# Effects of Encountering Juvenile Bypass Systems on Migration and Smolt-to-Adult Survival Rates

Tommy Garrison

Fish Passage Center

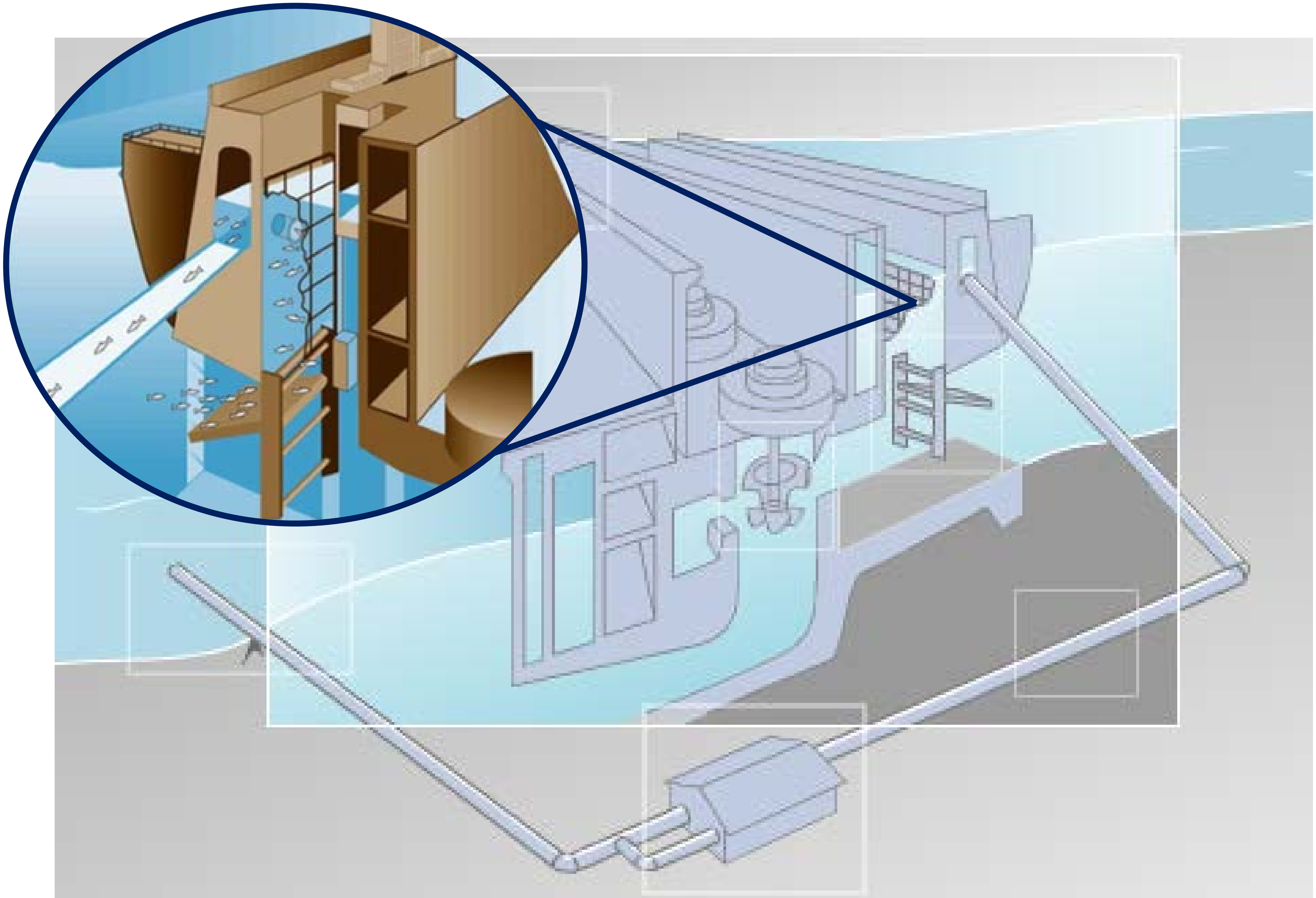
tgarrison@fpc.org

# Some of the Previous Research

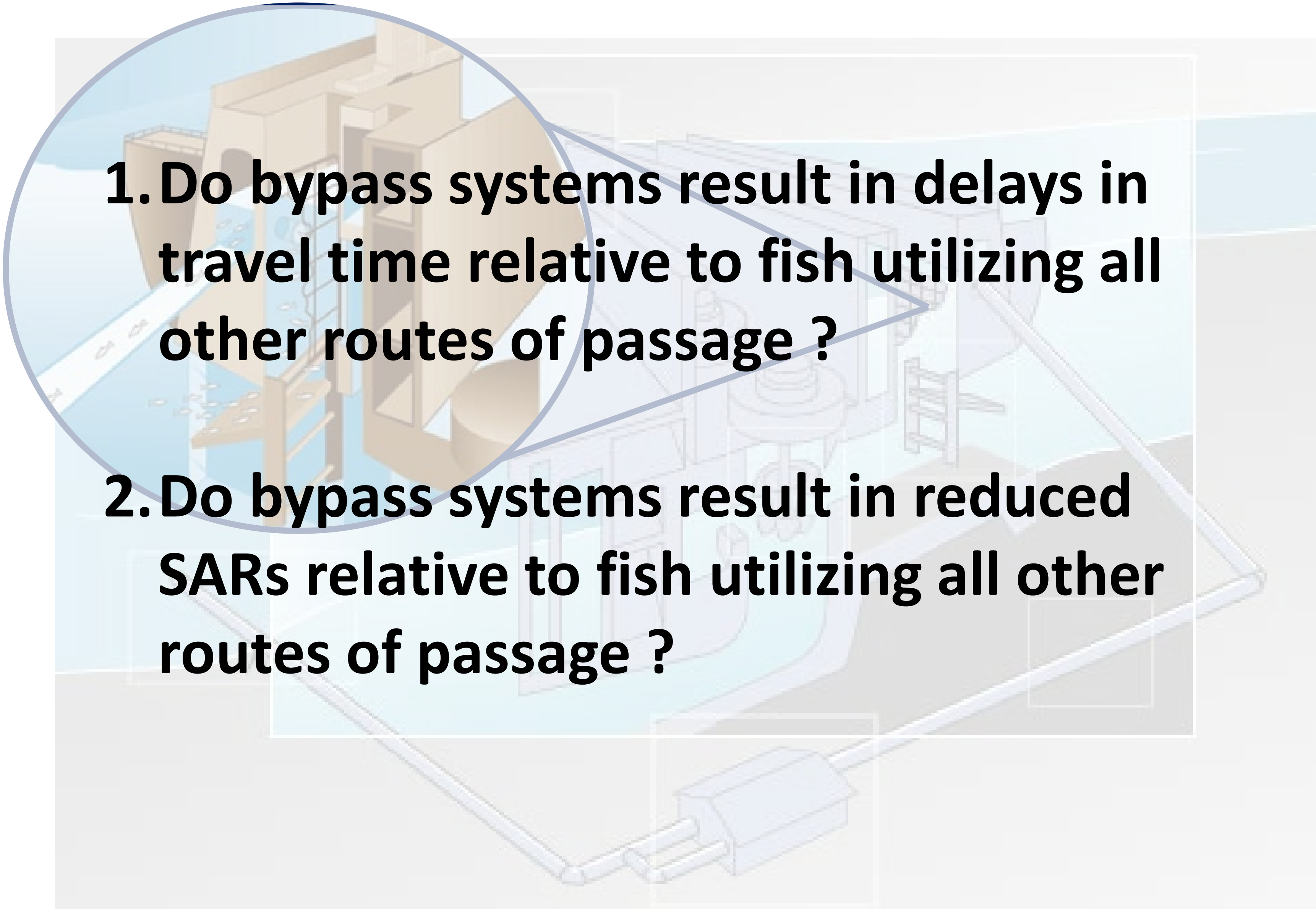
- Juvenile bypass and migration delay
  - Beeman and Maule (2001)
  - Muir et al. (2001)
  - Tuomikoski et al. (2010)

- Juvenile bypass and SARs
  - Sandford and Smith 2002
  - Williams et al. 2005
  - Ferguson et al. 2006
  - Buchanan et al. 2011
  - Tuomikoski et al. (2010)

