Northwest Power and Conservation Council

November 30, 2006

MEMORANDUM

TO: Council Members

FROM: Jim Ruff, Manager, Mainstem Passage and River Operations

SUBJECT: Joint Presentation by the U.S. Fish and Wildlife Service, U.S. Geological Survey and NOAA Fisheries Service Researchers on the Juvenile Life History Diversity of Fall Chinook Salmon in the Snake River Basin

Purpose

At the December 12th Council meeting, Billy Connor of USFWS, Ken Tiffan from USGS-Biological Resources Division and Bill Muir from NOAA's Northwest Fisheries Science Center will present some of the major findings from their recent research concerning juvenile life history diversity of Snake River fall Chinook salmon. This will be a similar presentation to information that was presented to the Policy Work Group of the BiOp remand collaboration discussions. In particular, they will present recent research information on the outmigration timing and patterns and resulting adult return rates of both ocean-type (subyearling) and reservoir-type (yearling) juvenile Snake River fall Chinook salmon.

See the attached abstract (Attachment 1) and powerpoint slides (Attachment 2) for additional information about their presentation.

Background

Snake River fall Chinook salmon are listed as threatened under the Endangered Species Act. This listed population includes fish that spawn in the mainstem Snake River below Hells Canyon Dam and in the lower reaches of its major tributaries (comprising approximately 70% of production), as well as in the Clearwater River and some of its tributaries (approximately 30% of production). As you are aware, juvenile fall Chinook salmon migrating from the Snake River Basin do not strictly adhere to a typical ocean-type life history, which is characterized by saltwater entry at age 0 and first-year wintering in the ocean. Recent research has shown that some of these fish overwinter in a mainstem reservoir prior to migrating to the ocean during the following spring at age one (commonly referred to as reservoir-type juveniles). More recently

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another group of juveniles, called “estuary-type,” have been found to spend their first winter in or near the brackish estuary and also enter the ocean as yearling fish.

I have asked the presenters to provide the Council with their most recent research results and information concerning juvenile life history diversity of Snake River fall Chinook salmon that should address the following questions:

1. What proportion of Snake River fall Chinook juveniles migrate to the ocean as subyearlings, and what proportion migrate out as yearlings?

2. Where in the Snake and Columbia rivers, i.e., in which river reaches or reservoirs, are the reservoir-type (yearling) life history fish residing during the winter months?

3. What proportion of returning Snake River fall Chinook adults were either yearling or subyearling migrants? and

4. Do the smolt-to-adult return rates (SARs) of Snake River fall Chinook yearling migrants differ from those of the subyearling migrants, and if so, how are they different?

At the conclusion of the presentation and if time permits, the Council may want to ask the researchers to discuss how their ongoing research efforts, which are funded through the fish and wildlife program, will address the critical uncertainties concerning the life history diversity of these listed fish. The Council may also want to ask what could be some of the management implications, e.g., related to river operations such as flow, spill and transportation, as a result of these research results.

Attachments (2)

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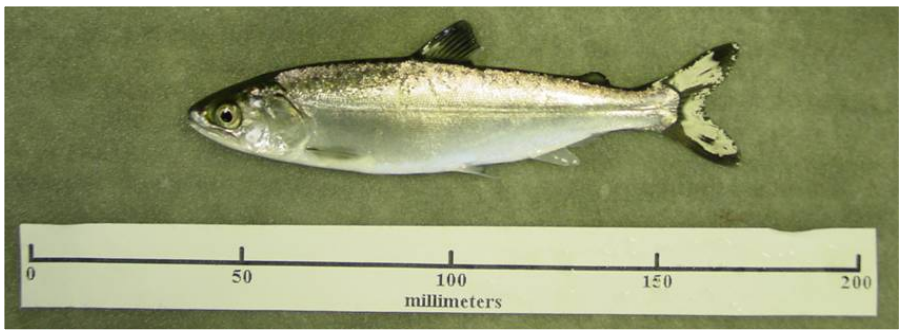
Attachment 1

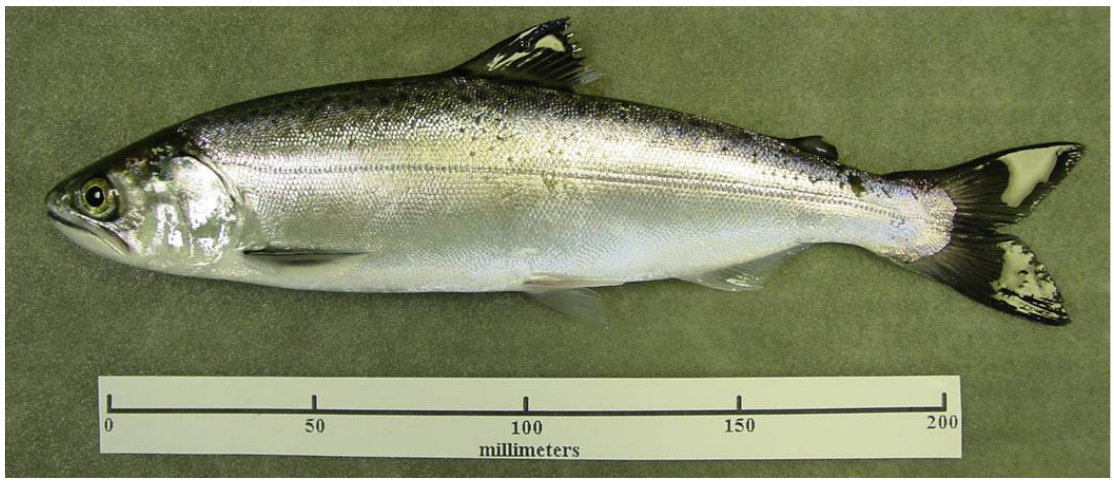
Juvenile Life History Diversity of Fall Chinook Salmon in the Snake River Basin

Abstract.—Prior to 2005, it was assumed that juvenile Snake River fall Chinook salmon entered saltwater predominately as subyearlings (i.e., age-0) spending their first winter in the ocean. Research published in 2005 provided the first peer-reviewed evidence for first year wintering in freshwater and yearling saltwater entry. The understanding of juvenile fall Chinook salmon that spend their first winter in freshwater and enter the ocean as yearlings is presently limited, but it is increasing. The goal of this briefing by staff of NOAA Fisheries, USFWS, and USGS is to summarize existing research results collected during non-spill years on age at ocean entry and: 1) spawning area distribution; 2) seasonal changes in migrational behavior; 3) location of overwintering; 4) SARs; 5) the return of full-term adults; and 6) implications for ongoing research. Since the early 1990s roughly 70% and 30% of the fall Chinook salmon redds counted upstream of Lower Granite Dam were counted in the Snake River and Clearwater River drainages, respectively. Data collected on juvenile PIT-tagged natural fall Chinook salmon has indicated the tendency to overwinter in freshwater increases as temperatures in the spawning and rearing areas decrease. The relatively warm Snake River produced fewer yearling migrants than the relatively cooler Clearwater River. Preliminary information suggests that Snake River juveniles were relatively active migrants, whereas many Clearwater River juveniles delayed seaward movement in Lower Granite Reservoir. Many juveniles that delayed seaward movement in Lower Granite Reservoir passed downstream dams during the winter when the juvenile fish bypass systems and PIT-tag monitors were not operated. PIT-tag data collected in the spring suggested that fall Chinook salmon wintered throughout the impounded Snake and Columbia Rivers. Reading scales of PIT tagged adults (blindly) with known juvenile passage histories has shown many fall Chinook transported as subyearlings also enter the ocean as yearlings, overwintering below Bonneville Dam, and also confirm our ability to correctly assign age at ocean entry based on scale analysis. Calculation of SARs for yearling migrants was somewhat biased by the absence of an estimate of mortality of subyearlings destined to become yearling migrants. Those juveniles that survive to become yearling migrants, however, return to spawn at much higher rates than those that migrated as subyearlings. The higher SARs of yearling migrants have been reflected in adult return data. The contribution of full term adults (i.e., ocean age II and above) has been substantial for yearling migrants based on data collected on the run-at-large adults, adults returning from life history studies, and adults returning from transportation studies. One explanation for this finding is that subyearling migrants enter the estuary and ocean at a much smaller size than yearling migrants increasing their vulnerability to picivorous predators. Determining the efficacy of transportation and spill is one of the most important tasks for Snake River fall Chinook salmon recovery. In order to accomplish this task, the fisheries community needs a better understanding of seasonal changes in the migrational behavior of fall Chinook salmon in the Snake River basin. Without this understanding, we run the risk of making decisions that might counter their recovery. Staff of NOAA Fisheries, USFWS, and USGS have proposed and are conducting studies to increase our understanding of fall Chinook salmon migrational behavior and how it affects their survival to adulthood.

