Comprehensive Passage (COMPASS) Model

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Outline

- Model Overview
- Modeling uncertainty
  - Reservoir Survival Relationships
  - Post Bonneville Survival
- Upper Columbia – Columbia River Treaty
- Birds!
- Graphical User’s Interface

Model Overview

- Goal: Predict inriver survival
  and relative Adult return rates
  in response to Alternative scenarios
  of hydro operations

Model Overview

- Key management inputs
  - Flow management
  - Spill (amount and timing)
  - Transportation timing
  - Dam configuration

Model Overview

- Key Outputs
  - Survival through hydrosystem (and points along the way)
  - Proportion fish transported
  - Travel Time, Arrival Timing to Estuary
  - Adult Return Rate
  - Many other outputs available

Model Components

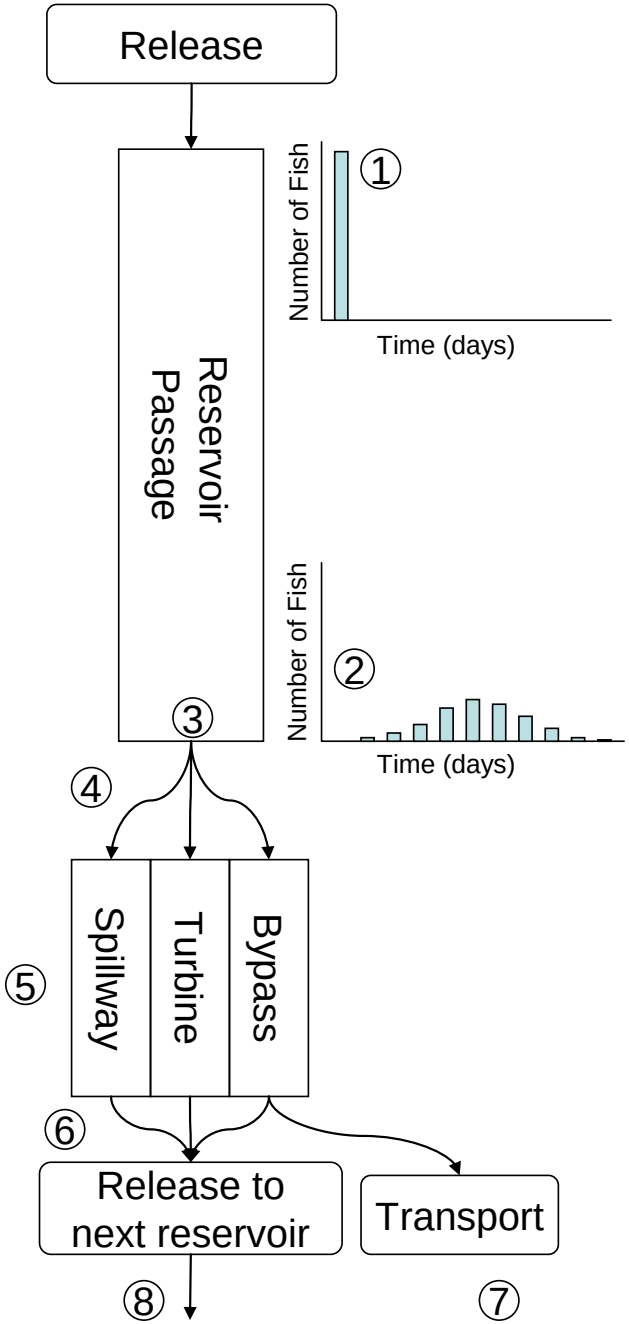
1) Reservoir Survival

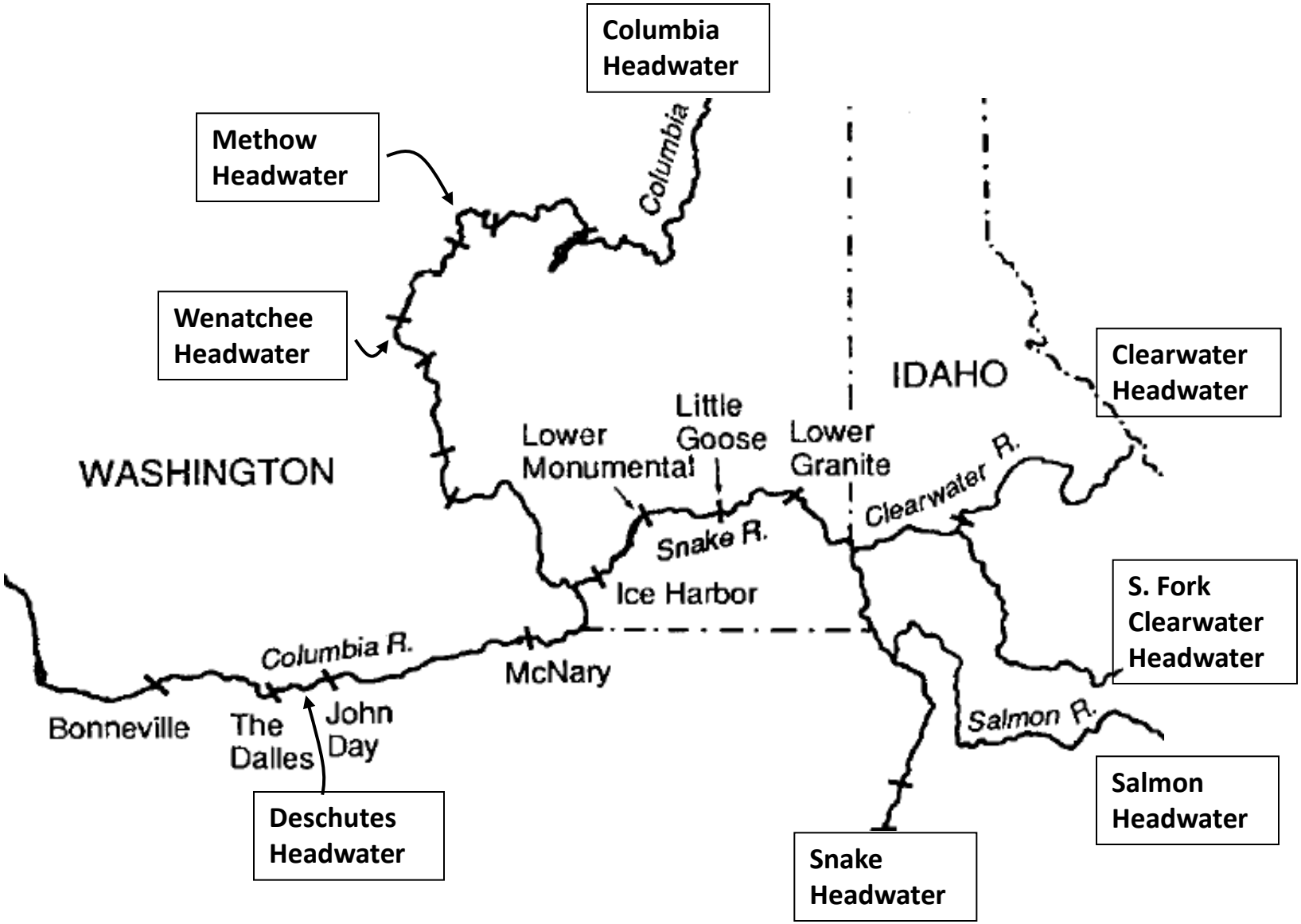
2) Dam Passage

3) Travel Time

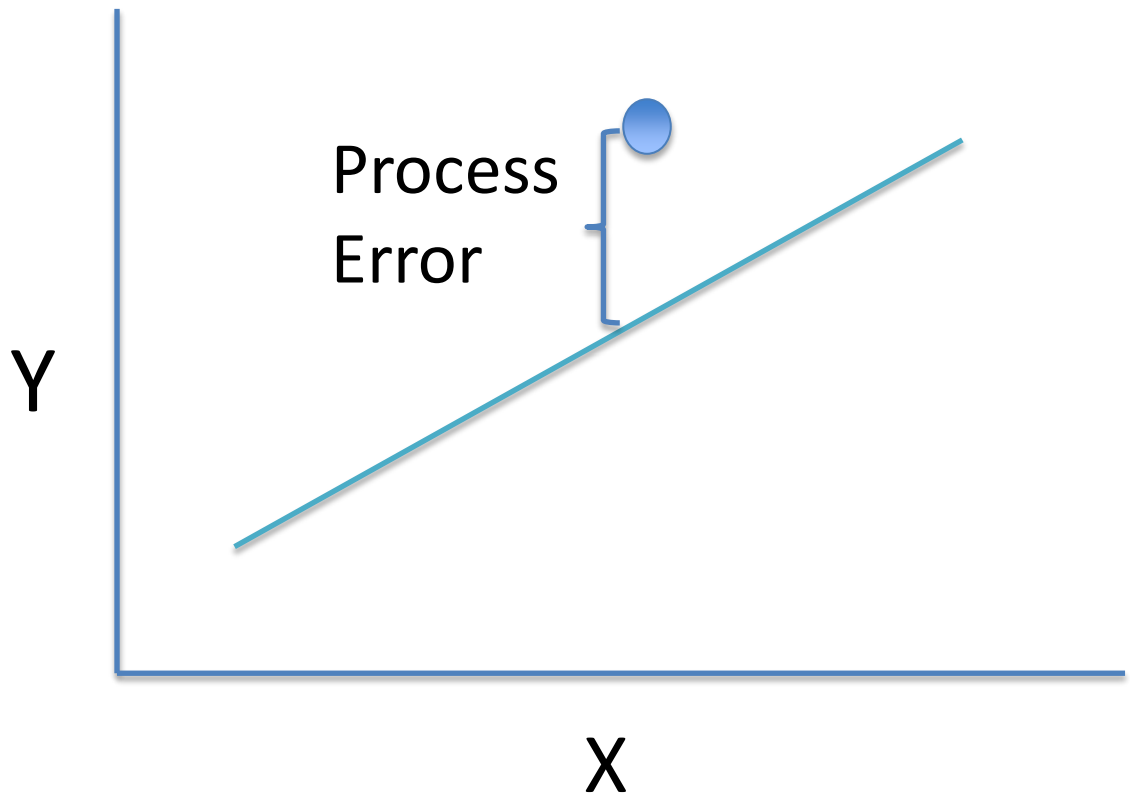
4) Hydrological Processes

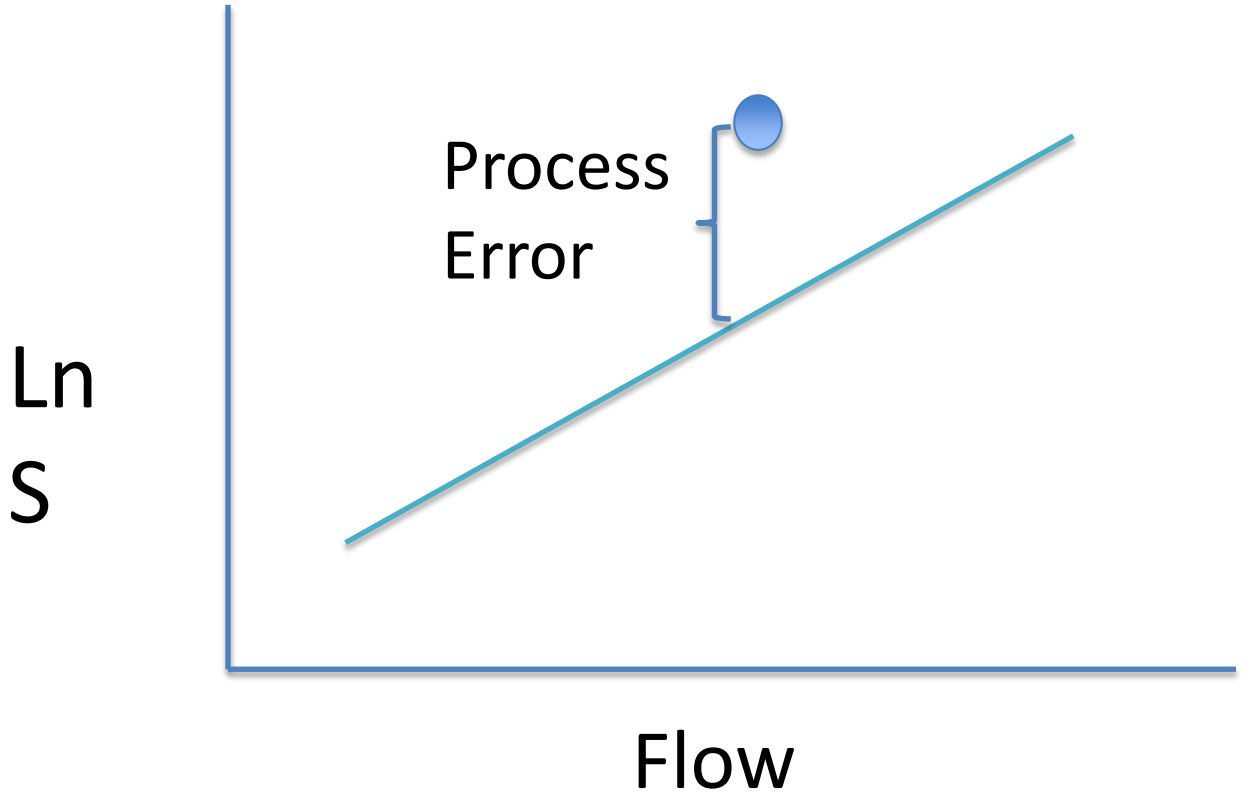
5) Post Bonneville Survival

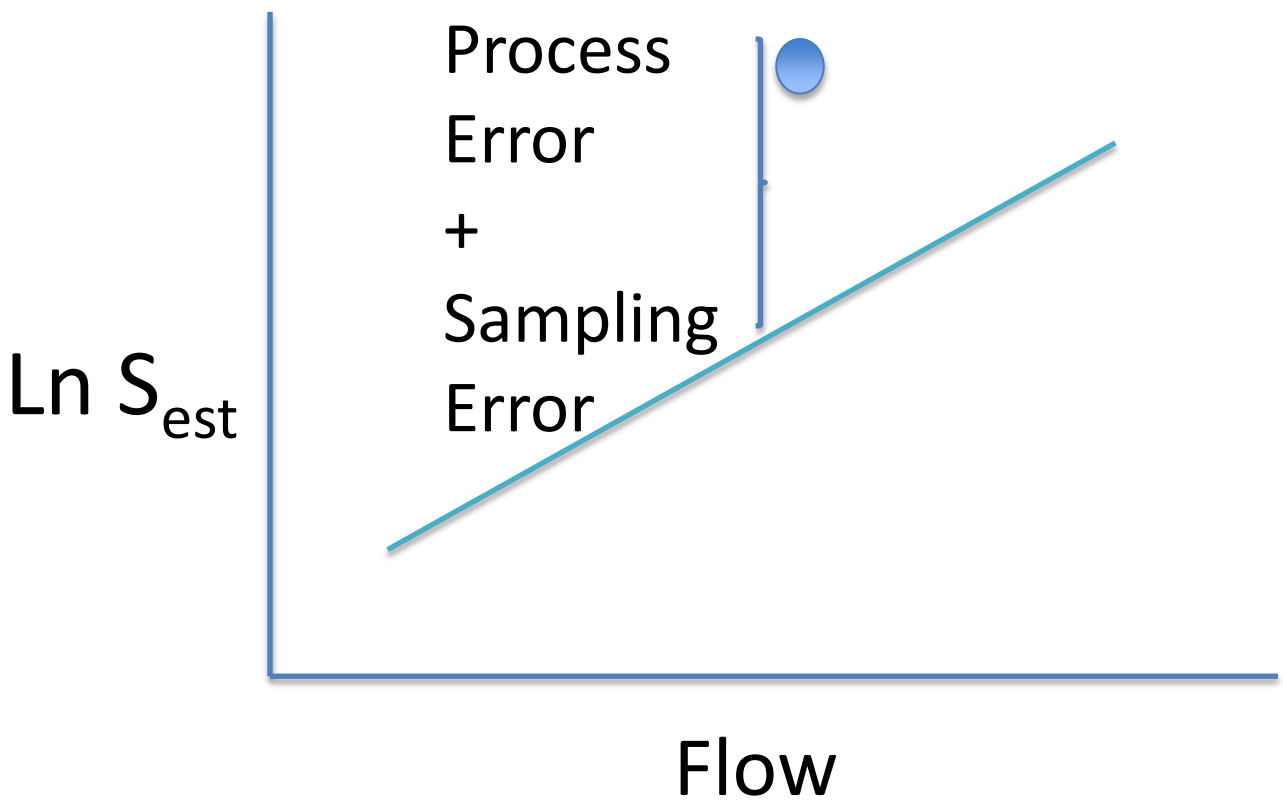

Release
Reservoir Passage
Number of Fish
Time (days)
①
Number of Fish
Time (days)
②
③
④
⑤
Spillway
Turbine
Bypass
⑥
Release to next reservoir
Transport
⑧
⑦


Columbia Headwater
Methow Headwater
Wenatchee Headwater
Clearwater Headwater
S. Fork Clearwater Headwater
Salmon Headwater
Snake Headwater
Deschutes Headwater
Columbia
IDAHO
WASHINGTON
Little Goose
Lower Monumental
Lower Granite
Clearwater R.
Snake R.
Ice Harbor
Columbia R.
McNary
Bonneville
The Dalles
John Day
Salmon R.

