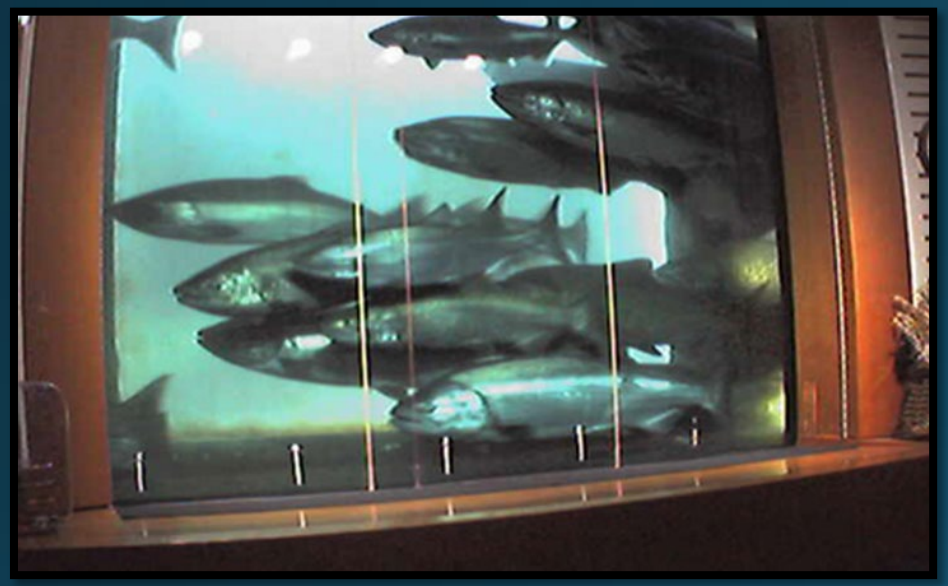
Improving abundance estimates for Snake River spring/summer Chinook Salmon



Chris Sullivan

December 14, 2022 ISRP Review

Objective: Highlight technologies that are advancing our ability to manage Chinook Salmon

- Parentage based tagging
- Run reconstruction
- Harvest monitoring
- Integrated program management
- Stray and PIT monitoring enhancements
- Broodstock composition and trait heritability
- Evaluation of unmarked releases

Background: The M&E Toolbox

Dam Counts

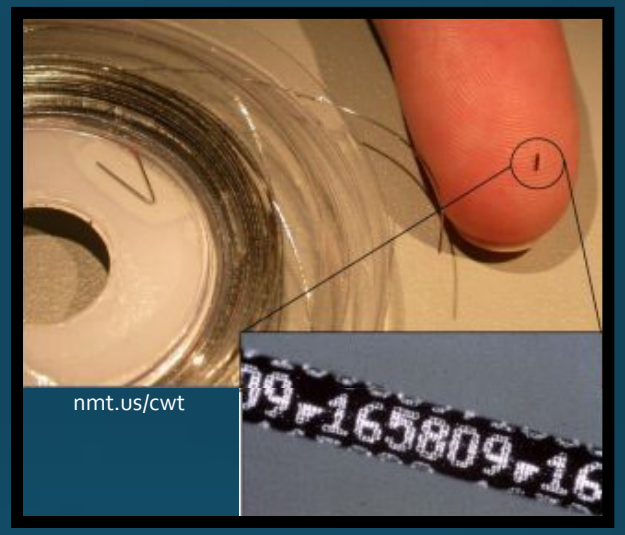
Abundance

Age composition

Run timing

External Marking

Origin (hatchery/natural)



CWT's

Age, stock, release site

Origin (hatchery/natural)

Abundance

Stray detection

PIT Tags

Age, stock, release site

Juvenile survival

Stock-specific run timing

Travel time

Abundance

Conversion rates

Stray detection

Fallback/re-ascension rates

The M&E Toolbox - Parentage based tagging

Age, stock, release site

Origin (Hatchery/Natural)

Abundance

Stray detection

pHOS/pNOB/PNI

The M&E Toolbox - Parentage based tagging

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pHOS/pNOB/PNI

Bonneville and Lower Granite Dam

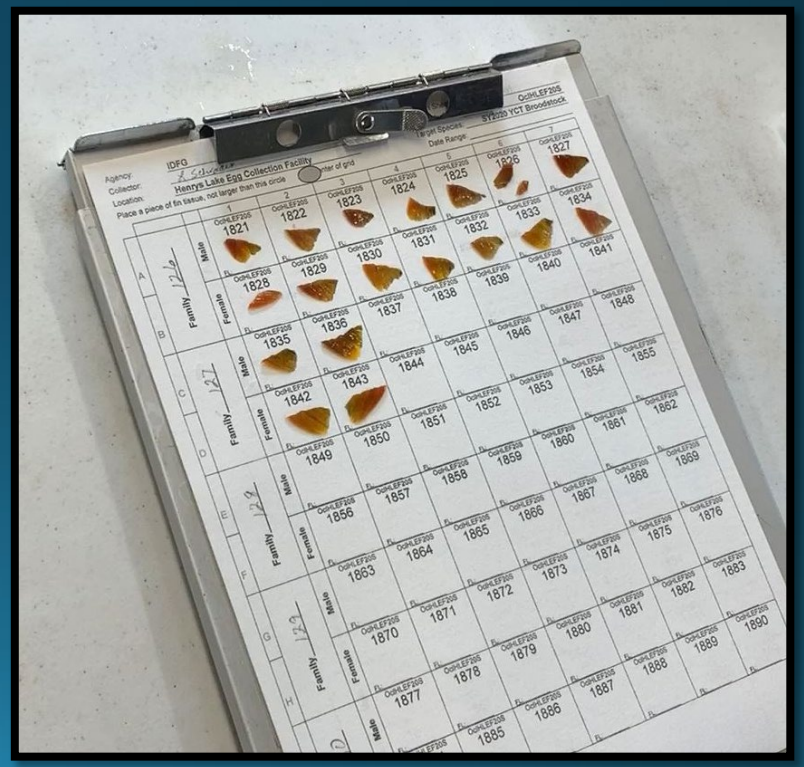
Fisheries

Hatchery weirs/traps

Spawning grounds

Parentage based tagging background

- Parentage-based tagging implemented in Snake R Basin in 2008
  - First sampling of adult returns in 2012
- All hatchery fish are "tagged" by genotyping parents at the time of spawning
- Cost-effective means to achieve high tagging rate
  - Typically > 95% tag rate
- Increased recovery of "tagged" fish
- PBT program reviewed by ISRP in 2021
  - Project # 2010-031-00



