On the habitat occupancy of some neotropical jays in South America, genus *Cyanocorax*

Sobre a ocupação de habitat de algumas gralhas neotropicais na América do Sul, gênero *Cyanocorax*

Luiz dos Anjos[1]*, Oscar Akio Shibatta[1]

Resumo

Neste estudo, a ocupação de habitat por dez espécies de gralhas do gênero *Cyanocorax* é avaliada levando em consideração as medidas morfométricas das espécies. Cinco medidas foram obtidas de 247 espécimes de museus: comprimento total, cauda, asa, bico, e tarso. Análise canônica das medidas obtidas revelou a existência de dois grupos distintos dentre as gralhas analisadas. Um grupo é formado por espécies com asa proporcionalmente longa, o qual tende a ocupar habitats abertos, como campo, cerrado e pantanal: *C. violaceus, C. cyanomelas, C. caeruleus,* e *C. cristatellus*. O outro grupo é formado por espécies de cauda proporcionalmente longa, e que habita especialmente habitats florestais ou arbustivos, como as florestas atlântica e amazônica e a caatinga: *C. affinis, C. mystacalis, C. cayanus, C. heilprini, C. chrysops* e *C. cyanopogon*. Dados da literatura sugerem que as espécies seguem estas tendências de ocupação mesmo quando elas são simpátricas em uma localidade.
Palavras-chave: Ocupação. Habitat. Morfometria multivariada.

Abstract

In this study, the habitat occupancy by ten jay species of genus *Cyanocorax* is evaluated taking into account the morphometric measurements of the species. Five measurements were gotten from 247 museums specimens: total length, wing, tail, bill, and tarsus. Canonical analyzes of the gotten measurements revealed the existence of two distinct groups among the analyzed jays. A group is composed by species with proportionally long wings, which tends to occupy open habitats, as grassland, cerrado and, pantanal: *C. violaceus, C. cyanomelas, C. caeruleus,* and *C. cristatellus*. Another group is composed by species with proportionally long tails and that inhabits forest or scrub habitats, as the Atlantic and Amazonian forests and the caatinga: *C. affinis, C. mystacalis, C. cayanus, C. heilprini, C. chrysops* and *C. cyanopogon.* Data from literature suggests that the species follow those occupancy tendencies even when they are sympatric in one locality.
Key words: Occupancy. Habitat. Multivariate morphometrics.

[1] Docentes do Departamento de Biologia Animal e Vegetal, Centro de Ciências Biológicas, Universidade Estadual de Londrina, 86051-990, Londrina, PR. *E-mail: llanjos@sercomtel.com.br

Introduction

Species of Corvidae tend to avoid large tracks of forests, being more commonly found in open areas, as ravens and crows, or at the forest edge, as jays and magpies (GOODWIN, 1976; MADGE; BURN, 1994). This family has origin in Australia, from which an ancestor was able to disperse to Asia (ERICSON et al., 2005). Corvids reached the Americas from the north, presumably by following the trans-Beringian route, later entering South America (ESPINOSA DE LOS MONTEROS; CRACRAFT, 1992; ERICSON et al., 2005). Based on DNA sequences, Bonaccorso and Peterson (2007) suggested that this radiation to South America was not a single event but three different invasions: one invasion originated *Cyanolyca*, other originated a single species, *Cyanocorax yncas*, and another one originated the remaining species of *Cyanocorax* (10 species). Therefore, only two genera of Corvids exist in South America, the neotropical jays *Cyanolyca* and *Cyanocorax*. Some species of *Cyanocorax* living in South America became specialist to occupy areas with scattered trees, perhaps due to the absence of other Corvids closely related to those open habitats, as *Corvus;* actually, the widespread *Corvus* is absent only in South America, occurring in all other continents (GOODWIN, 1976; MADGE; BURN, 1994). The Curl-crested Jay, *Cyanocorax cristatellus,* which inhabits the cerrado, a type of savanna in the plateau of Central Brazil, and the Purplish-crested Jay, *Cyanocorax cyanomelas,* which inhabits the pantanal, a flooded area with scattered small forest fragments in southern-central Brazil, could be considered the best examples (SICK, 1997; MADGE; BURN, 1994).

