Table 1. Summary of the species composition in ephemeral ponds, permanent ponds without fish, and permanent ponds with fish in the area sampled at Fort Leonard Wood, Missouri.

Species	Ephemeral (n = 93)	Proportion	Species	Permanent w/o Fish (n = 75)	Proportion	Species	Permanent w Fish n = 26)	Proportion
Hylid	65	0.699	*Rana clamitans*	72	0.960	*Rana catesbeiana*	25	0.962
Ambystoma maculatum	60	0.645	*Rana catesbeiana*	67	0.893	*Rana clamitans*	24	0.923
Notophthalmus viridescens louisianensis	58	0.624	*Notophthalmus viridescens louisianensis*	64	0.853	*Acris blanchardi*	18	0.692
Pseudacris crucifer	56	0.602	Hylid	60	0.800	*Notophthalmus viridescens louisianensis*	17	0.654
Ambystoma annulatum	49	0.527	*Rana sphenocephala*	58	0.773	*Rana sphenocephala*	14	0.538
Ambystoma opacum	43	0.462	*Acris blanchardi*	54	0.720	Hylid	13	0.500
Rana sphenocephala	41	0.441	*Ambystoma maculatum*	54	0.720	*Ambystoma maculatum*	10	0.385
Hyla chrysoscelis/ versicolor	26	0.279	*Pseudacris crucifer*	47	0.627	*Bufo spp*	9	0.346
Rana clamitans	24	0.258	*Hyla chrysoscelis/ versicolor*	41	0.547	*Hyla chrysoscelis/ versicolor*	8	0.308
Bufo spp	24	0.258	*Ambystoma annulatum*	38	0.507	*Pseudacris crucifer*	8	0.308
Acris blanchardi	20	0.215	*Ambystoma opacum*	31	0.413	*Ambystoma opacum*	3	0.115
Rana catesbeiana	18	0.194	*Bufo spp*	18	0.240	*Ambystoma annulatum*	2	0.077
Pseudacris maculata	17	0.183	*Rana palustris*	9	0.120	*Pseudacris maculata*	0	0.000
Rana palustris	5	0.054	*Pseudacris maculata*	2	0.027	*Rana palustris*	0	0.000

Proportion equals the number of ponds of particular hydroperiod type at which a species was detected during our surveys divided by the total number of ponds of that particular hydroperiod type during 2012 and 2013 combined.

