Prespawning Mortality of Middle Fork Willamette Chinook Salmon: improving trap, transport and release operations

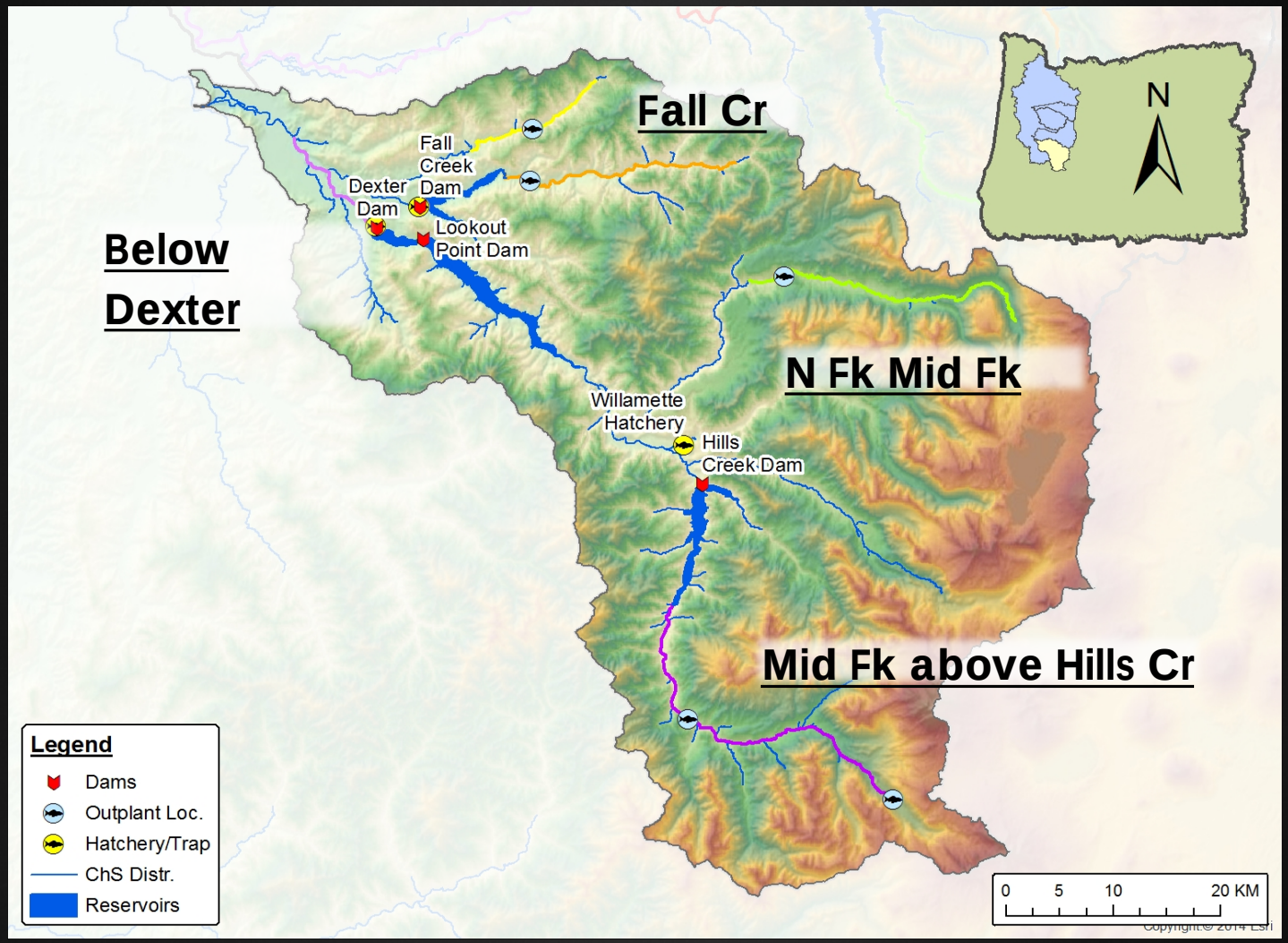
JAMES PETERSON, JUSTIN SANDERS, CAMERON SHARPE, MICHAEL KENT, CARL SCHRECK

USGS science for a changing world

Oregon State University

