Spring 2019 Adult Passage
TMT Year End Review, Dec. 11, 2019

Claire McGrath (NOAA)

1) Snake River s/s Chinook adult passage in Lower Snake River

2) Little Goose Operations Effects on Juvenile Passage (COMPASS simulation)

3) Effects of travel time and river conditions on upstream survival (Siegel and Crozier, Dec. 2019)

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Snake River s/s Chinook adult passage in Lower Snake River

- Highlights
  - LMN to LGS and ICH to LGR travel times were slower than expected
    - DART running 3-day tool, FPC Passage Indicator
  - Year-end convergence rates were comparable to recent years (LMN to LGS and ICH to LGR)
  - Must account for fallback when using ladder counts
- Fishing pressure was high but within harvest quota

**See link on TMT website to updated seasonal summary of passage metrics*

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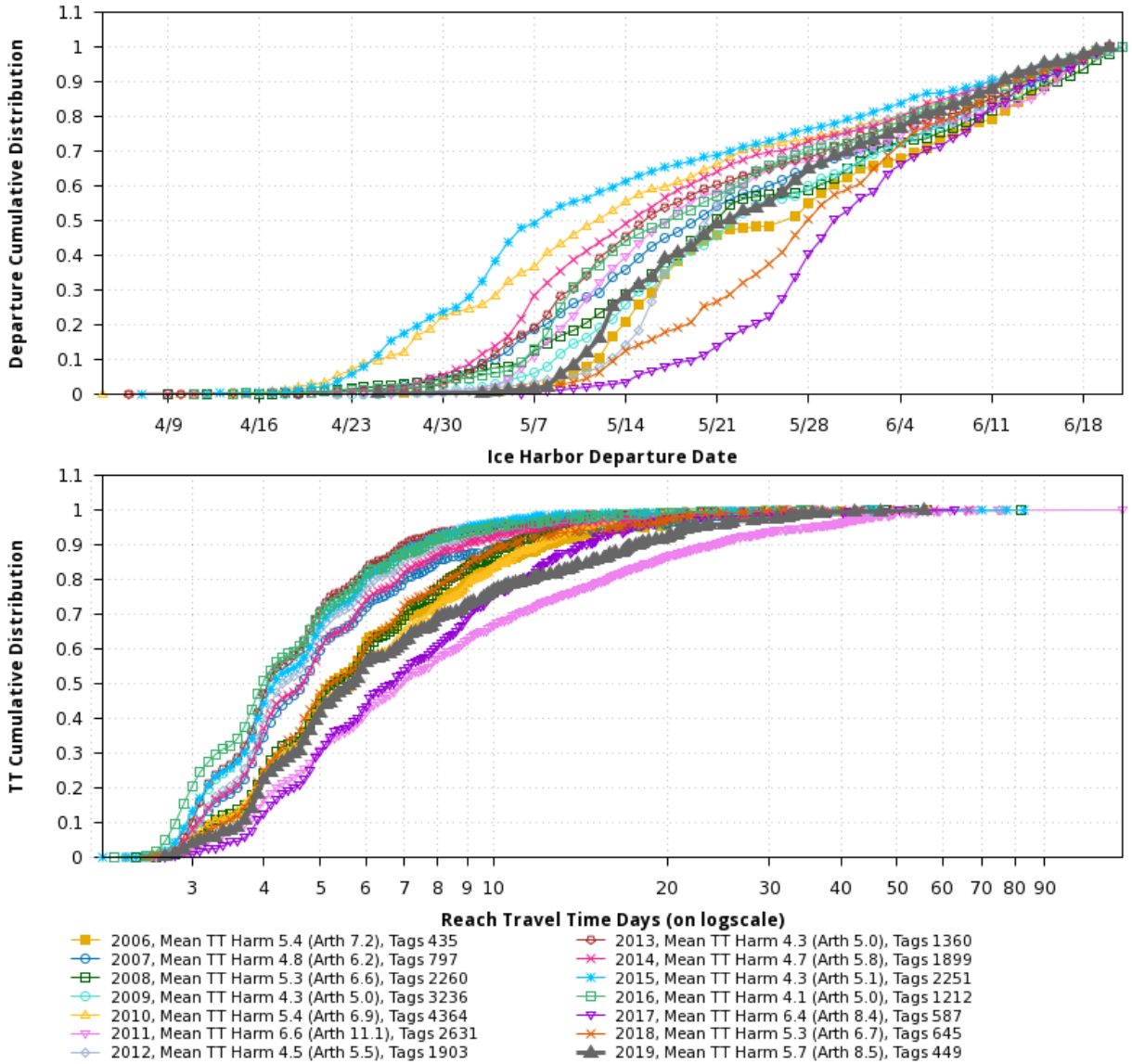
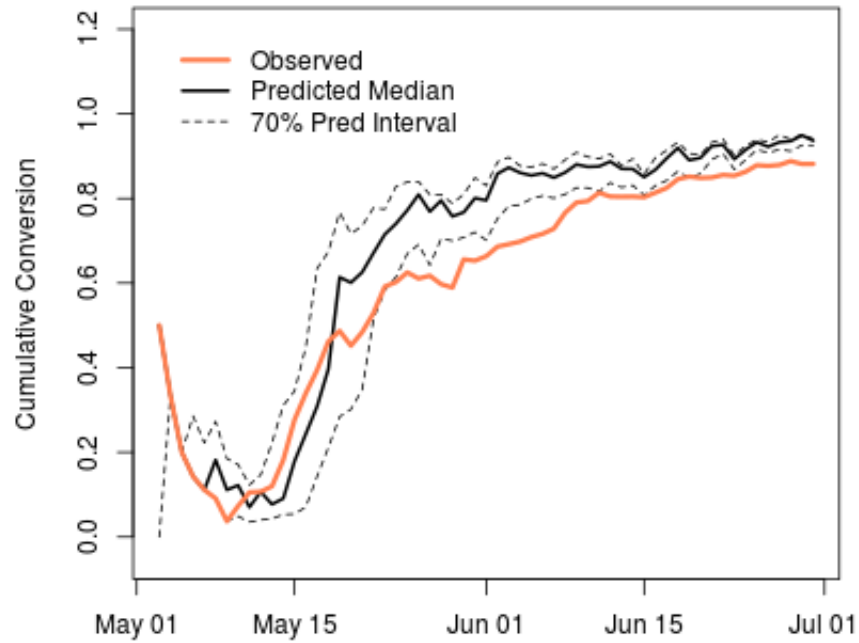
ICH:LWG PIT Tagged Adult Chinook Departures (during Spring Spill 4/3-6/20) and Reach Travel Time

