

Generating estimates of catch for wild steelhead in recreational fisheries

Challenges and Solutions



Washington
Department of
**FISH and
WILDLIFE**

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Washington Department of Fish & Wildlife

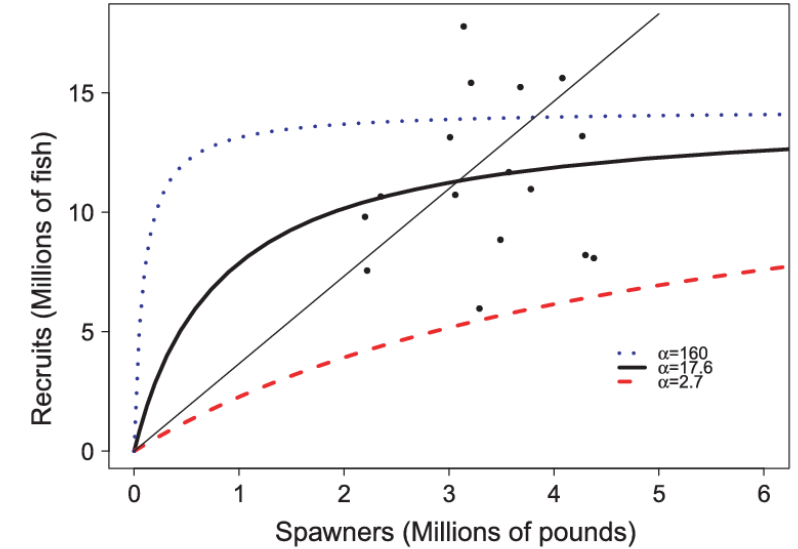
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Photo: Jonny Armstrong

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?

Catch Record Card (CRC)

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

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

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		
12			27		
13			28		
14			29		
15			30		

Record Hatchery Fish Here Only:

How are estimates of catch generated?

Catch Record Card (CRC)

Approach #1: Catch Record Cards (CRCs)

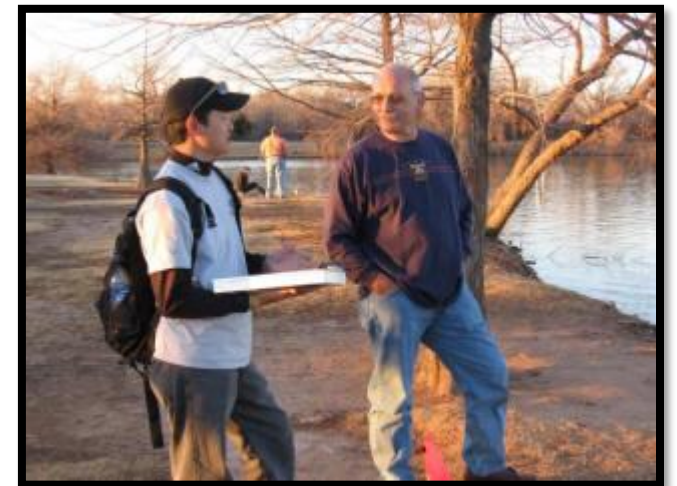
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Do Not Record Released Steelhead		
CATCH AREA CODE	MO. (1-12)	DAY (1-31)
1		15
2		17
3		18
4		19
5		20
6		21
7		22
8		23
9		24
10		25
11		26
12		27
13		28
14		29
15		30

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

1. Type of fishery

- Harvest
- Catch & Release

2. Timeliness of reporting

- In-season
- Post-season

3. Cost and Feasibility

CRC



All state-wide
CRC fisheries
(\$180K/year)

On-Site Creel



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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- 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