In the present study we evaluated differences in the body measurements (total length, wing, tail, bill, and tarsus) of all species of *Cyanocorax* living in South America, with exception of *C. yncas*. We expect that two ecological groups of *Cyanocorax* have radiated in South America according sizes of wing and tail proportionally to body lenght; one composed by species living in more open habitats, which would have larger wings, and other more related to forest, which would have larger tails.

Material and Methods

Measurements were taken from the jay species in four Museums: Museu de Zoologia da Universidade de São Paulo (MZUSP); Museu Paraense Emílio Goeldi (MPEG); Museu de História Natural Capão da Imbuia (MHNCI); Field Museum of Natural History (FMNH). The species (and the number of specimens) measured were: *C. violaceus* (21); *C. cyanomelas* (25); *C. caeruleus* (55); *C. cristatellus* (38); *C. affinis* (10); *C. mystacalis* (7); *C. cayanu*s (12); *C. heilprini* (6); *C. chrysop*s (21); *C. cyanopogon* (52). Measurements of total length, wing, tail, bill, and tarsus were gotten. Specimens with broken bill were not considered. The program PAST (HAMMER; HARPER; RYAN, 2001) was used to perform a canonical analyzes of the measurements. The terminology for the vegetation types follow, in general, that presented by Stotz et al. (1996).

Results

Two groups appeared in the canonical analyzes (Fig. 1; $l = 0.02946$, $p = 2.571x10^{-107}$): the first composed by *C. violaceus, C. cyanomelas, C. caeruleus,* and *C. cristatellus* (this last species more differentiated than the others) and the second composed by *C. affinis, C. mystacalis, C. cayanus, C. heilprini, C. chrysops and C. cyanopogon*. The first axis represents 91,3% of variation (eigenvalue = 12,35) and the second axis 6,031% (eigenvalue = 0,816) in relation to the original matrix.