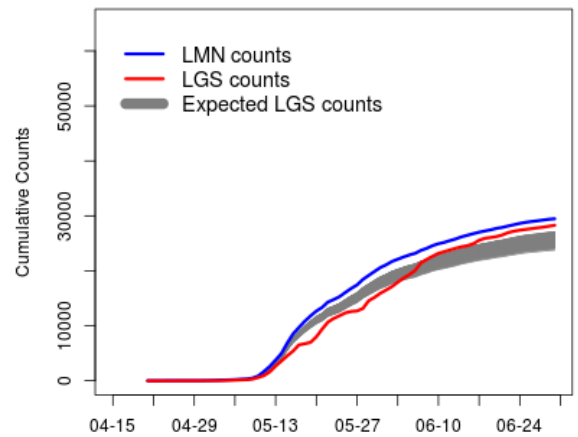


www.cbr.washington.edu/dart/ 2019 data is incomplete (data through 11/24). 25 Nov 2019

IHR to LGR, 2019



LMN & LGS Counts, 2019



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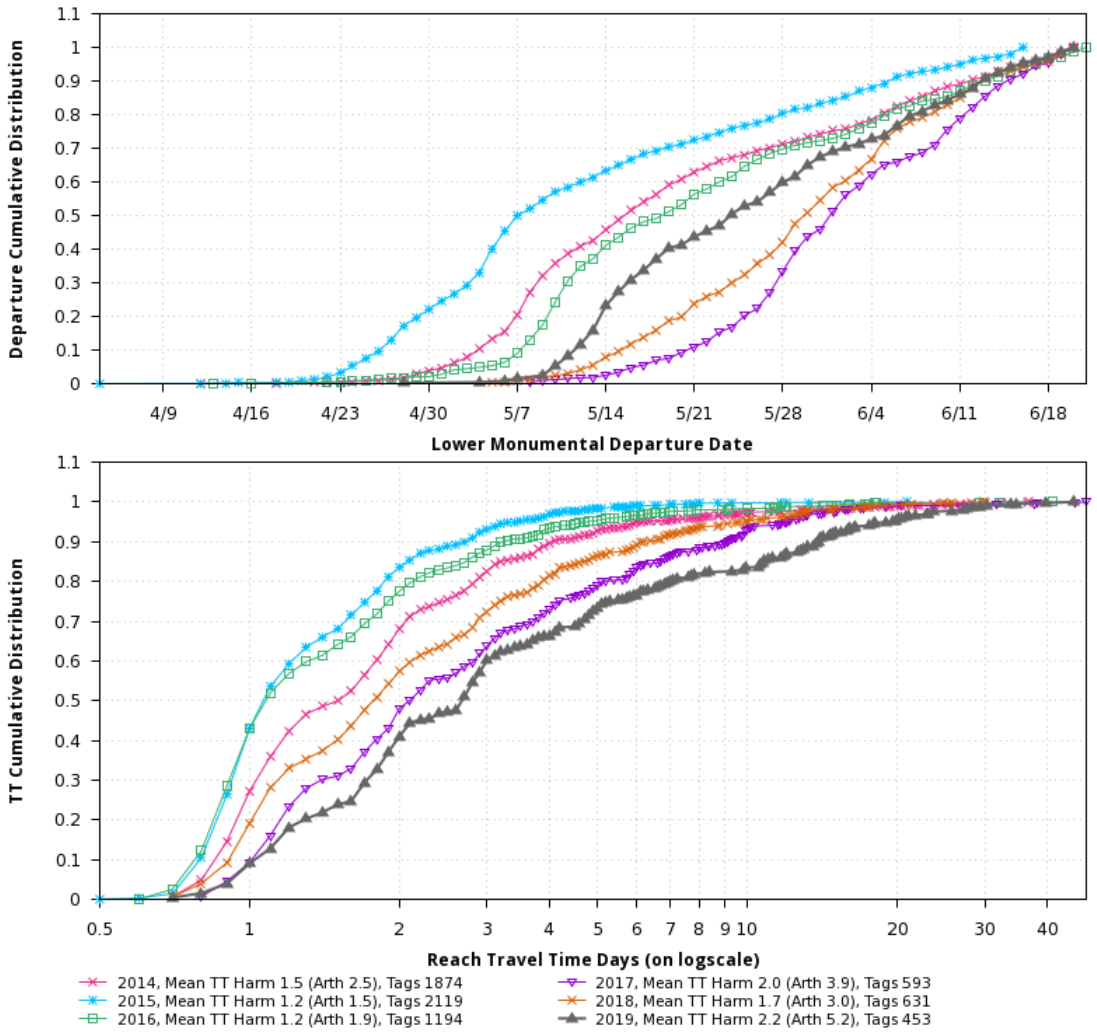
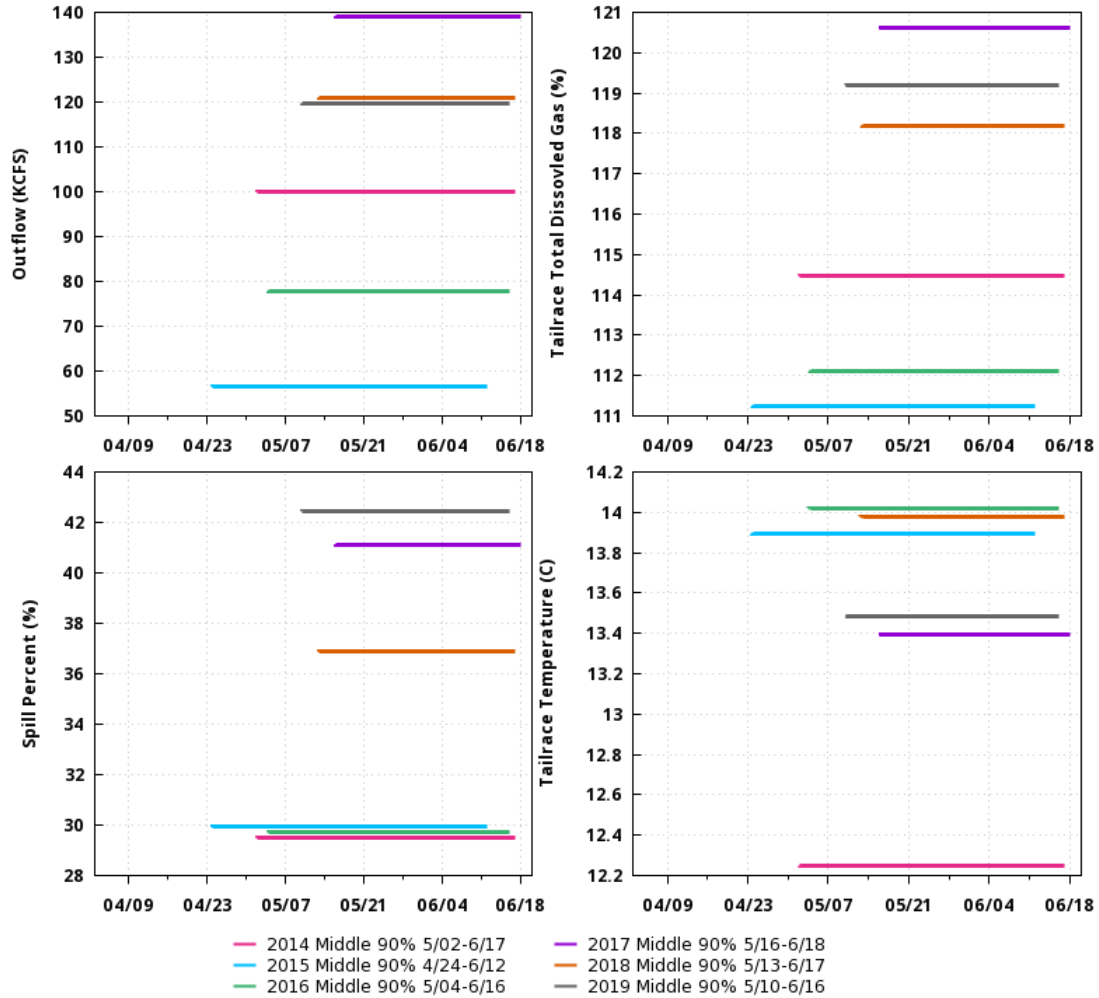
LMN:LGS PIT Tagged Adult Chinook Departures (during Spring Spill 4/3-6/20) and Reach Travel Time



