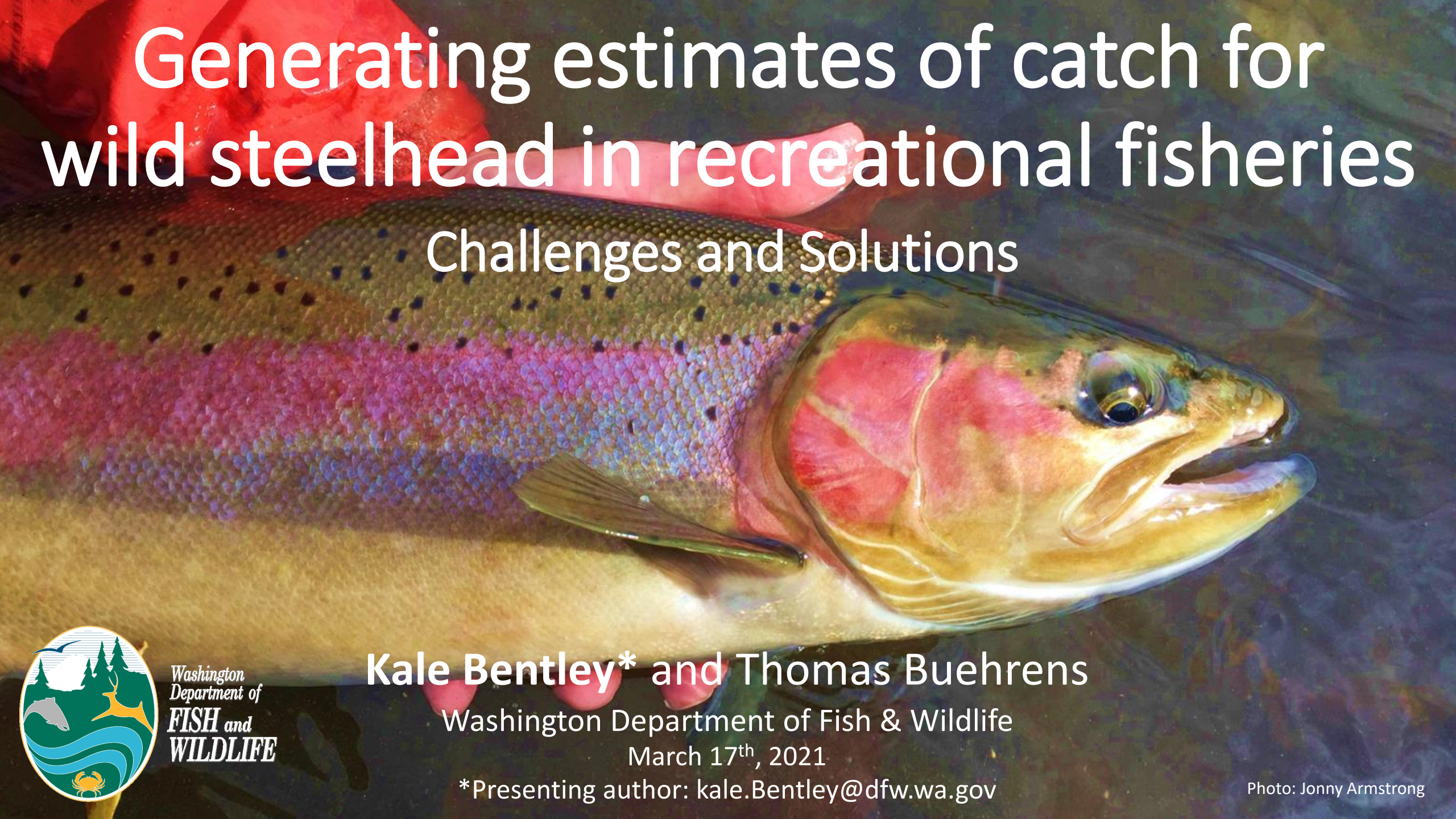
# Generating estimates of catch for wild steelhead in recreational fisheries

