



## A RARE MUTUAL COURTSHIP DISPLAY IN A SOUTH AMERICAN PASSERIFORM, THE BLUE-BILLED BLACK TYRANT (*KNIPOLEGUS CYANIROSTRIS*) (TYRANNIDAE: FLUVICOLINAE)

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**Abstract** · Territorial displays are a common behavior in *Knipolegus* and are only performed by males, while mutual displays are unknown in this genus. In October 2012, in a high-altitude grassland (Campos de Altitude) at Espírito Santo state, south-east Brazil, a pair of Blue-billed Black Tyrants *Knipolegus cyanirostris* was filmed performing very curious and subtle movements. Both individuals were silent and perched facing each other 0.59–0.65 m apart, with the male slightly lower, at an angle of c. 21°–23° below the female. The male moved its head downwards, moving its bill in a pendulum-like, downward motion, and then reassumed its upright stance, while the female, with its head slightly bent down, and moved its bill the same way as the male before also reassuming her original stance. It was a movement with a duration of 150 ms and almost impossible to see with the human eye. Finally, this mutual display suggests that courtship behavior in *Knipolegus* may be much more complex than is currently believed.

**Resumo** · Uma rara exibição de corte mútua em um passeriforme sul-americano: Maria-preta-de-bico-azulado (*Knipolegus cyanirostris*) (Tyrannidae: Fluvicolinae)

O display territorial é um comportamento comum em *Knipolegus*, mas são apenas realizados pelos machos, enquanto um display mútuo, onde tanto macho quanto fêmea se apresentam, é desconhecido para o gênero. Em outubro de 2012, nos Campos de Altitude do Espírito Santo, sudeste do Brasil, um casal de *K. cyanirostris* foi filmado realizando movimentos sutis e curiosos. Ambos os indivíduos estavam em silêncio, pousados frente a frente cerca de 0,59-0,65 m de distância um do outro, o macho apenas um pouco mais abaixo da fêmea, em um ângulo de 21–23°. O macho movia sua cabeça para baixo, realizando um movimento pendular com o bico, voltando em seguida na posição inicial. A fêmea, que mantinha sua cabeça quase o tempo todo um pouco abaixada, realizava o mesmo movimento com o bico, voltando então para a posição inicial, ainda com a cabeça levemente abaixada. Em um movimento com duração de aproximadamente 150 milissegundos e quase imperceptíveis para a visão humana. Esse display mútuo sugere que o comportamento de exibição no gênero *Knipolegus* pode ser muito mais complexo do que o atualmente conhecido.

**Key words:** Breeding · Court · Rituals · Sexual behavior · Tyrant-Flycatcher

### INTRODUCTION

The genus *Knipolegus* (Passeriformes: Tyrannidae) comprises 14 recognized species occurring throughout much of South America, all of which are usually quiet and inconspicuous (Cory & Hellmayr 1927, Traylor 1979, Ridgely & Tudor 2009, Fitzpatrick 2020, Remsen et al. 2020). Most species are sexually dimorphic, with mainly gray or blackish males and brownish females (Hosner & Moyle 2012, Fitzpatrick 2020). *Knipolegus* occur in diverse habitats, including Amazonian river islands, Andean montane forest edge, high-elevation arid valleys, open Pampas grassland, gallery woodland, and even semidesert (Fitzpatrick 2020). The genus is part of the subfamily Fluvicolinae, a very diverse clade of Tyrannidae characteristic of open habitats in southern South America (Cory & Hellmayr 1927, Ohlson et al. 2008, Fitzpatrick 2020, Ohlson et al. 2020). Members of Fluvicolinae perform some of the more elaborate displays among the Tyrannidae, including some species in the genus *Alectrurus* and *Hymenops* (Lowen et al. 2008, Fitzpatrick 2020).

The typical *Knipolegus* display is a territorial flight, performed by the male, which can be rather acrobatic and sometimes including a discreet vocalization or mechanical noise. These aerial maneuvers comprise three parts: an upward flight, an acrobatic turn in midair, and the return to a perch (Hosner & Moyle 2012). All three of these parts are slightly different between species (Sick 1997, Ridgely & Tudor 2009, Fitzpatrick 2020) and some taxa perform such a display without any known concomitant mechanical sounds or vocalizations (Belton 1985). These displays are described as territorial performances, but almost

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**Figure 1.** Beginning at altitudes of 1800–2000 m a.s.l., *campos de altitude* are found atop the highest summits of the main ranges in southeastern Brazil and are characterized by a high degree of endemism. View of the *campos de altitude* in the National Park of Caparaó (photograph by Odirlei V. Fonseca).

nothing is known concerning breeding (sexual) displays (Straneck & Carrizo 1983, Almonacid & Márquez 1992, Sick 1997, Ribeiro et al. 2002, Hosner & Moyle 2012, de la Peña 2013), and nothing regarding mutual courtship displays performed simultaneously by both males and females (Huxley 1923).