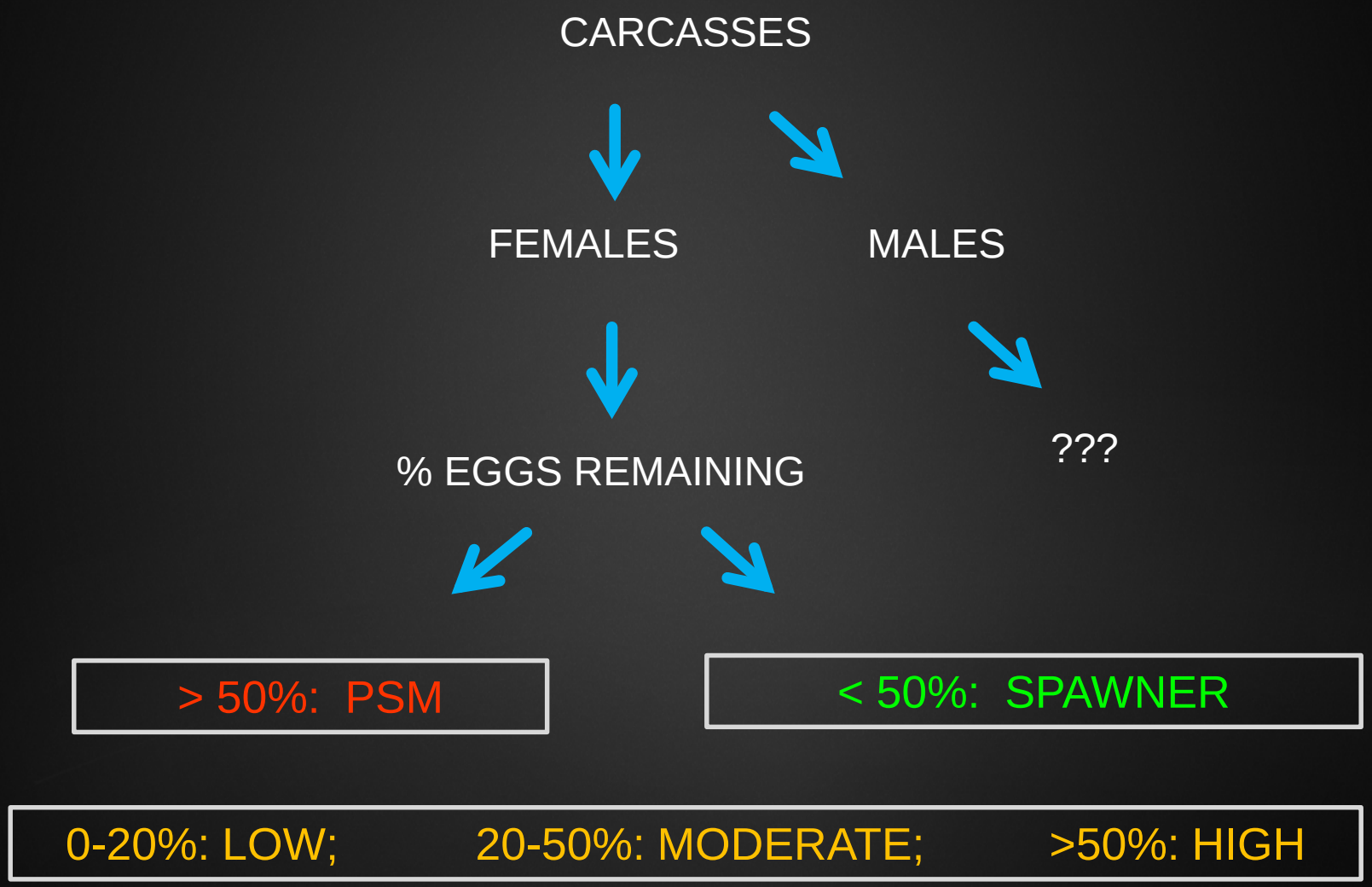
OREGON Fish & Wildlife

Trap, Transport and Outplanting MF Willamette

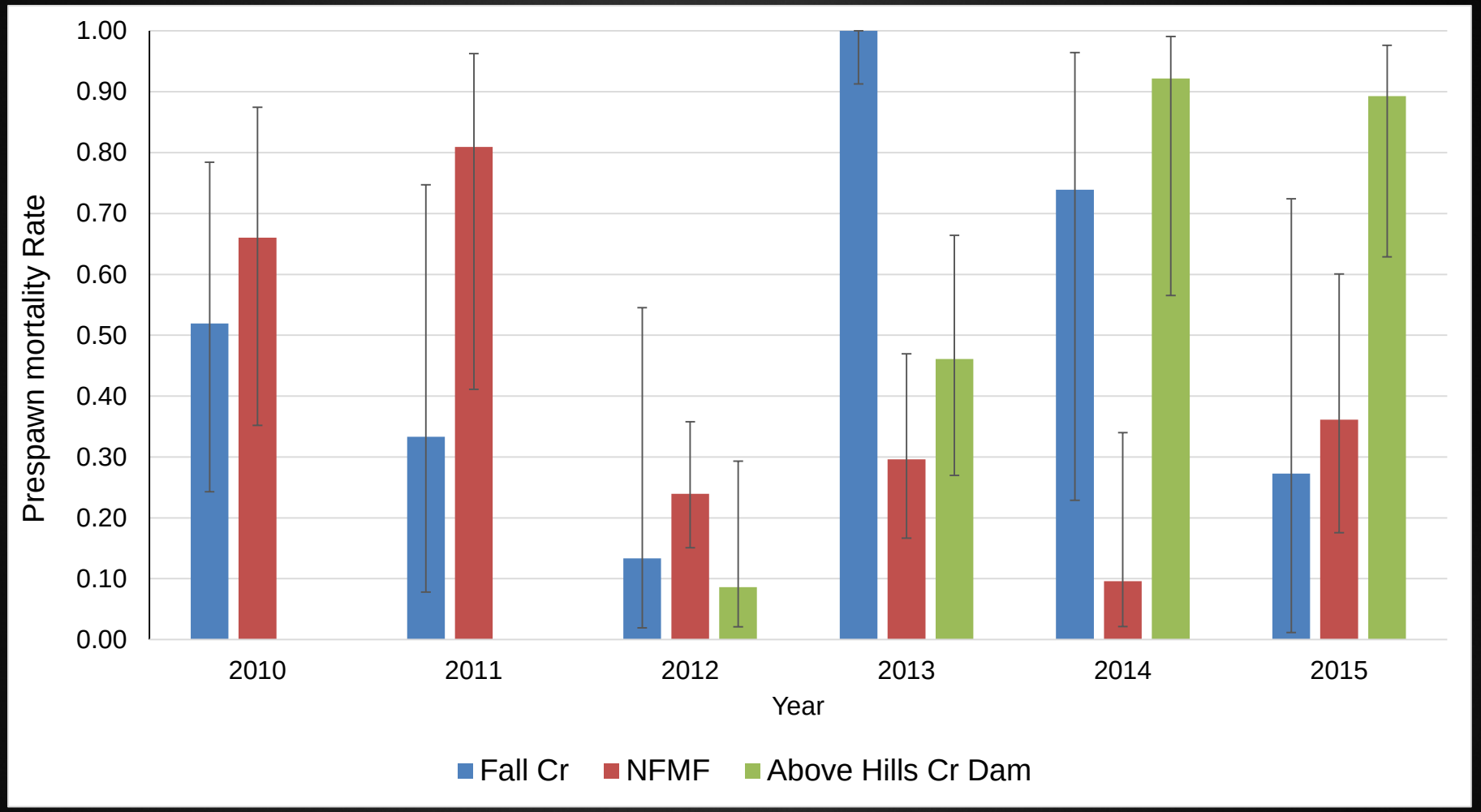


Planning for success: Habitat capacity ~ 10K+ NOR

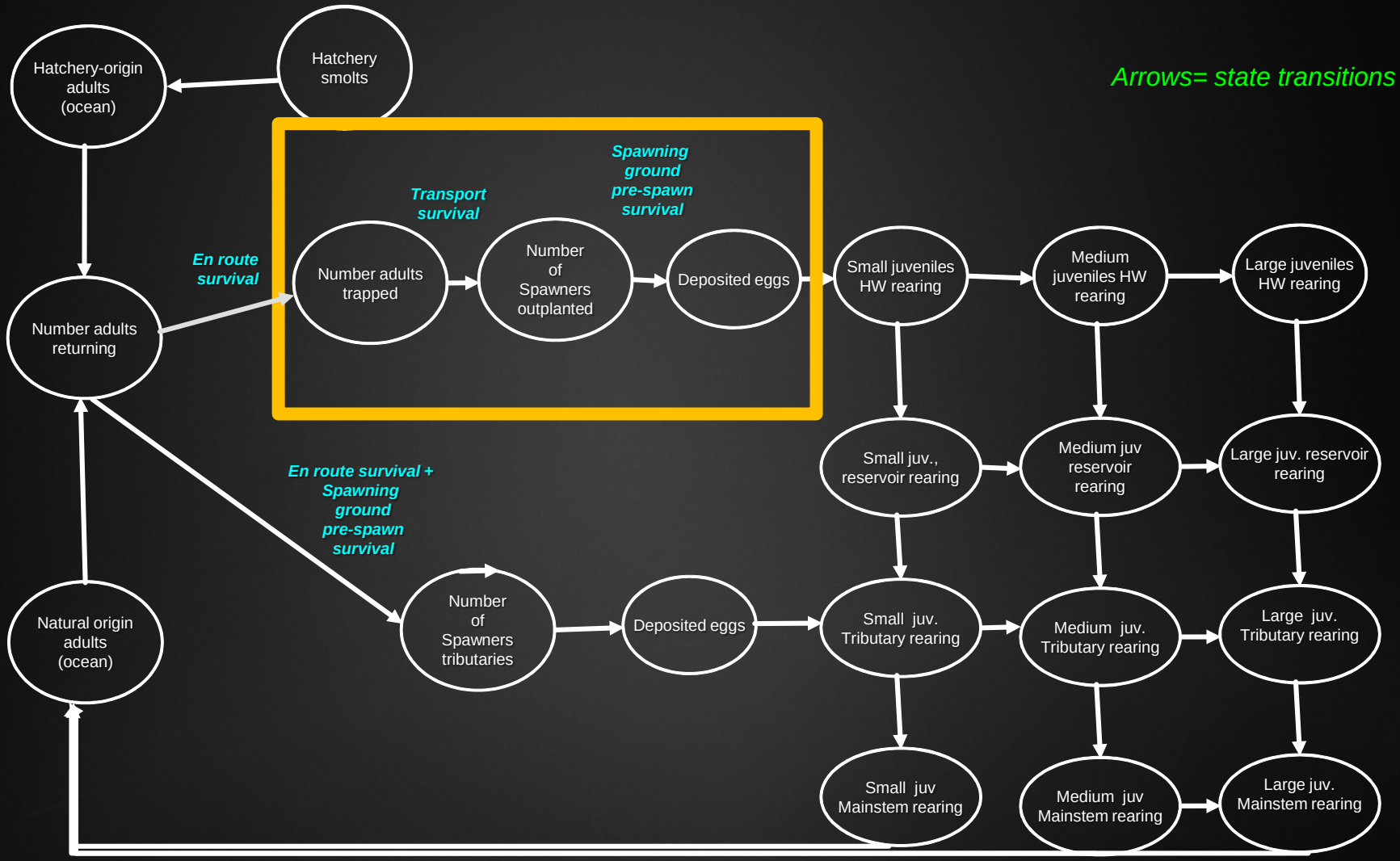
Problem: Prespawning Mortality (PSM)