# Juvenile Bypass Systems



# Juvenile Bypass Systems



1. Do bypass systems result in delays in travel time relative to fish utilizing all other routes of passage ?

2. Do bypass systems result in reduced SARs relative to fish utilizing all other routes of passage ?

# Comparative Survival Study

- PIT-tagged spring/summer Chinook + steelhead
- Migration years 2006-2014

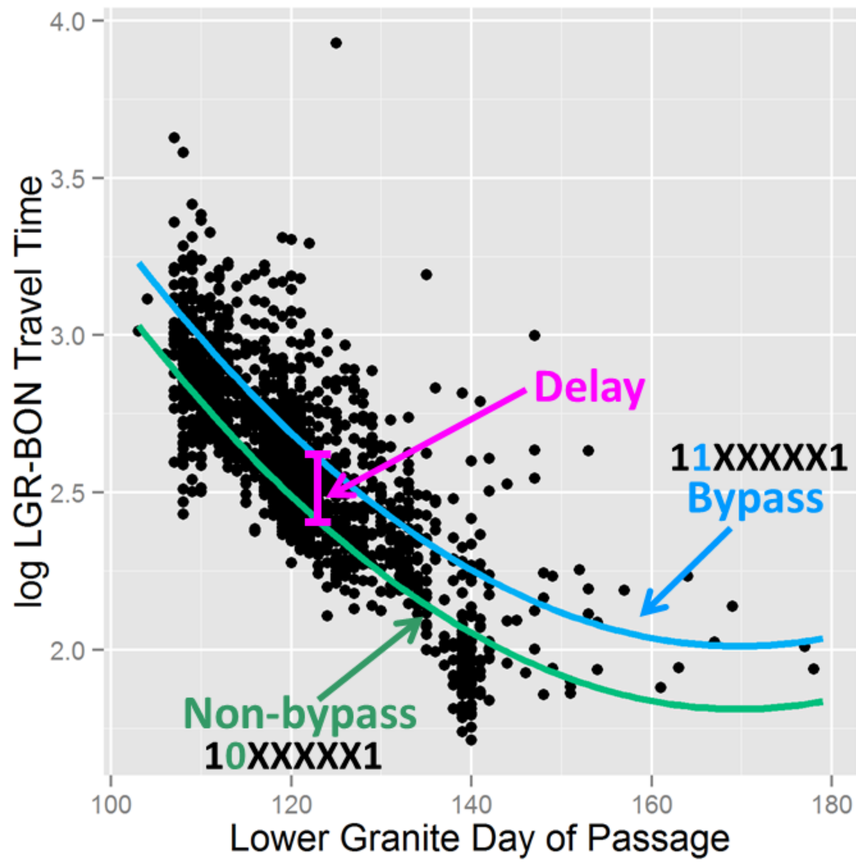
# Mixed Models for Travel Time

Travel Time ~ Gamma($\mu$,$r$)