One of the few species of black tyrants associated with forest environments is the Blue-billed Black Tyrant (*K. cyanirostris*) (Belton 1985, Sick 1997). This species is locally common at borders of humid forests, montane forests, gallery woodlands, and occasionally shrubby semi-open areas of Uruguay, Argentina, Paraguay, and southeastern Brazil, below 2200 m a.s.l. (Belton 1985, Sick 1997, Ridgely & Tudor 2009, Fitzpatrick 2020). Discreet and quiet, this species has pronounced sexual dichromatism, with the male being all glossy black with a blue-gray bill and red eye, and the female is brownish and heavily streaked on the underparts (Belton 1985, Fitzpatrick 2020). It appears to be an austral migrant in the south of its range, in Paraguay, Argentina, Uruguay and southernmost Brazil. The resident population in southeast Brazil makes altitudinal migrations, moving downslope during the austral winter (June to September) before returning to higher elevations during the austral spring and summer (October to March) (Stotz et al. 1996, Sick 1997, Fitzpatrick 2020). Although relatively numerous in the mountains of southeastern Brazil, this species' breeding and general ecology are poorly known, with few records of nests and eggs in

the month of December (Di Giacomo 1992, Crozariol 2016). Here, we describe for the first time in the genus a record of an unusual mutual courtship display behavior in *Knipolegus cyanirostris*.

