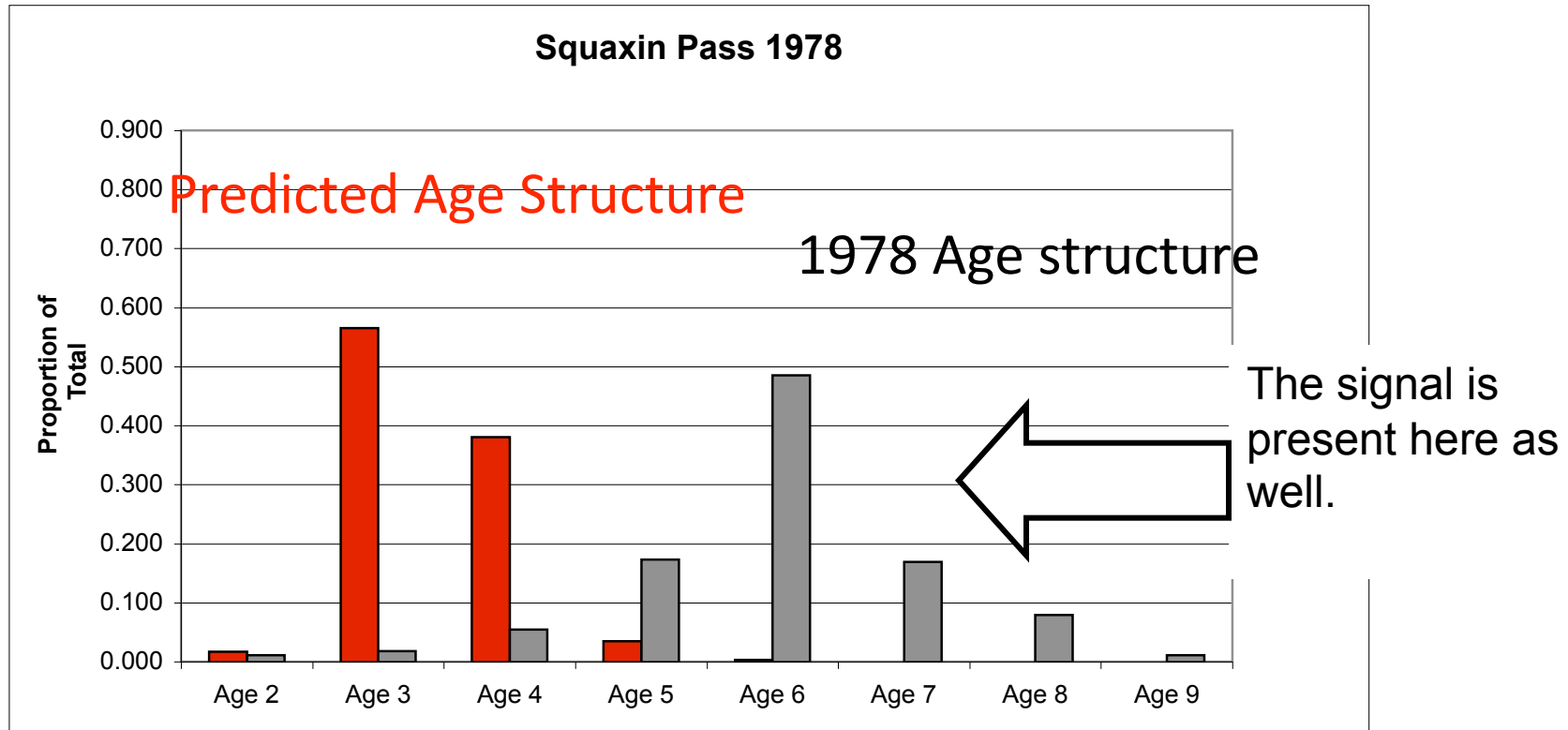


# Pacific Herring in Puget Sound-1978

1976 Comparison of Age Distributions

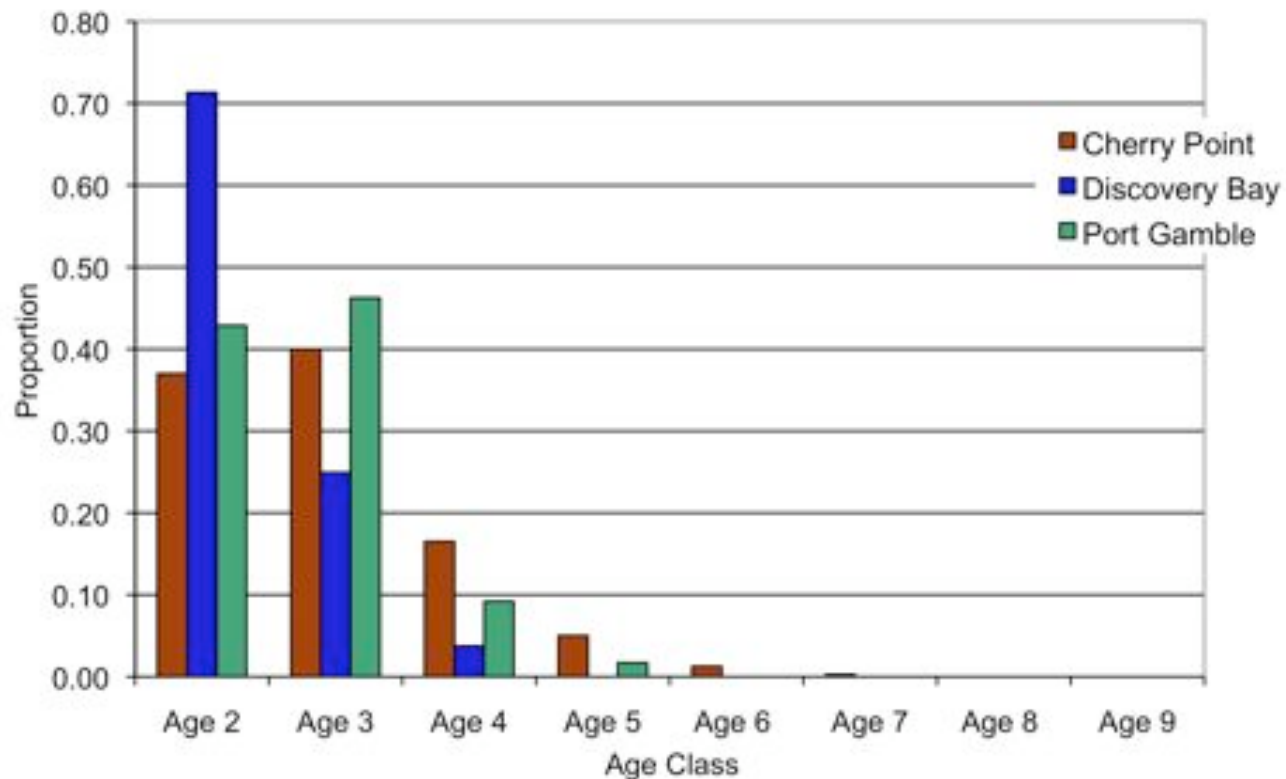


# Pacific Herring in Puget Sound- Projected

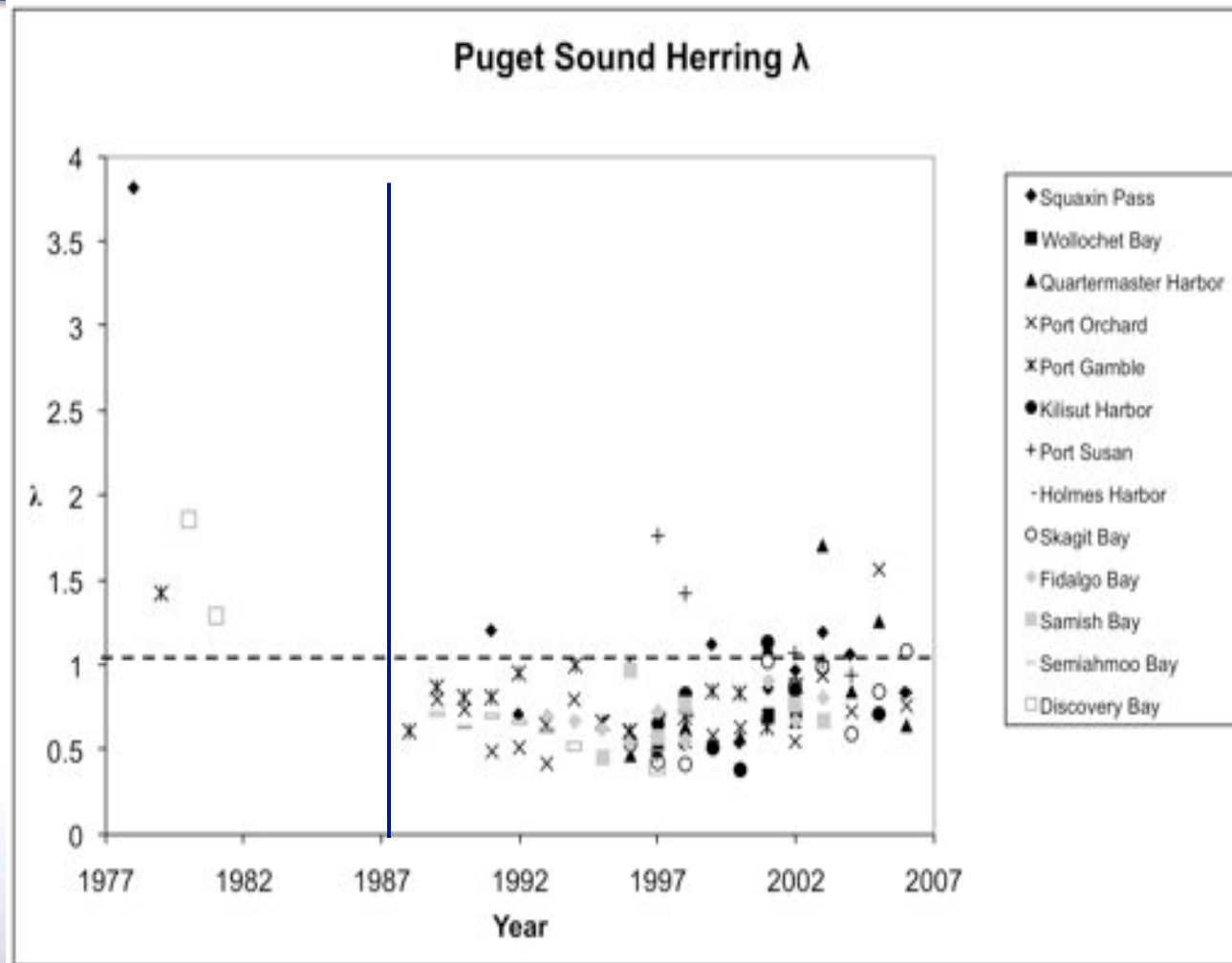


# Pacific Herring in Puget Sound 1988

1988 Comparison of Age Structure Distributions



