

THE BLACK-FRONTED PIPING-GUAN (*Pipile jacutinga*) IN NORTHEASTERN ARGENTINA: ACOUSTIC SURVEYS TO DETERMINE ITS CURRENT DISTRIBUTION

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ABSTRACT: The Black-fronted Piping-Guan (*Pipile jacutinga*), endemic to the Atlantic Forest, is considered one of the most threatened cracid species in the world and is extinct across much of its original range. Previous surveys of the Black-fronted Piping-Guan in Misiones, Argentina, were conducted mainly from streams or along their margins. Between 2021 and 2024, we surveyed 320 points in native forest from northern Misiones to northern Corrientes, Argentina. We accessed the points overland and without establishing them in relation to distance from streams. At each point, we carried out two 85-minute counts around dawn, one in person and one replicate using autonomous recorders. In total, we found nine Black-fronted Piping-Guan individuals at six points. We detected the species mainly through the mechanical wing-beating sound produced just before dawn. Detections were concentrated in north-central Misiones, in an area of only 60 × 20 km. Unlike previous studies, we found the Black-fronted Piping-Guan in areas without hunting control and far from navigable streams, at mean distances of 2351 m (range 286–4600 m), indicating that population surveys should include areas far from major streams. The results confirm the scarcity of this species. We highlight the potential reservoir for the species in the Piray Guazú stream basin. We show that in the study area, passive acoustic surveys are a useful tool for detecting the species, especially when directed at dawn, the period during which wing-beating appears to be most common, at least during winter and early spring.

KEYWORDS: Atlantic Forest, bioacoustics, Corrientes, Cracidae, Misiones, Neotropics

The Black-fronted Piping-Guan (*Pipile jacutinga*), the southernmost representative of its genus, is endemic to the Atlantic Forest of southeastern Brazil, northeastern Argentina, and eastern Paraguay and is considered one of the most threatened cracid species worldwide (Vale et al. 2018, IUCN 2025). It is listed as 'Endangered' both nationally and internationally, in Argentina as well as in Paraguay and Brazil (MAYDS & AA 2017, Fariña 2021, IUCN 2025). Although various threats have driven its population decline, hunting, first and foremost, and the loss of forest cover, secondly, have been decisive across its entire range (Galetti et

al. 1997, Bodrati & Cockle 2006, Fariña 2021). These threats have led to the species being considered probably extinct across much of its original range, with only isolated and fragmented populations remaining (Fariña 2021). In Argentina—where it reaches the southwestern limit of its distribution—it originally inhabited the whole of Misiones province and the northeastern tip of Corrientes, although it is currently concentrated in north-central Misiones (Short 1971, Bodrati & Cockle 2006, Chebez 2008, Cockle & Bodrati 2011, Fariña 2021). Despite its current conservation status, surveys of the species across the scale of

its historical distribution, or beyond its traditional habitats, are scarce (Fariña 2021). The environment associated with this species has been the Paranaense forests, particularly the strips of forest along rivers, with the species making little or no incursion into interior forest and rarely venturing more than one kilometer from rivers (Benstead et al. 1993, Bodrati & Cockle 2006, Chebez 2008, del Hoyo et al. 2020).

The Black-fronted Piping-Guan has a broad vocal repertoire, with more than 11 sound manifestations described for both captive and free-living individuals (Silva Bautista 2023). The species' vocalizations and sound manifestations range from calls, low and steady peeps, and a variety of whistles to screams, in addition to the mechanical sound produced by beating its wings (hereafter, 'wing-beating'; Paccagnella et al. 1994, De Souza et al. 2020, Silva Bautista 2023). The functions of these sound manifestations are diverse and include contact with conspecifics, peeping during foraging, and vocalizations related to reproduction (Paccagnella et al. 1994, De Souza et al. 2020, Silva Bautista 2023). Another guan present in the forests of northeastern Argentina that produces mechanical wing-beating sounds similar to those of the Black-fronted Piping-Guan is the Rusty-margined Guan (*Penelope superciliosus*). This cracid is also on the national red list, listed as 'Vulnerable', and on the international list as 'Near Threatened', although its situation is less serious than that of the Black-fronted Piping-Guan (MAyDS & AA 2017, IUCN 2025).

The use of Passive Acoustic Monitoring (PAM) has increased in recent years, particularly in bird studies (Sugai et al. 2019, Hoefer et al. 2023). This approach, which relies on autonomous recorders, offers several advantages: it eliminates the potential negative impact of observer presence, it allows species confirmation from recordings even years after data collection, it facilitates long-term monitoring, and it is especially suited to remote or hard-to-access areas (Acevedo & Villanueva-Rivera 2006, Frommolt et al. 2008). It also allows acoustic inventories to be gathered from multiple recording stations in a single day under optimal weather conditions. However, traditional in-person counts can detect birds that vocalize infrequently or remain silent, and they offer greater precision in estimating the number of individuals (Darras et al. 2019), in addition to allowing visual detection of species. The combined use of autonomous recordings and point counts improves the quality and reliability of biodiversity assessments. Previous research has shown that these methods often produce comparable estimates of species identification, richness, abundance, and

community structure (Lambert & McDonald 2014, Sedláček et al. 2015, Darras et al. 2018, Hoefer et al. 2023) and that integrating both approaches increases the overall effectiveness of inventories (Drake et al. 2021, de Araújo et al. 2024).

