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Apparent cooperative breeding at a nest of the Silvery-throated Jay (*Cyanolyca argentigula*) and first nest description

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ABSTRACT—The Silvery-throated Jay (*Cyanolyca argentigula*) is a poorly known Neotropical corvid endemic to the Cordillera de Talamanca of Costa Rica and western Panama. In April 2016, we found an active Silvery-throated Jay nest in Chirripó National Park, Costa Rica. Here we provide the first description of the breeding biology of this species, including nest architecture, estimates of incubation and nestling periods, and observations of adults attending the nest. The large cup nest, placement in the crown of a small tree, and breeding phenology are similar to other *Cyanolyca* species. We observed up to 5 adults associated with this nest, including at least 3 different adults that fed chicks. These observations suggest cooperative breeding at this nest but are also consistent with the possibility of communal breeding. Future studies with color-banded individuals and genetic sampling will be necessary to better understand what seems to be cooperative breeding in the Silvery-throated Jay. *Received 22 December 2016. Accepted 30 April 2017.*

Key words: breeding behavior, cooperative breeding, *Cyanolyca*, Neotropical birds, nesting biology.

Probable reproducción cooperativa en un nido de *Cyanolyca argentigula* y primera descripción de su nido

RESUMEN (Spanish)—La *Cyanolyca argentigula* es un córvido poco conocido endémico a la Cordillera de Talamanca de Costa Rica y el oeste de Panamá. En abril de 2016, encontramos un nido activo de *C. argentigula* en el Parque Nacional Chirripó, Costa Rica. Aquí presentamos la primera descripción de la biología reproductiva de esta especie, incluyendo la arquitectura del nido, una estimación de la duración de los períodos de incubación y polluelos y observaciones de adultos atendiendo al nido. El nido en forma de cuenco, su localización en la corona de un pequeño árbol y la fenología reproductiva de la especie son similares a otras especies de *Cyanolyca*. Observamos hasta cinco adultos asociados con este nido, incluyendo por lo menos 3 adultos diferentes que alimentaron a los polluelos. Estas observaciones sugieren reproducción cooperativa en este nido, pero también son consistentes con la posibilidad de reproducción comunitaria. Estudios futuros con individuos anillados con colores y que usan muestreos genéticos serán necesarios para

mejor entender lo que parece ser reproducción cooperativa en la *Cyanolyca argentigula*.

Palabras clave: aves neotropicales, biología de anidamiento, comportamiento reproductivo, *Cyanolyca*, reproducción cooperativa.

The genus *Cyanolyca* consists of 9 species of Neotropical jays that inhabit montane cloud forests from Mexico to Bolivia. Most species are social, and all are brightly colored in various shades of blue. Because of their restricted habitats and, in most species, low population densities, however, little is known about their breeding biology. For example, we are aware of published nest descriptions for only 4 of the 9 species: Azure-hooded Jay (*C. cucullata*), Dwarf Jay (*C. nanus*), Beautiful Jay (*C. pulchra*), and Turquoise Jay (*C. turcosa*). Each of these 4 species builds large cup nests, typically placed in the crowns of small trees located in gaps in cloud forest (Hardy 1971, Winnett-Murray et al. 1988, Eisermann and Brooks 2006, Solano-Ugalde et al. 2010, Greeney and Ortega 2015). The nests are similar in construction, with small twigs used to construct the nest cup and thin fibrils used to line the inner cup. Nest sizes of Azure-hooded Jay and Turquoise Jay range from 20 to 30 cm outside diameter, while Dwarf Jay and Beautiful Jay nests are smaller, ~15 cm outside diameter.

Other aspects of breeding biology, such as phenology and clutch size, are also similar among the 4 species of *Cyanolyca* with described nests. The Dwarf Jay, Beautiful Jay, and Azure-hooded Jay typically nest from March to June, but the Turquoise Jay shows a wider span of almost year-round nesting dates, possibly correlated with different seasonal patterns of rainfall in different regions of its range. Documented clutch size is 2 in the Beautiful Jay and Turquoise Jay. The same clutch size may be true in the Azure-hooded Jay, where 2 nests had 2 chicks each and another nest held a single fledgling. The Dwarf Jay, found further north in Mesoamerica, has a clutch size of

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Figure 1. The nest was a large cup constructed of twigs, plant fibers, and moss. An egg is barely visible (photo by F. Spooner).



Figure 2. Nest in the crown of a small tree within forest but only 10 m from a gap created by a wide trail and an upslope clearing. An arrow points to the nest's approximate position (photo by G. Montgomery).

2–3 eggs and an incubation period of ~20 d. Known nestling period lengths for the genus are ~24 d in the Beautiful Jay (Laufenberg and Woodward 2010) and at least 20 d in the Azure-hooded Jay. Although cooperative breeding is widespread in jays, of the 4 *Cyanolyca* species with described nests, only Turquoise Jay has been documented breeding cooperatively. Communal breeding, in which multiple adults contribute eggs to the same nest, has not been observed in *Cyanolyca* but has been found in other New World jays, such as the Brown Jay (*Psilorhinus morio*; Lawton and Lawton 1985).