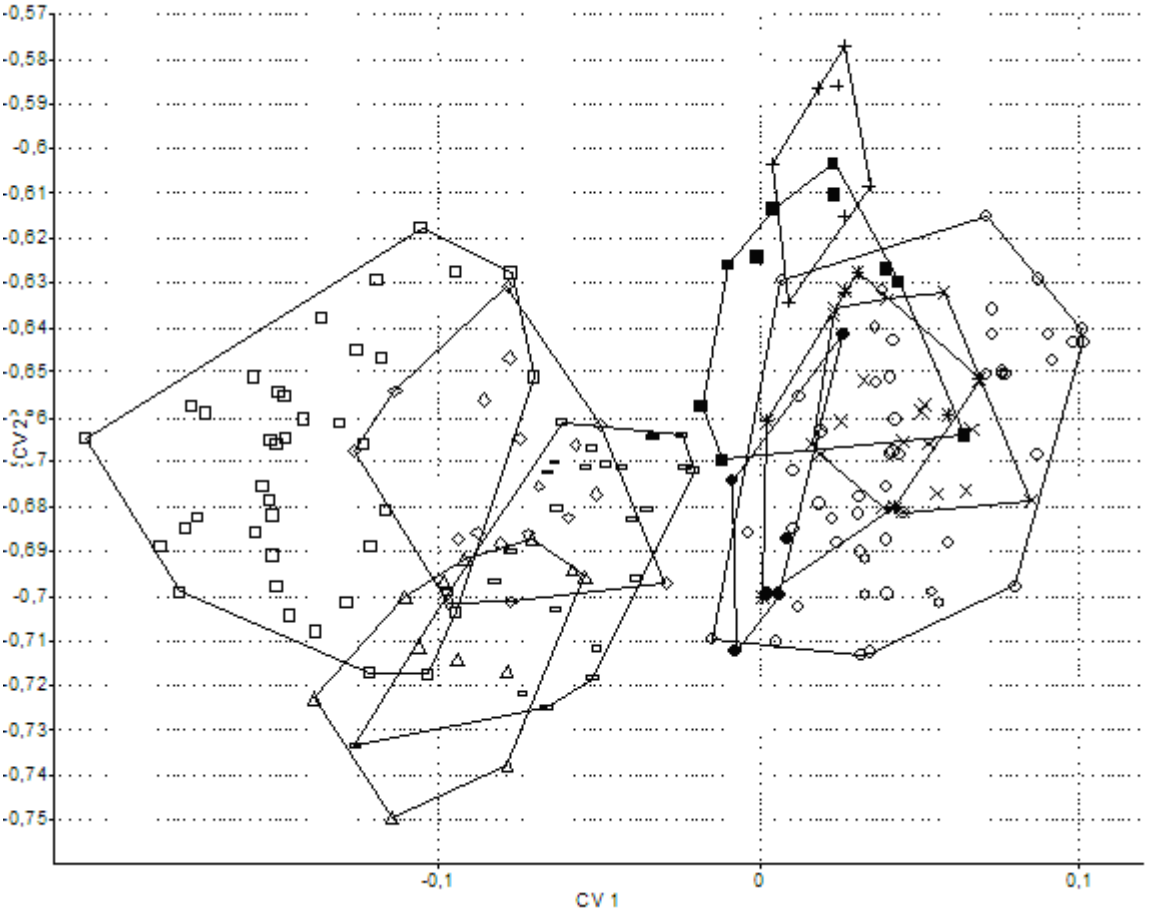

Figure 1. Canonical analyzes of measurements in the ten jay species analyzed, which are codified as: open square = C. cristatellus; open triangle = *C. violaceus*; open diamond = *C. caeruleus*; open rectangle = *C. cyanomela*s; dark square = *C. cayanu*s; plus sign = *C. mystacalis*; open circle = *C. cyanopogon*; asterisk = *C. affinis*; X = *C. chrysops;* dark circle = *C. heilprini.*

The measurements of total length, wing, and tail were more important in the first axis, while the tarsus size was more important in the second axis (Table1). Although any statistical analyzes have been done, the proportion wing/total length seems larger in the first group, while the proportion tail/total length seems larger in the second group. (Table 2); the only exception was *C. mystacalis*, which presented similar proportions wing/total length and tail/total length.

Table 1. Weigh of canonical variables in axis 1 (CV1) and 2 (CV2) in relation to measurements (see figure 1).

	CV 1	CV 2
Total length	0.53674	-0.32927
Wing	-0.52339	-0.45722
Tail	0.61094	-0.40116
Tarsus	0.23029	0.68478
Bill	0.1081	0.22953

Table 2. Mean±SD (mm) of the proportions between the wing/total length and of tail/total length of the studied jays, considering their groups (see results).

Species	Group	Wing/total lenght	Tail/total lenght
C. cristatellus	1	0.58±0,03	0.43±0,02
C. cyanomelas	1	0.50±0,02	0.46±0,02
C. caeruleus	1	0.51±0,02	0.45±0,02
C. violaceus	1	0.52±0,03	0.46±0,03
C. heilprini	2	0.47±0,02	0.49±0,01
C. chrysops	2	0.45±0,02	0.50±0,02
C. cyanopogon	2	0.45±0,03	0.50±0,03
C. cayanus	2	0.48±0,02	0.48±0,03
C. mystacalis	2	0.44±0,01	0.45±0,01
C. affinis	2	0.48±0,04	0.51±0,02

Discussion

Analyzes presented here on the ten species suggests two distinct groups among the analyzed jays. These groups may reflect their habitat occupancy, although most of the jay species may live in more than one habitat. One group composed by species with longer wings, which favors long flies, supposedly used to cover larger distances over open habitats. The other group is composed by jays with shorter wings, which allow mostly shorter flies, supposedly in areas with higher density of trees or bushes. Indications from literature seem to confirm those tendencies, although published field observations are rare for some species.

Cyanocorax cristatellus has the largest wings, which is coherent, since it lives in an open habitat, the cerrado. Some authors consider *C. cristatellus* endemic of cerrado (e.g. SICK, 1985), although it can also live in gallery forest, Tropical Deciduous forest, and grassland areas with sparse covering of shrubs and trees. Amaral and Macedo (2003), studying three flocks of this species in Central Brazil, estimated a large area of home range (172 ha); they also mentioned extensive movements, with the displacement of one individual monitored reaching 1,500m in 1 h and 45 min.

