USGS
science for a changing world

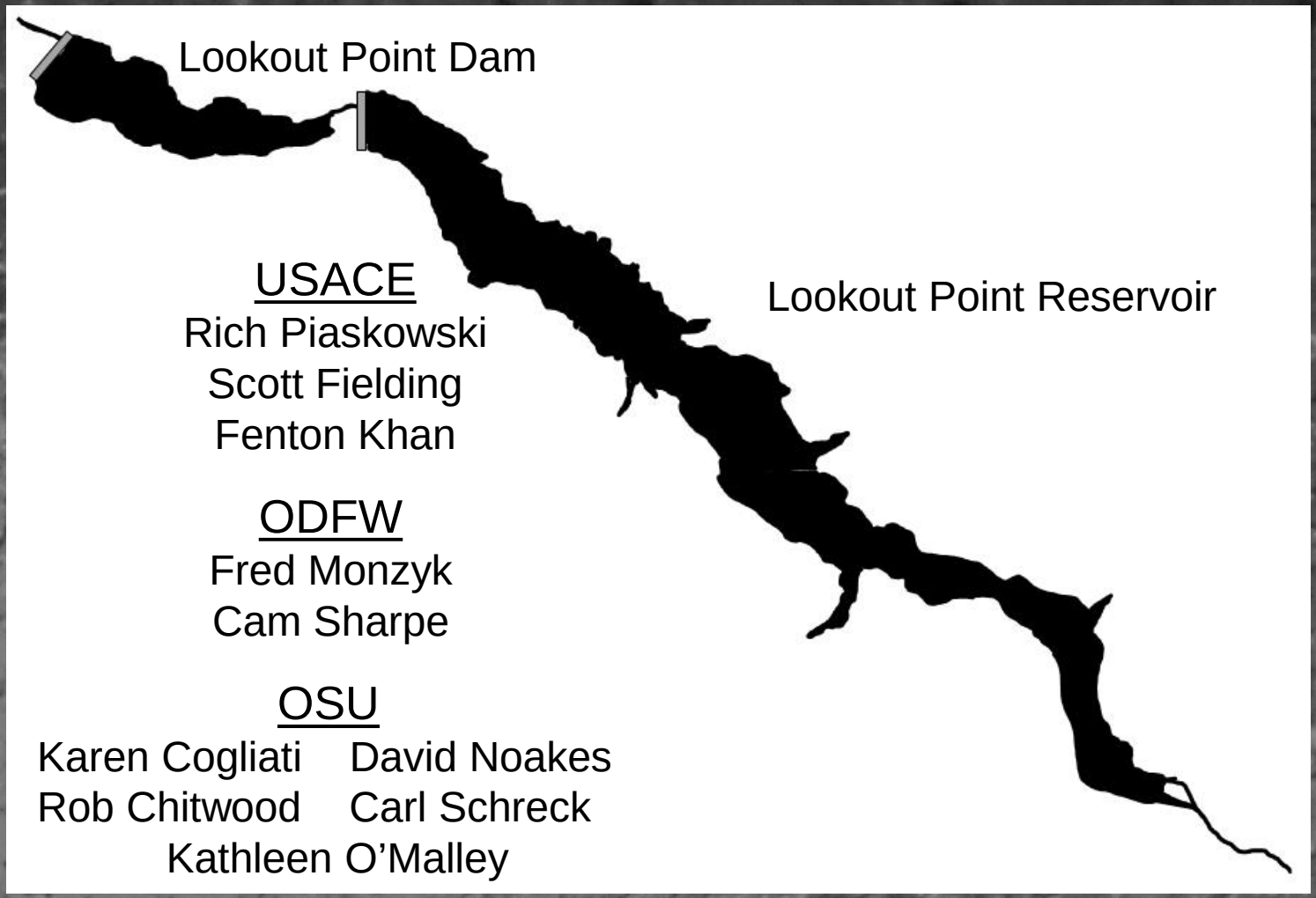
Development of a Study Design and Implementation Plan for an Evaluation of Juvenile Salmon Survival in Lookout Point Reservoir