The aim of this study was to assess, through acoustic surveys carried out during mid- and late winter—using in-person count points and autonomous recorders—the entire current and historical distribution of the Black-fronted Piping-Guan in Argentina, seeking to describe its most frequent sound manifestations, the time of greatest activity, and the sites with the greatest presence of the species. We compared the abundance of the Black-fronted Piping-Guan in the surveys with that of the Rusty-margined Guan. Unlike previous surveys of the Black-fronted Piping-Guan in Misiones—which were carried out mainly from streams or along their margins (Chebez 1985, Benstead et al. 1993, Cockle & Bodrati 2011, Fariña R. personal communication, Di Cosmo T. unpublished data)—our surveys were at sites accessed overland without regard to distance from streams.

METHODS

Study area

We conducted the study in native forest areas of the Atlantic Forest ecoregion of northeastern Argentina (25°37'-28°21'S, 53°37'-55°40'W, Fig. 1), representing the southwestern limit of this ecoregion at a global scale, where it transitions into the Campos district, forming an ecotone (Arana et al. 2021). The region has semi-deciduous forests under a humid subtropical climate, with mean monthly temperatures of 16–22°C and rainfall ranging from 1000–2200 mm. This 372 × 100 km study region shows differing histories of forestry use, ranging from areas under active logging during our fieldwork to sectors that have never been disturbed. Two primary forest types characterize the region (Arana et al. 2021, Marques & Grelle 2021): the Interior Mixed Forest, composed of semi-deciduous tropical formations without marked dry seasons, and the higher-elevation Araucaria Mixed Forest, dominated by *Araucaria angustifolia* and tree ferns under colder conditions. Within the regions occupied by these forests, the study area encompassed 40 localities where we carried out acoustic surveys (hereafter, sampling sites). We distributed the sampling sites evenly across the study area (Fig. 1). We carried out the study across a variety of unprotected and protected areas, including different levels of protection, such as municipal, provincial, national, and privately

managed reserves. All count points were located in native forest, in patches or strips that, within a radius of at least 5 km, showed no complete isolation, i.e., they were connected to other patches. The forest areas surveyed varied in size and in the composition of the surrounding matrix, including strips of native vegetation surrounded by forestry plantations (mainly *Pinus* sp. and *Eucalyptus* sp.); plantations for agricultural and annual crops, such as Tea (*Camellia Sinensis*), tobacco (*Nicotiana* sp.), and Yerba Mate (*Ilex paraguaiensis*); cattle-ranching areas; family farms; and forest patches surrounded by grasslands or bordered by rivers, such as the natural 'mogotes' (no larger than 40,000 m² or 200 m wide) of the southern part of the area, up to some of the most extensive natural corridors of the southern Atlantic Forest (Map-Biomas 2025).

Sampling methodology

We carried out acoustic and visual surveys at count points in the forests of northeastern Argentina, aiming to survey the full complement of bird species at the points as well as the density of scarce woodpecker

species (Picidae), although in this study, we focus on the results regarding the Black-fronted Piping-Guan. The surveys were carried out between late June and mid-September of 2021, 2022, 2023, and 2024. This period corresponds to mid- and late winter and to the pre-breeding stage of most species, the time of greatest vocal activity in birds (Sick 1997). At each of the 40 sampling sites, we established eight count points. We stayed for a single week at each site and visited 11 sites in the first year, 10 in the second, 11 in the third, and eight in the fourth.

Count points were separated by at least 830 m from one another to minimize the detection of the same individuals, based on information on focal species and previous passive acoustic survey studies in the Atlantic Forest (Lammertink & Fernández 2022, de Araújo et al. 2024), and by more than 300 m from roads to avoid biases from edge effects and disturbed vegetation, such as the effects of selective logging and the invasion of exotic tree species. Points were accessed on foot overland and were located without regard to their distance from streams. Counts lasted