Estimated Prespawning Mortality

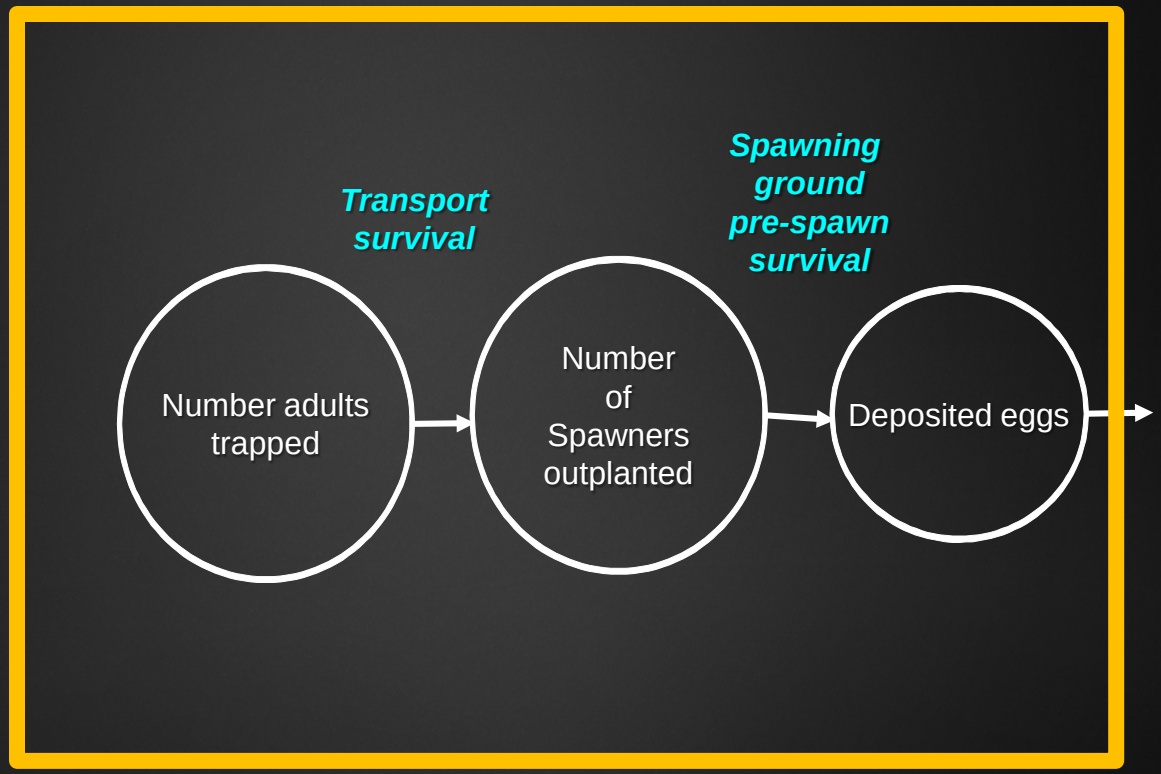


Willamette Spring Chinook Salmon Conceptual Model



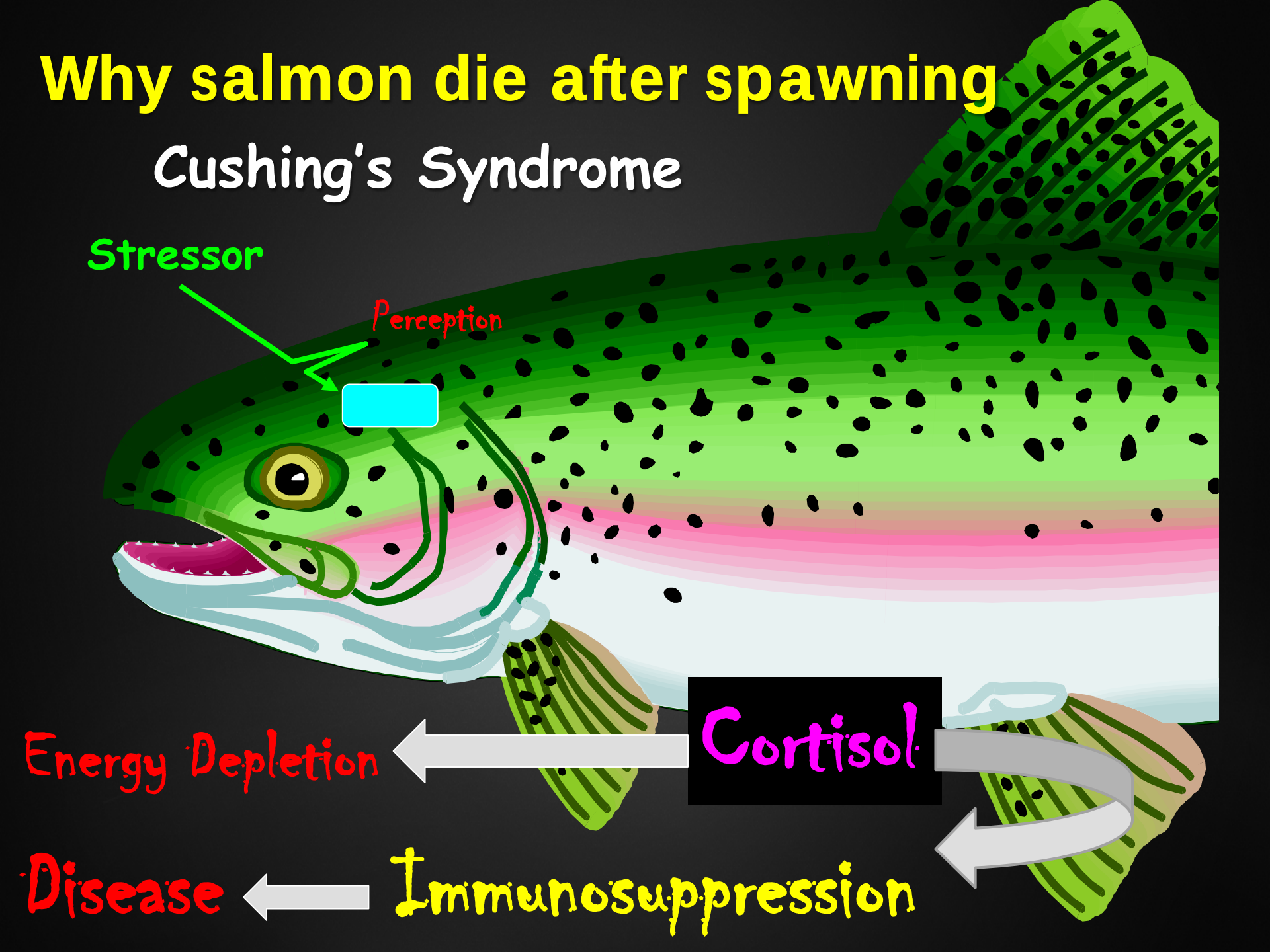
Willamette Spring Chinook Salmon Conceptual Model: Trap-transport-outplant

