An Ecological Approach for Optimizing Hatchery Release Timing of Salmon

Eric Lauver - Lead Biologist

Todd Pearsons, Ph.D. - Senior Fisheries Scientist

WA-BC Chapter Annual Meeting

Bremerton, WA

April 11, 2019

Grant County
PUBLIC UTILITY DISTRICT

Introduction


https://www.youtube.com/watch?v=vBME9YT3N2M


https://www.heraldnet.com/northwest/warm-waters-off-west-coast-has-lingering-effects-for-salmon/


https://www.drweil.com/diet-nutrition/food-safety/worms-in-salmon/


s://www.nwcouncil.org/news/ocean-predators


https://wdfw.wa.gov/fishing/salmon/howtocatch/freshwater.html

Strong focus, effort, and expense

Least focus, effort, and expense

Release Timing

- ✓ Least sophisticated activity
- ✓ Often based on operational convenience
- ✓ Self-imposed constraints
- ✓ Could releases be conducted better?

Unaware of a model that recommends when to release fish

https://www.critfc.org/fish-and-watersheds/columbia-river-fish-species/columbia-river-salmon/

https://www.fws.gov/sfbaydelta/GlobalImages/drought-related_large_images_march_2014/chinook_salmon_smolts_delivered_to_san_pablo_bay.jpg

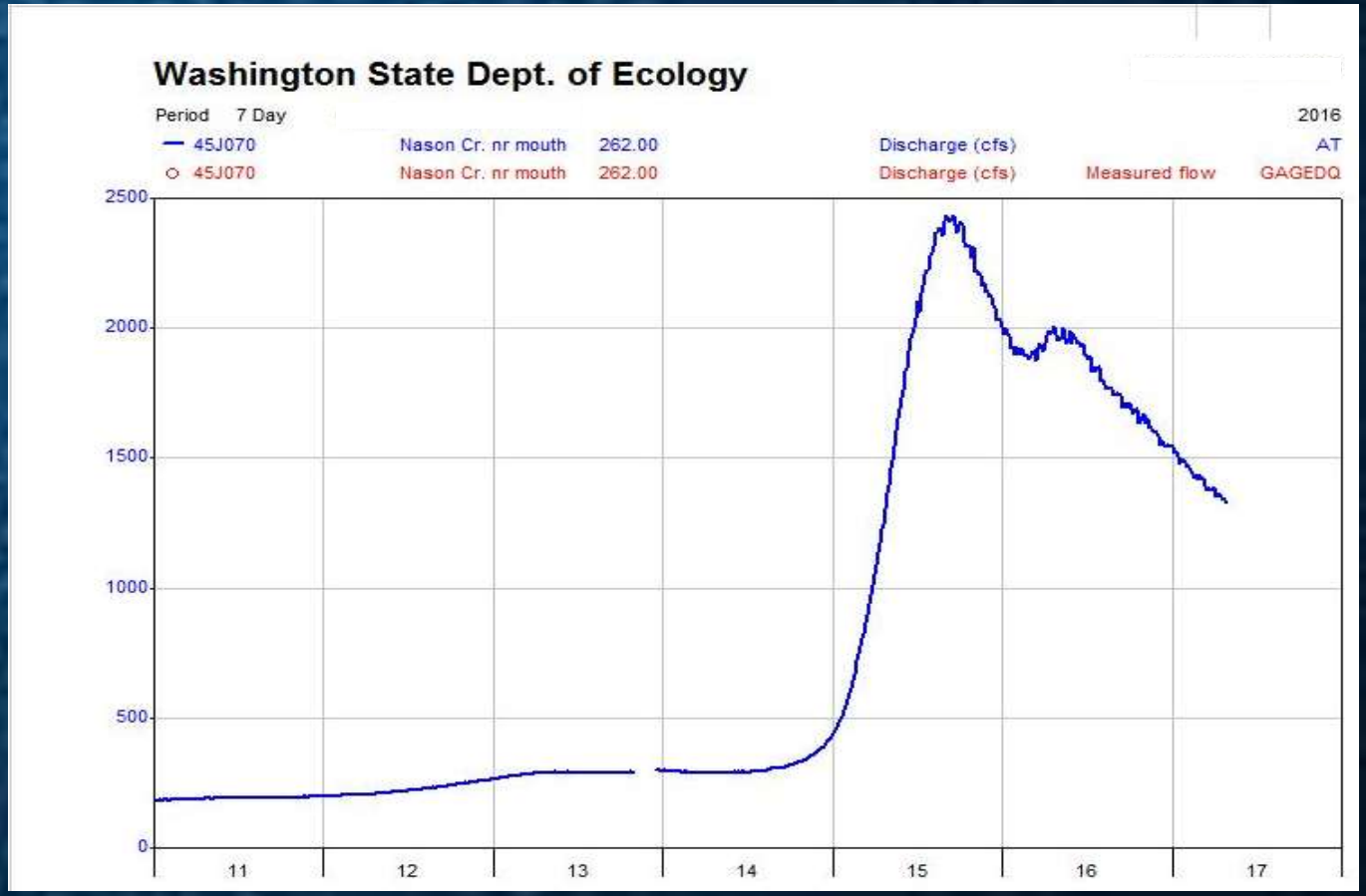
Common Release-timing Factors

- ✓tradition
- ✓hatchery staff availability
- ✓equipment availability
- ✓hydro system spill
- ✓poor fish health
- ✓tagging schedules
- ✓studies
- ✓monitoring
- ✓hatchery space limitations