Tobias Kock and Russell Perry
US Geological Survey

February 8, 2017

U.S. Department of the Interior
U.S. Geological Survey

LOOKOUT POINT RESERVOIR



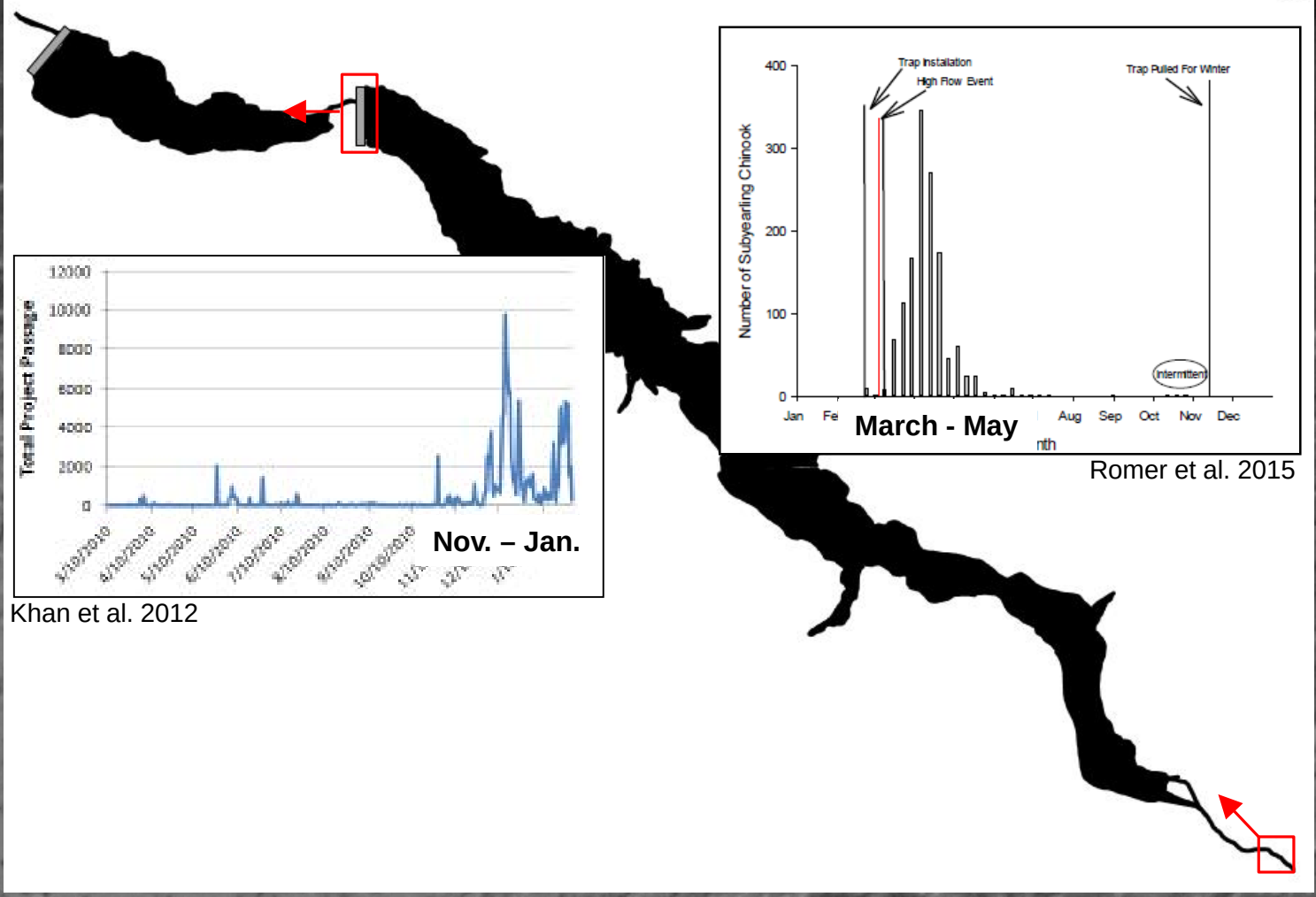
USACE
Rich Piaskowski
Scott Fielding
Fenton Khan

ODFW
Fred Monzyk
Cam Sharpe

OSU
Karen Cogliati
Rob Chitwood
David Noakes
Carl Schreck
Kathleen O'Malley

USGS

LOOKOUT POINT RESERVOIR

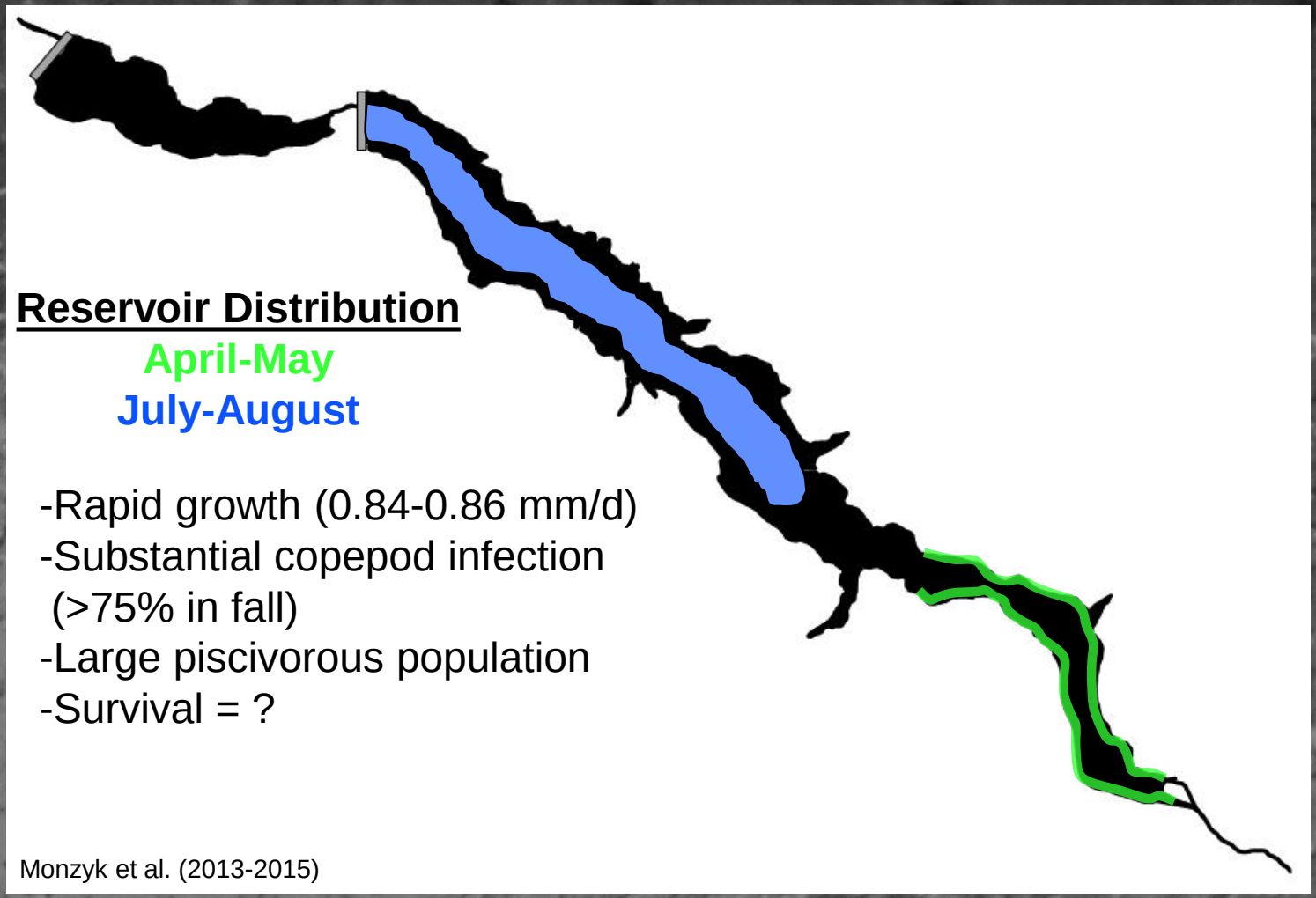


Romer et al. 2015

Khan et al. 2012

USGS

LOOKOUT POINT RESERVOIR



USGS

Survival Studies

Common for smolt-sized fish

- Acoustic, radio, and PIT tags
- Reach, passage, and route-specific estimates
- Numerous models and analytical techniques