# Reproduction below replacement



# Pacific Herring in Puget Sound-PCBs

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	Sample Site			
	Squaxin Pass	Quartermaster	Port Orchard	Cherry Point
ng PCBs/g lipid	2000(a)	1500(a,b)	2500(c)	1200(b)

Data from West *et al.* (2008).

2400ng PCB/g lipid Salmonid Larval Toxicity Threshold  
(Meador *et al.* 2002)

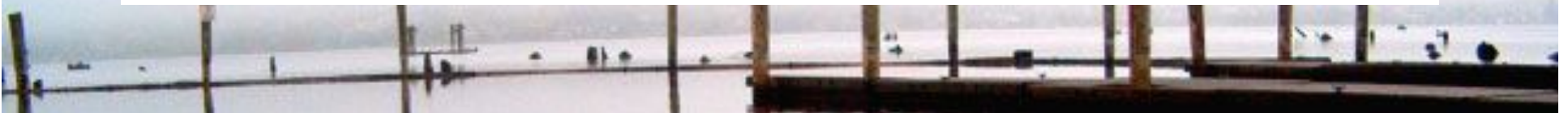


# Pacific Herring in Puget Sound-Disease

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Hershberger *et al.* (2002) has found that the incidence of the parasite *Icthyophonus hoferi* increases with the age of Pacific herring of the Puget Sound region. Fifty eight percent of Age 6 fish collected were infected. Viral hemorrhagic septicemia virus (VHSV) and other pathogens can also be found in the Pacific herring in the Puget Sound region.