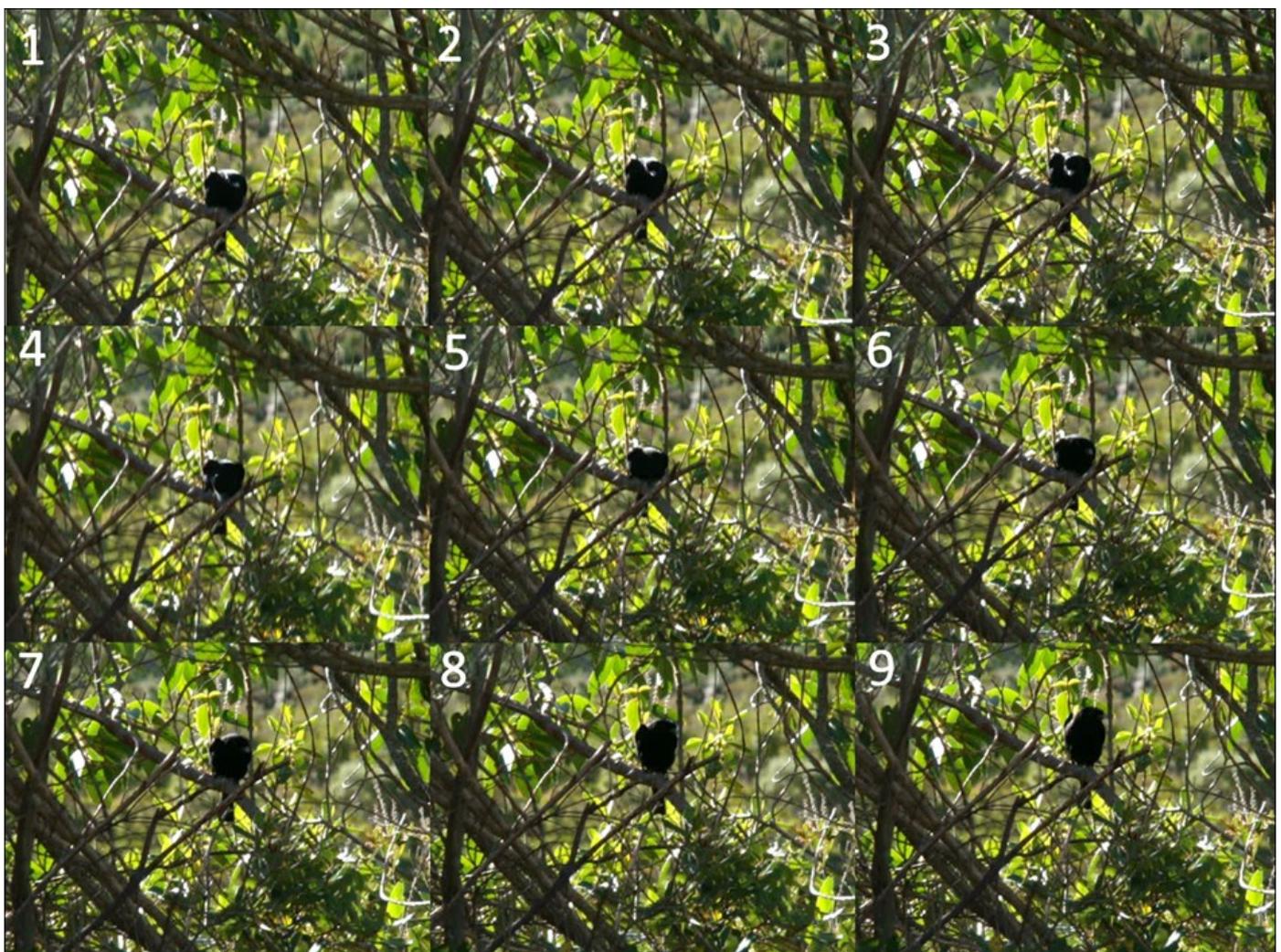
## METHODS

The record was made in high-altitude grasslands, known as *campos de altitude* (CA), in Caparaó National Park, Espírito Santo state, southeastern Brazil (20°27'29.25"S, 41°48'31.23"W). CA is a series of cool-humid formations restricted to the highest summits of the southeastern Brazilian highlands, dominated by grass and shrubs (Martinelli 1996, Safford 1999, Vasconcelos 2003). This formation is scattered across the highest peaks of the three major mountain chains that run parallel to the Brazilian coast: Serra do Mar, Serra da Mantiqueira and Serra do Caparaó (Safford 1999) (Figure 1). Considered by some authors as a representation of 'pseudopáramos' (e.g. Safford 1999), this relictual habitat has significant connections with similar habitats in the Andean páramos, including their birds and other taxa (Sick 1985, Fjeldså 1992). In the Serra do Caparaó timberlines, the ecotone between forest and grassland occurs, on average, at 2000–2300 m a.s.l. (Safford 1999).

In semi-open, shrub-dominated CA at an altitude of 2195 m a.s.l., during the morning (07:00 h) of 7 October 2012, Odilon VF filmed a pair of Blue-billed Black Tyrants using a



**Figure 2.** A) The picture represents the basic arrangement of the pair during the mutual courtship display: the male near the female, perched a bit lower. Illustration by Odilon V. Fonseca. B) Despite the pair changing perching twigs a few times during the display, an interesting observation was the angle of the male in relation to the female position, about 21°–23° lower.



**Figure 3.** This sequence presents one pendular movement performed by the male in nine frames. The male performed two or three pendular movements simultaneously, after which it reassumed its upright stance. This movement had an average duration of 525 ms.

Nikon Coolpix P530 camera, shooting 640x480/30 frames per second, at a distance of c. 5m from the birds, which were perched on a *candeia* (*Eremanthus erythropappus*, Asteraceae) bush and engaged in a peculiar interaction. To describe the mutual display and body movements of the birds in detail, we used the Kinovea 0.8.15 motion analysis software (Dehwko 2009).

## RESULTS

The recorded film had a total duration of 1 min, 54 s and 30 ms. It was divided into parts based on three focal points: male, female, and the pair, excluding parts where the birds did not appear. For each of these, the time span was as follows: male, 23 s and 400 ms; female, 23 s and 120 ms; and



**Figure 4.** Female performing a pendular movement similar to the male's. The movements occurred alternatively or simultaneously between the couple. During breaks, the female remained with its head slightly pointing downwards.