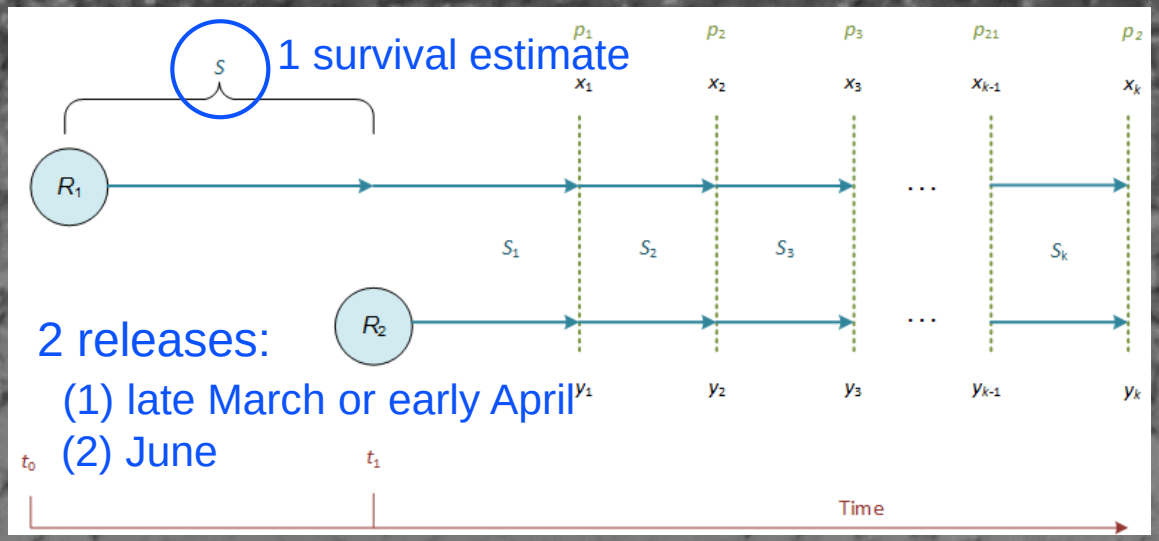
Challenging for fry-sized fish

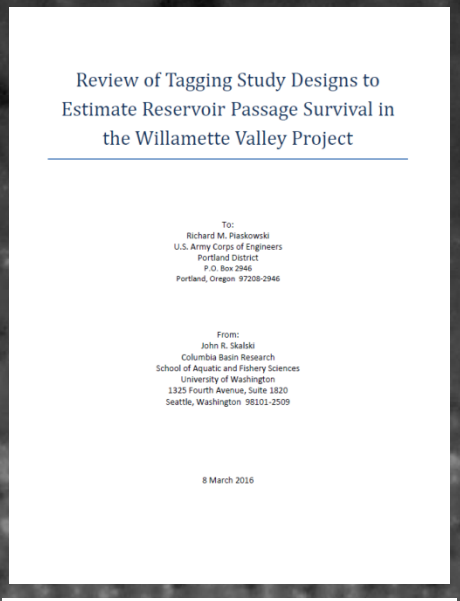
- Batch marking
- Some models designed
- Not field proven

Fry Survival Models

Models have been developed

- Skalski et al. 2009, Skalski 2015
- Staggered Release-Recovery Model

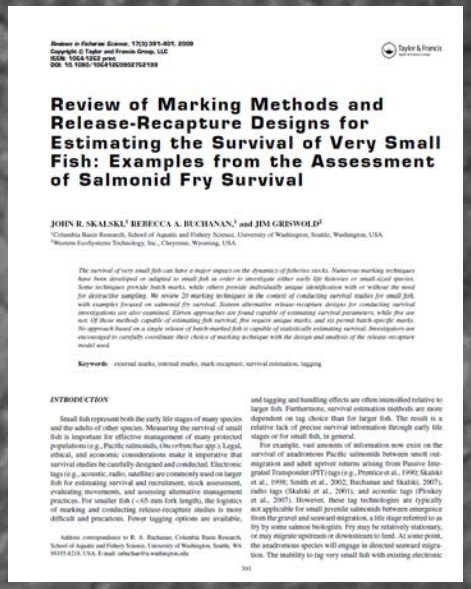



Review of Tagging Study Designs to Estimate Reservoir Passage Survival in the Willamette Valley Project

To:
Richard M. Piaskowski
U.S. Army Corps of Engineers
Portland District
P.O. Box 2946
Portland, Oregon 97208-2946

From:
John R. Skalski
Columbia Basin Research
School of Aquatic and Fishery Sciences
University of Washington
1325 Fourth Avenue, Suite 1820
Seattle, Washington 98101-2509

8 March 2016


Review of Marking Methods and Release-Recapture Designs for Estimating the Survival of Very Small Fish: Examples from the Assessment of Salmonid Fry Survival

