Integrating tools to manage steelhead fisheries

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Photo Credit: Bill McMilla

Managing Steelhead Fisheries

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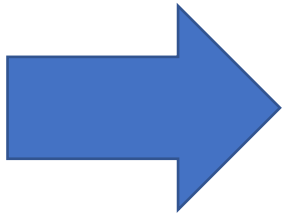
Why the need to change?

- Range-wide Declines in Abundance
- Endangered Species Act
- Treaty-Tribal co-management, harvest sharing, and reconciliation
- Increasingly diverse goals of stakeholders

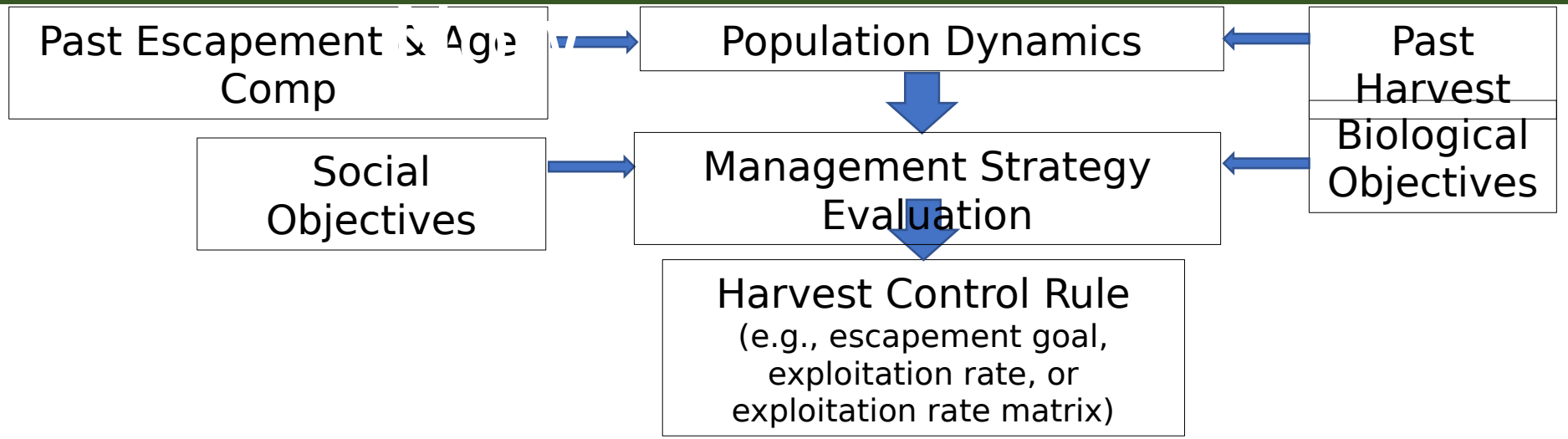


Need for management approach that:

- is scientifically rigorous
- is transparent
- is collaborative
- can quantify diverse tradeoffs and risks (e.g., conservation and fishing opportunity)
- enables in-season changes to ensure goals are met

Managing Steelhead Fisheries

Planning Fisheries



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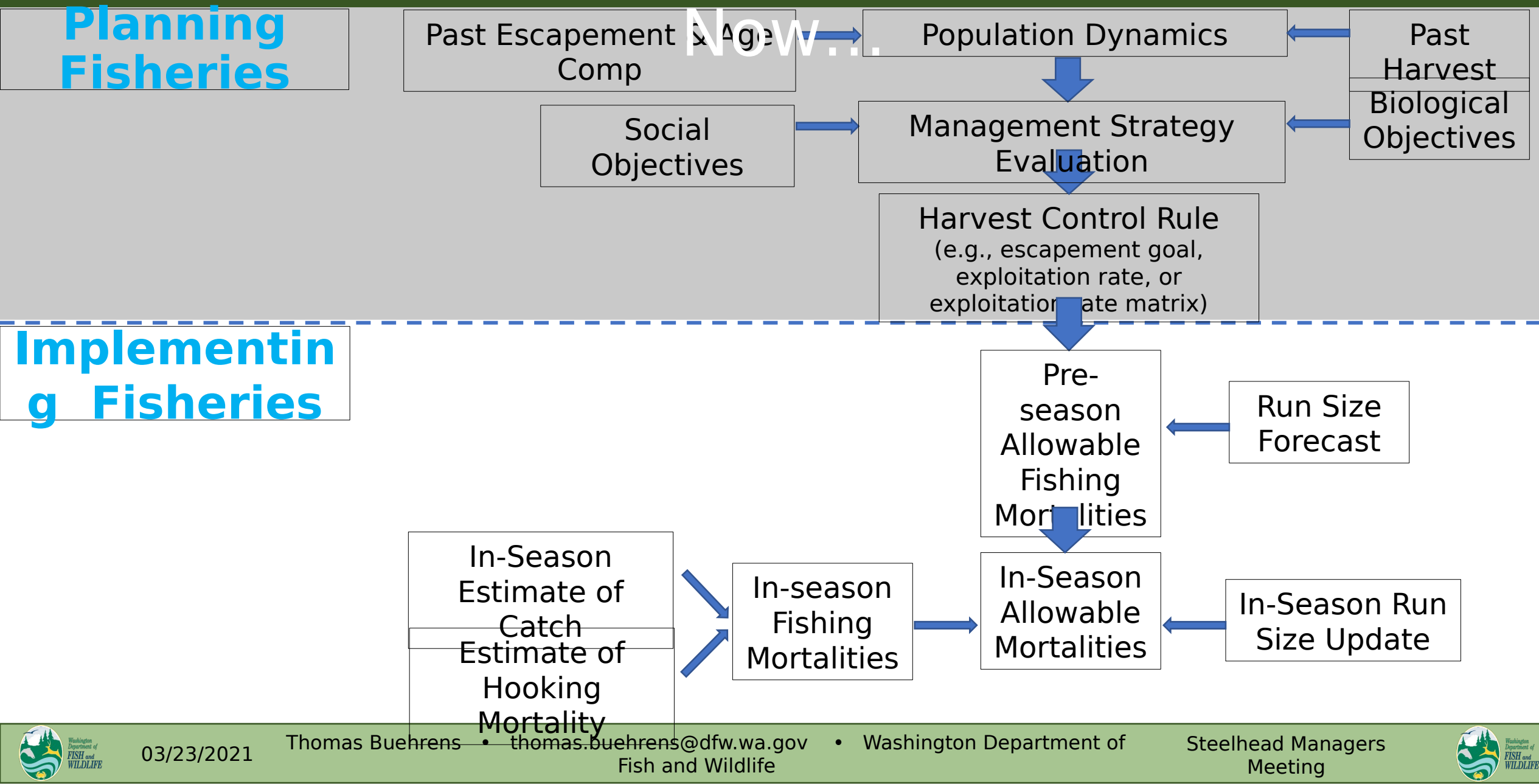

