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Linking environmental drivers with amphibian species diversity in ponds from subtropical grasslands

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ABSTRACT

Amphibian distribution patterns are known to be influenced by habitat diversity at breeding sites. Thus, breeding sites variability and how such variability influences anuran diversity is important. Here, we examine which characteristics at breeding sites are most influential on anuran diversity in grasslands associated with Araucaria forest, southern Brazil, especially in places at risk due to anthropic activities. We evaluate the associations between habitat heterogeneity and anuran species diversity in nine body of water from September 2008 to March 2010, in 12 field campaigns in which 16 species of anurans were found. Of the seven habitat descriptors we examined, water depth, pond surface area and distance to the nearest forest fragment explained 81% of total species diversity. Water depth, margin vegetation type, surface area and distance to the next body of water explained between 31-74% of the variance in abundance of nine of the 16 species. Thus, maintenance of body of water, of the vegetation along the water edge and natural forest fragments in the grasslands, along with fire control (used to renovation of pasture), are fundamentally important for the maintenance of anuran species diversity through the conservation of their breeding sites.

Key words: conservation, environmental variables, generalized linear models, hierarchical partitioning.

INTRODUCTION

Understanding processes, both biotic and abiotic, that generate patterns of species' distributions and the diversity that is a consequence of those processes is fundamental for community ecology (Huston 1994, Hutchinson 1959). Environmental heterogeneity at many scales is also important (Hamer and Parris 2011, Richter-Boix et al. 2007, Shulse et al. 2010, Silva et al. 2011a, 2012, Werner et al. 2009). Complex environments tend to have more microhabitats that allow differential resource use thereby favoring species coexistence (Campos and Vaz-Silva 2010, Cardoso et al. 1989, Conte and Rossa-Feres 2007, Rossa-Feres and Jim 2001, Vasconcelos et al. 2009).

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In frogs, the study of environmental heterogeneity and its influence on diversity has been useful in explaining landscape and local (body of water) distribution of species during the reproductive period. Local scale environmental characteristics studied include timing of water availability (Babbit 2005, Egan and Paton 2004, Lichtenberg et al. 2006, Richter-Boix et al. 2007, Santos et al. 2007, Vasconcelos et al. 2009), water depth (Babbit 2005, Babbit and Turner 2000, Burne and Griffin 2005), area (Afonso and Eterovick 2007, Burne and Griffin 2005, Keller et al. 2009, Parris 2004, Parris and McCarthy 1999) and vegetation in and around the body of water (Burne and Griffin 2005, Keller et al. 2009, Vasconcelos et al. 2009). Landscape scale factors usually include distance to forest fragments (Herrmann et al. 2005, Laan and Verboom 1990, Silva and Rossa-Feres 2007, 2011, Silva et al. 2011a, b) and distance between bodies of water (Burne and Griffin 2005). While understanding these factors is important for ecology and conservation (Silva et al. 2011), it is impossible to define just one relationship, since each location has both different species and different combinations of environmental features (Hazell et al. 2001, Vasconcelos et al. 2009).

Few studies have examined frog community structure in subtropical grasslands (review in Souza-Filho and Conte 2010), none of which examined environmental influences on occurrence. Subtropical grassland vegetation is a relict of a previous, drier period before the formation of Araucaria Forests and so has a variety of plants adapted to periods of hot weather (Behling 2002, Behling and Pillar 2007, Klein 1960, Maack 2012, Overbeck et al. 2007). Today, agriculture has reduced the extent of these subtropical grasslands to a much smaller area than they originally covered (Behling and Pillar 2007, Medeiros et al. 2005, Overbeck et al. 2007). This reduction is often due to periodic burning (to improve pasture), plowing for planting and the introduction of exotic trees, all of which change the original patterns of nutrient and water cycling (GISP 2005, Guimarães et al. 2010, Medeiros et al. 2005). Also, grasslands get very little attention in terms of conservation (Overbeck et al. 2007, Pillar et al. 2009), and so today it is urgent that these areas be studied for both an ecological understanding and for conservation and maintenance of diversity of anuran communities (Beja and Alcazar 2003, Hazell et al. 2001, Silva et al. 2011a, 2012). Thus, here we examine how environmental variation at local and larger scales influences diversity of frogs in bodies of water in subtropical grasslands.

