Science, Service, Stewardship

Transmission of the pathogen *Renibacterium salmoninarum* under different laboratory-controlled barging conditions

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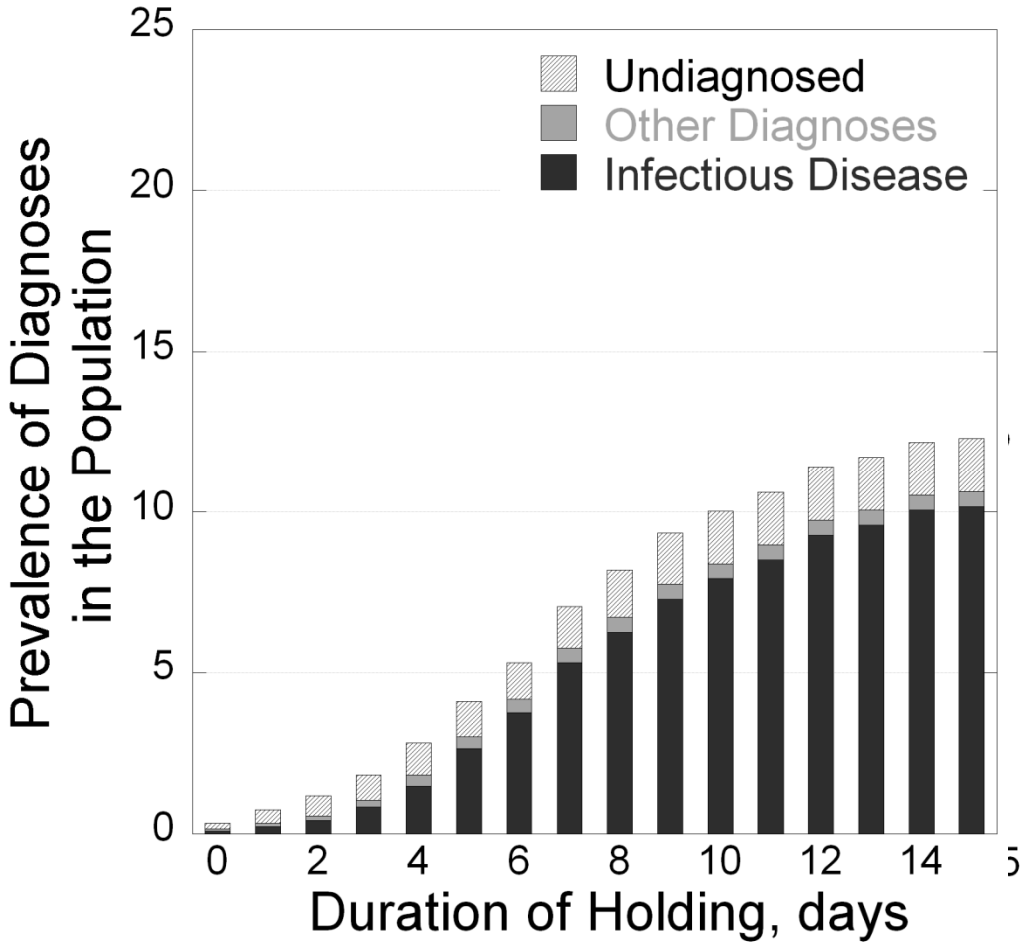
Differential mortality of transported and in-river outmigrants

Annually – delayed mortality greater in barged fish than in-river fish

Estuary net pen observations

- Greater barged fish mortality within 6 days of holding
  - Majority of mortalities within 14 days
- >80% of mortalities associated with infectious disease



