

US EPA ARCHIVE DOCUMENT

# Assessing occupancy estimates of pond-breeding amphibian larvae in Rhode Island



Peter Paton  
Annie Curtis

Dept. of Natural  
Resources Science

University of  
Rhode Island

17 March 2010



# Detection Probabilities and Site Occupancy Estimates

**Detection probability ( $p$ ):** the probability of detecting a species when actually present during a single visit

**Site occupancy ( $\psi$ ):** probability a site is occupied by species

# Effects of False Absences

- Nondetection does not mean absence
- False absences often ignored
- Rate of false absences may be high for amphibians
- Naïve occupancy estimates are biased low
- If ability to detect species varies among sites, comparisons will be biased
  - If a variable increases detection probability, more strength is given to the variable in habitat models
  - Strength of effects can be erroneous
- Can affect habitat models and management decisions

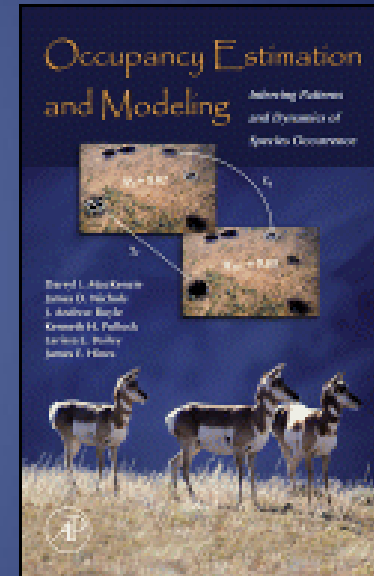
# Objectives

- Determine factors influencing detection probabilities for improved monitoring
  - Timing of surveys
  - Environmental conditions
- Determine habitat associations at both the landscape and within-pond scales
  - Effect of urbanization



