ESTIMATING INDIVIDUAL DETECTION PROBABILITY FOR STREAM-ASSOCIATED AMPHIBIANS USING MULTIPLE VISIT SURVEYS

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Introduction

Most stream-associated amphibian studies have used count data to index abundance (Kroll 2009). Inferences based on comparisons of these indices over time or space assume that detection probability remains constant. As part of an experimental study examining the effectiveness of different riparian buffer prescriptions on non-fish-bearing stream basins, we utilized recently developed models (Royle 2004) to estimate individual capture probability using data collected from in-stream amphibian surveys repeated over multiple sampling occasions during the pre-harvest interval.

These models consider site-specific population size, *N*, as independent random variables that are assumed to be distributed according to some mixing distribution. Thus prior parameters are estimated from the marginal likelihood of the observed count data, having been integrated over the prior distribution of *N*. This technique also allows for modeling of covariate effects on detection probability and abundance.

Our objectives were to determine how detection probability varied for the 3 species and if different covariates were associated with detection probability.

Methods

Site Selection

The experimental study is being conducted at 18 headwater basins across western Washington State, grouped into blocks (Figure 1). Within each basin we randomly selected the starting location of a 30-m stream plot from a 1st (n=18), 2nd (n=16) and 3rd (n=4) order tributary when available. All plots included in these analyses exhibited surface flow throughout the sample period.

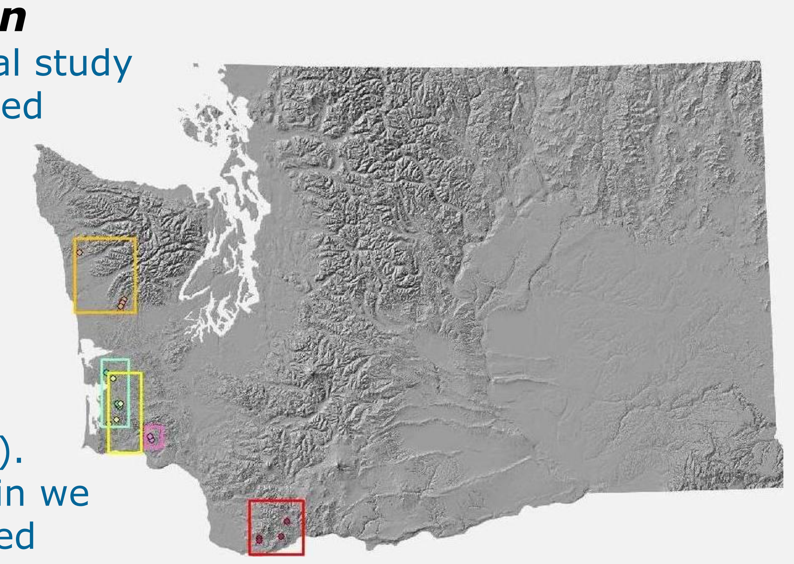


Figure 1: Distribution of Study Basins

Amphibian Surveys

We conducted surveys for stream-breeding amphibians (*Ascaphus truei*, *Rhyacotriton*, and *Dicamptodon*) using a longitudinal light-touch method whereby all moveable objects on the streambed that were gravel-sized or larger were overturned. We sampled all plots on 3 visits spaced 1-4 days apart in July and August 2008.

Analysis

We utilized the N-mixture models (Royle 2004) to:
1) Estimate individual detection probability for each species from spatially replicated counts; and
2) Model covariate effects on detection probability. We included 3 covariates in the models:
a) Weather over the 24-hr period prior to the survey (rain versus no rain)
b) Precipitation during the survey (yes or no)
c) Stream order (1st, 2nd, or 3rd)

We used a simulation study to compare the performance of poisson and negative binomial mixing distributions and chose the negative binomial distribution for this analysis.

Results

We surveyed a total of 38 plots on each of three different occasions. We made 1,192 captures of the focal species during the 114 individual surveys.

Dicamptodon

Dicamptodon (including *D. copei and D. tenebrosus)* were detected in 25 of 38 plots and included 438 captures. Detection probability ranged from 0.08 to 0.12 when modeled for each of the 3 covariates (Figure 2). None of the covariates had a strong association with detection probability.