Little is known about the breeding biology of the other 5 members of the genus: the Black-collared Jay (*C. armillata*), Black-throated Jay (*C. pumilo*), White-throated Jay (*C. mirabilis*), White-collared Jay (*C. viridicyanus*), and Silvery-throated Jay (*C. argentigula*). A report from western Venezuela provides a record of Black-collared Jay nesting on 17 April 2013 (D. Ascanio, Ascanio Birding Tours/Colección Ornitológica Phelps, unpub. data), and this species has been reported to exhibit cooperative breeding (Calderón-Leytón 2002). Little is known about the Black-throated Jay, the closest relative of the Silvery-throated Jay (Bonaccorso 2009), although the nest has been briefly described as made of twigs in the outer branches of tree canopy (Howell and Webb 1995), and nesting is thought to occur in spring or summer, as immatures have been reported in July and August (Gómez de Silva et al. 1999, Rodríguez-Flores et al. 2014).

Here we provide the first description of the nest of the Silvery-throated Jay, document likely

cooperative breeding at this nest, and provide additional observations of breeding biology. The Silvery-throated Jay is endemic to high elevation (>2,000 m a.s.l.) montane forests of Costa Rica and western Panamá (Stiles and Skutch 1989). Like most *Cyanolyca*, this species is social, and individuals usually travel in vocal groups of 4–10 as they forage in high elevation oak forest habitat, sometimes forming even larger aggregations (Stiles and Skutch 1989). Despite residing in a well-studied part of Central America, little has been previously published on the natural history and breeding biology of the Silvery-throated Jay.

Observations

Nest and site description

On 18 April 2016, we discovered a fully constructed, fresh-looking nest at 2,410 m a.s.l. along the Mount Chirripó trail in Chirripó National Park, San José Province, Costa Rica (~9°30'N, 83°36'W) in an area adjacent to the Cloudbridge Nature Reserve. The large cup-like nest was ~15 cm outside diameter and 20 cm tall, with a cup ~5 cm deep, situated about 8 m high in the central part of the crown of a small tree slightly >8 m tall. Given the height of the nest, we were unable to directly access it for more precise measurements. This tidy nest was primarily constructed of twigs and plant fibers, with some moss incorporated into the nest cup (Fig. 1).

The nest tree was situated on a steep slope, only ~10 m from a heavily trafficked trail used by both



Figure 3. An adult Silvery-throated Jay sits on the nest (photo by F. Spooner).

hikers and horses. The surrounding vegetation was dense mature montane cloud forest (Fig. 2). We estimated average tree diameter at breast height to be ~30 cm within 50 m of the nest tree and percent cover in the immediate vicinity of the nest to be ~70%. Although the area was forested, the wide trail and a nearby clearing with dead snags created edge habitat close to the nest tree. Despite the proximity to a busy trail, the jays exhibited tolerance for human activity near the nest and did not always flush when we spent time near the nest. Nests have been found near disturbed areas in other *Cyanolyca* species (Winnett-Murray et al. 1988, Solano-Ugalde et al. 2010, Greeney and Ortega 2015), perhaps suggesting that species in this genus are not particularly sensitive to some human presence when breeding.

Nest observations

After finding the empty nest on 18 April 2016, we visited the nest on 10 more occasions between 19 April and 7 June. All visits occurred in the morning between 0700 to 1200 h CST, and we observed the nest from 20 to 60 min per visit. Based on these visits, we provide rough estimates of egg-laying, hatching, and fledging dates. We estimate egg-laying to have occurred on 20 April (± 2 d; we first observed eggs on 22 Apr). Chicks hatched on 12 May (± 2 d; we observed naked fledglings on 14 May after only observing eggs on 10 May). The chicks were seen stretching wings and acting restlessly on 3 June and were absent on 7 June; thus, chicks likely fledged on 5 June (± 2 d). Incubation (Fig. 3) thus lasted 22 d (± 4 d) and the nestling period ~25 d (± 4 d). The height of the



Figure 4. The 3 chicks on 3 June 2016, when they were ~23 d old (± 2 d). The chicks apparently fledged before the next visit 4 d later (photo by F. Spooner).

nest prevented us from seeing into the bottom of the nest and describing the eggs; however, because we observed 3 chicks (Fig. 4), the number of eggs must have been at least 3.

