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Morphological variation, advertisement call, and tadpoles of *Bokermannohyla nanuzae* (Bokermann, 1973), and taxonomic status of *B. feioi* (Napoli & Caramaschi, 2004) (Anura, Hylidae, Cophomantini)

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Resumo

Bokermannohyla nanuzae (Bokermann & Sazima 1973) e *B. feioi* (Napoli & Caramaschi 2004) pertencem ao grupo de espécies de *B. circumdata*. A localidade-tipo da primeira espécie é a Serra do Cipó, Serra do Espinhaço, e a da segunda é o Parque Estadual do Ibitipoca, Serra da Mantiqueira, ambas no estado de Minas Gerais, Brasil. O padrão de desenhos dorsais, morfologia oral dos girinos e propriedades temporais dos cantos são indicadas como forma de distinguir essas espécies. Porém, diversos espécimes coletados entre as duas localidades-tipo permanecem sem identificação porque apresentam sobreposição nos caracteres e estados propostos para diagnosticar as duas espécies. Com o objetivo de avaliar a variação desses caracteres, foram realizadas análises de morfologia e morfometria de adultos, vocalizações e morfologia de girinos. Espécimes foram divididos em três unidades taxonômicas operacionais: *B. nanuzae* (Serra do Cipó e localidades ao norte, Serra do Espinhaço), *B. cf. nanuzae* (Quadrilátero Ferrífero, Serra do Espinhaço ao sul da Serra do Cipó), e *B. feioi* (Serra do Ibitipoca, Serra da Mantiqueira). Os padrões de desenhos do dorso e membros apresentam variação clinal e as três unidades são muito similares morfometricamente. As propriedades temporais e espectrais do canto apresentam sobreposição entre essas três unidades. Diferenças diagnósticas originalmente propostas para os girinos são variações intrapopulacionais e ocorrem em espécimes de todas as localidades analisadas. Assim, concluímos que essas três unidades são morfologicamente indistinguíveis. Portanto, *Bokermannohyla feioi* (Napoli & Caramaschi 2004) é designado como um sinônimo júnior de *Bokermannohyla nanuzae* (Bokermann & Sazima 1973), o que estende a distribuição geográfica desta para a Serra da Mantiqueira.

Palavras Chave: Neotrópico, morfometria, taxonomia, distribuição geográfica

Abstract

Bokermannohyla nanuzae (Bokermann & Sazima 1973) and *B. feioi* (Napoli & Caramaschi 2004) belong to the *B. circumdata* species group. The type locality of the former is Serra do Cipó, Espinhaço mountain range, and of the latter is Parque Estadual do Ibitipoca, Mantiqueira mountain range, both in Minas Gerais State, Brazil. Differences on dorsal drawing pattern of adults, oral disc morphology of tadpoles, and temporal properties of calls were proposed to distinguish these two species. However, several specimens found between the two type localities remain unidentified because diagnostic characters and states occur in all of these populations. Thus, in order to assess these characters variations, we performed an analysis of the morphology and morphometry of adults, vocalization, and morphology of tadpoles. Specimens were divided into three operational taxonomic units (OTUs): *B. nanuzae* (Serra do Cipó and northwards, Espinhaço mountain range), *B. cf. nanuzae* (Quadrilátero Ferrífero, Espinhaço mountain range, south of Serra do Cipó), and *B. feioi* (Serra do Ibitipoca, Mantiqueira mountain range). Drawing patterns of the dorsum and limbs show clinal variation and the three units are morphometrically very similar. Temporal and spectral properties of calls overlap in these three units. The diag-

TABLE 4. Measurements (in mm) of 17 morphometric parameters obtained for *Bokermannohyla nanuzae*. SD = standard deviation; n = sample number.