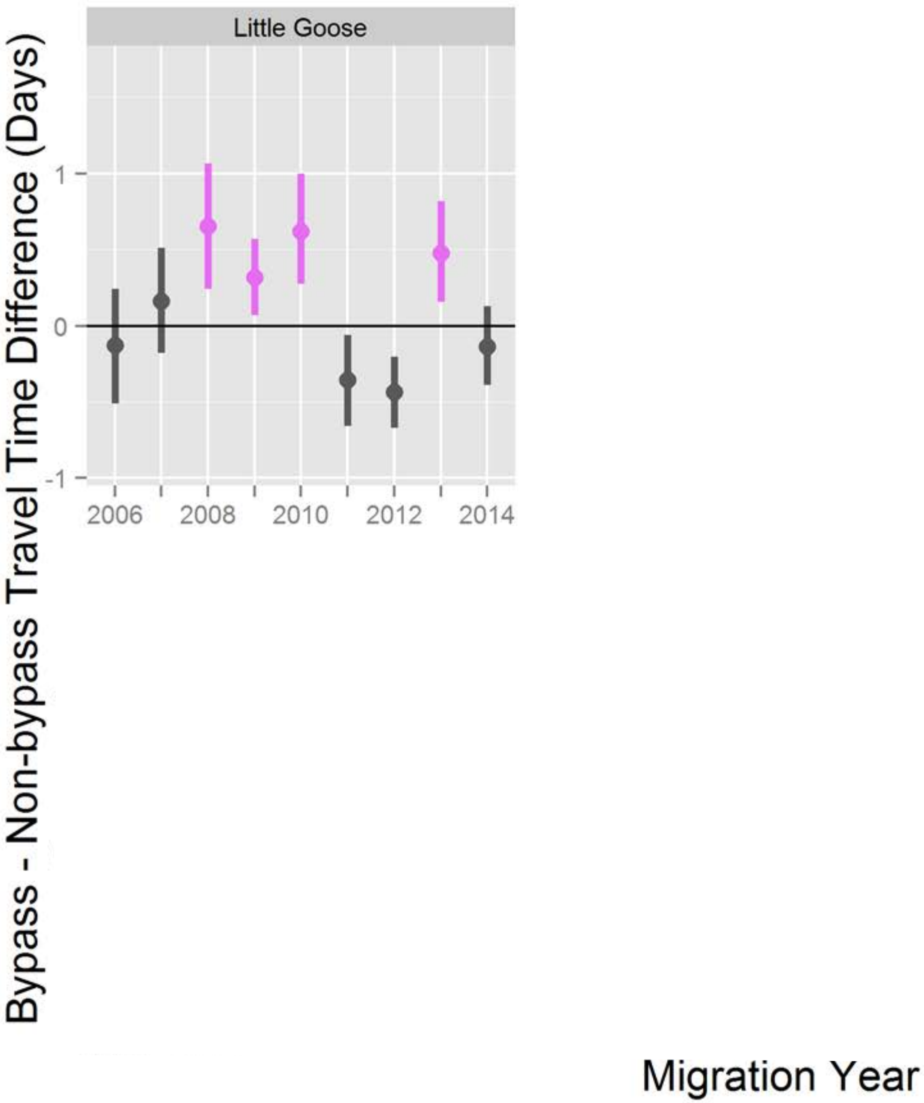
$\log(\mu)$ = Fixed + Random

Fixed = (Day +Flow +
Specific Dam Effects) x
Year

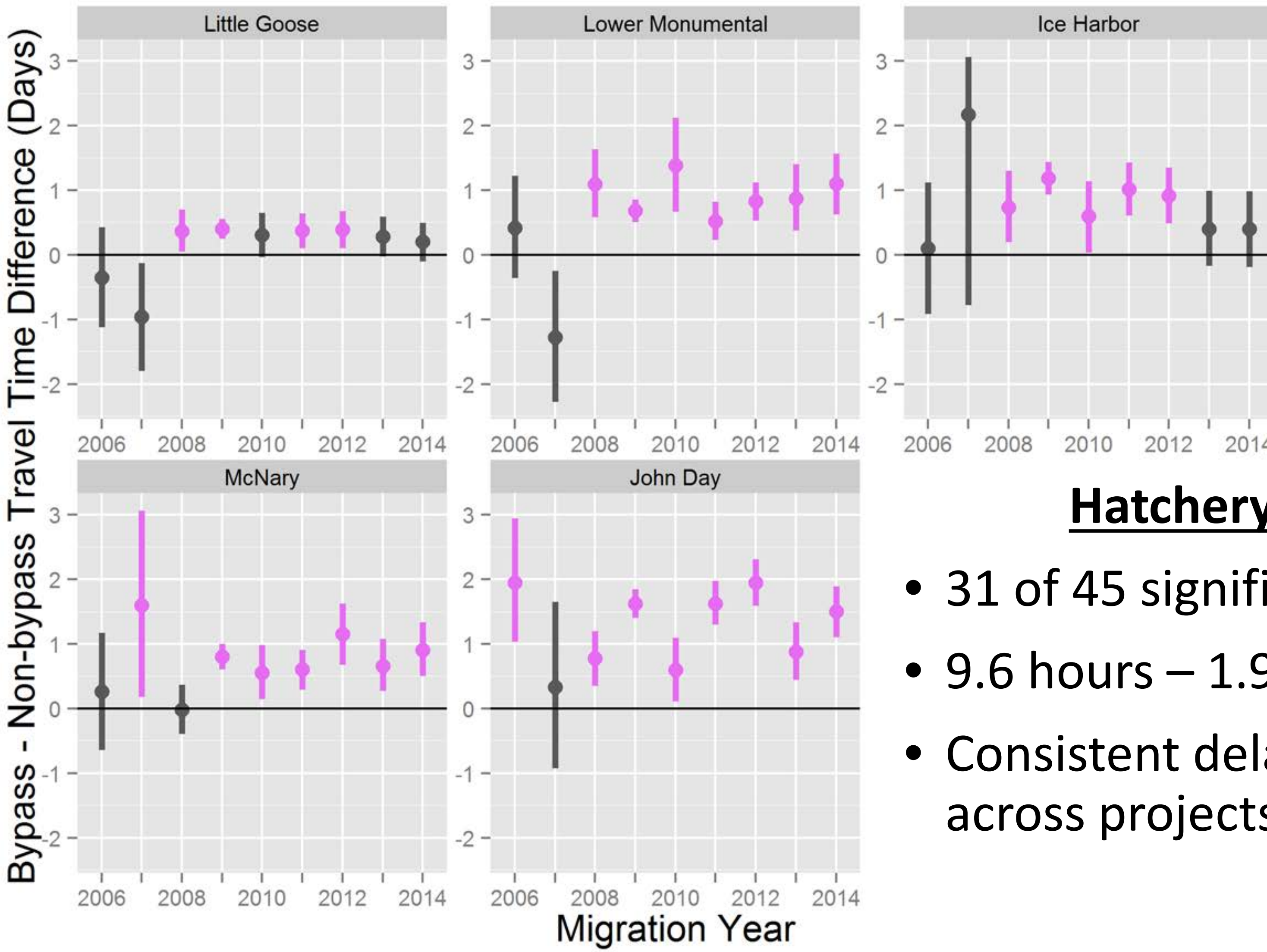
Random = Origin
Origin ~ Normal(0, $\sigma_O$)