Influence of Release Timing

Release timing differences, even as small as 12 hours, can have a dramatic influence on important biological metrics such as survival and ecological interactions

Differences in release timing may be among the largest performance benefit/cost in decisions about fish culture



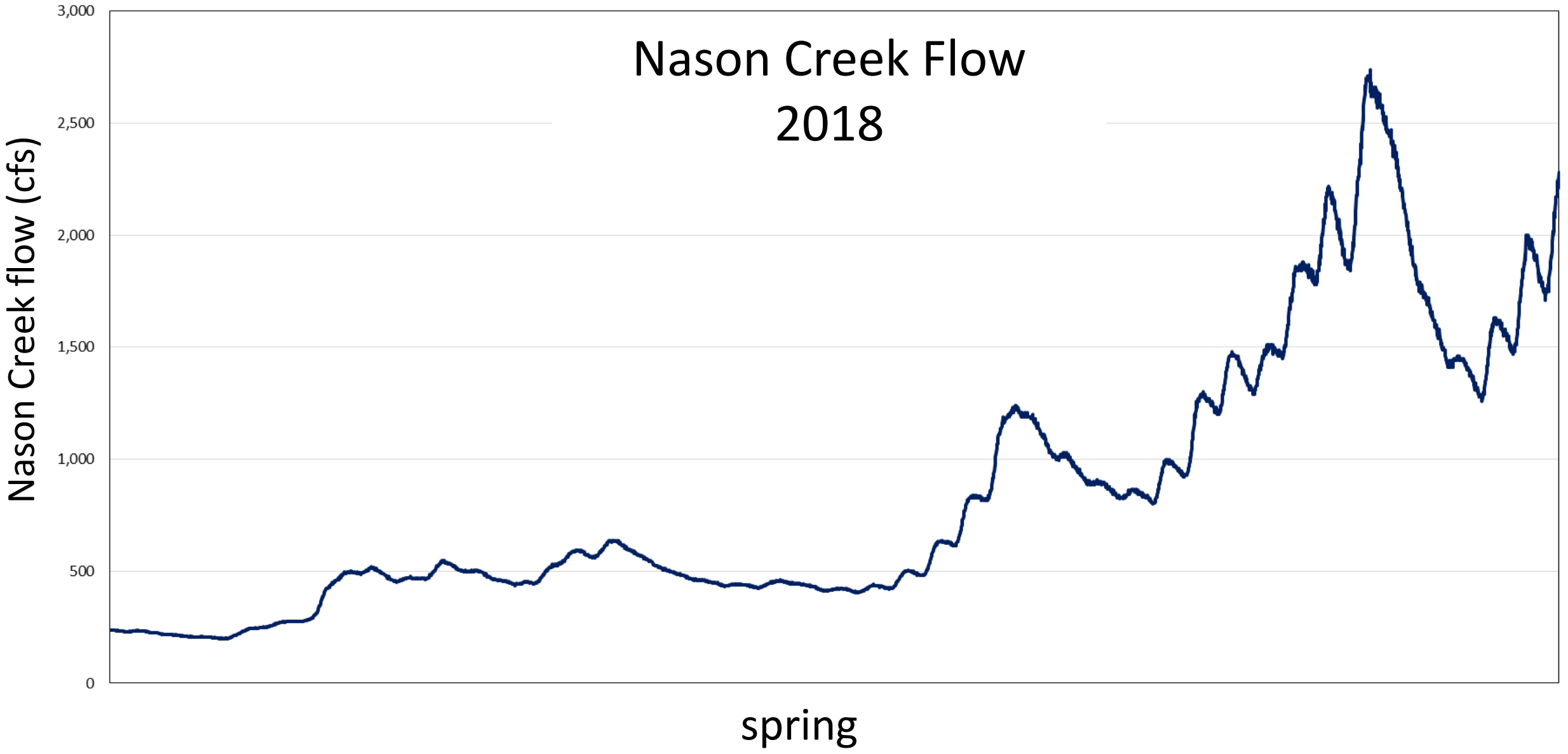
Focus of This Talk – forced releases

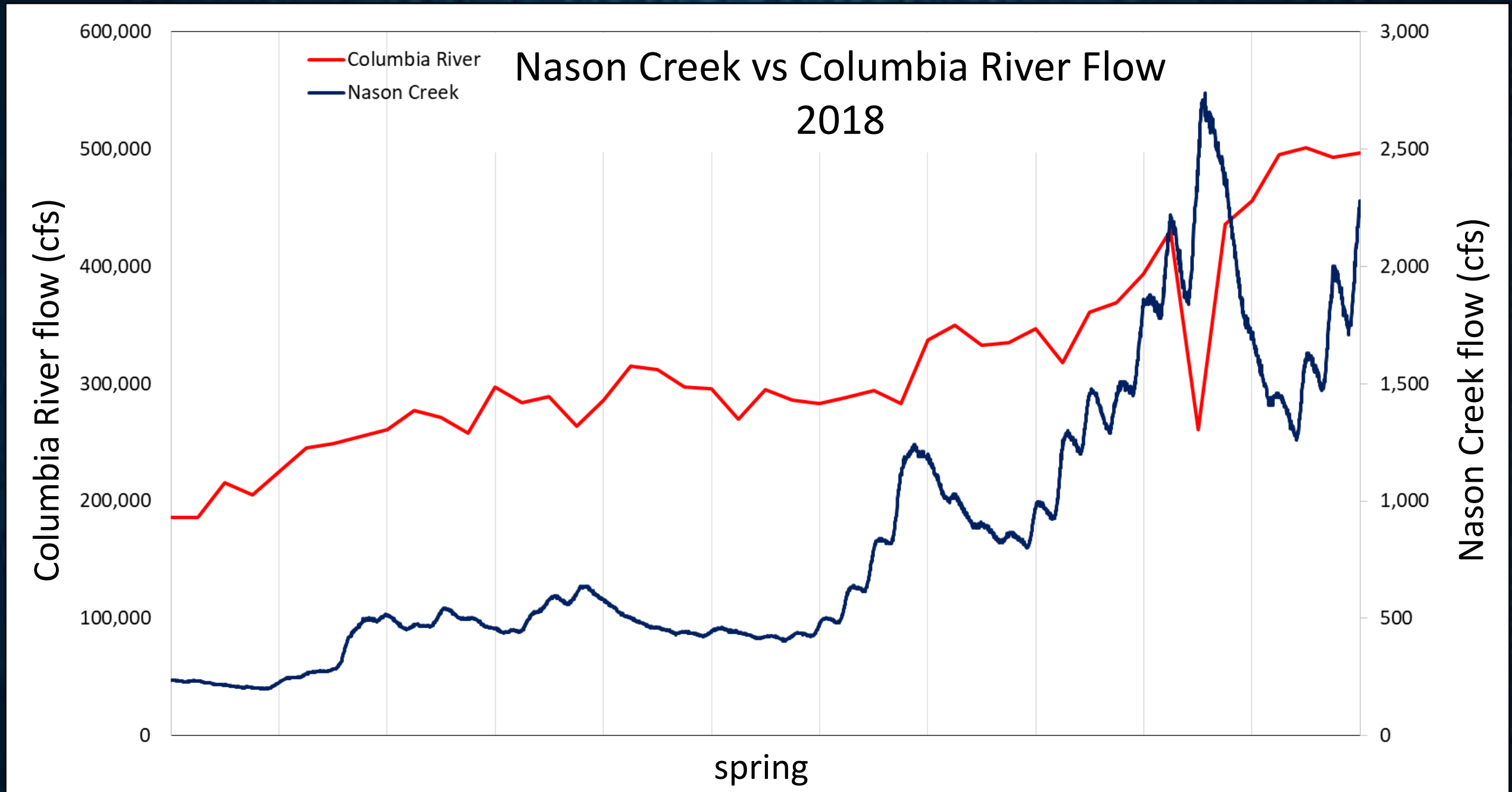
Suggested Defaults

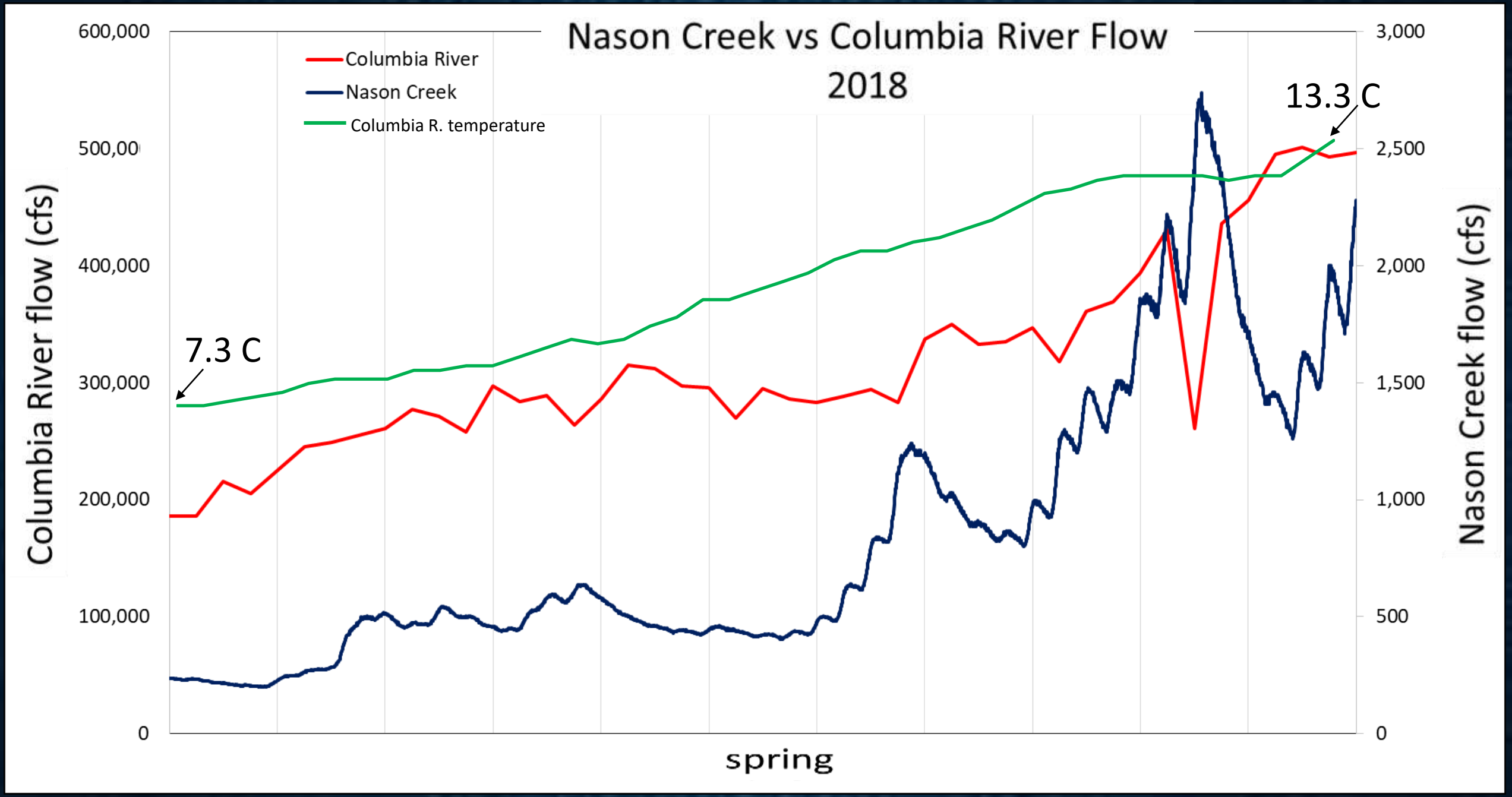
- Night releases
- Ascending hydrograph
- Pulsed
- Adjust staffing levels to support fish needs
  - borrow staff
  - reprioritize other work
  - work overtime

