Stream-Associated Amphibian Response to Forestry Practices in Western Washington

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Weyerhaeuser

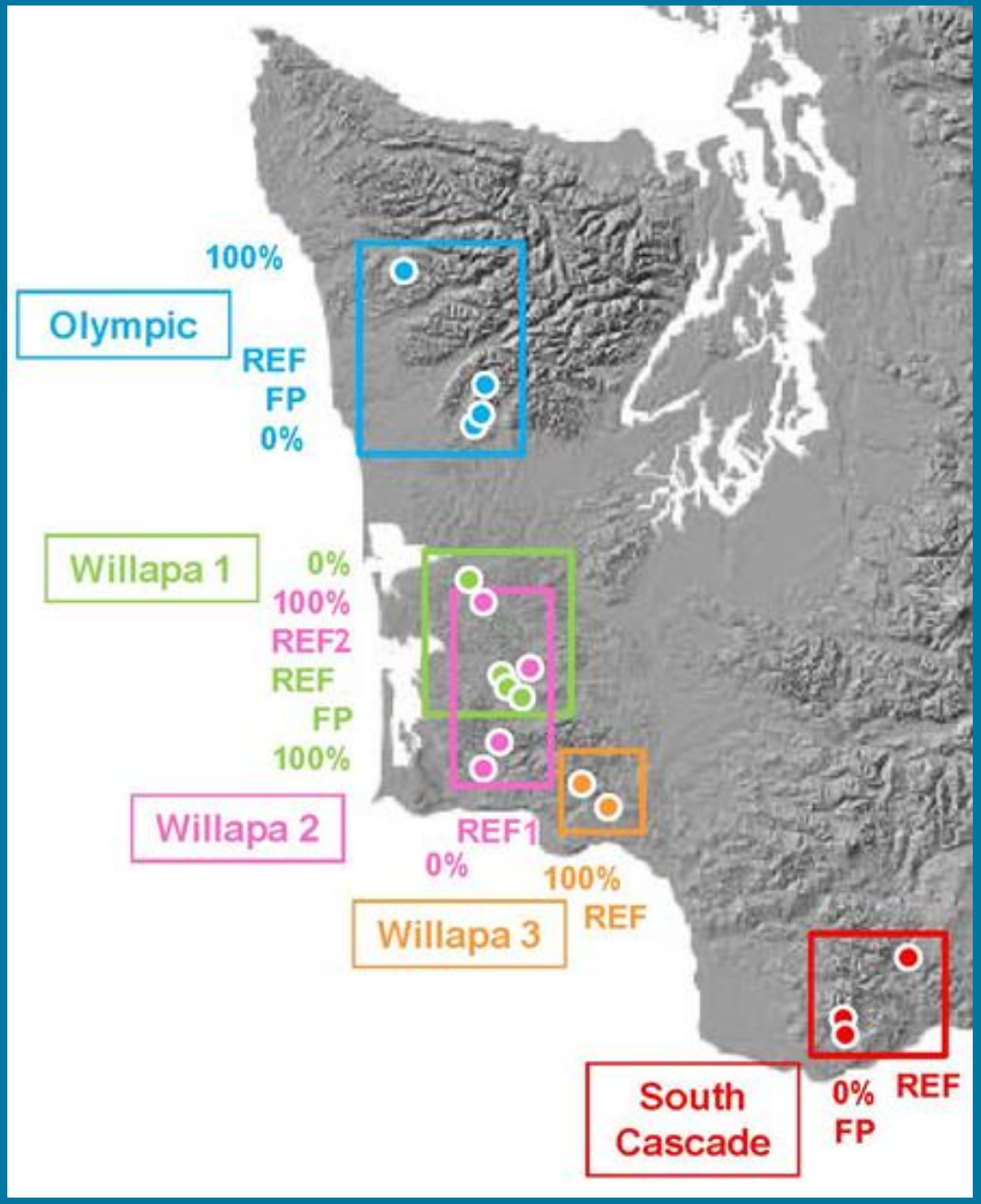
Study Objective

Evaluate effectiveness of WA State Forest Practices Rules: Compare riparian buffer configuration for non-fish-bearing streams to buffer alternatives:

- riparian stand characteristics
- water quality
- stream characteristics and productivity
- amphibian occupancy, density and genetics
- exports to fish-bearing streams
- response of fish downstream

Study Sites (N = 17)

