

Adult Wild- and Hatchery-Origin Steelhead Returns to the Cheakamus River in 2009



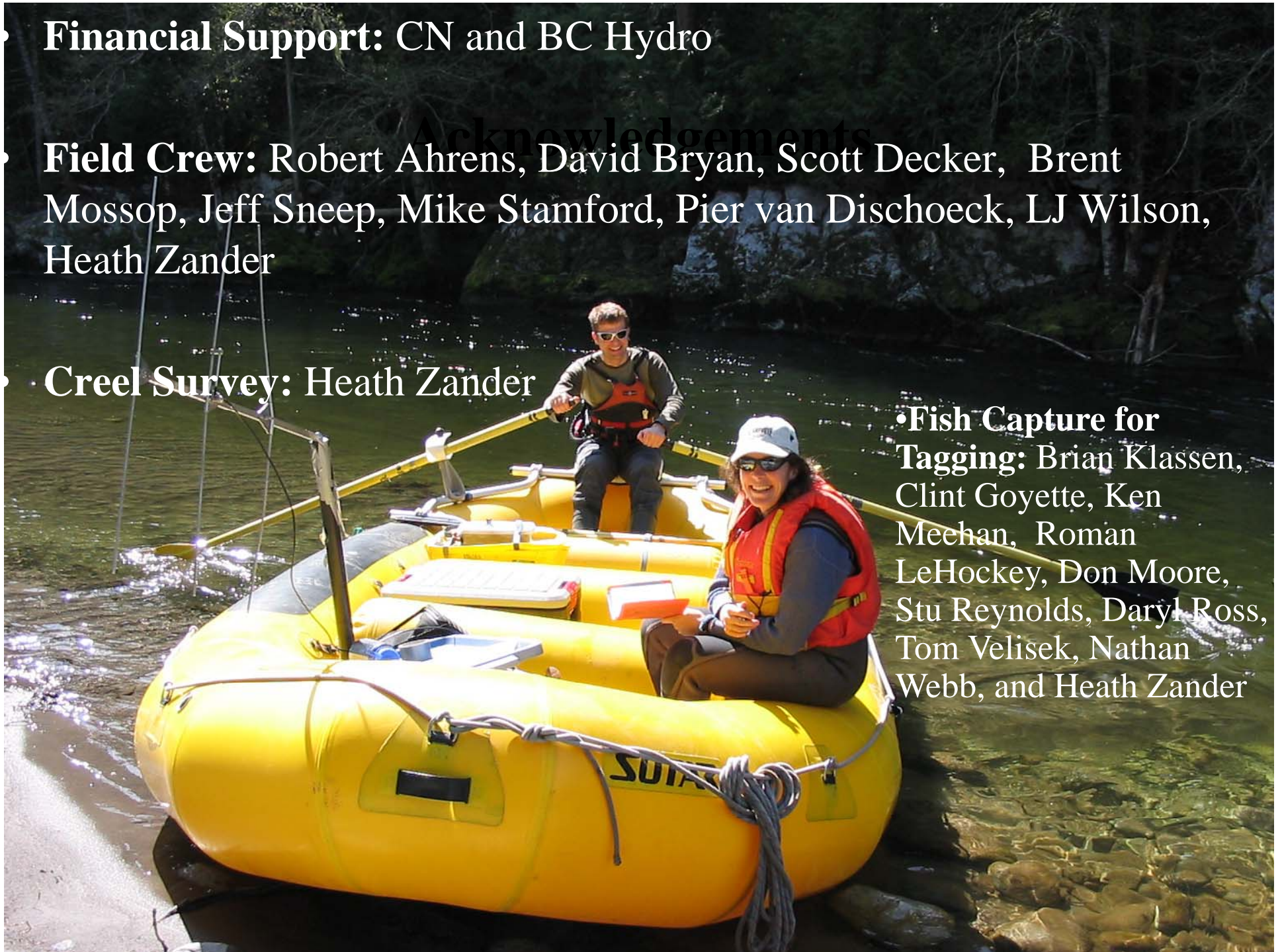
**Josh Korman
Don McCubbing
Caroline Melville**

• **Financial Support:** CN and BC Hydro

• **Field Crew:** Robert Ahrens, David Bryan, Scott Decker, Brent Mossop, Jeff Sneep, Mike Stamford, Pier van Dischoeck, LJ Wilson, Heath Zander

• **Creel Survey:** Heath Zander

• **Fish Capture for Tagging:** Brian Klassen, Clint Goyette, Ken Meehan, Roman LeHockey, Don Moore, Stu Reynolds, Daryl Ross, Tom Velisek, Nathan Webb, and Heath Zander