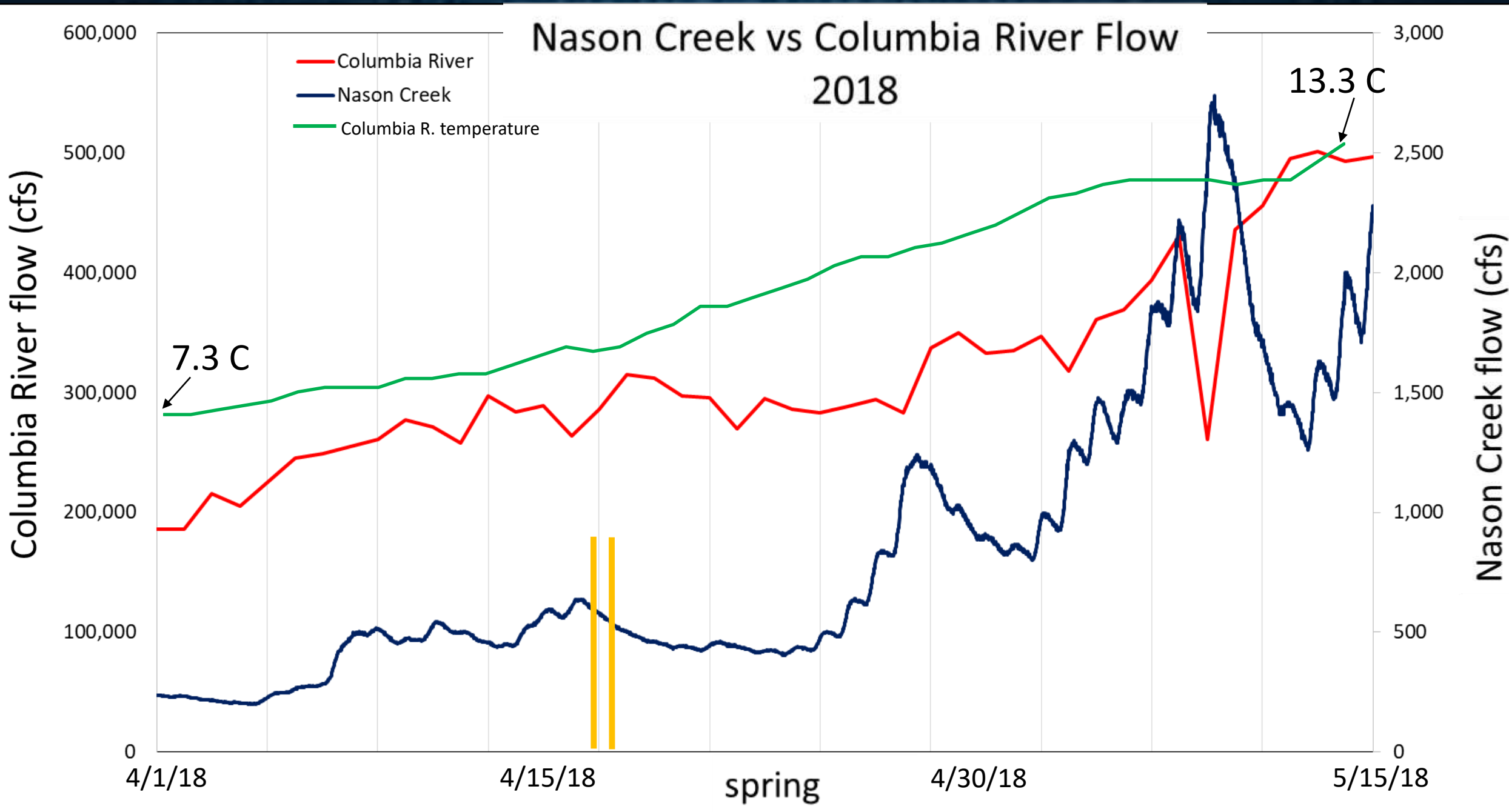
Influences of Release Timing

What's best for the fish,
and therefore the program?