Run Reconstruction

- LSRCP project area escapement goals measured at Lower Granite Dam

Run Reconstruction

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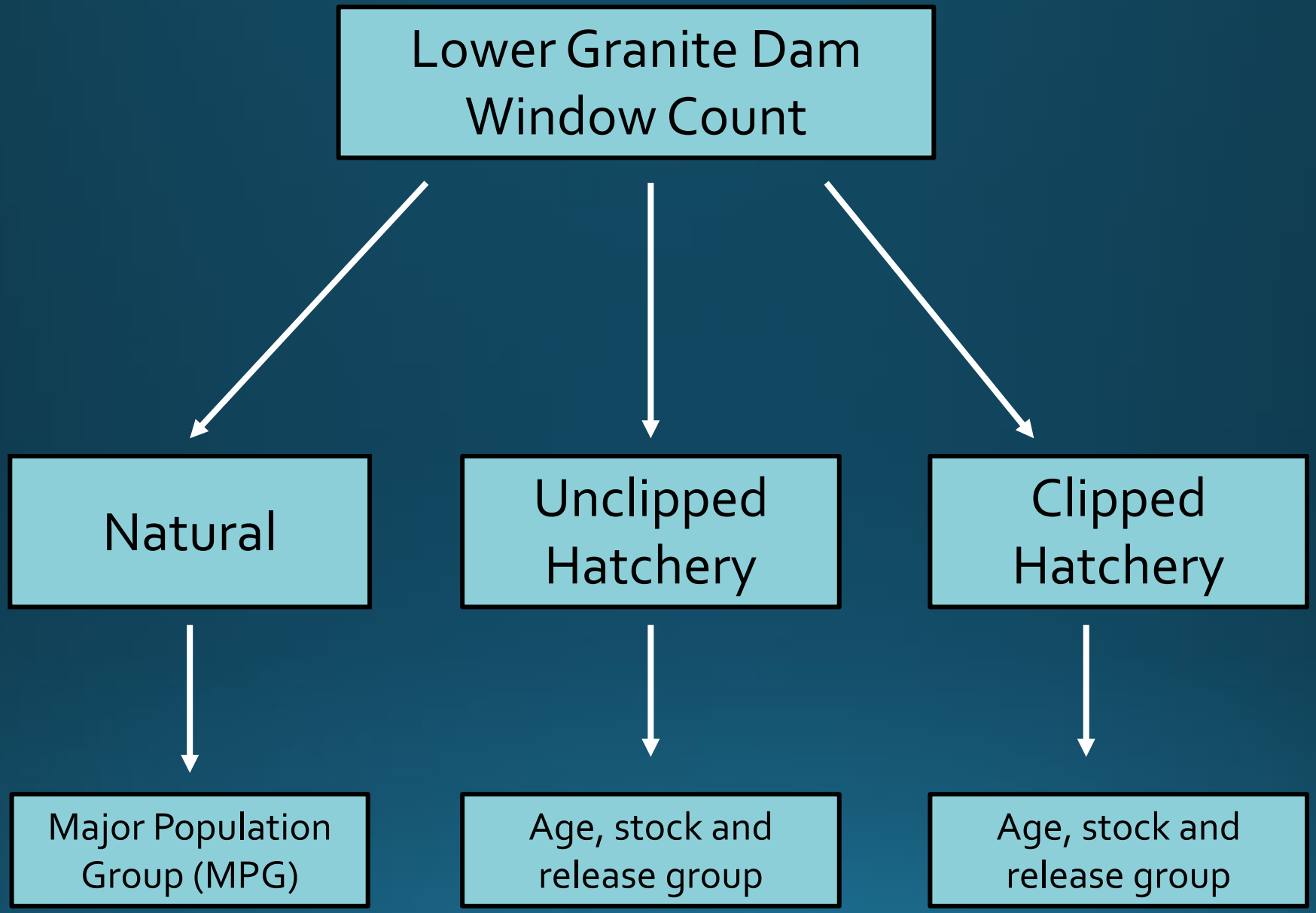
- Traditional = Harvest + Hatchery Returns + Spawning Ground Escapement

Run Reconstruction

- LSRCP project area escapement goals measured at Lower Granite Dam
- Traditional = Harvest + Hatchery Returns + Spawning Ground Escapement
- PBT allows direct estimates to be made at Lower Granite Dam

Run Reconstruction: Escapement at LGR using PBT

- Lower Granite Dam adult trap is operated 5 days/week throughout the adult migration
- Fin tissue is collected from all unclipped Chinook that are trapped (~ 20% sample rate)
- Fin tissue is collected from a subsample of the clipped hatchery fish trapped (2-8% sample rate)
- DNA is extracted from fin tissue for PBT/GSI analysis


Lower Granite Dam Window Count
Natural
Unclipped Hatchery
Clipped Hatchery
Major Population Group (MPG)
Age, stock and release group
Age, stock and release group

Advantages of using PBT for estimating abundance at LGR

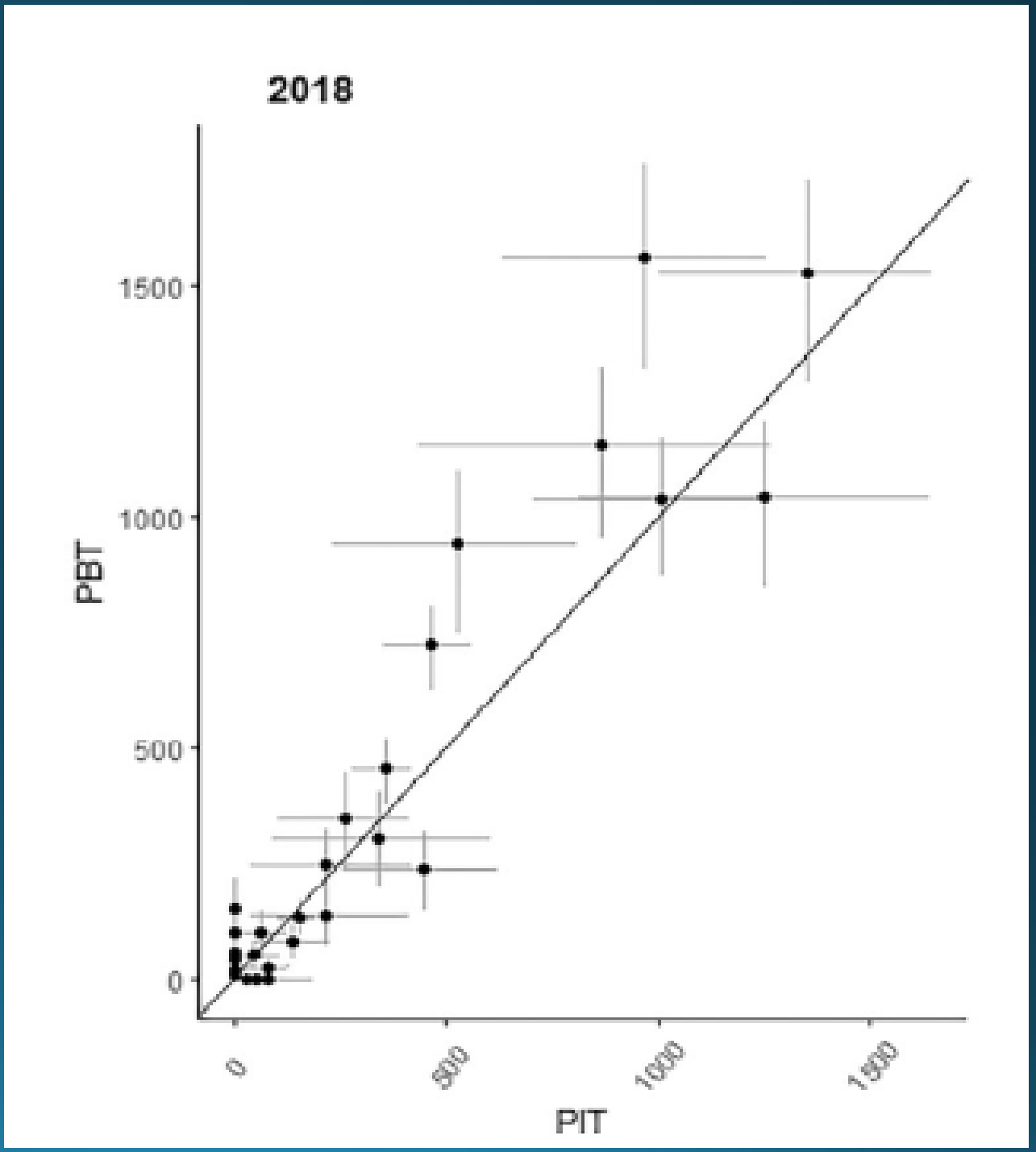
- High tagging rates
- Non-lethal tag recovery
- No tag loss or differential mortality
- Ability to estimate abundance of groups with few/no PIT tags
  - Parr releases, integrated programs, egg box programs
- Not subject to the potential biases associated with traditional run reconstruction (harvest estimates, carcass recovery)
- Accounts for the escapement and mortality that is not accounted for in traditional run reconstruction

Current limitations of using PBT for estimating abundance at LGR

- Lacks precision for small populations (<500 individuals)
  - Most of the NE Oregon programs
- Longer reporting/identification time as samples are processed
- Potential impacts from trap shutdowns (mechanical, global pandemics)

Comparing Abundance Estimates - Hatchery

- Coykendall et al. 2022 compared stock/age based estimates @ Lower Granite Dam using PIT tags and PBT
- PIT tag estimates are lower than PBT-based estimates
  - Tag loss and differential mortality