## Challenges and Solutions



**Kale Bentley*** and Thomas Buehrens

Washington Department of Fish & Wildlife

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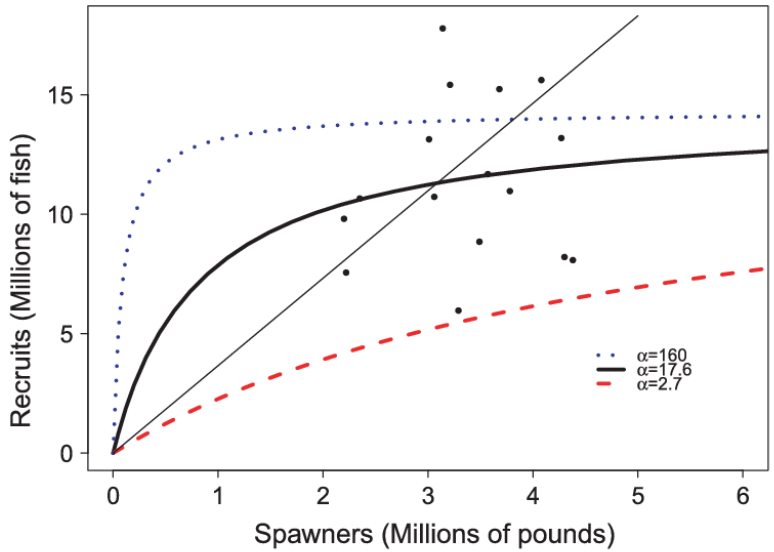
Photo: Jonny Armstrong

# Why generate estimates of impacts?

- Quantifying abundance, demographics, and harvest are important for managing exploited stocks
- WDFW must quantify impacts from recreational fisheries on depressed stocks
  - ESA listings
  - Co-manager agreements
  - Agency mission




# How are impacts quantified?

- Impacts from recreational fisheries can be quantified many ways
- Typically, impacts = mortalities via catch
- The type of fishery dictates relationship between mortalities and catch
- Catch estimates are needed to operate recreational fisheries

**Harvest fishery**

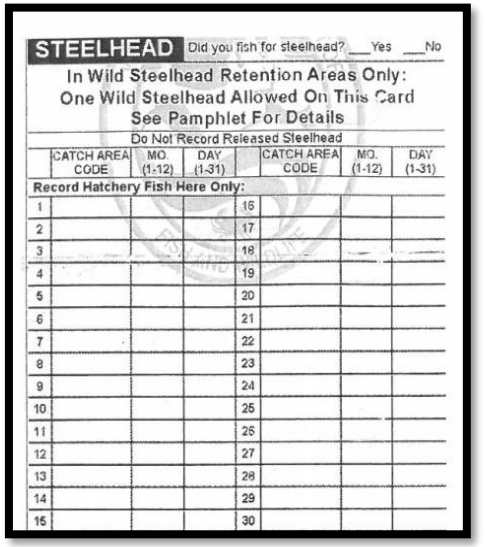

**C&R fishery**

# How are estimates of catch generated?

## Approach #1: Catch Record Cards (CRCs)

- Overview
  - Anglers are legally required to record and report harvest of salmon, steelhead, sturgeon, halibut (and crab)
  - Estimates of catch generated by expanding reported cards
- Advantages
  - Centralized system
  - Can generate estimates for all state-wide CRC fisheries
  - Relatively cheap (~$180K/year)
- Disadvantages
  - Only require anglers to report harvest (currently)
  - Estimates are delayed 1-2 years

**Catch Record Card (CRC)**



STEELHEAD Did you fish for steelhead? ___Yes ___No

In Wild Steelhead Retention Areas Only:
One Wild Steelhead Allowed On This Card
See Pamphlet For Details

Do Not Record Released Steelhead

Record Hatchery Fish Here Only:

| | CATCH AREA CODE | MO. (1-12) | DAY (1-31) | | CATCH AREA CODE | MO. (1-12) | DAY (1-31) |
|---|---|---|---|---|---|---|---|
| 1 | | | | 16 | | | |
| 2 | | | | 17 | | | |
| 3 | | | | 18 | | | |
| 4 | | | | 19 | | | |
| 5 | | | | 20 | | | |
| 6 | | | | 21 | | | |
| 7 | | | | 22 | | | |
| 8 | | | | 23 | | | |
| 9 | | | | 24 | | | |
| 10 | | | | 25 | | | |
| 11 | | | | 26 | | | |
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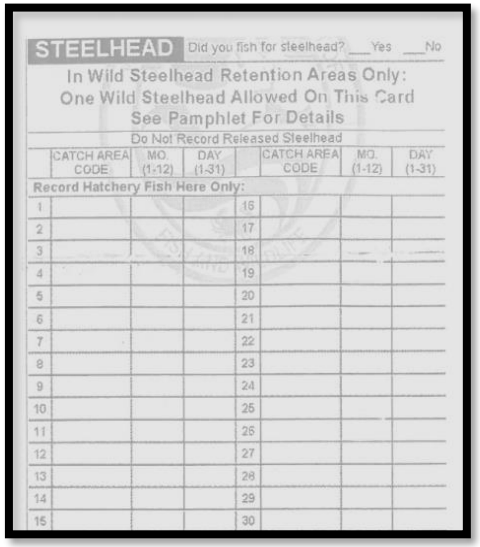
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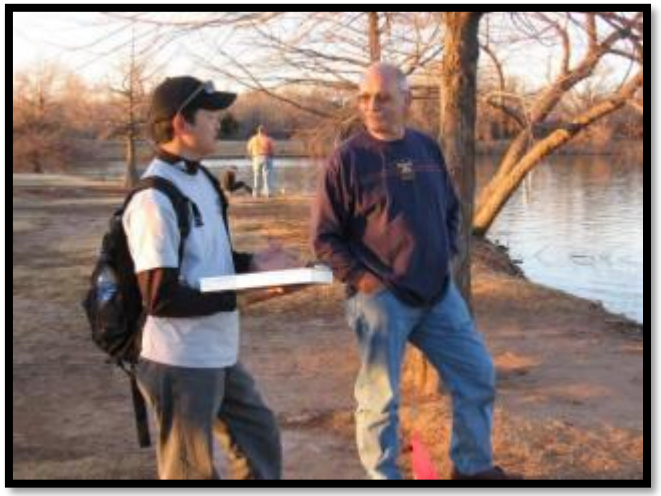
On-site Creel Surveys



## Approach #2: On-site creel surveys

- Overview
  - Enumerate and interview anglers
  - Estimate catch via estimates of effort & CPUE
- Advantages
  - Works for both harvest and C&R fisheries
  - Catch estimates can be generated in-season
- Disadvantages
  - Expensive to implement (e.g., Skagit steelhead fishery; ~$180K)

# Selecting an approach for catch estimates

| Consideration | CRC | On-Site Creel |
| --- | --- | --- |
| 1. Type of fishery | ✓ | ✓ |
| ➢ Harvest | ✗ | ✓ |
| ➢ Catch & Release | | |
| 2. Timeliness of reporting | ✗ | ✓ |
| ➢ In-season | ✓ | ✓ |
| ➢ Post-season | | |
| 3. Cost and Feasibility |  |  |
| | All state-wide CRC fisheries ($180K/year) | One fishery e.g., Skagit creel ($180K) |

# Summary: Challenges and Solutions

- **Reality: On-site creels are the only available method to (statistically) estimate catch of wild C&R steelhead**

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  - Inconsistent methods
  - Redundancy

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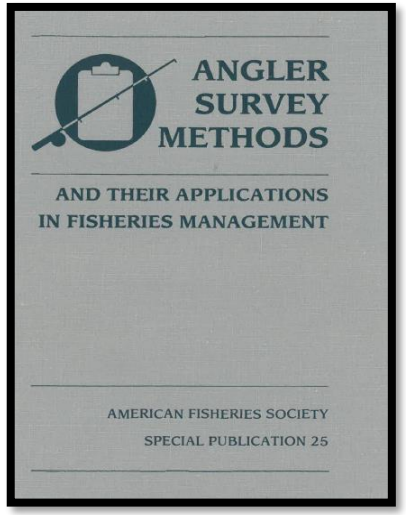
- **Reality: On-site creels are the only available method to (statistically) estimate catch of wild C&R steelhead**
- **Challenge: No centralized creel program**
  - Limited coordination
  - Inconsistent methods
  - Redundancy
- **Solution: Improve on-site creels by building a "grass-roots creel package"**
  - Standardized protocols
  - Database and mobile e-data collection
  - Modernized creel model
  - Reproductible analysis and reporting