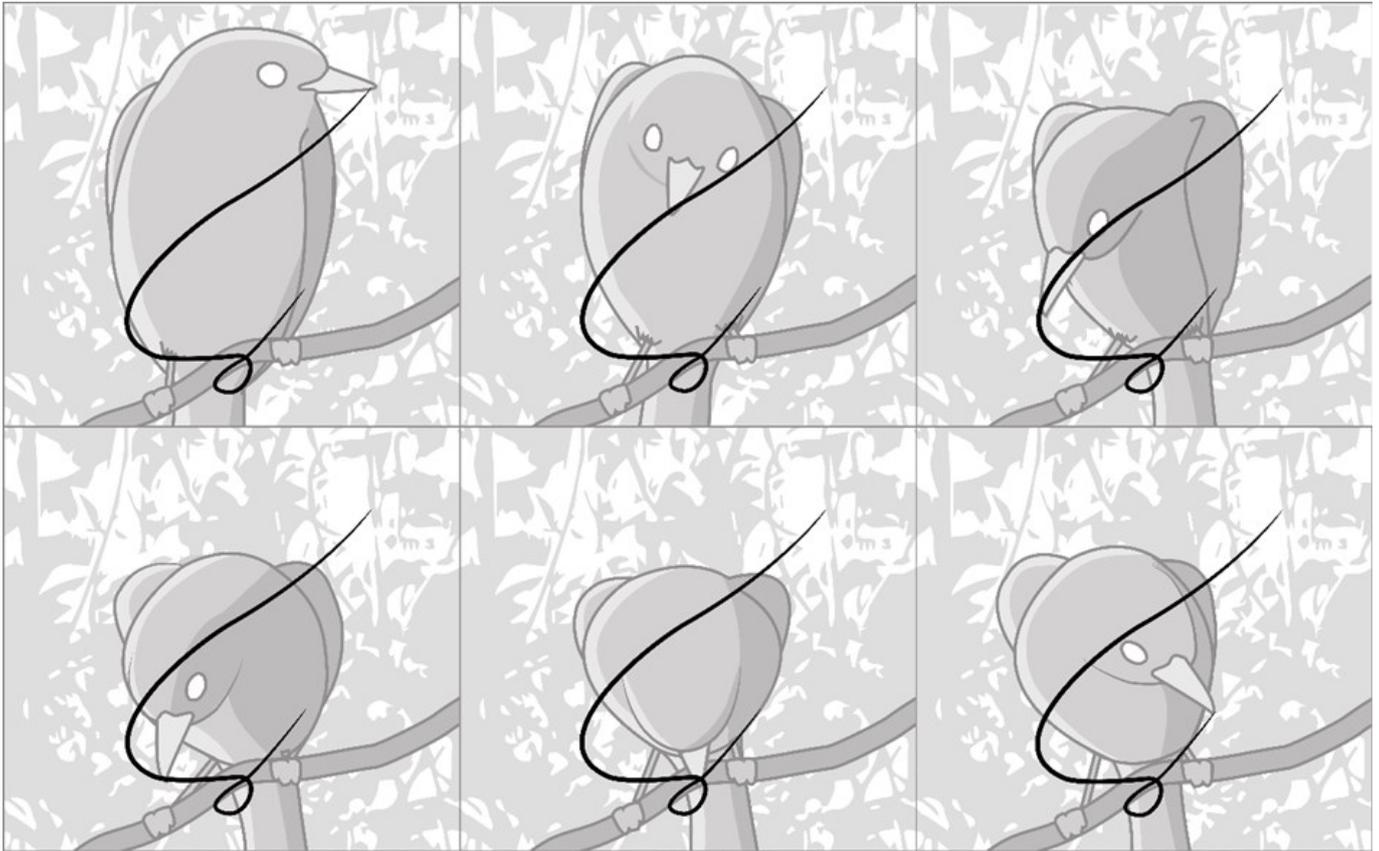
the pair, 31 s and 640 ms. The display consisted of discreet and silent behavior performed by both birds while facing each other, moving their head and bill alternately or simultaneously. Despite our efforts, we did not record any coupling as the couple moved into the dense vegetation. The video is available in internet archive 'Mutual courtship behavior in *Knipolegus cyanirostris*' at <https://archive.org/details/Kcyanirostris>

**Display description.** Both birds remained perched facing each other c. 1–1.7 m above ground, the male being slightly lower. The distance between the pair was 0.59–0.65 m and the angle of the male's perching twig in relation to the female's was about 21°–23° (Figure 2). The male was perched in an upright stance, and then moved its head downwards while motioning its bill in a pendular movement before re-assuming its upright stance (Figure 3). The female remained perched, with its head slightly bent down and moving its bill with the same motion as the male, and then re-assumed her original posture (Figure 4).

**Description of the pendulum motion.** The pendulum motions performed by the pair appeared quite alike, but a slow-motion (6% of normal speed) assessment of the film revealed some peculiarities (Figure 5).