Comparing Abundance Estimates - Hatchery

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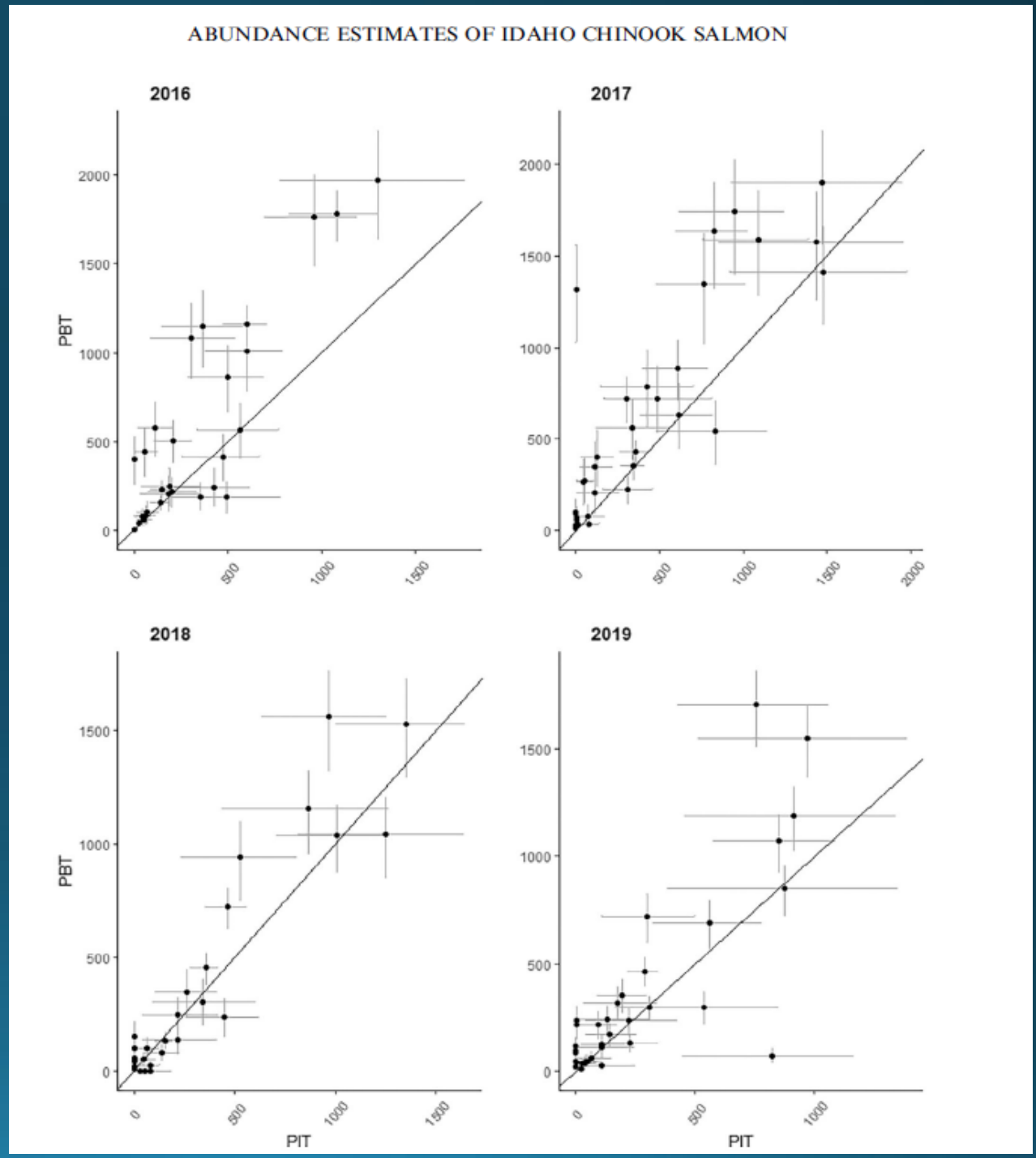
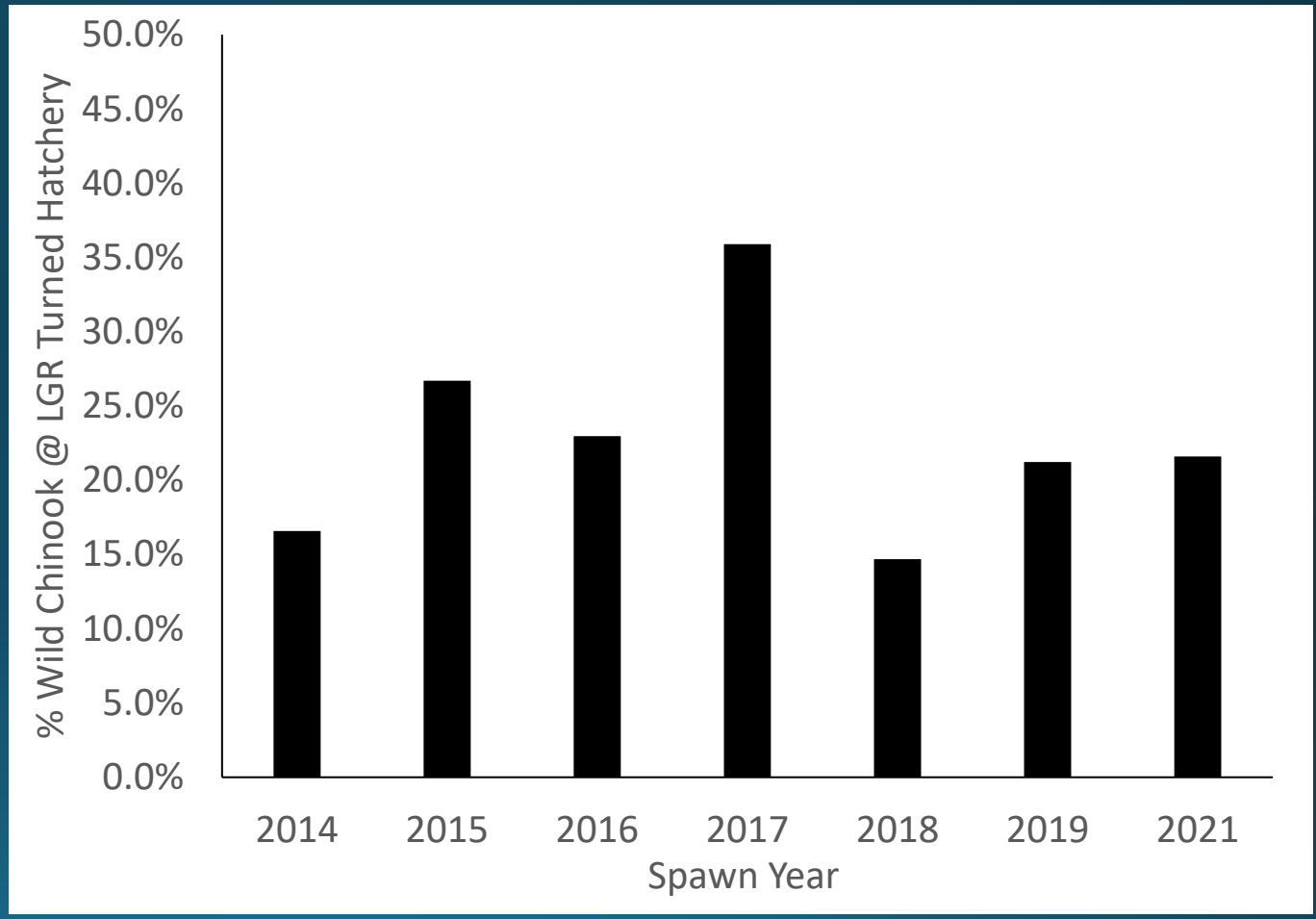
  - Consistent pattern through time



Comparing Abundance Estimates - Natural

- Genetic-informed corrections for undetected unclipped hatchery fish at Lower Granite Dam
  - Tag loss
  - CWT scanning error
  - Mis-clipped hatchery fish
  - Fish released with no mark/tag



Harvest Monitoring – stock composition

- Evaluation of stock composition in mixed-stock fisheries
  - Clearwater River basin (NPTH, Clearwater, Dworshak, Kooskia hatcheries)
  - Lower Salmon River (Rapid River, McCall, Pahsimeroi, Sawtooth)
- High PBT tagging rates result in robust sample numbers over CWT
- Increased harvest monitoring program efficiency