Summary: Challenges and Solutions

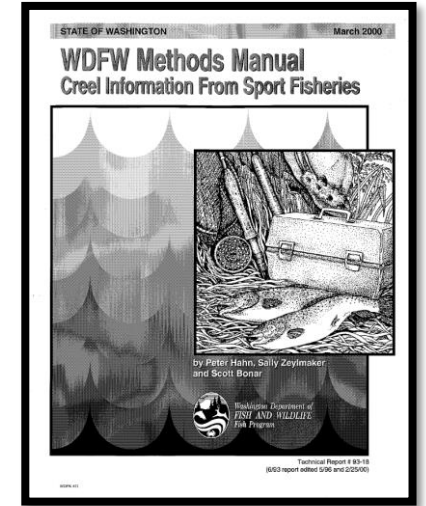
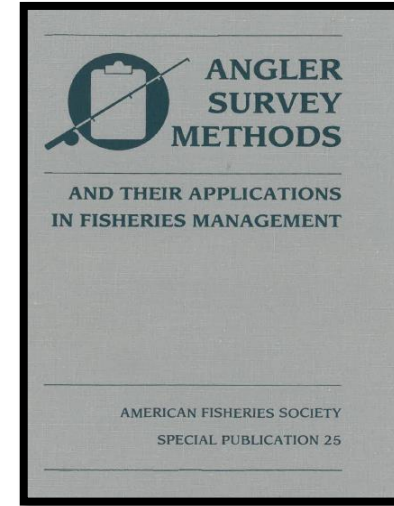
- Reality: On-site creels are the only available method to (statistically) estimate catch of wild C&R steelhead
- Challenge: No centralized creel program
 - Limited coordination
 - Inconsistent methods
 - Redundancy
- **Solution: Improve on-site creels by building a “grass-roots creel package”**
 - Standardized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



Improvement # 1 – Standardized study designs

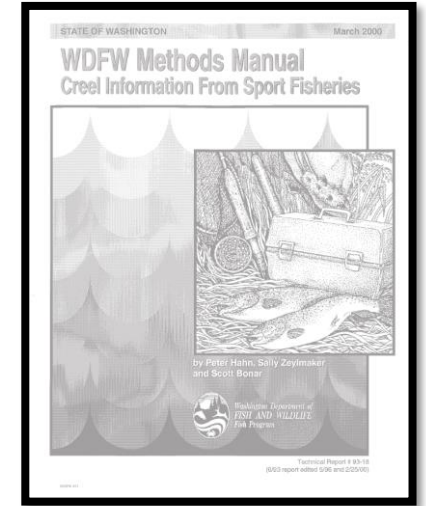
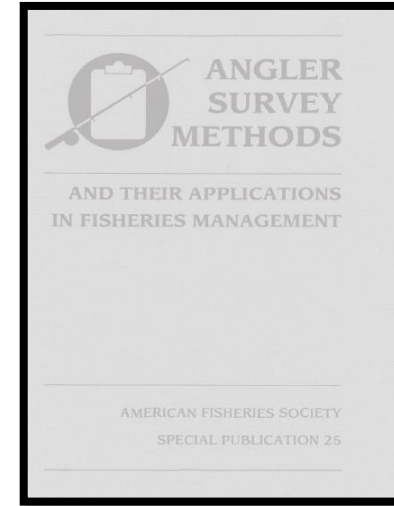
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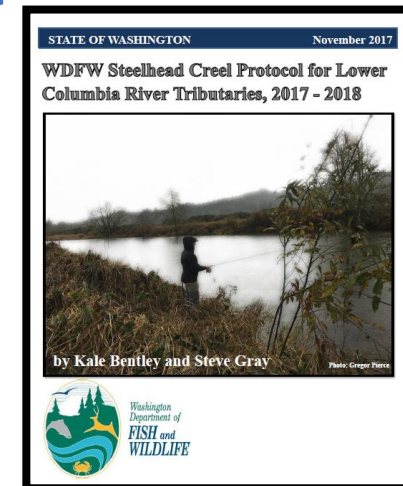
Solution: Updated steelhead creel protocols

- 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

Old protocols: Breath > Depth



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

WDFW LOWER COLUMBIA RIVER STEELHEAD CREEL SURVEY DATA FORM - SIDE A

Survey Type: CreeL Team

Survey Date: 2/20/2018

River name: Edwards

Date from seed: 1/1/2018

Start Time: 7:00

End Time: 7:00

Weather: Clear/Clouds

W. # 1

Angler: Shirley Allen

Cont. No. 3336

EFFORT COUNTS						
Section	Start Time	End Time	# of Volunteers	# of Anglers	Hours	Days
1	7:00	7:00	1	1	30	2
2	7:00	7:00	1	1	30	2
3	7:00	7:00	1	1	30	2
4	7:00	7:00	1	1	30	2
5	7:00	7:00	1	1	30	2
6	7:00	7:00	1	1	30	2
7	7:00	7:00	1	1	30	2
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14	7:00	7:00	1	1	30	2
15	7:00	7:00	1	1	30	2
16	7:00	7:00	1	1	30	2
17	7:00	7:00	1	1	30	2
18	7:00	7:00	1	1	30	2
19	7:00	7:00	1	1	30	2
20	7:00	7:00	1	1	30	2