www.cbr.washington.edu/dart/ 2019 data is incomplete (data through 11/24). 25 Nov 2019

River Conditions at Little Goose Averaged over Date Range of Lower Monumental Middle 90% of Adult PIT Tagged Chinook during Spring Spill (4/3-6/20)



www.cbr.washington.edu/dart/ Date Range: Lower Monumental Departure Dates 25 Nov 2019

Little Goose Operations
Effects on Juvenile Passage

- COMPASS[1,2] - compare hydrosystem survival across management scenarios
  - Calibrated for SR s/s Chinook salmon and SR steelhead in Columbia and Snake Rivers
  - Realistically simulates downstream survival and travel time of juvenile salmon under variable river conditions
  - Operate on sub-seasonal time steps
  - Produces results in agreement with available data (e.g., PIT tag)
  - Allows users to simulate effects of alternative management actions

[1] Comprehensive Passage (COMPASS) Model version 2.0 Review DRAFT Manual, July 2019.

[2] Zabel et al. (2008) Comprehensive passage (COMPASS) model: a model of downstream migration and survival of juvenile salmonids through a hydropower system. Hydrobiologia 609:289-300.

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Scenarios – Model run for spring, April 3 – June 20

Gas cap

- 120% spill cap (2019)
- 125% spill cap (2020)

Hydrology – operations applied to hourly flows within historical flow records

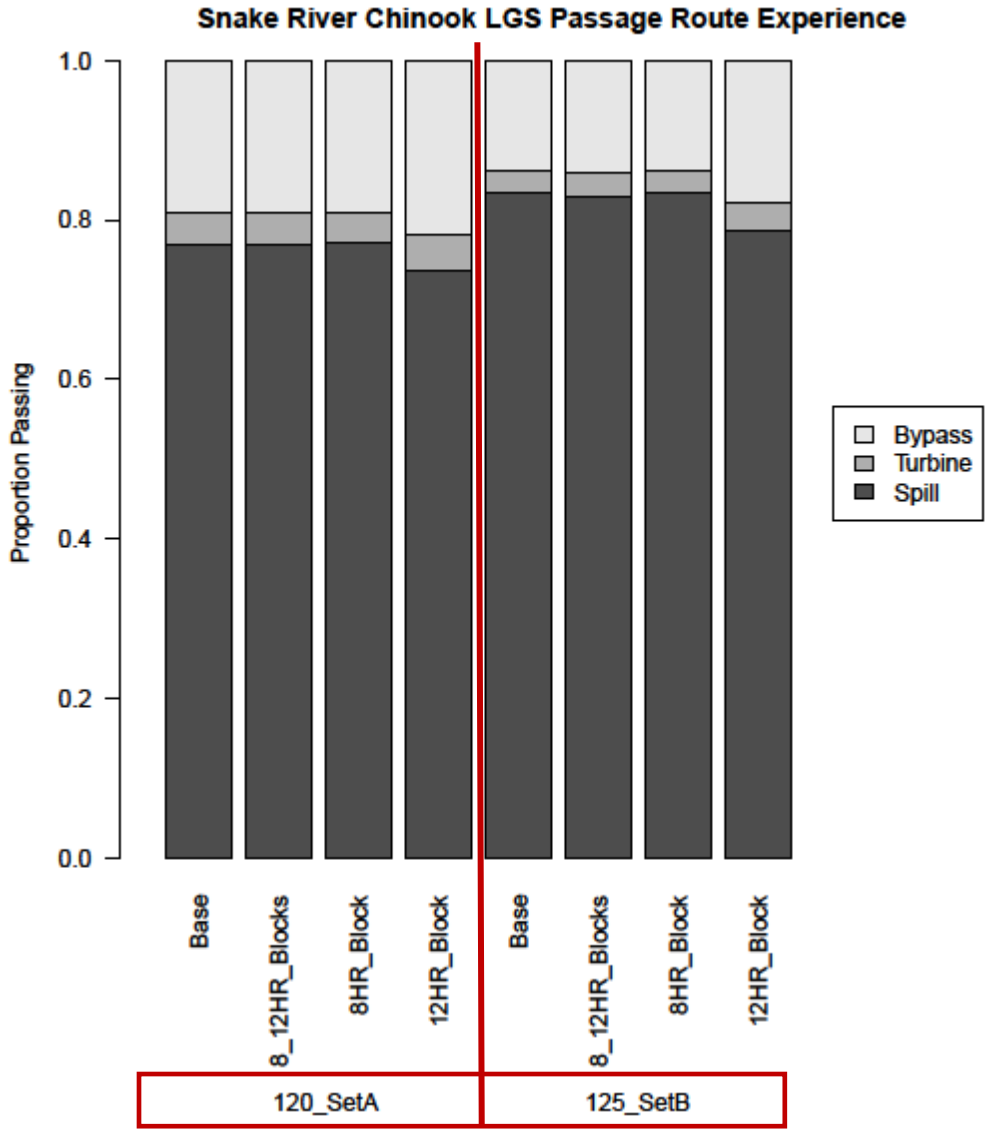
- 2011 (Wet)
- 2019
- 2015 (Dry)