Monte Carlo COMPASS


Process
Error
Y
X

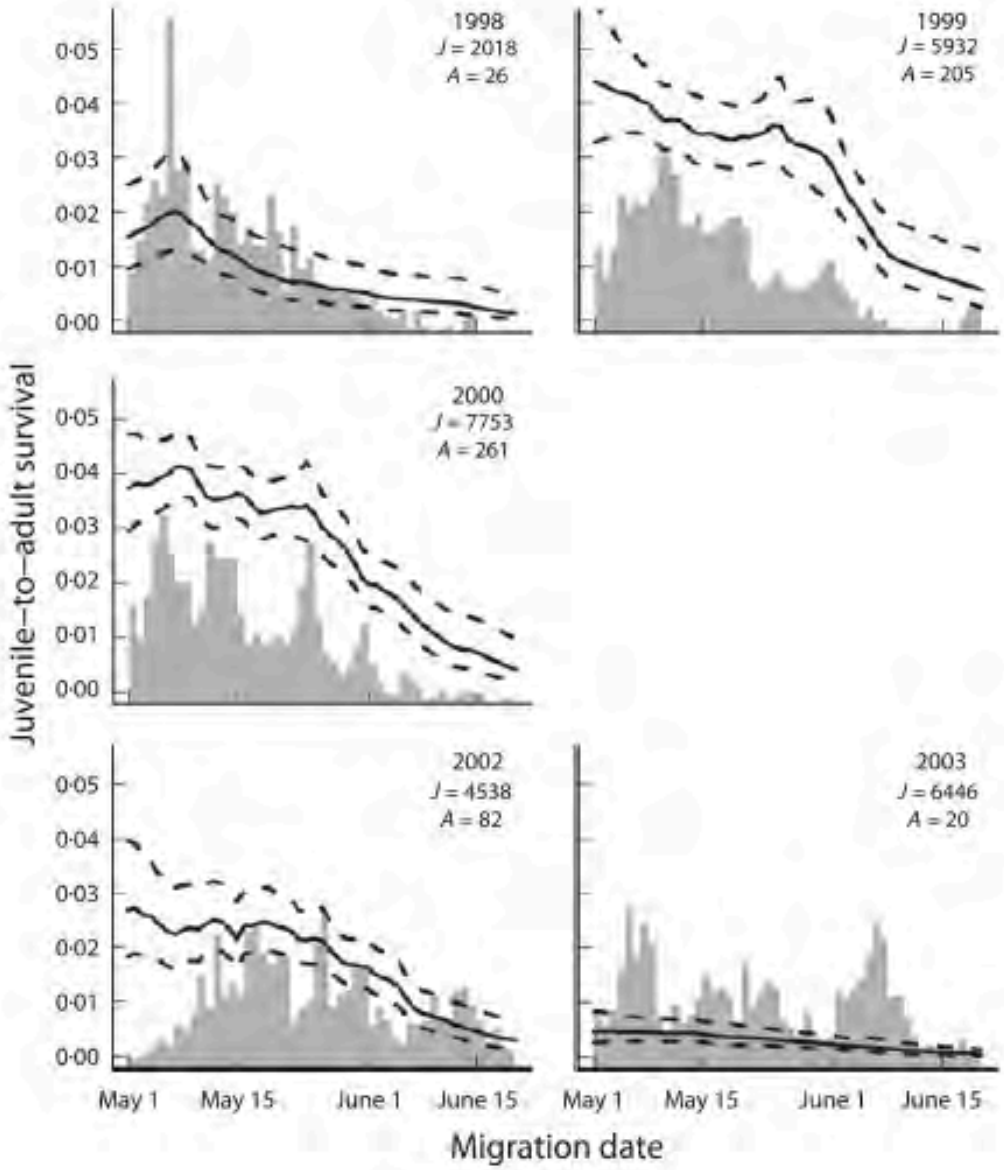

Process
Error
Ln
S
Flow


Process
Error
+
Sampling
Error
Ln S_{est}
Flow

<u>But</u> we know the variance about our survival estimates, So we can use *Variance Components* to Separate process error from sampling error.

We arrived at this method after several bouts of review with the ISAB, and it is now fully implemented in COMPASS.

Post Bonneville Survival – Snake River sp/su Chinook

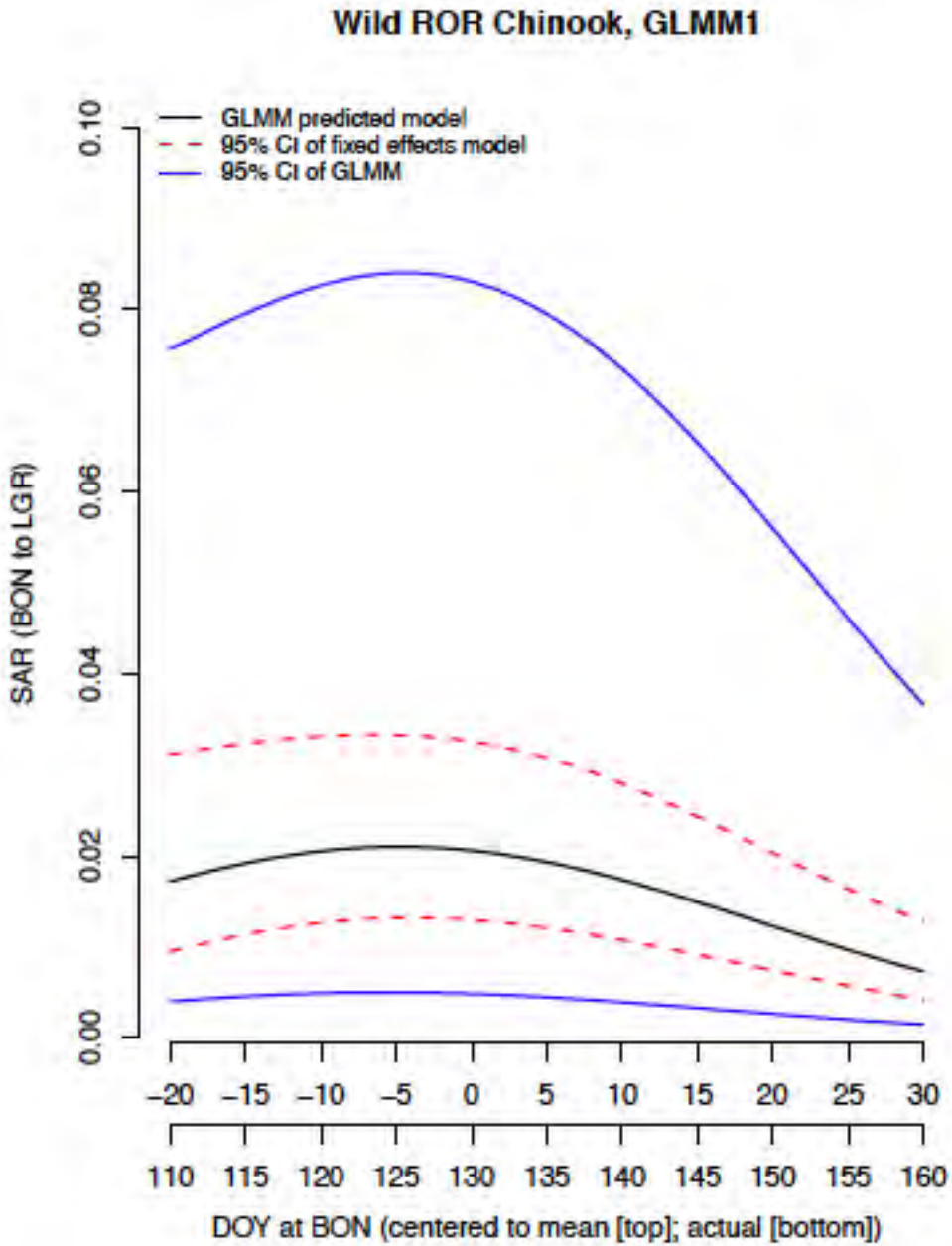


Scheuerell et al. 2009. J. Applied Ecology

Post Bonneville Updates:

Additional Years of data

Mixed effects modeling:
- treats year-to-year variability as a random factor



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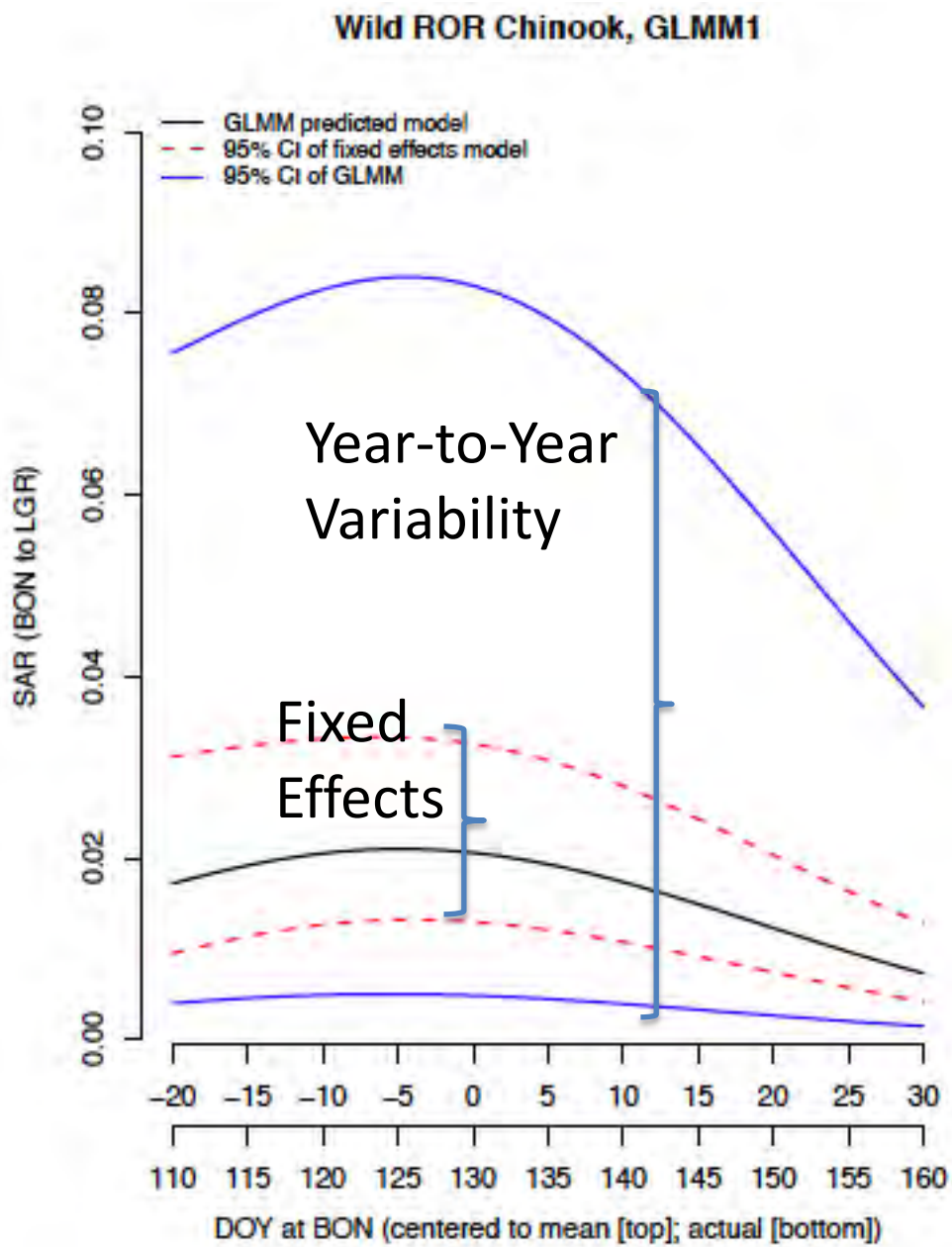
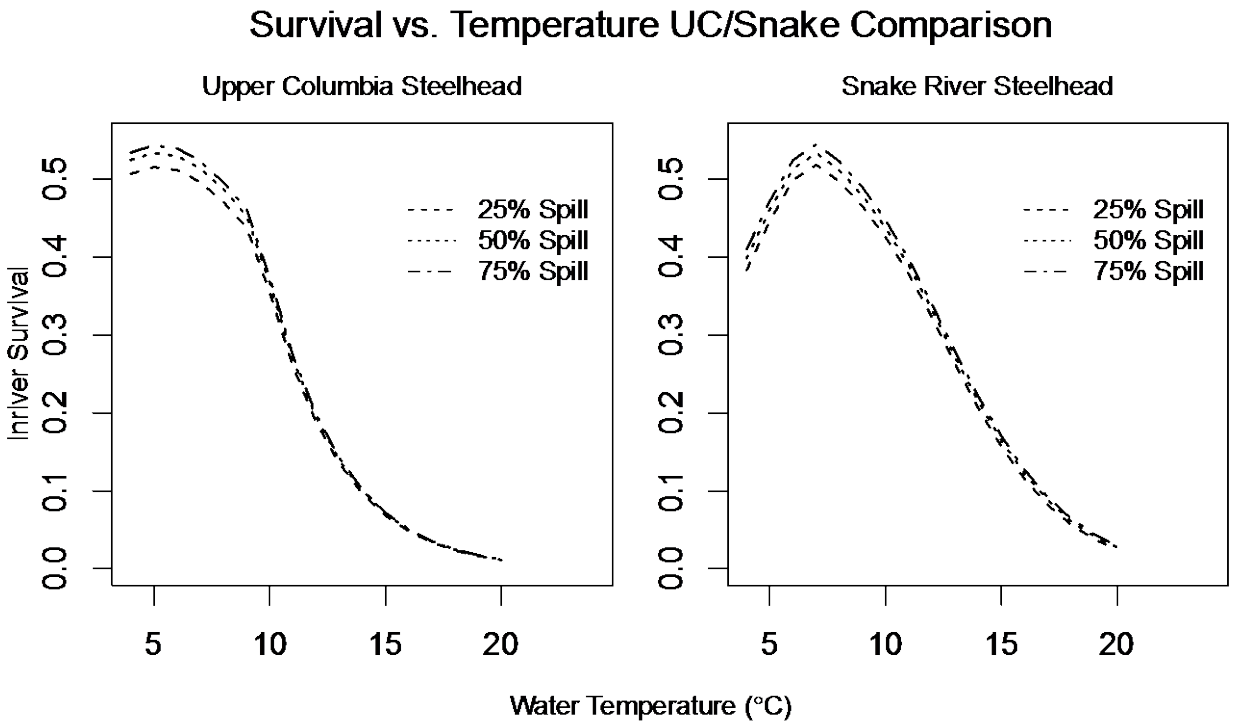
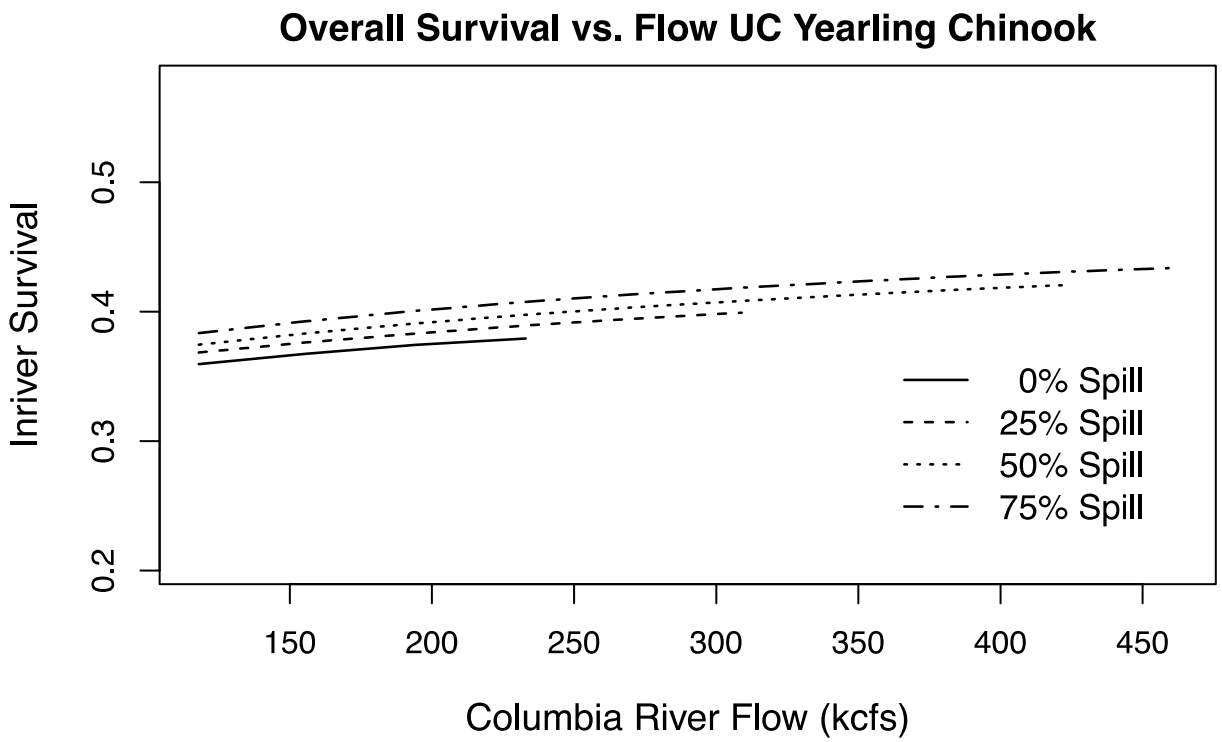
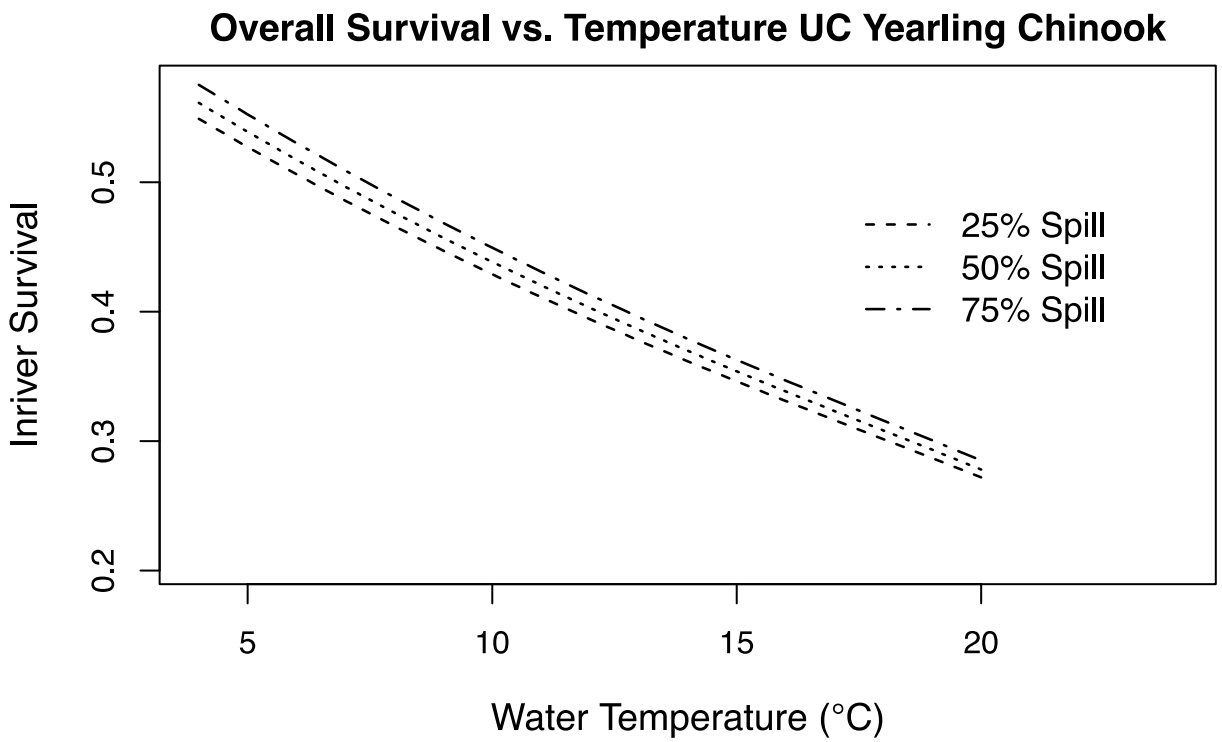
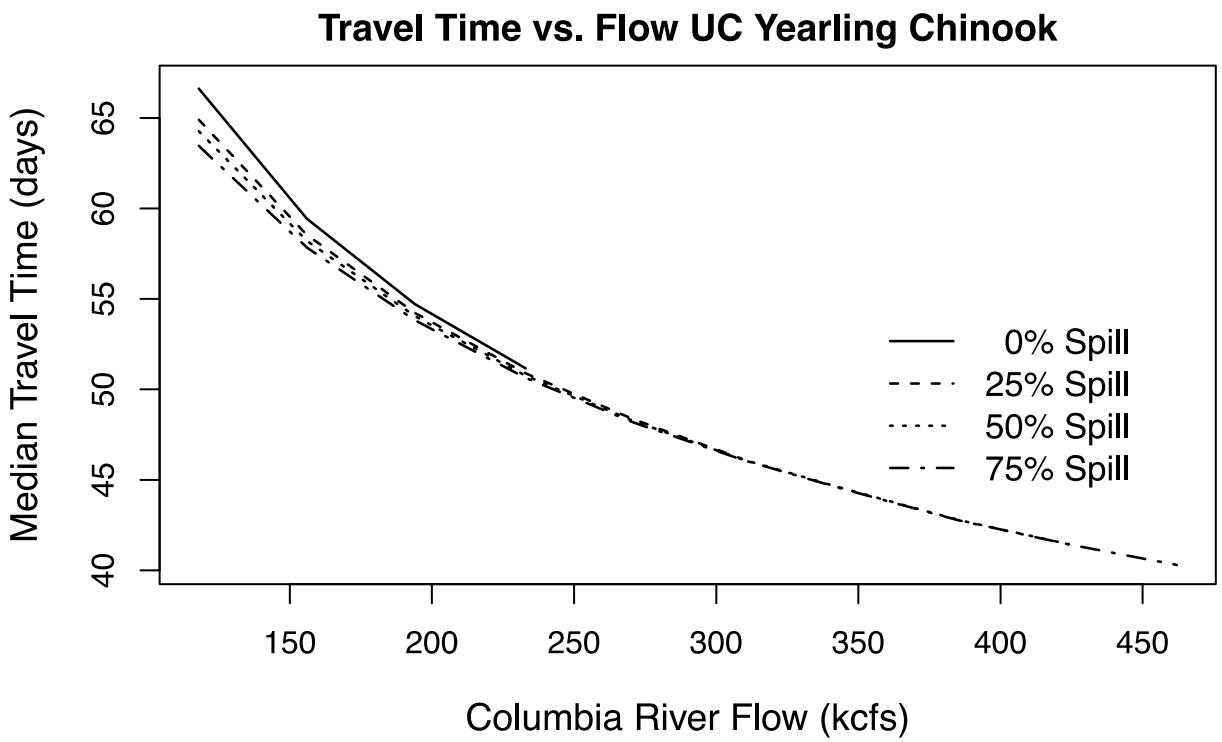