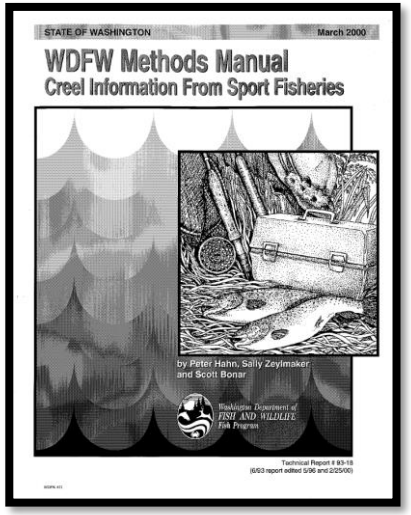
# Improvement # 1 – Standardized study designs

**Old protocols: Breath > Depth**

## Challenge: Variable study designs

- Angler survey methods have existed for many decades e.g., Pollock et al. 1994, WDFW 90s
- Wide range of approaches & equations
- Implementation can be quite variable



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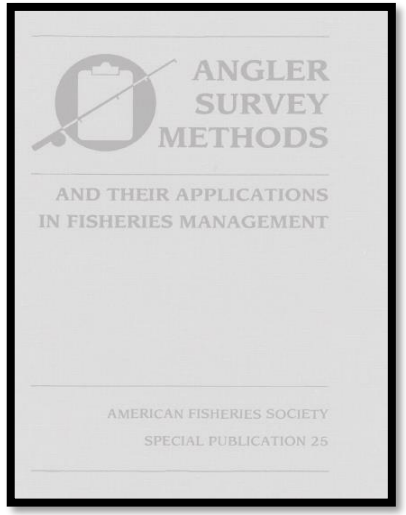
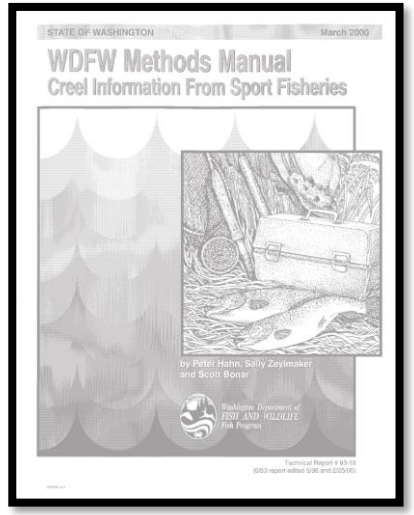
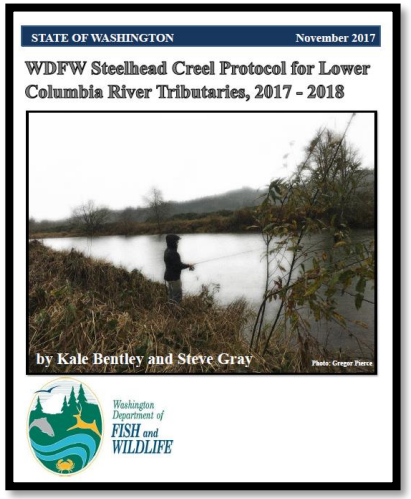



## Solution: Updated steelhead creel protocols

- Survey type chosen to match fishery
  - Focused on roving-roving creels
- Standardized protocol
  - High level components (e.g., spatial expansions)
  - Consistent interview questions
  - Defined data types and options

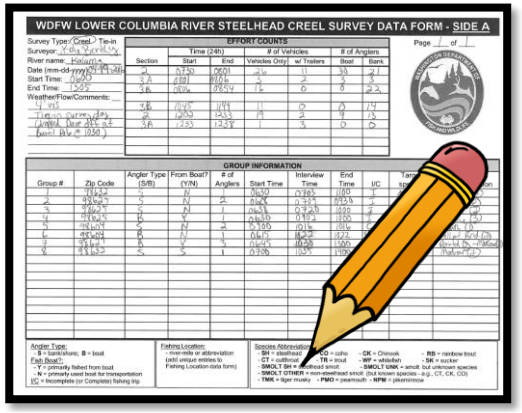
New protocols: Breath < Depth

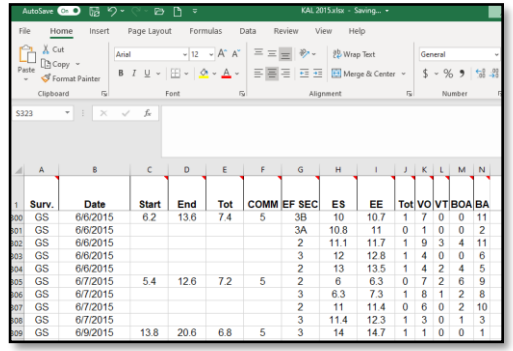


# Improvement # 2 – Data collection & storage

## Challenge: No centralized database

- Most data stored in spreadsheets
- Variable data fields for same data
- Paper datasheets requiring hand entry