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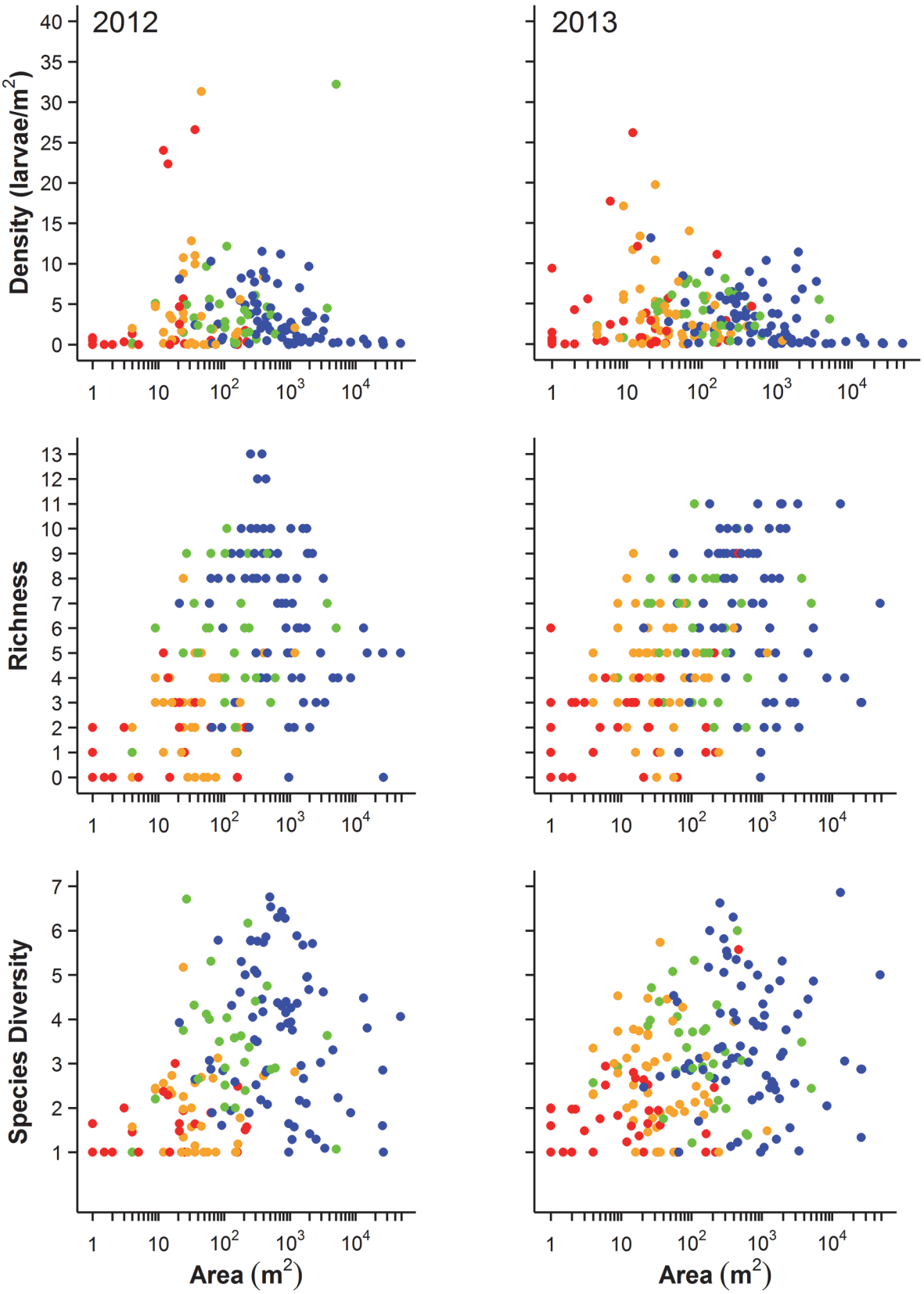
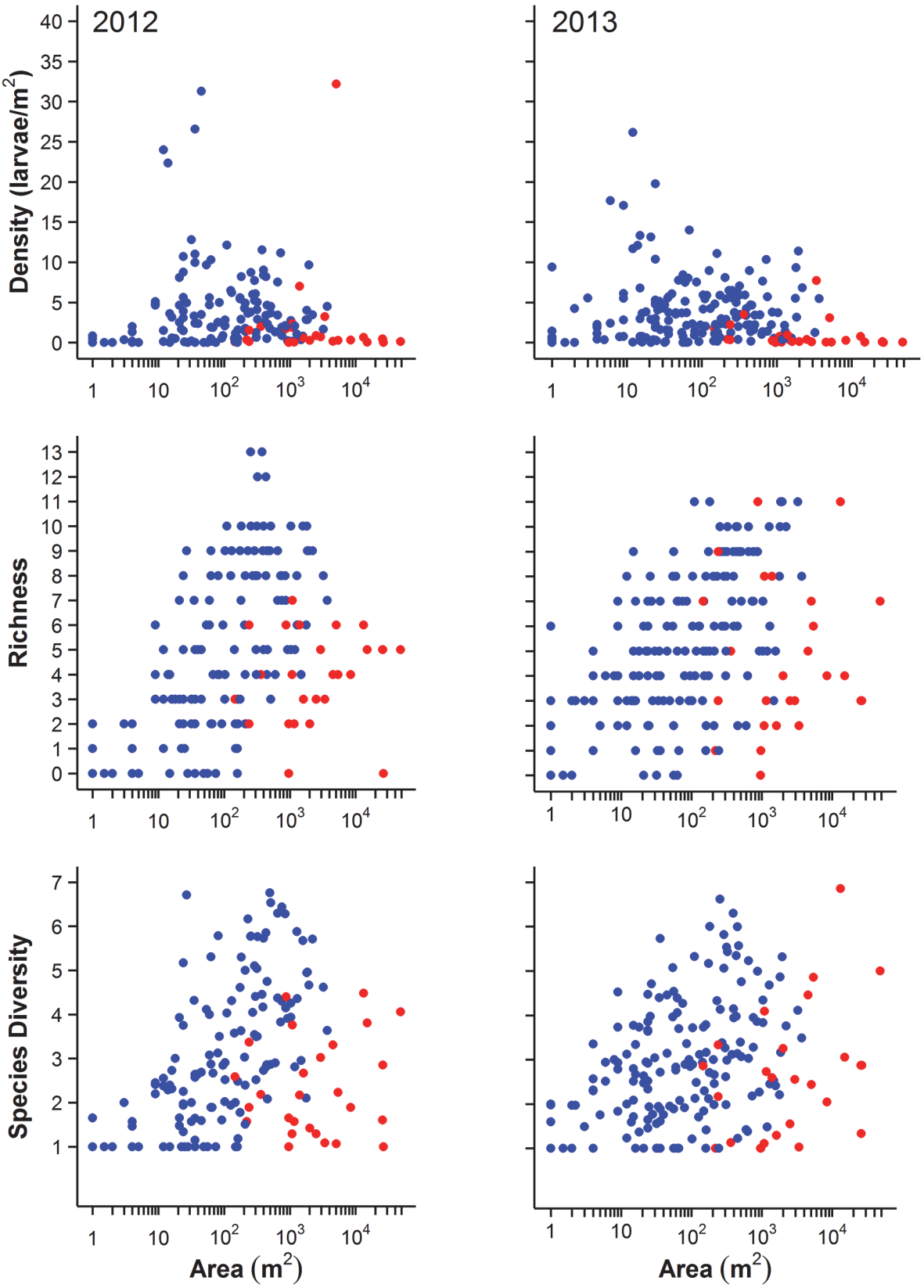
overdispersion. For these we used distributions that best fit our data and added pond as a random effect to account for unique location effects. For abundance, we used generalized linear mixed effects models with a Poisson distribution and pond identity as a random effect to correct for overdispersion. The mean sampling date of a pond within each survey period (February-March or May-June) was also included as a random effect to account for repeated surveys of ponds. Sampling effort (i.e. total number of traps/dipnets) was included as an offset parameter. Thus, our response from these models was relative abundance of amphibians scaled to sampling effort, hereafter amphibian density. Richness was modeled with a generalized linear model using a negative binomial distribution, and diversity using a generalized linear mixed effects model with a Gamma distribution. To determine the pond area where amphibian density, richness, and diversity peaked, we resampled our data with replacement, and calculated the mean and 95% confidence intervals from 1000 bootstrap iterations.