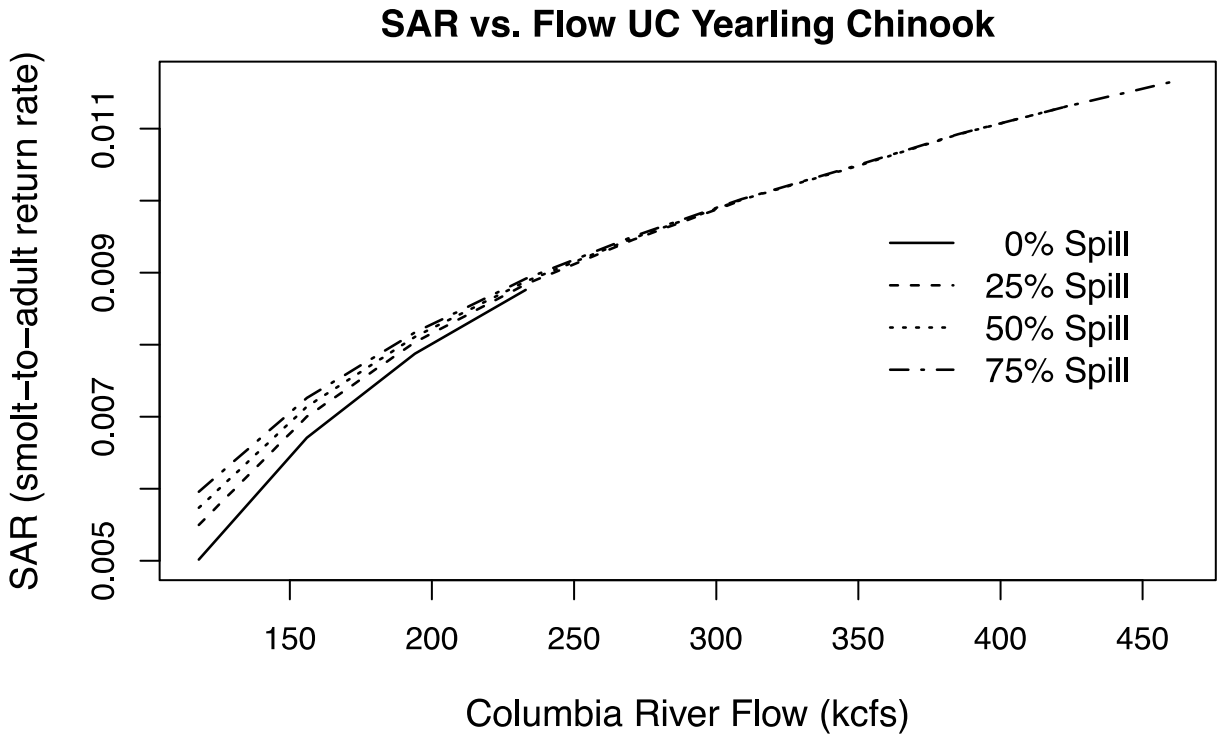
Upper Columbia River COMPASS For the Columbia River Treaty

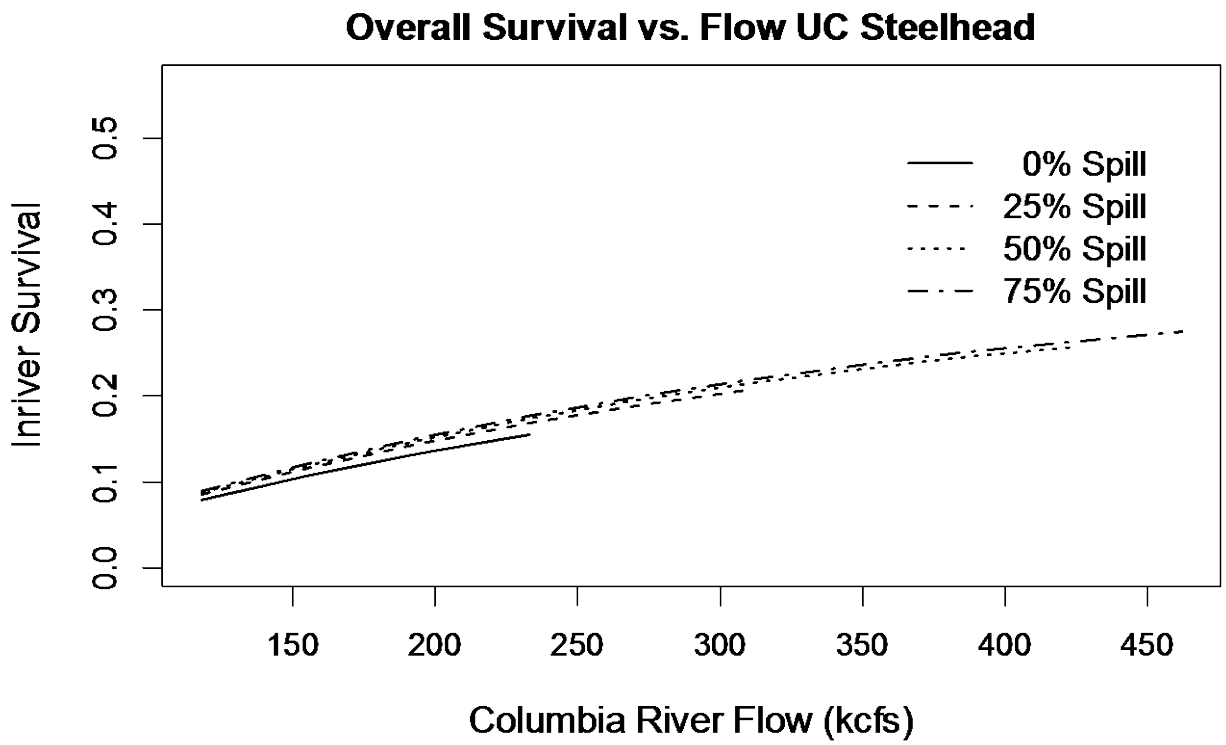

Survival vs. Temperature UC/Snake Comparison
Upper Columbia Steelhead
Snake River Steelhead
25% Spill
50% Spill
75% Spill
Inriver Survival
0.0
0.1
0.2
0.3
0.4
0.5
5
10
15
20
Water Temperature (°C)

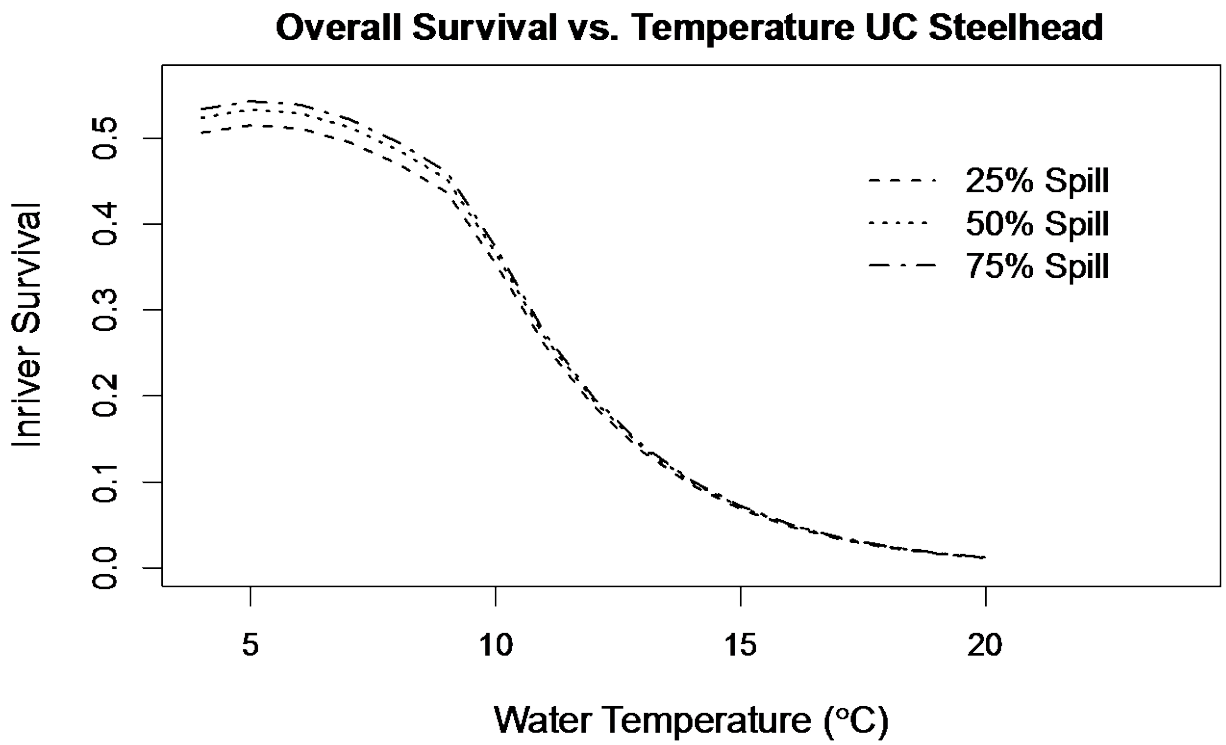

Overall Survival vs. Flow UC Yearling Chinook
Inriver Survival
0.2
0.3
0.4
0.5
150
200
250
300
350
400
450
Columbia River Flow (kcfs)
0% Spill
25% Spill
50% Spill
75% Spill