MATERIALS AND METHODS

Study Area

Subtropical grasslands are common in southern Brazil, where are located in the Pampa biome and in the Atlantic Forest biome forming mosaics with Araucaria forest, within which the Palmas Grasslands is found (Overbeck 2007, Pillar and Vélez 2010, Maack 2012). The original grasslands of Palmas comprised 2,350 km^2 and had many small patches of riverine mixed rainforests (*capão*) along with isolated remnants of Araucaria forests scattered in the grasslands (Maack 2012). Today, grasslands are threatened due to a variety of activities, such as conversion to pasture (and burning to renew the pasture) as well as for pine and eucalyptus plantations (Behling and Pillar 2007, Medeiros et al. 2005, Overbeck et al. 2007).

Frogs were studied at the Campos de Palmas Wildlife Refuge (16,600ha, 26°31’40”S, 51°36’17”W) in Palmas and General Carneiro, in southern Brazil (Fig. 1). The climate is temperate, with mild summers and no well-defined rainy season (IAPAR 2014), and rainfall is about 1800 mm yr^{-1}, average relative humidity at 70% and average temperature of 16 °C.

Field Study

We searched for frogs at nine ponds during 12, 2-day field campaigns during two breeding seasons: September 2008 to April 2009 and September 2009

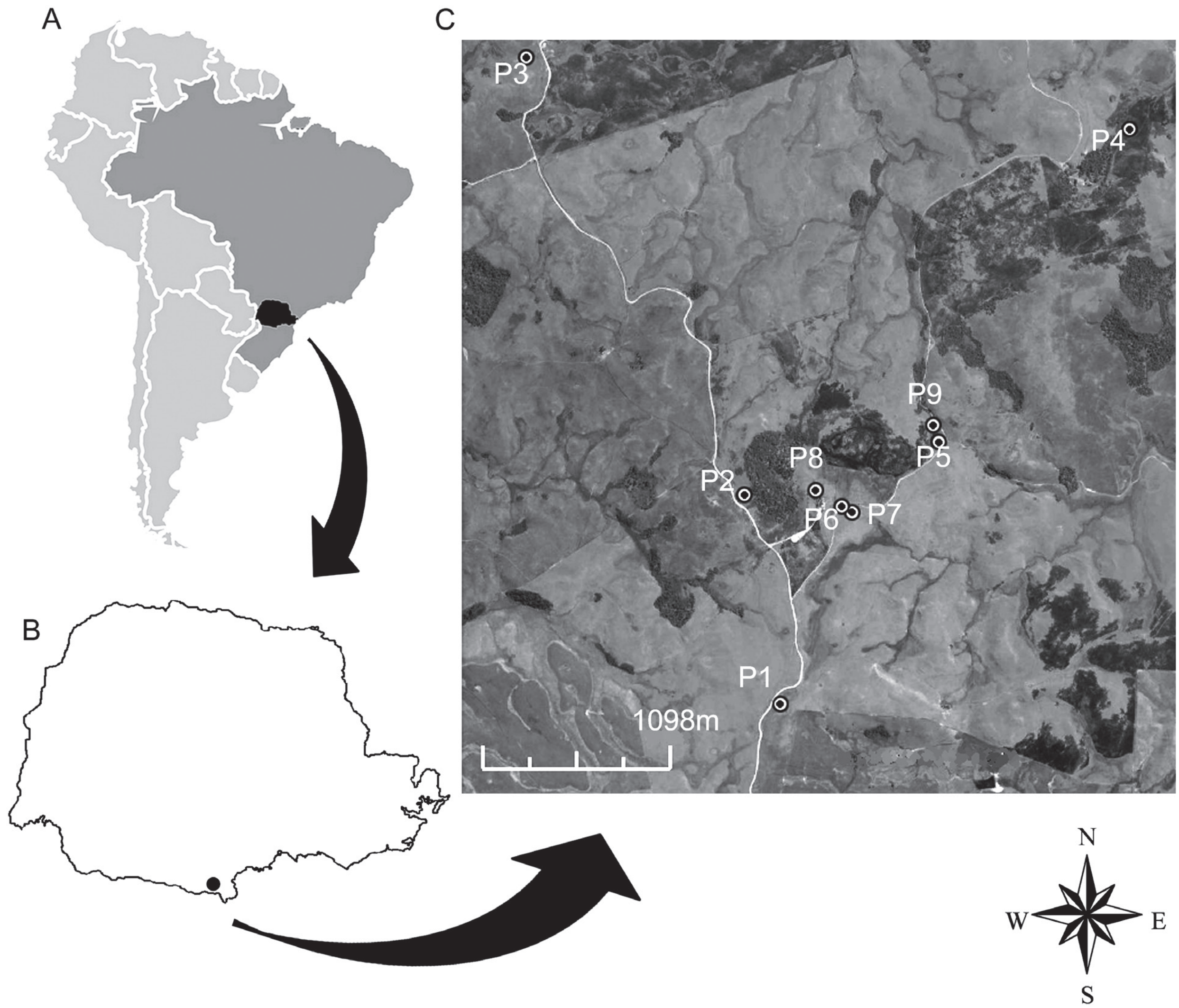

Figure 1 - Map of South America (**a**) with Paraná highlighted (**b**) and satellite imagery of sampling locations (**c**) in a subtropical natural field landscape. Image adapted from Google Earth.

to March 2010 (Table I). We counted frogs between the hours of 18:00 – 23:00 h by active search at breeding sites, following Scott Jr and Woodward (1994). We walked slowly along the perimeter of the pond, noting all individuals seen and males heard while vocalizing. During each count, we visited ponds randomly and switched directions in each visit to avoid bias (Conte and Rossa-Feres 2006).

In October 2008 and 2009, at each pond we measured four environmental variables to test for the influence of environmental variability: AREA – maximum pond surface area (m^2), PVEI - emergent vegetation (as percent cover of the pond surface area), DEPT – maximum pond depth (cm), and VEGE - vegetation bordering the pond (herbaceous, shrub, tree and), 1 = only one type of vegetation, 2 = two type of vegetation, 3 = three type of vegetation. We measured these variables in October because it is historically the month with the greatest rainfall and anuran density (Conte and Rossa-Feres 2006, 2007). The hydroperiod (HYDR) as analyzed throughout the entire field