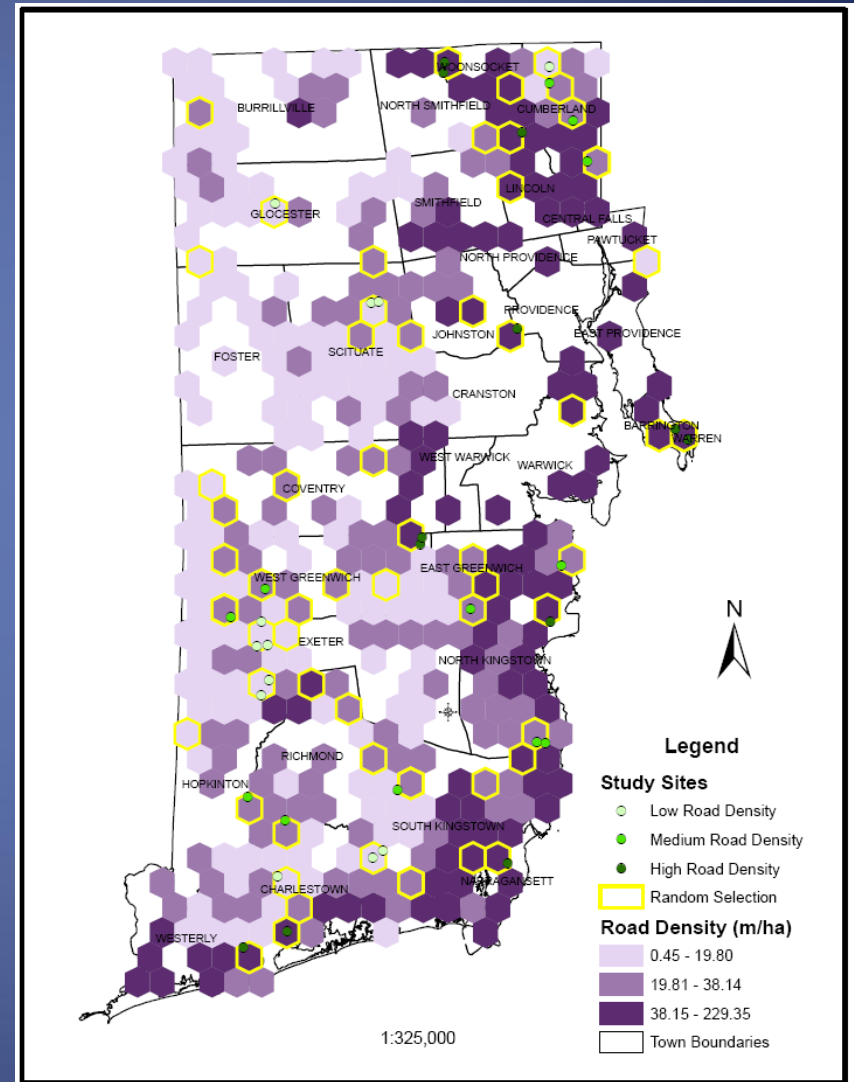
# Program PRESENCE

- Model detection probabilities and covariates influencing detection:  $p(\text{Cov})$
- Corrects for detection probabilities in estimating site occupancy and covariates influencing occupancy:  $\psi(\text{Cov})$
- Uses logistic regression to calculate  $p(\text{Cov})$  and  $\psi(\text{Cov})$



# Sampling Scheme

- 36 random sites
- 9 visits per site at 10-day intervals
- Dip netting
  - 19 May - 30 July



# Bleached boots between site visits to prevent spreading diseases such as Ranavirus



22059-001, Ventral body skin and oral disc of larval Wood Frog (15x). Red foci (petechiae) due to ranaviral infection



22090-006, Gular skin of larval Markbled Salamander (10x). Red foci (petechiae) due to ranaviral infection

4 of 36 ponds had mortality events from Ranavirus  
Based on diagnoses from National Wildlife Health Center

# Potential Covariates Influencing Detection Probabilities

## Survey Specific

- Date
- Time of day
- Weather (wind, cloud cover)
- Water temperature
- Water depth

## Site Specific

- Woody-within pond vegetation (% cover)
- Persistent emergent vegetation (% cover)



# Analysis Steps

1. Estimate covariates influencing detection probability and rank models with AIC
2. Used best detection model to model occupancy
3. Verified top models were best by using occupancy and detection models within 2  $\Delta$ AIC
4. Model averaged to calculate parameter estimates