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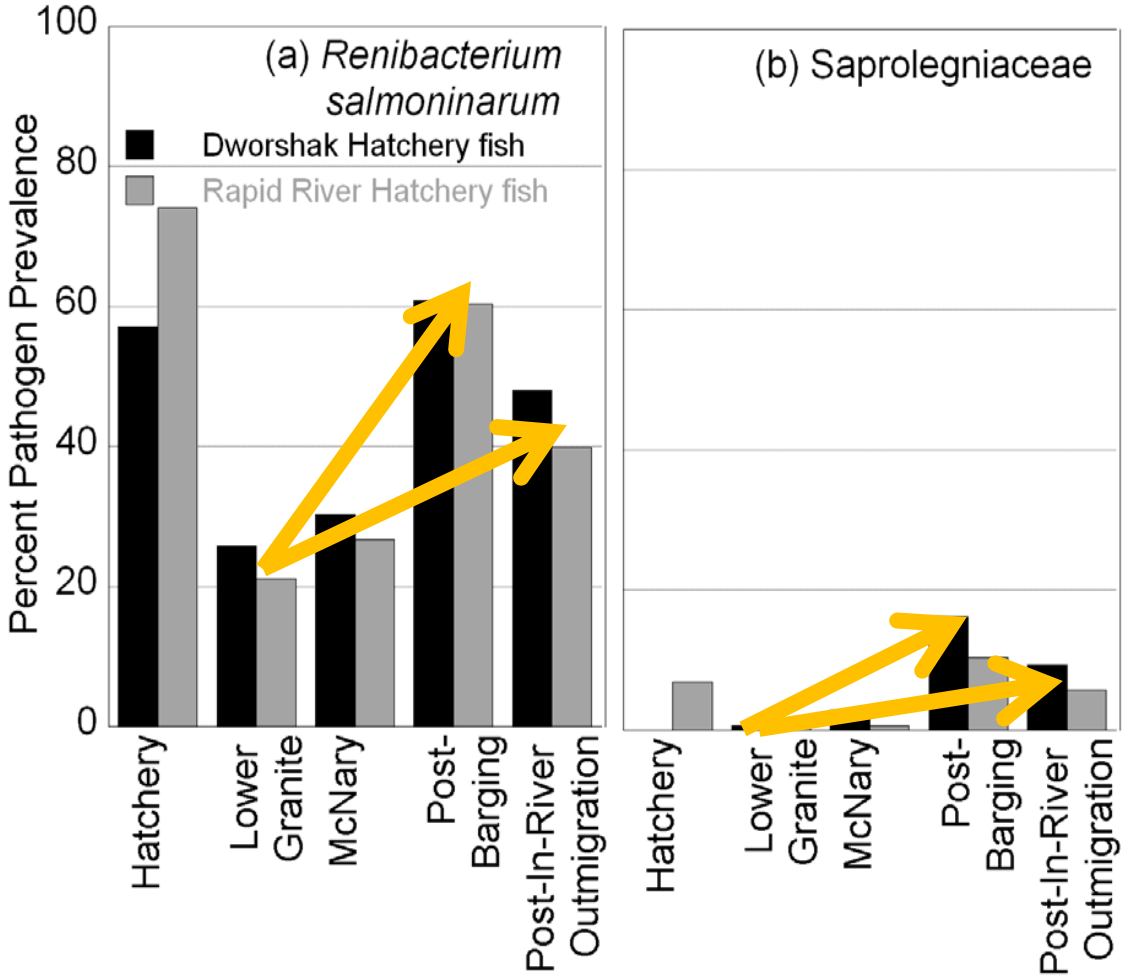
2007 Pathogen Prevalence

- Pathogen prevalence increased during outmigration
- Increased pathogens detected in barged fish relative to in-river



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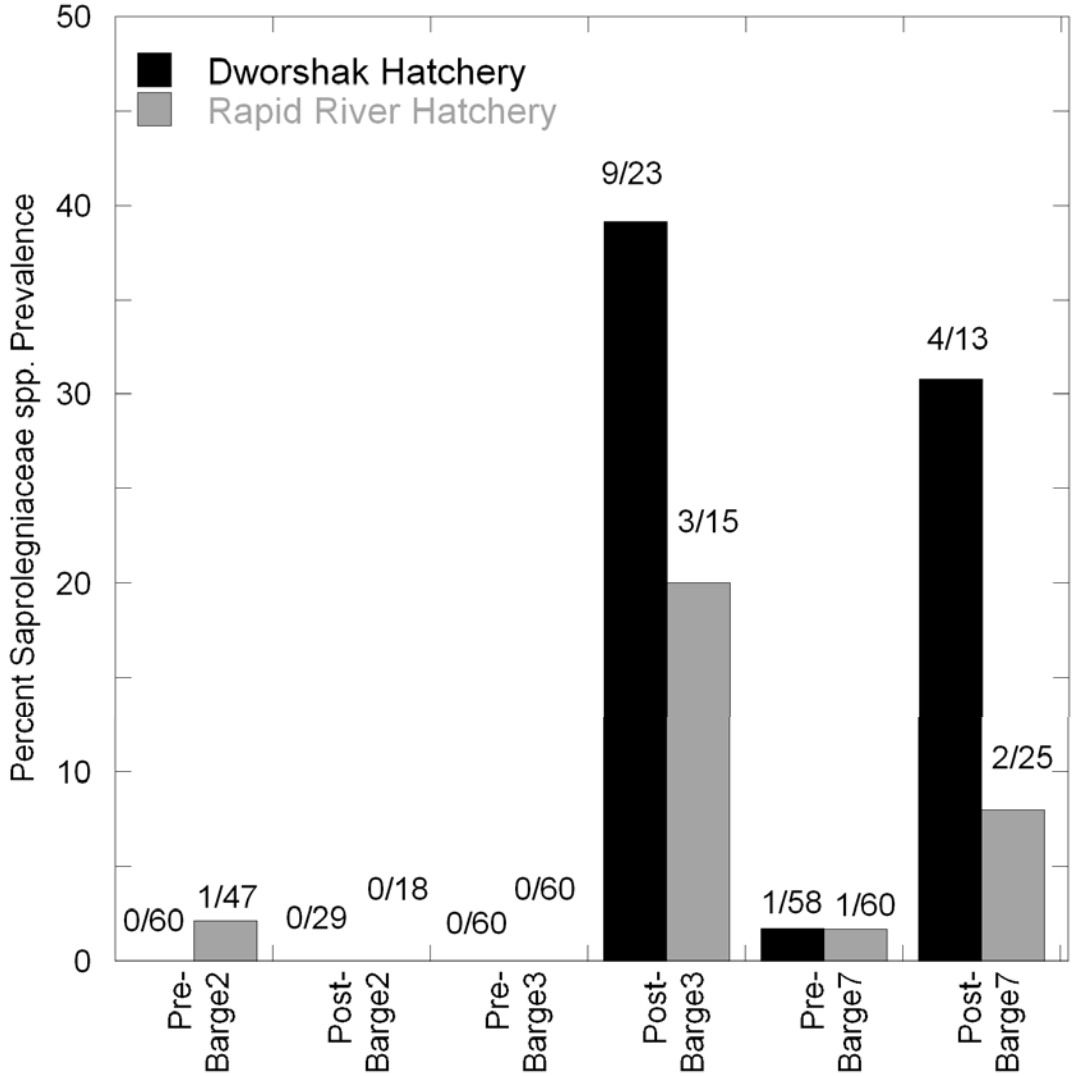
Preliminary Transmission