TABLE I
Characterization of bodies of water in natural fields in a subtropical field landscape from September 2008 to April 2009 and September 2009 to March 2010.

Point	Longitude	Latitude	Season	Veg	Depth (cm)	Area (m²)	PVEI (%)
1	-51.661306	-26.555667	Short	H, S, T	40	900	20
2	-51.663389	-26.545028	Short	H, S, T	40	1980	40
3	-51.676000	-26.522556	Long	H, S	80	1440	80
4	-51.641250	-26.526139	Short	H	20	408	5
5	-51.652306	-26.542333	Long	H, S	80	896	60
6	-51.658222	-26.545861	Short	H, S	40	480	20
7	-51.657250	-26.545944	Short	H, S	30	300	5
8	-51.659444	-26.544750	Long	H, S, T	50	600	30
9	-51.65261	-26.54147	Long	H, S, T	20	35	30

H – herbaceous; S – shrubs; T – tress; P1 to P8 are temporary ponds and P9 is a marshy area next to a stream. Environmental variables: Season is length of hydroperiod; Veg - type of vegetation surrounding the body of water; Depth (cm) – pond depth; Area (m^2) – surface area of the pond and PVEI (%) – percent emergent vegetation inside the body of water.

work and was classified as short (< 6 mo) or long (> 6 mo). We also measured larger scale features: CFFD – distance to nearest forest fragment and CBPD – distance to nearest pond.

Data Analysis

We tested for spatial autocorrelation among environmental variables using Moran's I and the program Spatial Analysis in Macroecology v. 3.0 (SAM, Rangel et al. 2006) and considered variance inflation factors (VIF) > 3 to indicate colinearity and we removed such variables from the analysis, following Zuur et al. (2009).

To evaluate the influence of environmental variables on the richness we fitted generalized linear models (GLMs, McCullagh and Nelder 1989) to the data using the GLM function implemented in the statistical package NLME (Pinheiro et al. 2012, R Development Core Team 2012). Since our data were not overdispersed, the analyses were carried out with Poisson distribution and log link function. To determine the optimal model, we started with a model in which the fixed component contained all explanatory variables. We used Akaike's information criterion, corrected for small sample sizes (AICc, Burnham and Anderson 1998), to select explanatory variables that were driving total species richness. We used Akaike weights to evaluate model-selection uncertainty.