# Phenology of Adult Immigration to Breeding Pools



Wood frog



Spotted salamander



Red-spotted newt

**March**



Spring peeper



Am. toad



Pickerel frog

**April**

**May-  
June**



Gray treefrog



Green frog



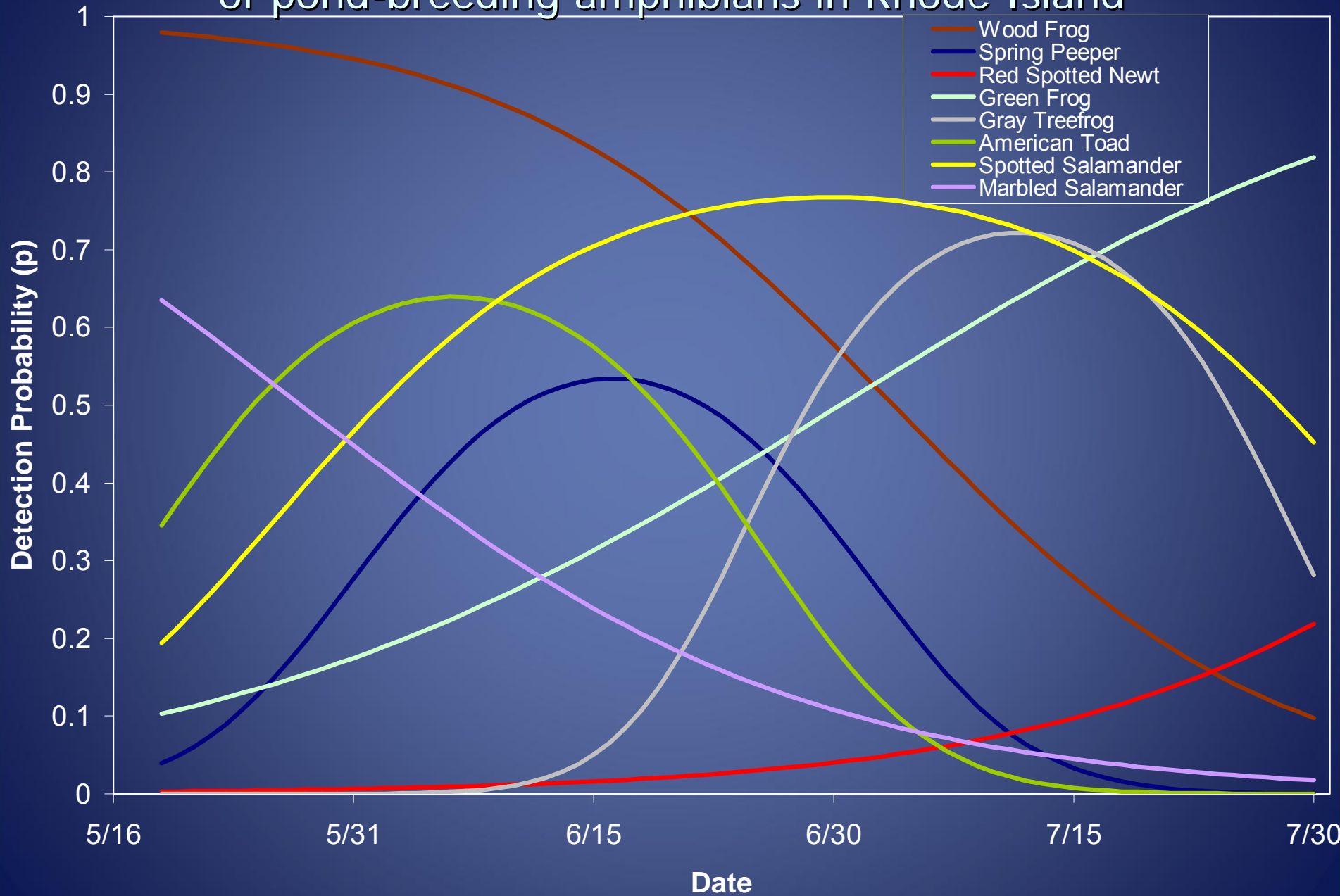
Am. Bullfrog

**August**



Marbled salamander

# Seasonal variation in detection probabilities of pond-breeding amphibians in Rhode Island



# Detection Probability for Larval Spotted Salamanders

Logit  $p_1 = -52.1068$

+0.5922(Date)

