A Pilot Study to Estimate Fry Survival in Lookout Point Reservoir, Oregon, 2017

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

Research Goal and Objectives

Goal

Estimate survival of Chinook salmon fry in Lookout Point Reservoir during 2017

Objectives

Use a staggered release-recovery study design (staggered release model) to estimate fry survival during April-July, 2017

Use a parentage-based tagging *N*-mixture study design (*N*-mixture model) to estimate fry survival during April-October, 2017

Compare estimates from the two study designs, and to available literature, and develop recommendations for an approach that could be used at other locations within the Willamette Project

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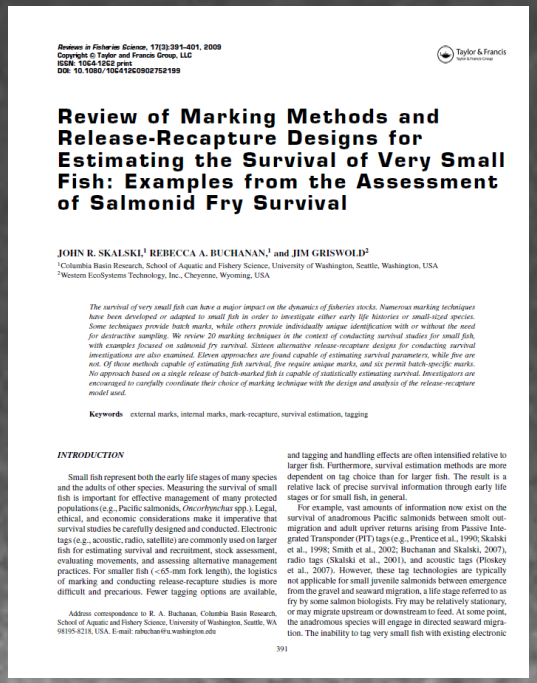
Survival Models

Two models

Staggered release model

N-mixture model



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

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The survival of very small fish can have a major impact on the dynamics of fisheries stocks. Numerous marking techniques have been developed or adapted to small fish in order to investigate either early life histories or small-sized species. Some techniques provide batch marks, while others provide individually unique identification with or without the need for destructive sampling. We review 20 marking techniques in the context of conducting survival studies for small fish, with examples focused on salmonid fry survival. Sixteen alternative release-recapture designs for conducting survival investigations are also examined. Eleven approaches are found capable of estimating survival parameters, while five are not. Of those methods capable of estimating fish survival, five require unique marks, and six permit batch-specific marks. No approach based on a single release of batch-marked fish is capable of statistically estimating survival. Investigators are encouraged to carefully coordinate their choice of marking technique with the design and analysis of the release-recapture model used.

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 outmigration 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 (Ploskey 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

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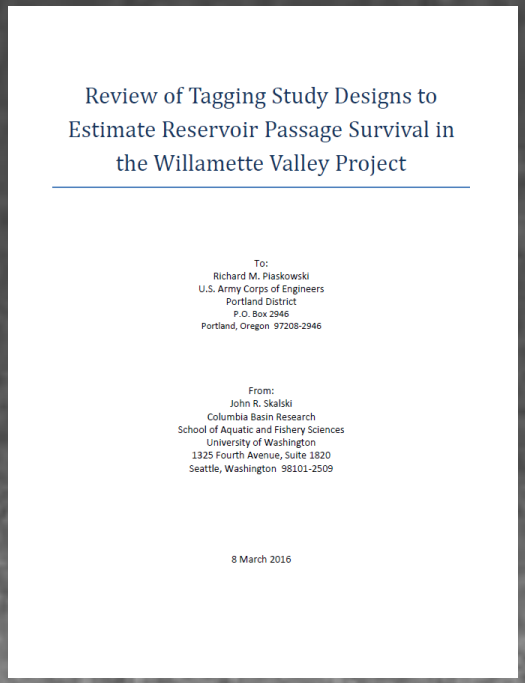

Review of Tagging Study Designs to Estimate Reservoir Passage Survival in the Willamette Valley Project