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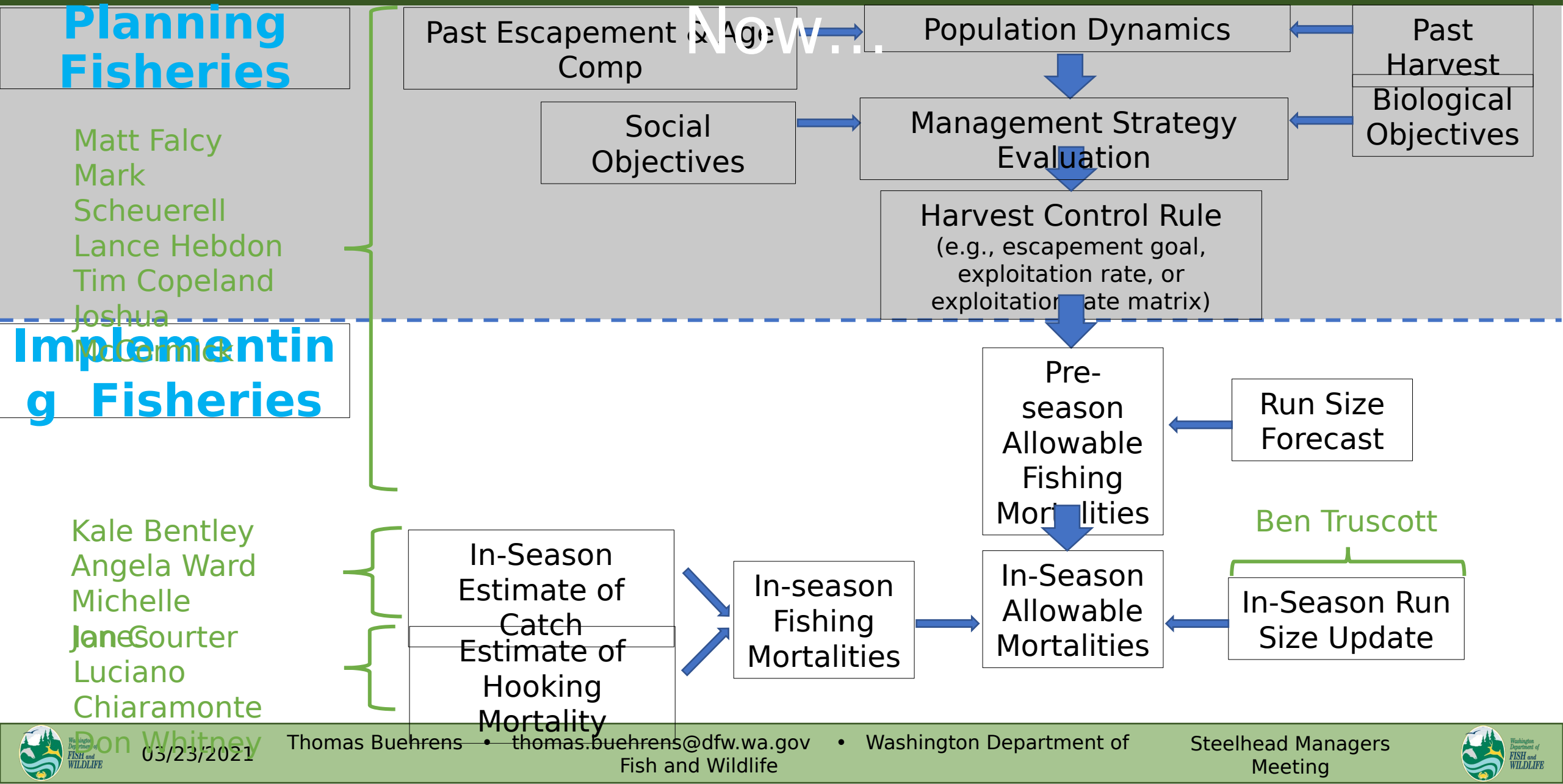


How do we pull this all together?

An Example: the Skagit Winter Steelhead C&R Fishery

- Closed due to ESA in 2009
- Reopened in 2018 after NOAA approved Resource Management Plan (RMP)
- All wild; no hatcheries
- Winter-Spring sport C&R fishery
- Co-management and fishery impact sharing with three treaty tribes

Resource Management Plan

Goal: identify harvest control rule that will maximize opportunity while not substantively reducing the population's ability to meet four conservation reference points relative to a no-fishing alternative

- Used population dynamic model to conduct viability analysis & explore effects of proposed fisheries
- Established exploitation rate ceiling matrix