- Pathogen transmission during barging
  - Individual barges
- Live-box experiments
  - Pascho and Elliot, 1989
  - Elliot and Pascho, 1991



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Objective

To identify operating conditions that reduce disease transmission and subsequent delayed mortality in transported Snake River spring/summer Chinook salmon.

- —Determine the impacts of holding density and flow exchange rates have on *Renibacterium salmoninarum* transmission under laboratory conditions

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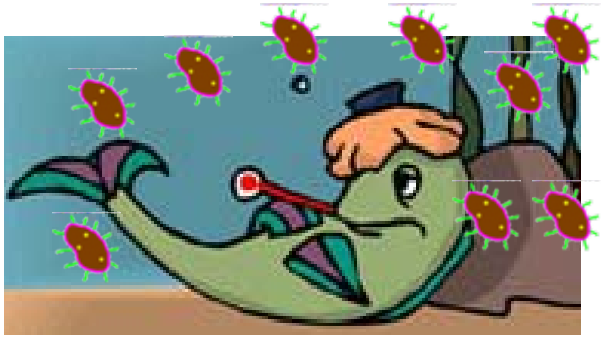
Disease Transmission

Vertical Transmission

- Infected parent passes pathogen to their progeny

Horizontal transmission

- Infected fish infects non-progeny fish due to shared contact or environment



Donor

Susceptible

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Transport Operations from Lower Granite Dam

Transport Timing

- Raceway- up to 24 hours
- Barges- ~36 hours

Fish Density

- Raceway- 0.01 – 0.40 lb/gal
- Barges- 0.01 – 0.26 lb/gal

Barge Hold Exchange Rates

- 1 engine *(<0.17lb fish/gal)* – 1.8 exchanges/hr
- 2 engines *(0.17-0.33lb fish/gal)*– 3.7 exchanges/hr
- 3 engines *(0.33-0.42lb fish/gal)* – 5.5 exchanges/hr

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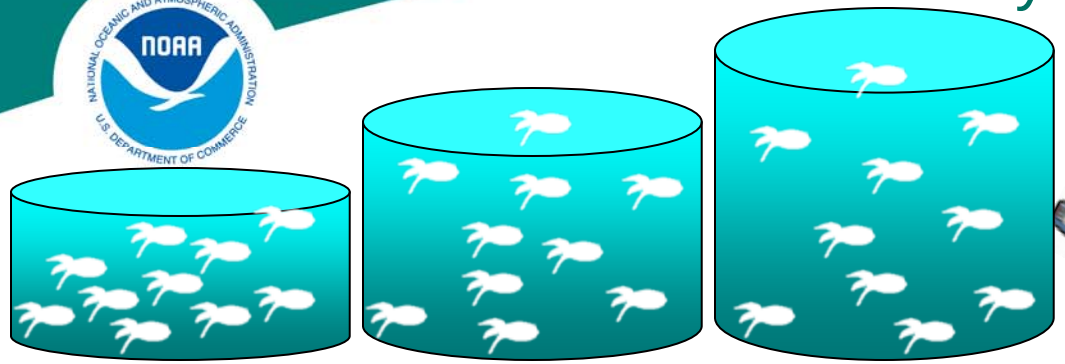
Laboratory disease transmission