Based on the above analysis, we found all three responses peaked at intermediate pond sizes (see Results). However, a substantial number of intermediate sized ponds also had low richness, diversity and abundance values. We therefore explored the within-pond factors that


2012
2013
Density (larvae/m^2)
Richness
Species Diversity
Area (m^2)
Area (m^2)


2012
2013
Density (larvae/m^2)
Richness
Species Diversity
Area (m^2)
Area (m^2)

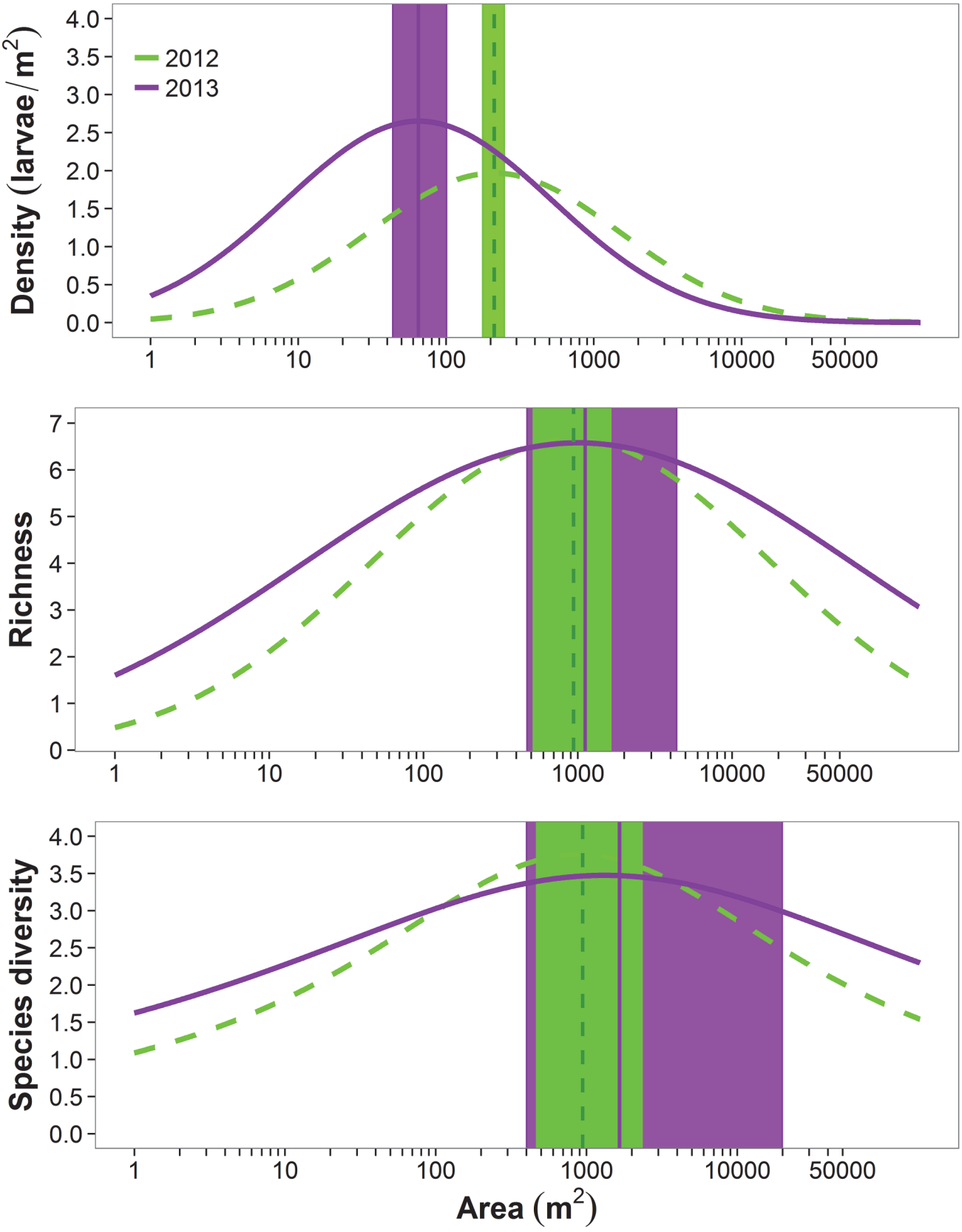

Density (larvae/m²)
2012
2013
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.5
0.0
1
10
100
1000
10000
50000
Richness
7
6
5
4
3
2
1
0
Species diversity
Area (m²)

Fig 5. Model fit for species richness, effective number of species, and mean density of amphibians in ponds at Fort Leonard Wood, Missouri for 2012 and 2013 in relationship to log (pond area m^2). Vertical lines indicate the pond area where the curve peaks, and shaded areas indicate 95% prediction intervals around this mean.

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species may respond more strongly to one aspect of disturbance than another that is not accounted for by pond area alone. Our sampling intentionally included ditches and road ruts that can hold water for longer periods of time than predicted based on area alone and were found to be more productive for amphibians than expected. If such highly artificial waterbodies are excluded from sampling based on their small size or an *a priori* expectation that they are not productive for amphibians, then the full gradient of breeding resources could be biased and species

Table 3. Summary tables of generalized linear mixed effects models fit with a binomial distribution.

Density peak	**Parameter**	**Estimate**	**S.E.**	**z-value**	***P***
	Intercept	2.022	0.245	8.264	<0.001
	Canopy	**0.529**	**0.148**	**3.575**	**<0.001**
	Fish present	**-2.909**	**0.543**	**-5.360**	**<0.001**
	Hydroperiod	-0.028	0.228	-0.124	0.901
	Hydroperiod^2	*-0.314*	*0.174*	*-1.808*	*0.071*
	Number of habitats	*0.300*	*0.168*	*1.783*	*0.075*
	Predator density	**0.453**	**0.165**	**2.746**	**0.006**
	Predator density^2	**-0.093**	**0.037**	**-2.541**	**0.011**
	Predator diversity	**0.441**	**0.126**	**3.501**	**<0.001**
	Predator diversity^2	-0.062	0.091	-0.681	0.496
Richness peak	**Parameter**	**Estimate**	**S.E.**	**z-value**	***P***
	Intercept	1.472	0.370	3.977	<0.001
	Canopy	0.157	0.185	0.846	0.397
	Fish present	**-1.657**	**0.528**	**-3.141**	**0.002**
	Hydroperiod	0.402	0.348	1.157	0.247
	Hydroperiod^2	-0.126	0.199	-0.635	0.526
	Number of habitats	0.271	0.190	1.423	0.155
	Predator density	**1.067**	**0.381**	**2.801**	**0.005**
	Predator density^2	**-0.197**	**0.107**	**-1.848**	**0.065**
	Predator diversity	**0.640**	**0.223**	**2.878**	**0.004**
	Predator diversity^2	0.121	0.187	0.650	0.516
Diversity peak	**Parameter**	**Estimate**	**S.E.**	**z-value**	***P***
	Intercept	1.386	0.354	3.922	<0.001
	Canopy	0.238	0.219	1.085	0.278
	Fish present	-1.660	0.573	-2.897	0.004
	Hydroperiod	-0.114	0.476	-0.240	0.811
	Hydroperiod^2	-0.361	0.246	-1.468	0.142
	Number of habitats	**0.746**	**0.221**	**3.373**	**0.001**
	Predator density	**1.363**	**0.396**	**3.440**	**0.001**
	Predator density^2	**-0.453**	**0.197**	**-2.299**	**0.021**
	Predator diversity	**0.480**	**0.236**	**2.036**	**0.042**
	Predator diversity^2	0.233	0.199	1.175	0.240

Each model predicts whether a pond is contributing to the peaked distribution observed in density, species richness, or species diversity (Appendix B). All parameters are scaled and centered, so parameter estimates correspond to the relative effects of each parameter. Parameter estimates are on the logit scale. Bolded parameters are significant, while those in italics are near significant ($\alpha = 0.05$).

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