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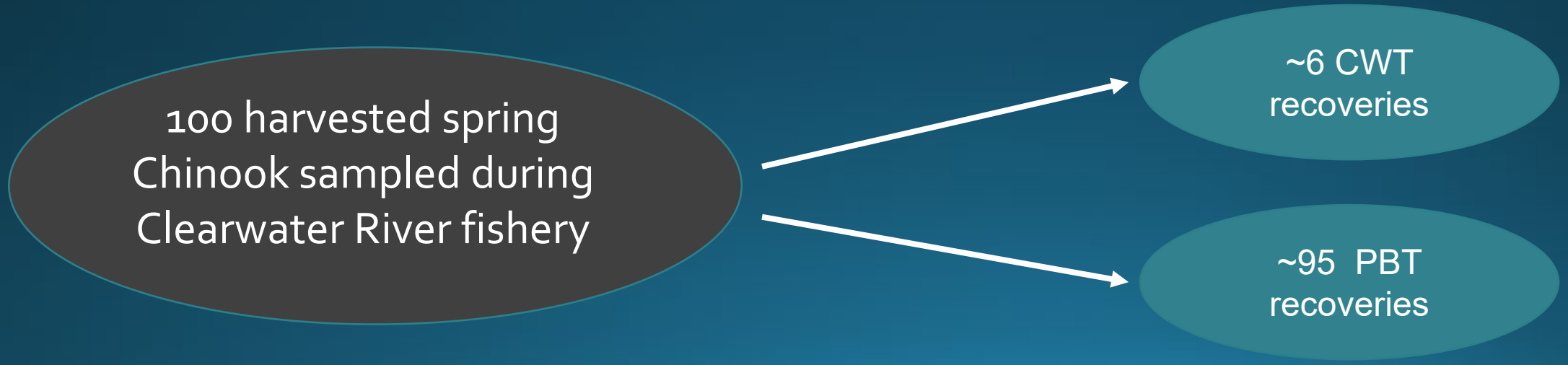

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- In-season harvest share adjustments

Harvest Monitoring – in-season management

- Mid-season processing of genetic samples collected at Lower Granite
- Allows us to "correct" PIT tag expansion rates in real-time for some stocks
  - Clearwater Basin
  - Lower Salmon/Little Salmon rivers
- Results in increased harvest and fishery duration in some years

Harvest Monitoring – in-season management

Year	PIT-based Harvest Share	PBT-based Harvest Share	Harvest Share Difference	Fishery Management Changes
2017	1,231	2,173	942	4 additional weeks on Little Salmon River
2018	537	1,374	837	2 additional weeks on Lower Salmon R, 4 additional weeks on Little Salmon R
2021	1,158	1,767	609	1 additional week on Lower Salmon R, 2 additional weeks on Little Salmon R

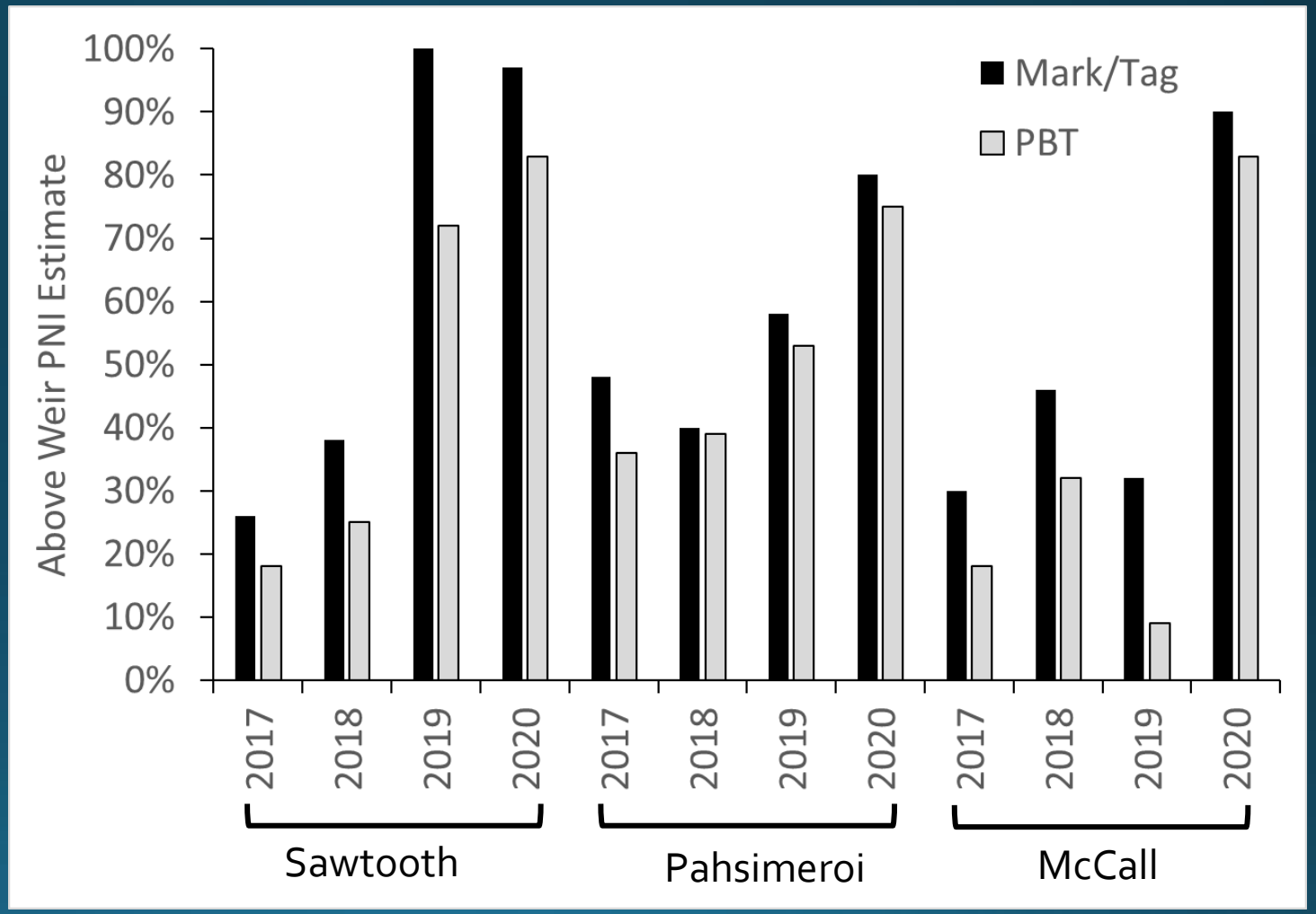
Integrated Chinook Programs

- Combination of marks and tags used for in-season weir management
  - Segregated – Adipose clip
  - Integrated – No clip, 100% CWT
  - Natural – No clip, no tag

- PBT used to estimate productivity of the natural and hatchery populations spawning naturally