Nason Creek Flow
2018
Nason Creek flow (cfs)
3,000
2,500
2,000
1,500
1,000
500
0
spring


Nason Creek vs Columbia River Flow
2018
Columbia River
Nason Creek
600,000
500,000
400,000
300,000
200,000
100,000
0
3,000
2,500
2,000
1,500
1,000
500
0
Columbia River flow (cfs)
Nason Creek flow (cfs)
spring


Nason Creek vs Columbia River Flow
2018
Columbia River
Nason Creek
Columbia R. temperature
7.3 C
13.3 C
600,000
500,00
400,000
300,000
200,000
100,000
0
3,000
2,500
2,000
1,500
1,000
500
0
Columbia River flow (cfs)
Nason Creek flow (cfs)
spring


Nason Creek vs Columbia River Flow
2018
Columbia River
Nason Creek
Columbia R. temperature
7.3 C
13.3 C
Columbia River flow (cfs)
Nason Creek flow (cfs)
600,000
500,00
400,000
300,000
200,000
100,000
0
3,000
2,500
2,000
1,500
1,000
500
0
4/1/18
4/15/18
spring
4/30/18
5/15/18

1. Fish Readiness

- Attempt to release fish when fish are most ready to survive and migrate in the stream
- Behavior (migratory behavior)
- Coloration (body, fin coloration)
- Size (target/optimal size)
- Health

http://www.fishsciences.net/projects/stanislaus/caswell%20outmigration/caspost4/stanpostcard4.htm

$$\text{Fish} = w_1(\%\ \text{behavior}) + w_2(\%\ \text{coloration}) + w_3(\%\ \text{size})$$

2. Ecological Interactions

- Attempt to release fish to minimize undesirable interactions with other taxa
  - Predators
  - NTTOC

One alternative is to minimize risk using PCD-risk 2 model

$$\text{Interaction} = w_1(100\% - \%\text{predation}) + w_2(100\% - \%\text{NTTOC1 impact}) + w_3(100\% - \%\text{NTTOC2 impact})$$

3. Environmental Conditions (discharge, clarity, temperature)

1. Attempt to release fish during the best conditions within a year (e.g., just prior to a cold peak-flow event)
2. Make predictions of discharge, clarity, and temperature based upon snow pack, forecasted air temperature, forecasted precipitation, water-release schedules from dams

$$\text{Environment} = w_1(\%\text{max discharge trib}) + w_2(\%\text{max discharge main}) + w_3(\%\text{min temp trib}) + w_4(\%\text{min temp main})$$

Conceptual Model

w_1(% Fish)

w_2(% Environment)

$+ w_3$(% Interaction)