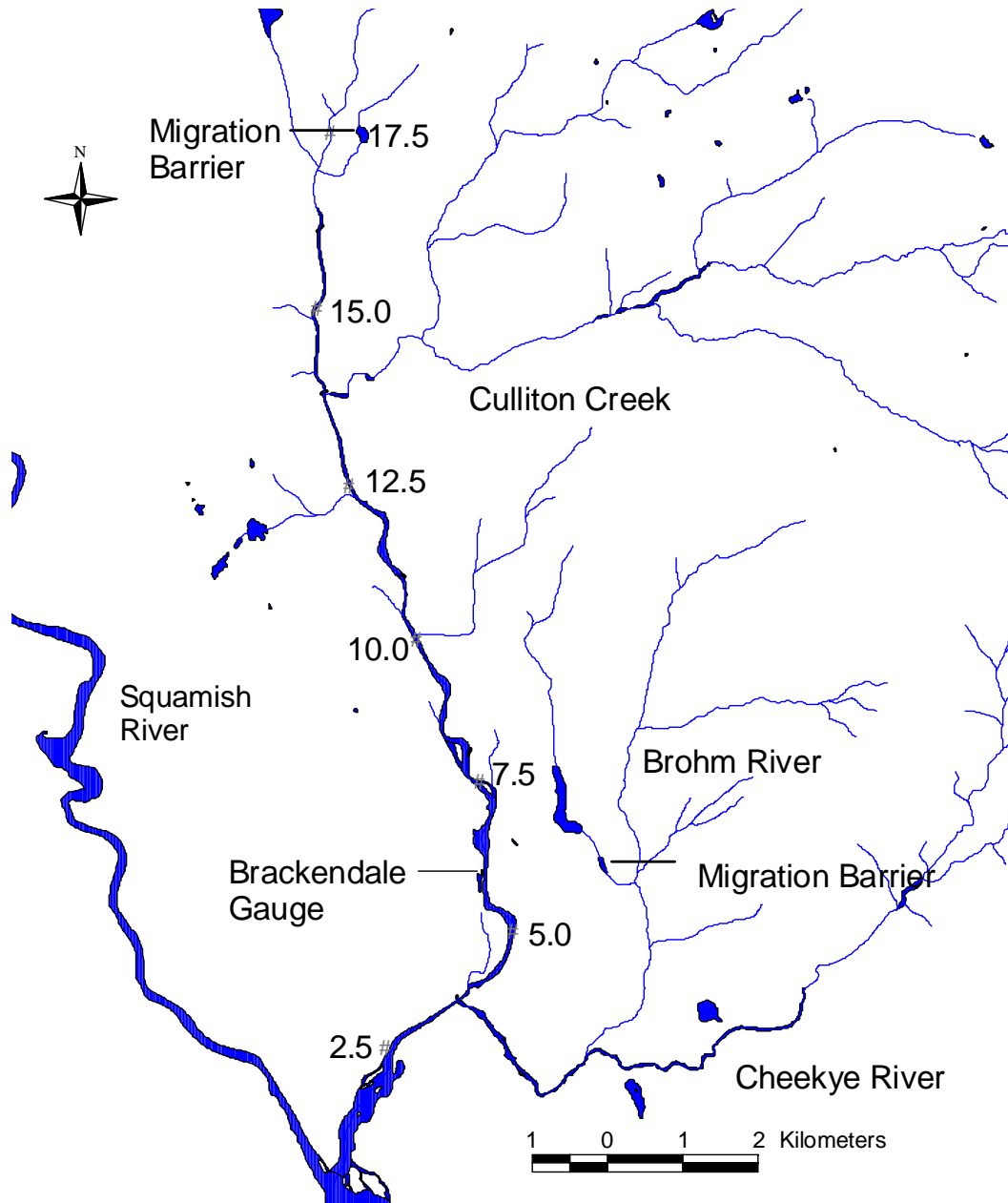


Objectives of Steelhead Escapement Program

- Provide a long-term assessment of adult steelhead returns to the Cheakamus River to evaluate stock status and effects of flow regime.
- Evaluate impact of sodium hydroxide spill and benefits of hatchery mitigation program.

Outline of Talk

- Methods and basic results from 2009 program
- Modelling approach and escapement estimates
- Estimate of 2007 hatchery release return-rate
- Stock-recruitment relationship to estimate stock size required to meet smolt capacity. Did hatchery program meet conservation goals (part 1)?
- Preliminary results from 2010



Study Area

(upstream barrier to Cheekye)

Estimating Escapement from Repeat Counts

Escapement by stock Origin \longrightarrow $E_O = \frac{u_{O,t}}{q_{obs,t} * q_{run,t}}$

Counts from swim surveys & angling data (composition) \swarrow

Proportion of fish present that are counted (detection probability or efficiency, from swim surveys + telemetry) \swarrow

Proportion of run present (from run-timing from telemetry) \swarrow

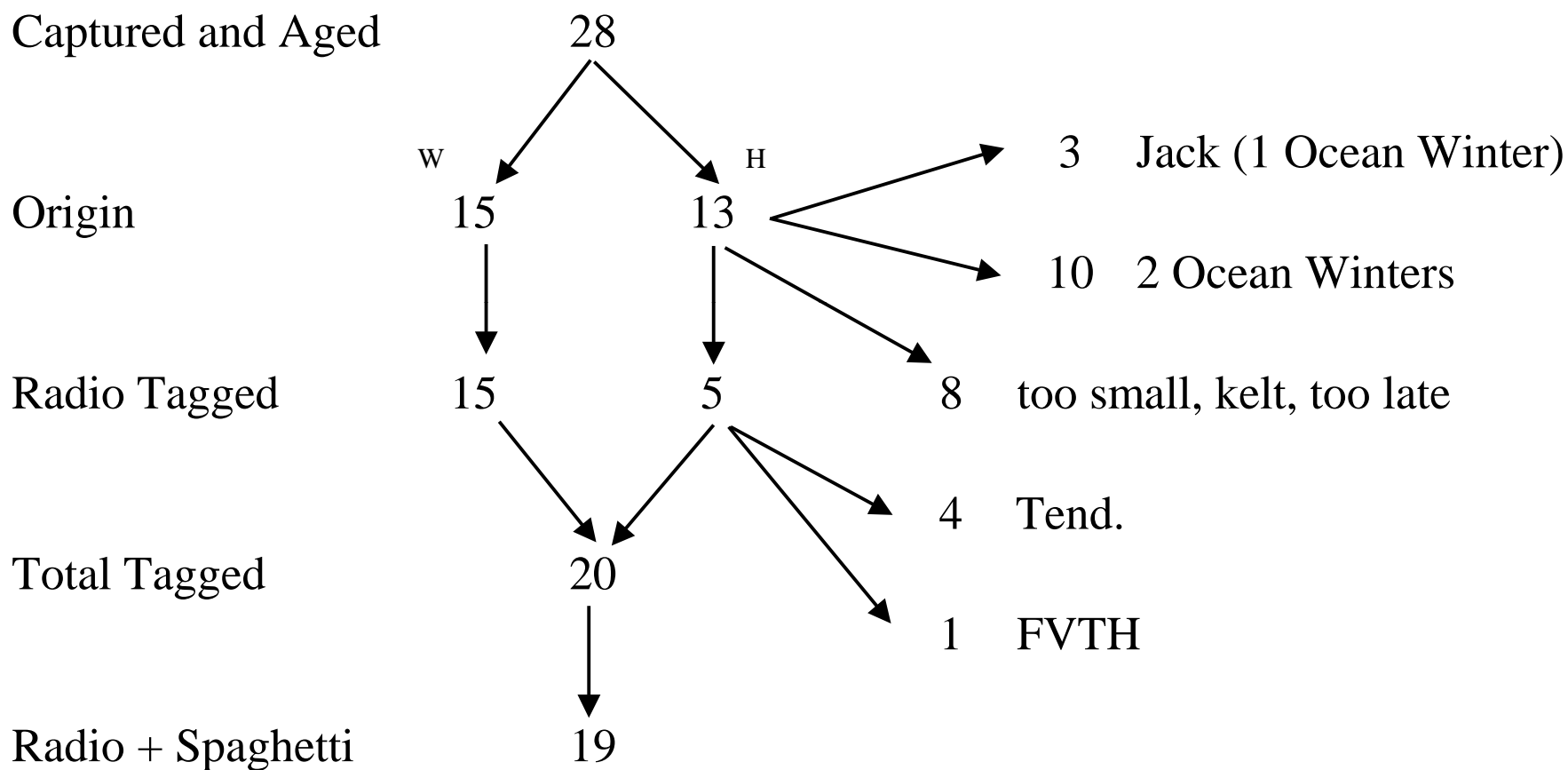
$$q_{obs,t} = \frac{r_t}{R_t}$$

Mark-Recapture

r_t = # tagged fish observed

R_t = # tagged fish present (telemetry)