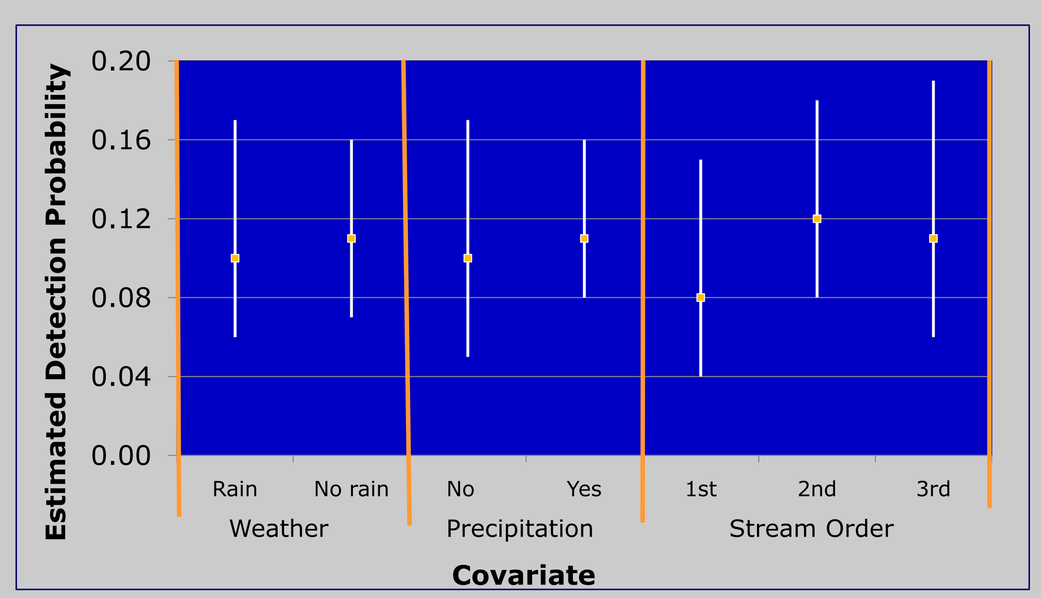


Figure 2. Estimated detection probability and 95% confidence limits for *Dicamptodon* modeled with 3 covariates.

Rhyacotriton

*Dicamptodon (*including *R. olympicus, R. kezerii*, and *R. cascadae)* were detected in 31 of 38 plots and included 680 captures. Detection probability ranged from 0.08 to 0.18 (Figure 3). None of the covariates had a strong association with detection probability.

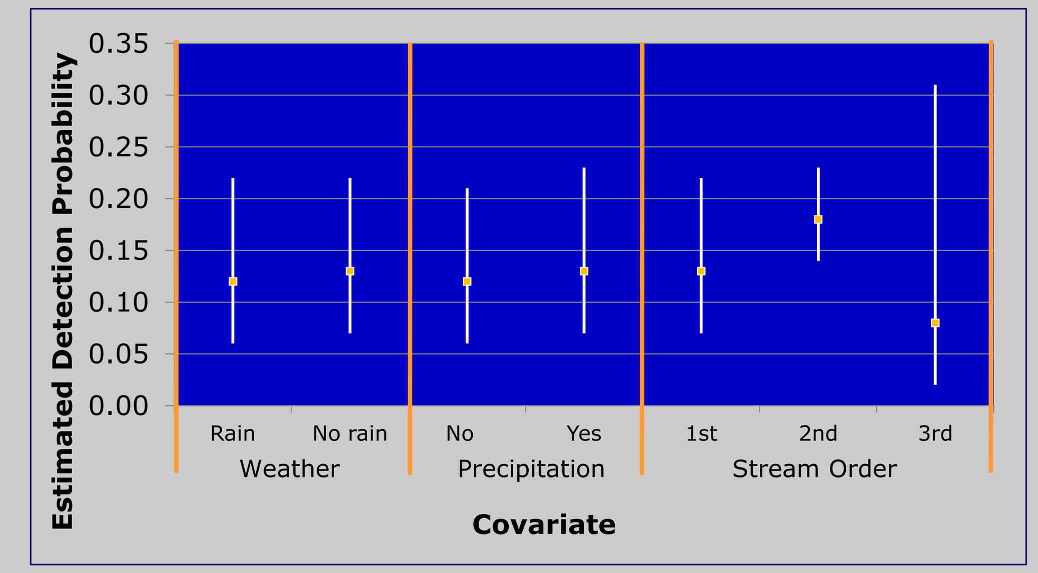


Figure 3. Estimated detection probability and 95% confidence limits for *Rhyacotriton* modeled with 3 covariates.

Ascaphus

A. truei were detected in 17 of 32 plots (excluding 6 plots at 3 sites where *A. truei* are presumed not to occur) and included 74 captures (17 post-metamorphic adults and 57 larvae). Due to differences in size, behavior and mobility, we separated the 2 life stages for these analyses.

Post-metamorphic *A. truei* were detected in 10 of 32 plots. Detection probability ranged from 0.002 to 0.007 (Figure 4). Low numbers of detections made it difficult to estimate detection probability or evaluate the effect of covariates for this species and life-stage.