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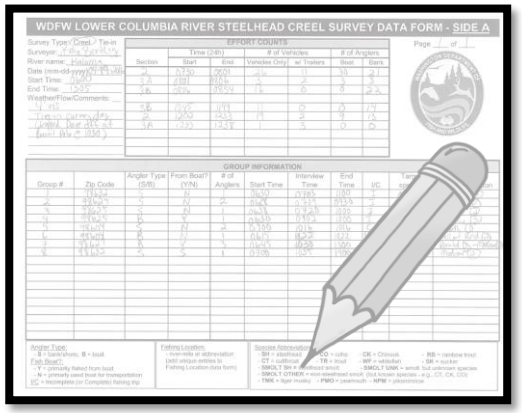
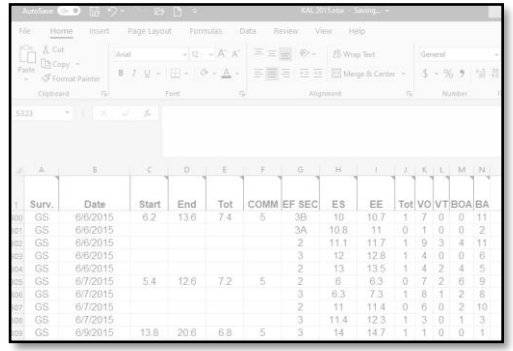
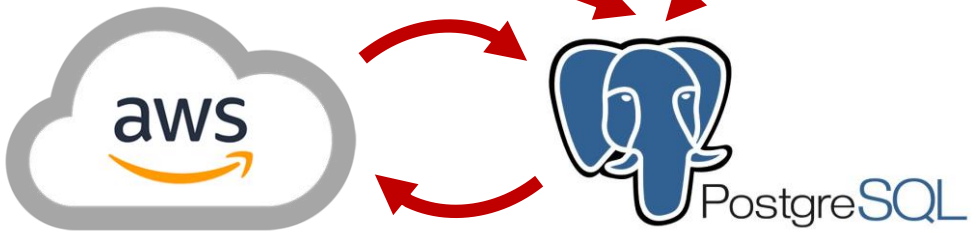


## Solution: Relational database & e-Data

- Database
  - 1st generation: Microsoft Access back-end
  - 2nd generation: PostgreSQL back-end & AWS
- Data collection/entry
  - 1st generation: Access Front-end
  - 2nd generation: mobile iForm & Access front-end
  - 3rd generation: mobile iForm & Angular JS front-end