# Estimates of Bypass Delay



# Estimates of Bypass Delay




**Hatchery Steelhead**

- 31 of 45 significant estimates
- 9.6 hours – 1.9 days delay
- Consistent delay observed across projects and years

# Mixed Models for SARs

Survival ~ Bernoulli($p$)

logit($p$) = Fixed + Random

Fixed = (Day +

Cumulative Bypass Effects ) x

Year

Random = Origin

Origin ~ Normal(0, $\sigma_O$)

Length ~ Normal(0, $\sigma_L$) ?

Evidence Linking Delayed Mortality of Snake River Salmon to Their Earlier Hydrosystem Experience

PHAEDRA BUDY* AND GARY P. THIEDE

Utah Cooperative Fish and Wildlife Research Unit, U.S. Geological Survey, Department of Fisheries and Wildlife, Utah State University, Logan, Utah 84322-5290, USA

NICK BOUWES

Eco Logical Research, 456 South 100 West, Providence, Utah 84332, USA

C. E. PETROSKY

Idaho Department of Fish and Game, 600 South Walnut Street, Post Office Box 25, Boise, Idaho 83707, USA

HOWARD SCHALLER

Columbia River Program Office, U.S. Fish and Wildlife Service, 9317 Northeast Highway 99, Suite I, Vancouver, Washington 98665, USA

Abstract.—The numbers of Snake River salmon and steelhead Oncorhynchus spp. have substantially declined since the completion of the Columbia River hydrosystem. We used analytical approaches to identify management options for halting the decline of these stocks, such as removal of Snake River dams and improvements to the existing hydrosystem. The benefits these actions are predicted to have in terms of salmon recovery hinge on whether the mortality that takes place in the estuary and early in their ocean residence is related to earlier hydrosystem experience during