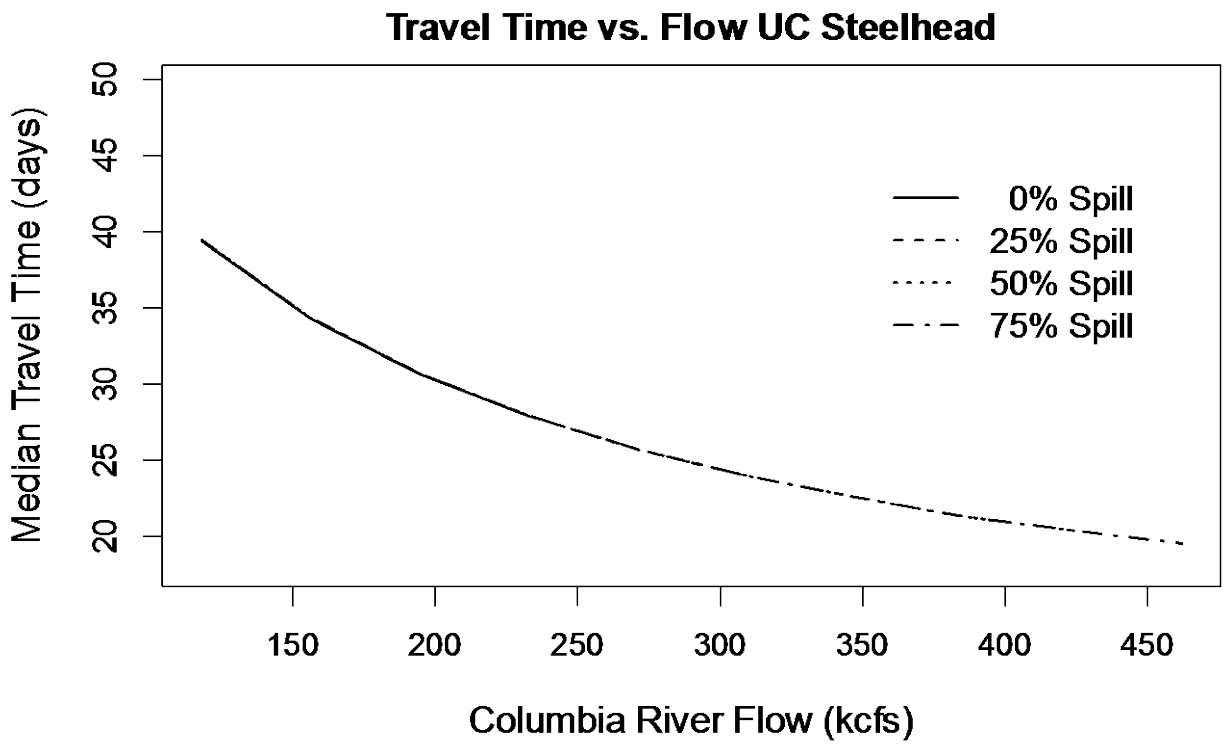

Overall Survival vs. Temperature UC Yearling Chinook
Inriver Survival
0.2
0.3
0.4
0.5
5
10
15
20
Water Temperature (°C)
25% Spill
50% Spill
75% Spill

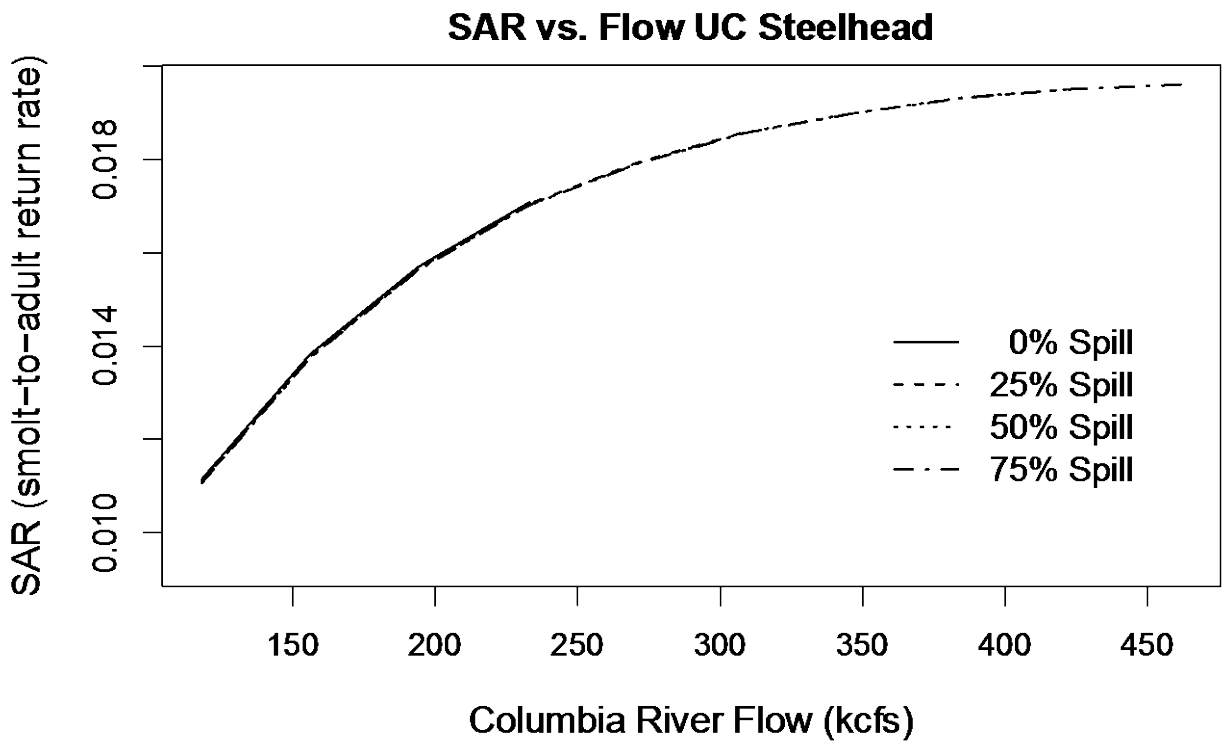

Travel Time vs. Flow UC Yearling Chinook
Median Travel Time (days)
40
45
50
55
60
65
150
200
250
300
350
400
450
Columbia River Flow (kcfs)
0% Spill
25% Spill
50% Spill
75% Spill


SAR vs. Flow UC Yearling Chinook
SAR (smolt−to−adult return rate)
0.005
0.007
0.009
0.011
150
200
250
300
350
400
450
Columbia River Flow (kcfs)
0% Spill
25% Spill
50% Spill
75% Spill


Overall Survival vs. Flow UC Steelhead
Inriver Survival
0.0
0.1
0.2
0.3
0.4
0.5
150
200
250
300
350
400
450
Columbia River Flow (kcfs)
0% Spill
25% Spill
50% Spill
75% Spill


Overall Survival vs. Temperature UC Steelhead
Inriver Survival
0.0
0.1
0.2
0.3
0.4
0.5
5
10
15
20
Water Temperature (°C)
25% Spill
50% Spill
75% Spill


Travel Time vs. Flow UC Steelhead
Median Travel Time (days)
20
25
30
35
40
45
50
150
200
250
300
350
400
450
Columbia River Flow (kcfs)
0% Spill
25% Spill
50% Spill
75% Spill


SAR vs. Flow UC Steelhead
SAR (smolt−to−adult return rate)
0.010
0.014
0.018
150
200
250
300
350
400
450
Columbia River Flow (kcfs)
0% Spill
25% Spill
50% Spill
75% Spill