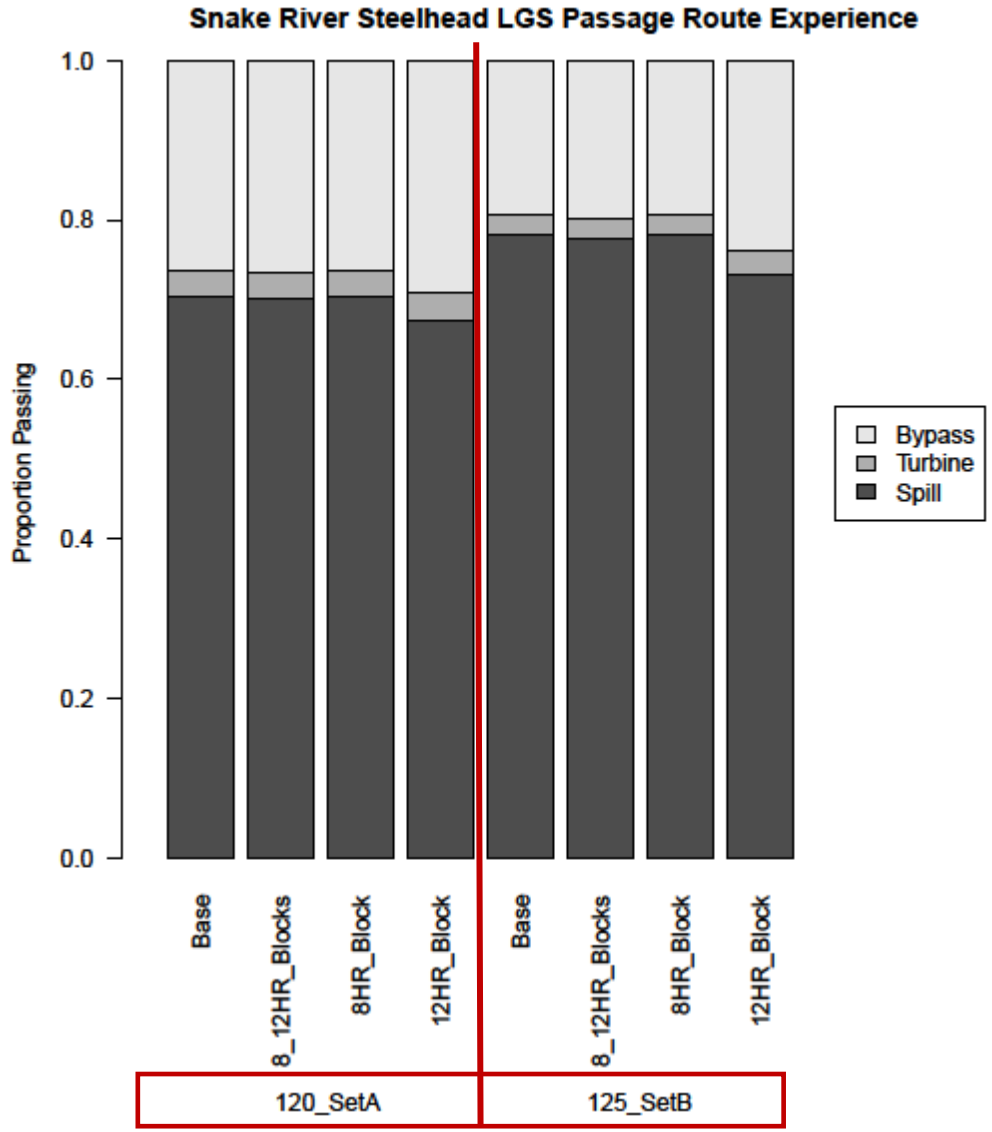
Spill Operations

- Baseline 4 hr am, 4 hr pm (B)
- LGS 8 hr block
- LGS 8-12 hr block
- LGS 12 hr block