Page 1 of 1

GROUP INFORMATION						
Group #	Zip Code	Angler Type (S/F)	From Boat (Y/N)	# of Anglers	Start Time	Interview End
1	99102	F	N	1	7:00	7:00
2	99102	F	N	1	7:00	7:00
3	99102	F	N	1	7:00	7:00
4	99102	F	N	1	7:00	7:00
5	99102	F	N	1	7:00	7:00
6	99102	F	N	1	7:00	7:00
7	99102	F	N	1	7:00	7:00
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13	99102	F	N	1	7:00	7:00
14	99102	F	N	1	7:00	7:00
15	99102	F	N	1	7:00	7:00
16	99102	F	N	1	7:00	7:00
17	99102	F	N	1	7:00	7:00
18	99102	F	N	1	7:00	7:00
19	99102	F	N	1	7:00	7:00
20	99102	F	N	1	7:00	7:00

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1	99102	F	N	1	7:00	7:00			
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3	99102	F	N	1	7:00	7:00			
4	99102	F	N	1	7:00	7:00			
5	99102	F	N	1	7:00	7:00			
6	99102	F	N	1	7:00	7:00			
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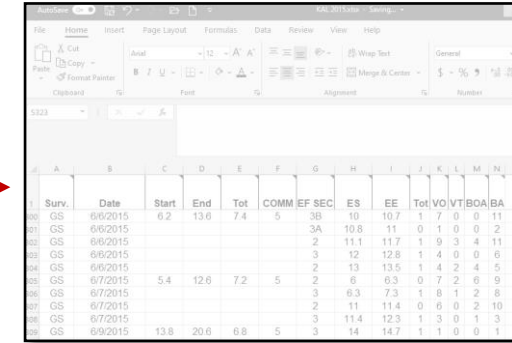
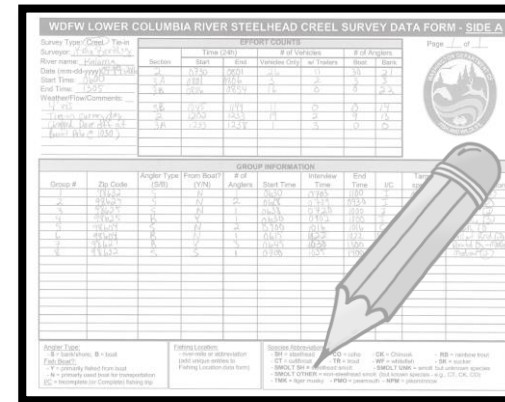


The screenshot shows the Microsoft Excel 2010 ribbon with the Font tab selected. The ribbon includes tabs for File, Home, Insert, Page Layout, Formulas, Data, Review, View, and Help. The Font tab displays options for font face (Arial), font size (12), bold (B), italic (I), underline (U), font color (A), and background color (A). The Paragraph tab shows options for bullet points, numbering, and indentation. The Styles tab shows options for cell styles and themes. The status bar at the bottom shows 'Formulas' and 'Number'.

Improvement # 2 – Data collection & storage

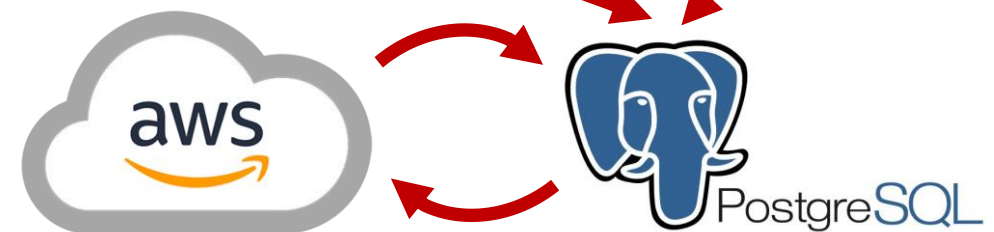
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Solution: Relational database & e-Data