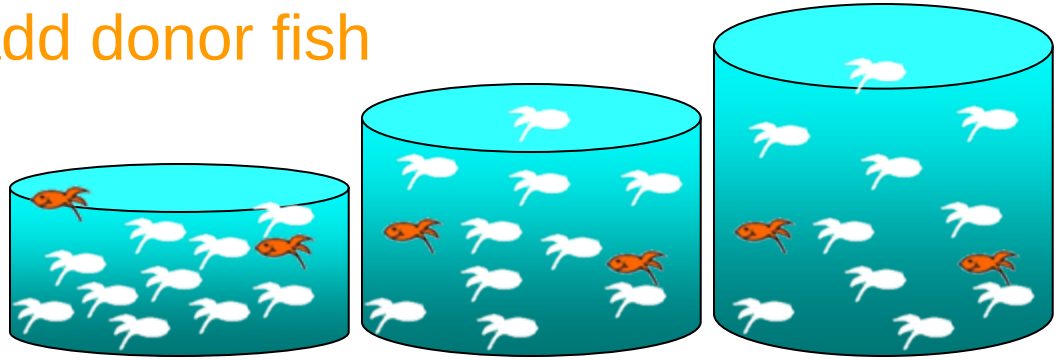
Densities

0.05, 0.18, & 0.5lb/gal

Exchange Rates

2.0 and 5.7 ex/hr

add donor fish

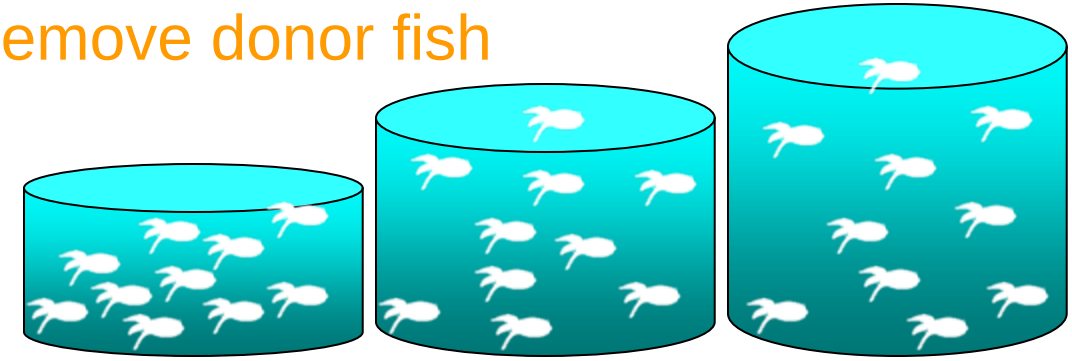


Exposure Period

Raceway + Barge

= 60 hours

remove donor fish



Monitor for pathogen

After 0, 35, and 75 days

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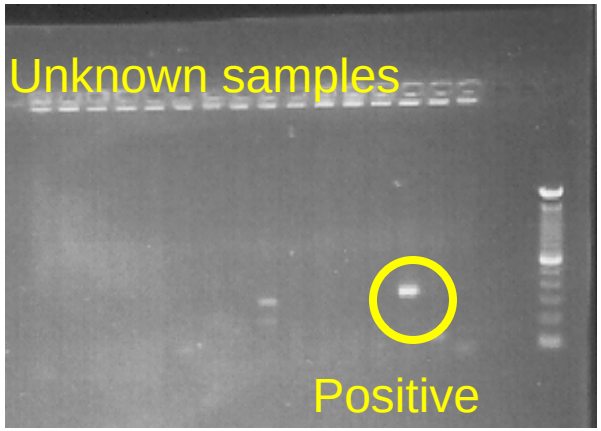
Monitor Pathogen DNA by PCR

Nested PCR

Conventional presence/absence PCR

Highly sensitive detection of DNA

Cannot indicate severity

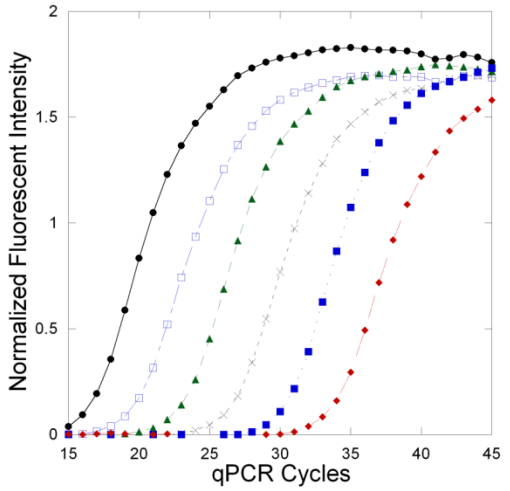


Quantitative PCR

Real-time tracking of PCR amplification

Quantitative output indicative of infection severity

Cannot detect small amounts



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Work In Progress

- Nested and quantitative PCR sample analysis
  - Kidney and gills of susceptible fish
    - 0, 35, and 75-days post-exposure
- Preliminary experiments
  - Characterizing donor fish
    - Pathogen shedding
    - Donor prevalence
  - Transmission confirmation