Integrated Chinook Programs

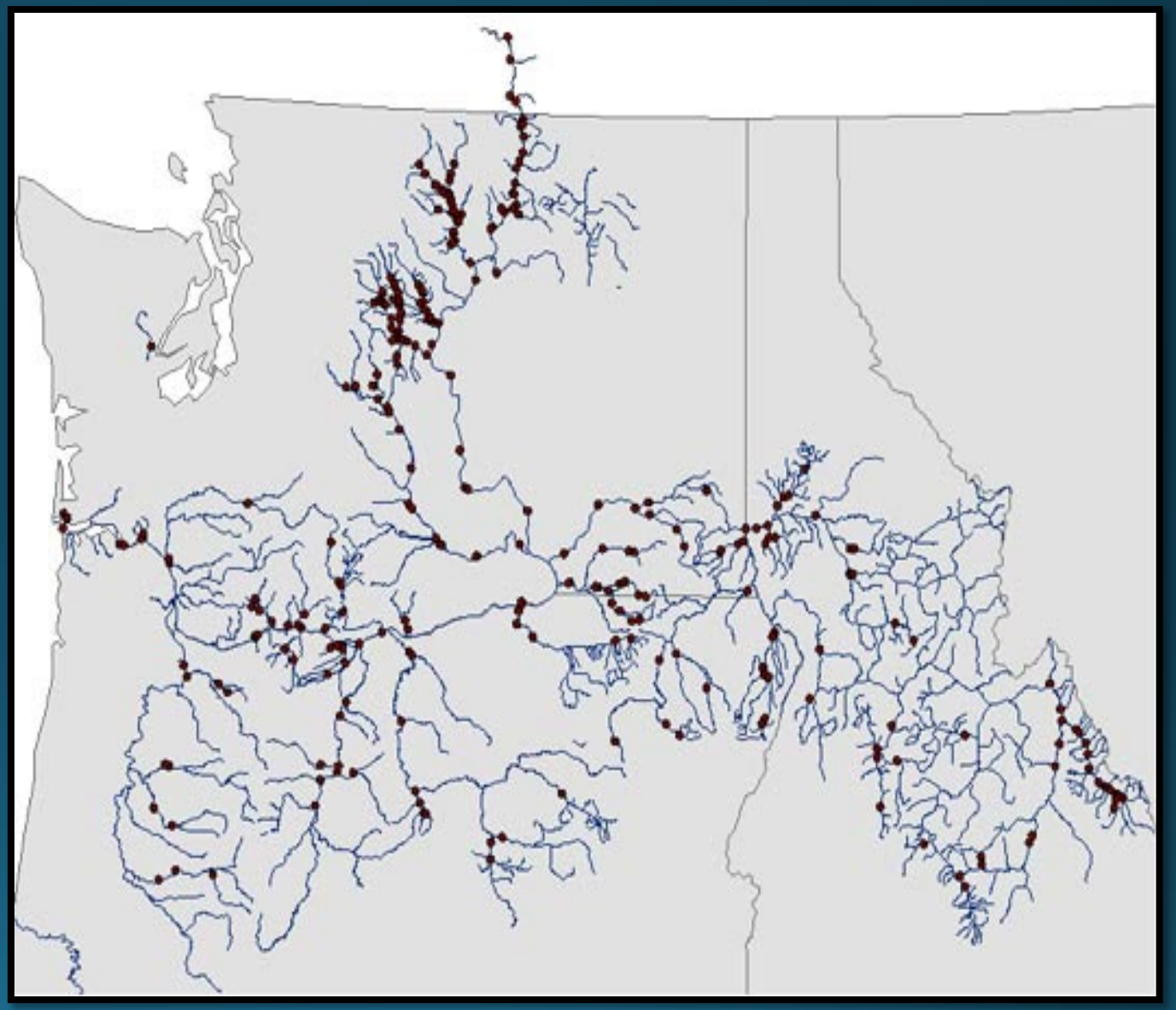
- Improved accuracy of above-weir PNI estimates using PBT
  - Shed CWT's, mis-clipped adipose fins, and CWT scanning errors



Data from Venditti et al. 2022

Stray Monitoring

- CWT's
  - Fisheries, hatchery rack, spawning ground surveys
- PIT tags
  - Increased in-stream PIT arrays



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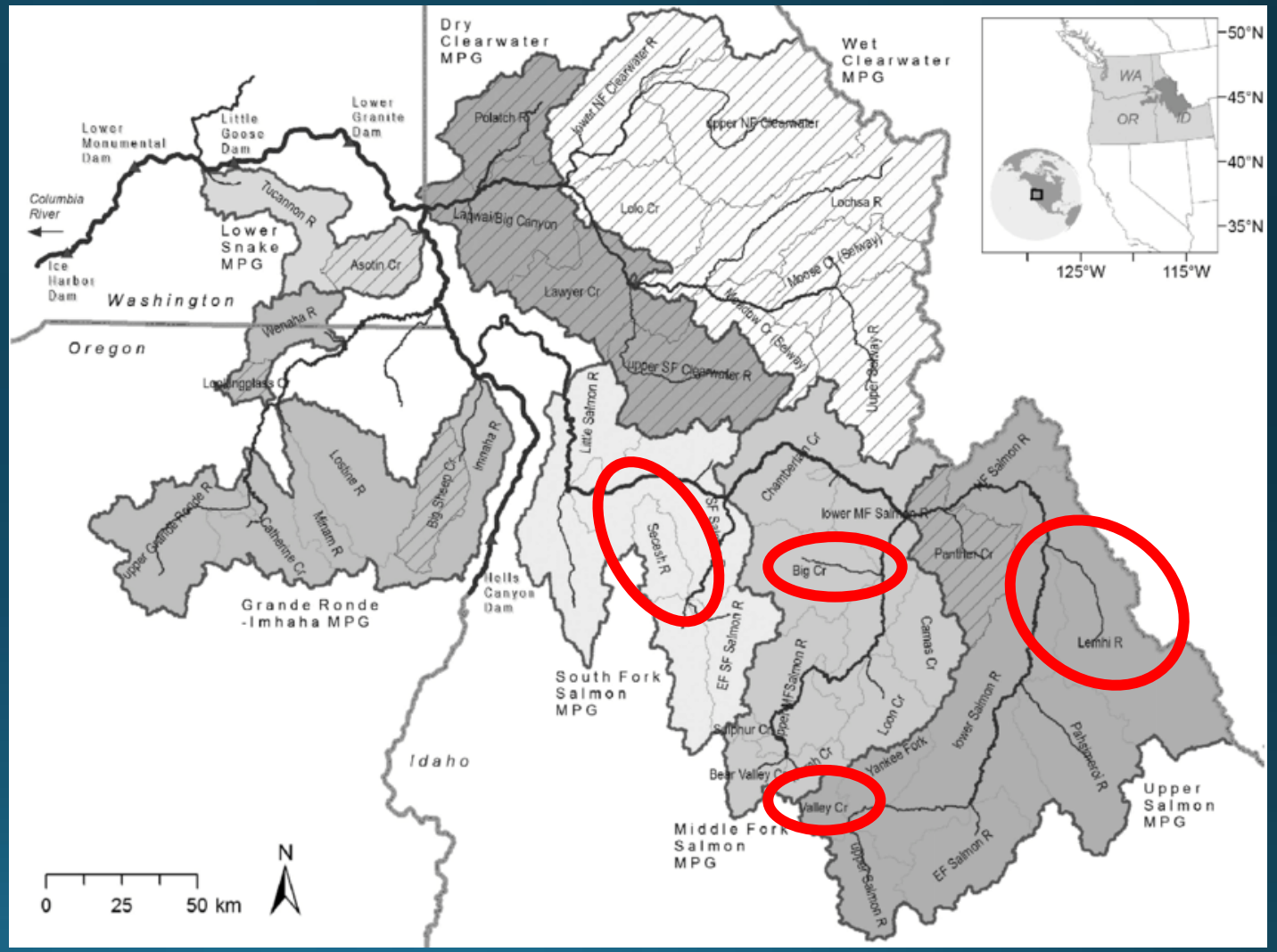