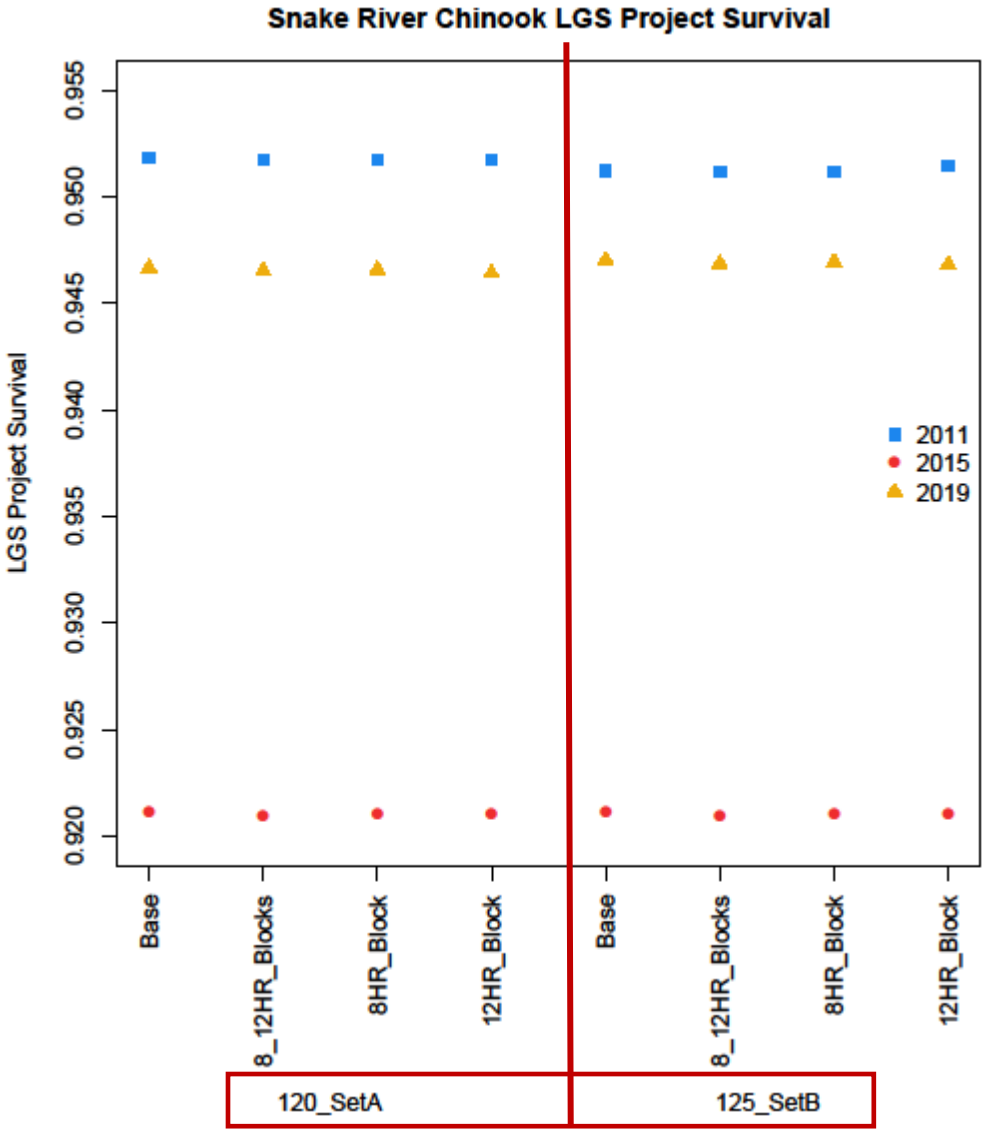
Project	Baseline	LGS 8 hour block	LGS 8-12 hour blocks	LGS 12 hour block
LWG	B	B	B	B
LGS	B	8 hr block	April 3 – May 15: 8 hr block May 16 – June 20: 12 hour block	12 hr block
LMN	B	B	B	B
IHR	B	B	B	B
MCN	B	B	B	B
JDA	B	B	B	B
TDA	B	B	B	B
BON	B	B	B	B

Passage Route (average over water years)





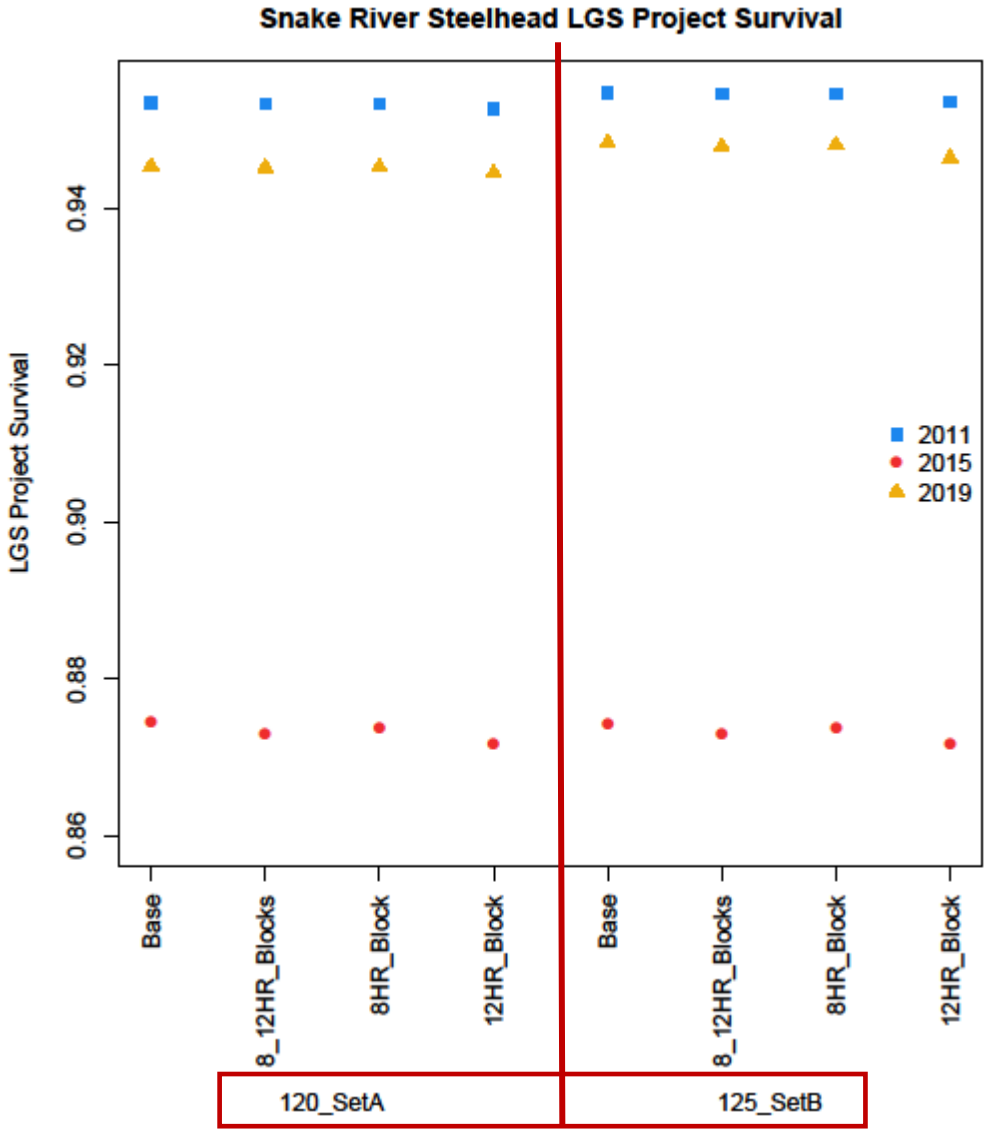
Little Goose Project Survival



Wet

2019

Dry



LGS Juvenile Passage – Chinook, Average over water years

Gas Cap	Performance Spill Hours	Mean Hydrosystem Survival	LGS Project Survival	Proportion Destined for Transport	Proportion Powerhouse Passage
120%	Baseline	56.68%	93.99%	31.1%	21.2%
	8-12 hr blocks	56.69%	93.97%	31.2%	21.2%
	8 hr block	56.67%	93.98%	31.1%	21.2%
	12 hr block	56.71%	93.97%	32.2%	21.6%
125%	Baseline	56.77%	93.98%	22.3%	17.7%
	8-12 hr blocks	56.79%	93.97%	22.5%	17.75%
	8 hr block	56.76%	93.97%	22.3%	17.70%
	12 hr block	56.82%	93.98%	24.3%	18.30%