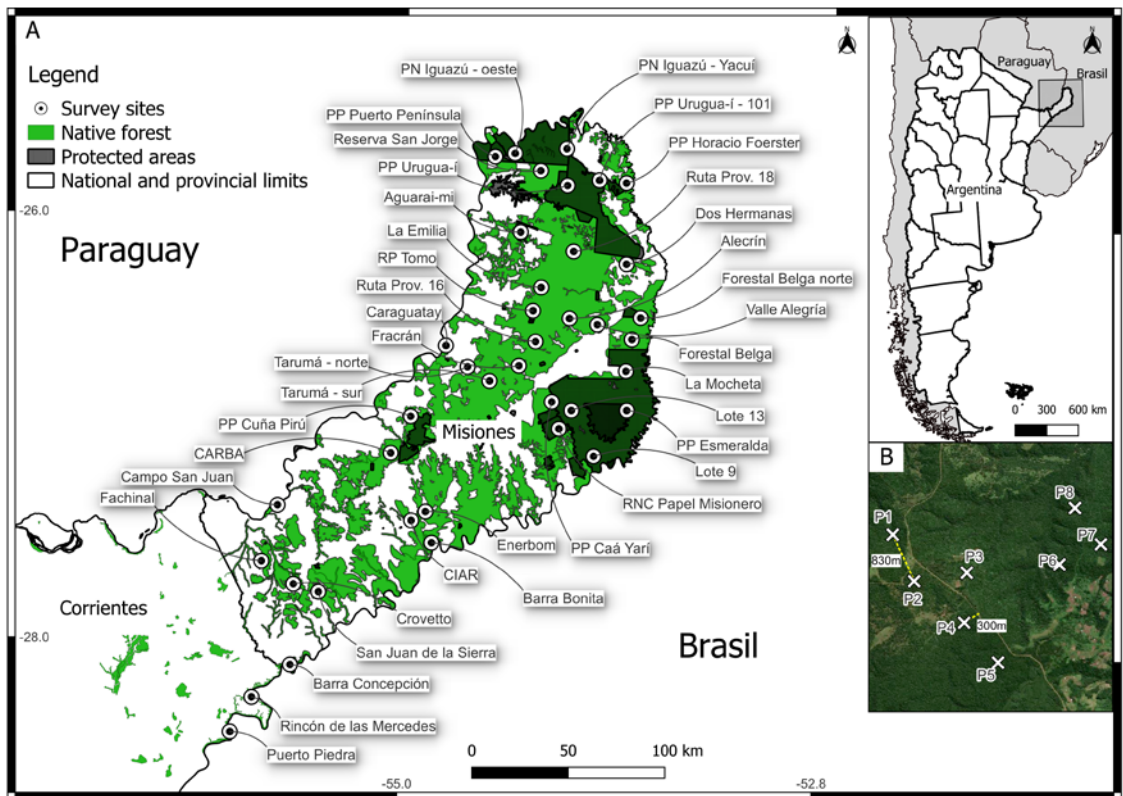


Figure 1. A) Study area with the 40 locations where surveys were conducted across Misiones and Corrientes provinces, Argentina. Points indicate survey sites, native forest areas are shown in green, and protected areas are shown with hatching. PP: Provincial Park. PN: National Park. RNC: Natural and Cultural Reserve. The upper right inset shows the location of the study area within Argentina. B) Example of one of the surveyed sites showing the eight point-count locations, separated by at least 830 m from each other and located 300 m from roads.

85 min around dawn (25 min before and up to one hour after sunrise), coinciding with the peak of bird activity (de Araújo et al. 2021), totaling 170 min per point. All birds observed or heard were identified by five experienced observers (Martjan Lammertink, Daniela Zaffignani, Iván Ebrecht, Julián Márquez & Tomás Di Cosmo).

At each count point, we installed an automatic recording unit (SM4, Wildlife Acoustics). Each autonomous recorder was set to record continuously from 6:00 to 9:00 am, ensuring we covered the dawn time window for the duration of the surveys. We subsequently listened to the 85-min segment selected according to the time of dawn for each day. Recordings were made at a sampling rate of 24,000 Hz and in .wav format.

We surveyed each point twice, once in person and once through recordings, on different days. However, if an in-person count was canceled due to poor weather, we replaced it with a count from a recording, so that 19% of the points had both replicates from recordings. Each replicate was treated as an independent sample. We listened to the recordings in real time, without the use of detection software.

We carried out counts at the same point (in person and recording, or both from recordings) separated by a maximum interval of three days and under favorable weather conditions, avoiding rain and strong winds that could affect bird detection. To estimate abundances greater than one individual, we used the following criteria. In the in-person counts, we considered visual confirmations and/or situations in which the species' vocalizations came simultaneously from different directions or locations. In both the in-person counts and the recordings, we also treated as distinct individuals those cases in which repeated vocalizations were detected with consistent differences in intensity, making it unlikely that they corresponded to a single individual moving continuously toward or away from the observer. Since we found that the main indication of the presence of the Black-fronted Piping-Guan was the wing-beating sound, we present a sonogram and frequency metrics for this sound in comparison with the similar wing-beating display sound of the Rusty-margined Guan.

Maps were built using the QGIS 3.36 program (QGIS Development Team 2024). Distance to navigable streams was calculated using Google Earth Pro. We considered a stream navigable if it had a minimum width of 2 m and a minimum depth of 40 cm, under typical conditions outside of floods or droughts, where one

could paddle or push a kayak or other individual boat.

RESULTS

We surveyed a total of 320 count points, analyzing 53,619 minutes of listening, of which 40.1% were in-person listening sessions and 59.9% were from recordings. We found evidence of the Black-fronted Piping-Guan at six of the 320 points, corresponding to four of 40 different sites (Fig. 2). We tallied a total of nine individuals. Presences were concentrated in north-central Misiones province, between latitudes of 26.4°S and 26.6°S.