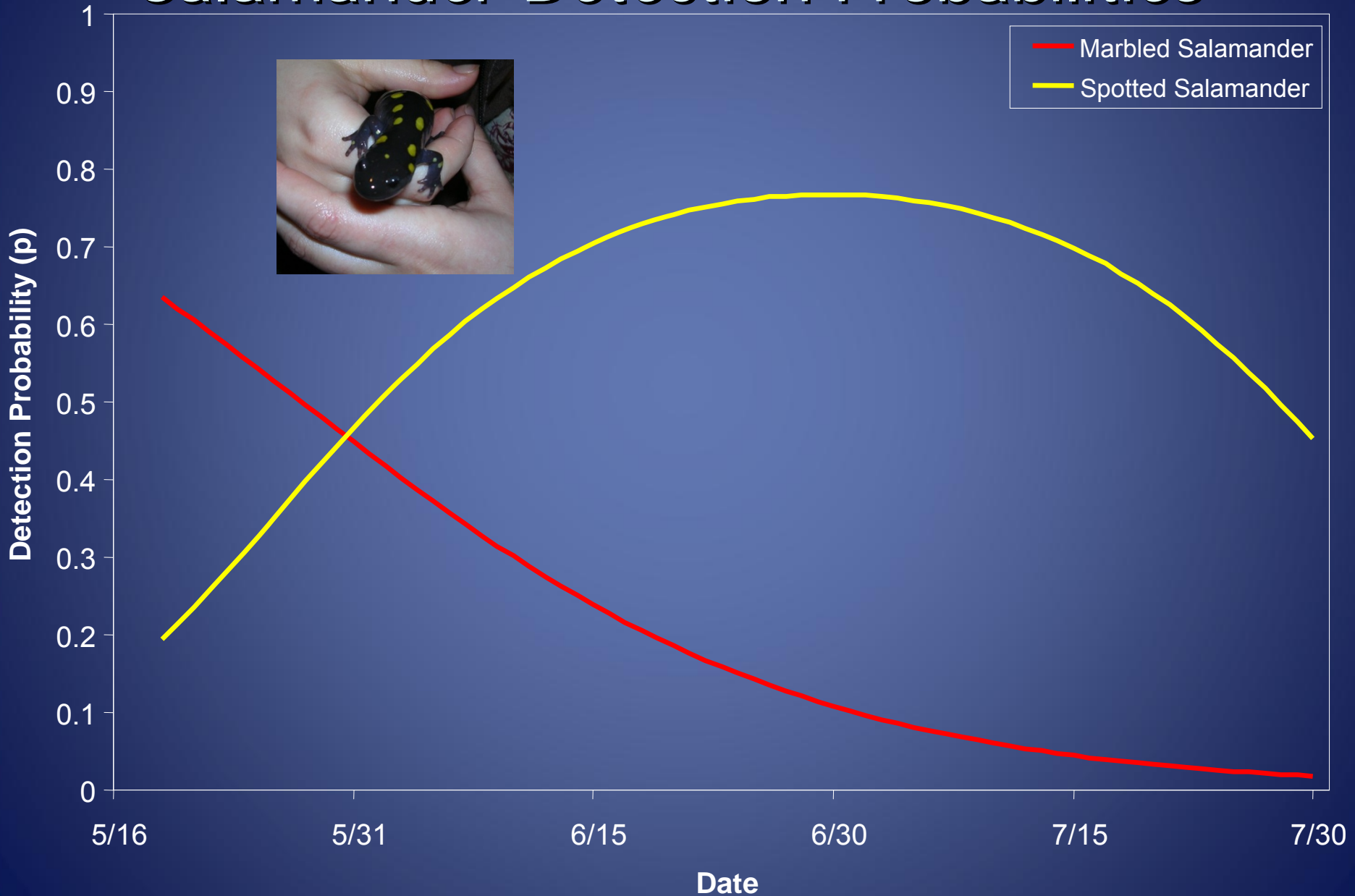
- 0.0016(Date<sup>2</sup>)

- 0.2210(Water Depth)