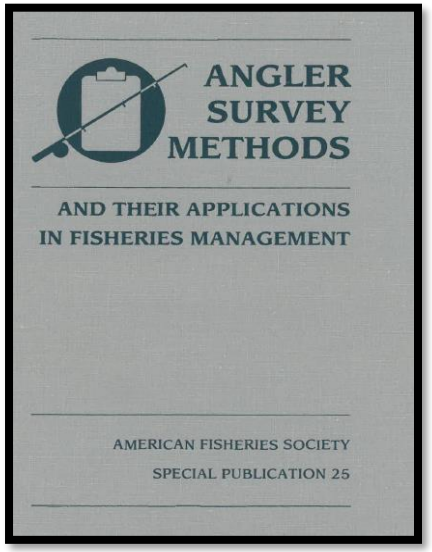


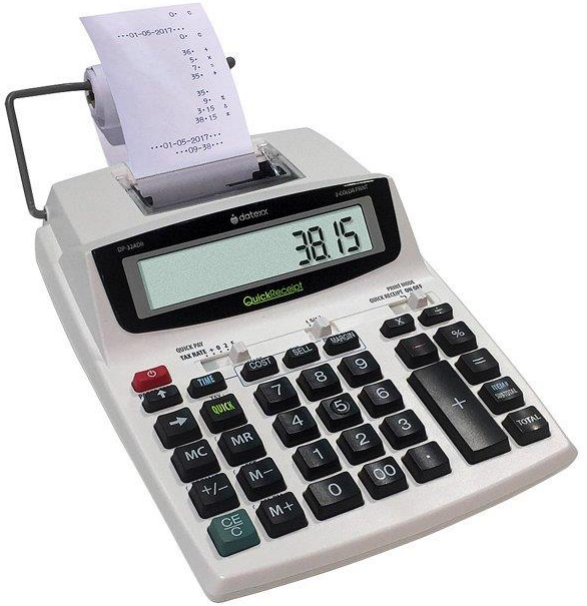


# Improvement # 3 – Modernized creel model

## Challenge: Outdated creel model

- Analytical methods developed >40 years ago
- Limitations of traditional estimators
  - ➢ Ignores generative processes of data
  - ➢ Ignores spatial & temporal auto-correlation in data
  - ➢ Ignores need for spatial expansions
  - ➢ Ignores components of uncertainty



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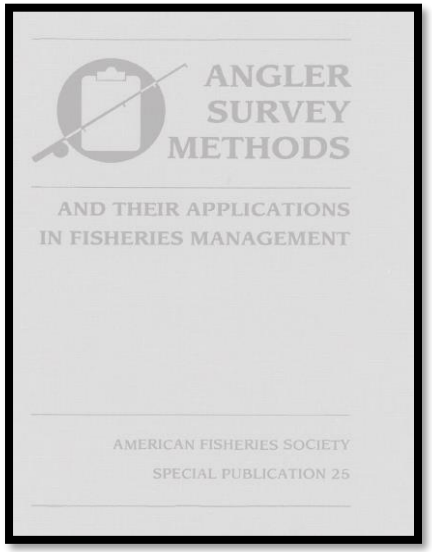
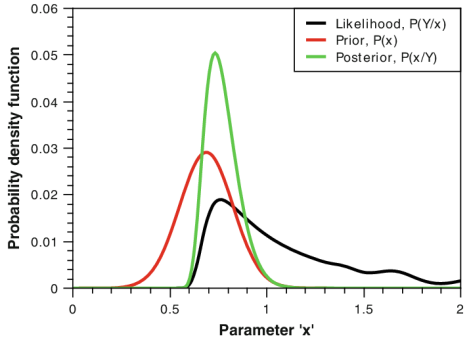
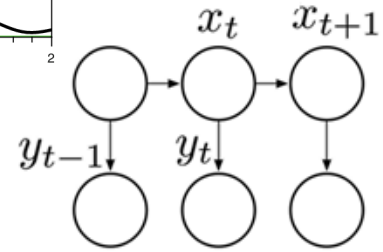



## Solution: Bayesian, state-space creel survey model

- Two-part model: process & observation
- Allows for serial auto-correlation in space & time among angler-types and sections
- Generates unbiased estimates of catch
- Accurately quantifies uncertainty



# Improvement # 4 – analysis & reporting

**Challenge: Inconsistent analysis & ease of use**

- Variable analysis used across projects
- Difficult to validate model and results
- Redundancy
- Steep learning curve to use new creel model

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## Solution: Standardized analysis

- Complete analysis in R (.Rmd)
  - Import data from database (or standalone spreadsheet)
  - Data summarization and formatting
  - Generates estimates using new model
  - Summarizes output in tables & figures
- R code publicly available on GitHub
  - Code is “functionalized” but not yet an R package
  - Code and model specific to “roving-roving” study design

rmarkdown

GitHub

**github.com/tbuehrens/CreelAnalysis**

# Remaining challenges

- Expanding the use of our “grass-roots creel package”
- On-site creel surveys are very expensive…what are other options?