- 1st, 2nd and 3rd order
- perennial, non-fish-bearing
- managed 2nd-growth forests
- private / state / federal
- 30 - 80 yr old stands
- 31 - 133 ac basins



Study Timeline

Pre-Harvest Sampling (2006-2008)

Harvest Implementation (2008/2009)

Post-Harvest Sampling (2009-2010)

Data Analyses

BACI

Before-After Control-Impact

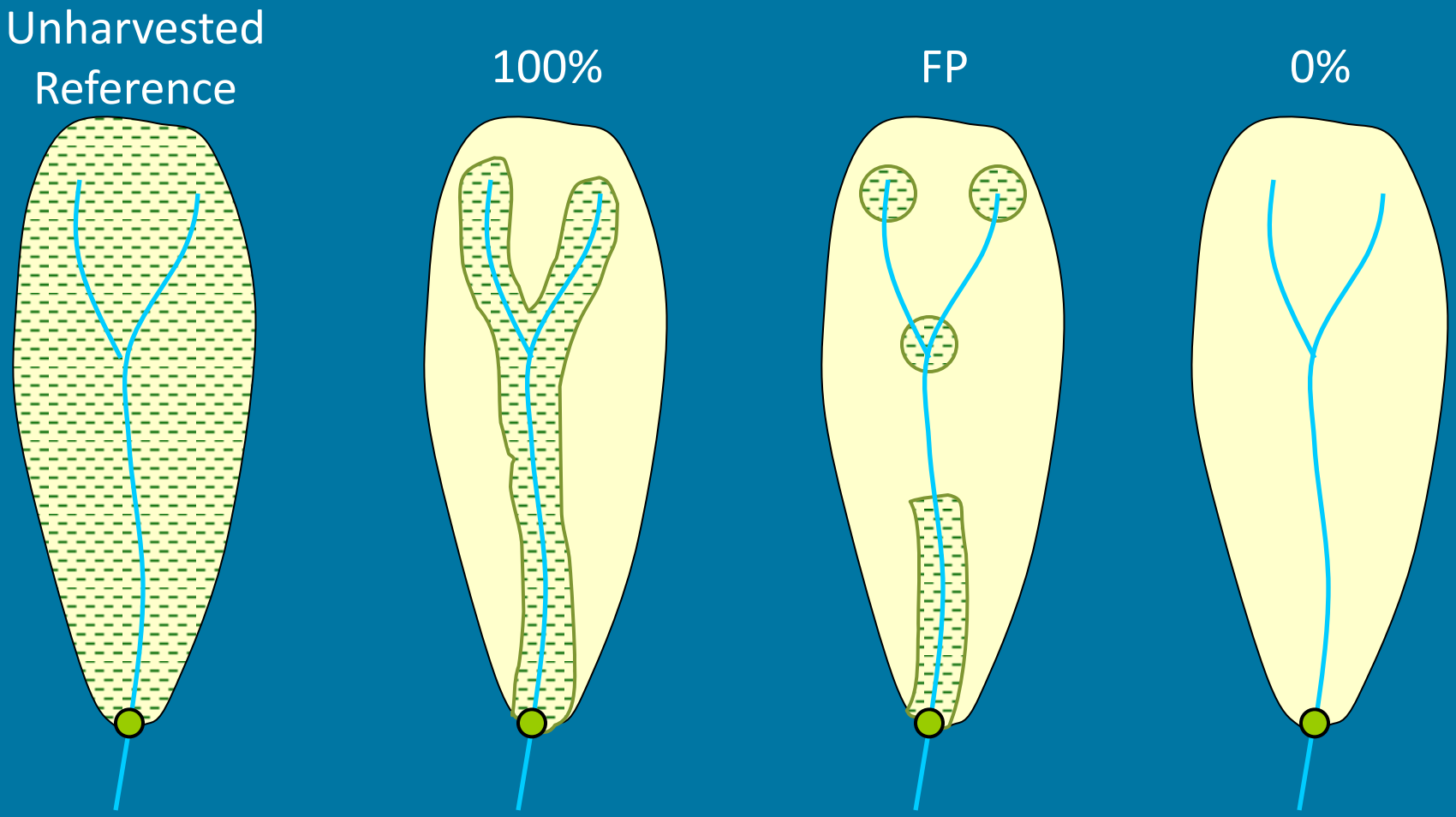
Harvest effect

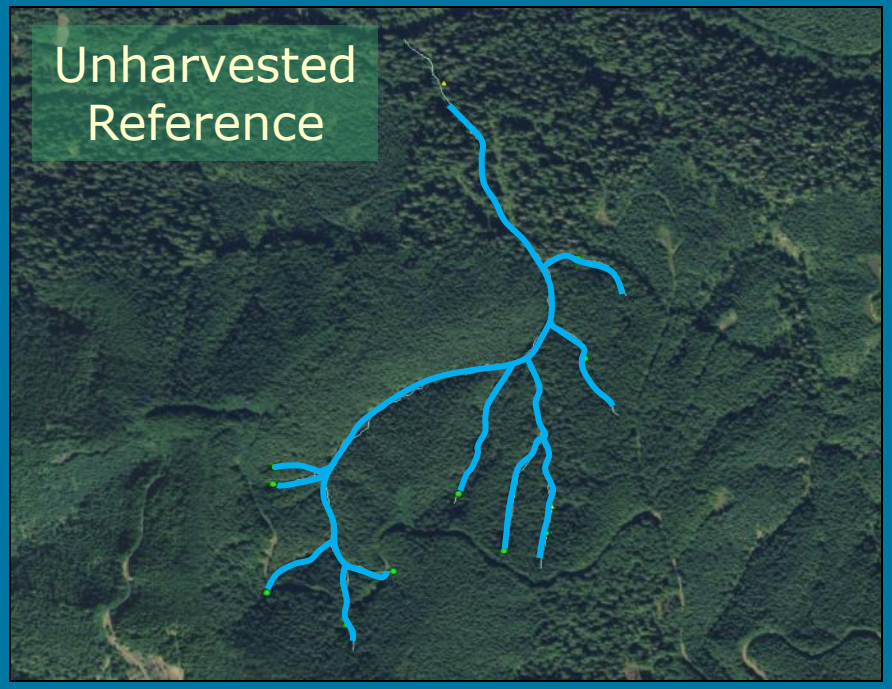
pre- / post- comparison

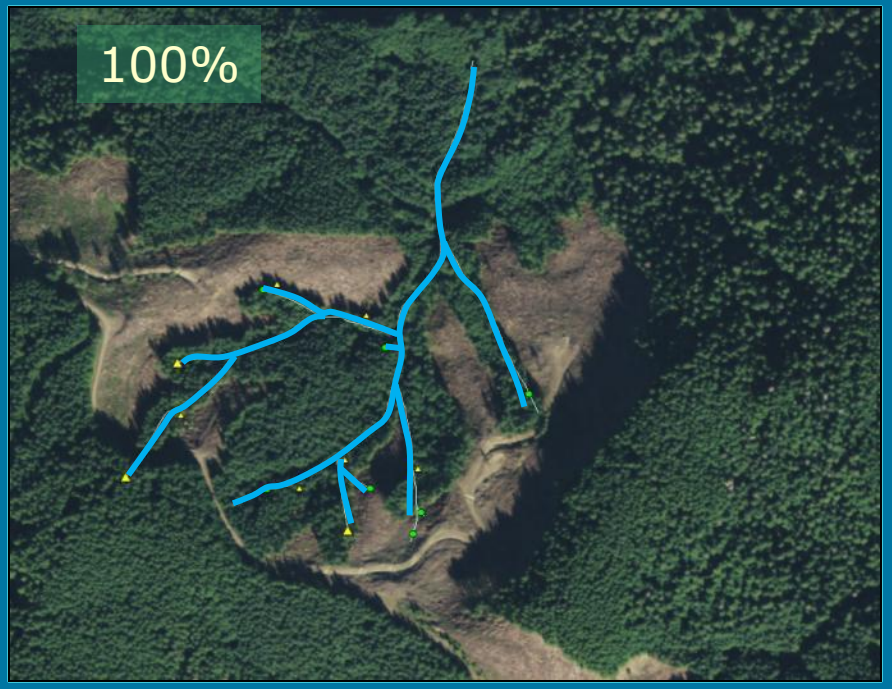
Environmental confound