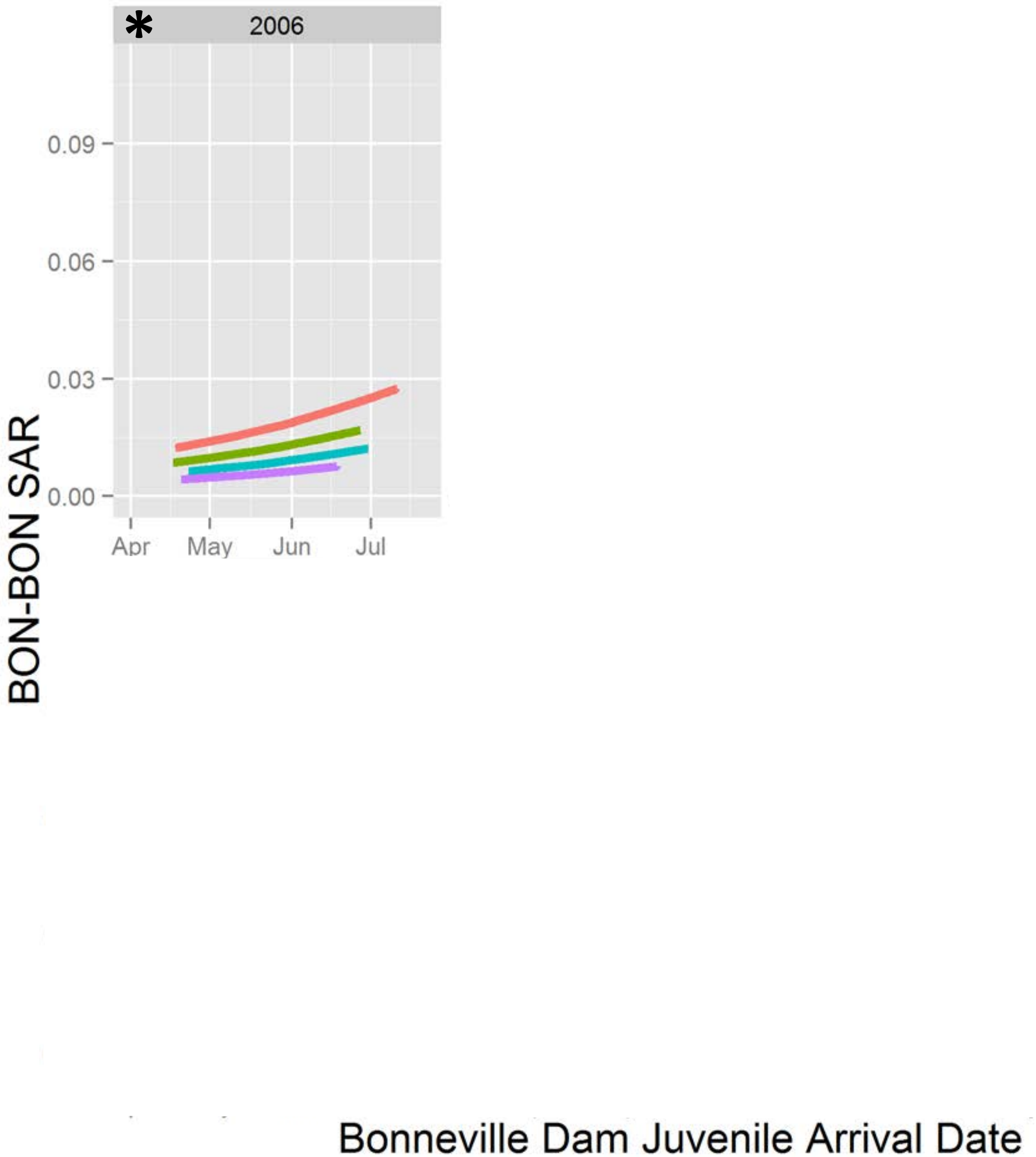
SURVIVAL AND SELECTION OF MIGRATING SALMON FROM CAPTURE–RECAPTURE MODELS WITH INDIVIDUAL TRAITS

RICHARD W. ZABEL,[1,*] TYLER WAGNER,[2,3] JAMES L. CONGLETON,[3] STEVEN G. SMITH,[1] AND JOHN G. WILLIAMS[1]

[1]Northwest Fisheries Science Center, 2725 Montlake Blvd. E, Seattle, Washington 98112-2097 USA
[2]Idaho Cooperative Fish and Wildlife Research Unit, Department of Fish and Wildlife Resources, University of Idaho, Moscow, Idaho 83844-1141 USA
[3]U.S. Geological Survey, Idaho Cooperative Fish and Wildlife Research Unit, Department of Fish and Wildlife Resources, University of Idaho, Moscow, Idaho 83844-1141 USA

Abstract. Capture–recapture studies are powerful tools for studying animal population dynamics, providing information on population abundance, survival rates, population growth rates, and selection for phenotypic traits. In these studies, the probability of observing a tagged individual reflects both the probability of the individual surviving to the time of recapture and the probability of recapturing an animal, given that it is alive. If both