We tested for the influence of environmental variables on frog species richness and abundance (the sum of all individuals found in all the campaigns) using generalized linear models using the Poisson distribution (GLM; McCullagh and Nelder 1989) and compared models using Akaike Information Criterion (AIC, Burnham and Anderson 2002) using the statistical package NLME (Pinheiro et al. 2012, R Development Core Team 2012). We detected overdispersion and corrected using the negative binomial distribution and log-link function with the MASS package in R (Venables and Ripley 2002, Zuur et al. 2009). We evaluated the deviance explained and weight by each model to determine the optimal model best explaining habitat variables driving total species abundance.

We determined which environmental variables were most important for frog abundance by species (for those with > 25 individuals), using an analysis of hierarchical partitioning (Mac Nally 2002) using the statistical package hier.part (Walsh and Mac Nally 2008) in R. This hierarchical analysis compares all possible models of the effects of independent environmental variables on abundance (the dependent variable) and then estimates the strength of the contribution of each variable and groups of variables (Chevan and Sutherland 1991, Mac Nally 1996, 2000).

RESULTS

We recorded 16 species belonging to five families: Bufonidae, Hylidae, Leptodactylidae, Microhylidae and Odontophrynidae (Table II). Both emergent PVEI and HYDR had VIF > 3 and were removed from further analysis. Three out of 16 species had abundance below 25 individuals and, therefore, were not analyzed.

None of the explanatory variables predicted total species richness well: DEPT (likelihood ratio test, all df = 1, χ^2 = 0.33, P = 0.56), VEGE (χ^2 = 0.12, P = 0.72), AREA (χ^2 = 0.085, P = 0.76), CFFD (χ^2 = 0.05, P = 0.81), CBPD (χ^2 = 0.01, P = 0.89).

However, larger and deeper ponds that were closer to forest fragments had greater anuran diversity. Of the five environmental variables analyzed, the model with AREA, DEPT and CFFD was the most parsimonious and explained 81% of the total variation of species abundance (Table III).

Four environmental variables (AREA, DEPT, CBPD and VEGE) explained from 31% to 74% of the total variation in species abundance of nine species in bodies of water (Table IV, Fig. 2): *Dendropsophus minutus*, *Hypsiboas prasinus* and *Physalaemus* aff. *gracilis* with AREA; *Pseudis cardosoi* and *Leptodactylus* cf. *latrans* com DEPT; *Scinax squalirostris* and *Physalaemus cuvieri* with DEPT and AREA; *Scinax uruguayus* with CBPD; *Hypsiboas leptolineatus* with VEGE. The distributions of *Rhinella icterica*, *Scinax granulatus, Leptodactylus plaumanni* and *Elachistocleis bicolor* were not related to the environmental variables analyzed.

TABLE II
List of species, abundance and occurrence in bodies of water between September 2008 and April 2009 and September 2009 and March 2010 in a subtropical landscape of natural fields.

	P1	P2	P3	P4	P5	P6	P7	P8	P9
Bufonidae									
Rhinella icterica (Spix, 1824)				8		10	2	4	1
Hylidae									
Aplastodiscus perviridis A. Lutz in B. Lutz, 1950		1	3			3			13
Dendropsophus minutus (Peters, 1872)	71	556	372	12	122	14	7	183	8
Hypsiboas leptolineatus (P. Braun & C. Braun, 1977)		1			3				68
Hypsiboas prasinus (Burmeister, 1856)	19	41	29		2		4	8	1
Pseudis cardosoi Kwet, 2000			98		1			3	
Scinax aromothyella Faivovich, 2005			5	2					
Scinax granulatus (Peters, 1871)	47	160	138	7	63	12	44	240	
Scinax squalirostris (A. Lutz, 1925)	34	98	191	11	74	3	29	43	4
Scinax uruguayus (Schmidt, 1944)	216	107	32	24	3	11	145	160	
Leptodactylidae									
Physalaemus cuvieri Fitzinger, 1826	26	43	229	4	60	22	4	46	3
Physalaemus aff. *gracilis*	11	18	5	3	4			4	1
Leptodactylus plaumanni Ahl, 1936	6	9	3	9		2	1	9	
Leptodactylus cf. *latrans*	2	6	13	2	21	7	3	10	6
Microhylidae									
Elachistocleis bicolor (Valenciennes in Guérin-Menéville, 1838)	11		12			3	1	15	
Odontophrynidae									
Odontophrynus americanus (Duméril & Bibron, 1841)	1		1	7	2				

TABLE III
Generalized linear models used to analyze the influence of environmental heterogeneity on species distribution in bodies of water in a landscape of natural fields from September 2008 to April 2009 and from September 2009 to March 2010.