Arrows= state transitions



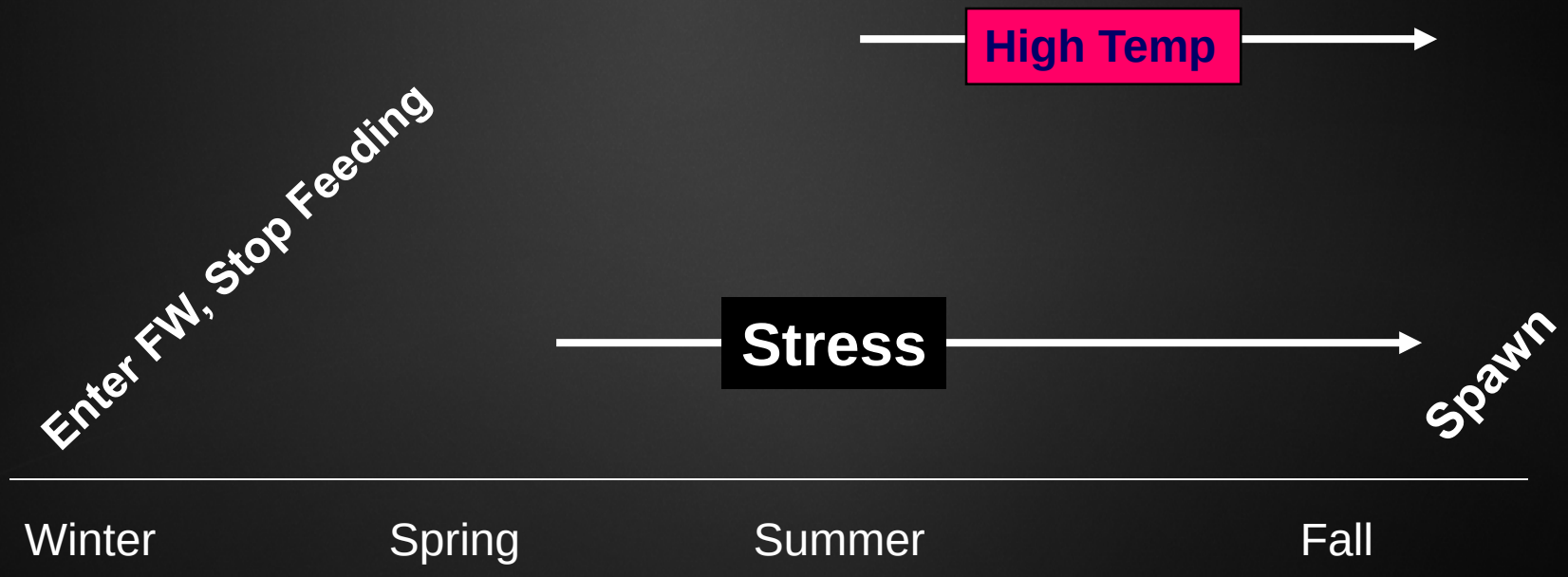
Why salmon die after spawning

Cushing's Syndrome

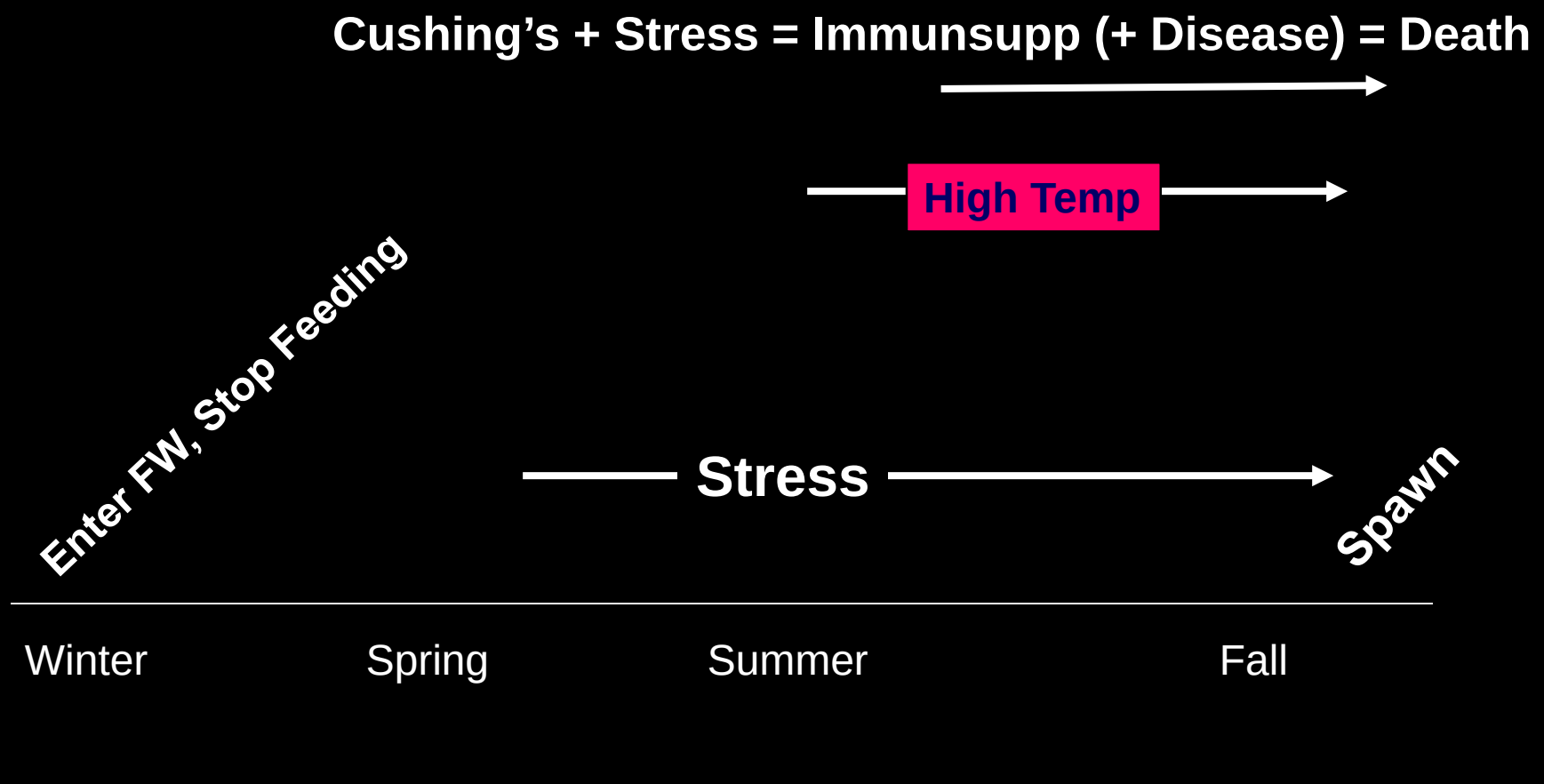


Why do salmon die early?

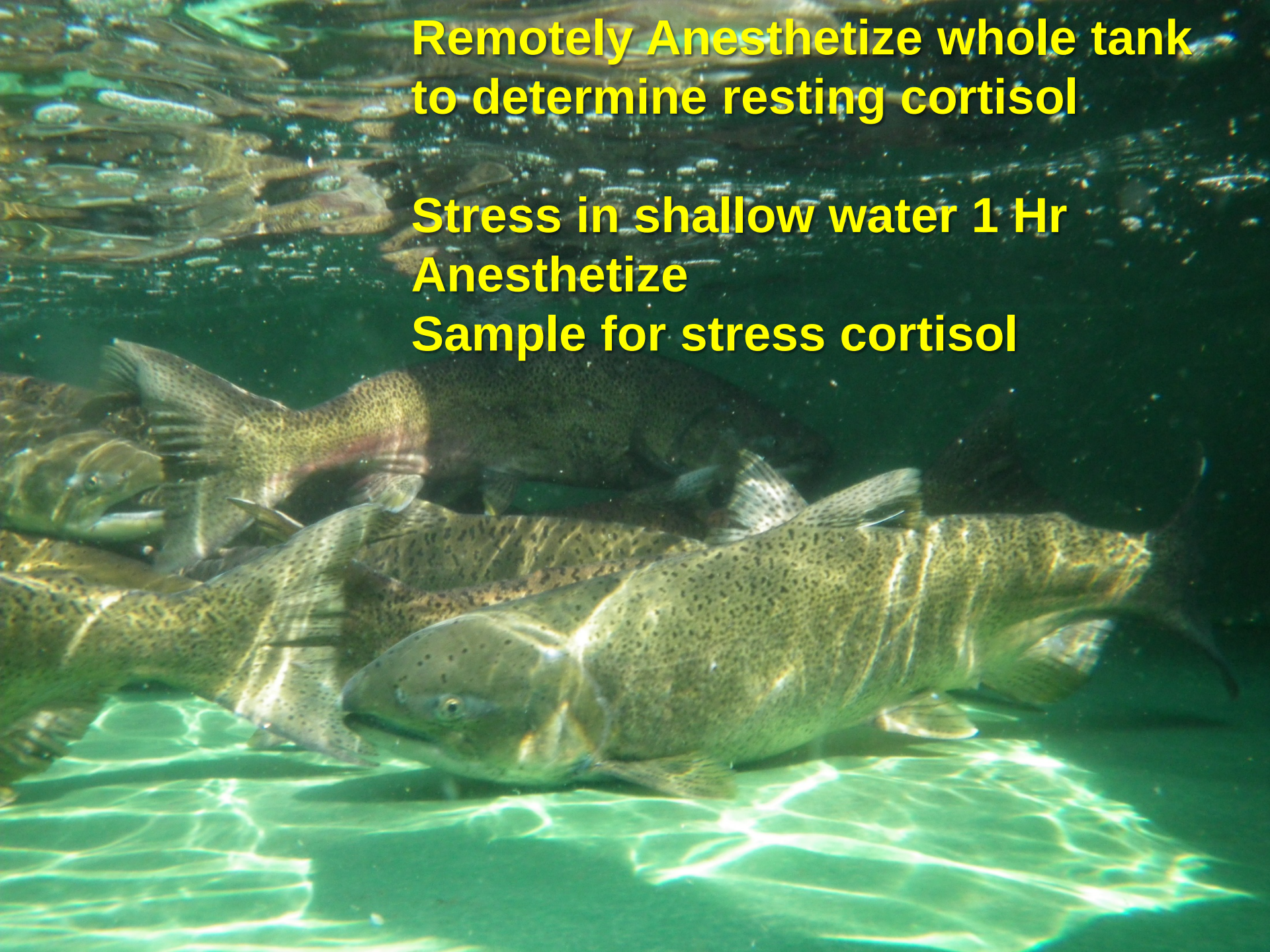
Sequence of Events in Adult Spring Chinook



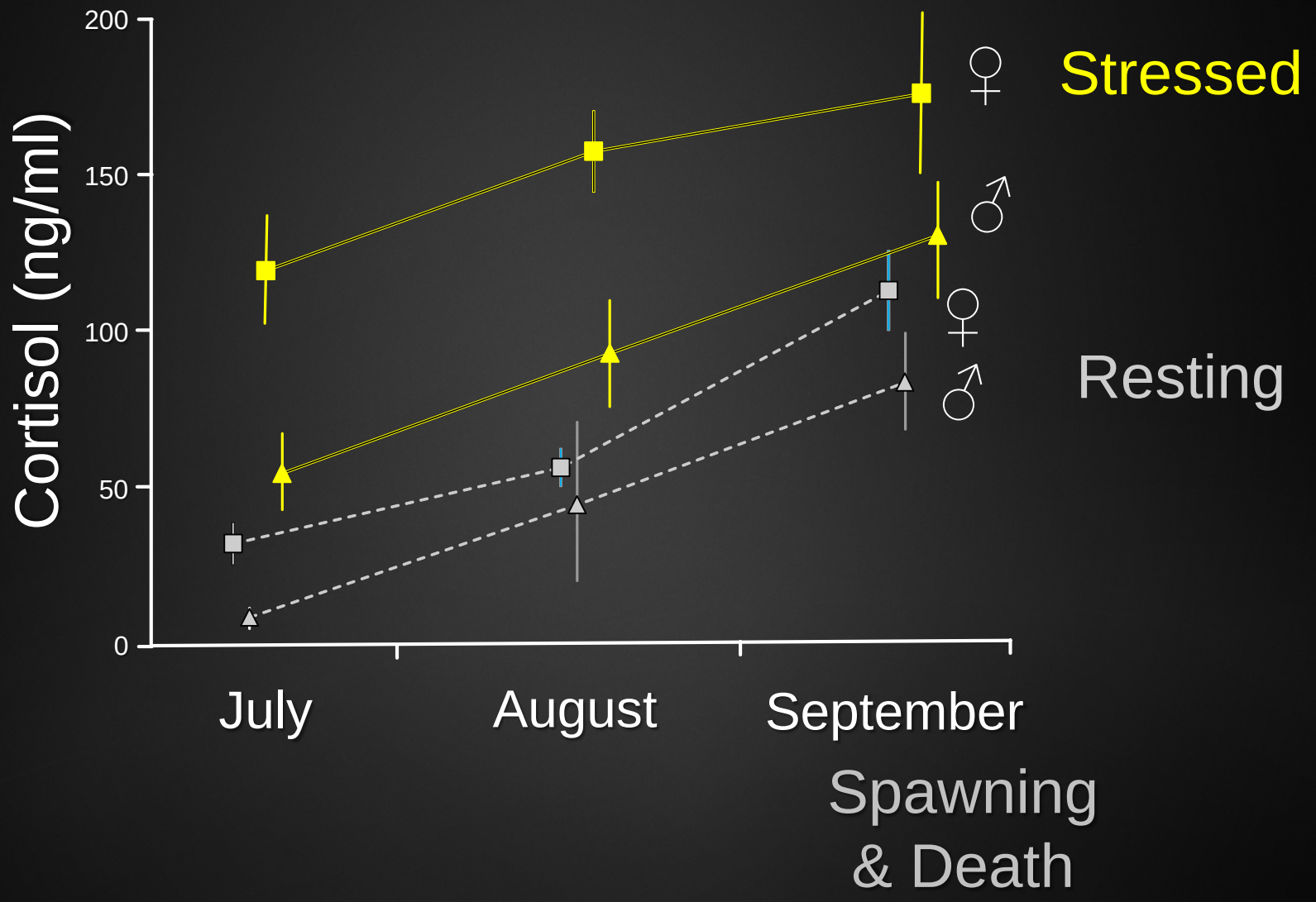
Effects of stress + Cushing's syndrome



Determine if cortisol stress response maintained whilst Cushingoid


Remotely Anesthetize whole tank
to determine resting cortisol
Stress in shallow water 1 Hr
Anesthetize
Sample for stress cortisol

Experimental Evidence of Stress Response



Schreck et al. in prep

Importance =

Double whammy:

- increased resting stress hormone
- increased response to stressor

More stress earlier means:

1. More rapid energy drain
2. Less ability to resist pathogens
3. Enhanced probability of PSM

Factors related to PSM

Transport mortality (Colvin et al.)