Juvenile life history diversity of fall Chinook salmon in the Snake River basin

William Connor, U.S. Fish and Wildlife Service
Kenneth Tiffan, U.S. Geological Survey
William Muir, NOAA Fisheries





Goal: Summarize existing data collected during non-spill years on age at migration/age at ocean entry and

Contribution to full-term adults

Proportion of Age-0 and Age-1 migrants

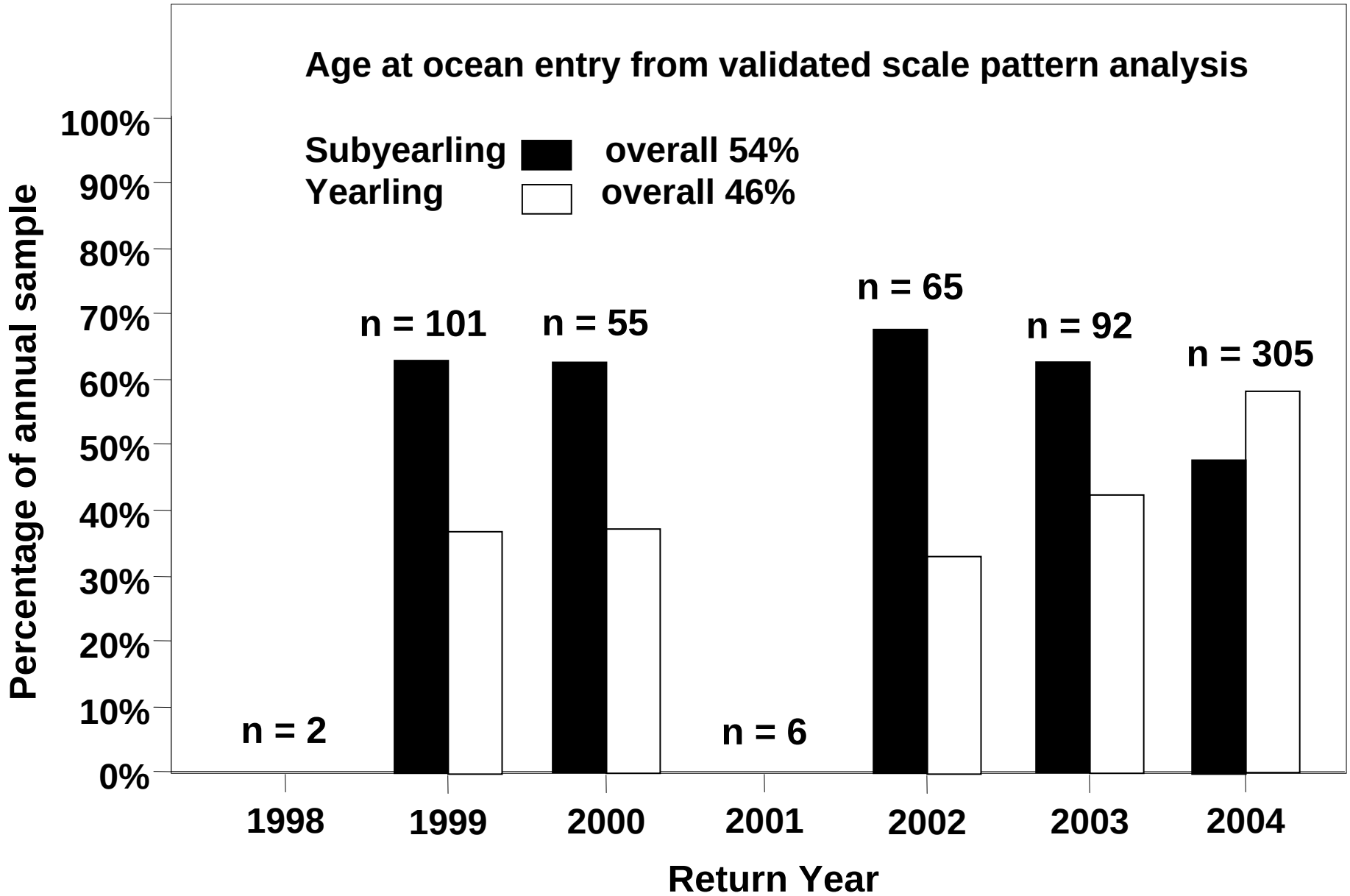
Overwintering location of Age-1 migrants

Smolt-to-adult return rates (SARs)

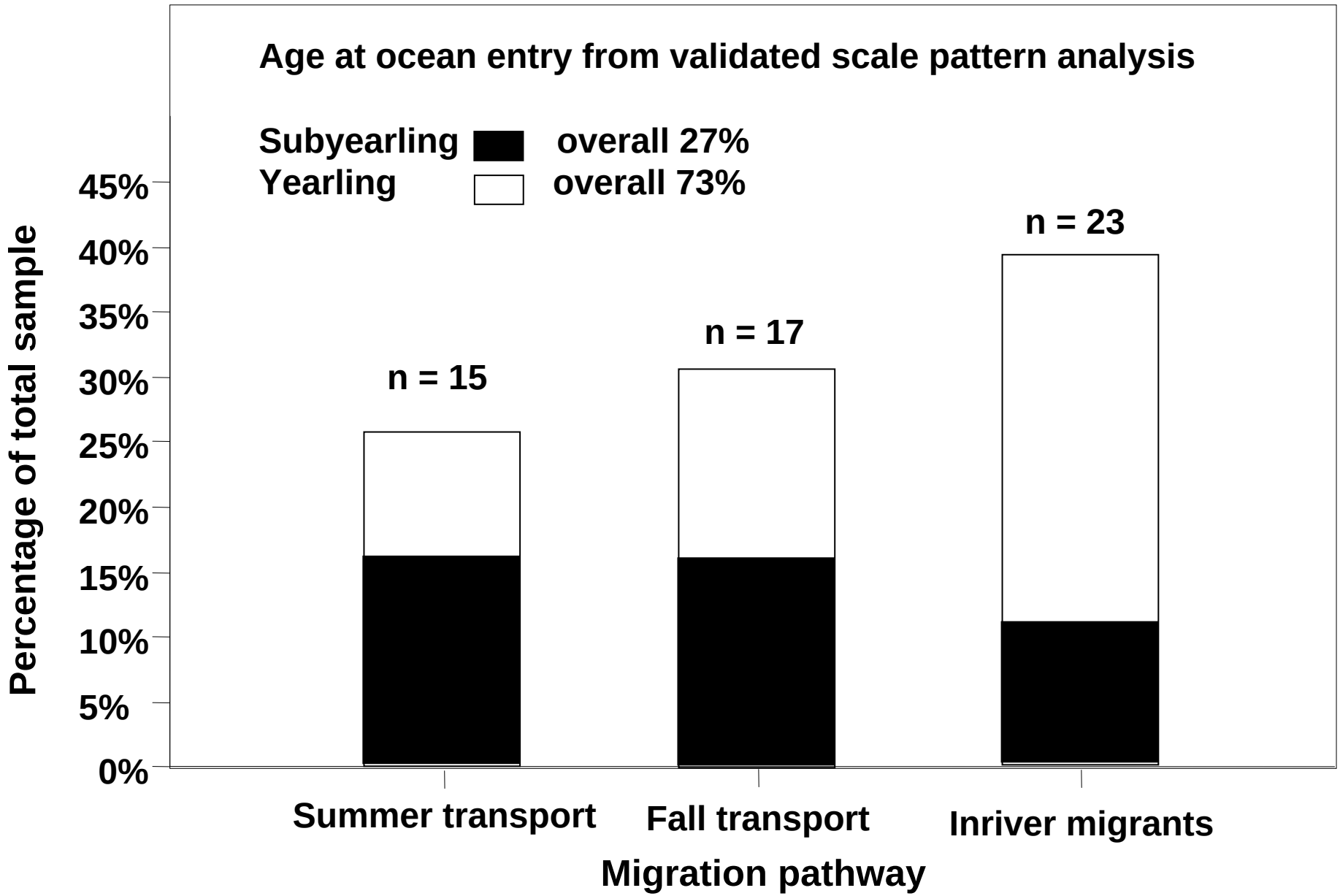
Adult Contribution at LGR Dam

- Only include “full-term” adults (ocean age = 2)
- Scale pattern data from the wild adult run at large (return years 1998 to 2004)
- Scale pattern data from wild and hatchery adults that were transported or migrated inriver (return year 2005)
- Scale pattern data and juvenile PIT-tag histories from wild and hatchery adults that were juvenile inriver migrants (return years 1998 to 2004)

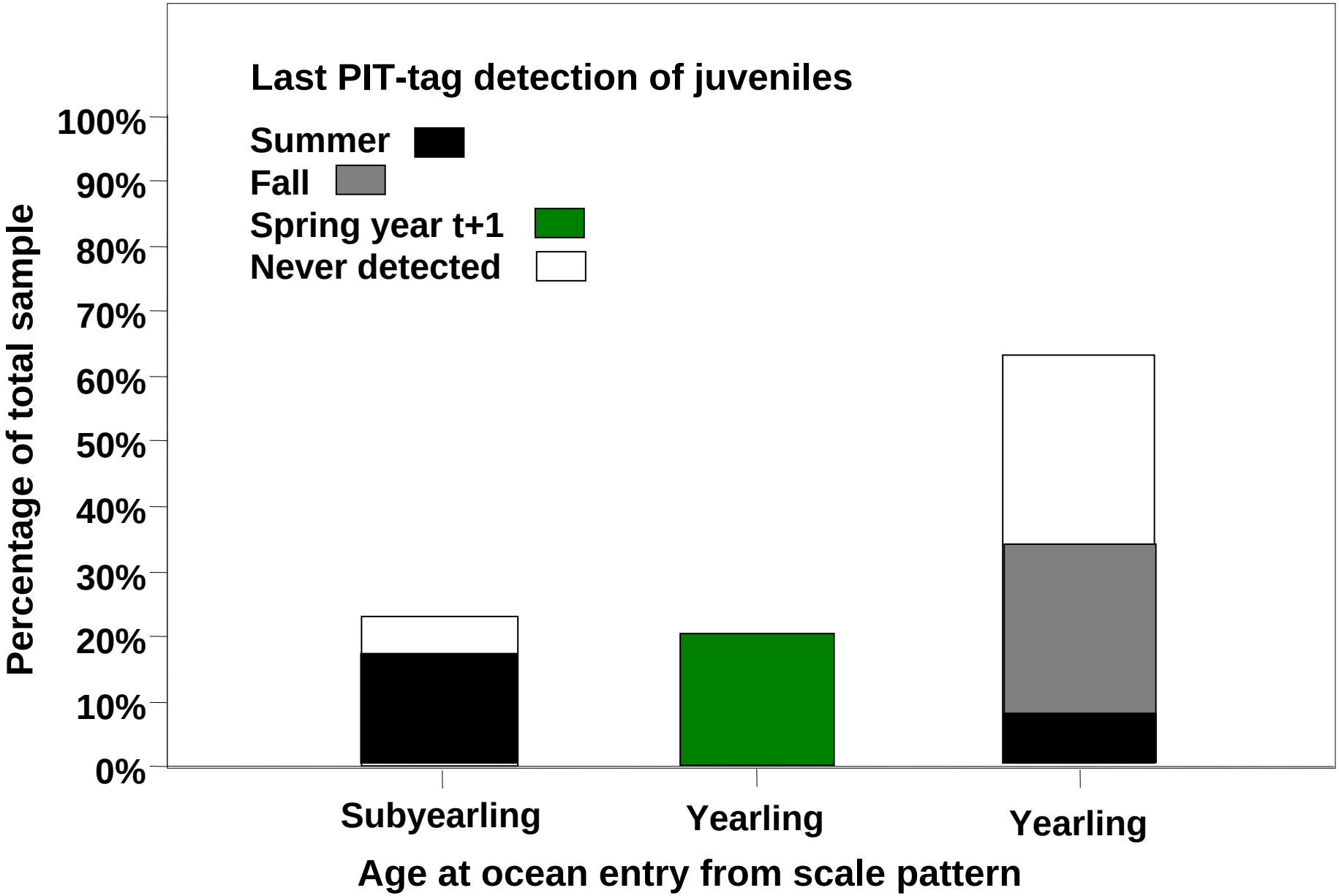
Full-term wild run-at-large adults sampled at LGR 1998-2004