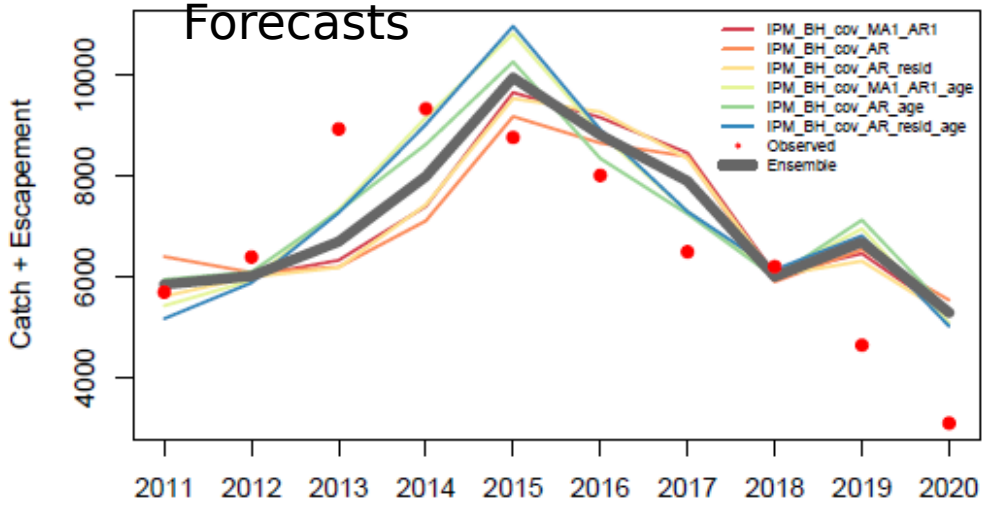
Minimum Run Size	Maximum Run Size	Exploitation Rate
0	4000	0.04
4001	6000	0.10
6001	8000	0.20
8001	∞	0.25

- Established 10% as assumed sport C&R mortality rate
- Therefore, sport fishing mortality = catch * 10%

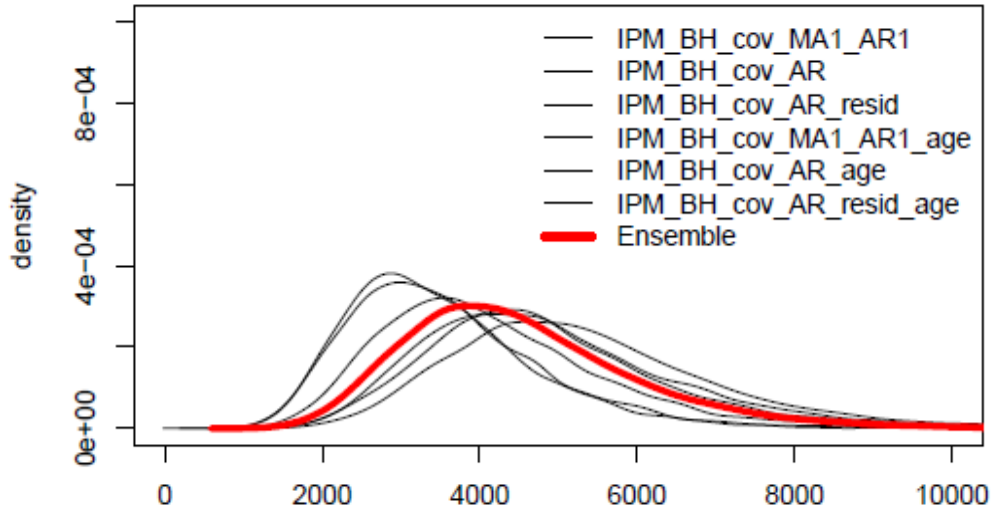
Pre-Season Forecast

- Used IPM model presented by Mark Scheuerell earlier today
- Included 6 variations of model with different time-series error structure for age comp and recruitment residuals
- Evaluated model performance using 10 years of one-step ahead forecasts
- Developed model-averaged “ensemble” forecast using “Leave-Forward-Out Information Criterion”

10 Years of One-Step Ahead Forecasts



2021 Run Size Forecasts



Ensemble Forecast

Run Size	Percentile
2283	2.5
3470	25.0
4297	50.0
5322	75.0
8166	97.5

What is the allowable harvest/fishing mortality?

- Within a harvest rate bin, the allowable harvest varies as a function of run size:
  - Example: run size is 4-6000 and max ER = 10%
    - Runsize = 4500; Allowable Mortality = 450
    - Runsize = 5000; Allowable Mortality = 500

- But what if the run size forecast spans multiple ER bins?
  - Allowable mortality still varies proportionally to run size within a bin
  - We don’t know which ER bin is in effect!