Marty *et al.* (2003) have linked VHSV to the reduction of recruitment of Pacific herring in Prince William Sound. As in Puget Sound, the prevalence of *I. hoferi* increases with the age of the fish, but no relationship between *I. hoferi* and the decline in Pacific herring in Prince William Sound was found.



# Pacific Herring in Puget Sound-Context

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## Multiple stressors

Concentrations just below a salmonid toxicity threshold for PCBs, are the populations loosing immuno-competance?

Populations are infected with a variety of pathogens, some have been linked to population declines in the past.

Think of the scale in time and space.



# Whirling Disease and T and E Trout

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And now for something completely different...but is where SETAC needs to go.....



# Whirling Disease and T and E Trout

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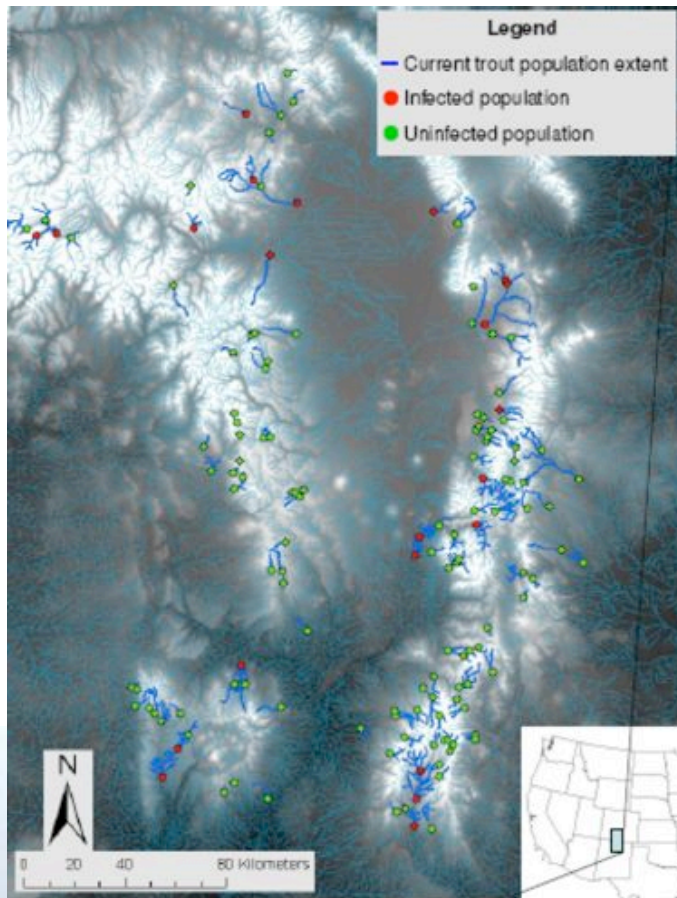
Risk assessment approach for Whirling Disease affecting Rio Grande Cut Throat Trout.

P. Bryant, C. Caldwell, L. Kaminski and W.G. Landis

Invasive parasitic pathogen that causes deformities to the skeleton with an intermediate host.