Models	ΔAIC	k	wAIC	% DEV
DEPT + AREA + CFFD	0	4	0.4	81
DEPT + AREA + CFFD + CBPD	0.2	5	0.3	84
DEPT + VEGE + AREA + CFFD + CBPD	1.8	6	0.2	85
DEPT + CFFD	2.9	3	0.1	68
DEPT	8.4	2	0	32

ΔAIC - AIC information criterion for each model from the most parsimonious; k = number of parameters; wAIC – AIC weights for each model; % DEV - percent variance explanation.

DISCUSSION

Anuran diversity and the presence of some species in natural fields were affected by both local characteristics of the body of water (such as area, type of vegetation around the body of water and water depth) and larger scale features (such as distance from the nearest fragment and distance from the nearest body of water). Environmental characteristics (vegetation, area and depth) determine habitat heterogeneity as a consequence of structural complexity of bodies of water and determine the availability of microhabitats used by anurans as sites for calling and egg-laying during the breeding period (Afonso and Eterovick 2007, Bastazini et al. 2007, Burne and Griffin 2005, Silva et al. 2012, Vasconcelos et al. 2009).

The effects of solar incidence on open areas waterbodies are reduced by a larger pond area and depth (higher water storage). This decreases evaporation and the risk of rapid droughts (dessication), reducing environmental unpredictability during the larval period and until the end of metamorphosis (Parris and McCarthy 1999, Laan and Verboom 1990, Parris 2004, Babbit 2005, Santos et al. 2007). Greater predictability of water availability is important for reproductive success in species of anurans with prolonged reproduction, such as *Leptodactylus* cf. *latrans* and *Physalaemus cuvieri* (Conte and Rossa-Feres 2006), and species that use deeper areas for calling and egg-laying, such as *Pseudis cardosoi* (Kwet 2000, Conte et al. 2010). Nonetheless, larger area (especially if depth does not increase) can result in more vegetation both in and around the body of water. This increased vegetation favors the segregation of arboreal species that use vertical call sites, which reduces the number of physical confrontations and agonistic interactions in the dispute over females and calling sites (e.g. *D. minutus, H. prasinus*, *H. leptolineatus* and *S. squalirostris*; Cardoso and Haddad 1984, Cardoso et al. 1989, Conte and Machado 2005, Pombal Jr and Haddad 2005, Rossa-Feres and Jim 2001, Wells 2007). Increased vegetation also provides microhabitat for terrestrial species that vocalize from the shore, shallow areas or in cavities covered by vegetation (e.g. *P.* aff. *gracilis*; Conte and Machado 2005). Vegetation protects egg masses from desiccation and predation and can result in increased survival for larvae, for individuals metamorphosing into the adult stage and for adults that use this vegetation as shelter from predators and extreme temperatures during the breeding season (Hazell et al. 2001).

Although the frogs in this study are found mainly in association with open areas, nearness to the forest fragment was associated with greater diversity and may be a consequence of greater