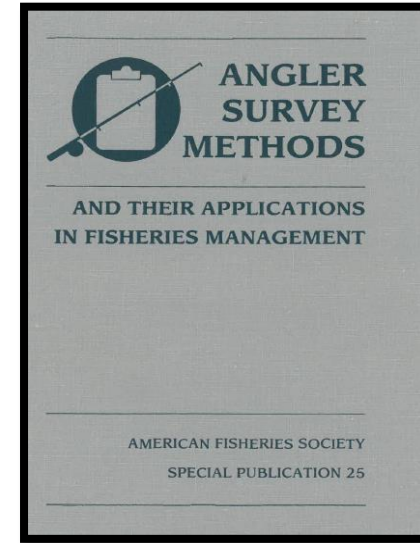
- Database
 - 1st generation: Microsoft Access back-end
 - 2nd generation: PostgreSQL back-end & AWS
- Data collection/entry
 - 1st generation: Access Front-end
 - 2nd generation: mobile iForm & Access front-end
 - 3rd generation: mobile iForm & Angular JS front-end



Improvement # 3 – Modernized creel model

Challenge: Outdated creel model

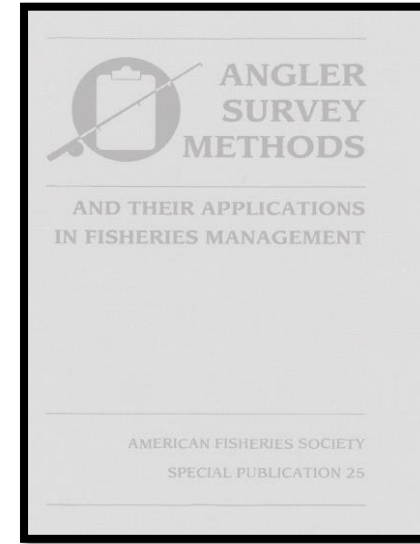
- Analytical methods developed >40 years ago
- Limitations of traditional estimators
 - Ignores generative processes of data
 - Ignores spatial & temporal auto-correlation in data
 - Ignores need for spatial expansions
 - Ignores components of uncertainty



Improvement # 3 – Modernized creel model

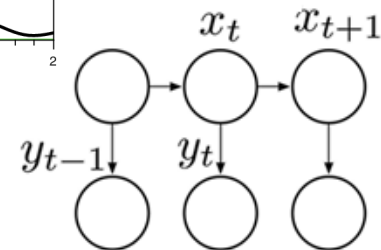
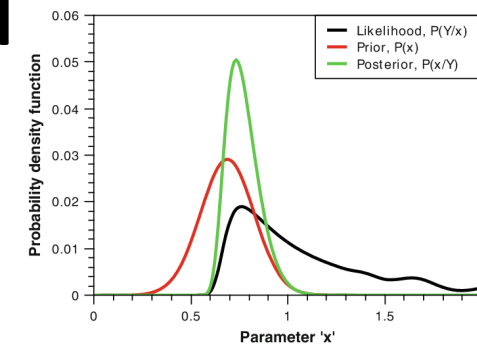
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- Limitations of traditional estimators
 - Ignores generative processes of data
 - Ignores spatial & temporal auto-correlation in data
 - Ignores need for spatial expansions
 - Ignores components of uncertainty



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



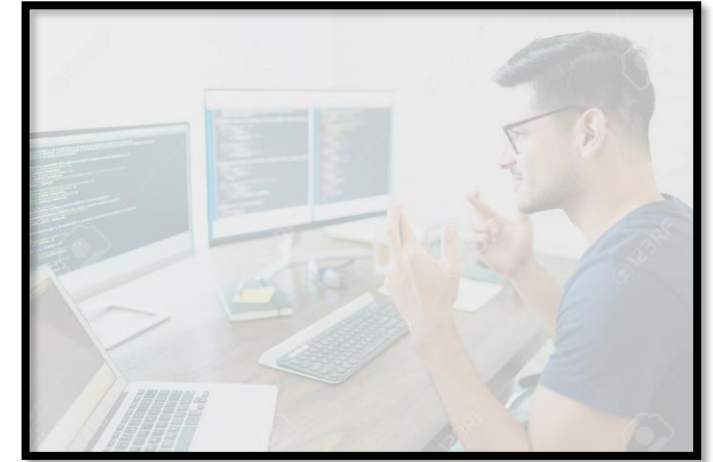
Improvement # 4 – analysis & reporting

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

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



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?