Tagging Summary (2009)



		2009	2000-2005	Total
q_{run}	←	17	105	122
	←	4	54	58
q_{obs}	←	10	52	62

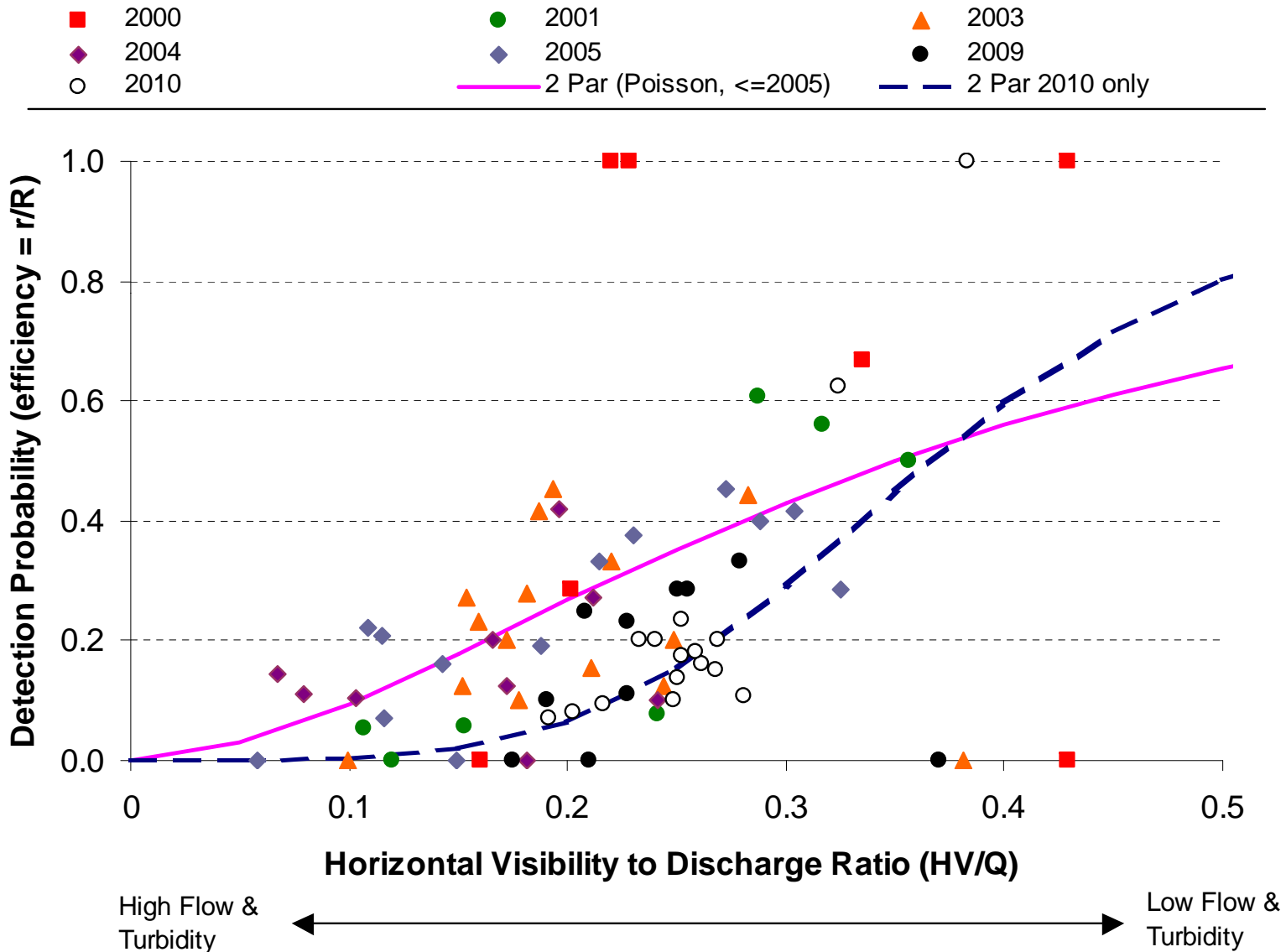
Impacts of Tagging on Population

	# Fish Tagged	Max. # Tagged That Died	Max % Tagged That Died	Population Size	% Pop. Tagged	Max % Pop. That Died
2001	31	2	6%	393	7.9%	0.5%
2003	33	2	6%	399	8.3%	0.5%
2004	36	1	3%	413	8.7%	0.2%
2005	37	0	0%	408	9.1%	0.0%
2009	28	0	0%	237	11.8%	0.0%
2010	53	4	8%	1500	3.5%	0.3%
Total	218	9	4%		8.2%	0.3%