Chinook, 2019 Model Year Results

Gas Cap	Performance Spill Hours	In-River Survival (LGR to BON)	Proportion Transported	Mean Travel Time (LGR to BON)
120%	Baseline	59.49%	47.9%	19.55
	8-12 hr blocks	59.49%	48.0%	19.56
	8 hr block	59.48%	47.9%	19.55
	12 hr block	59.53%	48.8%	19.60
125%	Baseline	59.57%	32.2%	18.77
	8-12 hr blocks	59.59%	32.6%	18.80
	8 hr block	59.57%	32.2%	18.78
	12 hr block	59.64%	34.6%	18.87

Steelhead, 2019 Model Year Results

Gas Cap	Performance Spill Hours	In-River Survival (LGR to BON)	Proportion Transported	Mean Travel Time (LGR to BON)
120%	Baseline	52.78%	51.6%	16.39
	8-12 hr blocks	52.78%	51.7%	16.40
	8 hr block	52.77%	54.6%	16.39
	12 hr block	52.79%	52.1%	16.42
125%	Baseline	53.09%	37.4%	15.95
	8-12 hr blocks	53.11%	37.7%	15.97
	8 hr block	53.07%	37.4%	15.96
	12 hr block	53.10%	39.3%	16.01

Effects of travel time and river conditions on upstream survival of Snake River s/s Chinook (Siegel and Crozier, Dec. 2019)

1) How do conditions at Little Goose Dam affect travel times from Ice Harbor to Lower Granite?

2) How does travel time at three spatial scales within the hydrosystem affect apparent survival to spawning tributaries?

3) Can we detect an effect of conditions at Little Goose Dam on upstream survival directly?

Key Challenge = highly variable upstream detection efficiencies

Apparent survival = Fxn (Survival, Detection probability)

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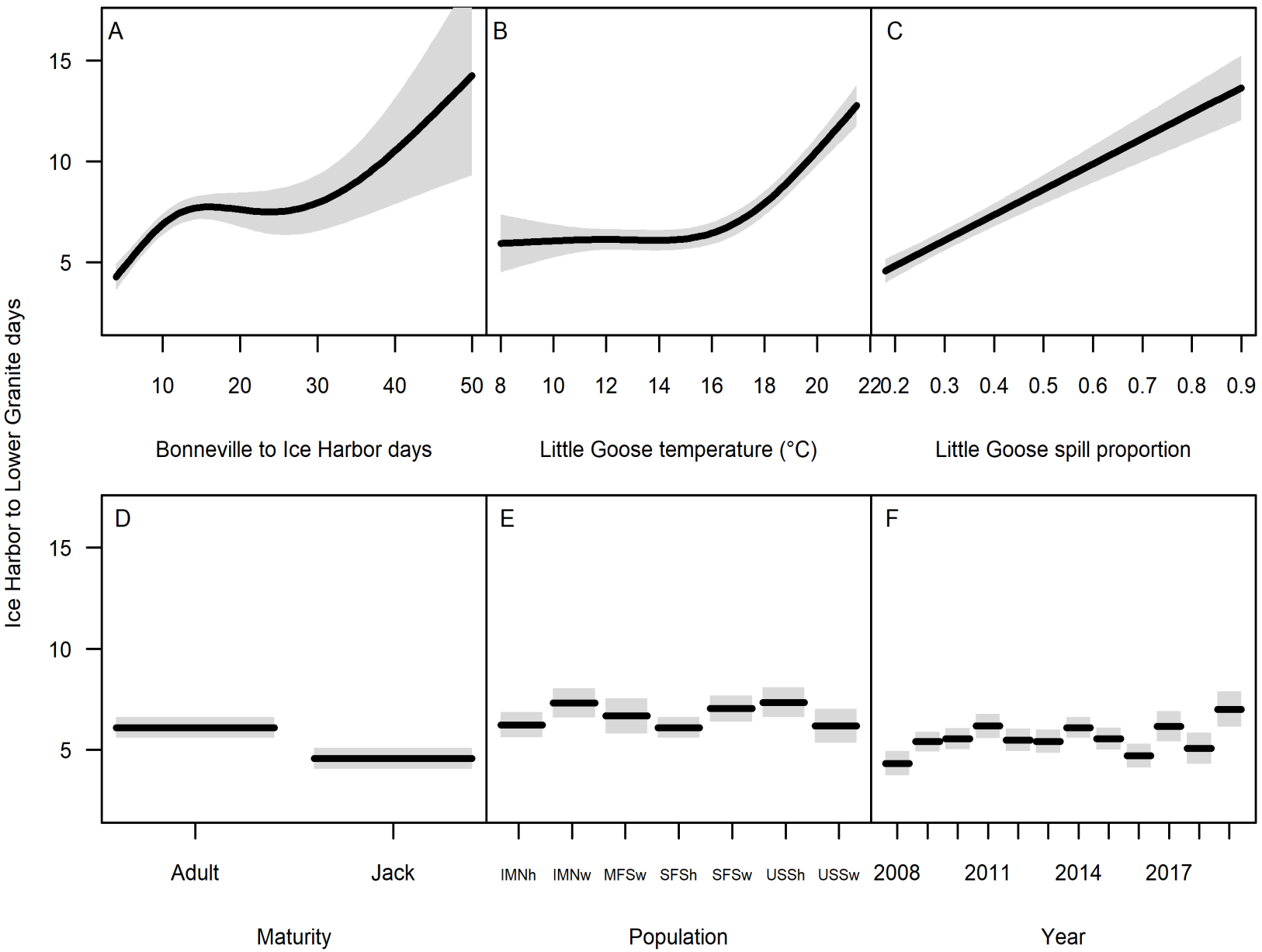
Objective 1: How do conditions at Little Goose Dam affect travel times from Ice Harbor to Lower Granite?