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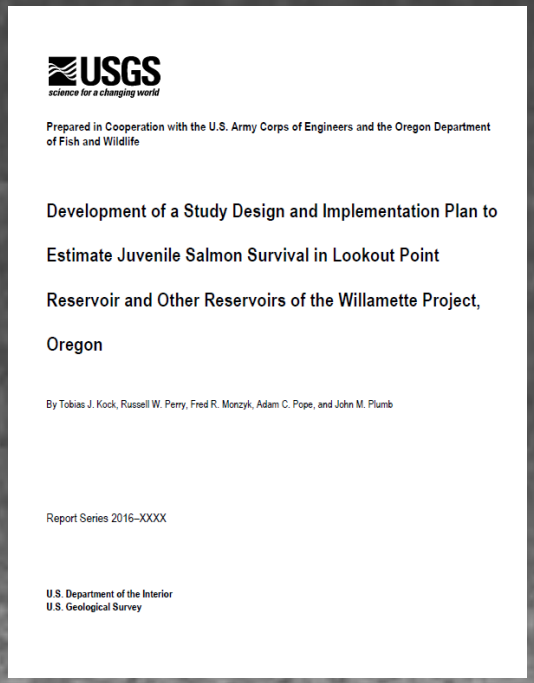

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Development of a Study Design and Implementation Plan to Estimate Juvenile Salmon Survival in Lookout Point Reservoir and Other Reservoirs of the Willamette Project, Oregon

By Tobias J. Kock, Russell W. Perry, Fred R. Monzyk, Adam C. Pope, and John M. Plumb

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Survival Models

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Survival Models

Staggered release model

- Estimates from intervals between releases
- Sampling occurs after at least 2 groups of fish are released
- Assumes that fish from different releases are similar

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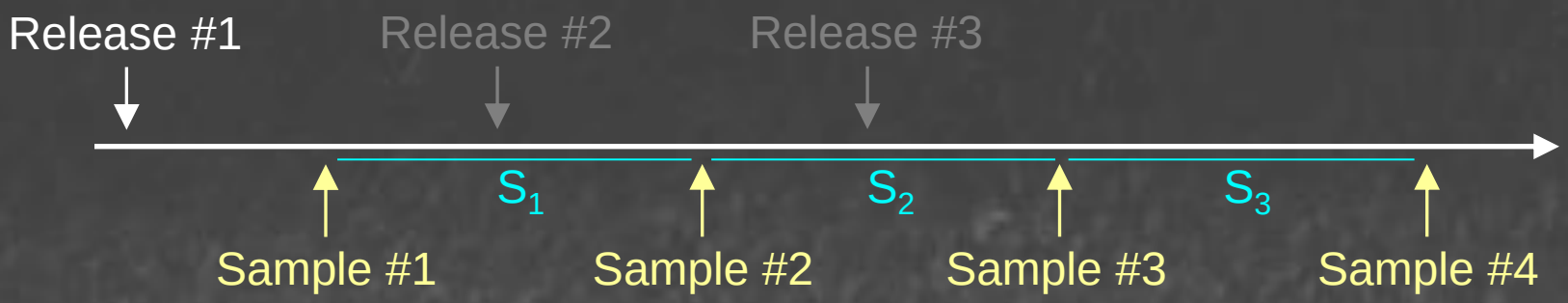
Survival Models



Staggered release model

- Estimates from intervals between releases
- Sampling occurs after at least 2 groups of fish are released
- Assumes that fish from different releases are similar

N-mixture model

- Estimates from intervals between sampling occasions
- Sampling occurs after at least 1 group of fish is released
- Requires PBT tagging to identify fish from unique families

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Details of Study Design

Month	Fish releases		Sampling occasions
April	*n* = 75,000 FL = 48 mm	April 14	April 10-13
May			May 8-11
June	*n* = 50,000 FL = 97 mm	June 16	June 12-15
July	*n* = 10,000 FL = 120 mm	July 15	July 10-13
August	NOR outplants *n* = 687 fish		August 14-17
September			September 11-14
October			October 10-13