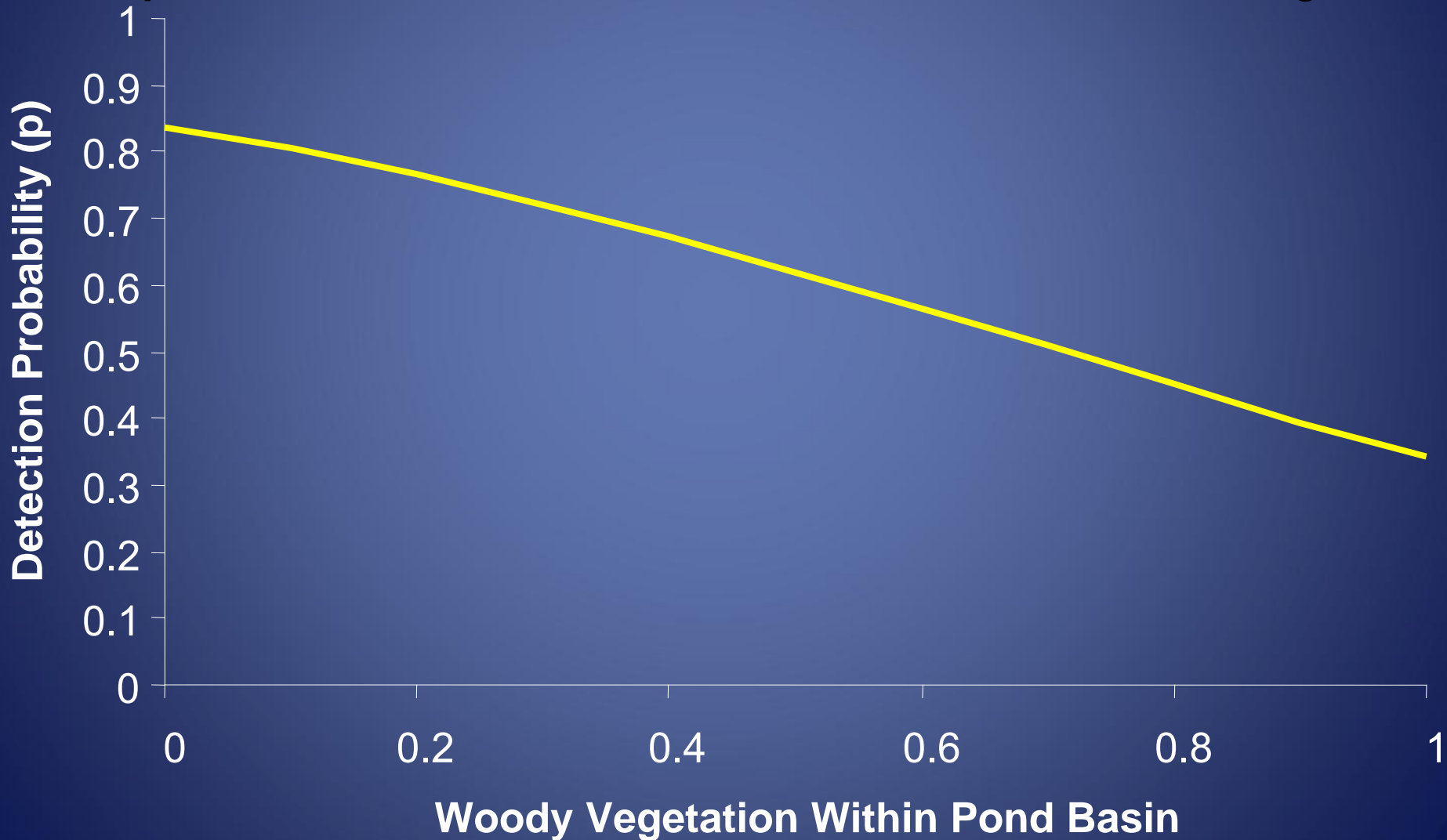
+ 0.3149(Cloud)

- 2.2969(Woody Veg)

# Seasonal Variation in Larval Salamander Detection Probabilities



# Effect of Woody Vegetation on Larval Spotted Salamander Detection Probability



# Detection Probability for Larval Marbled Salamanders

Logit  $p_1 = -22.6671$

– 0.2357 (Date)

– 1.3054 (Water Depth)