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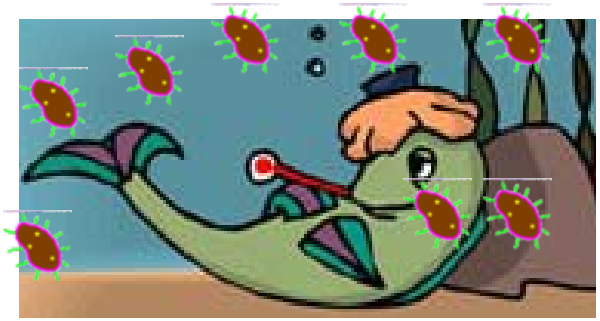
Characterizing Donor Fish: Pathogen Shedding



Aims:

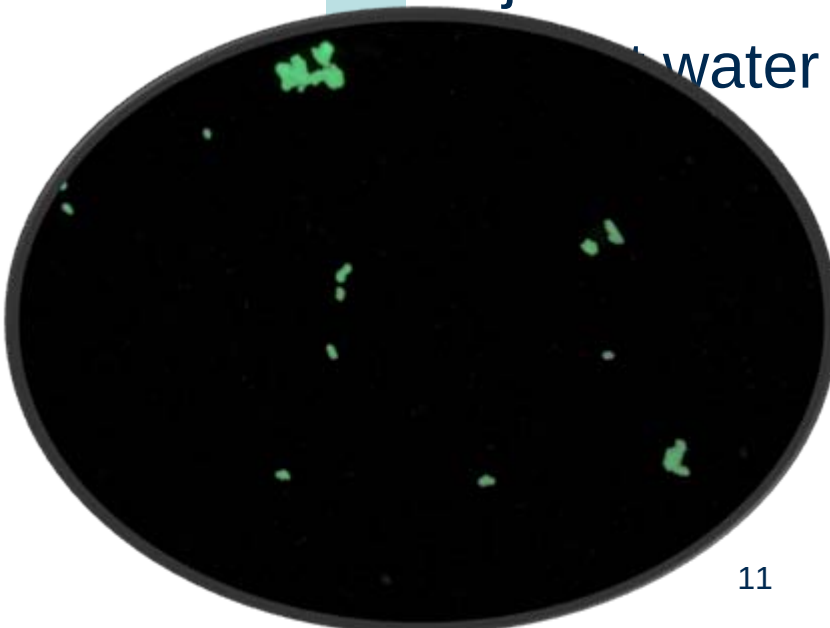
- Determine concentration of pathogens shed
- Determine the time course of shedding

Method[a]:

- MFAT = membrane filtration fluorescent antibody technique

Inject fish

water



[a] Elliot and Barila, 1987

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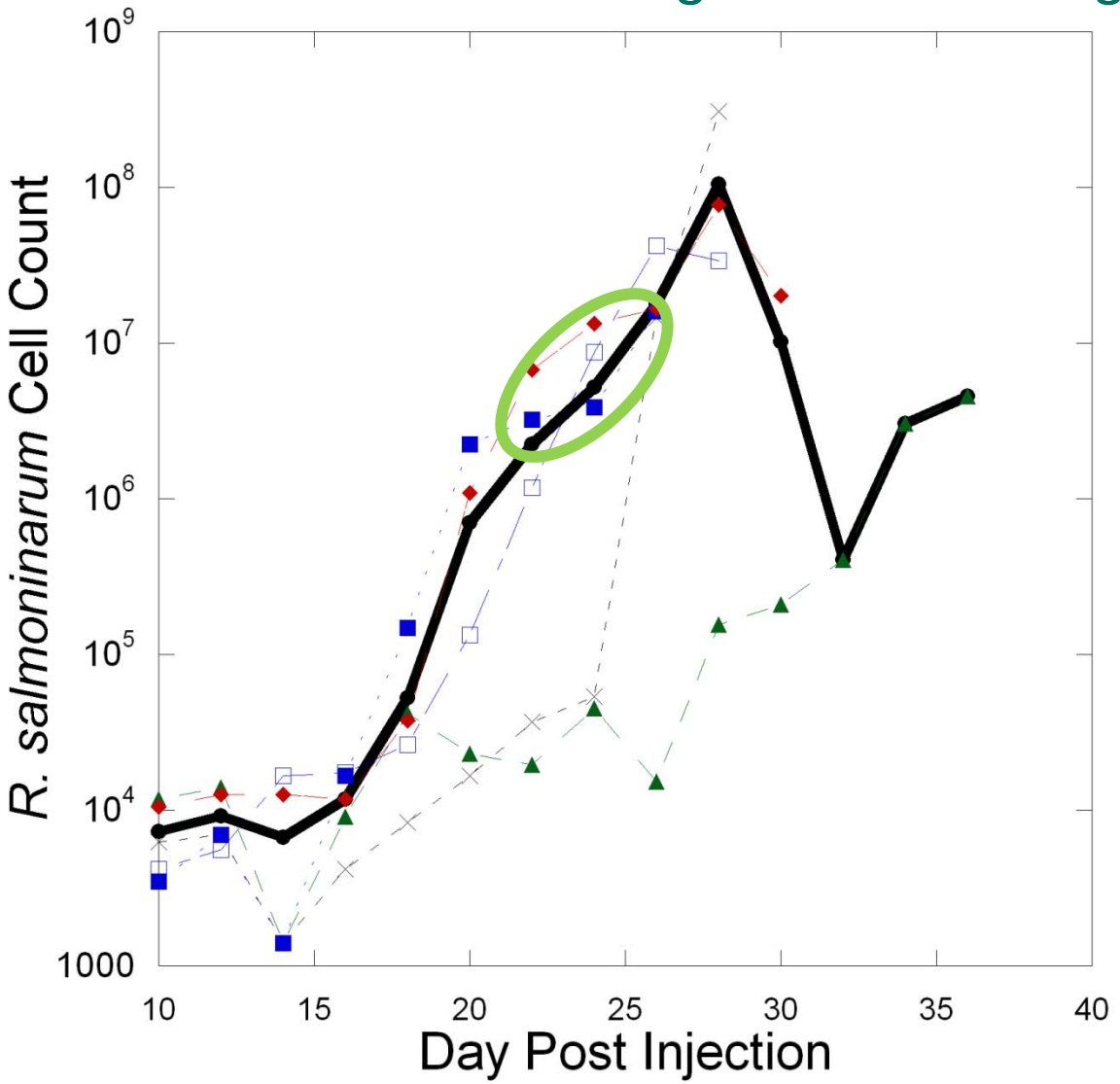
Characterizing Donor Fish: Pathogen Shedding