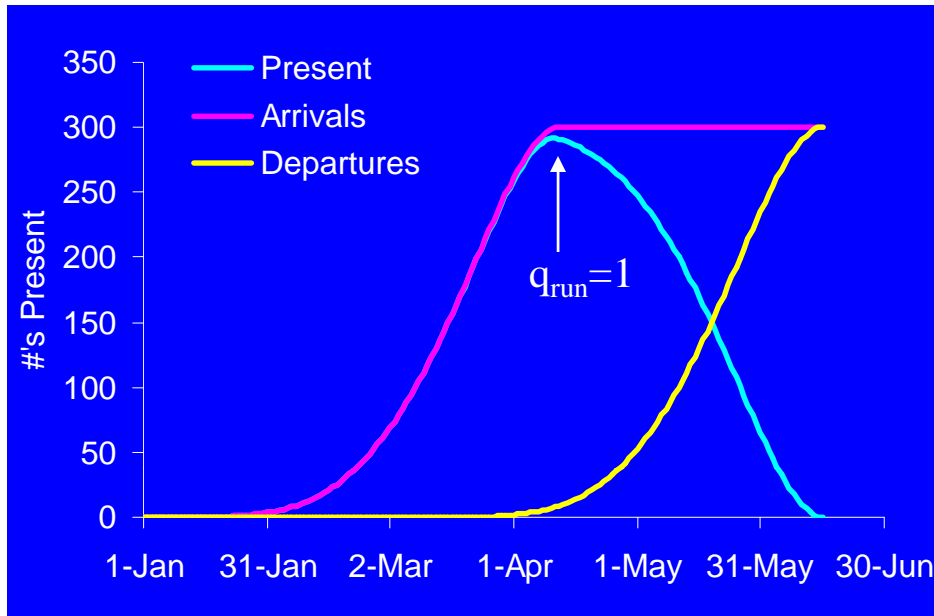
Summary of 2009 Swim Count and Mark-Recapture Data

Survey Date	Counted No Tag	Counted With Tag (r)	Tags Present (R)	Diver Efficiency (r/R)
17-Feb	2	0	0	
5-Mar	10	0	0	
12-Mar	15	0	0	
19-Mar	6	0	0	
26-Mar	12	0	1	0.00
2-Apr	16	1	3	0.33
7-Apr	7	1	4	0.25
15-Apr	8	0	7	0.00
16-Apr	8	2	7	0.29
23-Apr	15	3	13	0.23
24-Apr	21	4	14	0.29
29-Apr	14	0	18	0.00
30-Apr	15	2	18	0.11
15-May	17	1	10	0.10
Average Efficiency				0.16

Detection Probability Depends on River Conditions

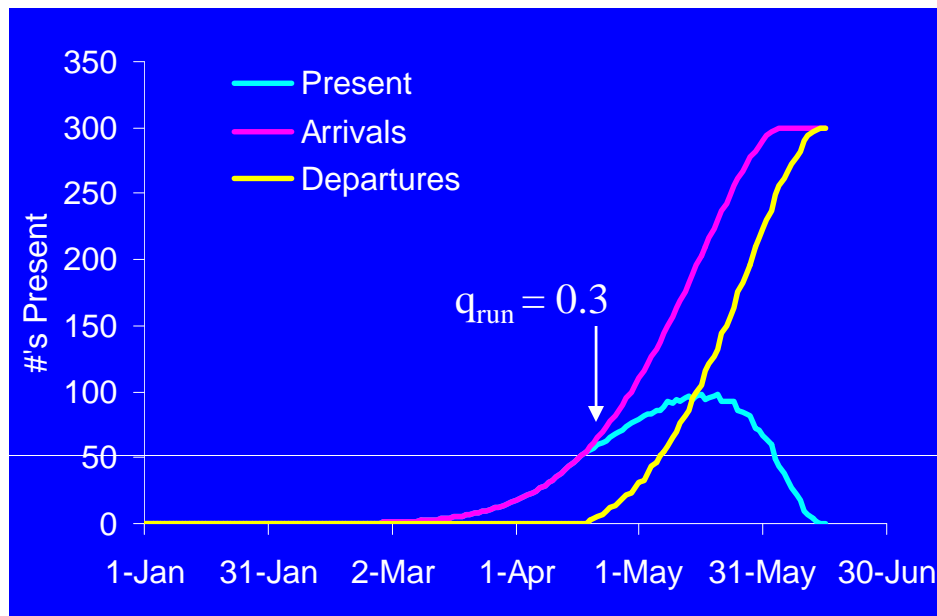


Dynamics of Run Timing (q_{run})



Early arrival

Long and constant survey life
(e.g., summer steelhead)



Later arrival

Shorter and declining survey life

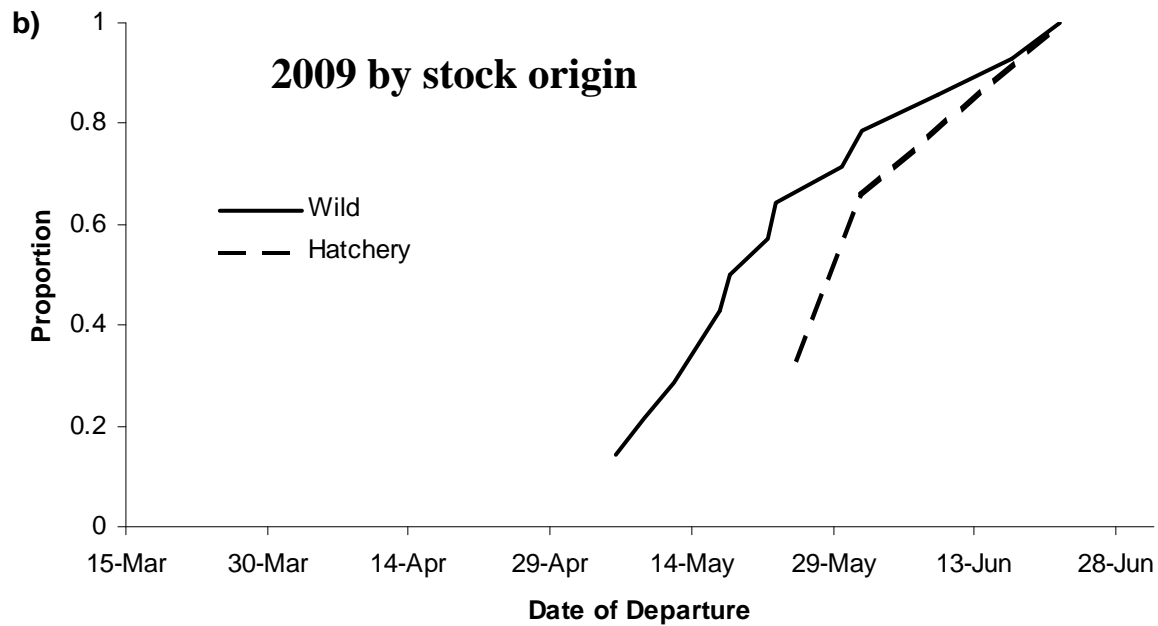
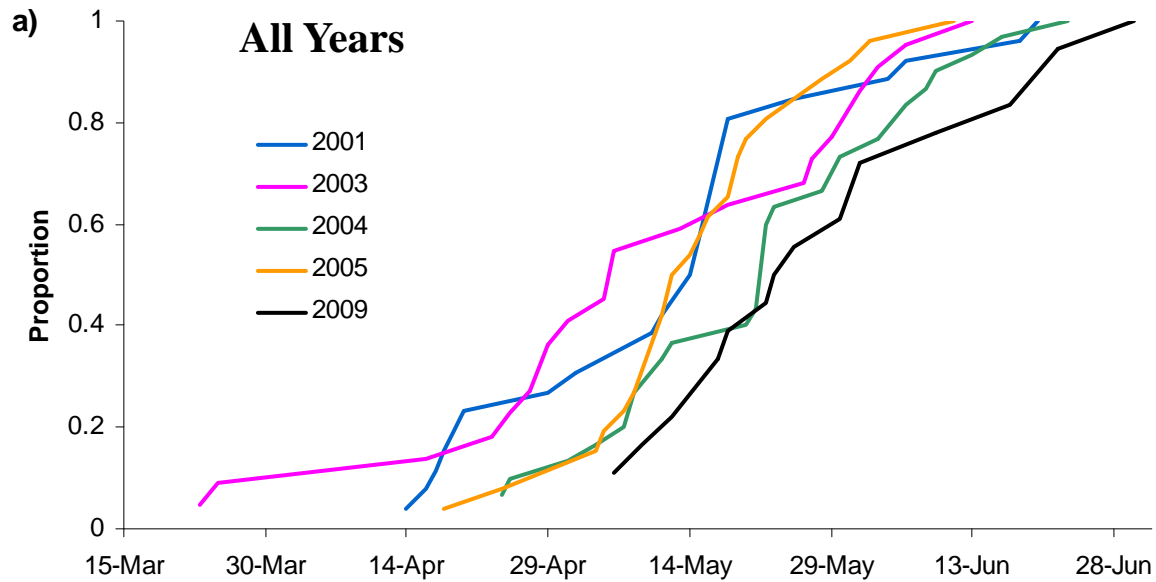
To estimate q_{run} in this case,
need to know 2 of 3 things:

Arrival timing

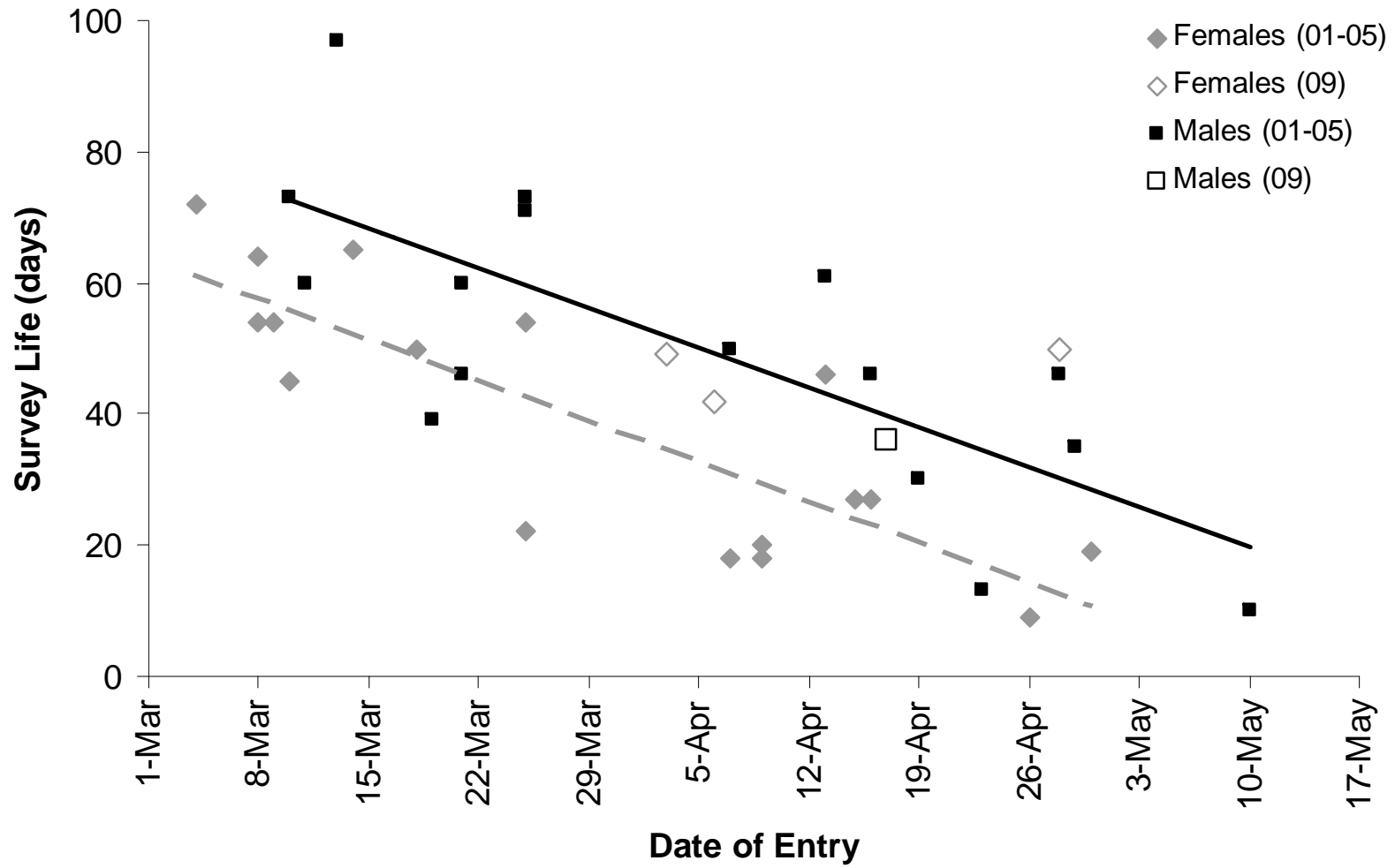
Departure timing

Survey Life

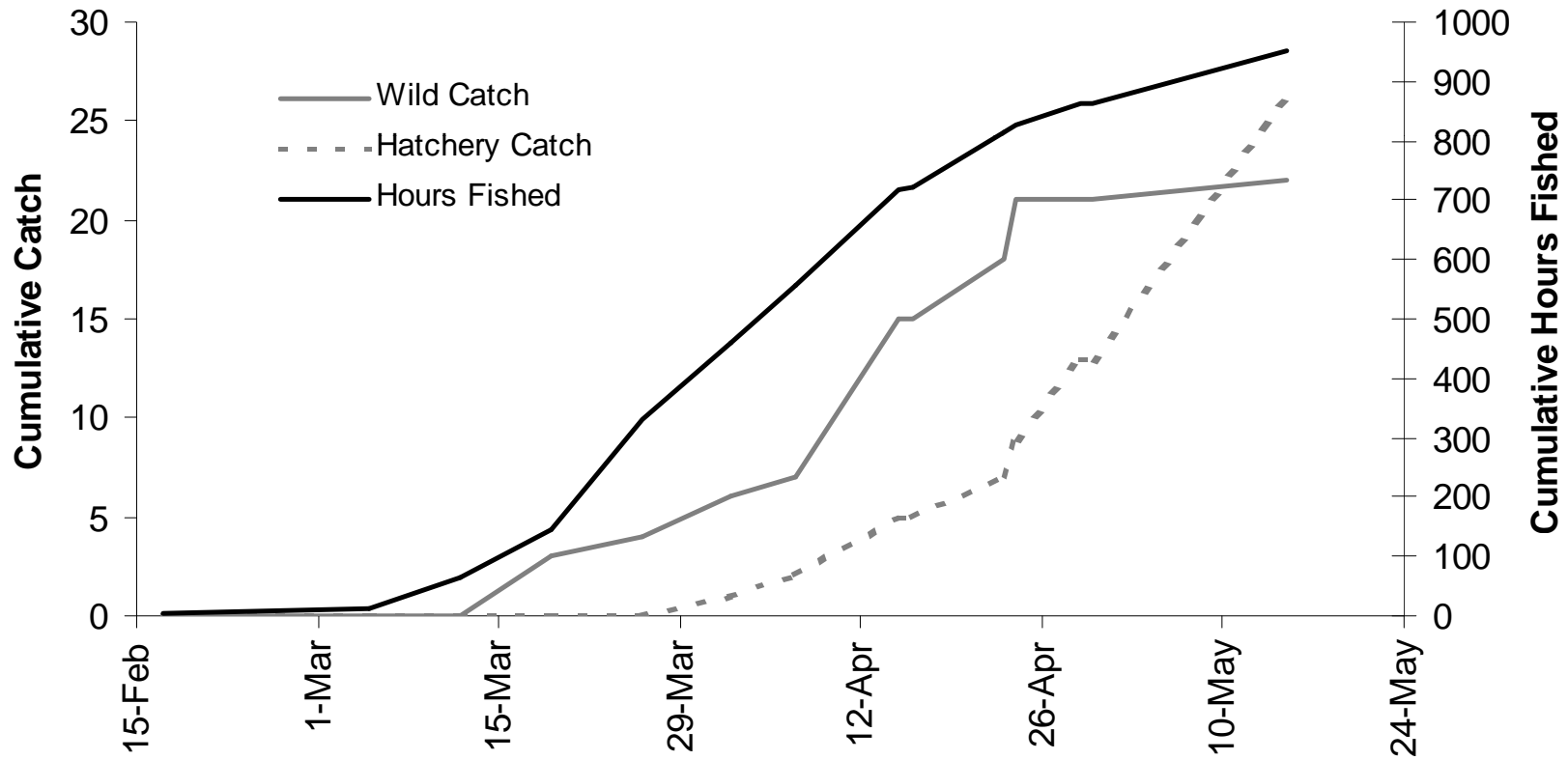
Departure Timing from Radio Telemetry



Survey Life from Radio Telemetry



Stock Composition from Creel and Log Book Surveys