controlled for with reference v. treatment comparison

Experimental Treatments




Unharvested
Reference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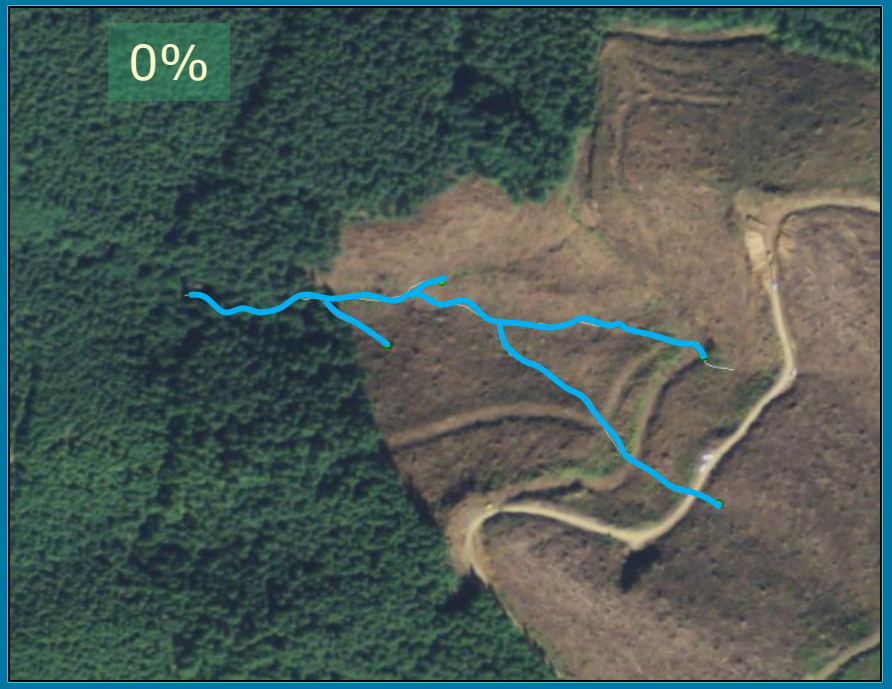
Forest Practices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Study Objectives

For three stream-associated amphibian taxa:

1. Compare abundance
2. Presence in areas obstructed by slash and windthrow

Coastal Tailed Frog
(*Ascaphus truei*)

Torrent Salamanders
(3 *Rhyacotriton* species)

Giant Salamanders
(2 *Dicamptodon* species)

Study-specific Influences on Detection

- Environmental variability
  (long-term study over 5-year period)
- Treatments applied
  (potential confound of detection with treatment)

Animal counts adjusted for detection

Binomial mixture models[1] estimate detection and abundance spatially and temporally replicated counts of unmarked animals

Assumptions:

- closure of population during sampling period
- independence of counts across sites

Detection covariates:

- Riparian condition (unharvested, buffered, unbuffered), stream order[2], stream temperature[2], year