**Male.** Each pendulum motion was performed singly and interrupted by a short pause. The mean duration of each complete pendulum motion was 490 ms (SD = 53.72; N = 12), with the pause between them ranging from 550 ms to 1 s and 930 ms. The fastest bill movement recorded during the pendulum motion lasted 0.53 m/s. The male made two or three pendulum motions during each sequence, after which it re-assumed its upright stance. During each pendulum movement of the head, it performed a small turn, while keeping its bill at a downward angle of c. 95–97°, before re-suming its original stance. This small turn is a looping performed with the tip of the bill in an almost invisible motion to the human eyes, as its duration is only of about 150 ms (Figure 6).

**Female.** The main difference of its behavior, compared to the male, was that most of the time it kept its head pointed slightly downwards. The female performed two to four uninterrupted pendulum motions, each lasting a mean of 420 ms (SD = 38.23; N = 16). Pauses between these sequences lasted from 2 s and 50 ms, to 4 s and 310 ms. Most of the pendulum sequences were performed alternately, sometimes simultaneously, with both birds remaining silent.



**Figure 5.** Detailed scheme of the “looping” movement performance. Slow motion analysis of the video revealed a peculiar movement with the tip of the bill during pendulum motion. Both sexes performed the motion. Illustrations by Odilon V. Fonseca.

## DISCUSSION

Mutual courtship displays, in which both male and female perform a synchronized or responsive display (Huxley 1923), are common in a few tyrant flycatcher species (Traylor 1979, Fitzpatrick 2020), but have not previously been recorded in the genus *Knipolegus*.

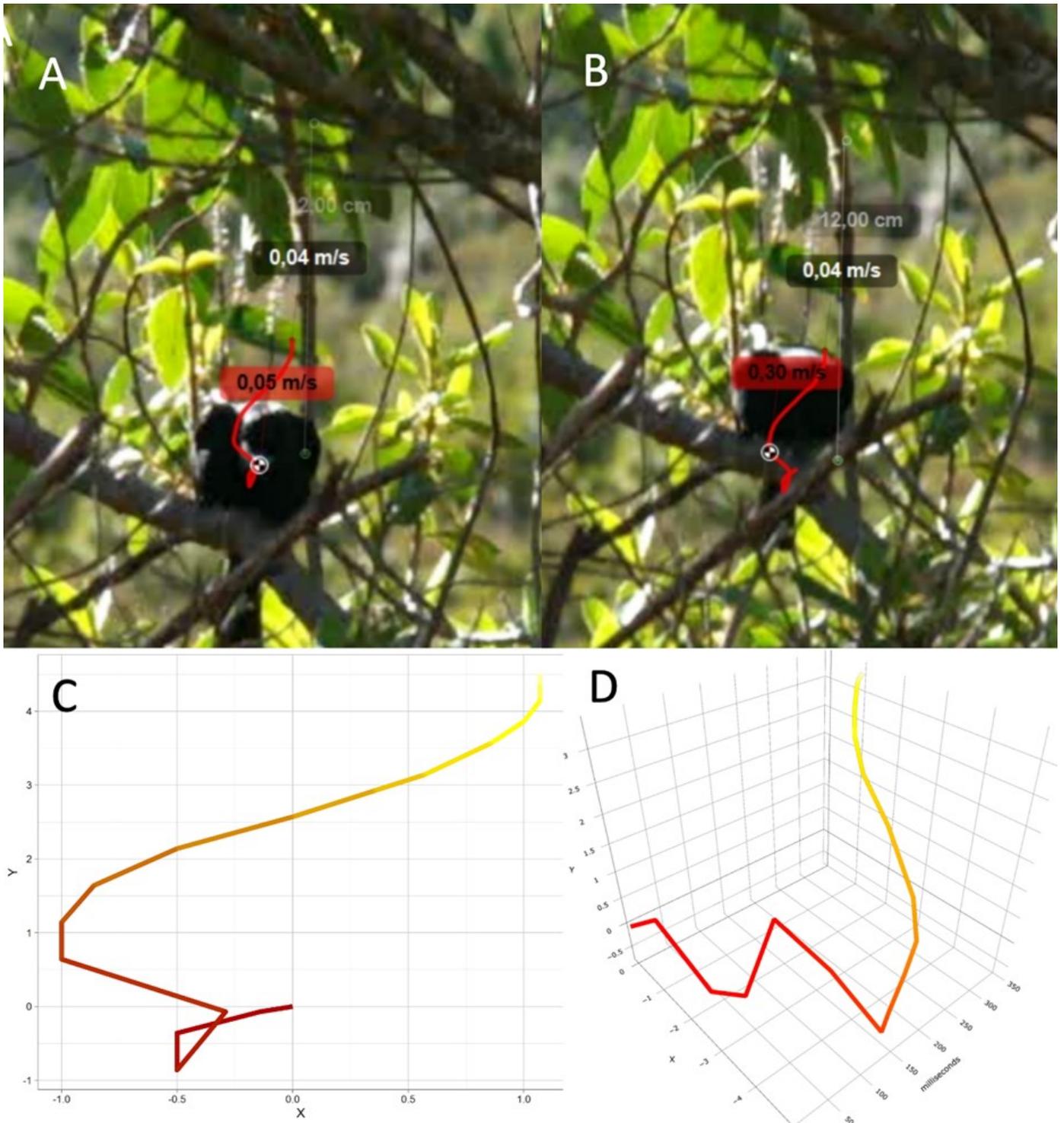
Although *Knipolegus* are usually unobtrusive and little-studied tyrants, territorial display behaviors have been described for many of the species (Straneck & Carrizo 1983, Almonacid & Márquez 1992, Sick 1997, Ribeiro et al. 2002, de la Peña 2013). Analyses indicates that these aerial displays have a complex, multi-origin evolution, or represent reversals of character states (Hosner & Moyle 2012). The description of the flight display in *K. cyanirostris* is very similar to that of its congeners: climbing into the air 5–10 m, then falling like a stone, and always seeming to remain silent (Ridgely & Tudor 2009). However, the courtship described here is clearly different from all reported behaviors of *Knipolegus*.