A. Slower migrating fish in the LC are more likely to continue to migrate slowly in the Snake

B. Temperatures above ~17C leads to slower migration

C. Fish tend to migrate slower at higher spill proportions

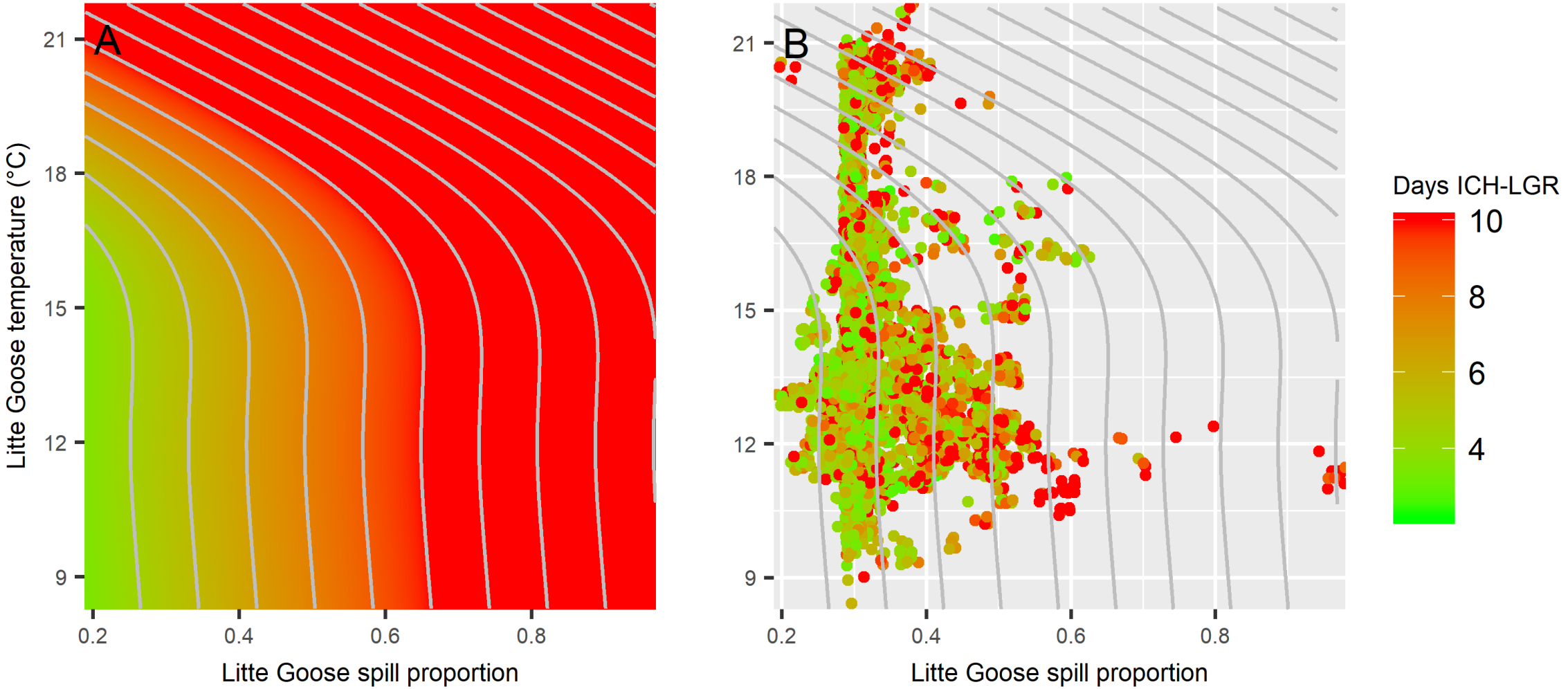
D. Jacks migrate faster than Adults

E. Some variability among populations

F. Some remaining variability across years

$$MigrationS_i = s(MigrationLC_i) + s(Temp._{3i}) + s(SpillProp._{3i}) + Age_i + Population + random(year)$$

Objective 1: How do conditions at Little Goose Dam affect travel times from Ice Harbor to Lower Granite?



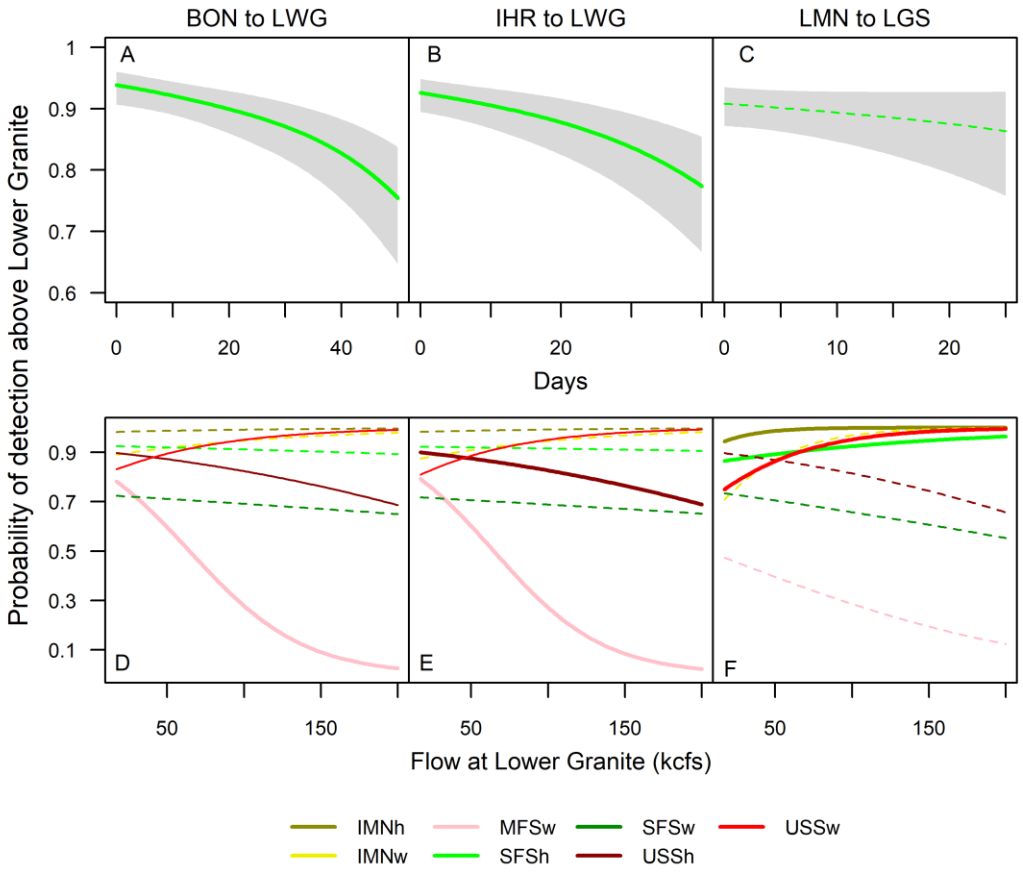
- Results suggest that early-migrating fish may slow down in Snake during high spill events
- Late-migrating fish are more likely to delay due to temperature

Objective 2: How does travel time at three spatial scales within the Power System affect apparent survival to spawning tributaries?