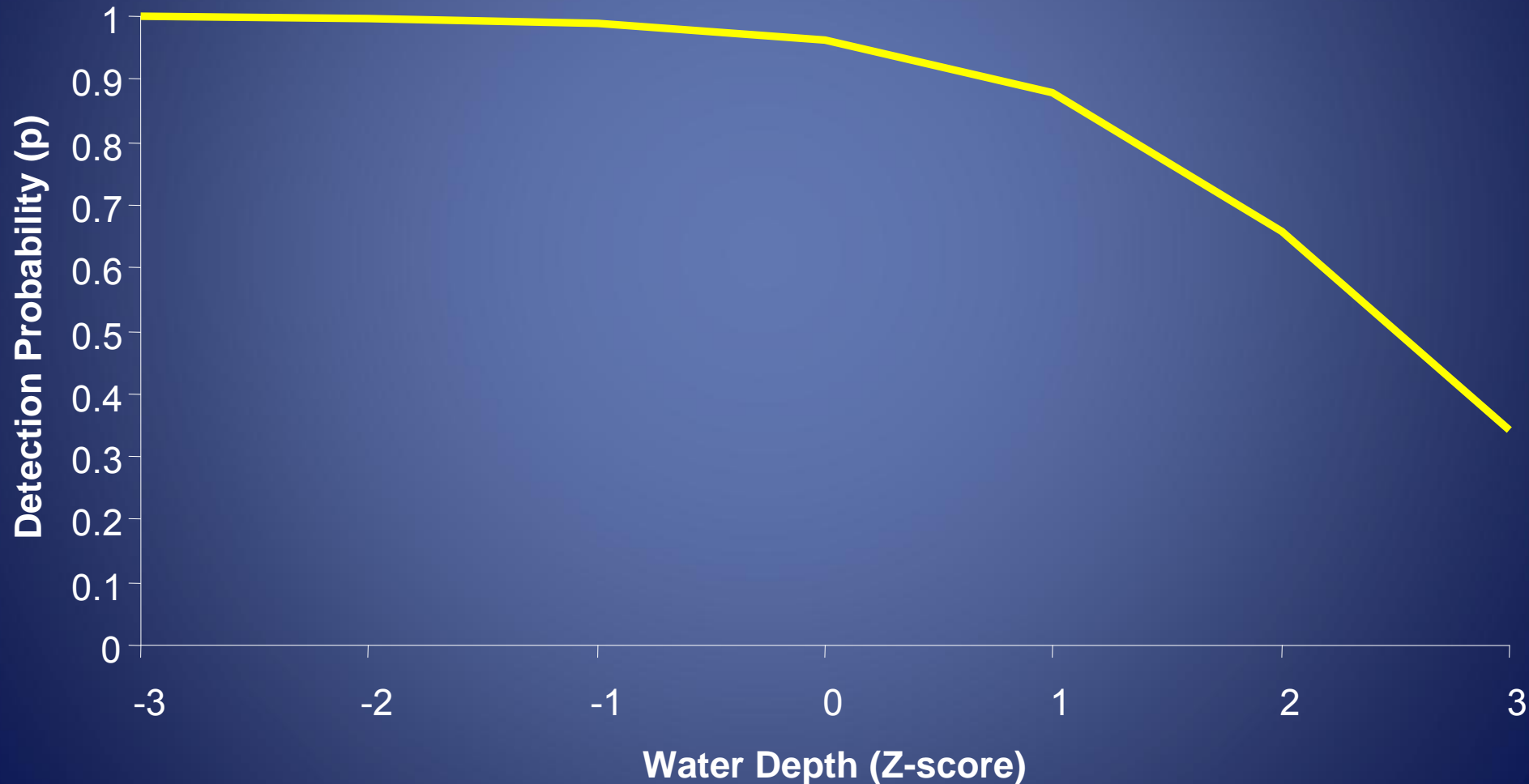
– 0.0445 (Wind)

+ 0.0164 (Cloud)