Loading, transport time

Willamette discharge (average)

Degree day accumulation (average)

Truck (batch) → 10.7

Trip of the day

Outplant mortality (Deweber et al.)

Outplant site

Week of year

Truck (batch) → 106.2

Year

MOR

Unknown mechanism related to batch

Pathogen status pre-transport?

Pathogen presence + exposure + fish status

Likely Pathogens	Direct transmission in water
Aeromonas salmonicida	Yes
Renibacterium salmoninarum	Yes
Salmincola californiensis	Yes
Nanophyetus salmincola	No, snails
Parvicapsula minibicornis	No, FW polychaetes
Ceratonova shasta	No, FW polychaetes

Pathogen transmission during transport?

Stress + Immunosuppression + exposure

Likely culprits

Aeromonas salmonicida = furunculosis

Renibacterium salmoninarum: = bacterial kidney disease (BKD)

Salmonicola californiensis: parasitic copepod;

Are fish infected during transport?

Objective: Develop diagnostic tests

2017 pilot study

Fall Creek Facility

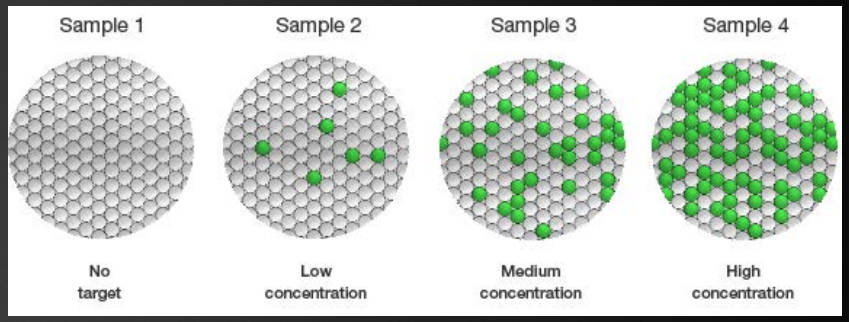
Sampled transport tanks water
- Pre-transport
- Post-transport

Detect environmental DNA (eDNA)

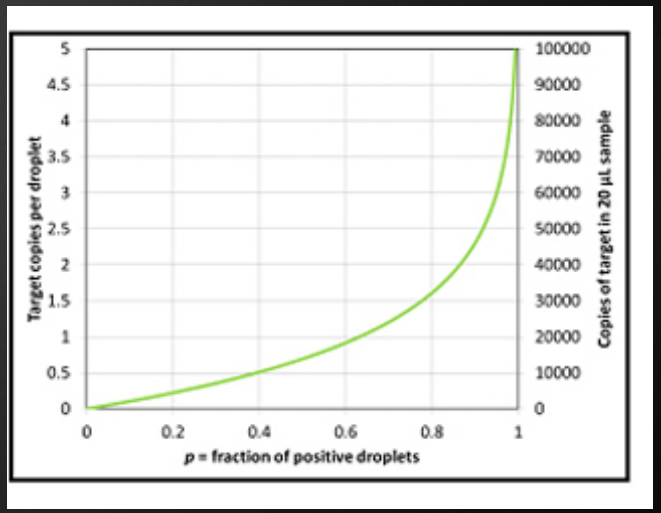
Wildfire complications

Quantification of pathogens: ddPCR analysis

Quantification determined based on fraction of positive droplets



Poisson statistics used to determine target DNA concentration in original sample



Advantages of ddPCR

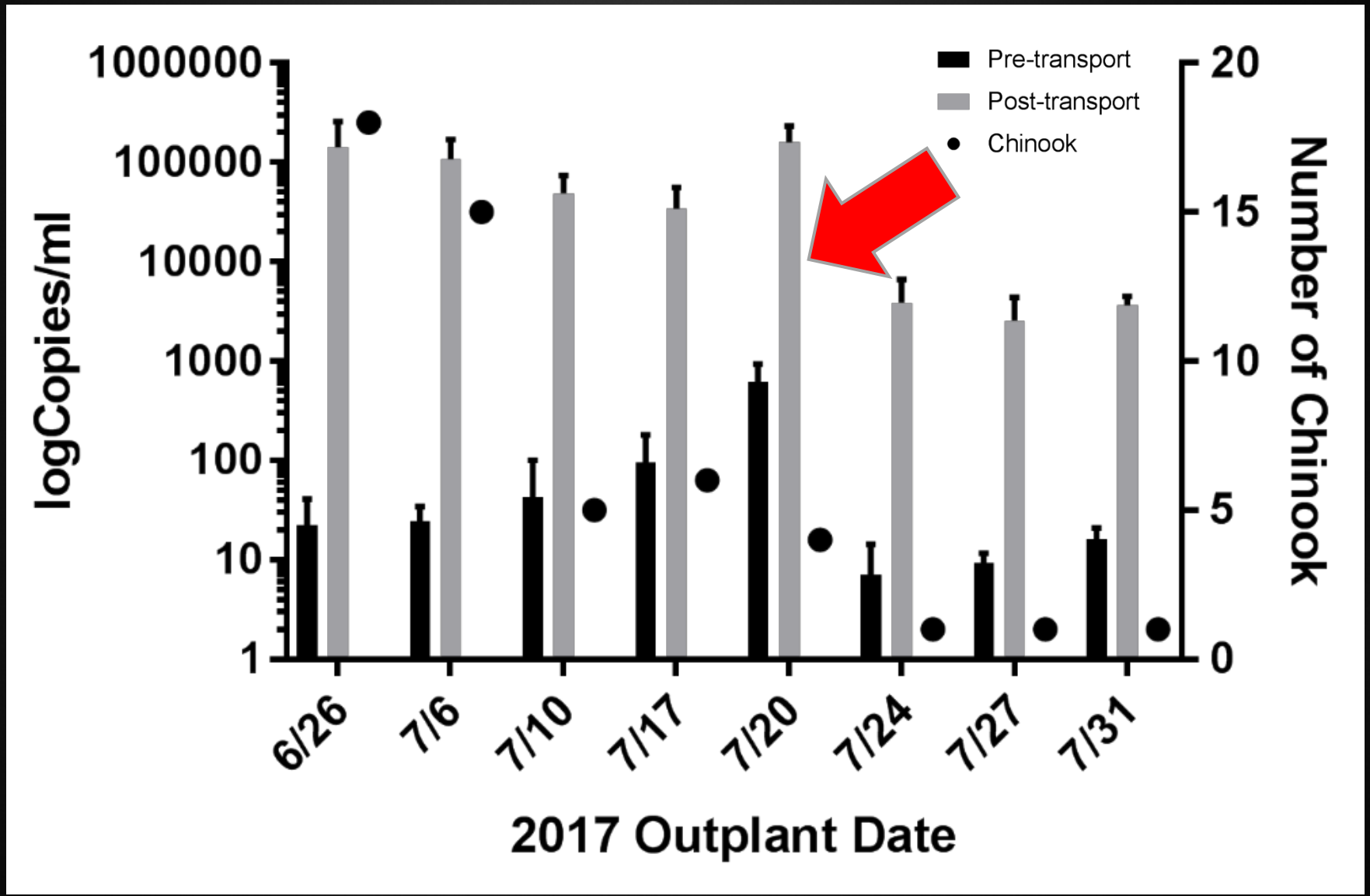
Absolute quantification without standard curve