In the group of *C. cristatellu*s are three other species with large wings: *C. cyanomelas, C. caeruleus,* and *C. violaceus. C. cyanomelas,* as *C. cristatellus,* inhabits cerrado and the Tropical Deciduous forest as in Paraguay (HAYES, 1995), but it also lives in pantanal, which is a region periodically flooded, with scattered small forest patches that occur in slightly elevated and non-flooded areas. It moves frequently over open fields between the forest patches, what would explain its large wings. But, commonly, *C. cyanomelas* stays longer in each patch, where it forages for food in all forest strata (Anjos, pers. observ.). *Cyanocorax caeruleus* also lives in natural forest fragments scattered in grassland (but not flooded periodically), a landscape that is found in higher elevations (above 800 m) in southern Brazil (ANJOS, 1991; ANJOS; BOÇON, 1999). Long flies over grassland areas among those forest fragments for distances above 1 km are not unusual in *C. caeruleus*. This species also inhabits large extensions of the Southern Temperate forest, found between 600 to 1,000m in southern Brazil, and of the Tropical Lowland

Evergreen forest (up to 800m); (ANJOS, 1995). In those forest types, *C. caeruleus* occupies mainly the canopy, being rarely watched at the understory and on the ground (ANJOS; UEJIMA 1994). Some islands covered by forest and close to the coast are frequently visited by this species; to reach these islands this jay needs to fly up 2 km over the sea (Anjos, pers. obs). *Cyanocorax violaceus*, which is poorly known, seems to explore the river edge and mangrove forests in Amazonia (RESTALL; RODNER; LENTINO, 2006); probably, this species could also perform long flies along and crossing the large rivers.

In contrast, the species of the second group lives at the mid-story and under-story, perching frequently on the ground, when occupy vegetation with tall-trees, as humid forests, and all strata, when in habitats which vegetation has short-trees, as the Tropical Deciduous forest. *Cyanocorax. chrysops* does not perform long flies, usually up to 100 m (ANJOS, 1995). It lives in a variety of different habitats, as the Tropical Evergreen forest, the Southern Temperate forest, and the Gallery forest, beside cerrado and pantanal (MADGE; BURN, 1994; ANJOS, 1995; UEJIMA, 1998). When in forest, this species lives mainly at the middle levels, perching frequently at the ground (UEJIMA, 1998; BRUNETTA, 2009). In the Southern Temperate forest of southern Brazil, where it is sympatric with *C. caeruleus,* it tends to occupy the lower strata (ANJOS; UEJIMA, 1994). In pantanal, where is sympatric to *C. cyanomelas,* tends to live where there are aggregation of forest patches (Anjos, pers. observ.). *Cyanocorax cyanopogon,* which forms a sister-pair with *C. chrysops*, lives in caatinga, a mostly dry scrub area considered a type of Tropical Deciduous forest with short trees (MADGE; BURN, 1994; STOTZ et al., 1996). *Cyanocorax cyanopogon* does not perform long flies in this habitat, since the bushes and short trees are not too dispersed (Anjos, pers. observ.). This species also lives in cerrado but, it was noted that in one transect from caatinga to cerrado in northeastern Minas Gerais (southeastern Brazil) *C. cyanopogon* was replaced by *C. cristatellus* (WILLIS; ONIKY, 1991).

The habitat occupancy of the others four species are less known and field observation is desirable. The *C. mystacalis* lives in shrubby cactus stepped and mesquite forest in northwestern South America, also a kind of Tropical Deciduous forest with short trees, mostly near ground (RESTALL; RODNER; LENTINO, 2006); this species, supposedly, has similar habits to *C. cyanopogon* moving in short flies in its habitat. In the case of *C. affinis* the similarity is with *C. chrysops*, living at the edge and clearings of the Tropical Lowland evergreen forest in northeastern of South America (RESTALL; RODNER; LENTINO, 2006). *Cyanocorax heilprini* is closer related to white sand forests of the upper Rio Negro basin (Amazonia); (RESTALL; RODNER; LENTINO, 2006). *Cyanocorax cayannus* also is found in white sand forests of upper Rio Negro and Orinoco basins, but it also frequent more humid areas, as the forest edge (RESTALL; RODNER; LENTINO, 2006).

Although general tendencies could be pointed out above on habitat distribution of the studied jays, it is noticeable the scarce information available on the species. So, other factors, beside those showed above, could be also modeling the habitat occupancy of those jays.