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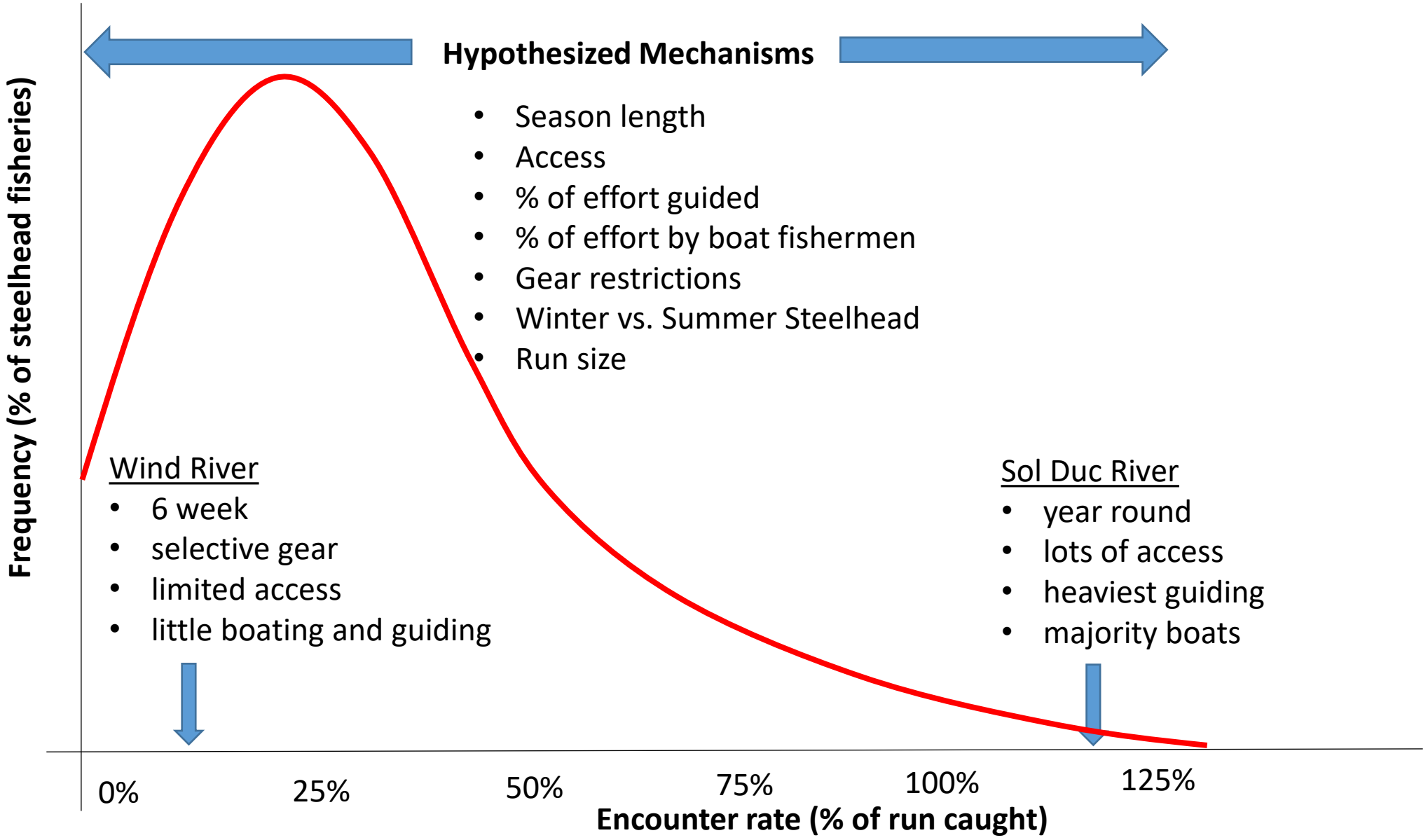
# Future Direction

- Characteristics of a better alternative to estimate C&R catch
  - In-season and timely
  - Cheap
  - Estimates of all catch everywhere all the time
- Approaches
  - 1.) Generalizable catch model
  - 2.) CRC for released fish

# Future Approach #1 - Generalizable creel model



# Future Approach #2 – CRCs for released fish

- Use existing CRC framework to generate estimates of released wild fish
  - Phase in adoption
  - Wouldn't require 100% adoption of e-CRC
  - Could "turn off" reporting for species/fisheries
- Barriers to adaption
  - Finite amount of space on the CRC
    - ➢ Problem: CRCs cost money, disincentive to record released fish
    - ➢ Solution: Develop an online or mobile CRC app
  - Reporting bias
    - ➢ Problem: Unrepresentative sampling, incorrect reporting
    - ➢ Solution: Quantify bias and adjust estimates accordingly

**Catch Record Card (CRC)**

# Concluding thoughts…

- Budgets have not matched increased demand for catch estimates
- Better creel models and other tools may reduce monitoring costs
- Ultimately, may need to rethink data collection/analysis and try “new” approaches

Photo: Charlie Cochran

# Questions?