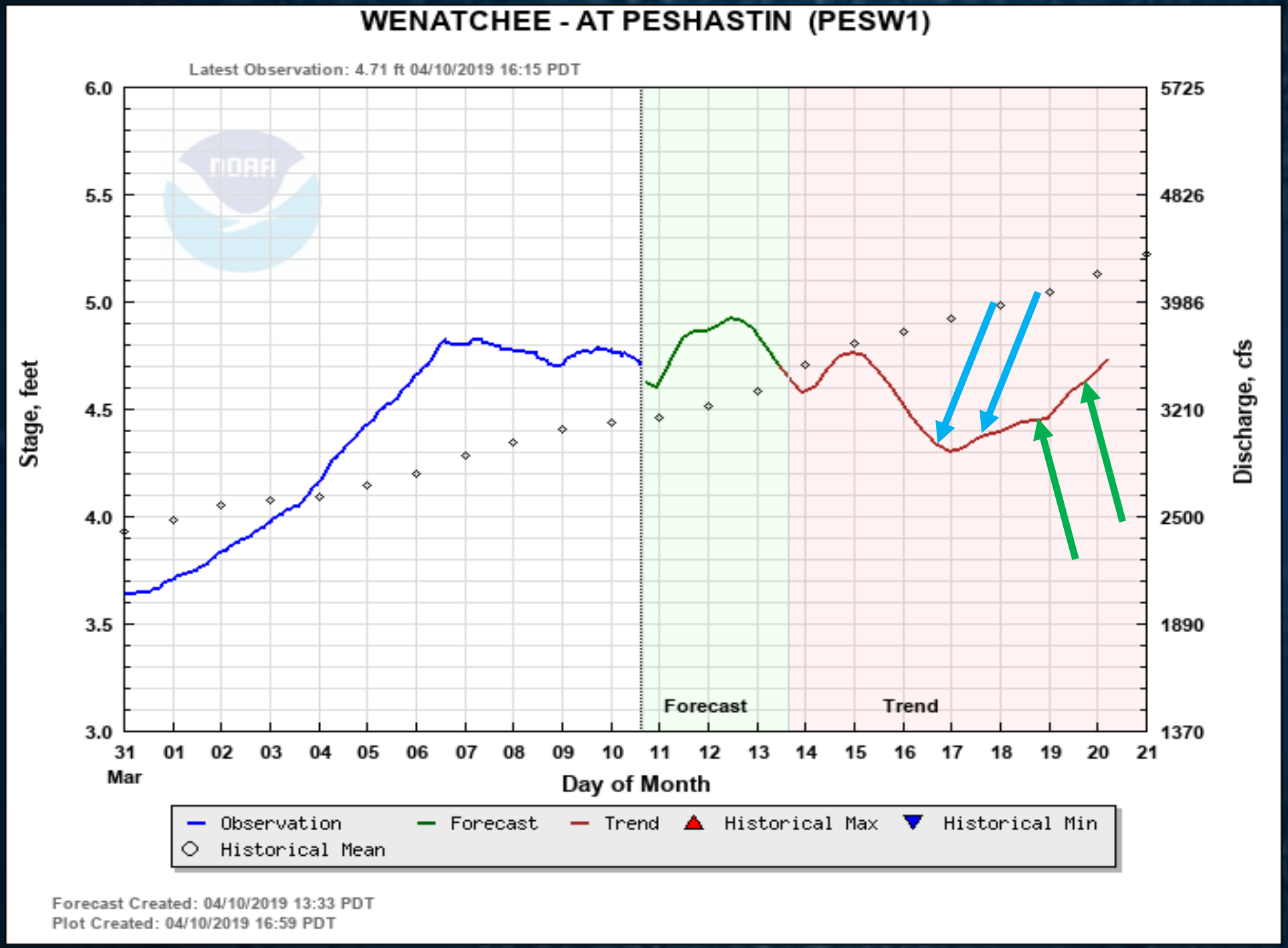
Examples

0.3(80%) + 0.2(90%) + 0.2(70%) = .56

0.2(75%) + 0.2(60%) + 0.3(50%) = .42

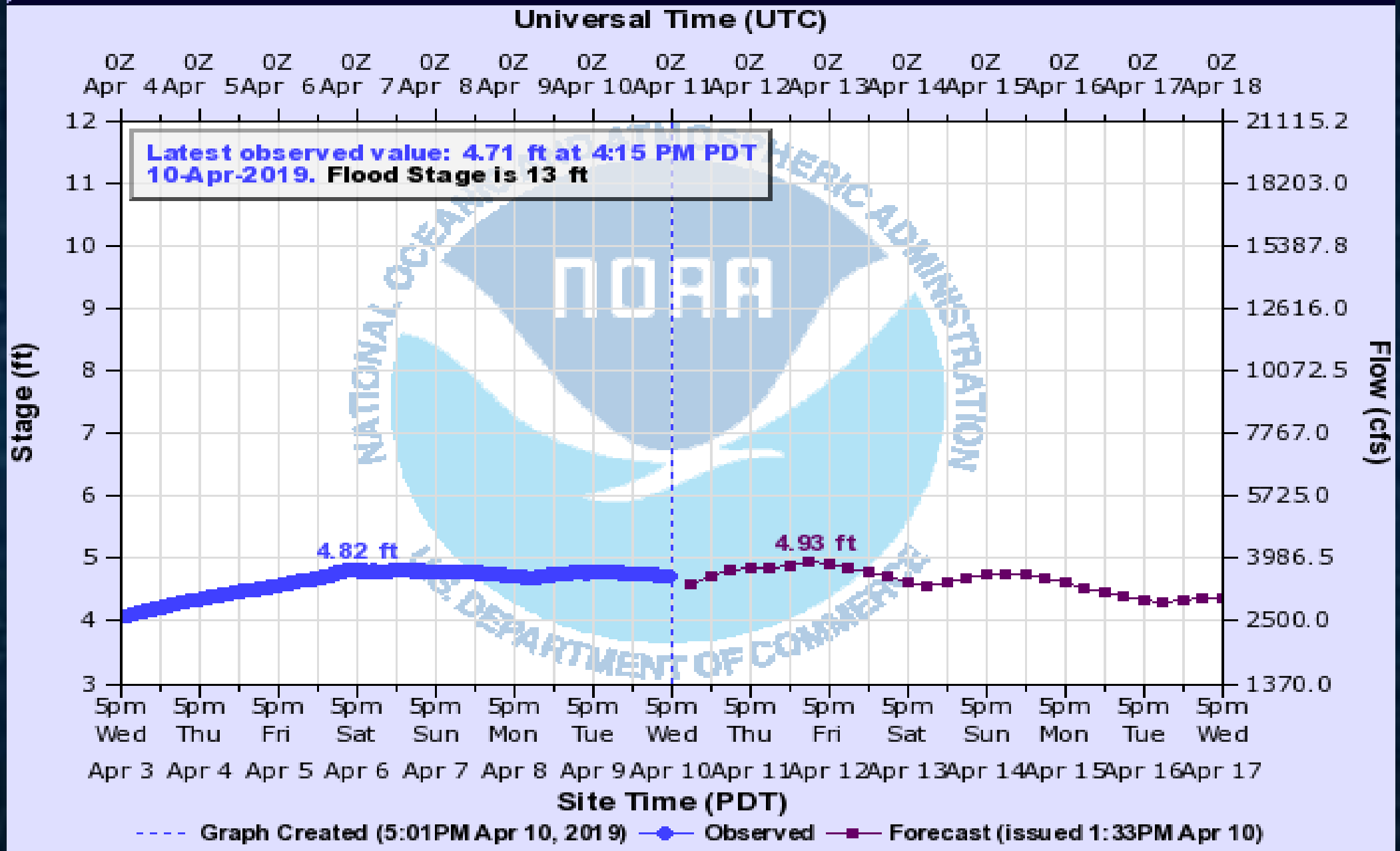
0.3(40%) + 0.3(80%) + 0.3(90%) = .63