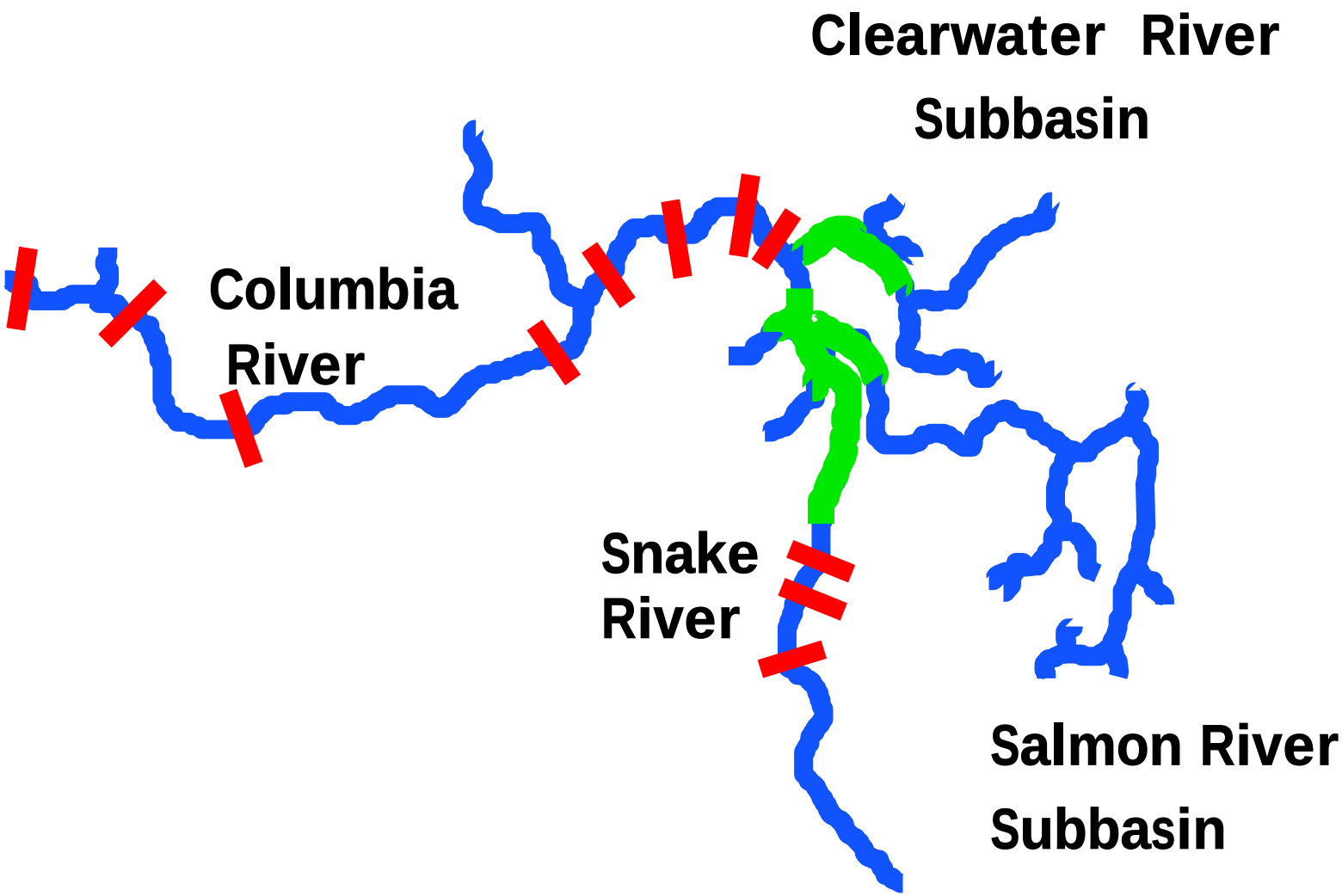
Full-term wild and hatchery adults sampled at LGR in 2005 that were released as subyearlings during 2001-2004 transport studies



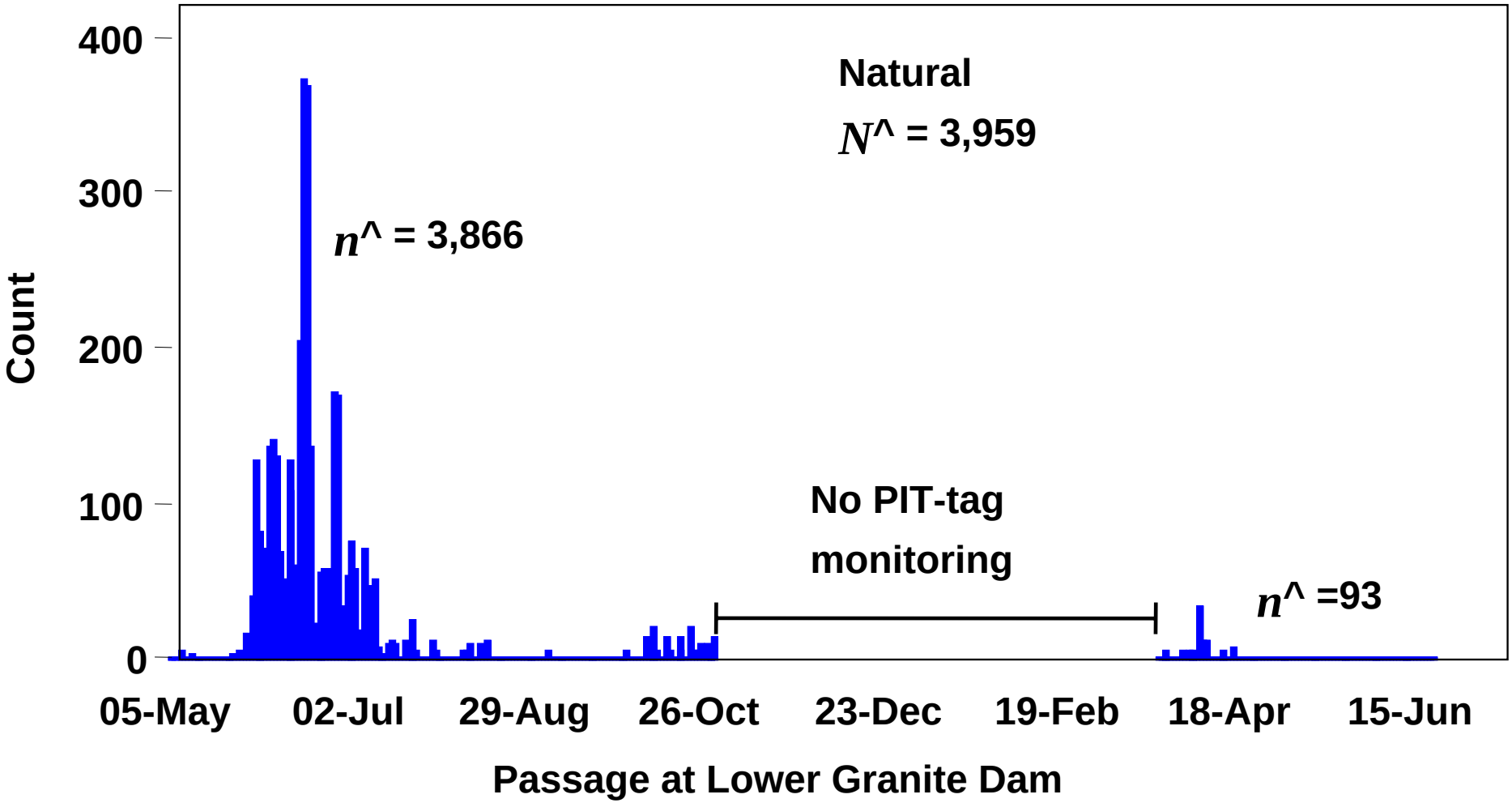
Full-term wild and hatchery adults sampled at LGR during 1998-2004 that had been inriver juvenile migrants