JOHN R. SKALSKI, REBECCA A. BUCHANAN, and JIM GRISWOLD

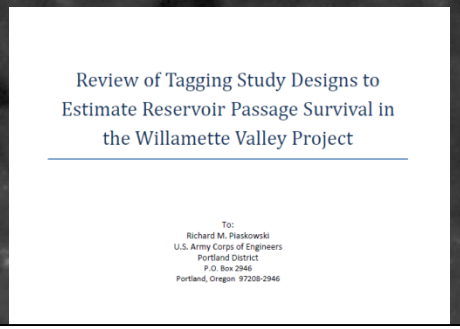
INTRODUCTION

USGS

Fry Survival Models

Models have been developed

- Skalski et al. 2009, Skalski 2015
- Staggered Release-Recovery Model

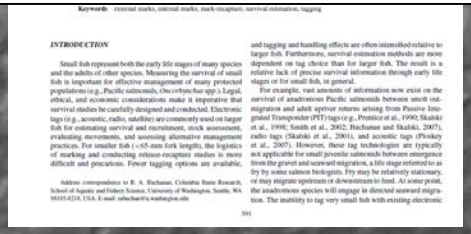

Review of Tagging Study Designs to Estimate Reservoir Passage Survival in the Willamette Valley Project

To:
Richard M. Piaskowski
U.S. Army Corps of Engineers
Portland District
P.O. Box 2946
Portland, Oregon 97208-2946

2.4 Model Assumptions

Assumptions of this paired release-recovery model include the following:

1. All fish act independently.
2. Both release groups share the same recovery probabilities (p_i) and intra-period survival probabilities (S_i) after the second release occurs (i.e., θ_i).
3. Sample sizes R_1 and R_2 are known without error.
4. Recovery numbers are correctly reported and assigned to the correct release group.
5. Fish do not lose their tags.


Keywords external marks, internal marks, mark-recapture, survival estimation, tagging

INTRODUCTION

Small fish represent both the early life stages of many species and the adults of other species. Measuring the survival of small fish is important for effective management of many protected populations (e.g., Pacific salmonids, *Oncorhynchus* spp.). Legal, ethical, and economic considerations make it imperative that survival studies be carefully designed and conducted. Electronic tags (e.g., acoustic, radio, satellite) are commonly used on larger fish for estimating survival and recruitment, stock assessment, evaluating movements, and assessing alternative management practices. For smaller fish (<65-mm fork length), the logistics of marking and conducting release-recapture studies is more difficult and precarious. Fewer tagging options are available, and tagging and handling effects are often intensified relative to larger fish. Furthermore, survival estimation methods are more dependent on tag choice than for larger fish. The result is a relative lack of precise survival information through early life stages or for small fish, in general.

For example, vast amounts of information now exist on the survival of anadromous Pacific salmonids between smolt out-migration and adult upriver returns arising from Passive Integrated Transponder (PIT) tags (e.g., Prentice et al., 1990; Skalski et al., 1998; Smith et al., 2002; Buchanan and Skalski, 2007), radio tags (Skalski et al., 2001), and acoustic tags (Prentice et al., 2007). However, these tag technologies are typically not applicable for small juvenile salmonids between emergence from the gravel and seaward migration, a life stage referred to as fry by some salmon biologists. Fry may be relatively stationary, or may migrate upstream or downstream to feed. At some point, the anadromous species will engage in directed seaward migration. The inability to tag very small fish with existing electronic

Address correspondence to R. A. Buchanan, Columbia Basin Research, School of Aquatic and Fishery Science, University of Washington, Seattle, WA 98195-5218, USA. E-mail: rabuchan@u.washington.edu

391

USGS

Fry Survival Models

PBT *N*-Mixture Model

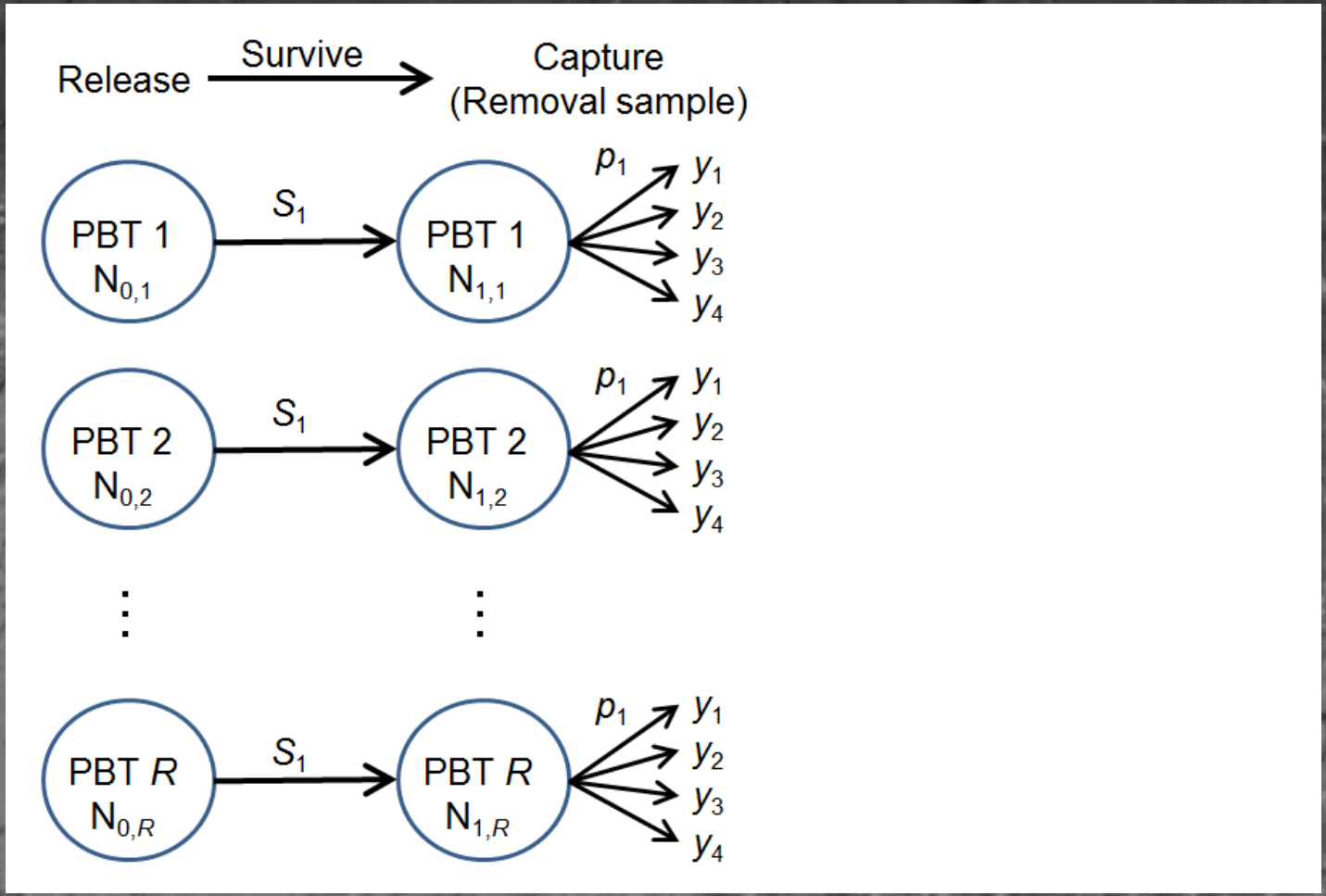
- Modified *N*-mixture model
- Requires 1 release group
- PBT used to mark fish