0.1(90%) + 0.1(85%) + 0.2(65%) = .18



- Scheduled release: April 16 & 17
- Optimized release: April 18 & 19

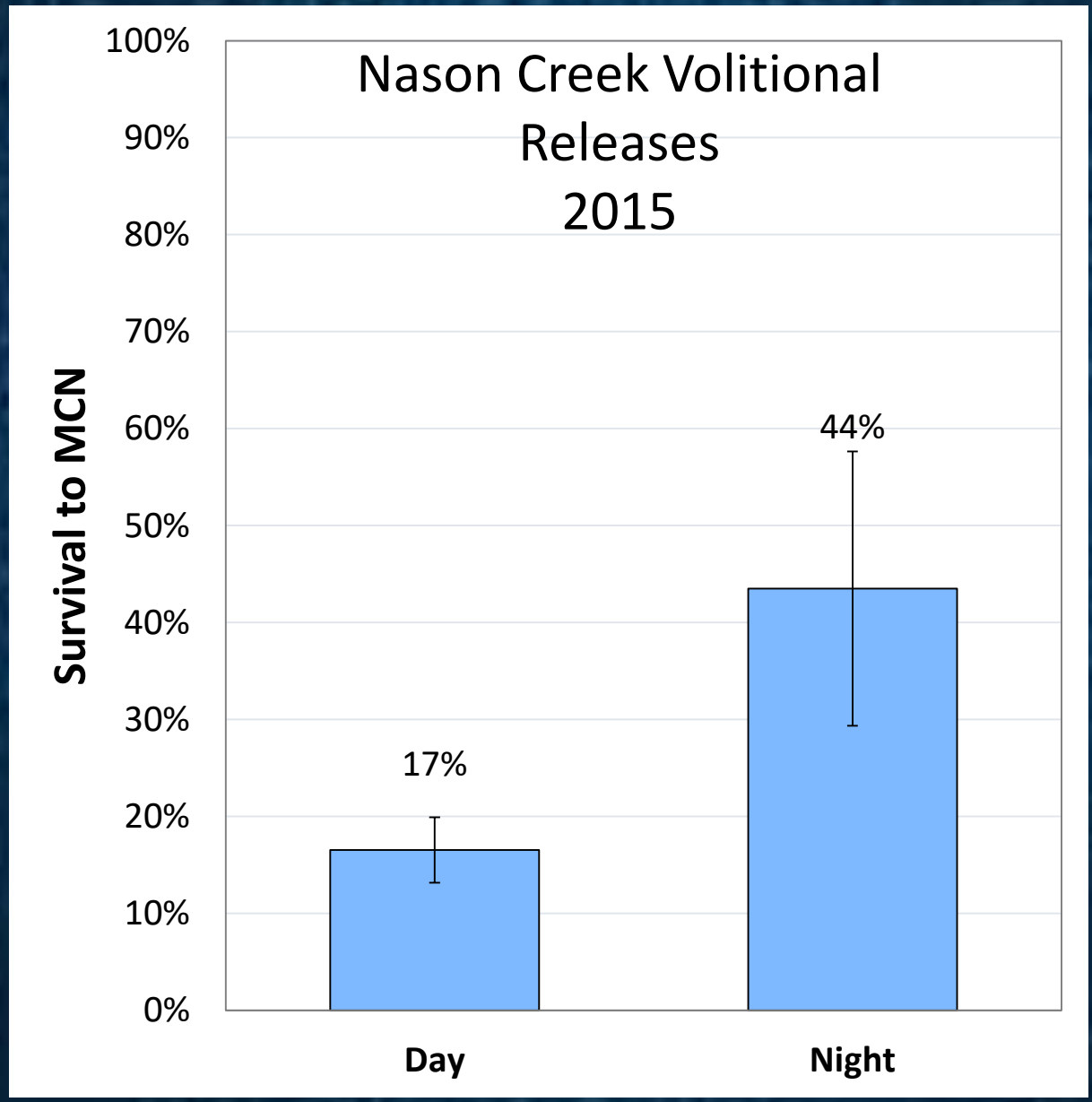
WENATCHEE RIVER AT PESHASTIN



PESW1(plotting HGIRG) "Gage 0" Datum: 1028.04'