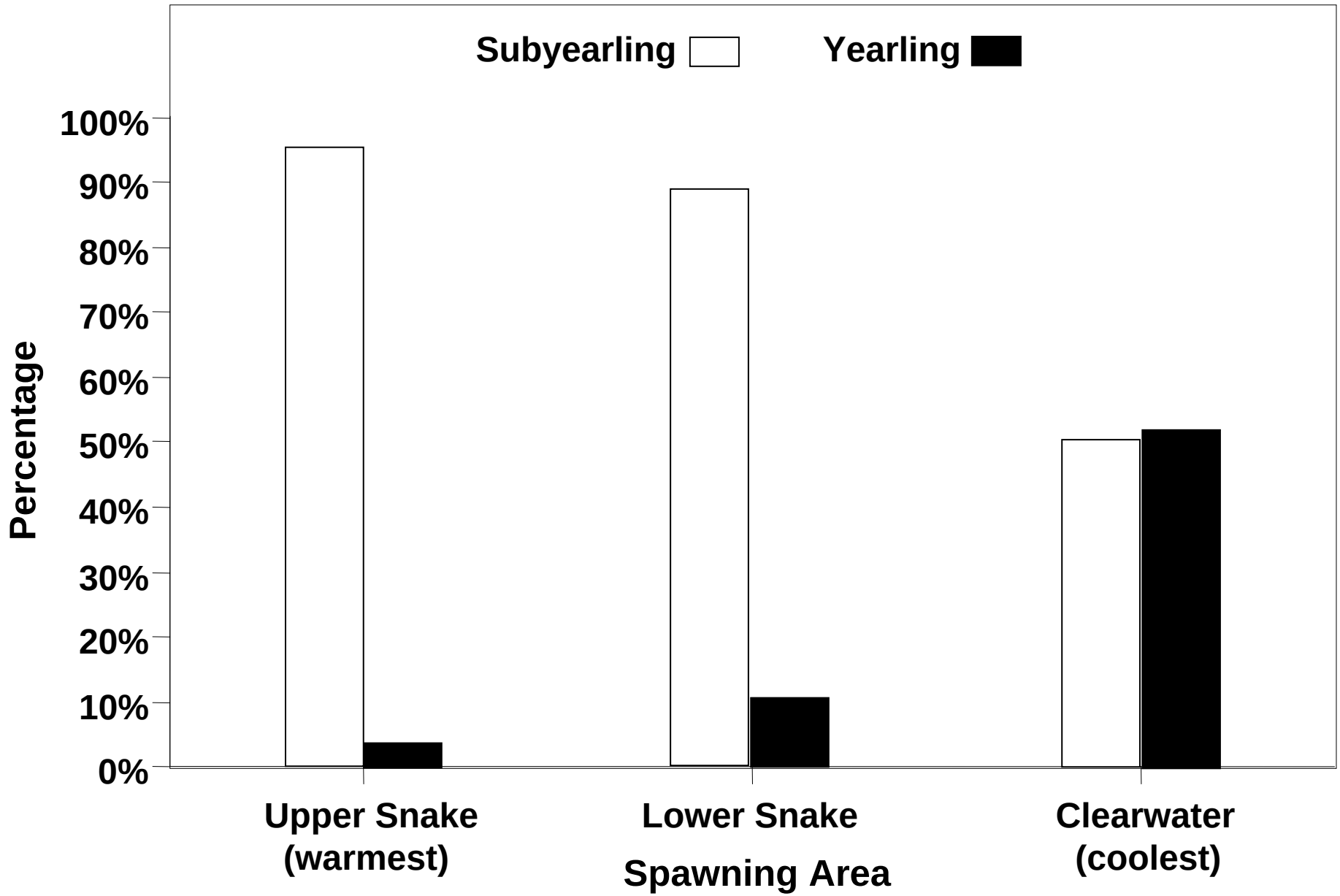
Proportion of migrants



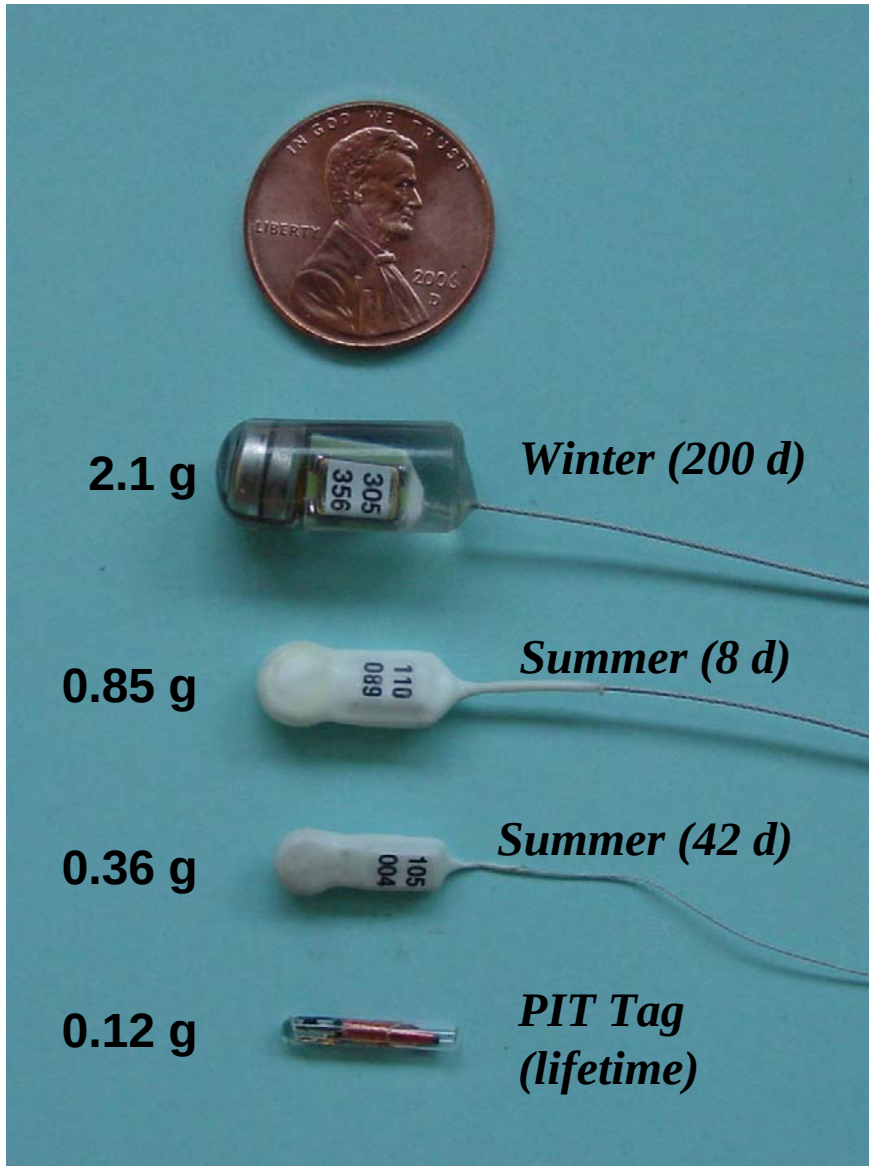
Population level passage of wild fall Chinook salmon in 2005 and 2006



Mean percentage of wild subyearling and yearling migrants (1992 to 2000)



Overwintering Location



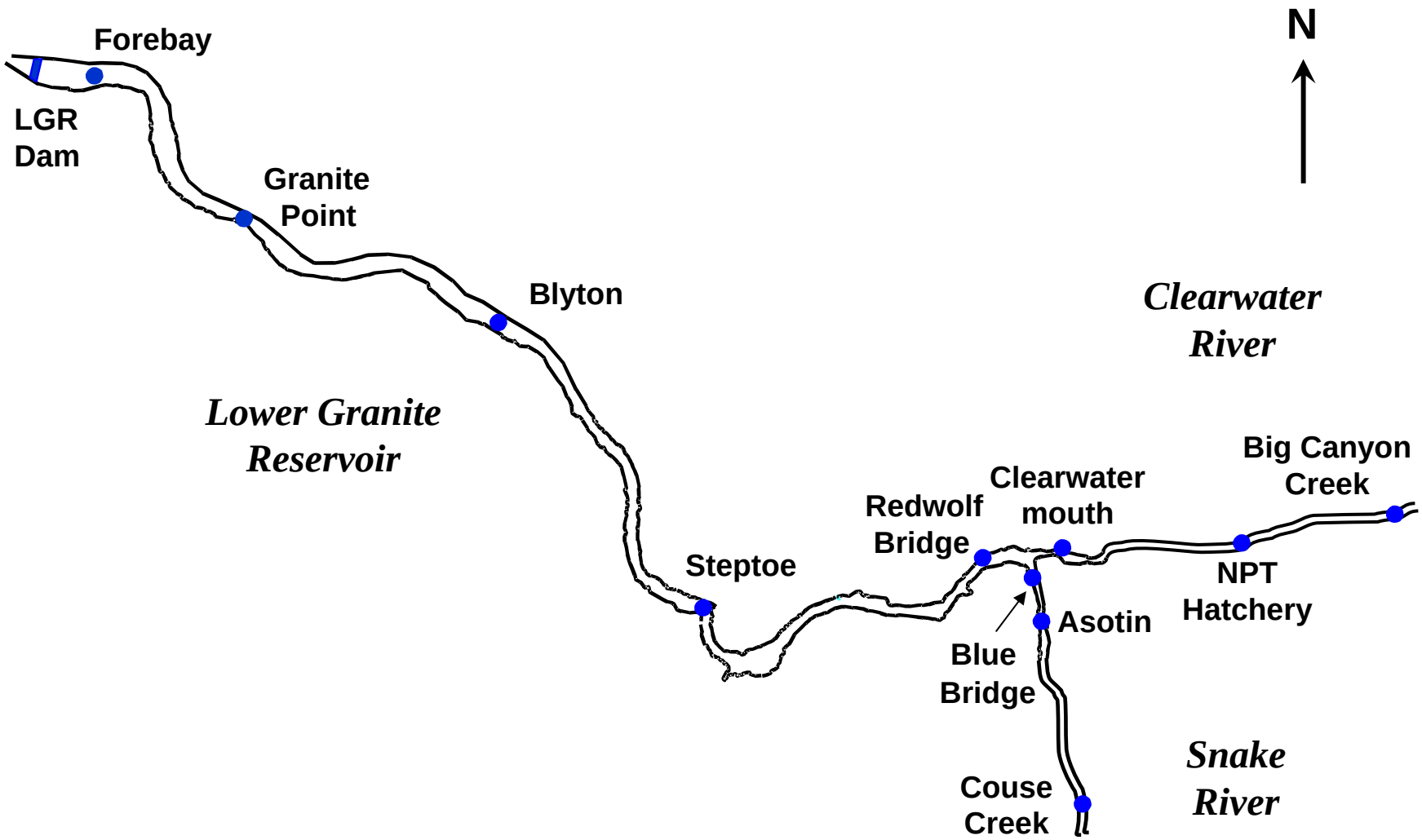
Tagged and released hatchery fall Chinook subyearlings used as wild fish surrogates during COE funded transportation research (2006)