At Tomo Private Reserve, we found a maximum of three different individuals at a single point, which was surveyed in person, while a point at Alecrín was the only point where we recorded the species in both replicates. The greatest distance from a navigable stream at which we found the Black-fronted Piping-Guan was at Alecrín, 4600 m from the Piray Guazú stream. The mean distance of detections from streams was 2351 m (Table 1). At all points, we detected the Black-fronted Piping-Guan through the wing-beating display sound, and at a single point at Forestal Belga norte, we also heard its whistle. Compared with the similar wing-beating display sound of the Rusty-margined Guan, the wing-beating of the Black-fronted Piping-Guan has a higher-pitched sound, with maximum energy concentration around 1000 Hz, whereas that of the Rusty-margined Guan sounds lower-pitched, with maximum energy below 500 Hz. In both species, the wing-beating is produced in two parts, with a pause in between (Fig. 3). Regarding the timing of the first acoustic detection of the Black-fronted Piping-Guan in a count, six occurred before dawn, between 20 and 25 min before sunrise, and one occurred 34 min after sunrise (Table 1).

In contrast to the scarcity of Black-fronted Piping-Guan detections, in the same surveys we detected the Rusty-margined Guan at 142 of the points (44%), with a total of 169 individuals, with detections of this species always being based on wing-beating sounds.

DISCUSSION

We were able to record the Black-fronted Piping-Guan at six of 320 points surveyed, representing less than 2% of the total points, which were located from the northernmost point of Misiones to northern Corrientes. Records were concentrated within a narrow band of 0.2° of latitude, in an area 20 kilometers north-south and 60 km east-west. Our

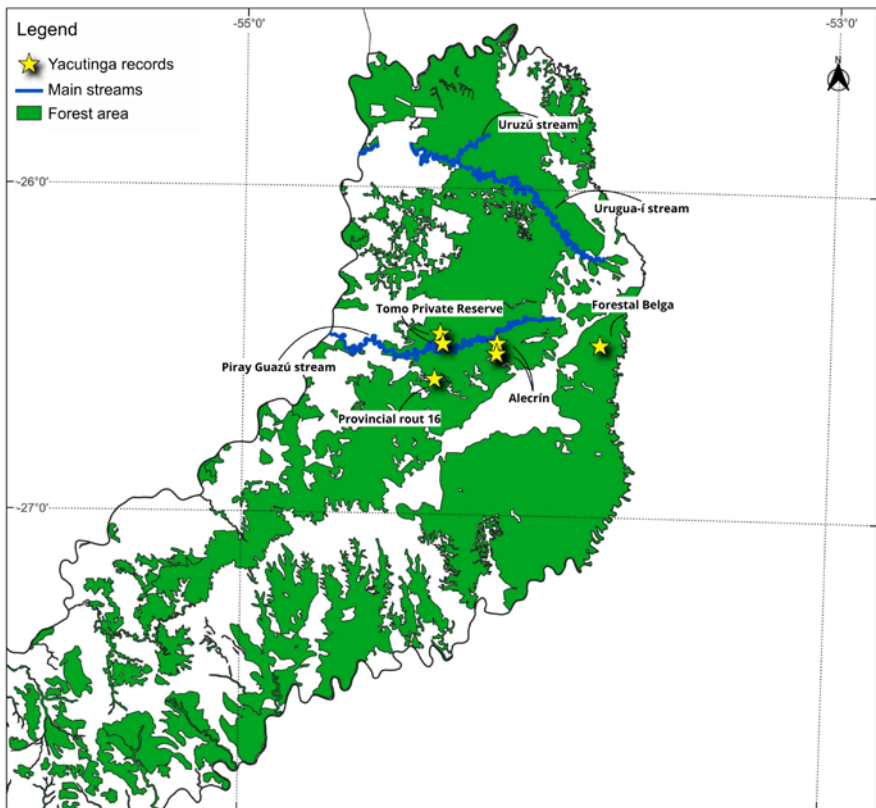


Figure 2. Map of Black-fronted Piping-Guan (*Pipile jacutinga*) occurrences based on our surveys in Misiones Province, Argentina. Stars indicate sites where Black-fronted Piping-Guan was detected, green indicates forested areas, and blue highlights the Piray Guazú stream, which accounted for most of the records, as well as the Urugua-I and Uruzú streams, where the species is also known to occur.

Table 1. Count points with Black-fronted Piping-Guan (*Pipile jacutinga*) presence in the surveys carried out in Misiones province and northern Corrientes, Argentina. The point surveyed, number of individuals, date, whether the record was made from recordings or in person, distance to the nearest stream, type of sound by which it was detected (wing-beating or whistle), how many minutes before or after dawn, and the time of dawn for that date and site are indicated.