Estimating Escapement from Multiple Data Sources

Multi-yr telemetry data

Survey life – entry date

Departure schedule

Observer efficiency

Annual swim count data

of marked and unmarked fish observed by survey

assessment model

Angling data

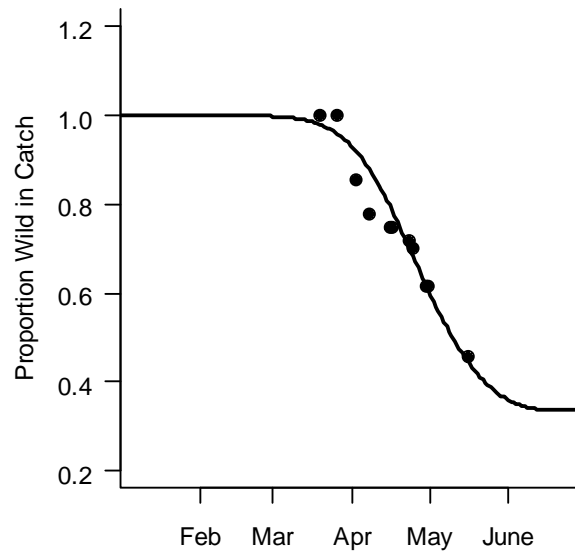
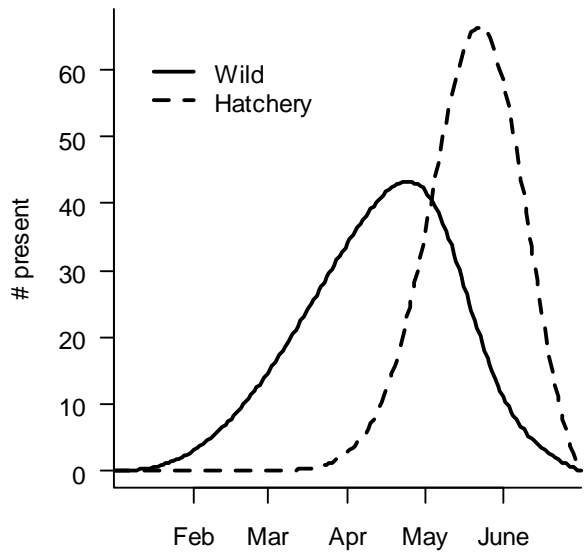
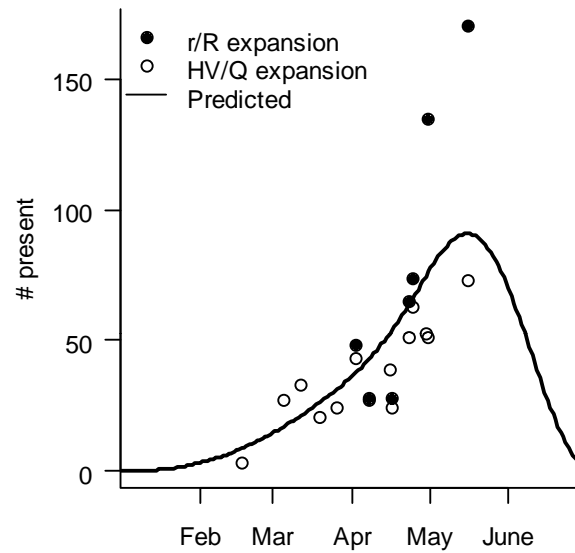
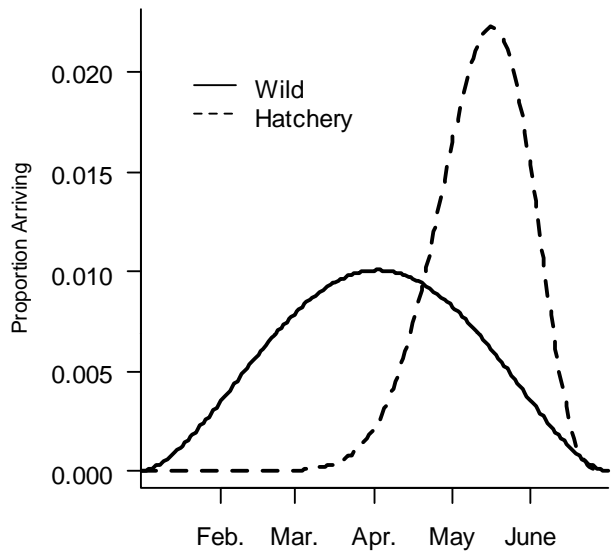
Catch of wild and hatchery steelhead by survey

Returns by brood year
(stock-recruitment)

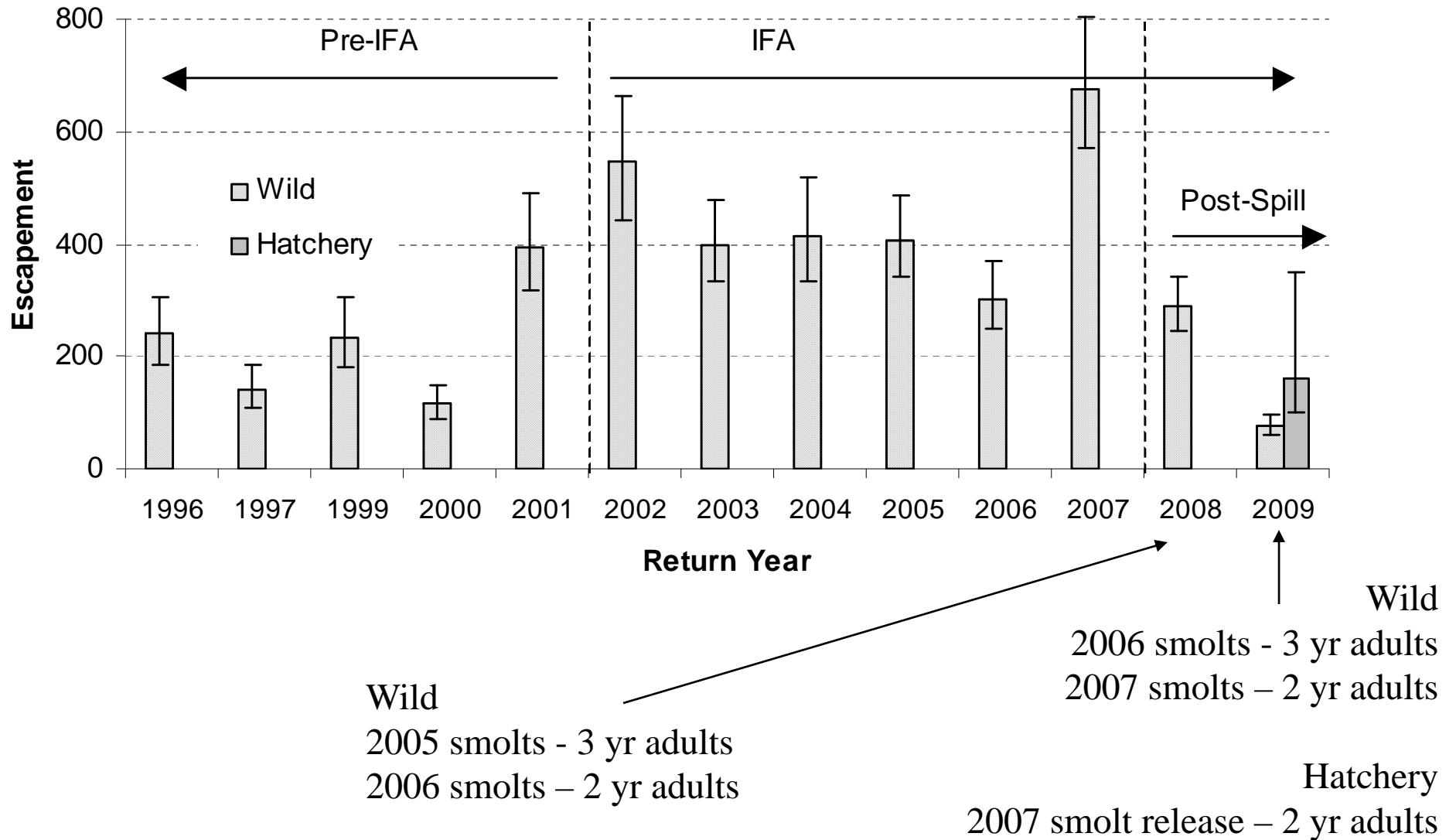
Age data

Escapement by origin (trend)