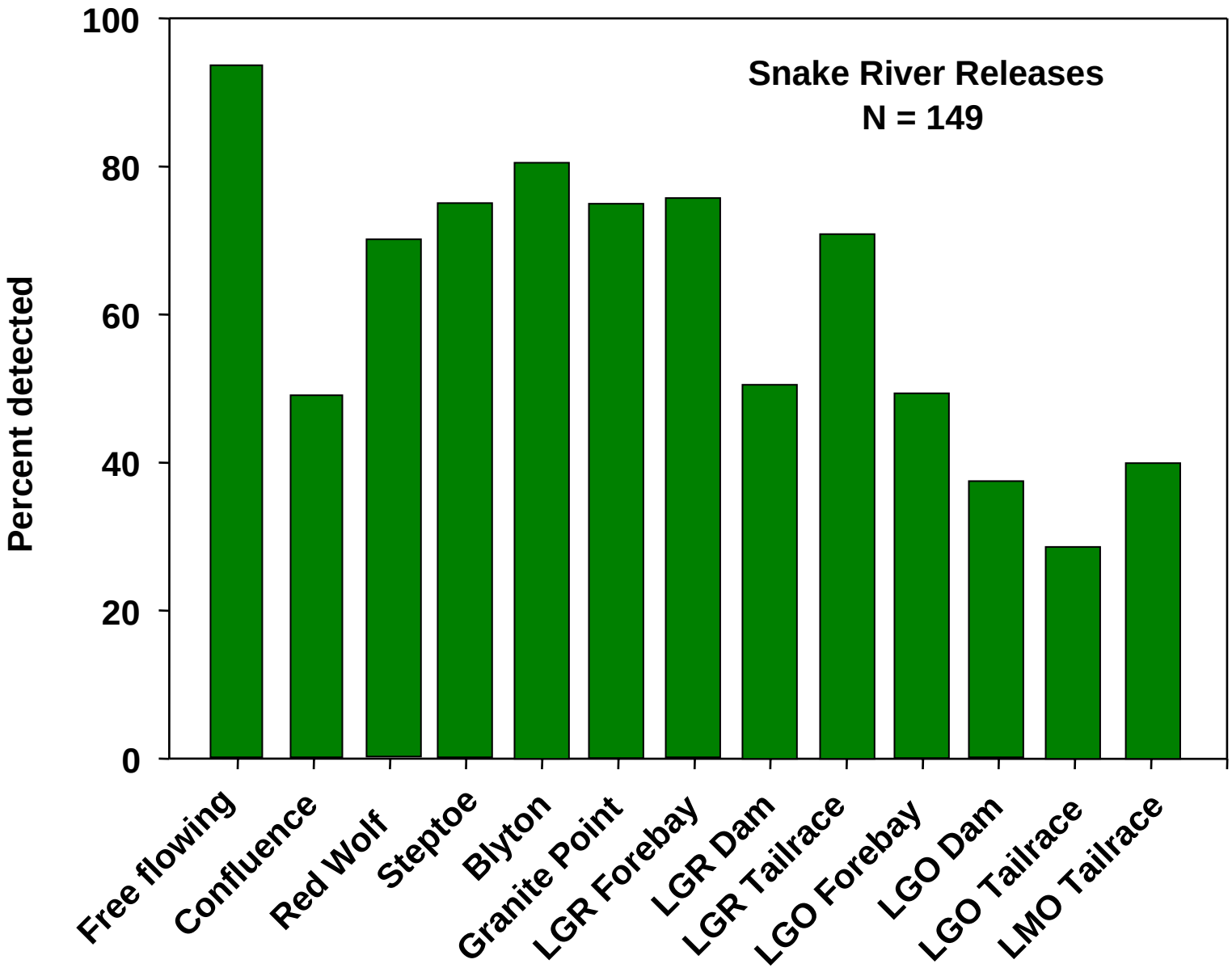
Used 0.36-g radio tags with a lifespan of 42 days

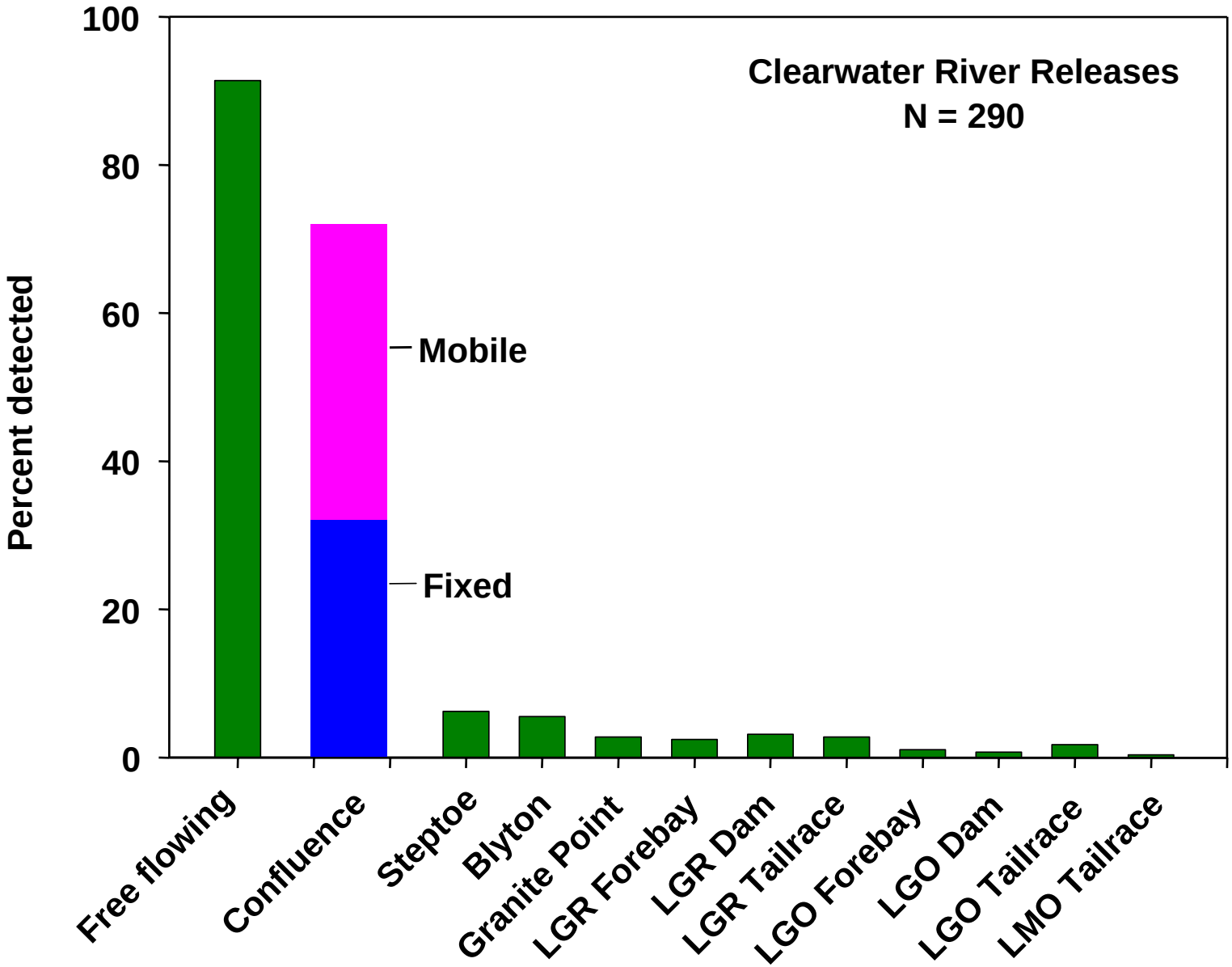
Release date	Site	N	FL
May 18	Snake	50	89
May 23	Snake	50	90
Jun 1	Snake	49	93
Jun 21	Clearwater	50*	92
Jun 28	Clearwater	50	91
Jul 3	Clearwater	50	91
Aug 9	Clearwater	50	103
Aug 16	Clearwater	50	105
Aug 23	Clearwater	40	109