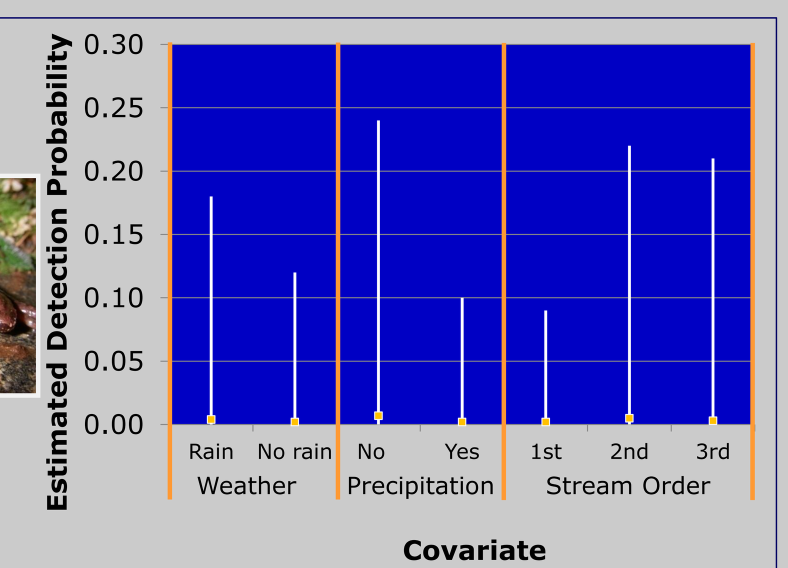
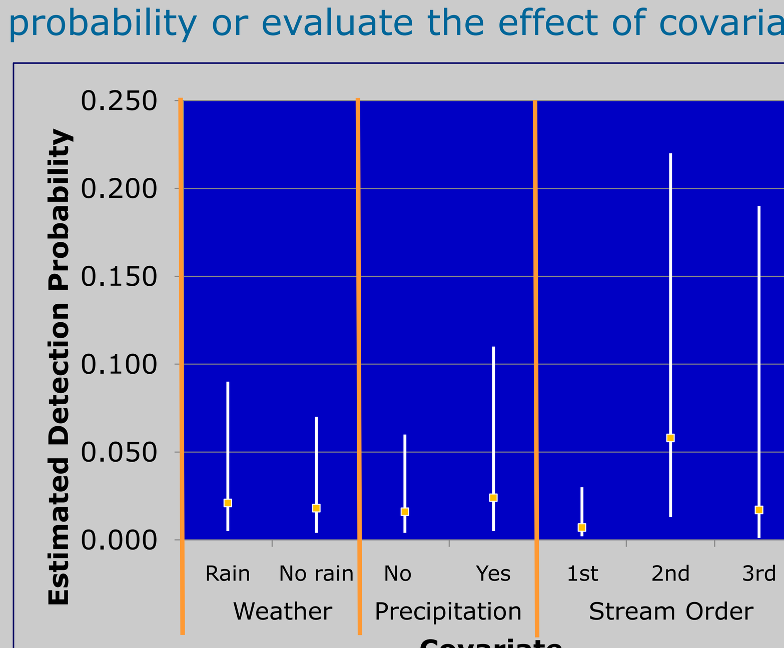


Figure 4. Estimated detection probability and 95% confidence limits for *A. truei post-metamorphs* modeled with 3 covariates.

Larval *A. truei* were detected in 12 of 32 plots. Detection probability ranged from 0.007 to 0.024 (Figure 5). Again, low numbers of detections made it difficult to estimate detection probability or evaluate the effect of covariates.



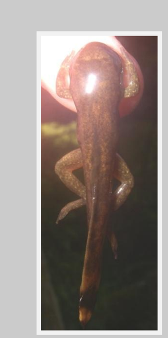


Figure 5. Estimated detection probability and 95% confidence limits of *A. truei* larvae modeled with 3 covariates.

Conclusions

Estimated detection probabilities were similar for *Rhyacotriton* and *Dicamptodon* (0.08–0.18). Estimated detection probabilities were lower for *A. truei.* Post-metamorph detection estimates were less than 0.01 and estimates for larvae, while higher than those for post-metamorphs, were 0.01-0.06. Low sample sizes likely impaired analyses for this species. Future work will include additional sampling in 1st and 2nd order streams as well as investigation of a zero inflated prior distribution, which may be a better assumption considering the large number of zero detection surveys.

The sample size was very small in 3rd order streams (n = 4), and variation in counts was high. Emphasis on 3rd order sampling will be a priority for future efforts.

These results indicate that weather and stream order had no significant impact on the probability of detection for *Dicamptodon* or *Rhyacotriton*, which allows us to compare counts of these species between plots sampled during this period. Repetition of these multiple pass surveys following completion of harvest treatments will allow for a comparison of detection probabilities over time as well as incorporation of the probabilities into unbiased estimates of abundance before and after harvest.

Literature Cited

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