A-C: Slower migrating fish are less likely to survive to spawning rivers, effects of reaches vary.

B: Continuous decline in survival with delayed migration in Snake.

D-F: Results consistent with our hypothesis that flow affects detection ability. Effects on survival may be detectable in some populations but not others
(when flow has less effect on detection ability, we can see the effect on survival)



Objective 3: Can we detect an effect of conditions at Little Goose Dam on upstream survival directly?

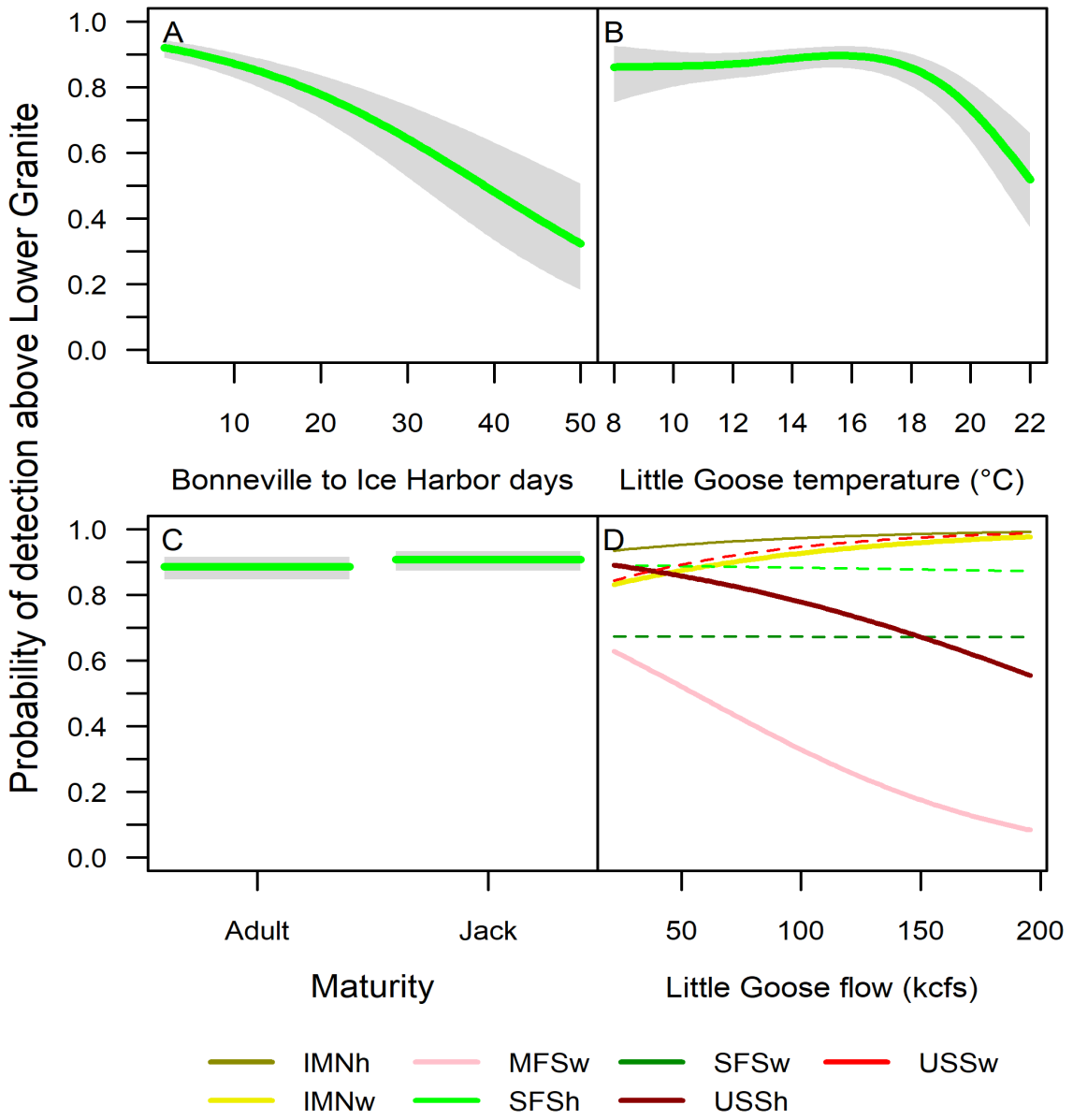
A. Substantial effect of migration time in LC retained

B. High temperature affects both migration speeds and upstream survival

C. Jacks have slightly higher migration survival

D. Interaction suggests flow reduces detection ability in some populations but may also positively affect survival

$$MigrationS_i = s(MigrationLC_i) + s(Temp._{3i}) + Age_i + Flow_{3i} * Population + \text{Year} * Population$$



Upstream Survival Study (Siegel and Crozier, 2019) Conclusions

- New models attempted to account for population-specific detection ability in spawning tributaries
- Temperatures above 18 ^{o}C cause migration delays and declines in survival
- Higher spill proportions (at LGS and other projects) are related to migration delays in the Snake, and delays in migration are associated with lower survival generally
- However, an effect of Little Goose spill on survival was not detected
  - High spill correlated with higher tributary flows, which may positively affect survival
  - Flow and spill affect the entire migration, Little Goose only explains a small piece
  - Little Goose reach has relatively small sample sizes

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Perspectives to Inform Management

- Higher spill proportions increase travel time and are associated with lower upstream survival

- Temperature: temperatures above 18 °C are associated with longer travel times and lower upstream survival

- The range of spill operations at LGS considered in 2019 and 2020 had little to no effect on juvenile travel time or project survival in COMPASS simulations

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