* 1 mortality

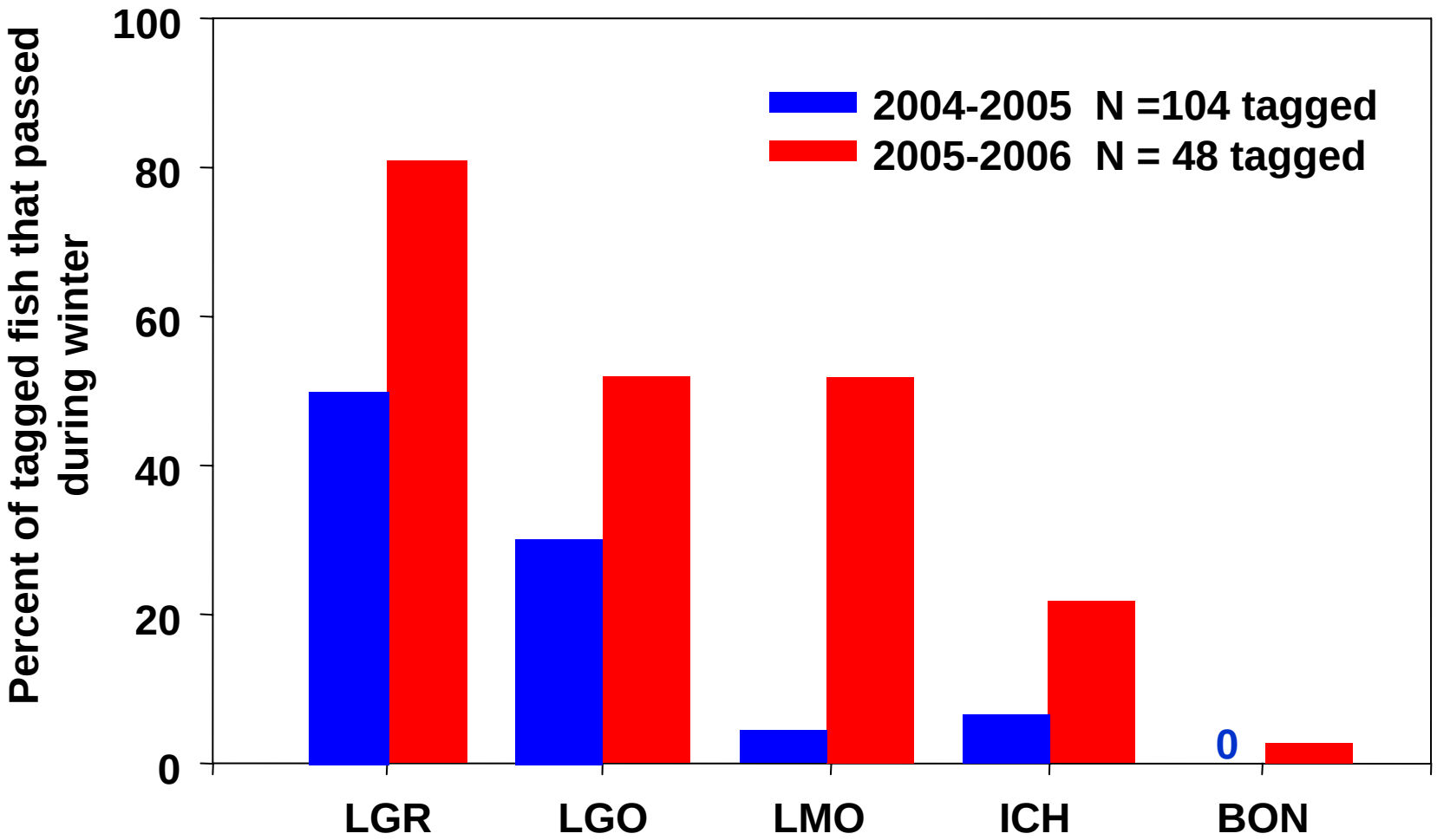
Summer and fall radio telemetry detection sites



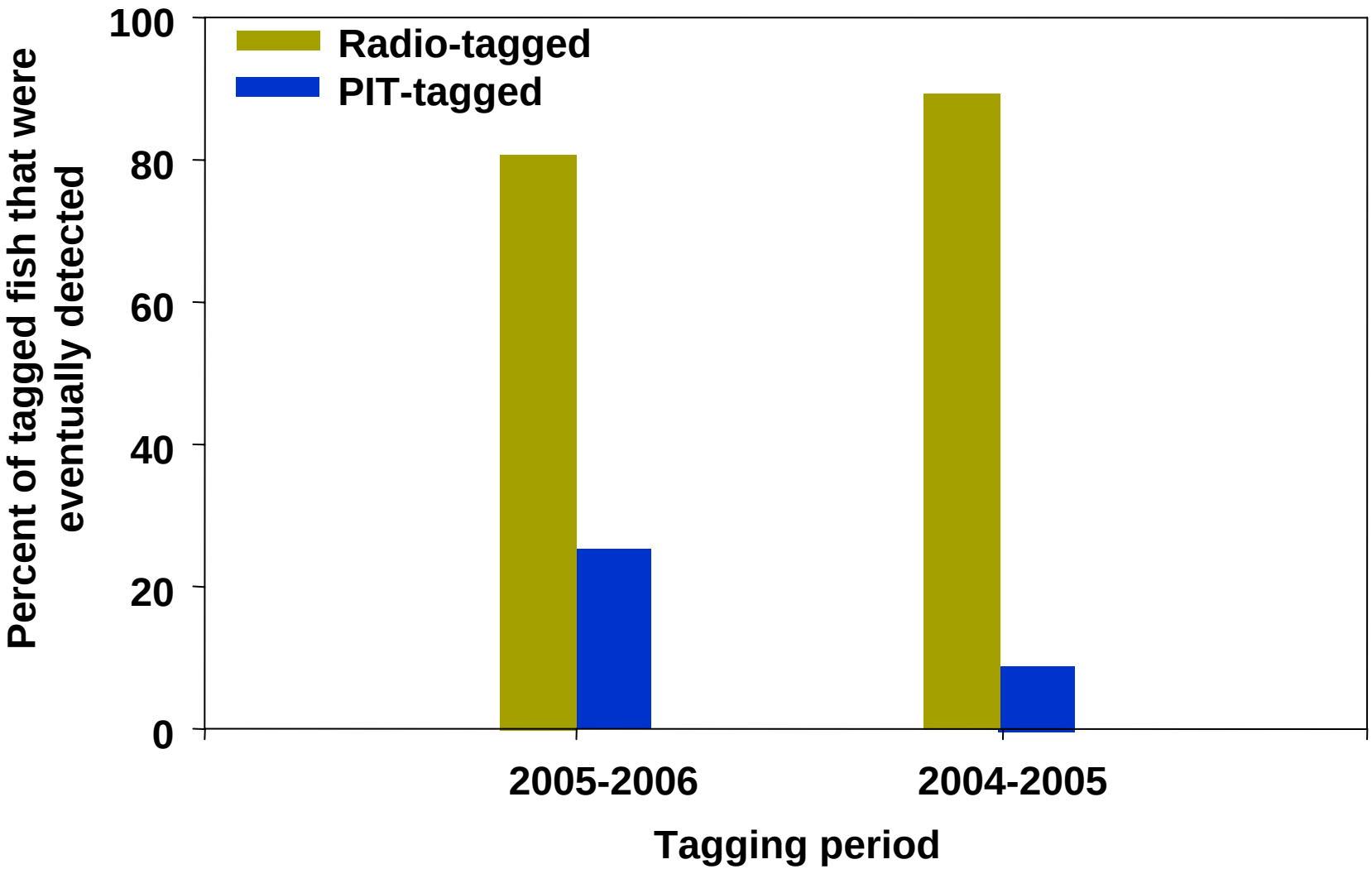

Snake River Releases
N = 149
Percent detected
100
80
60
40
20
0
Free flowing
Confluence
Red Wolf
Steptoe
Blyton
Granite Point
LGR Forebay
LGR Dam
LGR Tailrace
LGO Forebay
LGO Dam
LGO Tailrace
LMO Tailrace


Clearwater River Releases
N = 290
Percent detected
100
80
60
40
20
0
Mobile
Fixed
Free flowing
Confluence
Steptoe
Blyton
Granite Point
LGR Forebay
LGR Dam
LGR Tailrace
LGO Forebay
LGO Dam
LGO Tailrace
LMO Tailrace

Winter passage and location of reservoir-type juveniles tagged In Lower Granite Reservoir



Winter passage and location of reservoir-type juveniles tagged In Lower Granite Reservoir