Evidence for density-dependent avian predation rate on migrating juvenile salmon

James Faulkner, William Muir, and Steven Smith

National Marine Fisheries Service
Northwest Fisheries Science Center
Seattle, WA

Photo Russ Norwood

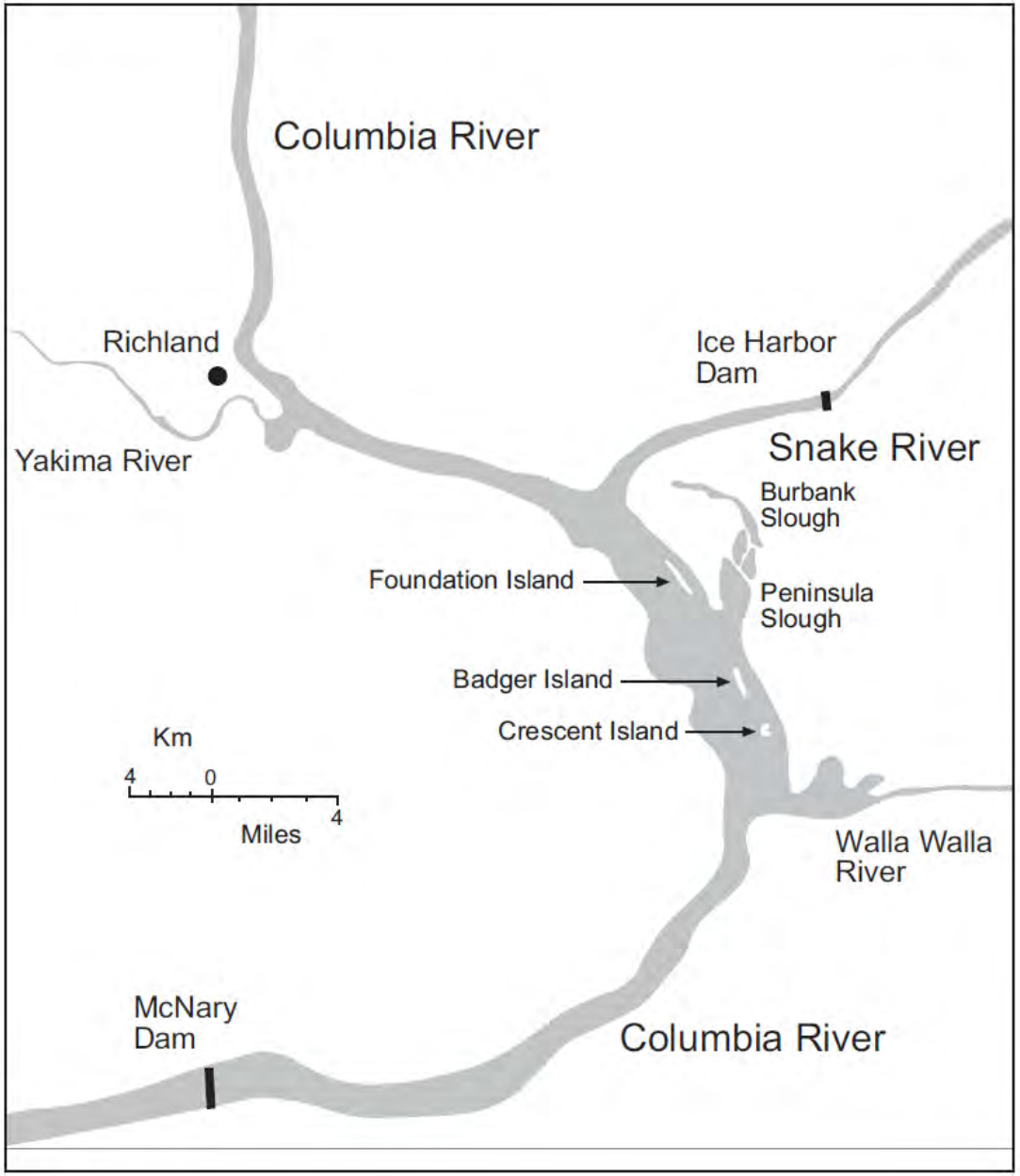
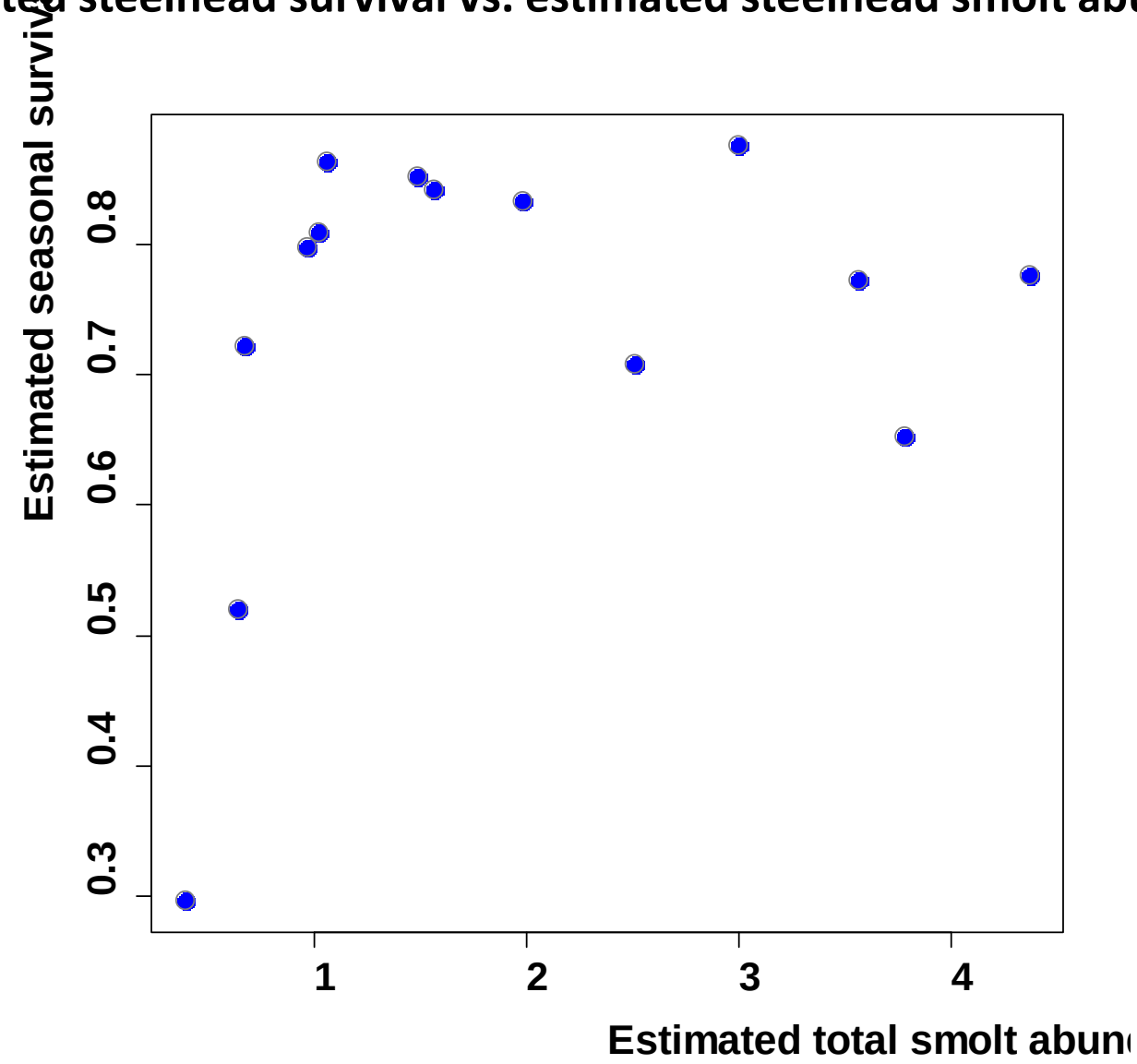


Figure of map 4 from Roby et al. 2010

Estimated steelhead survival vs. estimated steelhead smolt abundance

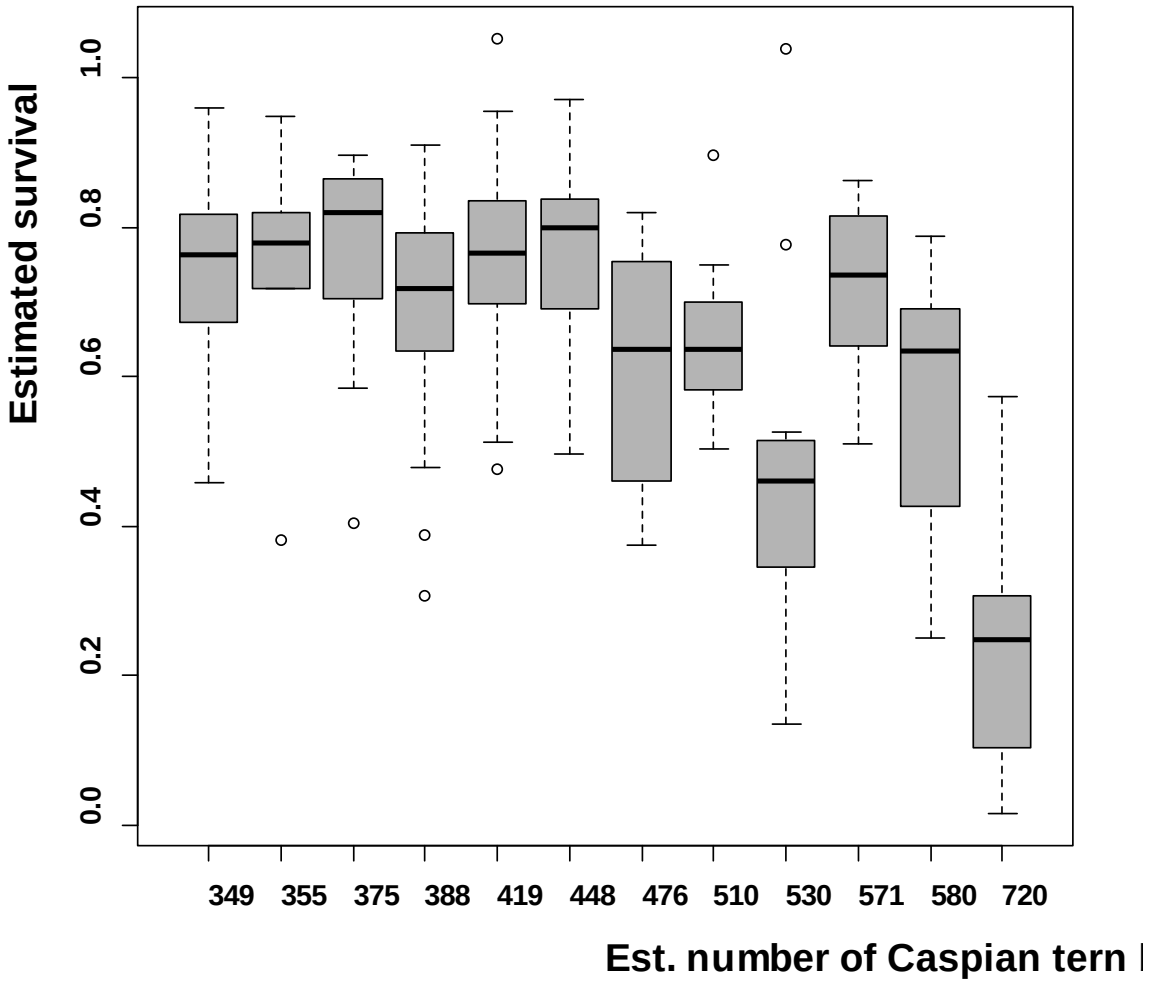


We fit 3 models:

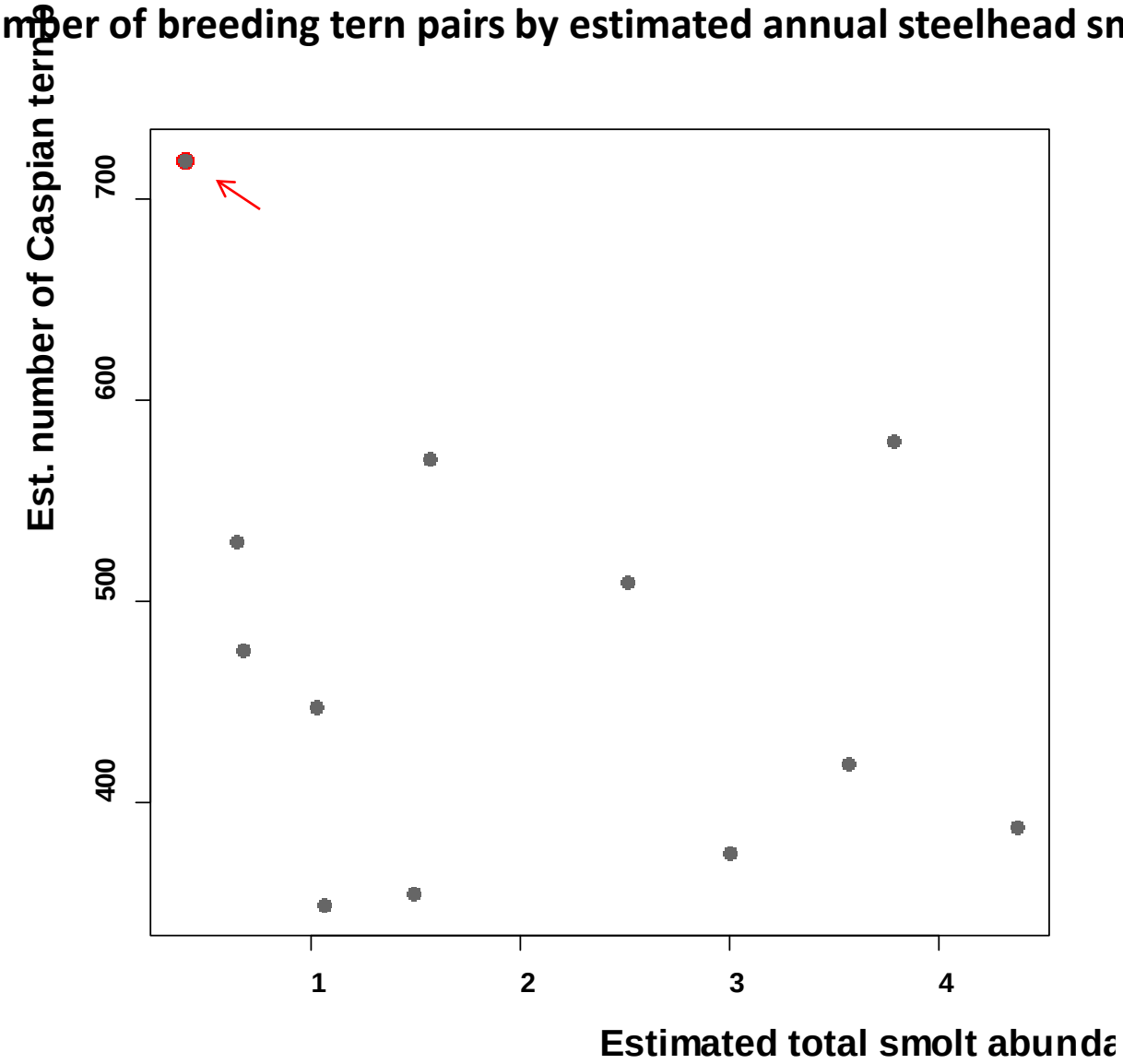
1) Null (current COMPASS model)
2) Survival related to Predator abundance
3) Survival related to predator*prey interaction

Model 2 was most supported.

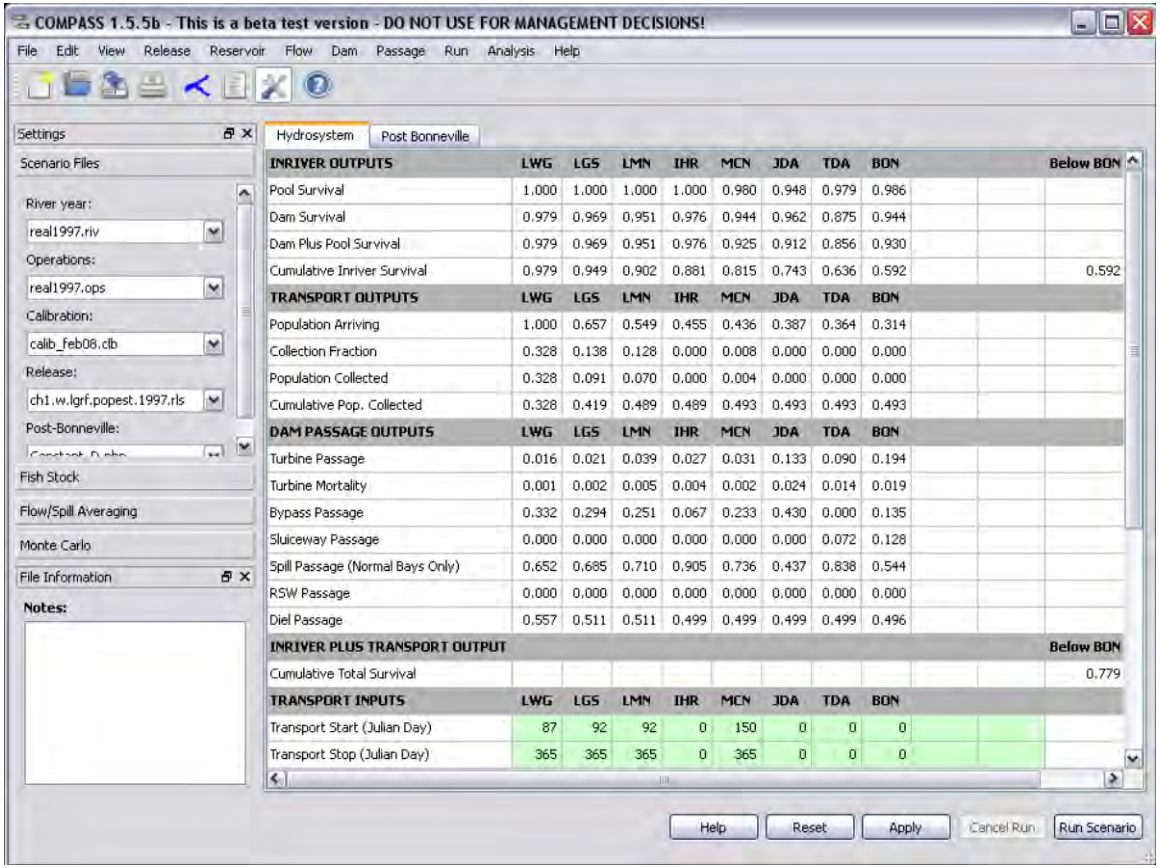
Estimated survival for weekly release groups by annual number of breeding pairs of terns



Estimated number of breeding tern pairs by estimated annual steelhead smolt abundance



Graphical User's Interface



INRIVER OUTPUTS	LWG	LGS	LMN	IHR	MCN	JDA	TDA	BON			Below BON
Pool Survival	1.000	1.000	1.000	1.000	0.980	0.948	0.979	0.986			
Dam Survival	0.979	0.969	0.951	0.976	0.944	0.962	0.875	0.944			
Dam Plus Pool Survival	0.979	0.969	0.951	0.976	0.925	0.912	0.856	0.930			
Cumulative Inriver Survival	0.979	0.949	0.902	0.881	0.815	0.743	0.636	0.592			0.592
TRANSPORT OUTPUTS	**LWG**	**LGS**	**LMN**	**IHR**	**MCN**	**JDA**	**TDA**	**BON**			
Population Arriving	1.000	0.657	0.549	0.455	0.436	0.387	0.364	0.314			
Collection Fraction	0.328	0.138	0.128	0.000	0.008	0.000	0.000	0.000			
Population Collected	0.328	0.091	0.070	0.000	0.004	0.000	0.000	0.000			
Cumulative Pop. Collected	0.328	0.419	0.489	0.489	0.493	0.493	0.493	0.493			
DAM PASSAGE OUTPUTS	**LWG**	**LGS**	**LMN**	**IHR**	**MCN**	**JDA**	**TDA**	**BON**			
Turbine Passage	0.016	0.021	0.039	0.027	0.031	0.133	0.090	0.194			
Turbine Mortality	0.001	0.002	0.005	0.004	0.002	0.024	0.014	0.019			
Bypass Passage	0.332	0.294	0.251	0.067	0.233	0.430	0.000	0.135			
Sluiceway Passage	0.000	0.000	0.000	0.000	0.000	0.000	0.072	0.128			
Spill Passage (Normal Bays Only)	0.652	0.685	0.710	0.905	0.736	0.437	0.838	0.544			
RSW Passage	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000			
Diel Passage	0.557	0.511	0.511	0.499	0.499	0.499	0.499	0.496			
INRIVER PLUS TRANSPORT OUTPUT											**Below BON**
Cumulative Total Survival											0.779
TRANSPORT INPUTS	**LWG**	**LGS**	**LMN**	**IHR**	**MCN**	**JDA**	**TDA**	**BON**			
Transport Start (Julian Day)	87	92	92	0	150	0	0	0			
Transport Stop (Julian Day)	365	365	365	0	365	0	0	0			

Acknowledgements:

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Current COMPASS team:

Jim Faulkner (NOAA)
Dan Widener (NOAA)
Jennifer Gosselin (UW/NOAA)
Nick Beer (UW)
Susannah Iltis (UW)
Jim Anderson (UW)