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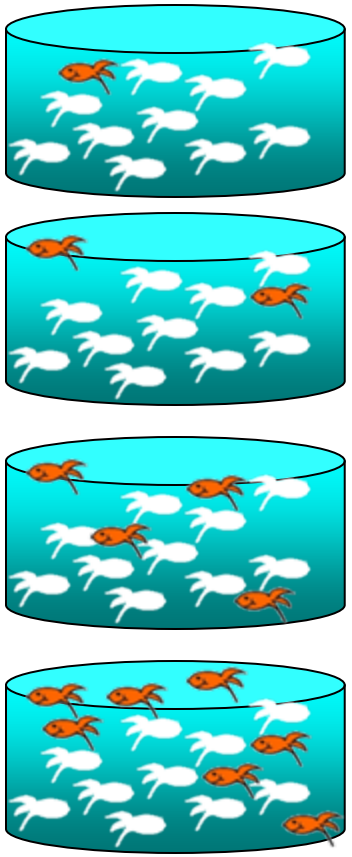
Characterizing Donor Fish: Quantity

Aim:

Evaluate pathogen transmission and variability with multiple donors

Method:

- Prevalence of donor fish ( ) among susceptible fish was varied for 60 hours (8%, 17%, 27%, 40%)
- PCR detection of *R. salmoninarum* in donors (kidneys) and susceptibles (kidneys + gills)