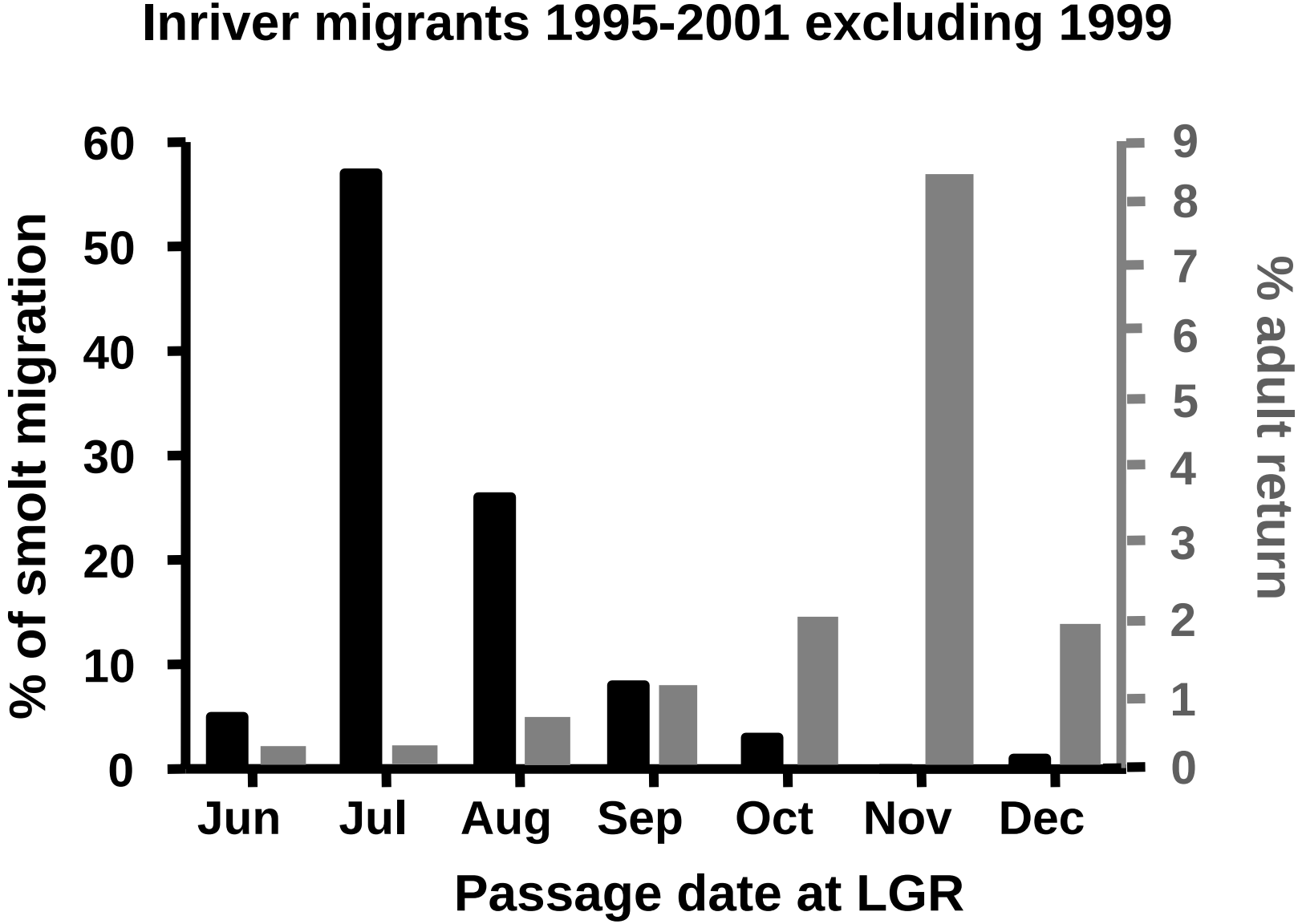


SARs

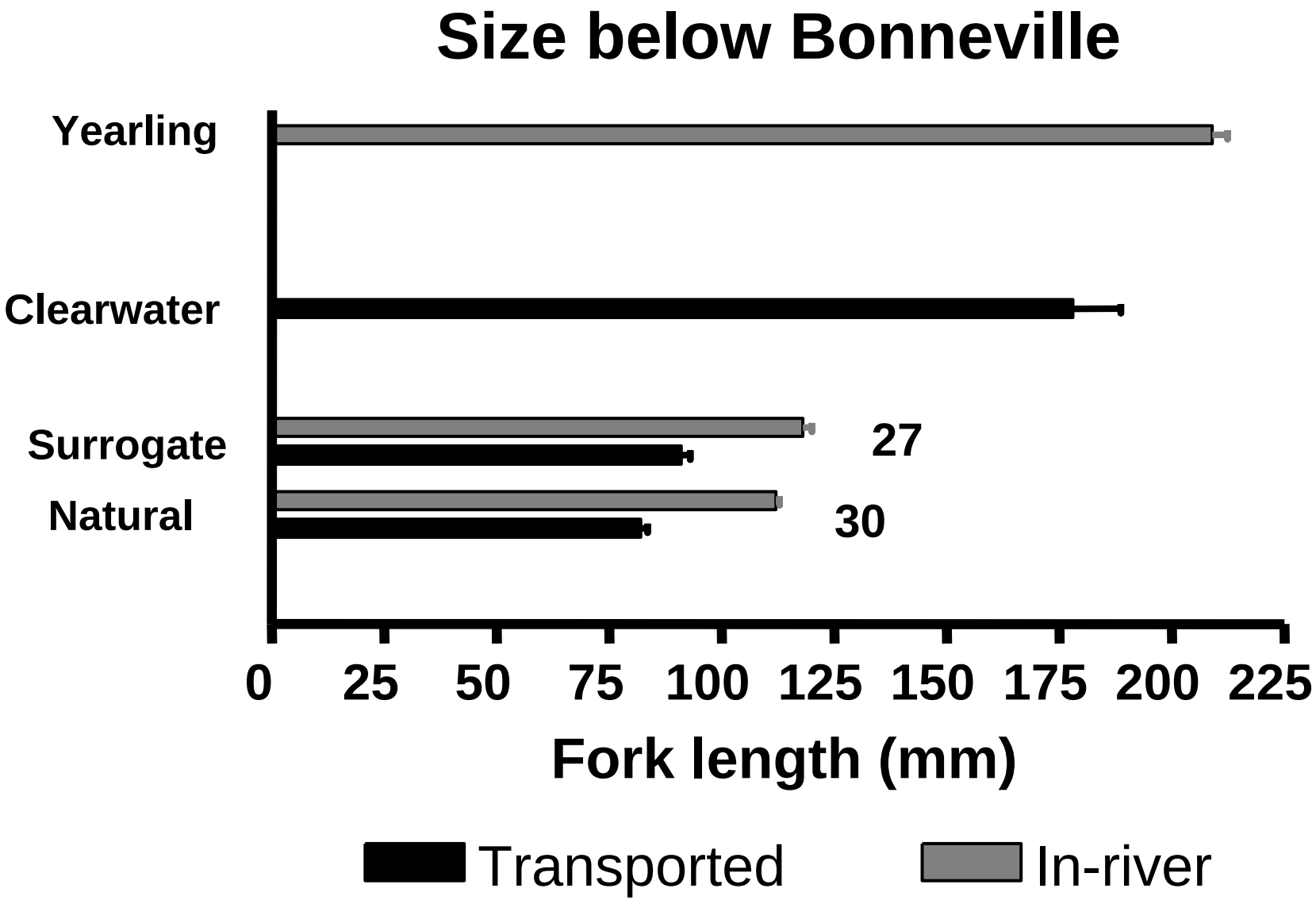
- Data from 1995-2001 survival studies using PIT-tagged hatchery smolts as surrogates for wild subyearlings
- 4,932 smolts were transported
- 53,324 smolts were bypassed
- 3,386 smolts were known to have migrated as yearlings (i.e., reservoir-type juveniles)

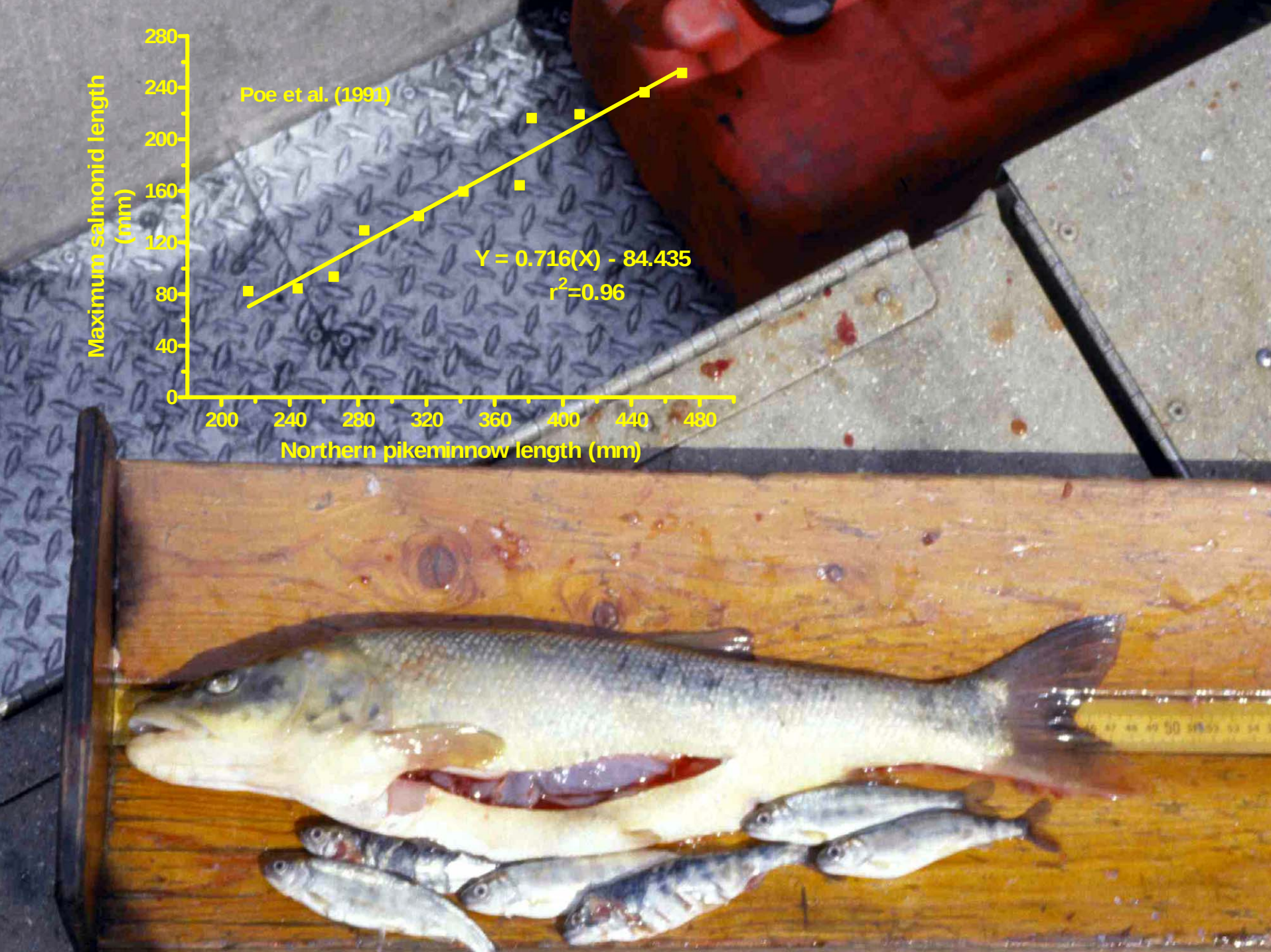
Disposition	# Adults	SAR*
Transported	22	0.51
Bypassed	183	0.56
Reservoir-types	51	1.35
Never detected	113	??