Minimum Run Size	Maximum Run Size	Exploitation Rate
0	4000	0.04
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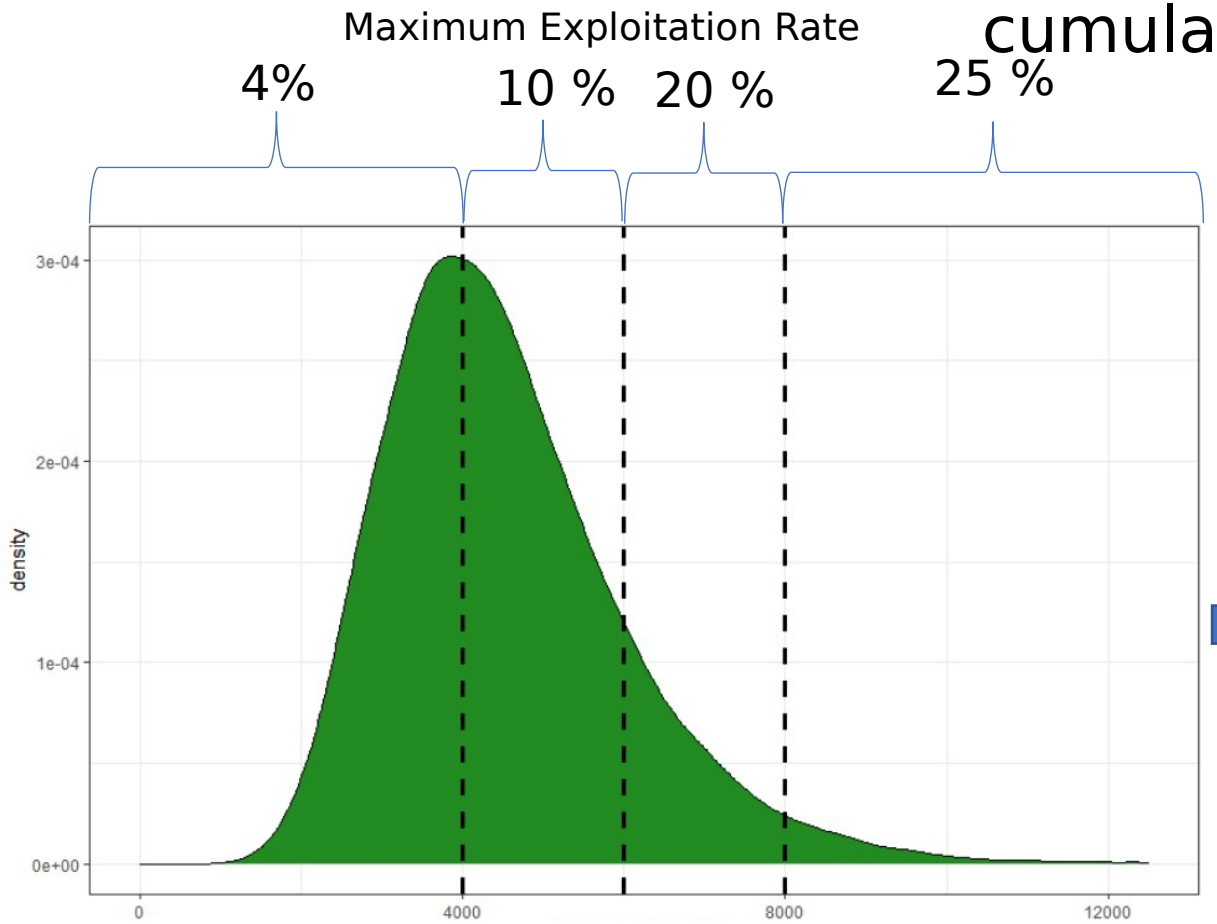
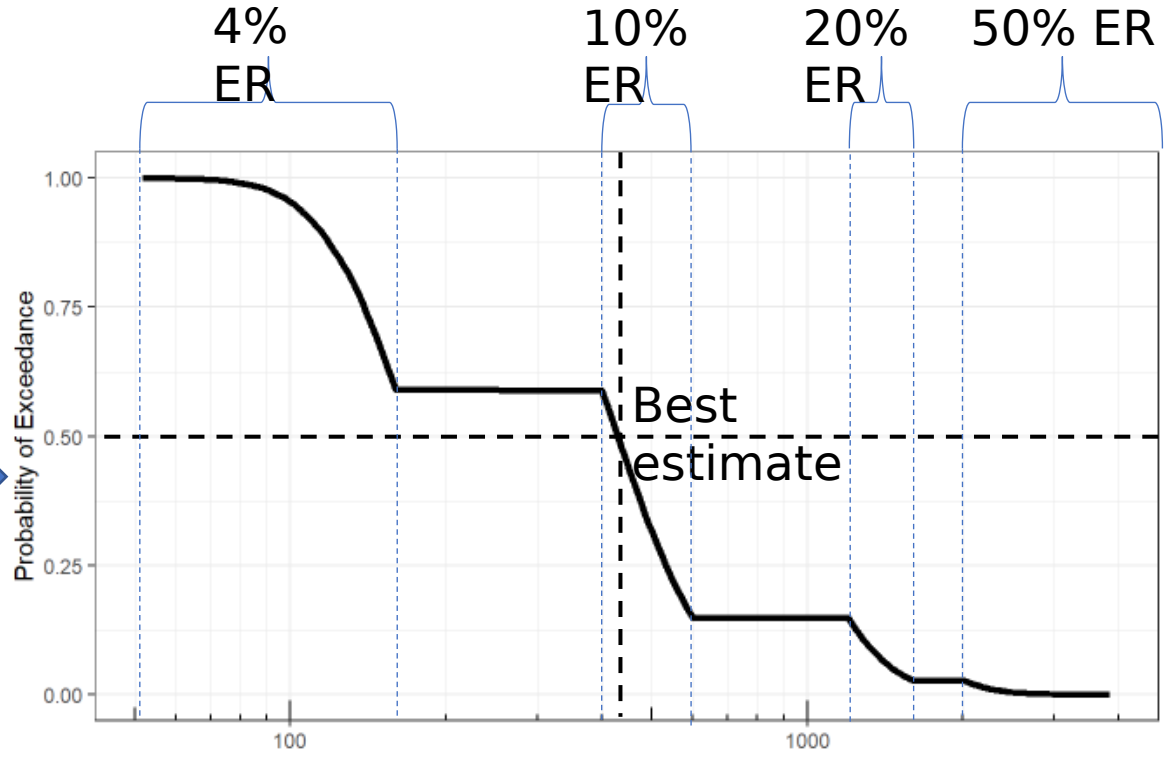
Pre-Season Plan: Allowable Harvest

Multiply the pre-season forecast quantiles by the corresponding the mortality rate & convert to cumulative distribution



Run size Forecast



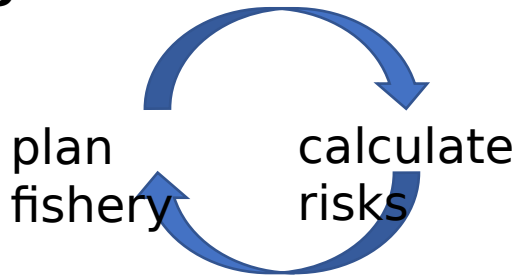
Allowable (State + Tribal) Harvest

Pre-Season Plan: Risk Assessment

Goal: balances risk of exceeding the allowable harvest with the risk of unnecessarily eliminating fishing opportunity