Fry Survival Models

PBT *N*-Mixture Model

Fry Survival Models

PBT *N*-Mixture Model



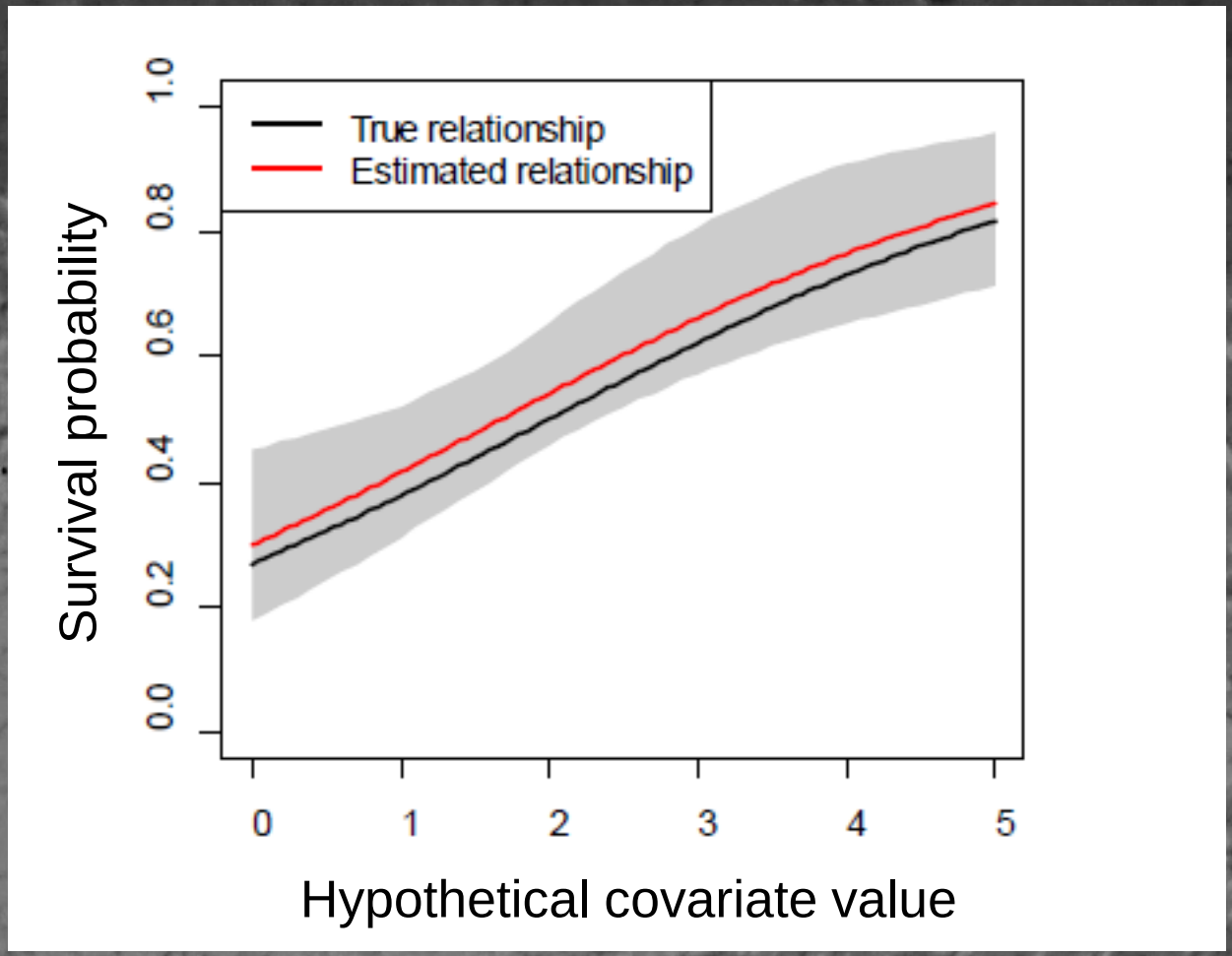
PBT *N*-Mixture Model

Can Parameters Be Estimated?