# Whirling Disease and T and E Trout



Mapping of Streams with RGCT populations

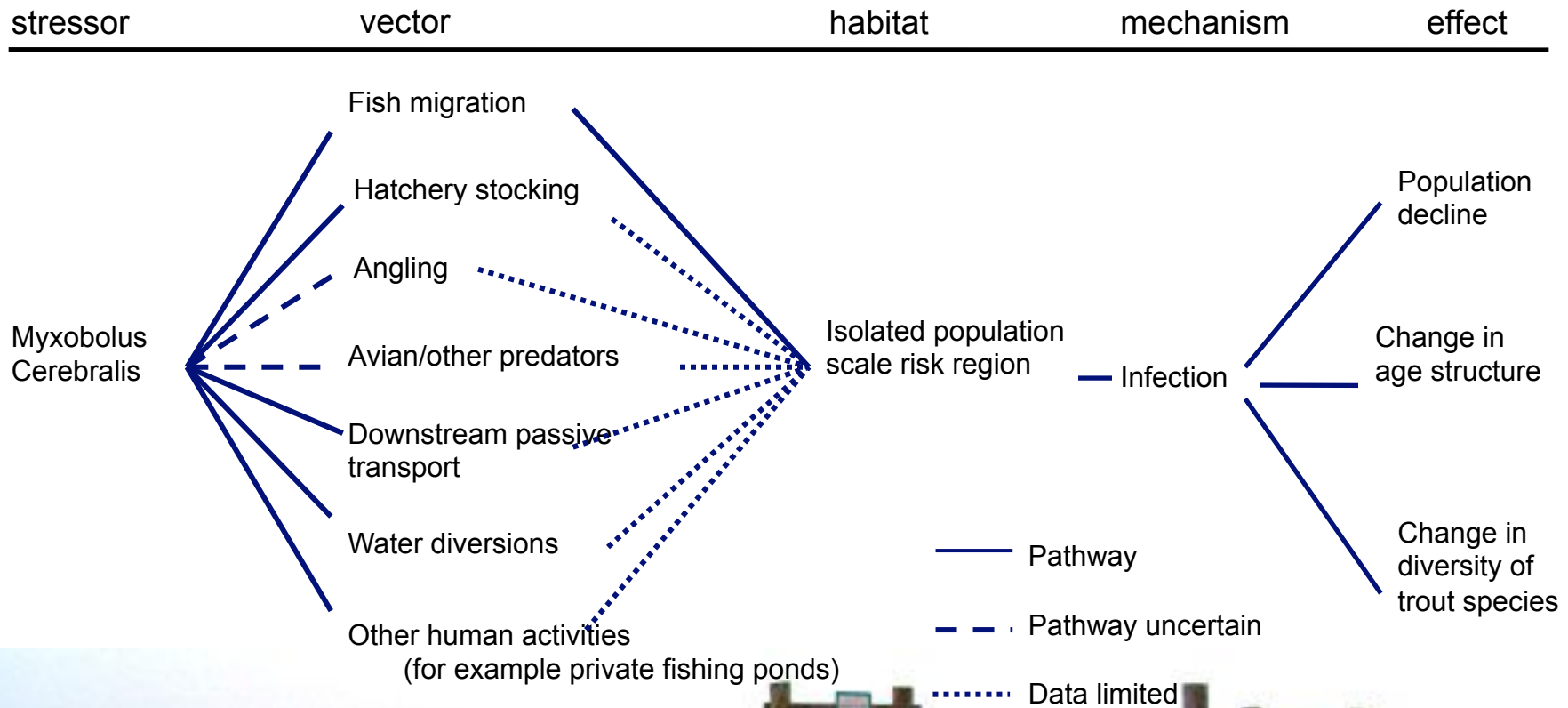
Mapping of infection status

Mapping of barriers to migration

100 Risk nodes to examine



# Whirling Disease Conceptual model



# Whirling Disease Conceptual model

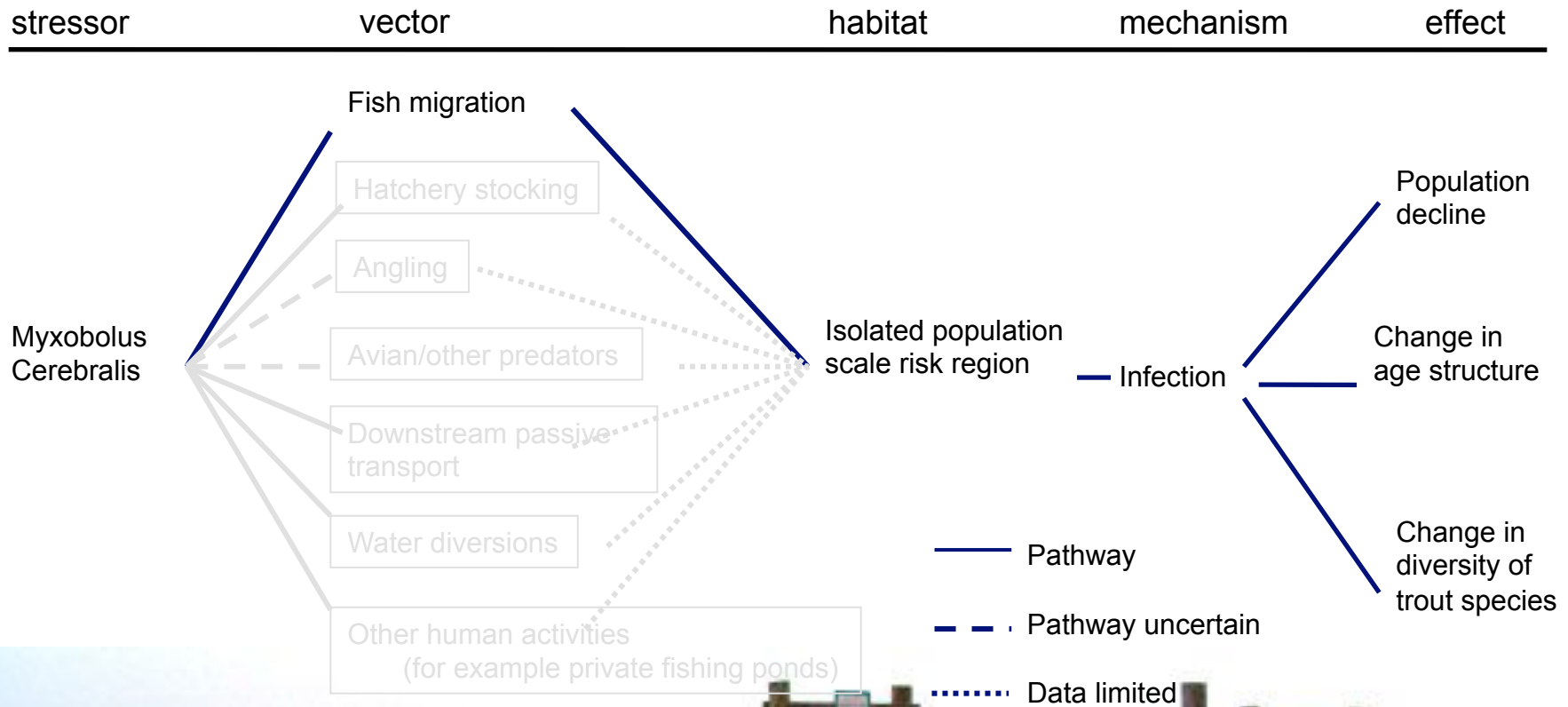
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However, uncertainty in this conceptual model is high for two reasons. First, the assessment area is large (960 km<sup>2</sup>) and there is limited spatial data covering that area.

Secondly, understanding of transport pathways for *M. cerebralis* is limited. Based on our current level of understanding, we have only one complete exposure pathway – migration of infected fish in the river system.



# Whirling Disease-one pathway



# Whirling Disease-did work

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## Risk Calculations---Hypothesis