	Females				Males			
	Mean	SD	Range	n	Mean	SD	Range	n
SVL	40.42	3.60	32.53–45.9	28	37.95	2.54	26.5–43.03	186
HW	12.75	1.35	10.40–16.17		12.08	1.14	8.1–20.55	
HL	13.54	1.21	11.00–15.77		12.90	0.82	9.37–14.72	
AL	10.66	1.08	8.40–12.93		10.83	7.73	7.3–115.1	
FAL	7.71	0.62	6.77–8.80		7.40	0.77	5.23–12.33	
HAL	11.93	0.98	9.63–13.72		11.88	0.97	7.83–14.83	
THL	19.17	1.55	16.07–21.93		18.21	1.30	12.8–21	
TBL	19.90	1.22	17.53–22.11		18.95	1.34	13.3–22.03	
FL	28.30	1.86	24.20–31.13		26.83	1.80	18.97–31.37	
IND	2.25	0.30	1.66–3.23		2.17	0.30	1.44–5.19	176
IOD	3.97	0.48	3.10–5.70		3.86	0.50	3.10–8.82	
ED	3.37	0.30	2.74–3.89		3.21	0.52	2.51–8.92	
UEW	2.58	0.56	1.93–5.03		2.43	0.40	1.76–6.37	
END	2.95	0.31	2.55–4.08		2.79	0.41	2.19–7.35	
TD	1.81	0.29	1.11–2.85		1.70	0.25	1.21–3.92	
DFIV	1.44	0.24	1.12–2.32		1.37	0.14	0.99–2.06	
DTIV	1.72	0.20	1.38–2.15		1.65	0.19	1.14–3.00	

Sexual dimorphism. As previously shown, morphometric differences between males and females were found only in five of the 17 measurements obtained. Forearms are not hypertrophied on males as usually seen on other species of the *B. circumdata* group. Males with a single, curved, hypertrophied, protruding, spine-shaped prepollex and no nuptial pads on the inner edge of finger II; smaller and not protruding prepollex present in females.

Natural history. *Bokermannohyla nanuzae* occurs at the riparian vegetation of streams on the Espinhaço and Mantiqueira mountain ranges, usually higher than 1,000 m above sea level. Males call alone or mostly in pairs (approximately 1 m from each other) and normally answer to calls of other males or playbacks. Call sites include branches, rocks, inside crevices on rocks, and among roots of the creek bank. These sites are situated more than 1 m from the creek and between 0.3 and 1.0 m from the ground. Other species of the *B. circumdata* group have been observed calling from inside holes or hollow surfaces (Caramaschi & Feio 1990; Heyer *et al.* 1990; Napoli & Caramaschi 2004; Pombal & Gordo 2004). The highest density of calling males was observed in Serra do Caraça, where about 10 males were split into pairs, and each pair was more than 5 m from another. Reproductive activity was observed between October and March, the wet season in Southeastern Brazil. Tadpoles have nocturnal activity and were found in streams hidden among leaves and submerged branches, or swimming over rocky bottoms. During the day, they form clusters under rocks or roots in the stream bed. In order to understand the context of calls emission, breeding behavior, and patterns of microhabitat use by adults of *B. nanuzae* at Serra do Caraça, see Lima *et al.* (2014a, b).

Geographic distribution. The type series of *B. nanuzae* was collected in a stream near km 126 of the road crossing Serra do Cipó, Jaboticatubas, Minas Gerais State (Bokermann & Sazima 1973). This site now corresponds to km 116 of the road MG-010 (1,265 meters above sea level) located in the Municipality of Santana do Riacho, between the district of Serra do Cipó and the Municipality of Conceição do Mato Dentro, at the southern region of the Espinhaço mountain range.

Bokermannohyla nanuzae occurs in streams near the road and inside the boundaries of the Parque Nacional da Serra do Cipó. The species is also found in other protected areas in Minas Gerais, such as Reserva Particular do Patrimônio Natural (RPPN) Santuário do Caraça, Municipality of Catas Altas; RPPN Capitão do Mato, Municipality of Nova Lima; Parque Estadual (PE) Serra do Intendente and Parque Municipal Ribeirão do Campo, both in the Municipality of Conceição do Mato Dentro; PE do Rio Preto, Municipality of São Gonçalo do Rio

Preto; Área de Proteção Ambiental Serra da Brígida and PE do Itacolomi, Municipality of Ouro Preto. Its occurrence was also confirmed in the municipalities of Caeté, Rio Acima, Barão de Cocais, Ouro Branco, Serro, Congonhas, Augusto de Lima, Itabira, Mariana, and Rio Vermelho. In addition, *B. nanuzae* occurs in the Mantiqueira mountain range at the PE do Ibitipoca, Conceição do Ibitipoca, Municipality of Lima Duarte.

The municipalities of São Gonçalo do Rio Preto and Lima Duarte represent the northern and southern limits of the distribution of *B. nanuzae*, respectively. The distribution gap currently observed among the watersheds of the Doce, Paraíba do Sul, and Grande Rivers may be due to lack of sampling, since several Brazilian regions remain unexplored regarding the amphibian fauna.

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