Point	Individuals	Date	Survey method	Stream	Distance (m)	Sound type	Time (minutes before (-) or after (+) dawn)	Time of dawn
Alecrín P6	1	14/09/2024	Recording	Piray Guazú	2014	Aleteo	-20	6:35
Alecrín P8 (replicate 1)	1	13/09/2024	Recording	Piray Guazú	4600	Aleteo	-22	6:36
Alecrín P8 (replicate 2)	1	14/09/2024	In person	Piray Guazú	4600	Aleteo	-27	6:35
Tomo P1	3	05/08/2022	In person	Piray Guazú	4200	Aleteo	-25	7:14
Tomo P8	1	05/08/2022	Recording	Piray Guazú	1549	Aleteo	-23	7:14
RP 16 P8	1	12/09/2021	In person	Las Antas	286	Aleteo	+34	6:38
Forestal Belga norte P2	1	28/08/2024	Recording	Cisnandez	362	Aleteo y silbo	-22	6:51
Mean and SD	1.29 ± 0.76				2351 ± 2132		-15 ± 20.11	

results support the concentration of records of the species in north-central Misiones and confirm the interpretation of local extinction, given the absence of records in both northern Corrientes and southern Misiones (Cockle & Bodrati 2011, Fariña 2021). Most of our records consisted of a single individual, which is in line with the available evidence indicating low population numbers, with the species mostly found in small groups (Pacagnella et al. 1994, Galetti et al. 1997, Bodrati & Cockle 2006, Cockle & Bodrati 2011).

Unlike the evidence in the literature, which suggests that this is a species absent from sites without formal protection against hunting (Chebez 1985, Galetti et al. 1997, Bodrati & Cockle 2006, Fariña 2021), all our records were in areas without control or monitoring of hunting pressure. Although the site with the greatest number of records was Tomo Private Reserve, it lacks park rangers and active monitoring. At this site, we encountered people entering to carry out activities such as fishing, with no controls or surveillance, even though it is a relatively remote site with difficult access. The site located along Provincial Route 16 is frequented by hunters and fishers heading toward the Las Antas stream. The two points with

presence at Alecrín are located near an area of family farms with human presence and disturbances such as clearing.

Until now, it has been thought that in Misiones the Black-fronted Piping-Guan is associated with areas near major streams (Benstead et al. 1993, Bodrati & Cockle 2006, Chebez 2008, del Hoyo et al. 2020); consequently, surveys of the species have been concentrated in these areas. Furthermore, current recommendations for searching for the species encourage surveys of forest streams by canoe or kayak (Fariña 2021). Our results indicate the presence of the species also away from major streams, which could be because the species also finds its requirements in the vicinity of minor streams, or because its habitat use is broader than previously thought. In any case, our results show that, for surveys and population modeling of the species in Misiones, it is essential to include native forest areas both far from and close to major streams.

Traditionally, the Black-fronted Piping-Guan in Misiones has been associated with the Uruguay and Uruzú streams (Fig. 2) and with Iguazú National

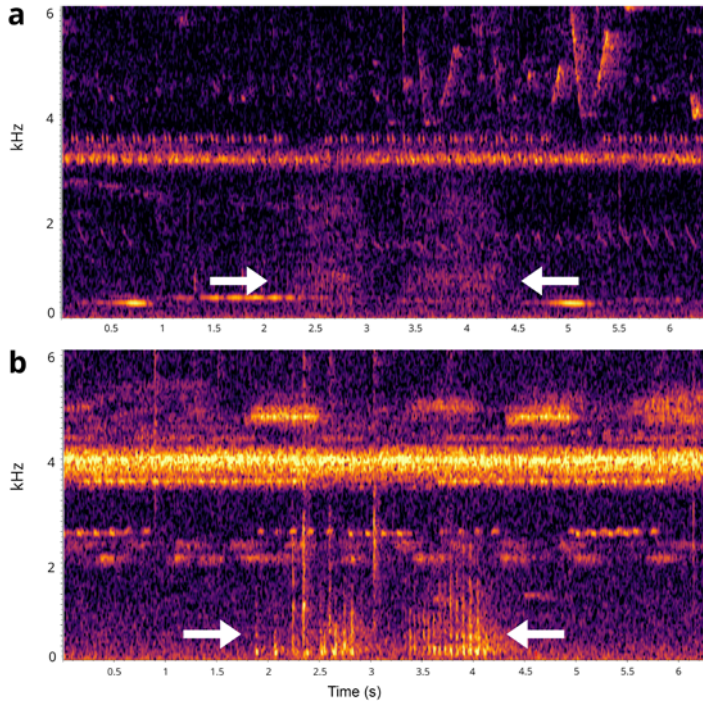


Figure 3. Spectrogram of typical wing-beating of the (a) Black-fronted Piping-Guan (*Pipile jacutinga*) and the (b) Rusty-margined Guan (*Penelope superciliosus*); it can be seen that the wing-beating is always produced in two parts, with a brief pause in between. The white arrows indicate the start and end of each wing-beating bout. Although the recordings were made at 24,000 Hz, a close-up is shown at the frequency where most of the energy of the wing-beating is concentrated, up to 6000 Hz. Recording belonging to the surveys of this study, from the SM4 autonomous recorders. (a) Wing-beating of the Black-fronted Piping-Guan, Tomo Private Reserve, Point 8, 5 August 2022 (deposited in the Macaulay Library, ML652577351). (b) Wing-beating of the Rusty-margined Guan, Iguazú National Park, Point 4, 7 July 2023 (deposited in the Macaulay Library, ML612515792).