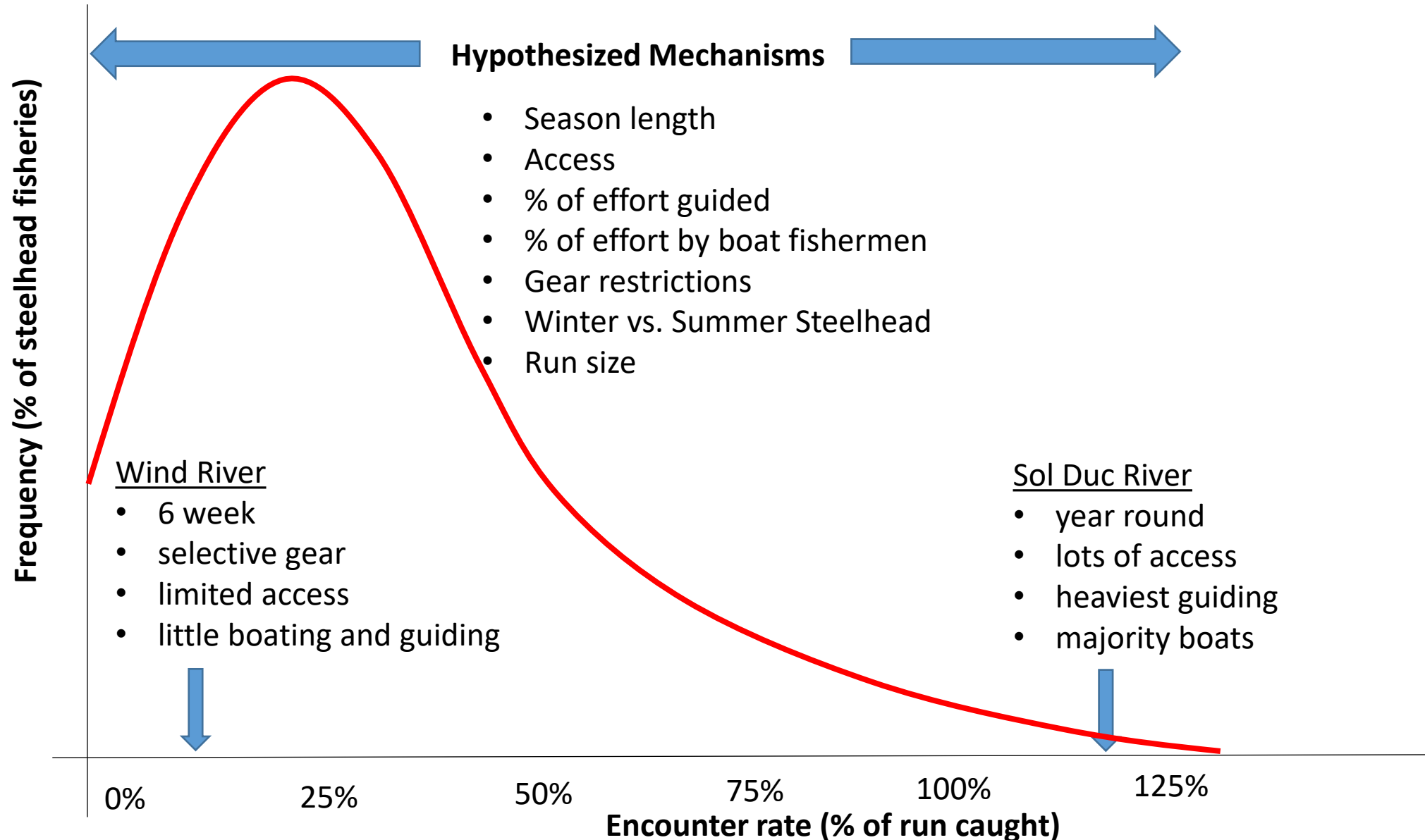
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Future Direction

- 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)

CATCH AREA CODE	MO. (1-12)	DAY (1-31)	CATCH AREA CODE	MO. (1-12)	DAY (1-31)



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?