Acknowledgements

The authors receive research grants from CNPq Brazilian Council for Development of Science and Technology (305593/07-2 and 308624/2009-2). The first authors thanks helpful assistance from the following persons: L. F. Silveira (Museu de Zoologia da Universidade de São Paulo), A. Aleixo (Museu Paraense Emílio Goeldi, Belém), P. S. Neto (Museu de História Natural Capão da Imbuia, Curitiba), J. Bates, S. Hackett, and D. Villard (Field Museum of Natural History).

References

AMARAL, M. F.; MACEDO, R. H. F. Breeding patterns and habitat use in the endemic curl-crested jay of central Brazil. *Journal of Field Ornitholog*y, Hoboken, v. 74, n. 4, p. 331-340, 2003.

ANJOS, L. *Gralha-azul: biologia e conservação*. Curitiba: Companhia de Seguros Gralha-azul, 1995.

_____. O ciclo anual de Cyanocorax caeruleus em floresta de araucária (Passeriformes: Corvidae). *Revista Brasileira de Ornitologia*, Rio de Janeiro, v. 2, p. 19-23, 1991.

ANJOS, L.; BOÇON, R. Bird communities in natural forest patches in southern Brazil. *The Wilson Bulletin,* Lawrence, v. 111, n. 3, p. 397-414, 1999.

ANJOS, L.; UEJIMA, A. M. K. V*ocalizations and foraging of Cyanocorax caeruleus and Cyanocorax chrysops: a comparative analysis*. In: INTERNATIONAL ORNITHOLOGICAL CONGRES, 21., 1994, Viena. Ornithological Notebook, Viena, 1994.

BONACCORSO, E.; PETERSON, A. T. *A* multilocus phylogeny of New World jay genera. *Molecular Phylogenetics and Evolution*, Detroit, v. 42, n. 2, p. 467-476, 2007.

BRUNETTA, B. *Ecologia e grito sócial da gralha-picaça (Cyanocorax chrysops)(Vieillot, 1818)(Passeriformes: Corvidae) em duas formações florestais da mata Atlântica,* Brasil. 2009. Dissertation (Master in Biological Science) - Universidade Estadual de Londrina, Londrina.

ERICSON, P. G. P.; JANSÉN, A. L.; JOHANSSON, U. S.; EKMAN, J. Inter-generic relationship of the crows, jays, magpies and allied groups (Aves: Corvidae) based on nucleotide sequence data. *Journal of Avian Biology,* Lund, v. 36, n. 3, p. 222-234, 2005.

ESPINOSA DE LOS MONTEROS, A.; CRACRAFT, J. Intergeneric relationships of New World jays inferred from cytochrome b gene sequences. *The Condor,* Berkeley, v. 99, n. 2, p. 490-502, 1992.

GOODWIN, D. *Crows of the world*. London: British Museum of Natural History, 1976.

HAMMER, O.; HARPER, D. A. T.; RYAN, P. D. PAST: palaentological statistics software package for education and data analysis. *Palaentologia Electronic*a, v. 4, n. 1, p. 1-9, 2001.

HAYES, F. E. S*tatus, distribution and biogeography of the Birds of Paraguay.* New York: Monograph in Field Ornithology 1, American Birding Association, 1995.

MADGE, S.; BURN, H. *Crows and jays.* London: Christopher Helm, 1994.

RESTALL, R.; RODNER, C.; LENTINO, M. *Birds of Northern South America: an identification guide.* London: Christopher Helm, 2006.

SICK, H. *Ornitologia brasileira, uma introdução.* Brasília: EDUNB, 1985.

STOTZ, D. F.; FITZPATRICK, J. W.; PARKER, T. A.; MOSKOVITS, D. K. *Neotropical Birds: Ecology and Conservation*. Chicago: University of Chicago Press, 1996.

UEJIMA, A. M. K. *Ecologia da gralha-picaça, Cyanocorax chrysops (Vieillot, 1818)(Passeriformes: Corvidae) em três áreas ao longo da bacia do rio Tibagi, Estado do Paraná, Brasil*. 1998. Dissertation (Master in Zoology) - Universidade Federal do Paraná, Curitiba.

WILLIS, E. O.; ONIKY, Y. Avifaunal transects across the open zones of northern Minas Gerais, Brazil. *Revista Brasileira de Ornitologia*, Rio de Janeiro, v. 2, p. 41-58, 1991.

Recebido em: 06 de novembro de 2009
Aceito em: 22 desetembro de 2010