Until now, male displays in the presence of a female had only briefly been described for *K. striaticeps*, *K. hudsoni* and *K. cyanirostris* (Sick 1997, de la Peña 2013, Fitzpatrick 2020). For *K. cyanirostris*, Sick (1997) only described a male with wings raised, gliding silently down in front of female [in the original: “O macho, conservando-se em silêncio, desliza, de asas levantadas, em frente à fêmea”]. Despite the short duration of the recording, our analyses clearly indicate the presence of a ritualized and collaborative display between the pair, not just the male. But without a video, this behavior is really difficult to perceive.

A few other tyrants perform a mutual display between pairs; the Streamer-tailed Tyrant (*Gubernetes yetapa*) offers one good example. Facing one another, or away, pairs of this species perform a duetting display while perched 10–50 cm apart, each alternately lowering their heads while raising and fanning the tail above a horizontal plane. They then raise their heads and lower their tails, and excitedly raise both wings near-vertically while calling and bill-clicking excitedly in syncopation (Fitzpatrick 2020). Wing flapping is another very common element in mutual displays among Fluvicolinae; for instance, genera such as *Fluvicola* and *Ochthoeca* exhibit an exaggerated flapping of the wings associated with vocalizations between pairs (Sick 1997, Fitzpatrick 2020).

The biological and ecological significance of mutual behaviors—like visual displays—is not entirely clear (Malacarne et al. 1991), but the classic explanation for mutual display is that it strengthens the pair bond (Huxley 1923, Armstrong 1965, Wachtmeister 2001). Territorial displays are widespread in the genus *Knipolegus*, with what appears to be signaling from pair members directed at other individuals; in mutual displays, between-pairs messaging can be excluded because the signal itself is discreet or is performed at a site where it would be undetectable at any distance (Wachtmeister 2001). The discreet nature of the display is true in the case of the *K. cyanirostris* display herein described. Therefore, it appears that other methods of advertisement have evolved in the only species of *Knipolegus* that lacks mechanical sounds or vocalizations as part of its display repertoire (Hosner & Moyle 2012).

Our record suggests that courtship behavior in *K. cyanirostris* is more complex than previously reported. Could the bluish bill, although only a male feature, play any role during



**Figure 6.** The frames (A-B) show a pendulum motion sequence carried out by the male and the red line tracks the movement of the tip of its bill. The velocity indication of movement (red box) was based on the scale (projected average size) of the individual, around 12 cm. (C-D) The complete trajectory (red trace) of the movement made by the tip of the bill can be visualized in graphic parameters. Vertical and horizontal displacement (C) and three-dimensional projection showing the duration of the movement in 150 ms (D).

the display? If this were true, the observations presented here suggest that other species of *Knipolegus* may exhibit similar courtship displays and may explain the presence of bluish bills in many of them. Future observations may clarify this hypothesis.

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