- Low capture probabilities expected (1-2%)
- Simulation experiments conducted
  - 75,000 fish with 40 PBT marks
  - Monthly sampling: 4 months
- Can't estimate unique *p* and *S* for every month
  - *p* is too low
- Can fit simpler models
  - Constant *S* or *p* for consecutive months
  - *S* as a function of covariates
    - Time
    - Fish size

PBT *N*-Mixture Model

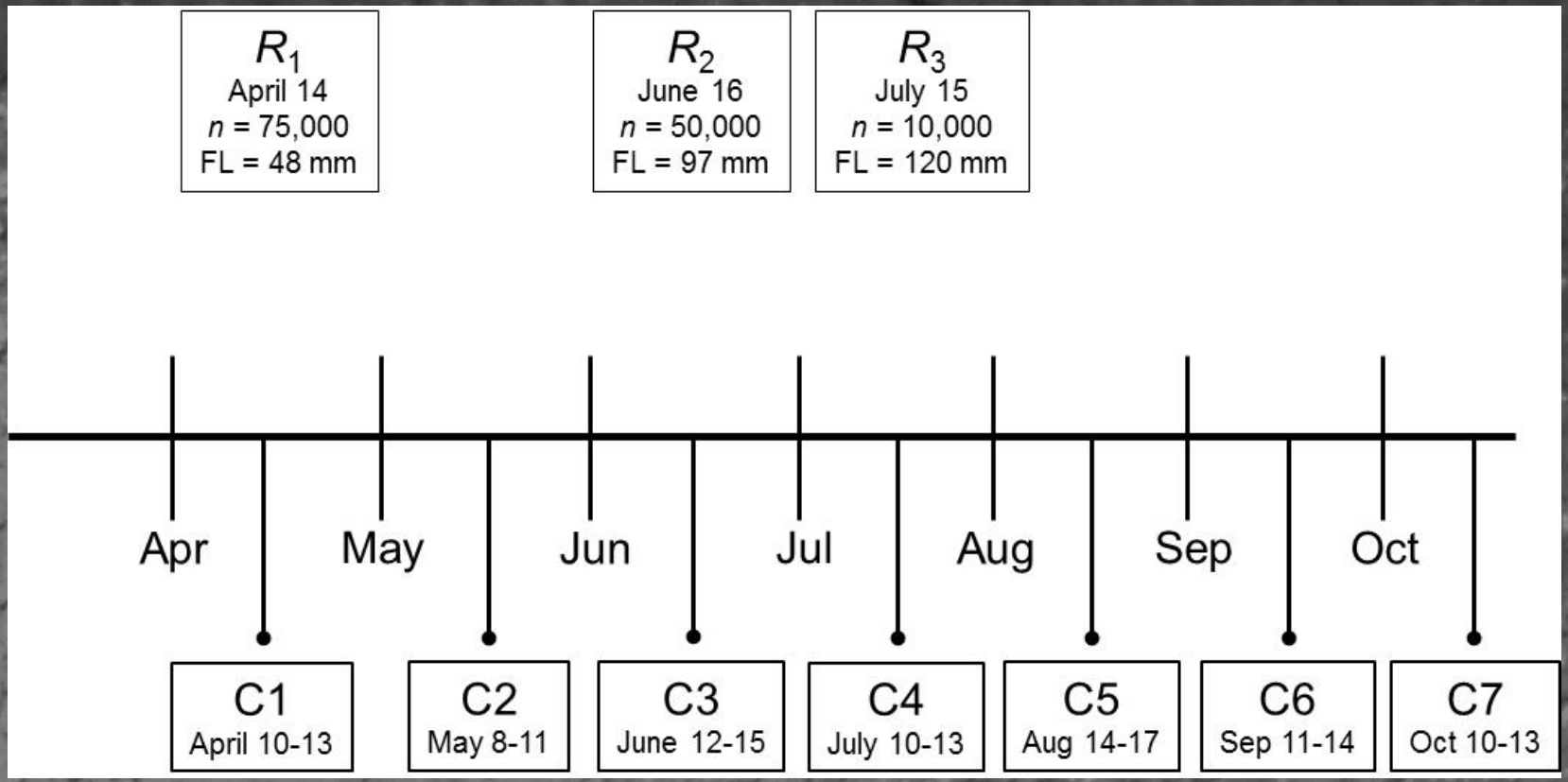
Can Parameters Be Estimated?