1. 2021 allowable impact based on threshold where max ER drops from 10% to 4%

2. Desire for fishery with a high probability of not exceeding 50% of the allowable harvest.



3. Calculate expected catch for a planned fishery assuming similar effort & CPUE to 2019 (the last opening)

4. Calculate risk posed by plan

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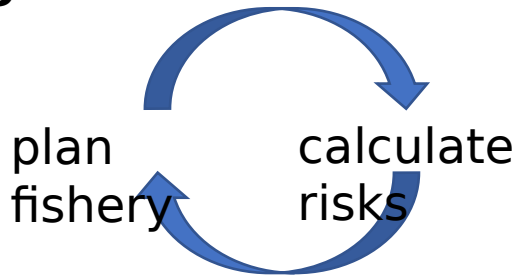

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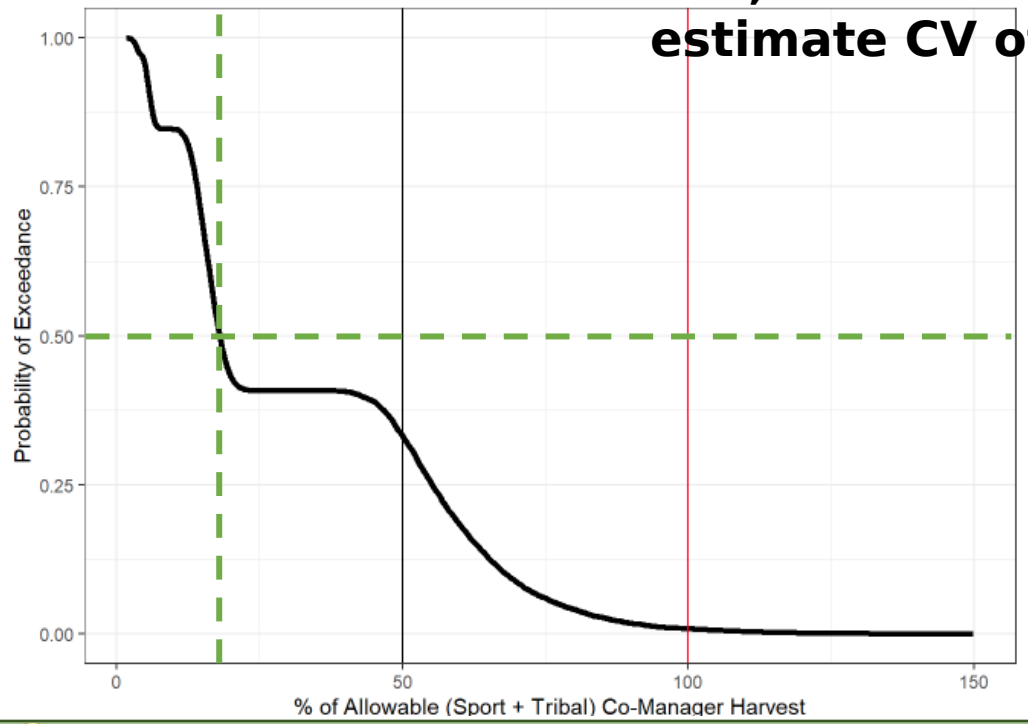
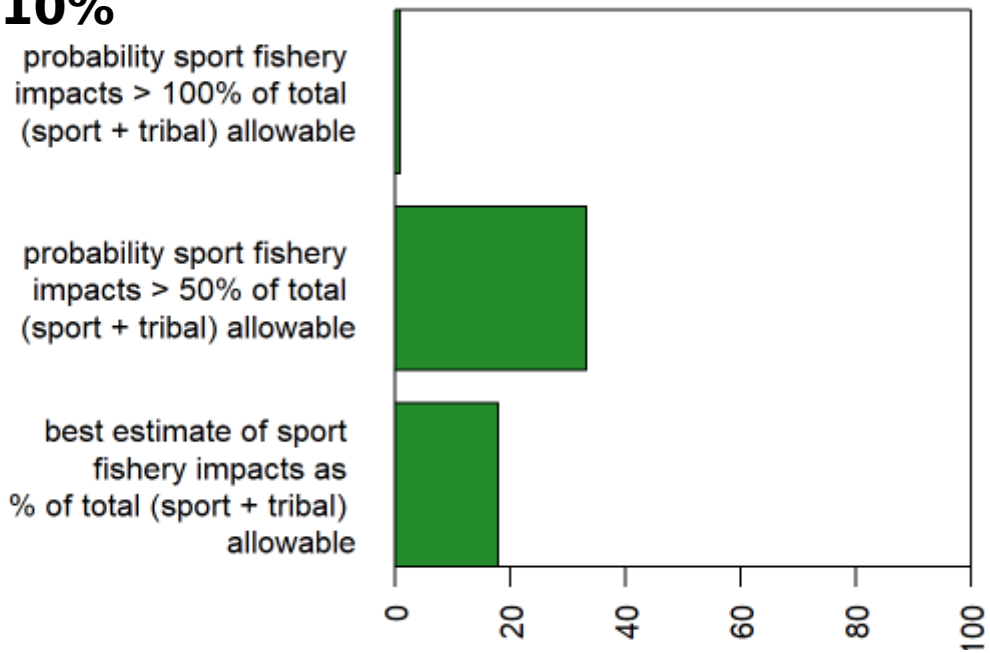
The final plan was a fishery with a catch of 760 fish, and 76 mortalities, and an assumed catch estimate CV of 10%