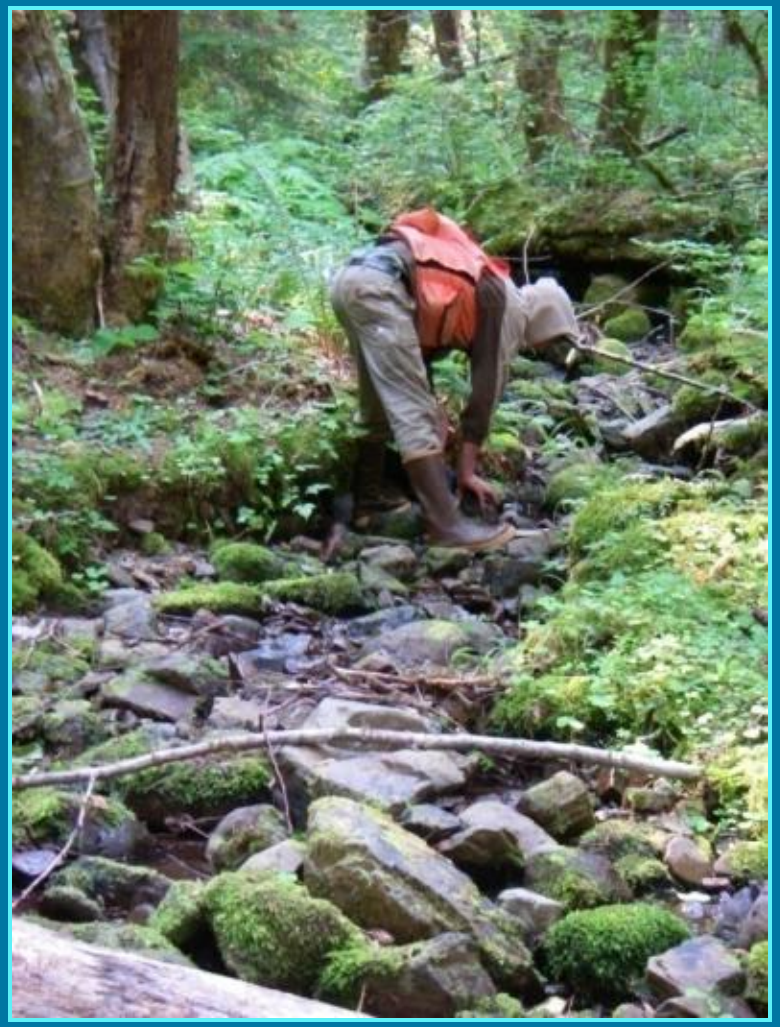


[1]Royle, J. A. 2004. *N-mixture models for estimating population size from spatially replicated counts.* Biometrics 60:108-115.

[2]McIntyre et al 2012. *Empirical and simulation evaluations of an abundance estimator using unmarked individuals of cryptic forest-dwelling taxa*. Forest Ecology and Management 286:129-136.

Methods

Light-touch Sampling



- Turn moveable objects
- Cobble-sized (> 64 mm)
- July – October
- Day (0700 – 1900 h)

Counts

- Systematic Sample
- N/F break to headwalls

Detection Plots

- 30-m detection plots
- 3 occasions
- Repeat samples at least 1 day apart
- Repeat samples conducted by different sampler

Light-touch adjusted for detection

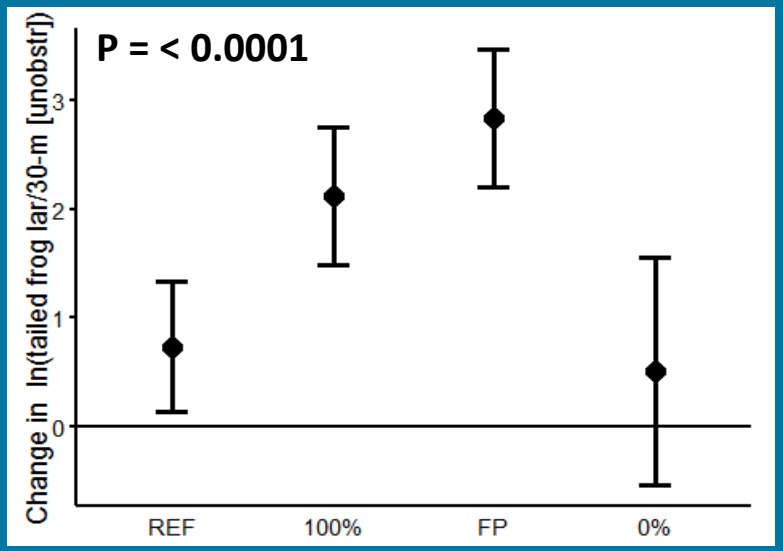
- Estimated detection probability for detection plots
- Adjusted basin-wide light-touch counts for imperfect detection (including covariates)
- Calculated weighted averages of adjusted counts based on length within each strata (riparian condition and stream order)

Abundance Results - Detection

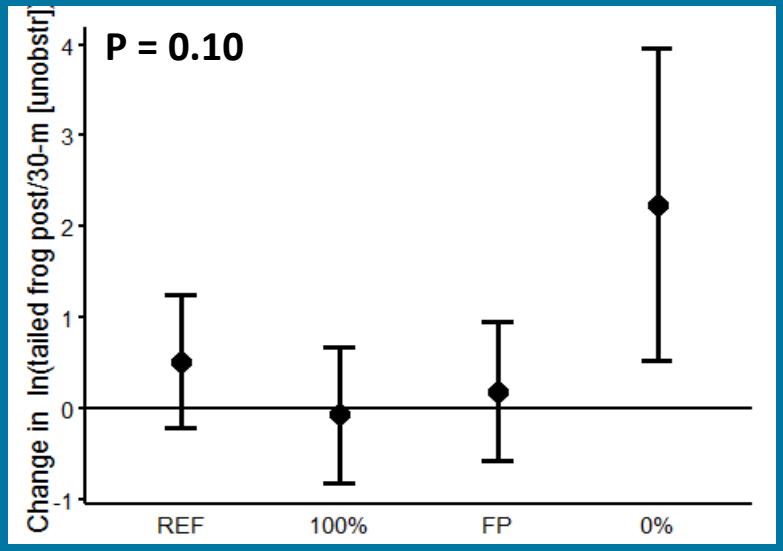
Evidence of covariate effect on detection