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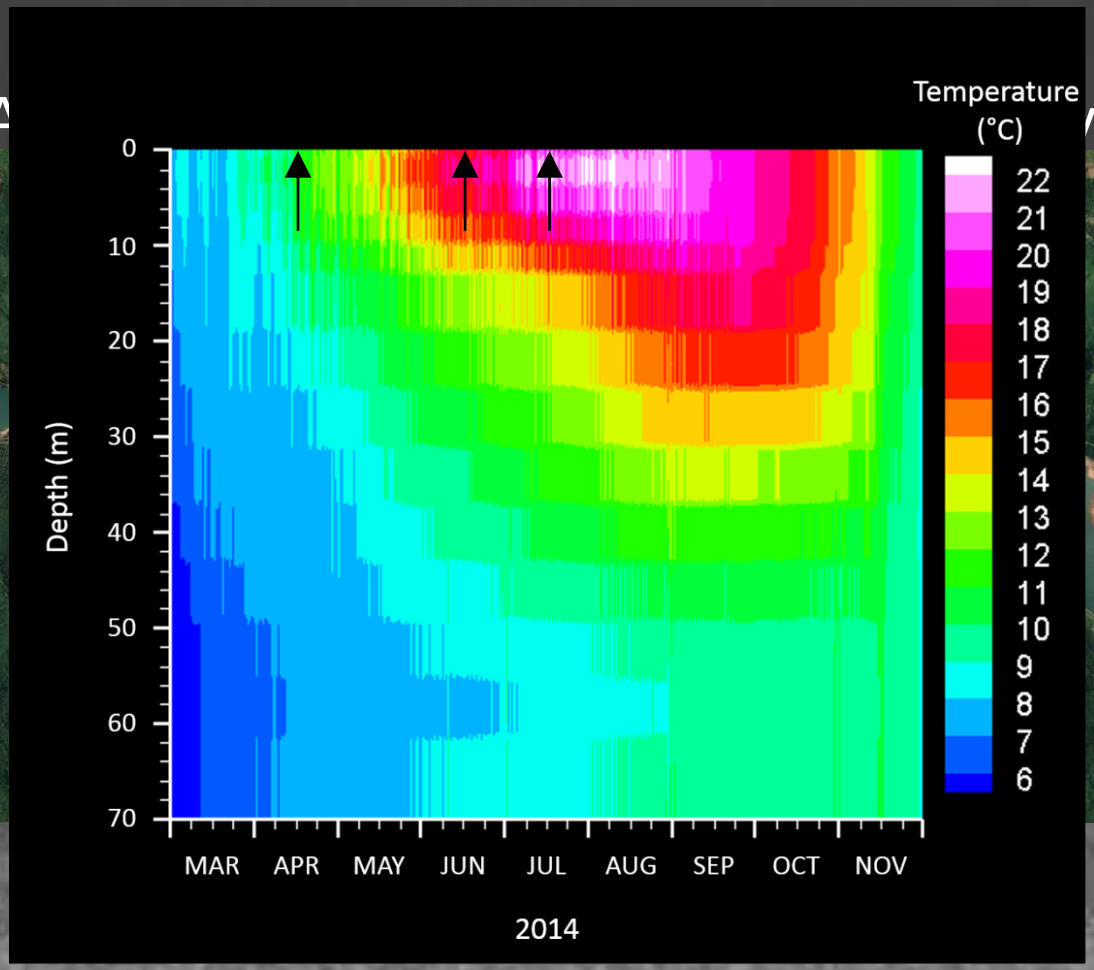
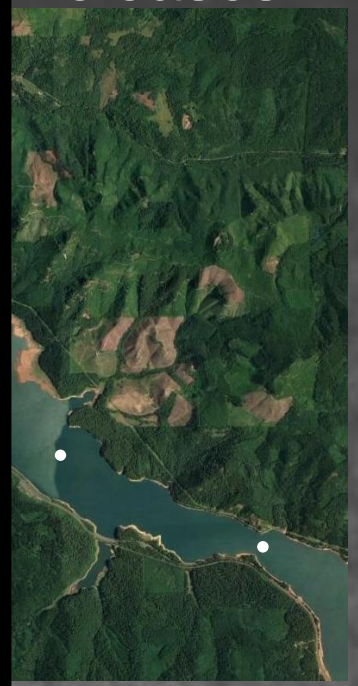
Fish Releases

A releases





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Details of Study Design

Month		Sampling occasions
April	Shoreline traps Electrofishing	April 10-13
May		May 8-11
June	Shoreline traps Electrofishing Gill nets	June 12-15
July	Gill nets	July 10-13
August		August 14-17
September		September 11-14
October		October 10-13