Park, since previous surveys have found its highest numbers for Argentina there, both in the literature and on citizen science platforms (Benstead et al. 1993, Bodrati & Cockle 2006, Cockle & Bodrati 2011, eBird 2026, EcoRegistros 2026). The lack of detection of the species during our surveys in Urugua-í Provincial Park could be due to the fact that, during the period we visited, we experienced unusually cold weather for the area. However, the fact that there are multiple records on citizen science platforms at a particular site (the Uruzú stream, near the public-use area of PP Urugua-í, or specific streams within Iguazú National Park, for example) does not imply that individuals occur with the same frequency or in the same abundance throughout the rest of the area. Often this involves a family group associated with a single site, and the multiple records may correspond to the same individuals. On the other hand, during our surveys, another large stream, the Piray Guazú, was the closest navigable stream for most of the records. This identifies the Piray Guazú as another possible reservoir for the Black-fronted Piping-Guan, in agreement with what was proposed by Gil (2022). Since our surveys were not concentrated exclusively in the Piray Guazú basin, we recommend conducting censuses along its streams to estimate the density of the species along the margins and associated riparian environments. Currently, the only protected area within this basin is Tomo Private Reserve, which lacks active patrolling. Future surveys of this system could help identify priority areas for the conservation of the Black-fronted Piping-Guan.

The Black-fronted Piping-Guan has a broad repertoire of sound manifestations, with 11 different types of vocalizations and a mechanical sound produced by wing-beating (Silva Bautista 2023). The wing-beating is produced during a brief flight, when moving from one branch to another (del Hoyo et al. 2020, and personal observation). Previous acoustic surveys of this species highlight peeps as its most frequent sound manifestation (Silva Bautista 2023). All the detections in the present study were through the wing-beating sound in August and September, with a single detection from a whistle in a recording in late August (Table 1). The difference in detectability among the different sound types (i.e., vocalizations vs. mechanical sounds) could be due to several reasons. The acoustic surveys used in the study by Silva Bautista (2023) were carried out in April, in autumn, whereas those of our study were during June–September, during the winter pair-formation stage. These differences could reflect seasonality in the sounds the species produces.

On the other hand, our surveys coincided with the pre-breeding and breeding season of most Atlantic Forest species (Lima et al. 2025). The Black-fronted Piping-Guan's vocalizations, whistles and peeps, can easily go unnoticed within a soundscape with dozens of species vocalizing simultaneously in similar frequency bands. The wing-beating sound, on the other hand, does not usually compete with other sounds, except with that of the Rusty-margined Guan, which is lower-pitched. The wing-beating of the Black-fronted Piping-Guan can be distinguished on a sonogram by having many more individual beats produced at higher speed (Fig. 3). A powerful resource for analyzing large numbers of recordings is automated detection, but we recommend that it be focused on the wing-beating sound. Future acoustic search studies of this species could train models not only on its vocalizations, but especially on the wing-beating sound.

Detections of the Black-fronted Piping-Guan were concentrated in the hours before dawn, even up to 25 minutes beforehand. Although our formal counts were carried out only in the morning, within the framework of four-day fieldwork activities, at each site, we remained alert to bird sounds throughout all hours and did not record wing-beating at other times. Apparently, the wing-beating sound is concentrated in the crepuscular hours before dawn, at least in this region during the winter season. Again, given the complexity of the soundscape at dawn and in the hours that follow, searching for this species in the moments before dawn could facilitate its auditory detection, since this is when its wing-beating is concentrated, at least during winter. To confirm and expand on our information regarding the patterns of vocal activity of the Black-fronted Piping-Guan, studies carried out throughout the year and covering different times of day are needed.

CONCLUSIONS

This study provides updated information on the status of the Black-fronted Piping-Guan in our country, contributing information on its sound manifestations, the time of greatest activity, and updates on its distribution. We highlight its low number of records, concentrated in unprotected sites subject to poaching, one of its greatest threats. Passive acoustic surveys proved to be a feasible option for detecting this species. However, the search needs to be focused. Specifically, we recommend focusing the search on the mechanical wing-beating sound and on the hours before dawn. Furthermore, although the species has traditionally been associated with the margins of

navigable streams, we recommend extending the search distance from adjacent margins up to 5 km. We recommend conducting surveys along the Piray Guazú stream, which appears to be a site with significant densities of the Black-fronted Piping-Guan and which may merit and require conservation actions such as the creation of protected areas with active patrolling and community outreach to discourage hunting. We reaffirm the need to protect this key area for the biodiversity of Misiones (Gil 2022).