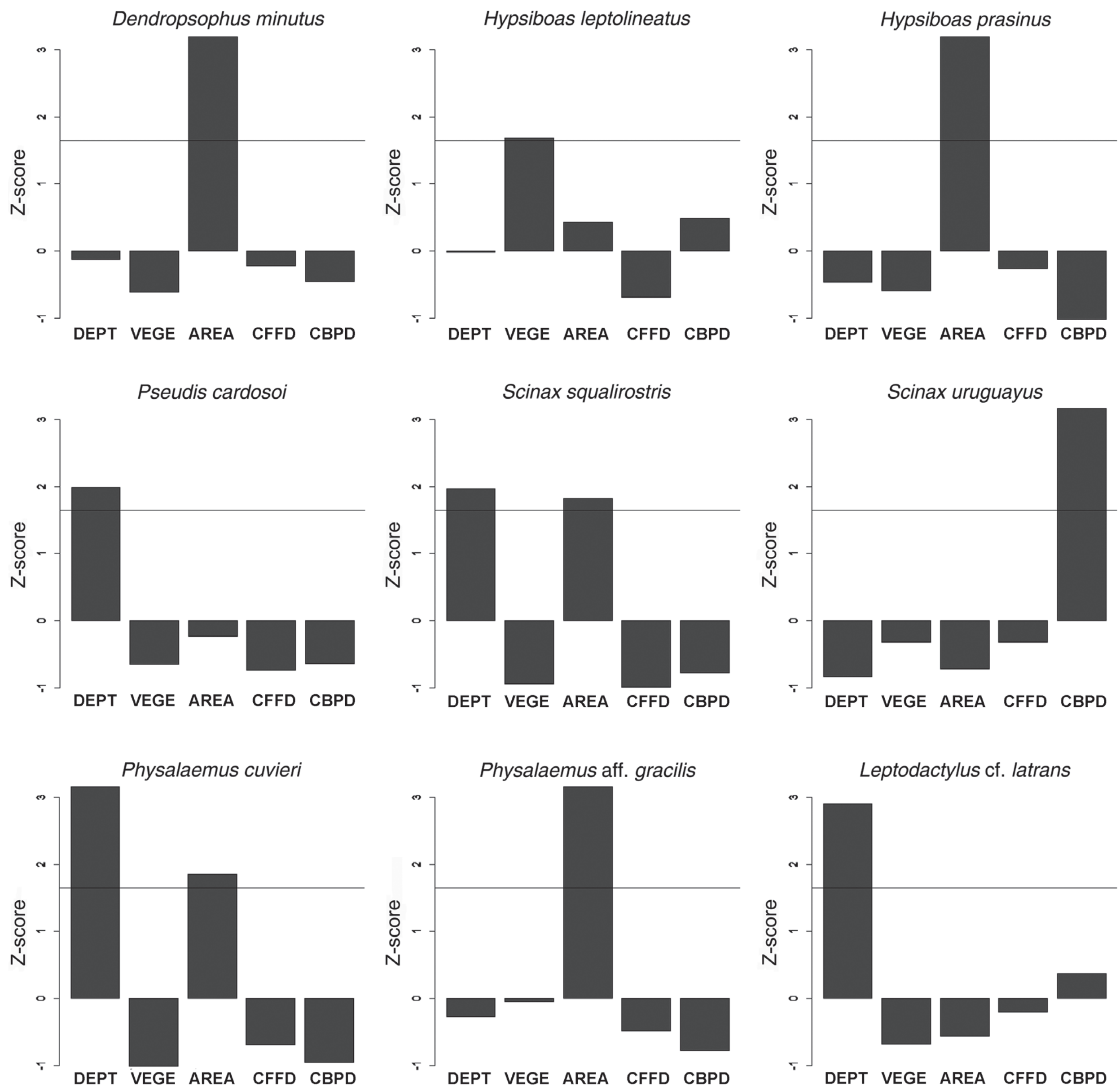

Figure 2 - Independent contributions of environmental variables to abundance of nine species sampled in natural fields of a subtropical natural field landscape from September 2008 to April 2009 and from September 2009 to March 2010. Bars are Z-scores that indicate the independent contribution of each variable based on randomization and possible predictor variables that explain species abundances. The horizontal line is the 95% confidence interval and bars above the line indicate statistical importance. DEPT - depth; VEGE - vegetation type (herbaceous, shrubby or arboreal) around the body of water and AREA - area in m^2; CFFD - distance to nearest forest fragment and CBPD - distance to nearest body of water.

availability of resources, such as areas for juvenile dispersal when open breeding areas are at risk of desiccation (Rothermel 2004, Rothermel and Semlitsch 2002, Silva and Rossa-Feres 2007), refuges during the dry season for both juveniles and adults (Silva and Rossa-Feres 2007), day-time shelter during the breeding season or foraging locations (Silva and Rossa-Feres 2007), and more stable levels of humidity closer to forest fragments (Silva and Rossa-Feres 2007, 2011).

TABLE IV

Hierarchical partition correlating the abundance of 14 anuran species sampled in natural fields of a subtropical natural field landscape from September 2008 to April 2009 and from September 2009 to March 2010.