Not reliant on amplification efficiency

Very precise: enables reliable measurement of small changes

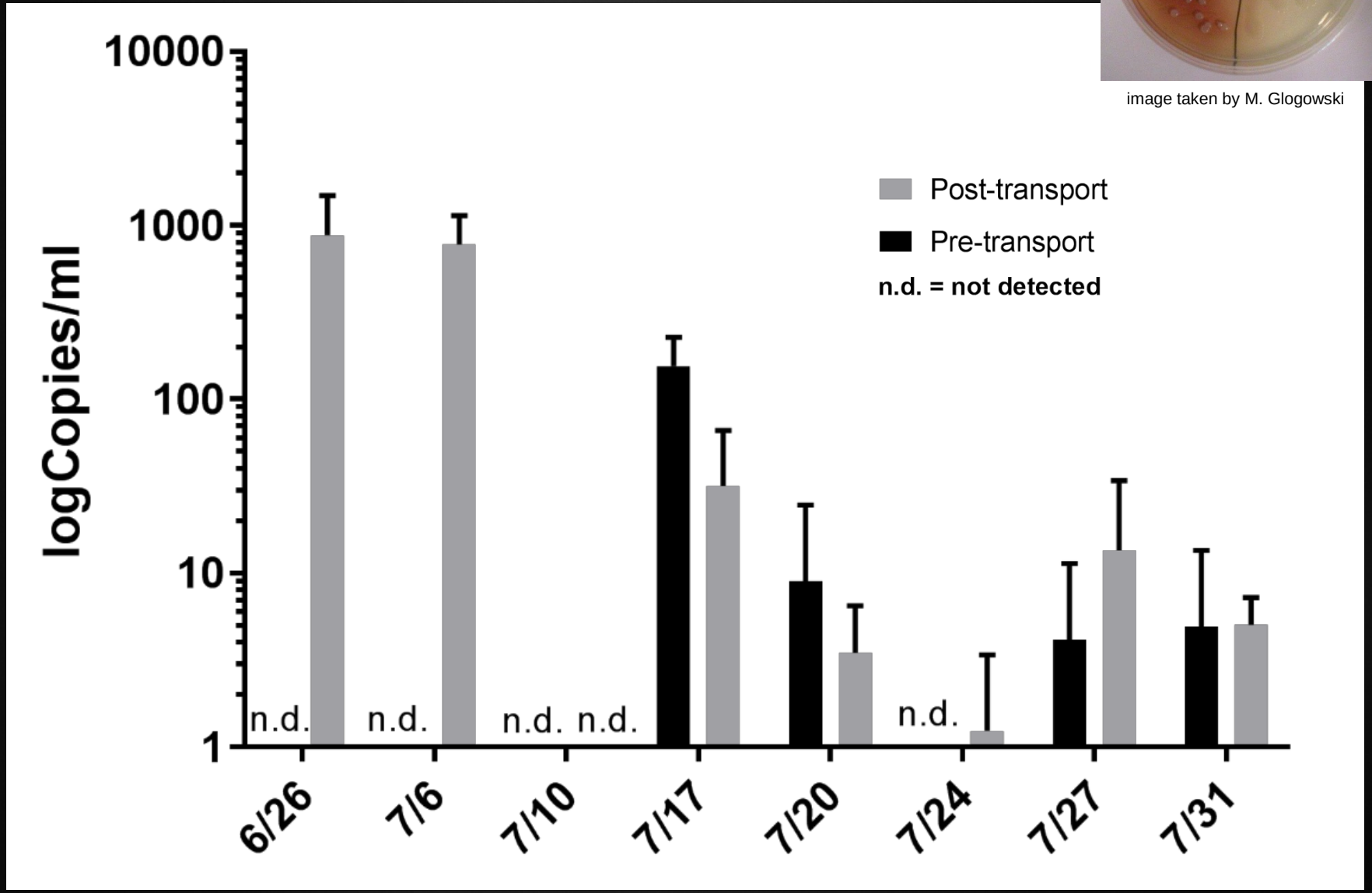
Greater sensitivity: inhibitor and background DNA dilution

Chinook

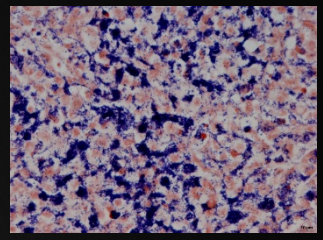

Pre-transport
Post-transport
Chinook
logCopies/ml
1000000
100000
10000
1000
100
10
1
Number of Chinook
20
15
10
5
0
6/26
7/6
7/10
7/17
7/20
7/24
7/27
7/31
2017 Outplant Date

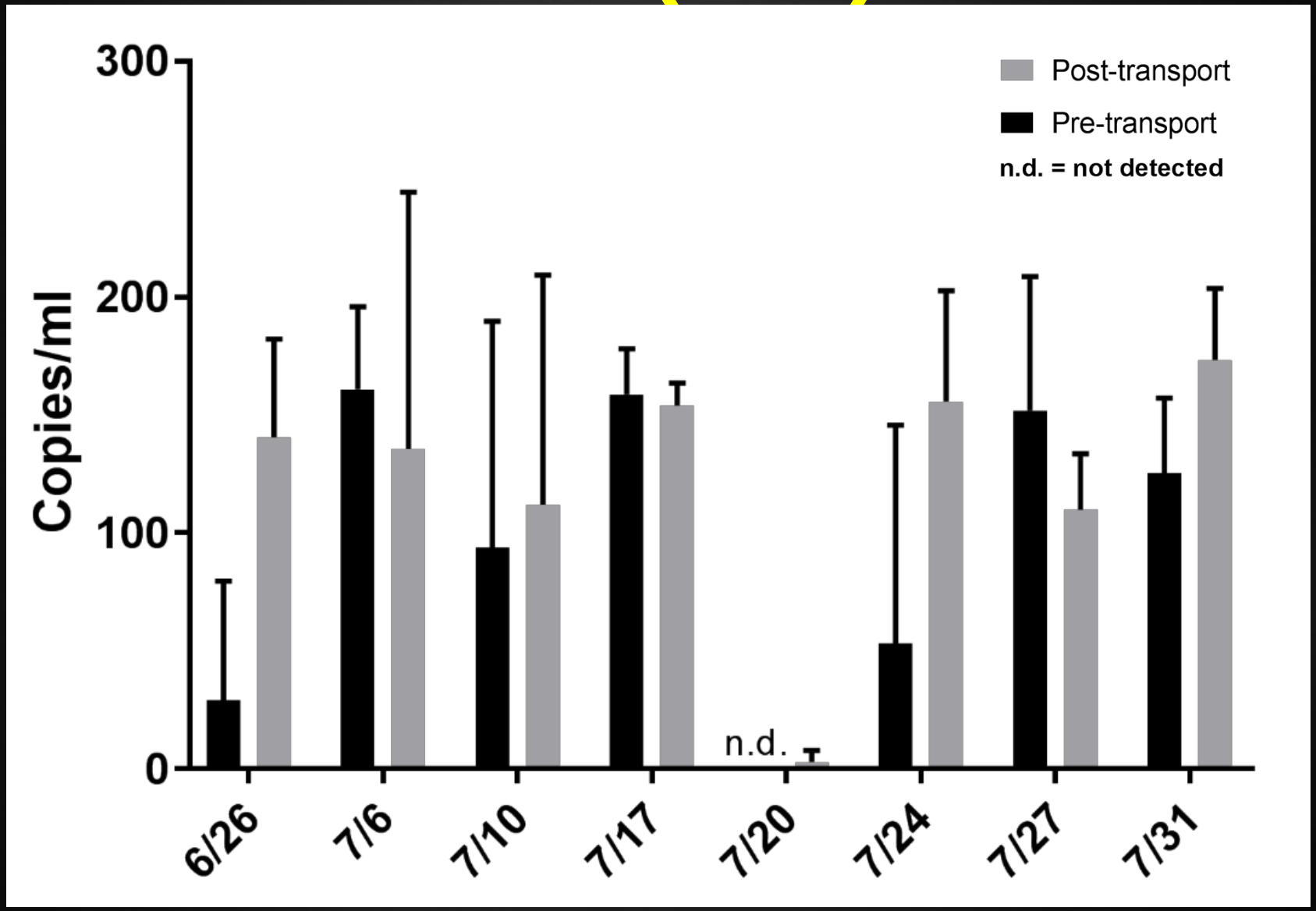
Aeromonas salmonicida (furunculosis)