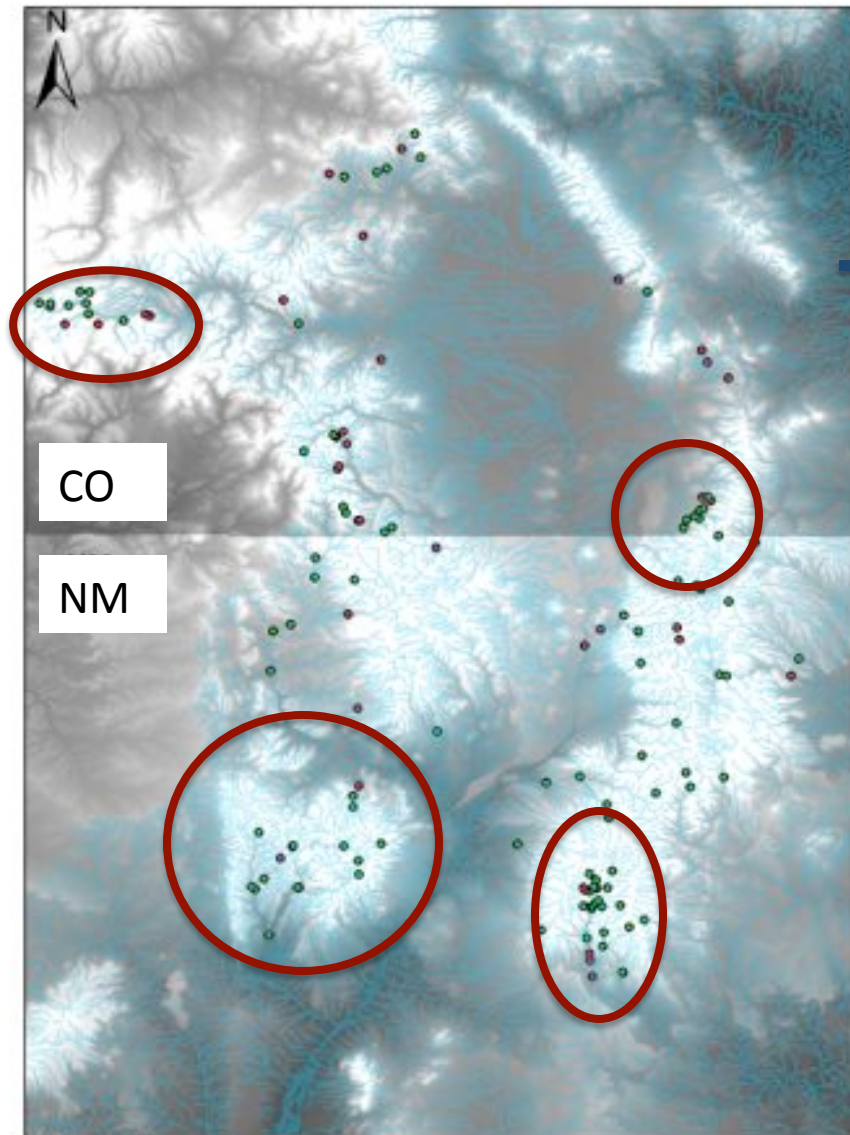
Using this single pathway as a source, in a risk assessment, we found that of 141 isolated populations, 42 (30%) are at high risk of whirling disease, 30 (21%) are at medium risk, and 69 (49%) are at low risk.

## Confirmation of the risk calculations

When these risk scores are compared to the whirling disease status, 45% of high risk streams are already infected, while only 3% of medium and low risk streams are infected.

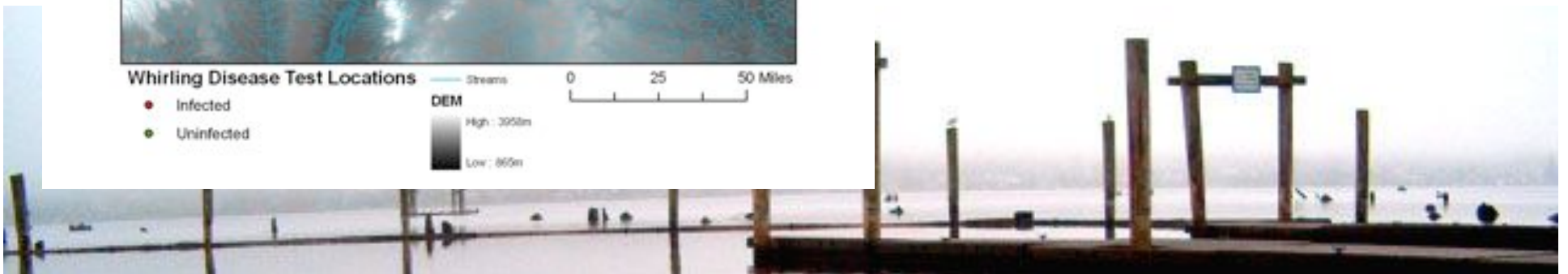


# Context-Landscape and Islands



Colorado Cutthroat Trout and Whirling Disease

Large spatial extent but really a series of large and small islands



# Context

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The world is about context.....

Multiple stressors at large scales over long periods of time with effects on a population.

The distribution and interaction with other biotic components is part of the context.



Thanks for your time.....