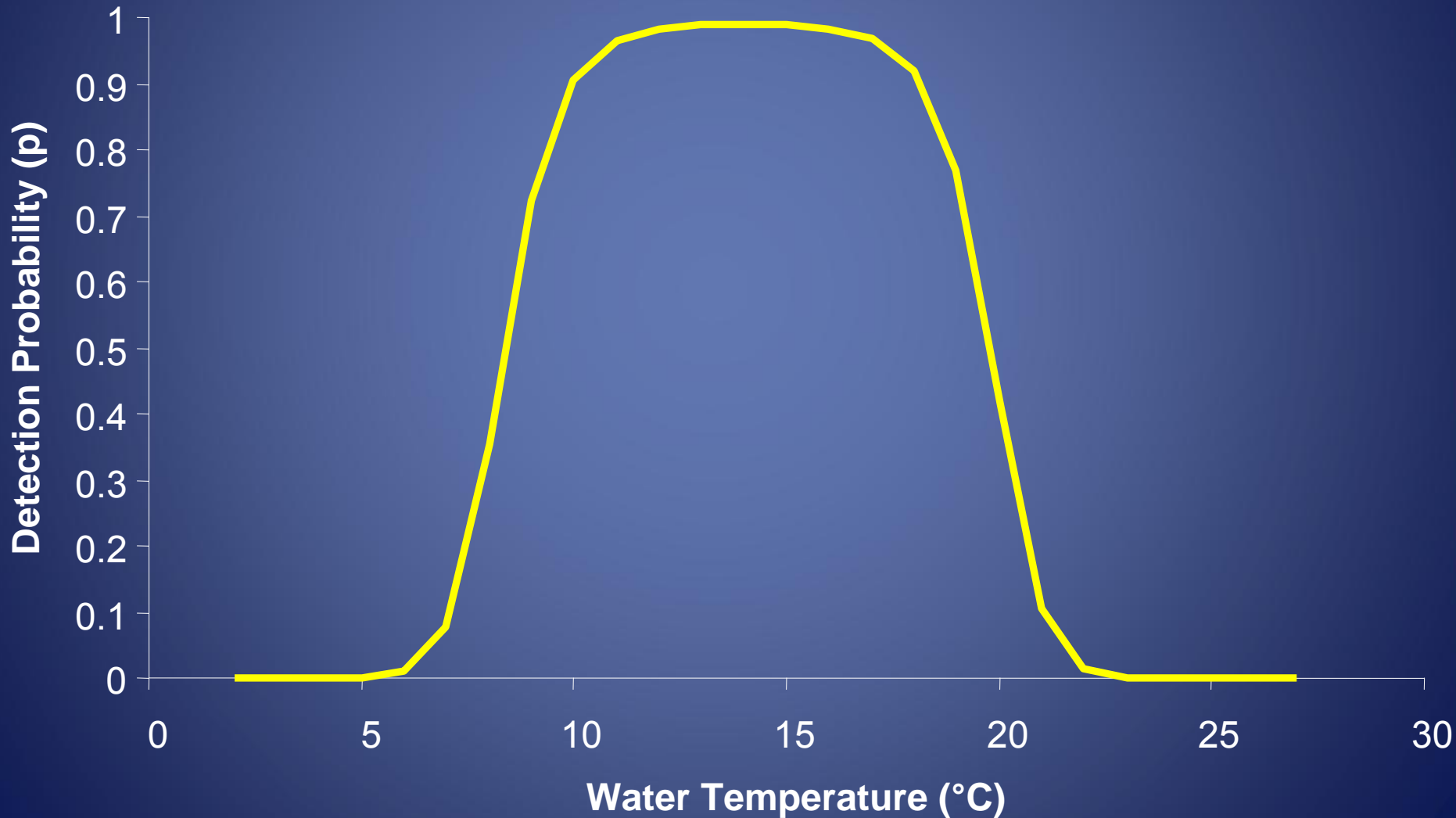
+ 5.9418 (Water temp)

– 0.1409 (Water temp<sup>2</sup>)

# Effect of Water Depth on Larval Marbled Salamander Detection Probability



# Effect of Water Temperature on Larval Marbled Salamander Detection Probability



# Detection Probabilities: Conclusions

- Requires multiple visits
- Distinct seasonal phenologies
- Covariates can strongly influence detection probabilities
- Detection probabilities can be estimated based on covariates



# Site Occupancy

- Accuracy of covariate associations increases after correcting for detection probabilities
- Road Density, Canopy Cover, and Pond Depth hypothesized to influence both species
- Persistent emergent vegetation hypothesized to influence Spotted Salamanders



# $\Psi$ Covariates

Covariate	Description	Mean	SD	Min	Max
Road	Road density (m/ha)	38.49	26.43	10.79	131.65
OBD	Open basin depth (m)	1.40	1.09	0.55	7.11
Canopy	Percent canopy cover	62.24	29.79	0	100.00
PRST	Percent cover of persistent emergent vegetation	21.28	27.70	0	99.28