image taken by M. Glogowski

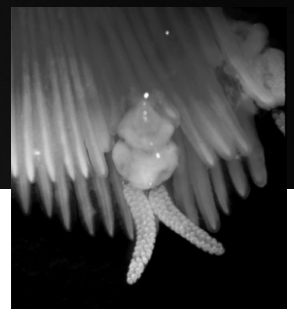


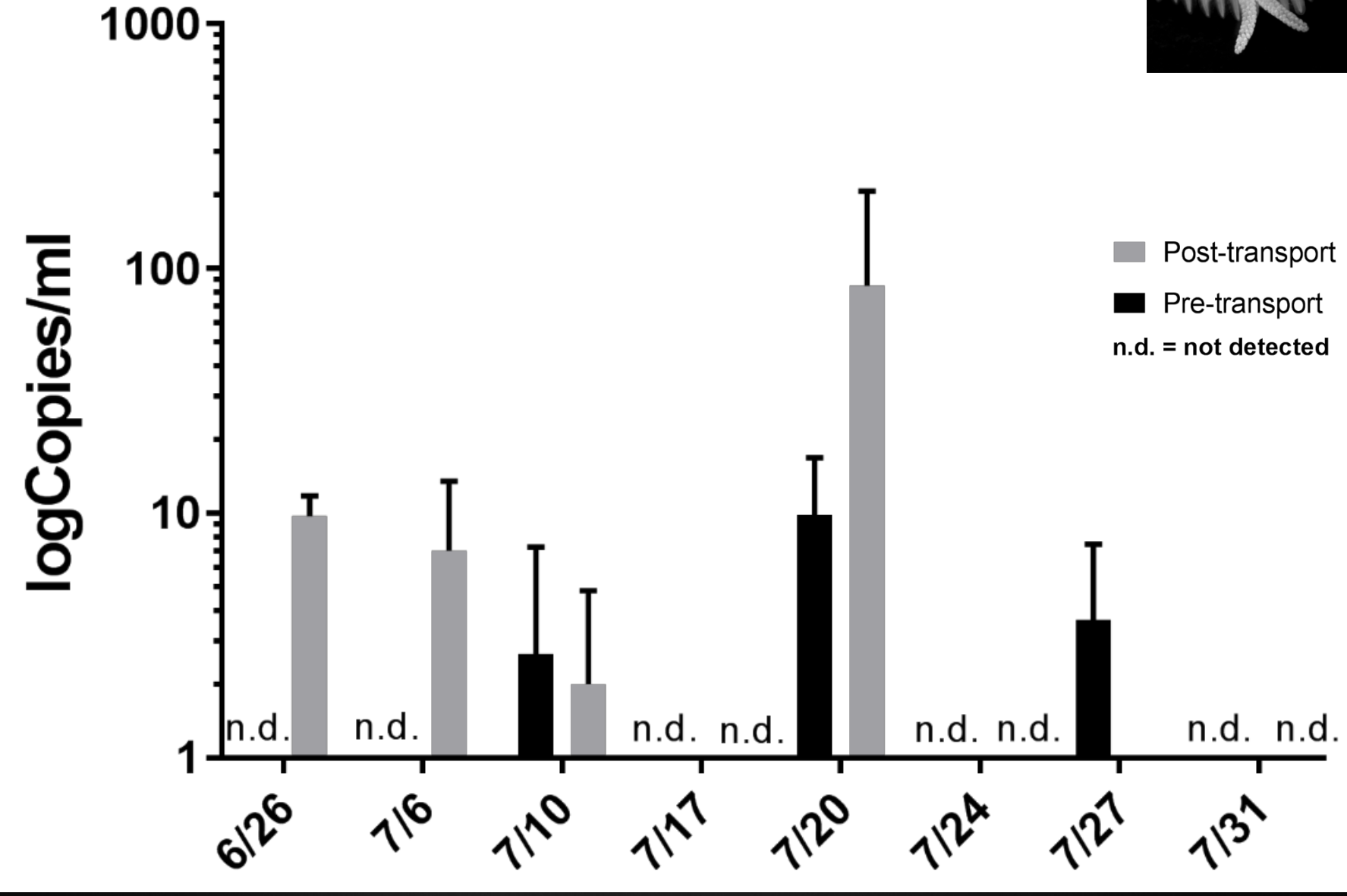
Renibacterium salmoninarum (BKD)