Rhinella icterica					*Aplastodiscus perviridis*					*Dendropsophus minutus*				
	I	J	R^2	Z-score		I	J	R^2	Z-score		I	J	R^2	Z-score
DEPT	0.09	0.07	14.33	-0.27	DEPT	0.06	0.03	9.26	-0.54	DEPT	0.11	0.08	11.31	-0.13
VEGE	0.30	-0.02	47.20	1.3	VEGE	0.17	-0.07	24.71	0.42	VEGE	0.05	0.06	5.12	-0.61
AREA	0.13	0.08	20.83	0.03	AREA	0.15	-0.02	22.46	0.32	AREA	0.65	0.23	67.00	4.22
CFFD	0.08	-0.08	12.89	-0.53	CFFD	0.03	-0.01	3.98	-0.77	CFFD	0.09	0.03	9.40	-0.22
CBPD	0.03	0.00	4.75	-0.78	CBPD	0.27	-0.13	39.59	1.3	CBPD	0.07	-0.01	7.16	-0.46
Hypsiboas leptolineatus					*Hypsiboas prasinus*					*Pseudis cardosoi*				
	I	J	R^2	Z-score		I	J	R^2	Z-score		I	J	R^2	Z-score
DEPT	0.11	0.03	14.26	-0.02	DEPT	0.07	0.02	7.55	-0.47	DEPT	0.30	0.07	58.89	1.99
VEGE	0.26	-0.13	32.21	1.69	VEGE	0.07	0.10	7.08	-0.59	VEGE	0.05	-0.02	10.26	-0.65
AREA	0.20	0.01	24.36	0.43	AREA	0.70	0.15	74.88	4.72	AREA	0.09	0.08	17.48	-0.23
CFFD	0.04	-0.03	4.56	-0.69	CFFD	0.09	0.08	9.79	-0.26	CFFD	0.04	-0.03	7.21	-0.74
CBPD	0.20	-0.11	24.61	0.49	CBPD	0.01	0.00	0.70	-1.02	CBPD	0.03	0.03	6.15	-0.64
Scinax granulatus					*Scinax squalirostris*					*Scinax uruguayus*				
	I	J	R^2	Z-score		I	J	R^2	Z-score		I	J	R^2	Z-score
DEPT	0.19	0.02	30.97	0.86	DEPT	0.38	0.21	46.90	1.97	DEPT	0.01	0.01	1.41	-0.84
VEGE	0.09	0.10	14.54	-0.55	VEGE	0.01	-0.01	1.18	-0.95	VEGE	0.10	0.15	10.86	-0.32
AREA	0.16	0.16	25.53	-0.85	AREA	0.37	0.22	45.99	1.82	AREA	0.04	-0.01	4.17	-0.72
CFFD	0.17	0.03	27.87	-0.41	CFFD	0.02	-0.02	2.31	-0.99	CFFD	0.09	0.15	9.66	-0.32
CBPD	0.01	-0.01	1.10	0.01	CBPD	0.03	0.03	3.63	-0.78	CBPD	0.65	0.13	73.91	5.59
Physalaemus aff. gracilis					*Physalaemus cuvieri*					*Leptodatylus plaumanni*				
	I	J	R^2	Z-score		I	J	R^2	Z-score		I	J	R^2	Z-score
DEPT	0.08	-0.07	8.42	-0.27	DEPT	0.59	0.21	62.90	4.16	DEPT	0.11	-0.07	28.66	-0.08
VEGE	0.13	0.09	13.59	-0.05	VEGE	0.02	0.01	1.84	-1.01	VEGE	0.01	0.00	2.49	-0.96
AREA	0.70	0.00	71.51	5.48	AREA	0.30	0.25	31.62	1.85	AREA	0.23	-0.08	56.45	1.11
CFFD	0.05	0.03	4.85	-0.49	CFFD	0.03	-0.03	2.68	-0.69	CFFD	0.04	0.03	10.85	-0.73
CBPD	0.02	0.00	1.63	-0.78	CBPD	0.01	0.01	0.96	-0.96	CBPD	0.01	0.00	1.55	-1
Leptodactylus cf. latrans					*Elachistocleis bicolor*									
	I	J	R^2	Z-score		I	J	R^2	Z-score					
DEPT	0.59	0.16	63.08	2.9	DEPT	0.23	-0.07	44.17	0.86					
VEGE	0.03	-0.03	3.45	-0.68	VEGE	0.05	0.07	10.26	-0.55					
AREA	0.06	0.01	6.06	-0.57	AREA	0.03	0.00	5.36	-0.85					
CFFD	0.11	0.08	11.55	-0.2	CFFD	0.08	0.01	15.38	-0.41					
DSTP	0.15	0.08	15.86	0.37	CBPD	0.13	0.02	24.82	0.01					

I – contribution of the predictor; J – interaction between each predictor and the others predictors; R^2 - percentage of total explained variance; Z-Score – value of I from randomizations of the data matrix for possible predictors variables that explain the abundance of each species.