Observations courtesy of US Geological Survey

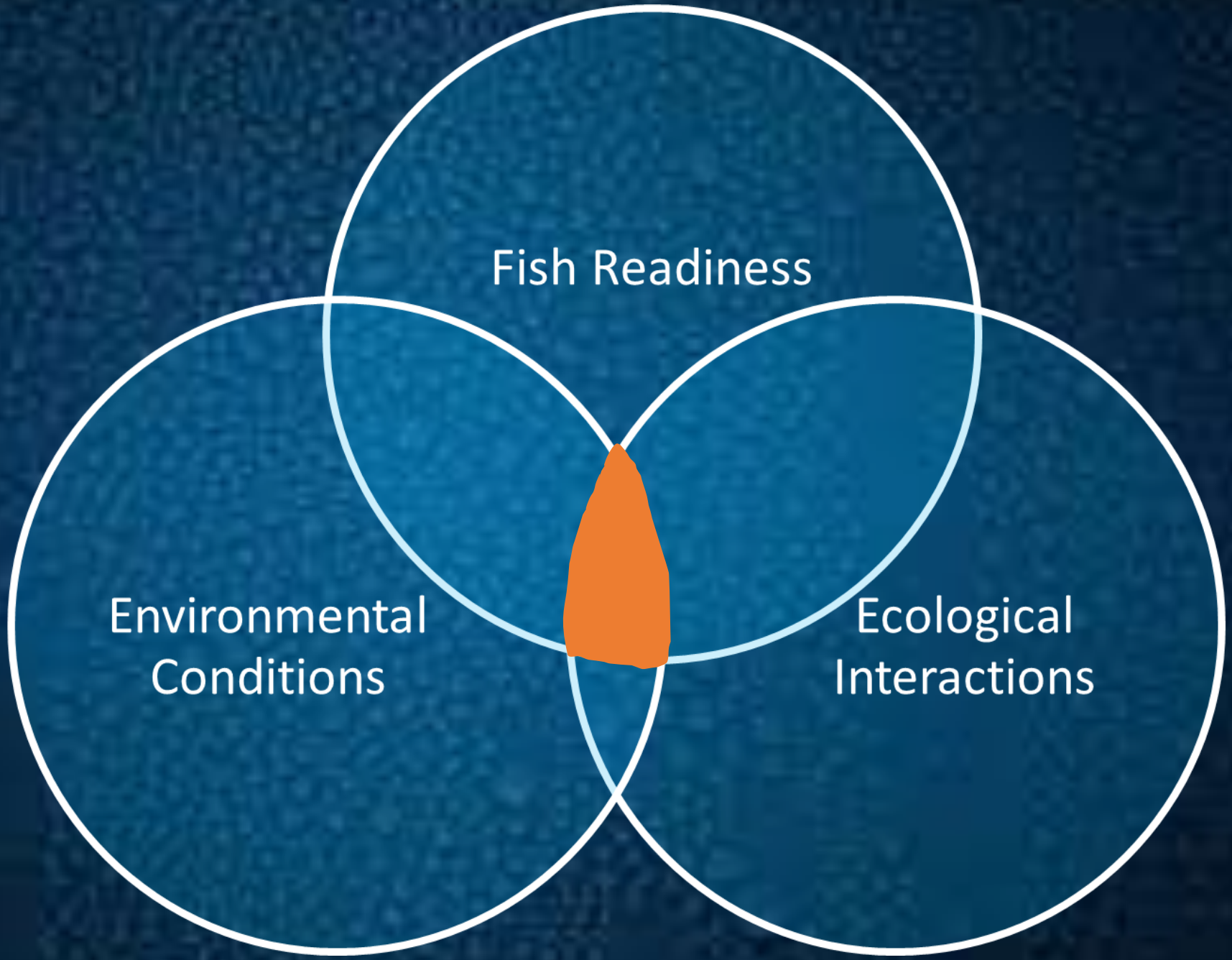
Survival to McNary: Volitional by Hour (2015)



Work in Progress

- ✓Model is not parameterized (spCh, suCh, fCh)
- ✓Two years of alternative releases done, three more replicates
- ✓Monitoring survival for Nason Creek (spCh), Carlton (suCh)
- ✓More retroactive analyses

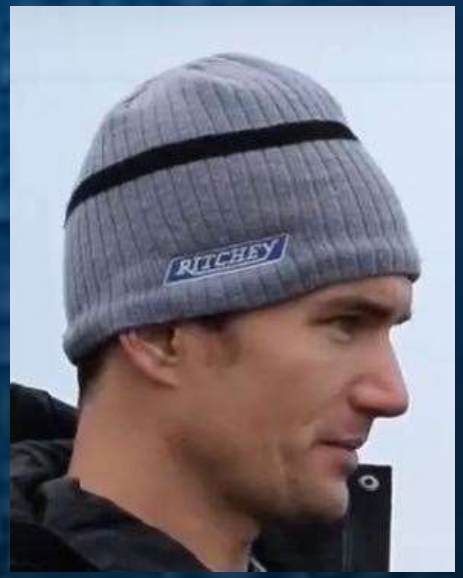
Conclusion


Fish Readiness
Environmental Conditions
Ecological Interactions

Acknowledgments

Todd Pearsons, Ph.D.
Senior Fisheries Scientist
Grant County Public Utility District

Peter Graf
Fisheries Scientist
Grant County Public Utility District



Grant County
PUBLIC UTILITY DISTRICT