# Post-Bonneville SARs

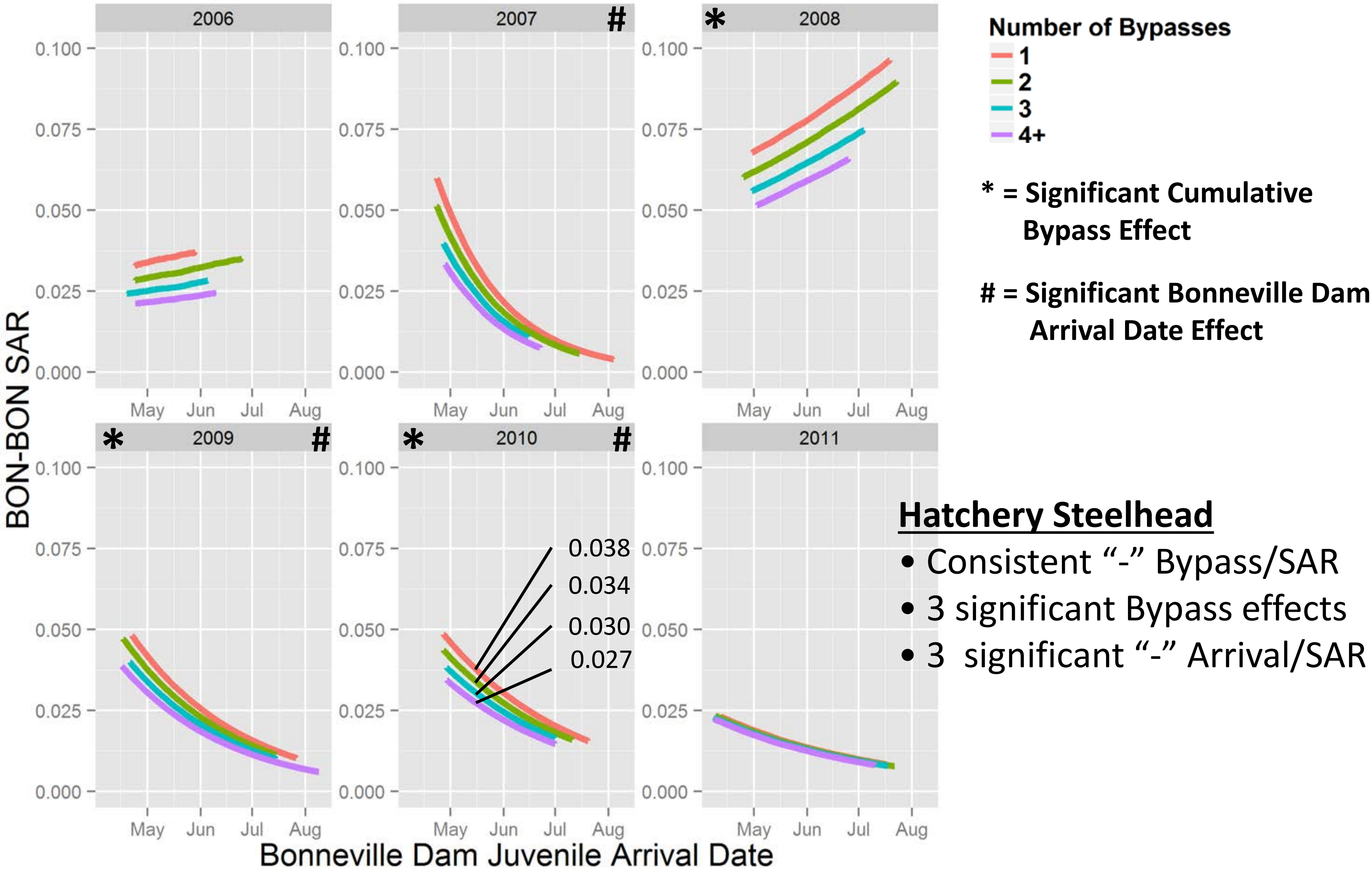



**Number of Bypasses**
- 1
- 2
- 3
- 4+

*** = Significant Cumulative Bypass Effect**

**# = Significant Bonneville Dam Arrival Date Effect**

# Post-Bonneville SARs




**Hatchery Steelhead**

- Consistent "-" Bypass/SAR
- 3 significant Bypass effects
- 3 significant "-" Arrival/SAR

# Overall Conclusions

- Bypass systems delay fish
- Reducing bypass exposure should increase SARs
- There's other metrics related to bypass systems than concrete survival