USGS

FIELDWORK IN 2017

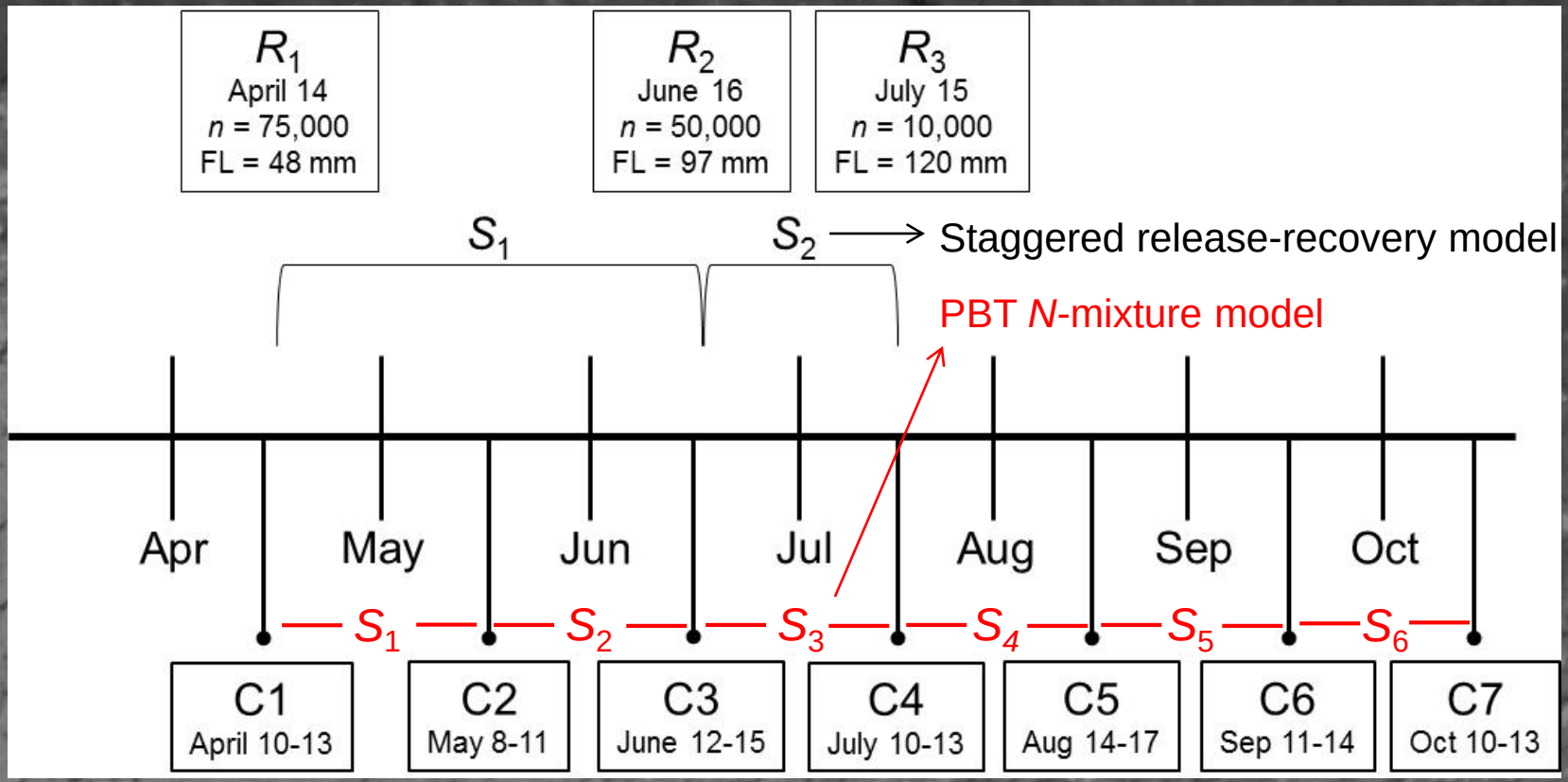
- Release 3 groups of fish
- Conduct monthly sampling in reservoir



USGS

FIELDWORK IN 2017

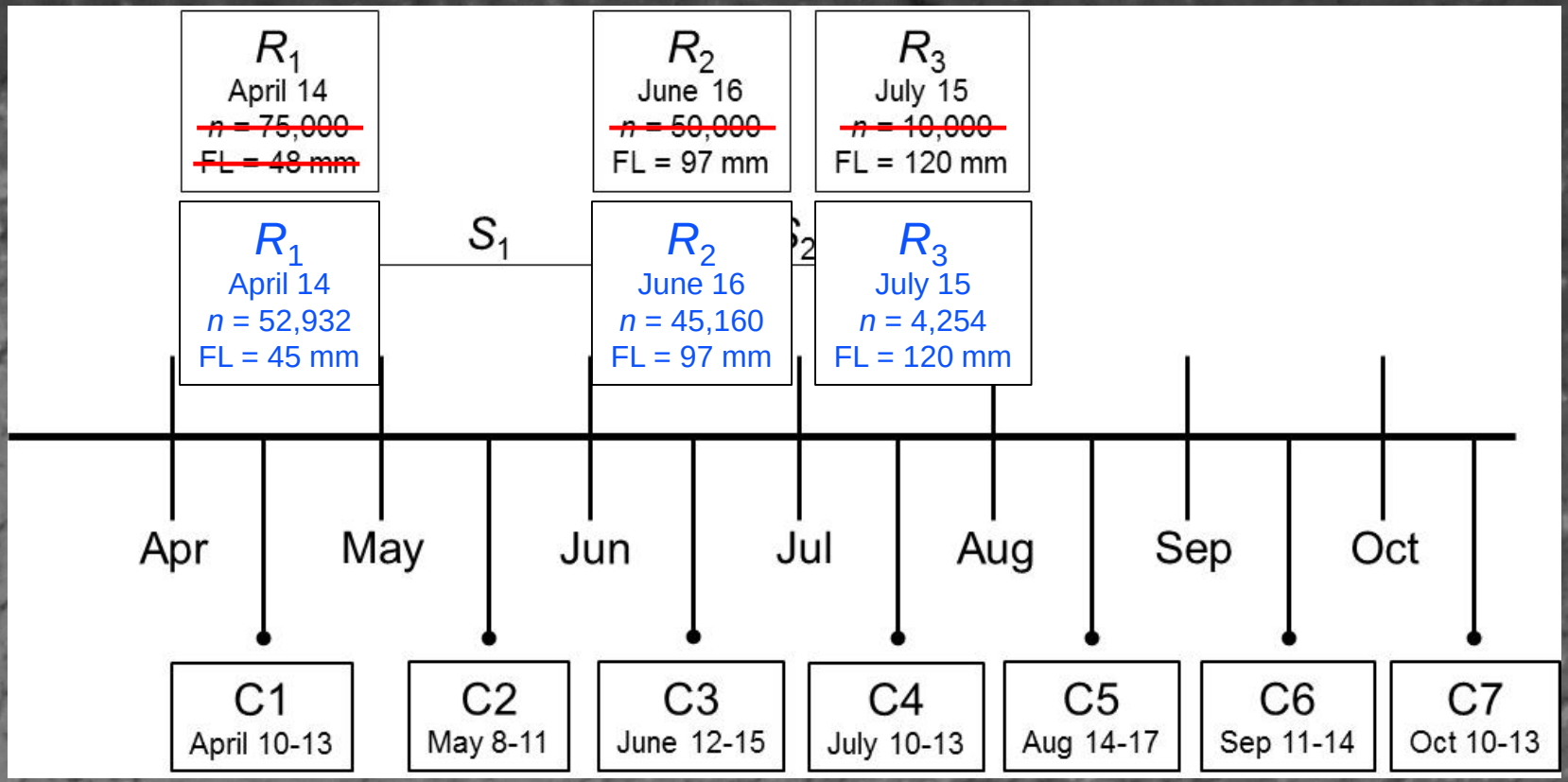
- Release 3 groups of fish
- Conduct monthly sampling in reservoir