< 1% chance that harvest > 100% of ER ceiling

33% probability that harvest > 50% of ER ceiling

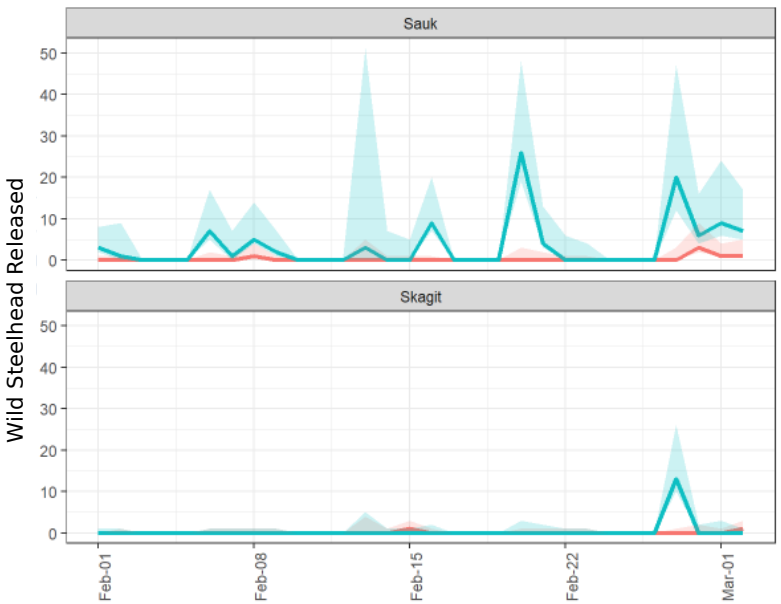
76 mortalities = 18% of ER ceiling

In-Season Monitoring: Catch, Effort, & CPUE

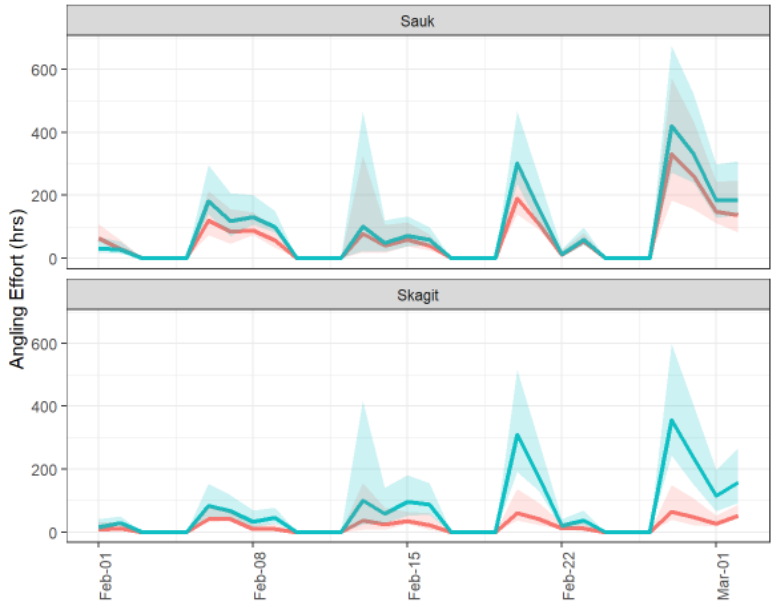
- Creel survey of sport fishery in Skagit and Sauk (a tributary)
- In-season statistical analysis (Kale Bentley will discuss model later today)

Daily Results (through 3/2/2021)

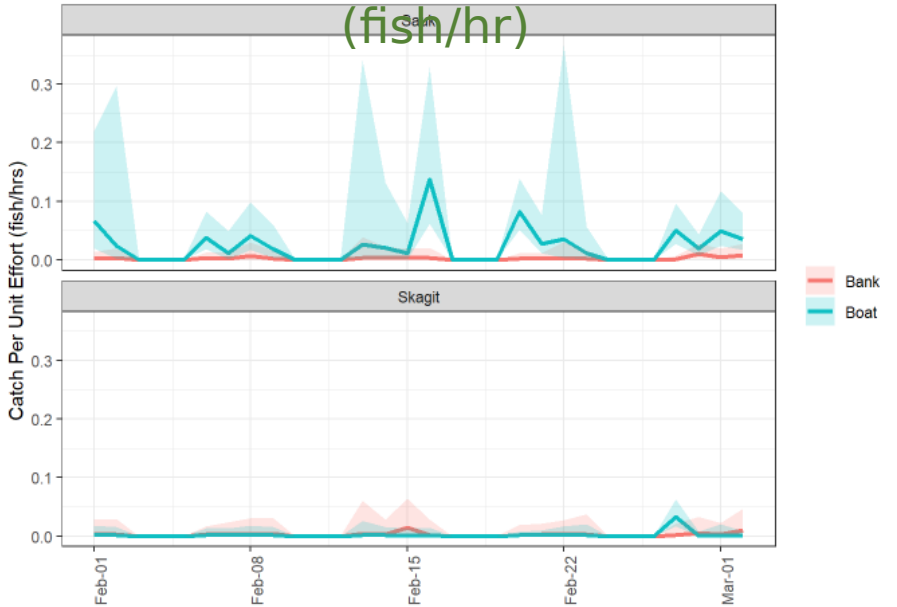
Catch



Effort



CPUE (fish/hr)