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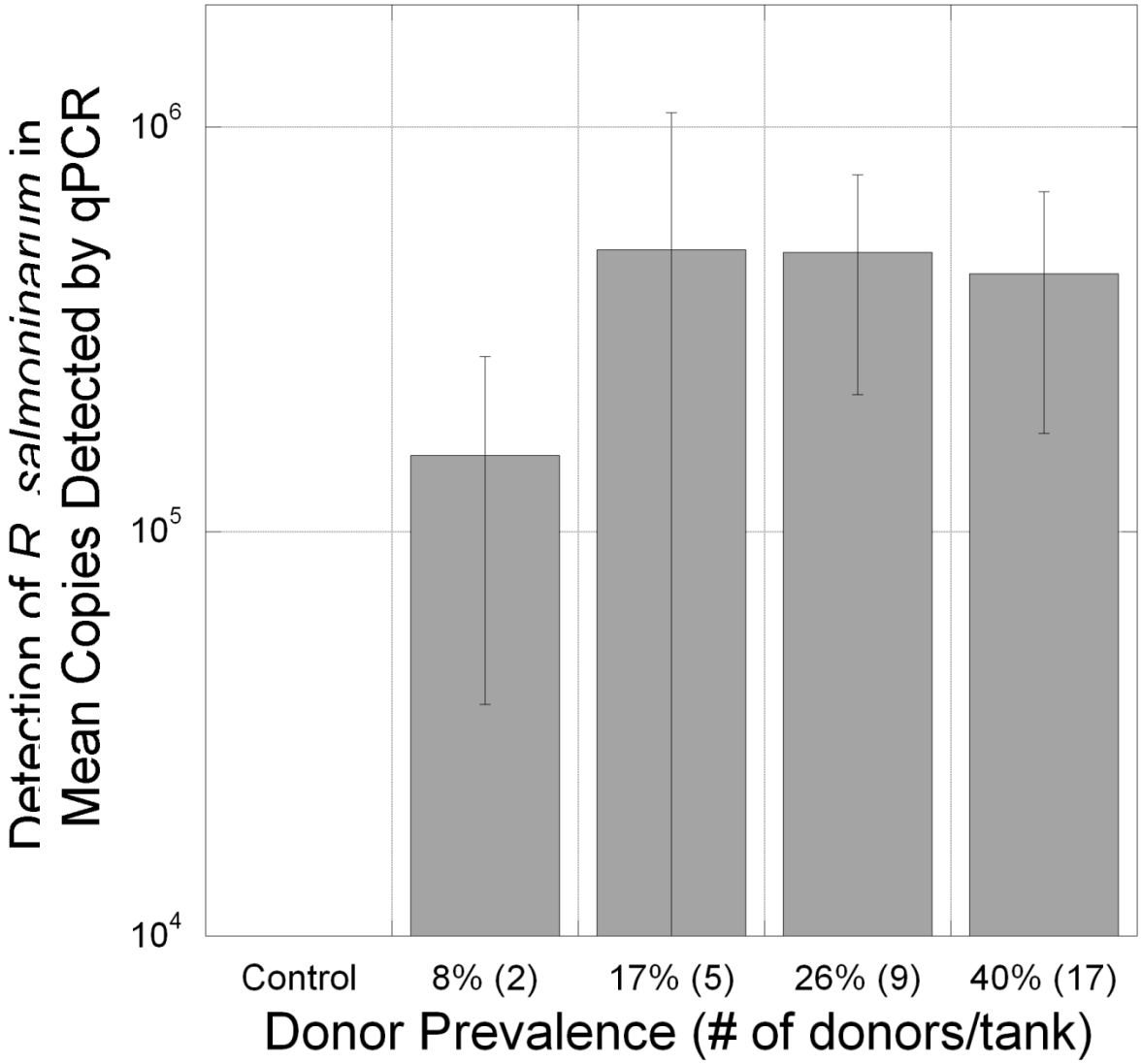
Characterizing Donor Fish: Quantity

Nested PCR is more sensitive

qPCR indicates:

- Control positives are negligible
- Stable mean copy number with >5 donors



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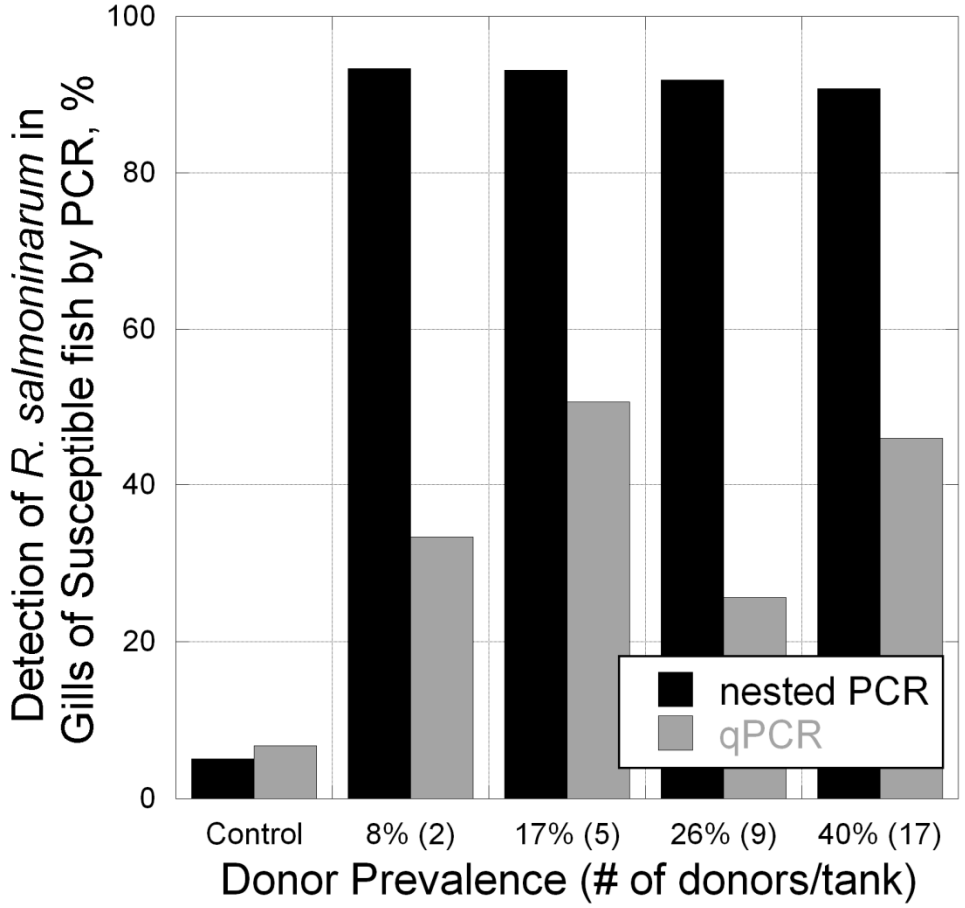
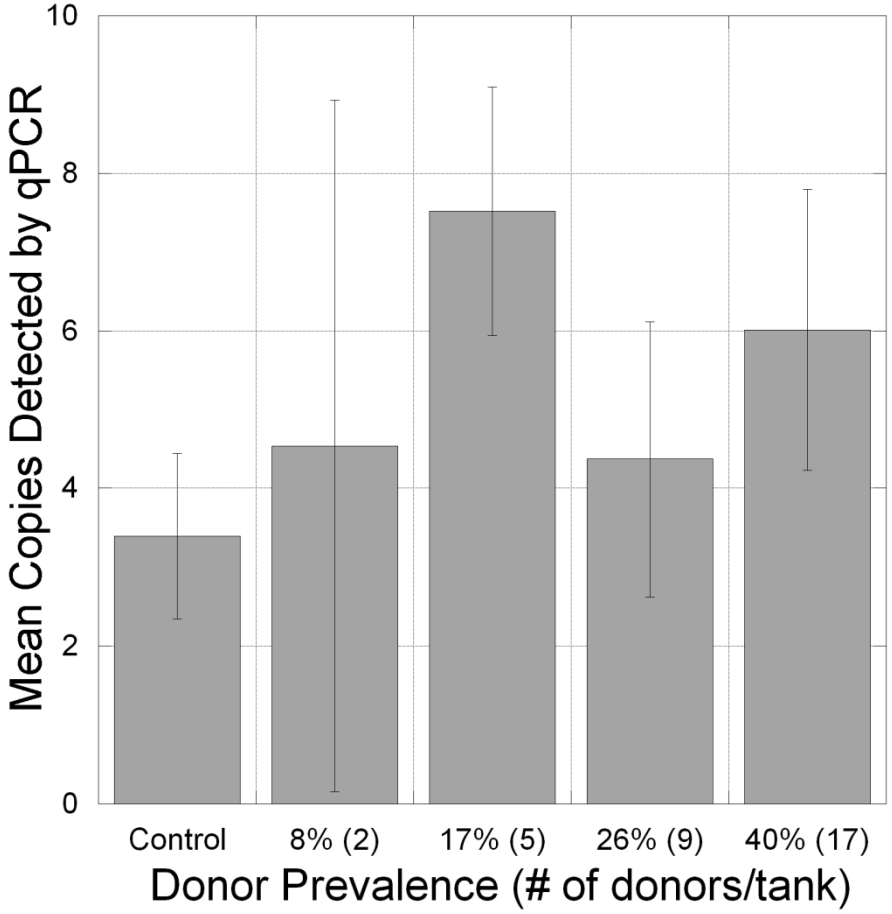
Transmission of *R. salmoninarum* to Gills of Susceptible Fish





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Preliminary Conclusions

- Lab conditions are close surrogates for field transport conditions
- Up to 615 million cells shed per severely infected fish per day
- Transmission to gills occurred in over 90% of susceptible fish in 60 hours

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Acknowledgements

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Citations

Elliott, D. G. and T. Y. Barila. 1987. Membrane filtration - fluorescent antibody staining procedure for detecting and quantifying *Renibacterium salmoninarum* in coelomic fluid of chinook salmon (*Oncorhynchus tshawytscha*). Can. J. Fish. Aquatic Sci. 44(1): 206-210.

Elliott DG, Pascho RJ. 1991. Juvenile fish transportation: Impact of bacterial kidney disease on survival of spring/summer Chinook salmon stocks, 1989. Annual Report, 1989 (Contract E86880047) prepared by the U.S. Fish and Wildlife Service, Seattle, WA. for the U. S. Army Corps of Engineers, Walla Walla, WA.

Pascho RJ, Elliott DG. 1989. Juvenile fish transportation: Impact of bacterial kidney disease on survival of spring/summer Chinook salmon stocks, 1988. Annual Report, 1988 (Contract E86880047) prepared by the U.S. Fish and Wildlife Service, Seattle, WA. for the U.S. Army Corps of Engineers, Walla Walla, Wa.

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Field Transport Conditions Vs. Lab

	Field Conditions	Lab Conditions
Exposure time, hrs	~60	60
Density, lb/gal	0.01 – 0.4	0.05, 0.18, 0.5
Exchanges, ex/hr	1.8, 3.7, 5.5	2.0, 5.7
Donor prevalence	20-35%	37%