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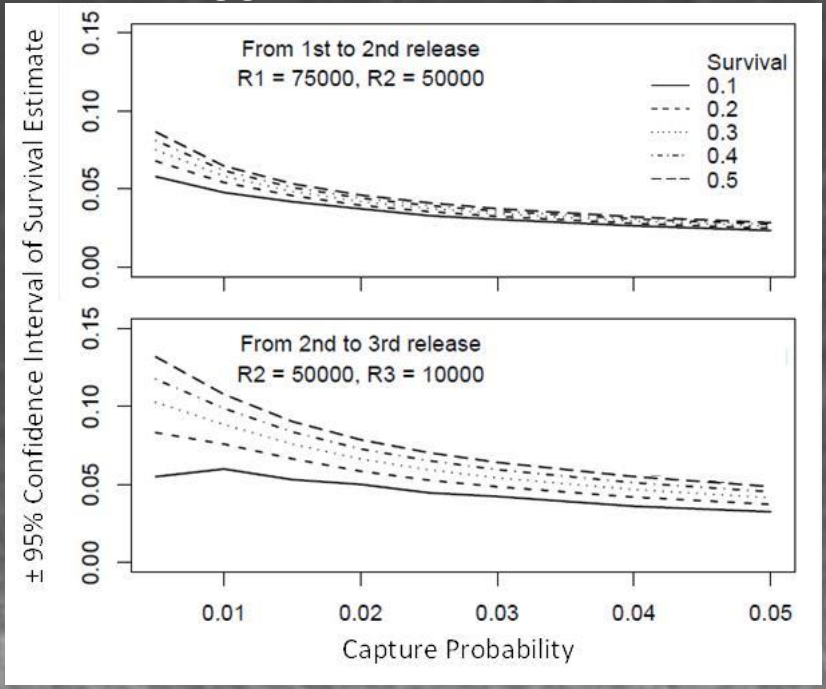
Sampling and Precision

Effort and collection estimates

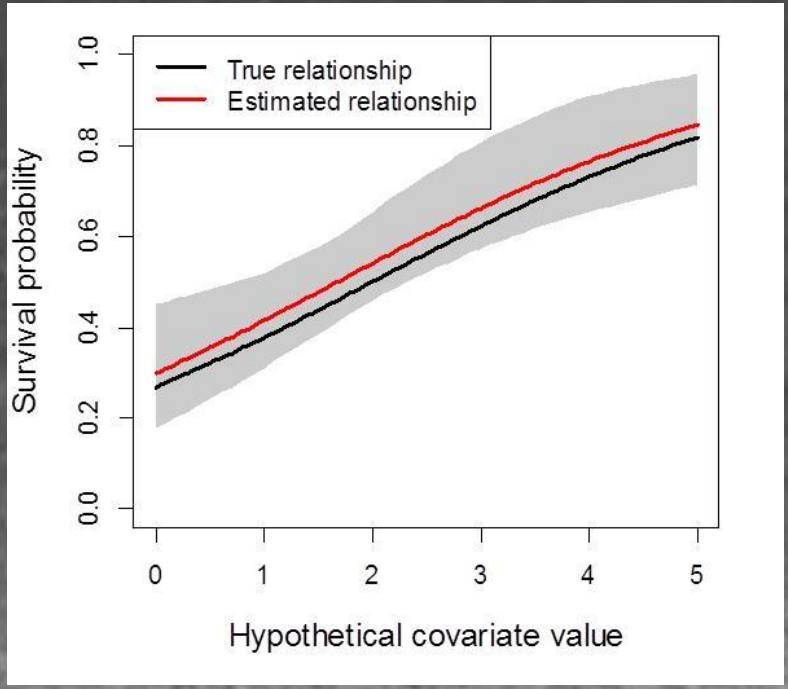
40 traps/nets fished each day

Overall recapture goal = 2% (250-450 fish/group)

Staggered release model



N-mixture model



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Summary

Two models will be evaluated

- Both are conceptually sound but not field proven
- Side-by-side testing = multiple opportunities to evaluate performance

Staggered release model

- Less complex fish marking requirements
- Survival estimates defined by release timing
- Fish similarities between release groups will be difficult to achieve

N-mixture model

- Requires PBT marking of fish
- Survival estimates defined by sampling occasions
- Estimation success will depend on collection success

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