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USE OF ARTIFICIAL INTELLIGENCE

No artificial intelligence tool was used in this manuscript.

REFERENCES

- Acevedo MA, Villanueva-Rivera LJ (2006) Using Automated Digital Recording Systems as Effective Tools for the Monitoring of Birds and Amphibians. *Wildlife Society Bulletin* 34(1):211-214. [https://doi.org/10.2193/0091-7648\(2006\)34%255B211:UADRSA%255D2.0.CO;2](https://doi.org/10.2193/0091-7648(2006)34%255B211:UADRSA%255D2.0.CO;2)
- Arana MD, Natale E, Ferretti N, Romano G, Oggero A, Martínez G, Posadas P, Morrone J (2021) Esquema Biogeográfico de la República Argentina. Fundación Miguel Lillo. Opera Lilloana 56:1-240
- Benstead PJ, Hearn RD, Jeffs CJS, Callaghan DA, Calo J, Gil G, Johnson AE, Stagi Nedelcoff AR (1993) Pato Serrucho 93: an expedition to assess the current status of the Brazilian Merganser *Mergus octosetaceus* in North-east Argentina. *Wildfowl and Wetlands Trust, Slimbridge, UK*
- Bodrati A, Cockle K (2006) Habitat, distribution, and conservation of Atlantic Forest birds in Argentina: notes on nine rare or threatened species. *Ornitología Neotropical* 17(2):243-258
- Chebez JC (1985) Nuestras Aves Amenazadas: La Yacutinga (*Aburria jacutinga*). *Nuestras Aves* 7:16-17. <https://doi.org/10.56178/na.vi7.1154>
- Chebez JC (2008). Los que se van. Editorial Albatros, Buenos Aires
- Cockle KL, Bodrati A (2011) Situación de la Yacutinga (*Aburria jacutinga*) en Argentina. *Bulletin of the Cracid Specialist Group* 31:12-21
- Darras K, Batáry P, Furnas B, Celis-Murillo A, Van Wilgenburg SL, Mulyani YA, Tscharnatke T (2018) Comparing the sampling performance of sound recorders versus point counts in bird surveys: A meta-analysis. *Journal of Applied Ecology* 55(6):2575-2586. <https://doi.org/10.1111/1365-2664.13229>
- Darras K, Batáry P, Furnas BJ, Grass I, Mulyani YA, Tscharnatke T (2019) Autonomous sound recording outperforms human observation for sampling birds: A systematic map and user guide. *Ecological Applications* 29(6):e01954. <https://doi.org/10.1002/eap.1954>
- de Araújo CB, Jardim M, Saturnino N, dos SF, Rosa GM, Lima MR, dos Anjos L (2021) The optimal listening period for an effective assessment of bird richness and composition: a case study of Neotropical forest. *Journal of Ornithology* 162:303-306. <https://doi.org/10.1007/s10336-020-01812-6>
- de Araújo CB, Lima MR, Albuquerque P, Alquezar RD, Barreiros M, Jardim M, Gangenova E, Machado RB, Phalan BT, Roos AL, Rosa GLM, Saturnino N, Simões CR, Torres IM D, Varela D, Zurano JP, Marques PAM, Dos Anjos L (2024) Acoustic monitoring of anurans and birds in tropical biomes. *Biotropica* 56(3):e13307. <https://doi.org/10.1111/btp.13307>
- de Souza LD, Tassoni Pereira A, Azevedo CS, São Bernardo CS, Develley PF, Ruiz-Miranda CR (2020). Reproductive and agonistic behaviors of Black-fronted Piping Guans candidates for release and reintroduced (Galliformes: Cracidae) in the Brazilian Atlantic Forest. *Oecologia Australis* 24(04):791-802. <https://doi.org/10.4257/oeco.2020.2404.04>
- del Hoyo J, Kirwan GM, Sharpe CJ (2020) Black-fronted Piping-Guan (*Pipile jacutinga*), version 1.0. In: del Hoyo J, Elliott A, Sargatal J, Christie DA, de Juana E (eds) *Birds of the World*. Cornell Lab of Ornithology, Ithaca, NY, USA. <https://doi.org/10.1111/btp.13307>