USGS

FIELDWORK IN 2017

- Release 3 groups of fish
- Conduct monthly sampling in reservoir



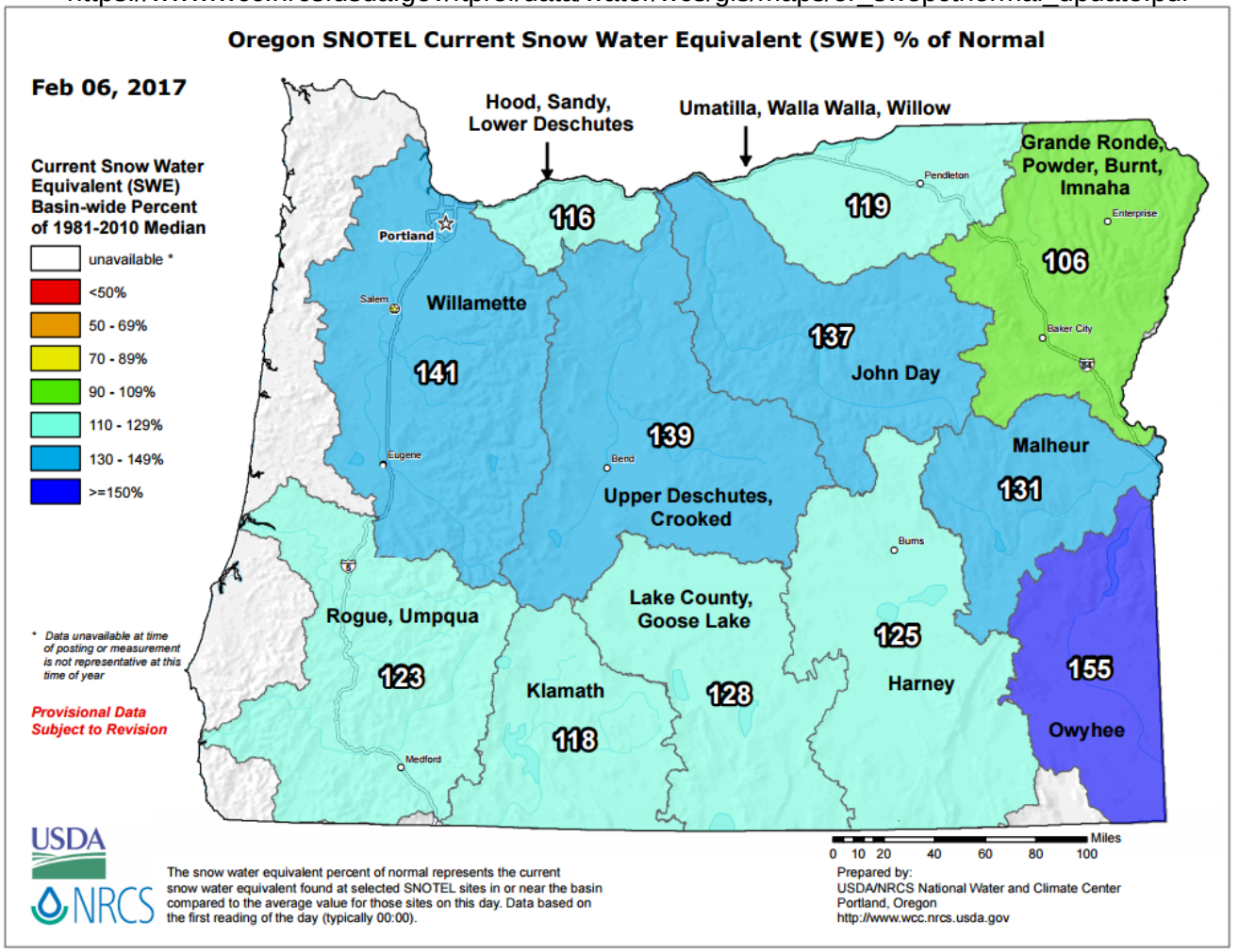
USGS

Fieldwork in 2017

- Release 3 groups of fish
- Conduct monthly sampling in reservoir
  - 4 sampling days/month
  - 40 “sets”/day
  - Floating box traps, Oneida Lake traps, gill nets
  - Other techniques possible including beach seines and electrofishing

MURPHY'S CONTRIBUTION

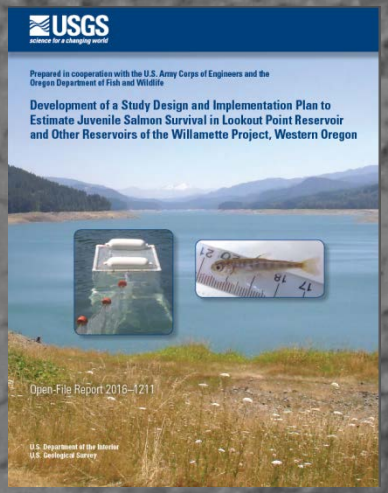
https://www.wcc.nrcs.usda.gov/ftpref/data/water/wcs/gis/maps/or_swepctnormal_update.pdf



USGS

SUMMARY

- 2 study designs will be evaluated
  - Both conceptually sound, neither field tested
  - Side-by-side testing will be insightful
  - 2017 is a “pilot” study
    - Learning curve for fish releases
    - Unprecedented sampling effort planned
    - Study designs adaptations occurring



https://pubs.er.usgs.gov/publication/ofr20161211