# Spotted Salamanders

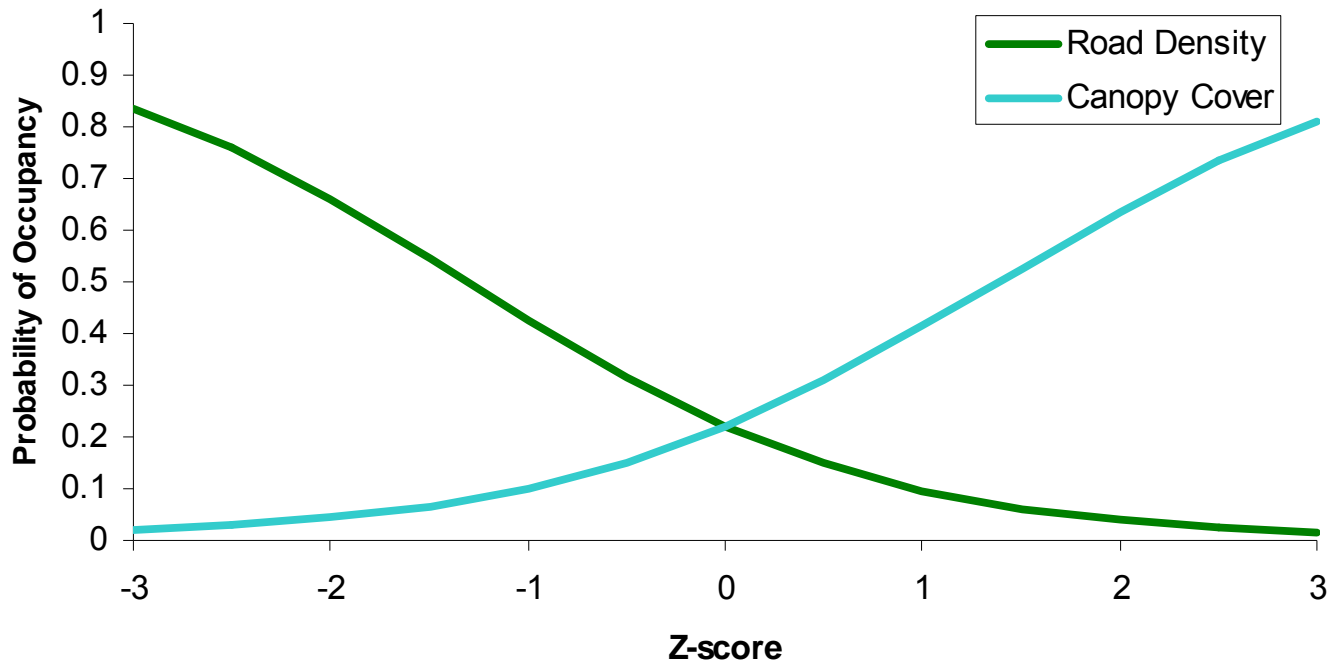
Model	AIC	$\Delta$ AIC	AIC wgt
$\psi$ (Canopy, PRST), $p$ (date, date <sup>2</sup> , WDY_IN, cloud, water depth)	271.63	0	0.5
$\psi$ (Canopy, PRST, OBD), $p$ (date, date <sup>2</sup> , WDY_IN, cloud, water depth)	272.77	1.14	0.28
$\psi$ (Canopy, PRST, Road), $p$ (date, date <sup>2</sup> , WDY_IN, cloud, water depth)	273.26	1.63	0.22



	Road			
	Density	Depth	Canopy	PRST
Estimate	-0.30	1.31	2.72	2.12
<i>SE</i>	0.47	1.51	1.07	0.91
<i>95% CI</i>	(-1.22	(-1.64	(0.64	(0.33
	0.63)	4.26)	4.81)	3.90)

# Marbled Salamanders

	Road		
	Density	Depth	Canopy
Estimate	-0.96	0.70	0.89
<i>SE</i>	0.66	1.08	0.55
<i>95% CI</i>	(-2.26	(-1.42	(-0.19
	0.33)	2.82)	1.97)



# Comparison of naïve occupancy estimates to models using detection probabilities

Species	Detection probability	Naïve Occupancy	Modeled Occupancy	Difference
Spotted Salamander	0.51	0.69	0.75	0.053
Marbled Salamander	0.36	0.22	0.26	0.038
Wood Frog	0.39	0.72	0.76	0.041
Red-spotted Newt	0.03	0.11	0.27	0.161
Gray Treefrog	0.15	0.36	0.49	0.133

# Occupancy Conclusions

- Road density negatively impacts both salamander species
- Vegetative cover can strongly influence species presence
- Investigate both landscape factors and pond habitat
- Habitat associations are more accurate after accounting for detection probability
- More confidence in management actions