org/10.2173/bow.bfpgua1.01

- Drake A, De Zwaan DR, Altamirano TA, Wilson S, Hick K, Bravo C, Ibarra JT, Martin K (2021). Combining point counts and autonomous recording units improves avian survey efficacy across elevational gradients on two continents. *Ecology and Evolution* 11(13):8654-8682. <https://doi.org/10.1002/ece3.7678>
- eBird (2021) eBird: An online database of bird distribution and abundance [web application]. eBird, Cornell Lab of Ornithology, Ithaca, New York. [URL: <http://www.ebird.org/>] (20/02/2026)
- EcoRegistros (2024) Base de datos de registros de la comunidad. Accedido de [URL: <https://www.ecoregistros.org/>] (20/02/2026)
- Fariña R (2021) Plan para la Conservación de la Yacutinga en la Argentina. Resultados del taller de diagnóstico y consensos de trabajo. Aves Argentinas, Asociación Ornitológica del Plata y Ministerio de Ambiente y Recursos Naturales de la Provincia de Misiones. Pto. Iguazú, Misiones, Argentina
- Frommolt KH, Tauchert KH, Koch M (2008) Advantages and disadvantages of acoustic monitoring of birds – realistic scenarios for automated bioacoustic monitoring in a densely populated region. In: Frommolt KH, Bardeli R, Clausen M (eds) Computational bioacoustics for assessing biodiversity. Proceedings of the International Expert meeting on IT-based detection of bioacoustical patterns. BfN-Skripten, Germany. Pp. 83-92
- Galetti M, Martuscelli P, Olmos F, Aleixo A (1997) Ecology and conservation of the jacutinga *Pipile jacutinga* in the Atlantic forest of Brazil. *Biological Conservation* 82(1):31-39. [https://doi.org/10.1016/S0006-3207\(97\)00004-9](https://doi.org/10.1016/S0006-3207(97)00004-9)
- Gil GE (2022) Propuesta de áreas claves para la biodiversidad en la provincia de Misiones. 1a ed. Ciudad Autónoma de Buenos Aires: Aves Argentinas
- Hoefer S, McKnight DT, Allen-Ankins S, Nordberg EJ, Schwarzkopf L (2023) Passive acoustic monitoring in terrestrial vertebrates: a review. *Bioacoustics* 32(5):506-531. <https://doi.org/10.1080/09524622.2023.2209052>
- IUCN (2025) The IUCN Red List of Threatened Species. Versión 2025-2. [URL: <https://www.iucnredlist.org/>] (01/03/2026)
- Lambert KTA, McDonald PG (2014) A low-cost, yet simple and highly repeatable system for acoustically surveying cryptic species. *Austral Ecology* 39(7):779-785. <https://doi.org/10.1111/aec.12143>
- Lammertink M, Fernández JM (2022) Home range patterns of Helmeted Woodpecker (*Celeus galeatus*), Lineated Woodpecker (*Dryocopus lineatus*), and Robust Woodpecker (*Campephilus robustus*) in Misiones, Argentina, in a global perspective. *Avian Conservation and Ecology* 17(2):art34. <https://doi.org/10.5751/ACE-02277-170234>
- Lima DM, Sousa AEBA, Araujo HFP (2025) Temporal variation in the detection of endangered birds in the Northern Atlantic Forest. *Zoologia (Curitiba)* 42:e24019. <https://doi.org/10.1590/s1984-4689.v42.e24019>
- MapBiomas Project (2025) Collection 3.0 of the Annual Land Use Land Cover Maps of Brazil. [URL: <https://plataforma.bosqueatlantico.mapbiomas.org/>] (8/11/2024)
- Marques MCM, Grelle CEV (Eds.) (2021) The Atlantic Forest: History, Biodiversity, Threats and Opportunities of the Mega-diverse Forest. Springer International Publishing, Cham, Switzerland. <https://doi.org/10.1007/978-3-030-55322-7>
- MAYDS & AA (2017) Categorización de las Aves de la Argentina según su estado de conservación. Informe del Ministerio de Ambiente y Desarrollo Sustentable de la Nación y de Aves Argentinas
- Paccagnella SG, Filho RA, Lara AI, Neto PS (1994) Observações sobre *Pipile jacutinga* spix, 1825 (Aves, Cracidae) no Parque Estadual de Carlos Botelho, São Paulo, Brasil. *Iheringia (Série Zoologia)* 76(1):29-32
- QGIS (2024) QGIS Geographic Information System. QGIS Association
- Sedláček O, Vokurková J, Ferenc M, Djomo EN, Albrecht T, Hořák D (2015). A comparison of point counts with a new acoustic sampling method: A case study of a bird community from the montane forests of Mount Cameroon. *Ostrich* 86(3):213-220. <https://doi.org/10.2989/00306525.2015.1049669>
- Short LL (1971) Aves nuevas o poco comunes de Corrientes. *Revista del Museo de Ciencias Naturales Bernardino Rivadavia (Zoología)* 9(11):283-309
- Sick H (1997) Ornitología brasileira. 2a ed. Editora Nova Fronteira, Rio de Janeiro. Pp. 862
- Silva Bautista MA (2023) Bioacústica de *Aburria jacutinga* (SPIX, 1825) Estructura del repertorio acústico y actividad vocal en el Parque Nacional do Iguaçu, Brasil. Undergraduate thesis, Instituto Latino-Americano de Ciencias de la Vida y de la Naturaleza, Foz do Iguaçu
- Vale MM, Tourinho L, Lorini ML, Rajão H, Figueiredo MSL (2018) Endemic birds of the Atlantic Forest: traits, conservation status, and patterns of biodiversity. *Journal of Field Ornithology* 89(3):193-206. <https://doi.org/10.1111/jof.12256>