Some Components of 2009 Steelhead Escapement Estimate



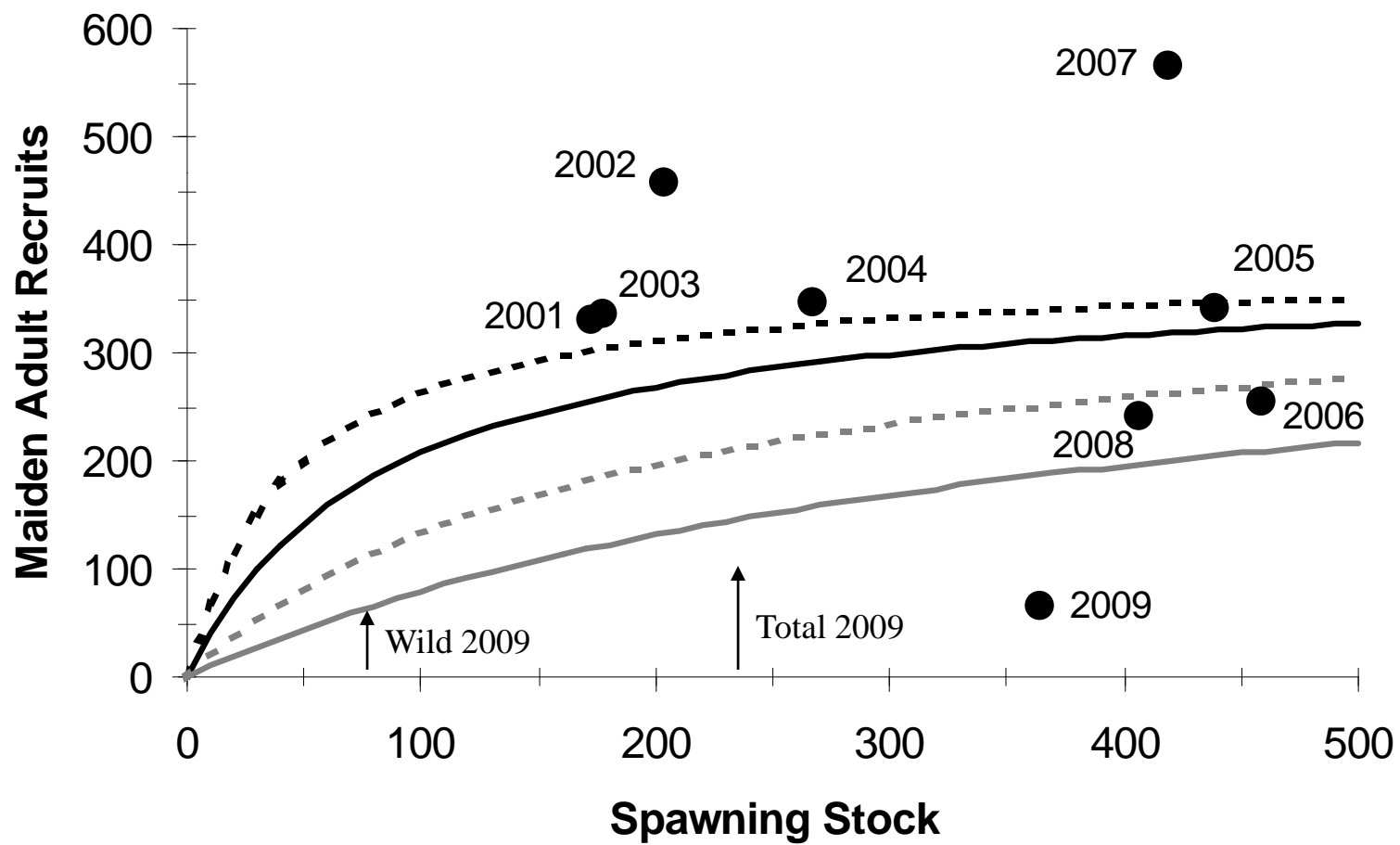
Cheakamus Steelhead Escapement Trend



Steelhead Hatchery Return Rate (from 2007 release, 2 yr adults only)

2007 Smolt Release	21,505		
		Lowest	Highest
	Expected	(5%)	(95%)
2009 Hatchery-Origin Escapement	161	65	316
2009 Hatchery-Origin Escapement from 2007 release only (no 2008 jacks)	124	50	243
2007 Smolt-release Return Rate	0.90%	0.30%	1.70%

Cheakamus Steelhead Stock-Recruitment



2009 Summary

- Escapement = 237 total (CV=0.47), 76 wild (CV=0.19), 161 hatchery (CV=0.67). Much later arrival-timing for hatchery fish which led to higher uncertainty. 2009 wild return lowest on record (spill effect).
- Returns under Instream Flow Agreement (IFA) 2-fold higher than pre-IFA. Unlikely to have been caused by higher marine survival. Positive trends also seen in char and resident rainbow data. Consider using data from IFA period only for recovery target.
- Hatchery return rate for 2007 release (2 yr adults only) ~ 1% but will be higher when ocean age 3 yr fish are included (using 2010 data). Goal of maintaining angling opportunities was met.
- Estimate a maximum of only ~ 150 spawners required to fully seed Cheakamus under current habitat conditions. Wild- + hatchery-origin escapement in 2009 was therefore likely sufficient to seed habitat.
- Reproductive potential of hatchery-origin spawners has not been established. Too early to tell whether the conservation goal of the hatchery program was met.

Preliminary 2010 Results

- 52 steelhead tagged (30 wild, 22 hatchery + 1 mort). 16 swims, many with 20+ tags. Average efficiency = 23%. Lower efficiency under same river conditions compared to previous years. Likely caused by Cheekye fan.
- Peak count of 140 steelhead, 120 resident rainbow, and 190 char (over multiple swims). Repeated estimates of peak expanded count for steelhead of ~ 1000. These are all largest counts and expanded counts since swims began in 1996.
- 620 angler hours surveyed in creel survey (no log book data entered yet):
 - 53 and 25 wild- and hatchery-origin steelhead landed.
 - 47 and 12 wild- and hatchery-origin resident rainbow landed.
 - 68% and 80% of steelhead and residents were wild-origin.
 - Wild- and hatchery-origin fish had very similar arrival timing.
- Steelhead escapement ~ 1500 fish (CV=0.17) = 1000 wild- and 500 hatchery-origin fish. Estimate will change slightly when additional information from telemetry program (survey life, departure schedule), and angler log books is included.