Adult behavior—We observed 3 or more adults around the nest on the majority of visits, including one occasion when we observed 3 different adults feeding chicks at the same time. On initial discovery of the nest, we observed 5 adults in the vicinity: 1 adult sat on the empty nest, 2 other individuals perched on the brim of the cup, and 2 additional adults preened within 10 m of the nest. During our 5 visits to the nest during the chick rearing and feeding period, we observed 3, 1, 4, 3, and 3 adults, respectively, but the maximum number of adults we observed directly assisting with egg/nestling care at any time was 3 birds. More individuals were possibly directly involved in attending the nest, but given that birds were unmarked, we could not distinguish individuals. During the incubation period, an adult was often observed incubating the eggs. During the nestling period, adults fed chicks frequently (4 times in 89 min, an average frequency of 2.7 feeding events/h). Throughout nest development, adults were often heard vocalizing in the area but rarely, if ever, vocalized at the nest. During both incubation and nestling periods, we also frequently observed an adult feeding the adult on the nest (5 times in 207 min, an average frequency of 1.45 feeding events/h).

Discussion

The Silvery-throated Jay nest we studied resembles that of its congeners in location,

structure, and size. Like other described *Cyanolyca* nests, the nest was a cup made of thin sticks, ~20 cm outside diameter, and placed in the crown of a small tree near a forest gap. While most described *Cyanolyca* nests have had clutch sizes of 2, we observed 3 nestlings. Other aspects of Silvery-throated Jay breeding biology are also consistent with data on congeners. Our estimate of incubation in this nest is 22 d (± 4 d), similar to the only known incubation period for another member of the genus (Hardy 1971). In addition to the nest we studied, a complete Silvery-throated Jay nest was found on 15 April 2011 in San Gerardo de Dota, San José Province, Costa Rica (D. Sherony, Nov 2016, pers. comm.). This nest had nestlings and at least 2 attending adults, with 2 additional adults close by. These 2 nesting dates are similar to those of Dwarf Jay, Beautiful Jay, Black-collared Jay, and Azure-hooded Jay but differ from the large range of nesting dates exhibited by Turquoise Jay. However, observations of Silvery-throated Jay nests and nest building from eBird (2016), a citizen science website, suggest nesting can occur earlier in the year as well (nests have been recorded on 29 Dec 2001, 21 Jan 2010, 23 Feb 2011, 24 Feb 2001, 13 Mar 2012, 6 Apr 1995, 11 Apr 2013, and 16 Apr 2007). Most Central American birds at high elevations typically nest from April to June (Skutch 1950). This timeframe seems to roughly apply to the Silvery-throated Jay, which may tend to nest in earlier months as well. More precise measurements of Silvery-throated Jay nest size and nesting periods, along with a description of the eggs, will be necessary for more rigorous comparisons of breeding biology within the genus.

We observed multiple adults attending the nest prior to egg laying and during the nestling period, and at least 4 adults were present near the additional Costa Rican nest described above (D. Sherony, Nov 2016, pers. comm.). Thus, Silvery-throated Jays seem to be cooperative breeders, at least facultatively. An alternate possibility is that Silvery-throated Jays engage in communal breeding, but this possibility is less likely because communal breeding is apparently rare in jay species (Brown 2014). Genetic testing would be necessary to rigorously assess whether Silvery-throated Jays might be communal breeders, but cooperative breeding in this species would not be unexpected; many species of jays are cooperative

breeders, and the Silvery-throated Jay is social and typically forages in small groups that may be family groups. However, although cooperative breeding may have been the ancestral state in corvids, it is not the norm in passerines. Across oscine passerines, an estimated 18.5% of species with paternal care exhibit cooperative breeding (Cockburn 2003). For corvids with a known breeding system, 27 of 84 species (32%) exhibit cooperative breeding (Ekman and Ericson 2006). Within *Cyanolyca*, cooperative breeding has been noted in 2 of 5 species with published information on parental care (Calderón-Leytón 2002, Greeney and Ortega 2015). We note that little of the breeding biology of the rest of the genus is known, even considering only species with published breeding biology data; only the Dwarf Jay has been studied at length. Clearly, more observations of breeding habits in *Cyanolyca* species are desirable to assess cooperative breeding in this genus. For example, the degree to which cooperative breeding is a facultative (vs. obligate) behavior within *Cyanolyca* is currently unknown.

More broadly, the prevalence of cooperative breeding is unknown for many Neotropical species at present. This data gap may impact the results of comparative studies of the evolution, ecology, and biogeography of cooperative breeding in passerines. For example, Jetz and Rubenstein (2011) found that cooperative breeding is most prevalent in arid, seasonal environments, in contrast to the humid montane forest that Silvery-throated Jays inhabit. Earlier studies have reached varied conclusions regarding the relationship between cooperative breeding and seasonality (Ligon and Burt 2004); for example, cooperative breeding may be associated with aseasonal environments in some groups (e.g., Ford et al. 1988, Gonzalez et al. 2013). We note that cooperative breeding among humid forest tropical birds may be more common than currently thought (e.g., Freeman and Arango 2010, Greeney et al. 2015), and that more natural history and breeding biology work in poorly known bird taxa may help inform these long-standing debates.

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