In-Season Monitoring: Catch, Effort, & CPUE

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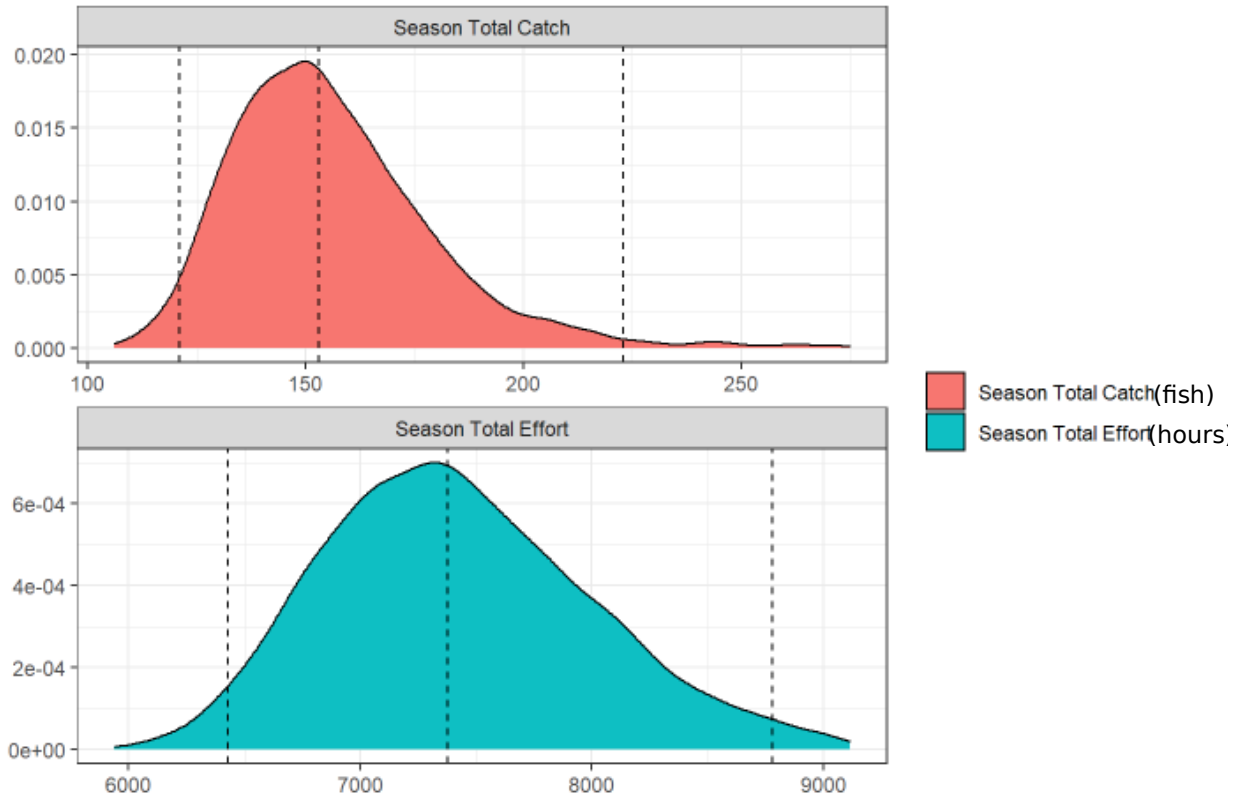
Cumulative Results (through 3/2/2021)



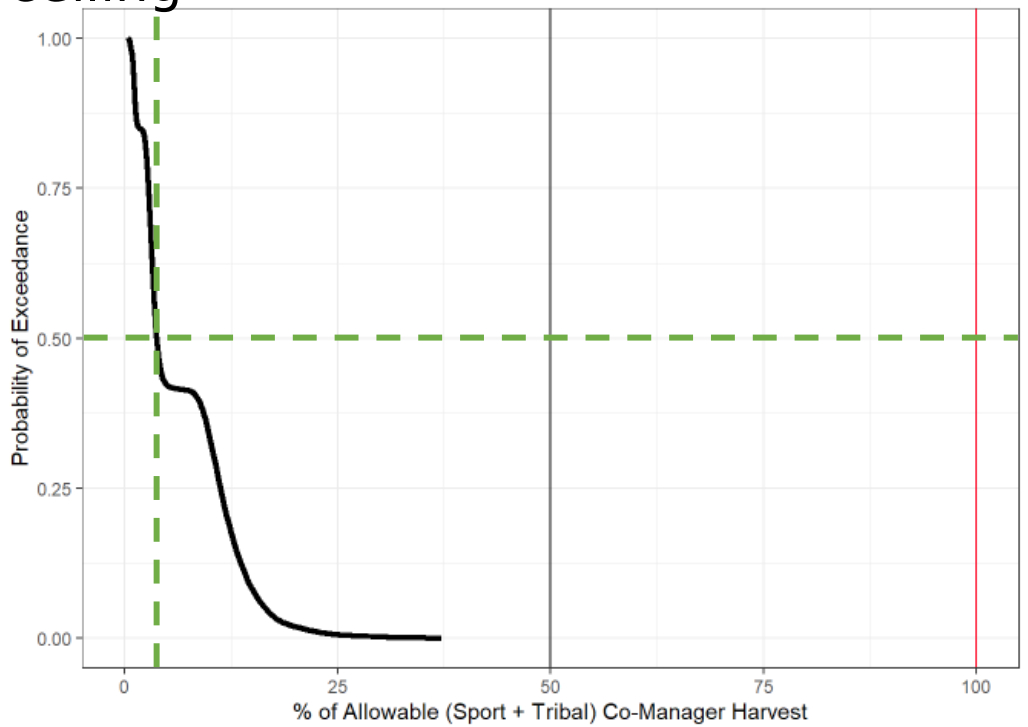
Best estimate

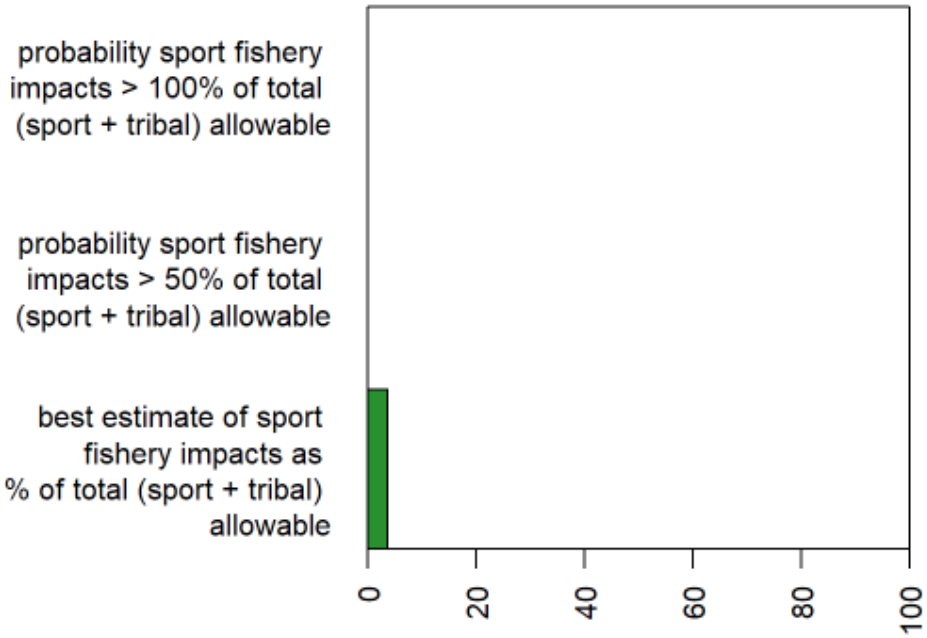
Variable	Mean	2.5%	25%	50%	75%	97.5%
Total_season_catch	159	121	140	153	169	223
Total_season_effort	7442	6430	7016	7376	7810	8779