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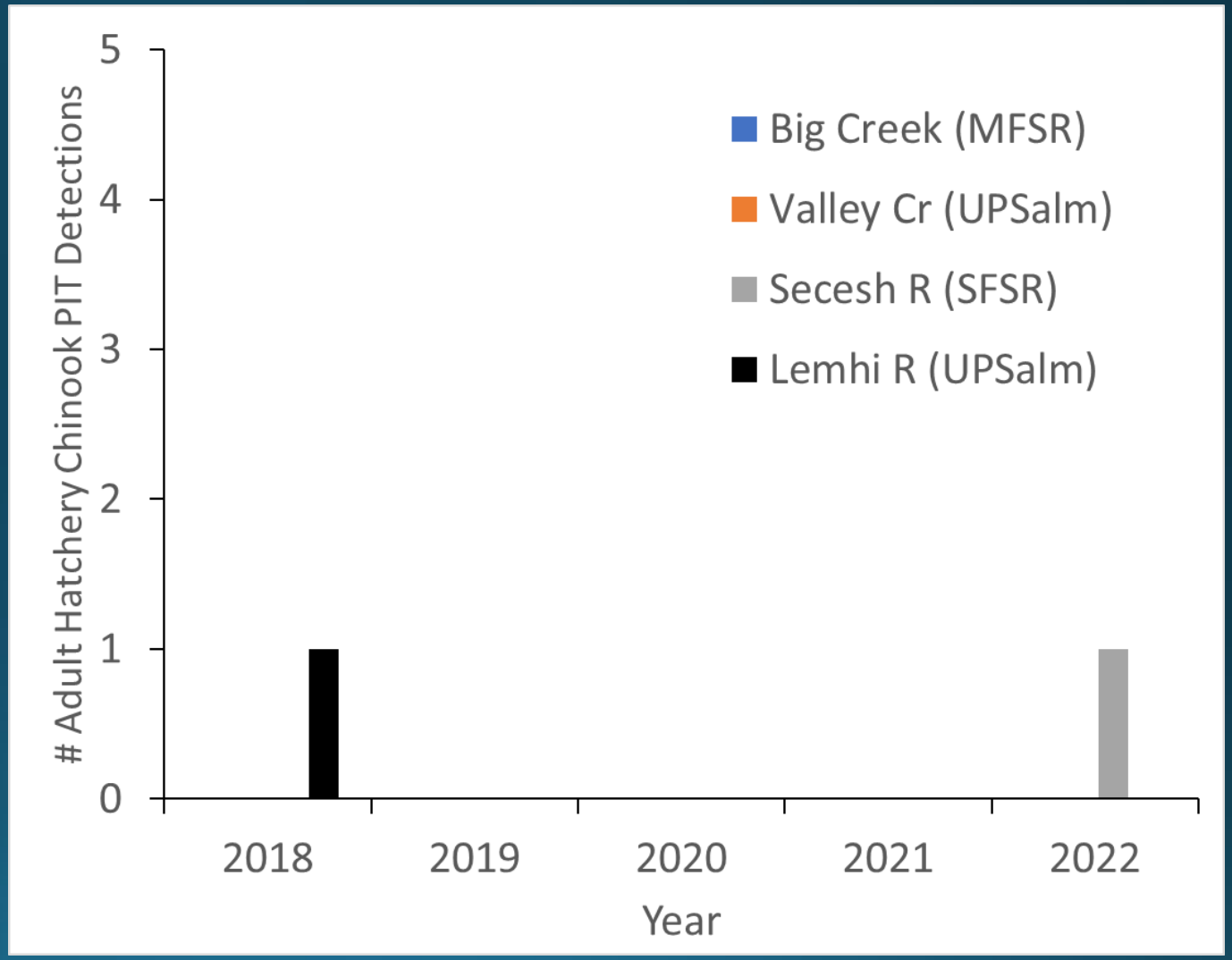
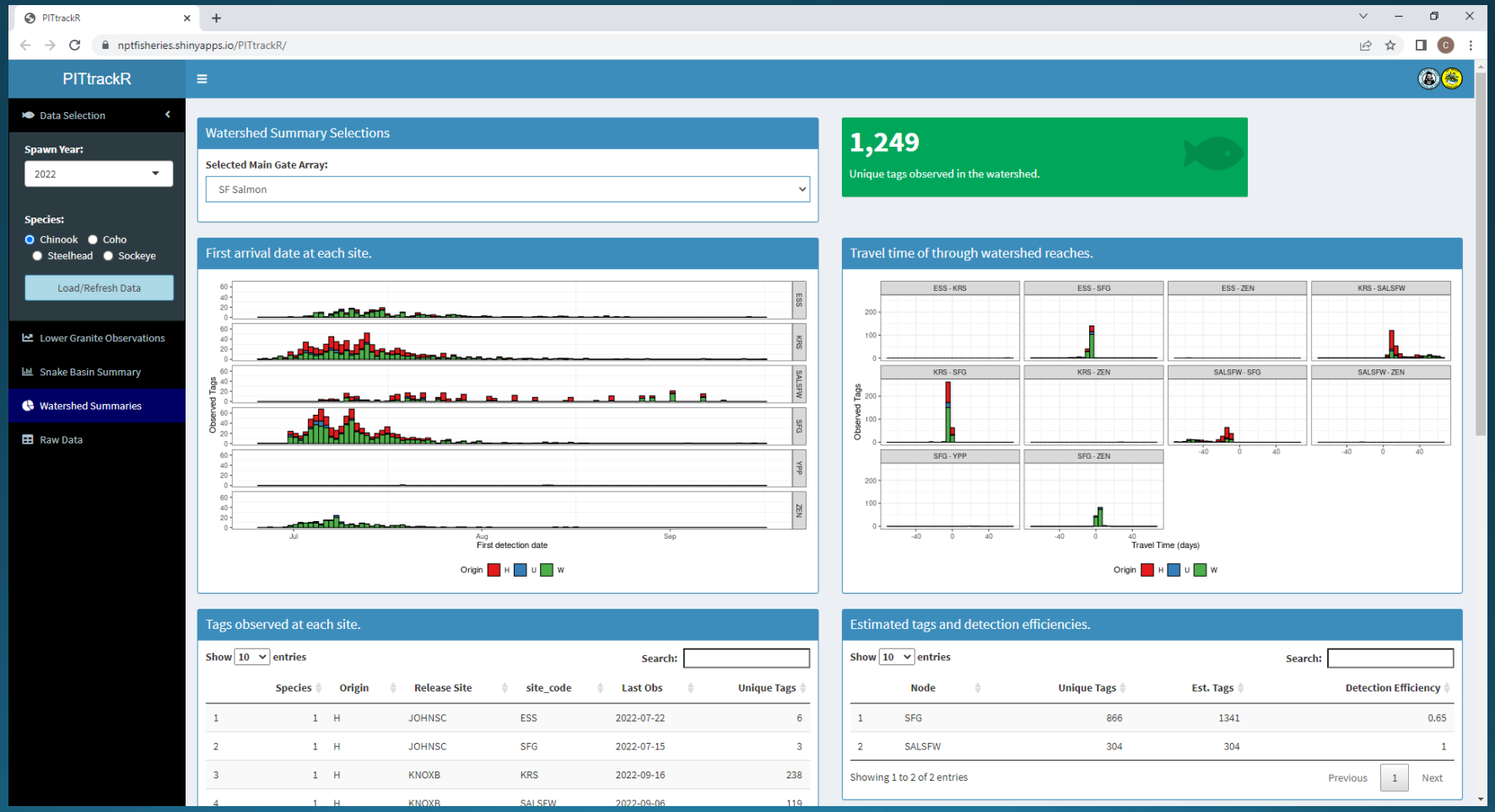


Stray Monitoring

- CWT's
  - Fisheries, hatchery rack, spawning ground surveys
- PIT tags
  - Increased in-stream PIT arrays
- PBT
  - 10,000+ adults sampled annually for broodstock