Proximity between bodies of water could facilitate migration of individuals between subpopulations, which are sources of colonization when local extinction in some bodies of water occurs (Burne and Griffin 2005, Laan and Verboom 1990, Semlitsch 2000). Furthermore, this dynamic might facilitate dispersion for amphibians that avoid inter- and intra-specific competition or may influence adult habitat choice for bodies of water without predators (Burne and Griffin 2005, Rieger et al. 2004). The use of larger bodies of water with longer hydroperiods or smaller bodies of water with shorter hydroperiods is determined by different reproductive adaptations, mainly in regard to larval development and survival (Peltzer and Lajmanovich 2004, Semlitsch 2000). Thus, a landscape with a mosaic of different sized bodies of water and different hydroperiods, along with a surrounding matrix of native vegetation, is ecologically important for the conservation and connectivity of anuran communities among bodies of water, *Scinax uruguayus* presence is facilitated by near proximity of bodies of water. Since this species is associated with open areas such as natural fields (Garcia et al. 2007), dispersion between nearby bodies of water could facilitate the choice of bodies of water for offspring development, increase genetic exchange among individuals and guarantee the reproductive success of the species (Burne and Griffin 2005).

Less than 0.5% of subtropical grasslands are protected (MMA 2000), and the rest of the area is private property where agriculture and livestock provide constant and intensive impact and fire is used to renew pastures and eliminate plants with low nutritional value to livestock (Overbeck et al. 2007). Fire is important in maintaining natural fields and the absence of fire, can favor establishment of shrubs in open areas and the advance of forests (Behling and Pillar 2007, Overbeck et al. 2007). Additionally, fire suppression results in the accumulation of flammable organic material and thereby increase the risk of fire (Behling and Pillar 2007) and compromise the survival of forest fragments (Weber et al. 2007). However, care is absolutely necessary to maintain amphibian anuran diversity in fields because fires can have their own impact on the dynamics that maintain anuran diversity in natural field landscapes. Without control, fire to renew pasture can destroy vegetation around bodies of water that frogs use for shelter and calling sites and as corridors by those species that leave day-time shelter in forests or forest fragments (Silva and Rossa-Feres 2007) and for arboreal species that move between nearby bodies of water. Therefore, we recommend that fire in natural fields be used carefully and in a way that preserves vegetation around and within forest fragments. Anuran diversity in the study area was influenced by the proximity of forest fragments and vegetation apparently influences habitat selection by some species, in particular, vegetation in and around bodies of water. Thus, precautions recommended here should preserve the features necessary for anuran reproduction and thus maintain anuran diversity in natural fields.

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RESUMO

Padrões de distribuição de anfíbios são conhecidos por serem influenciados pela diversidade do habitat dos sítios de reprodução. Assim, a variabilidade dos sítios de reprodução e o conhecimento de como esta variabilidade influencia a diversidade de anuros é de suma importância. Aqui, nós examinamos quais características dos sítios de reprodução são mais influentes sobre a diversidade de anuros em campos naturais associados à Floresta com Araucária, Sul do Brasil, especialmente em locais de risco devido às atividades antrópicas. Nós avaliamos as associações entre a heterogeneidade de habitats e diversidade de espécies de anuros em nove corpos d'água de setembro de 2008 a março de 2010, totalizando 12 amostragens, as quais 16 espécies foram registradas. Dos sete descritores ambientais analisados, a profundidade da água, a área do corpo d'água e a distância do fragmento de floresta mais próximo explicaram 81% do total na diversidade de espécies. A profundidade da água, o tipo de vegetação no entorno do corpo d'água, a superfície da área e a distância do corpo d'água mais próximo explicaram de 31% a 74% da variância na abundância de nove das 16 espécies. Desta forma, a manutenção dos corpos d'água, da vegetação do seu entorno e de fragmentos naturais existentes nos campos, assim como o controle do fogo (utilizado na renovação de pastagens), são de fundamental importância para a manutenção da diversidade de espécies de anuros através da conservação de seus sítios de reprodução.

Palavras-chave: conservação, variáveis ambientais, modelos linear generalizados, partição hierárquica.

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