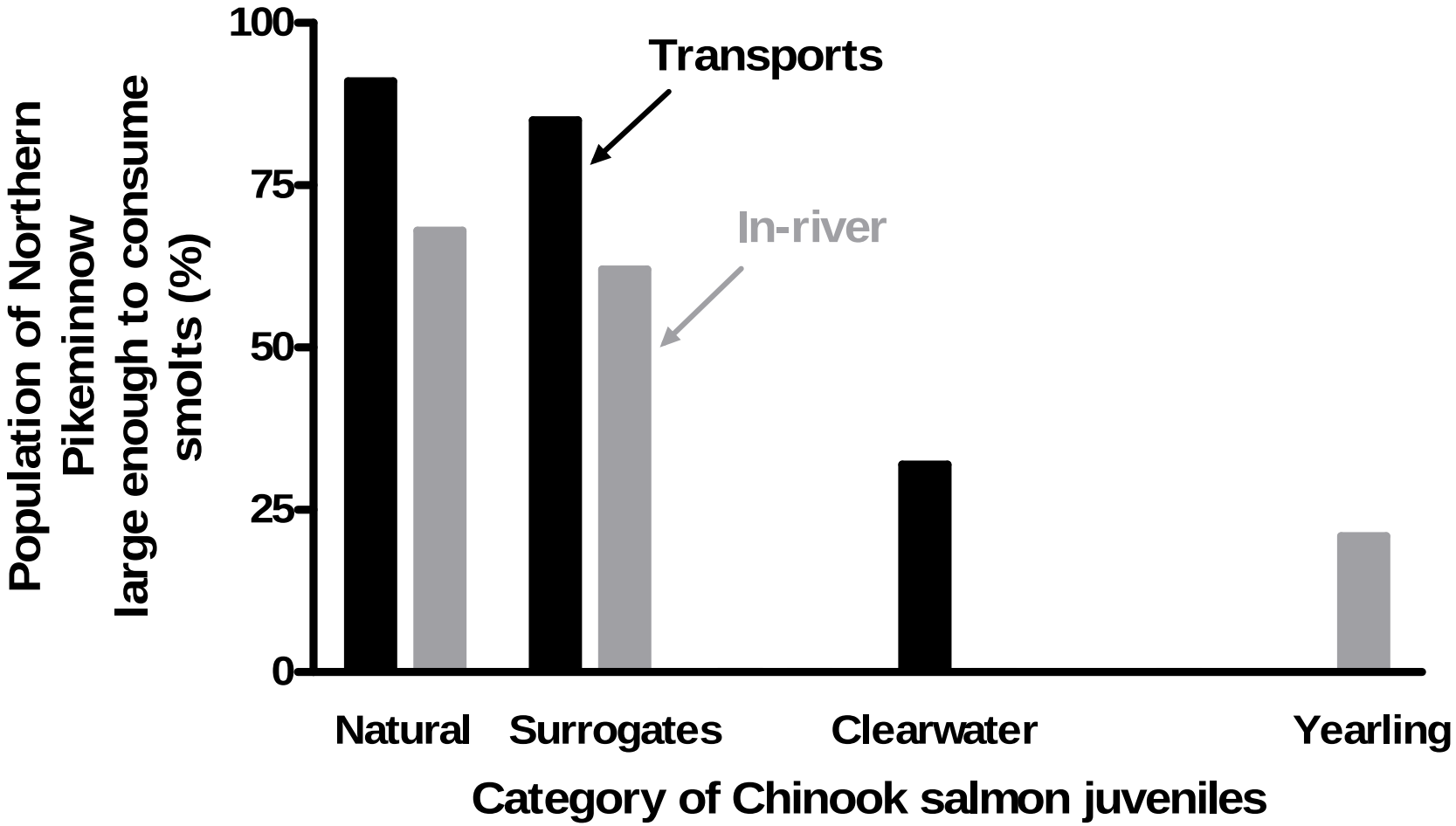
- *Estimated LGR to LGR

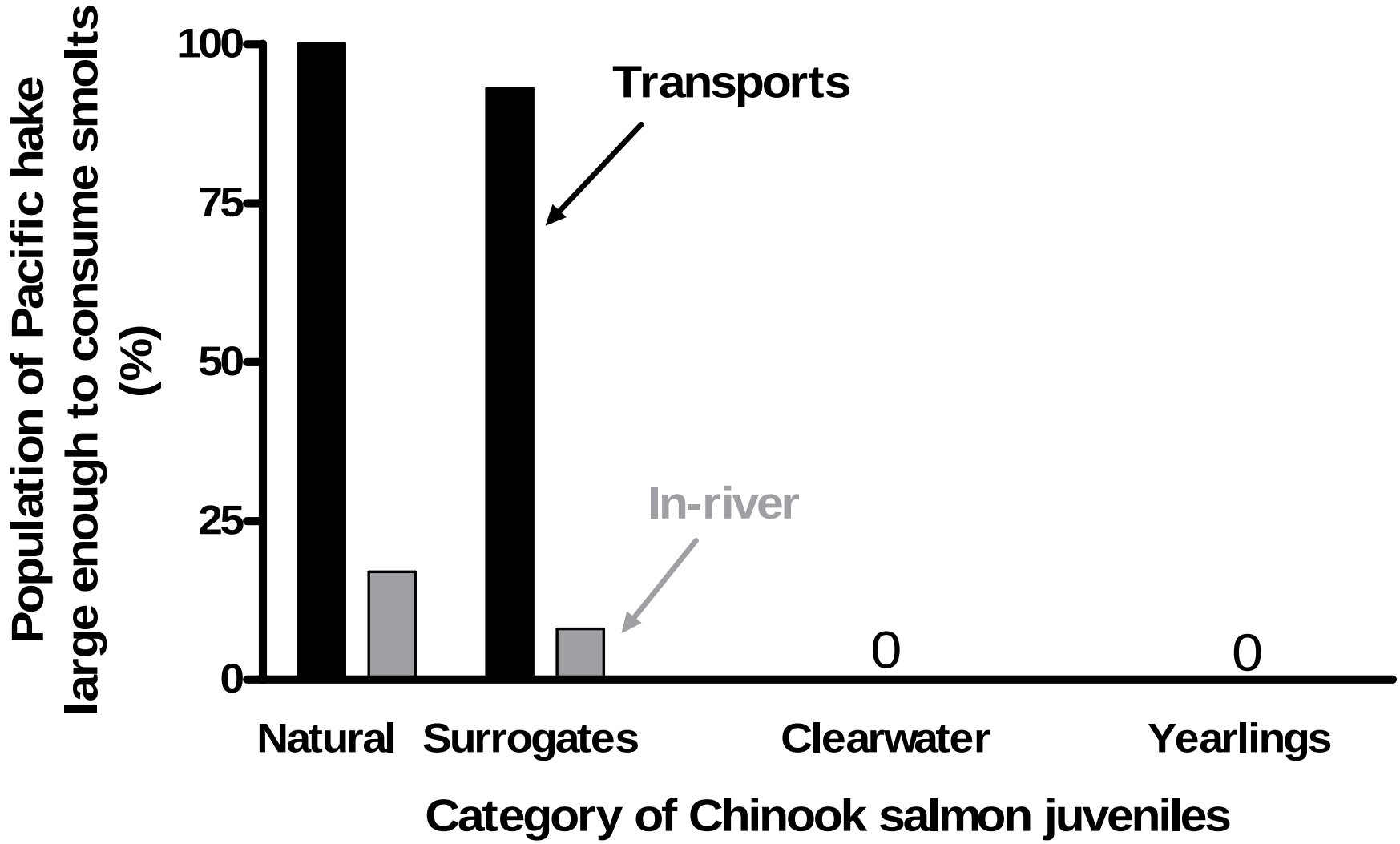

Inriver migrants 1995-2001 excluding 1999
% of smolt migration
60
50
40
30
20
10
0
9
8
7
6
5
4
3
2
1
0
% adult return
Jun
Jul
Aug
Sep
Oct
Nov
Dec
Passage date at LGR

Why do yearlings make up a small percentage of the migrants, but a large percentage of the full-term adults?


Size below Bonneville
Yearling
Clearwater
Surrogate
Natural
27
30
0
25
50
75
100
125
150
175
200
225
Fork length (mm)
Transported
In-river


Maximum salmonid length (mm)
280
240
200
160
120
80
40
0
Poe et al. (1991)
Y = 0.716(X) - 84.435
r2=0.96
200
240
280
320
360
400
440
480
Northern pikeminnow length (mm)


Population of Northern Pikeminnow large enough to consume smolts (%)
100
75
50
25
0
Transports
In-river
Natural
Surrogates
Clearwater
Yearling
Category of Chinook salmon juveniles


Population of Pacific hake large enough to consume smolts (%)
100
75
50
25
0
Transports
In-river
0
0
Natural
Surrogates
Clearwater
Yearlings
Category of Chinook salmon juveniles

Summary

- Limited recent data indicate that all yearling migrants do not winter exclusively in reservoirs, however, the data still indicate that reservoir-type juveniles contribute substantially to the return of full-term adults

- Though juveniles from cooler production areas are more likely to become yearling migrants than those from warmer production areas, yearling migrants are produced throughout the Snake River basin

- Recent data indicate late migrants delay seaward movement near the Snake-Clearwater confluence and that overwintering juveniles are present throughout the hydrosystem

Summary (Continued)

- Though SARs for yearling migrants cannot account for mortality prior to a fish becoming a yearling, the higher SAR estimates we reported for later migrants and yearling migrants are consistent with trends in adult composition
- Conducting a COE-funded transportation study with a method that does not account for the diversity in juvenile life history of Snake River fall Chinook salmon will result in decisions that could counter recovery