PIT tag tools – PITtrackR

- Tool developed by the Nez Perce Tribe
- Data from PTAGIS
- R Shiny App



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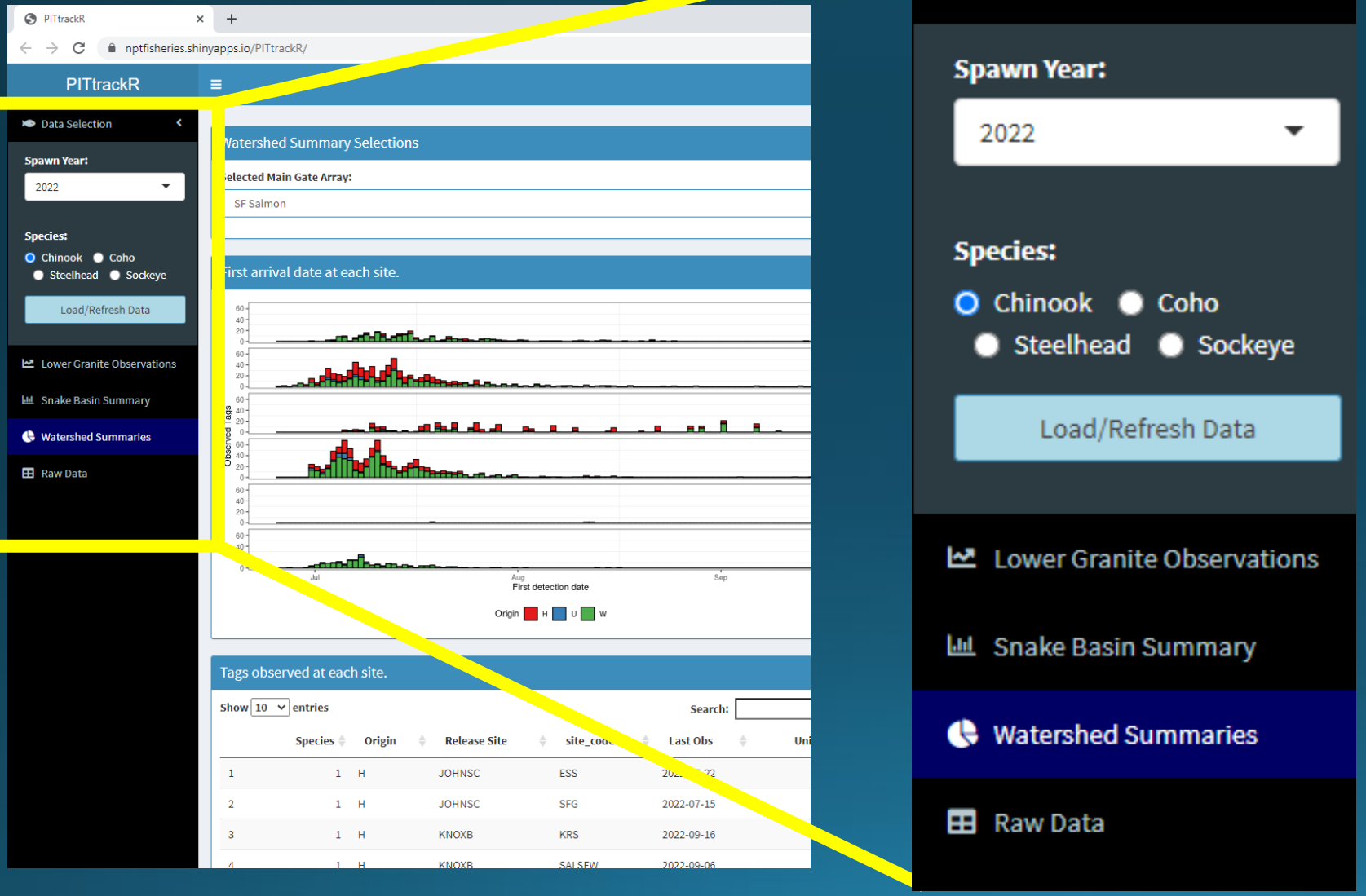

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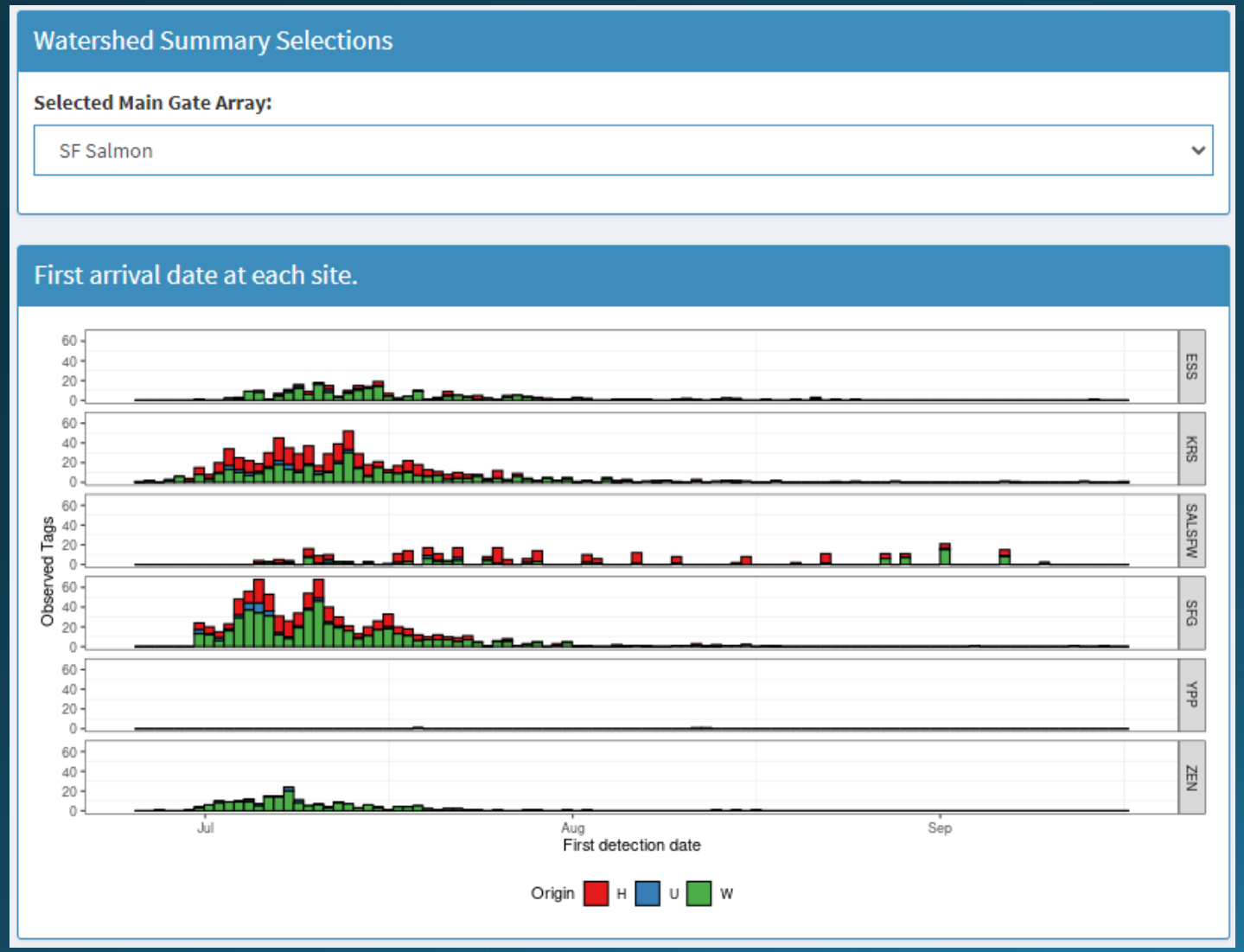