Detection Covariate	Tailed Frog Larvae	Tailed Frog Post	Torrent Salamander	Giant Salamander
Stand Condition	Y	N	Y	Y
Order	NA	NA	N	Y
Temperature	NA	NA	N	N
Year	NA	NA	N	N

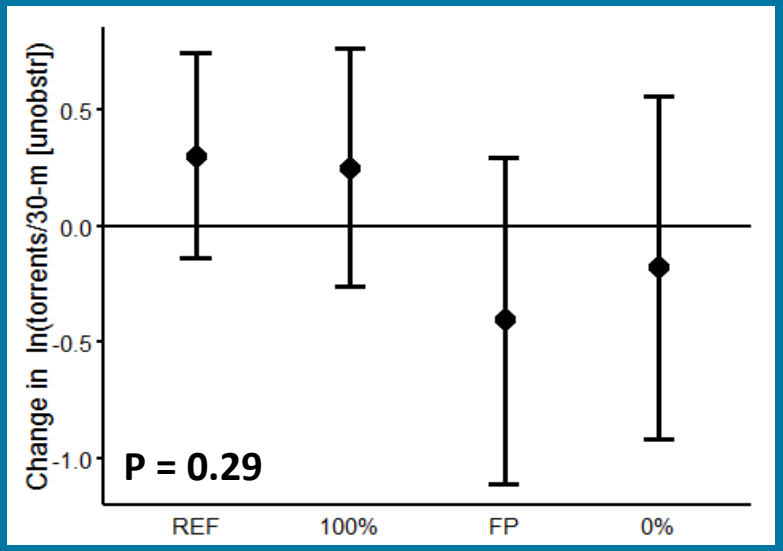
Abundance Results



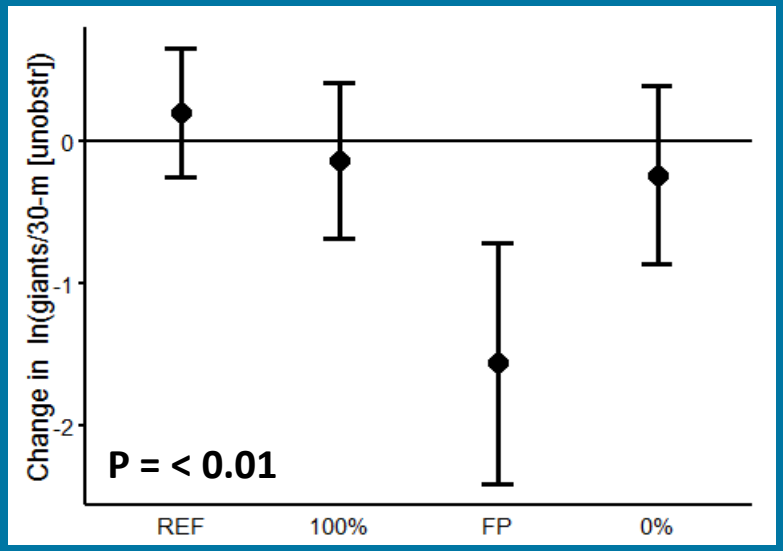
Tailed Frog – larvae



Tailed Frog – post



Torrent Salamanders



Giant Salamanders

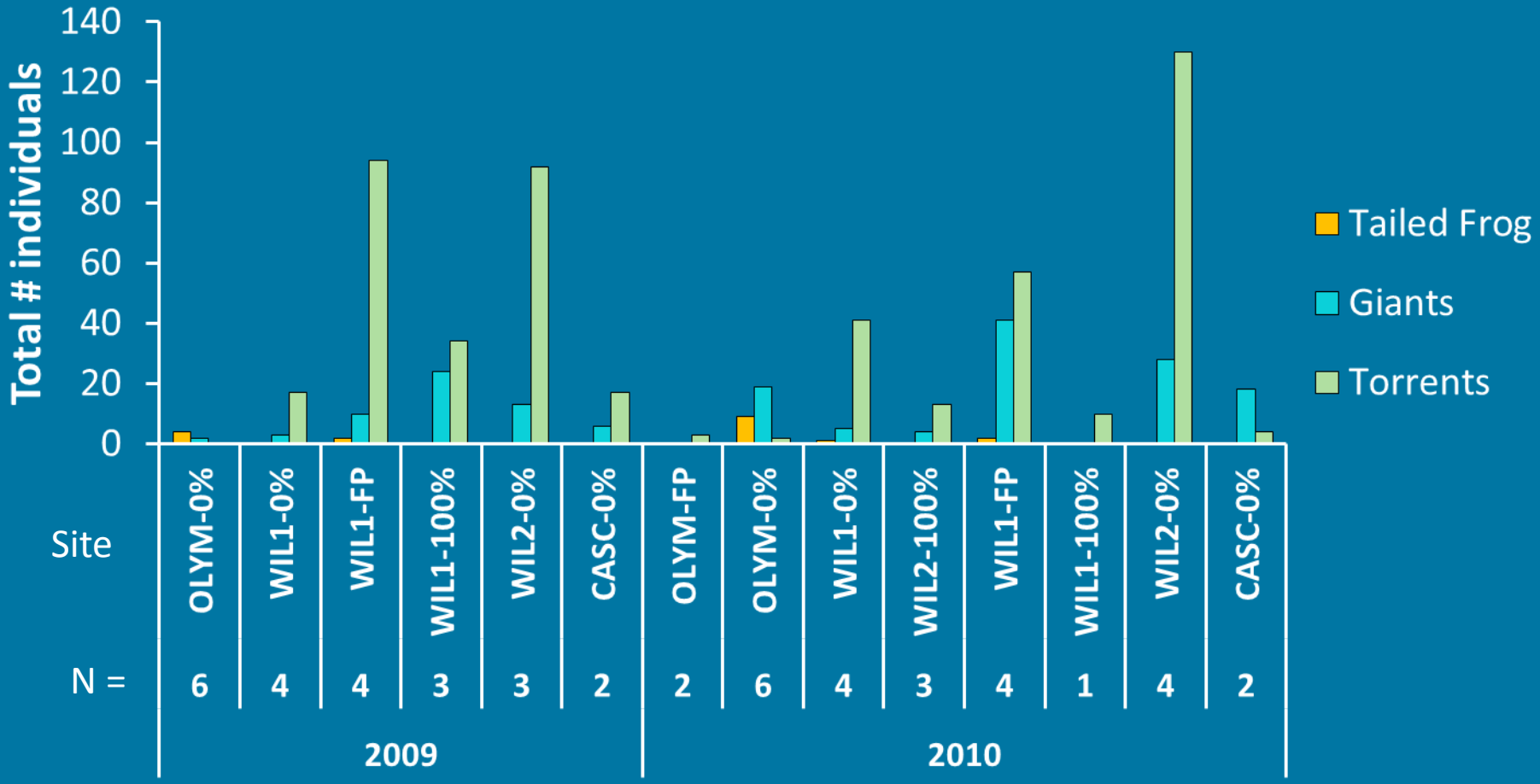
Presence in Obstructed Reaches

Sampling in obstructed reaches

- 3-m long rubble-rouse plots
- 1 – 6 plots per stream (N = 48 at 6 and 8 sites in 2009 and 2010)
- block nets placed up- and down-stream
- debris and stream substrates removed
- captured amphibians as encountered

Amphibians in obstructed reaches

- Tailed Frog: 2 of 6 (2009) and 3 of 8 (2010) basins [max #/plot = 8]
- Torrents: 5 of 6 (2009) and 8 of 8 (2010) basins [max #/plot = 60]
- Giants: 6 of 6 (2009) and 6 of 8 (2010) basins [max #/plot = 19]



Discussion

Abundance:

- Negative Giant Salamander response in FP treatment
  (82% decrease; not FP-designated species)
- Positive Tailed Frog larvae response in 100% and FP treatments
  (4 and 8 times greater, respectively)
- Positive Tailed Frog post-metamorph response in 0% treatment
  (6 times greater)
- Lack of Torrent Salamander response

Discussion

Amphibian use of obstructed reaches:

- All amphibians detected in obstructed reaches

Detection:

- Varied by riparian stand condition (tailed frog larvae, giant salamanders, torrent salamanders) and stream order (giant salamanders)
- Not accounting for detection could have resulted in biased results

Discussion

Short-term nature of study:

- Only 2 years post-harvest
- Does not describe potential impacts to reproduction
- Understanding long-term impacts will require study over longer temporal scale

Recommendations:

- Continued monitoring after at least one generational turnover
- Including both demographics and genetics

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