In-Season Monitoring: Risk Assessment

As of 3/2/2021:

- 0% chance that harvest > 100% of ER ceiling
- 0% probability that harvest > 50% of ER ceiling
- Catch of 153 fish = harvest of 15.3 fish = 3.1% of ER ceiling





Conclusions

- Integrated approach requires widely available inputs
  - estimate of run-size (forecast or in-season updates)
  - harvest control rule (escapement goal, fixed ER, ER matrix)
  - in-season estimate of catch (e.g., creel, electronic catch record card, fish tickets)

- Could be applied to all creeled steelhead fisheries in WA (and elsewhere)*

  * Subject to study design requirements, or alternative in-season estimates of catch

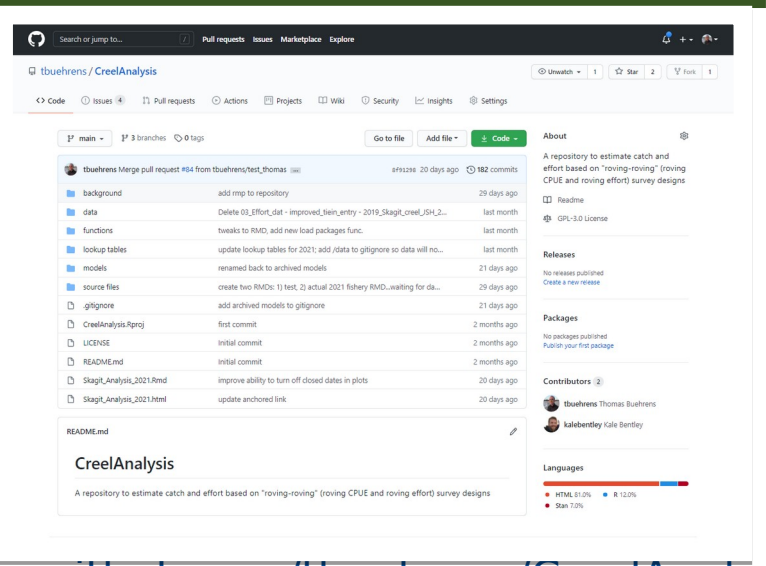
- Analyses and graphs developed into webpage via Rmarkdown (automated updates each week)

- Code available on GitHub (transparent, reproducible):

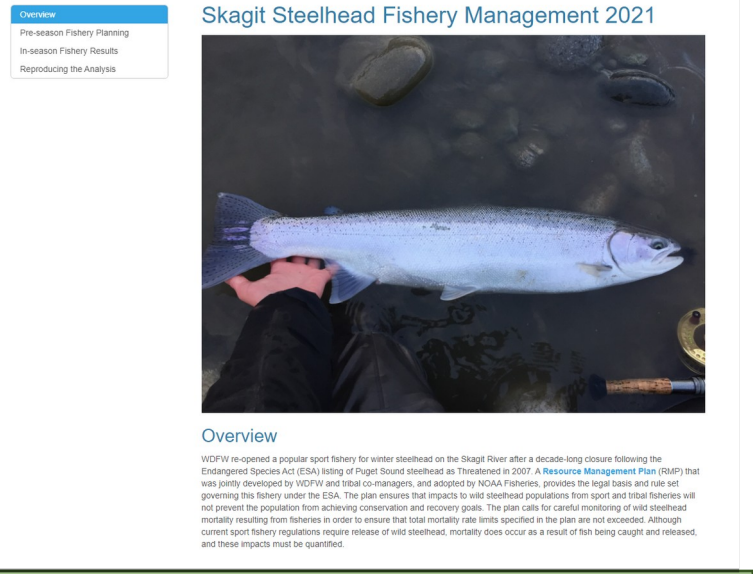
- Publications/R Package—not yet! Stay tuned.

- Modular design ability to improve/change each element (catch estimate, hooking mortality, run-size estimate, harvest control rule, pop dynamic model)

- Today's talks describe advances in many of these areas!



www.github.com/tbuehrens/CreelAnaly



Acknowledgements

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Skagit Co-Managers

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- Pete Kairis (Swinomish Indian Tribal Community)
- Bob McClure (Upper Skagit Indian Tribe)
- Garrett Rowles (Upper Skagit Indian Tribe)
- Andrew Fowler (WDFW)
- Amy Edwards (WDFW)
- Edward Eleazer (WDFW)
- Brett Barkdull (retired WDFW)
- Jillian Howard (formerly WDFW)

Other Speakers in Today's Steelhead Management Sessions

- Matt Falcy (USGS , University of Idaho)
- Mark Scheuerell (USGS, University of Washington)
- Lance Hebton, Tim Copeland, and Josh McCormick (IDFG)
- Ian Courter (Mount Hood Environmental)
- Luciano Chiaramonte (IDFG)
- Don Whitney (IDFG)
- Ben Truscott (WDFW)
- Kale Bentley (WDFW)
- Angela Ward and Michelle Jones (ODFW)

Photo Credit: Bill McMilla