PIT tag tools – PITtrackR

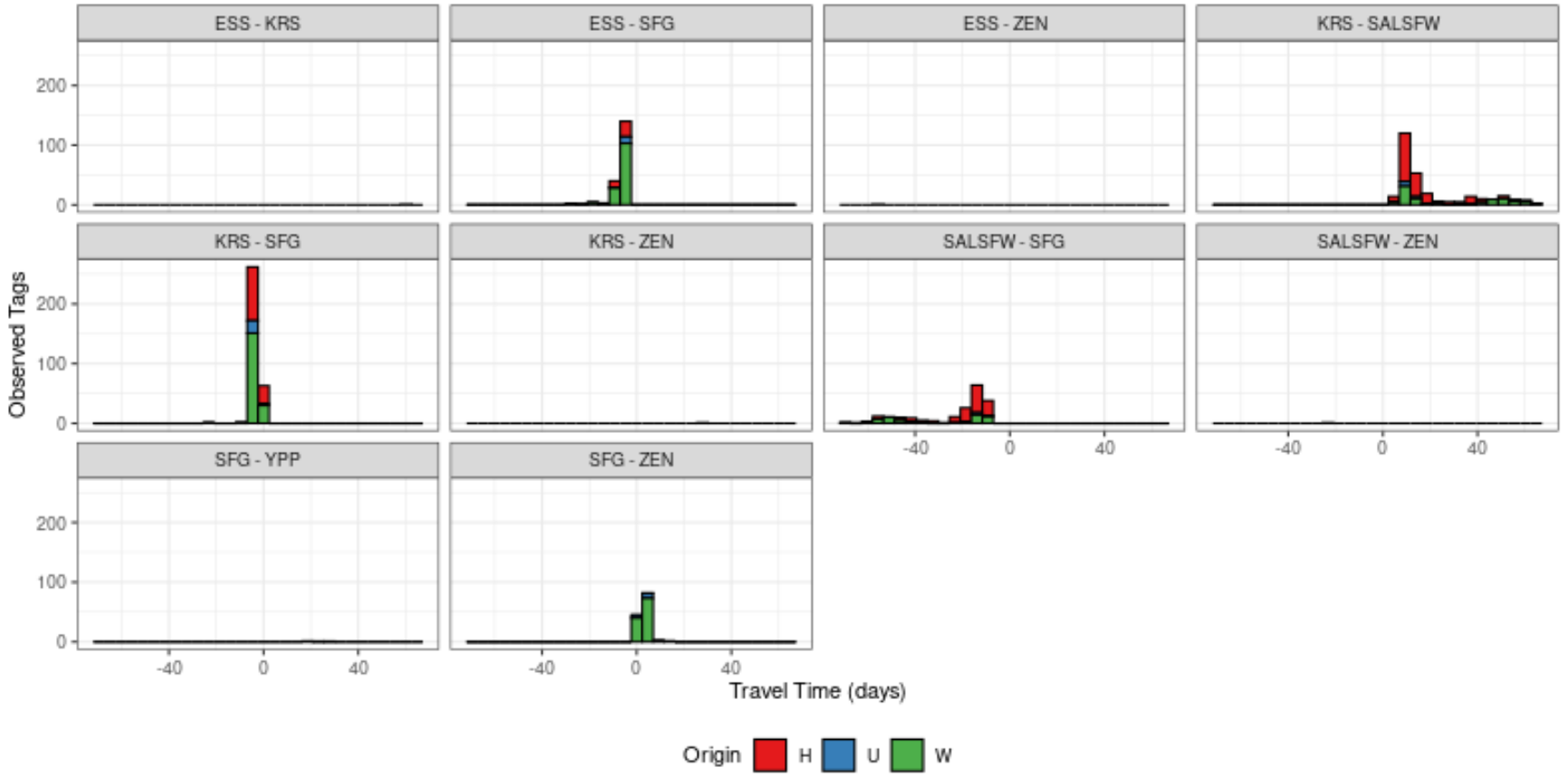
Watershed Summary Selections

Selected M

SF Salmo

First arriv

Travel time of through watershed reaches.



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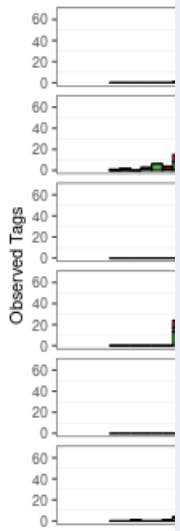
Selected Main Gat

SF Salmon

First arrival da



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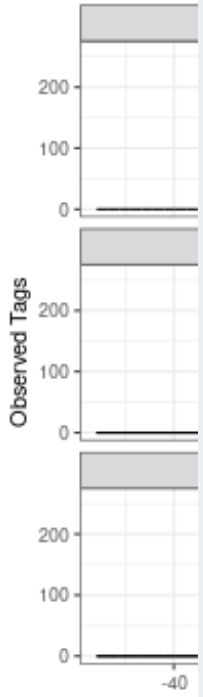

Tags observed at each site.

Show 10 entries

Search:

	Species	Origin	Release Site	site_code	Last Obs	Unique Tags
1	1	H	JOHNSC	ESS	2022-07-22	6
2	1	H	JOHNSC	SFG	2022-07-15	3
3	1	H	KNOXB	KRS	2022-09-16	238
4	1	H	KNOXB	SALSFW	2022-09-06	119
5	1	H	KNOXB	SFG	2022-09-15	180
6	1	H	KNOXB	YPP	2022-08-12	2
7	1	H	KNOXB	ZEN	2022-07-11	1
8	1	H	LGRLDR	ESS	2022-08-21	48
9	1	H	LGRLDR	KRS	2022-09-06	116
10	1	H	LGRLDR	SALSFW	2022-09-06	76

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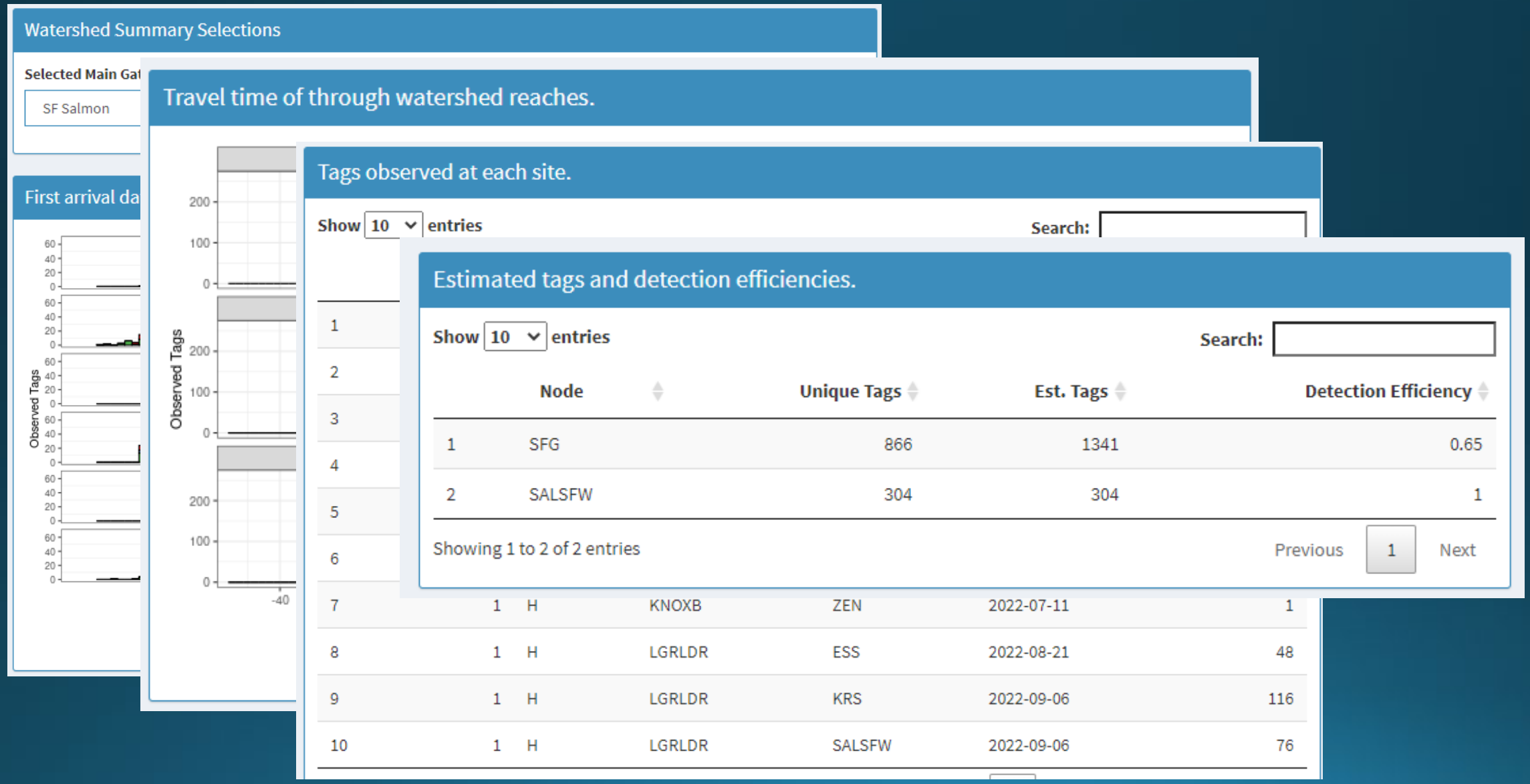

Broodstock evaluations

- Trait heritability
- Stock/age composition
- Stray detection

Evaluation of unmarked releases

- PBT enables previously unmarked releases to be evaluated
  - Egg outplants
  - Parr/presmolt releases

Photo credit: Nez Perce Tribe

Photo credit: Nez Perce Tribe

Evaluation of unmarked releases

- PBT enables previously unmarked releases to be evaluated
  - Egg outplants
  - Parr/presmolt releases
  - Contributions from adult outplants

Photo credit: Nez Perce Tribe

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Looking ahead…

- Single parent and grandparent analysis
  - Improved ability to estimate pHOS
- Expansion of PBT region-wide
  - Ocean and non-tribal fishery below Bonneville Dam
- Improving sampling program at Bonneville Dam AFF

Acknowledgements

- Hatchery staffs – the other marking crew
- Eagle and CRITFC genetics labs
- Harvest monitoring staff
- IDFG and NPT M&E staff
- Marking crews
- Funders (LSRCP, Idaho Power Company, BPA)

Questions?