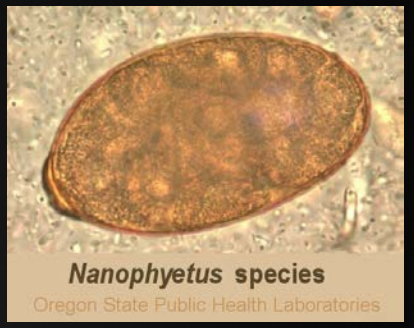


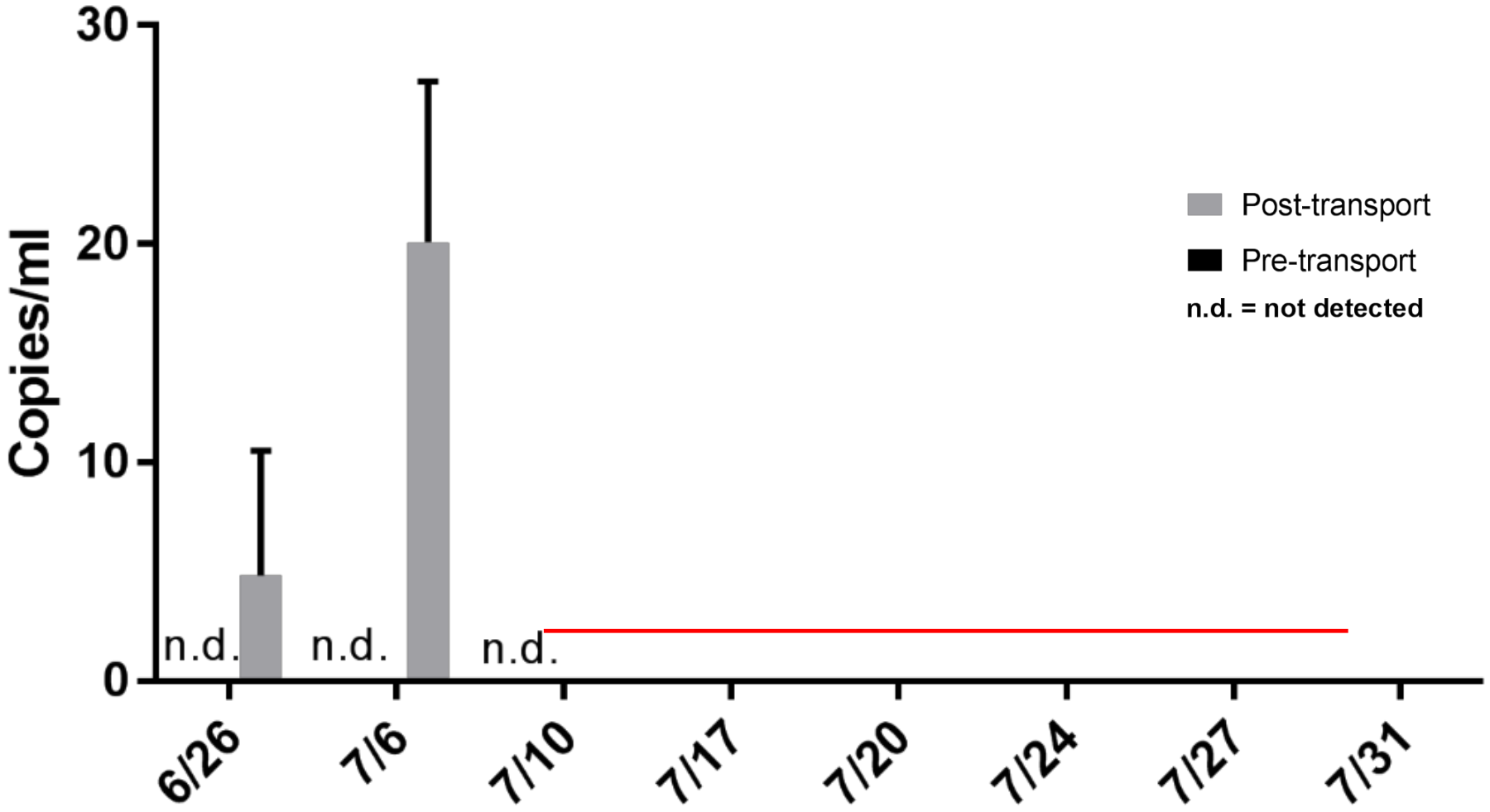
Salmincola californiensis



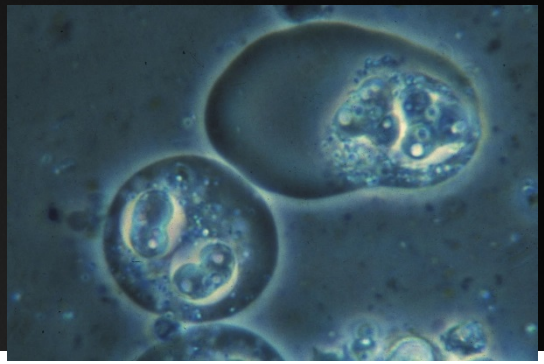


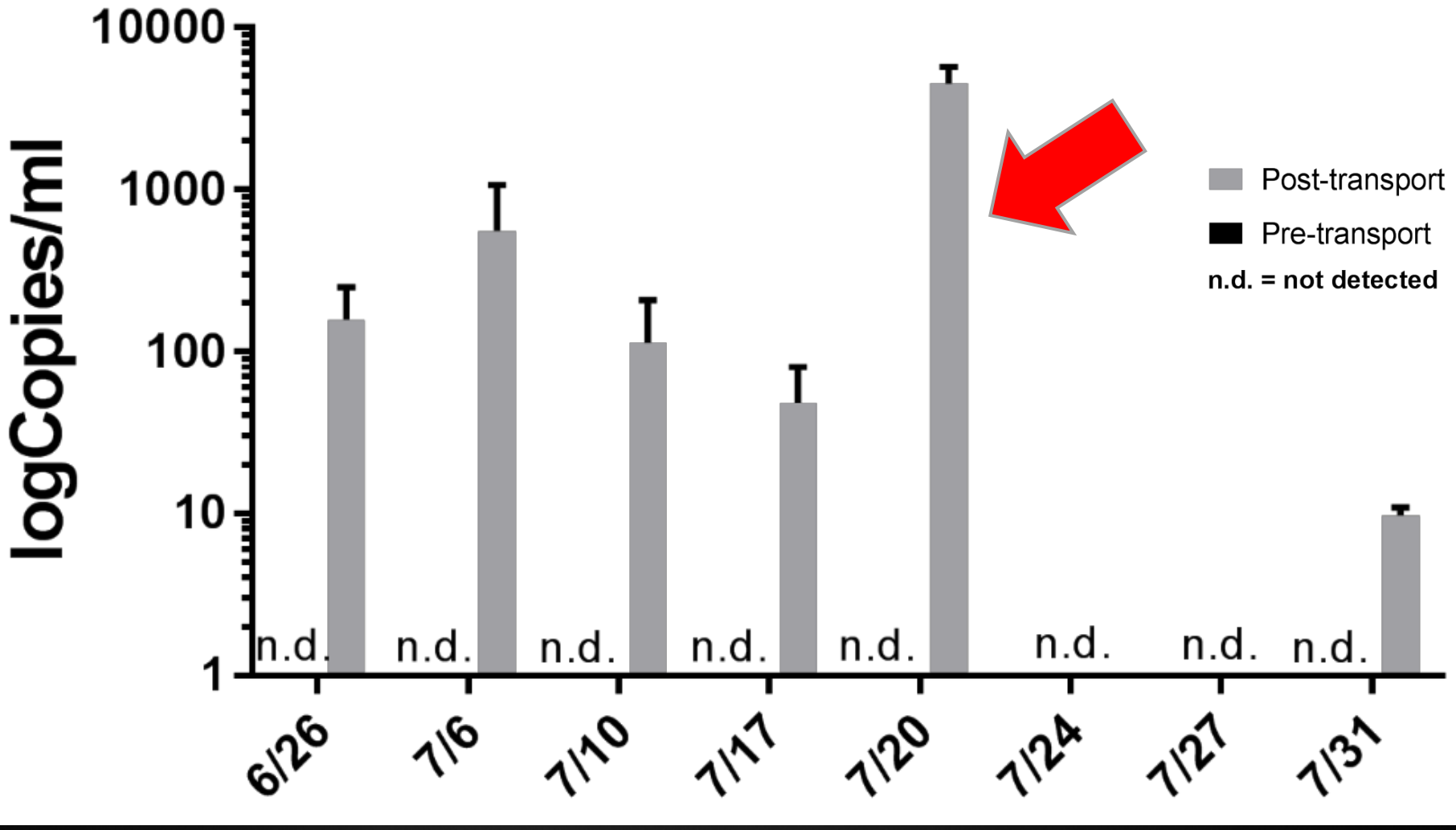
Nanophyetus salmincola



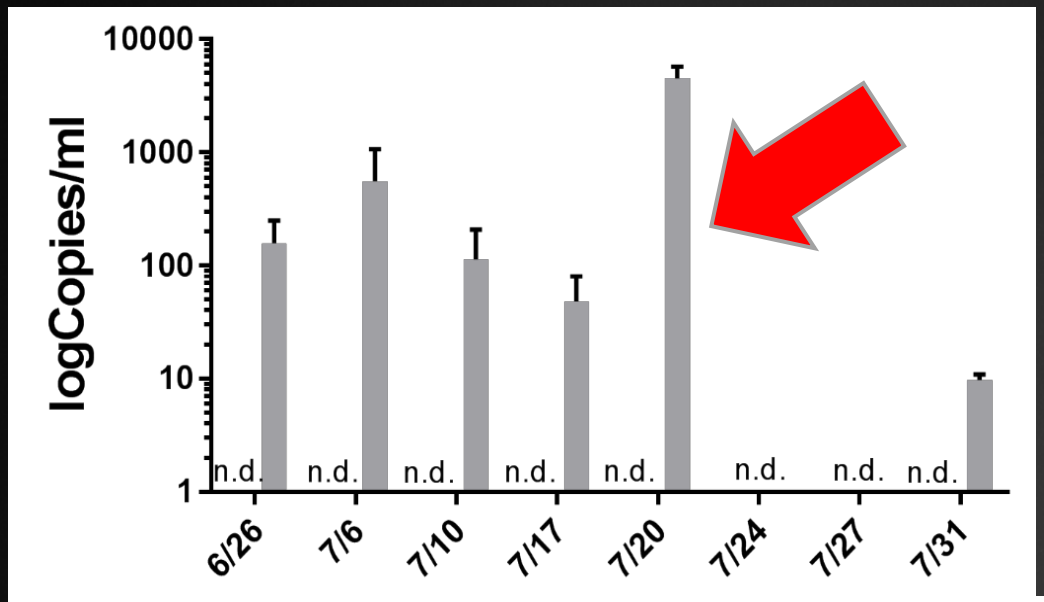


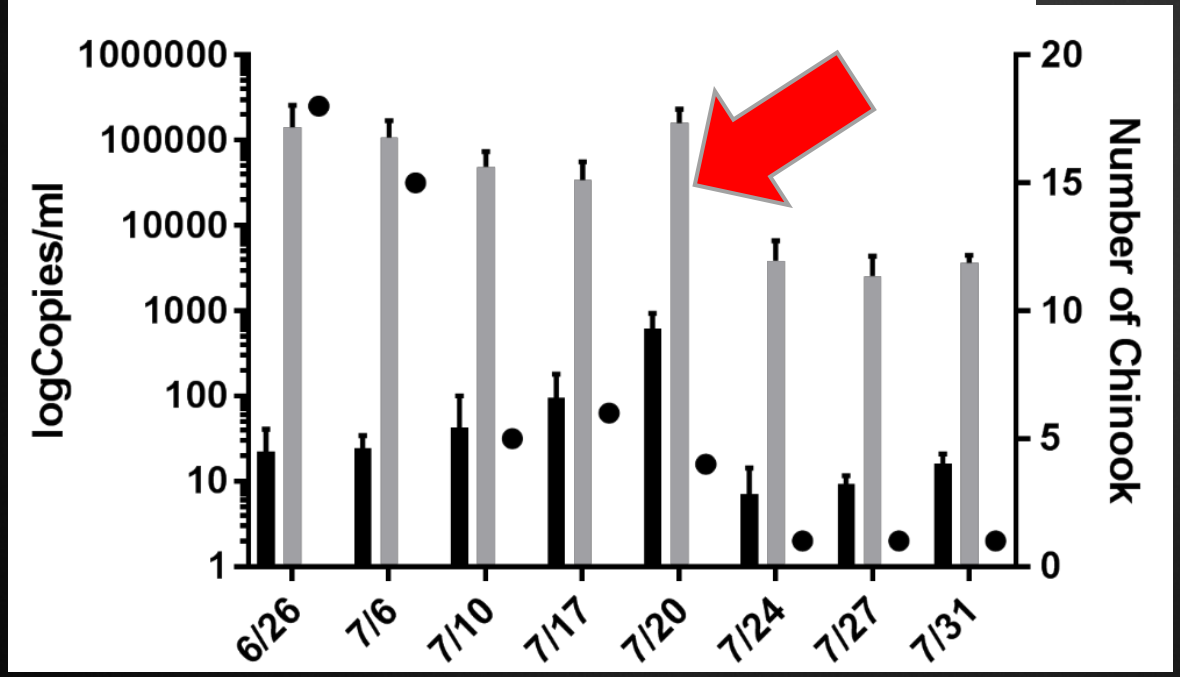
C. shasta

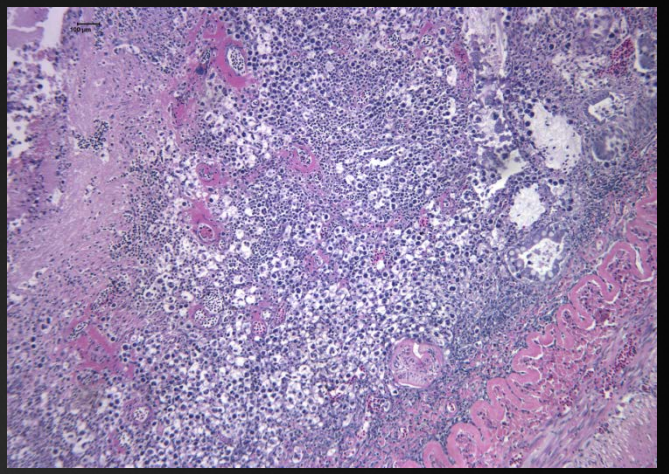



logCopies/ml
10000
1000
100
10
1
n.d.
n.d.
n.d.
n.d.
n.d.
n.d.
n.d.
n.d.
6/26
7/6
7/10
7/17
7/20
7/24
7/27
7/31
Post-transport
Pre-transport
n.d. = not detected

C. shasta







Chinook

Next Steps

- Experimental evaluation outplant strategies
  - NF MF Willamette
  - Fractional factorial design: Sedation & handling, Density, Arrival, Drive distance
- Pathogens and Disease
  - Test transport river, pre- & post-transport
  - Determine pathogen profiles t=0 fish
- Develop optimal outplanting strategies

Summary & Discussion

Yes, we can quantify pathogens!

Proliferative pathogens increase during transport (furunculosis)

Treatments feasible

Diagnostic test development

Used to estimate number outplants needed

Acknowledgements

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ODFW

- Hatchery
- Research
- Managers

USACE

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