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RESEARCH PAPER

The enigmatic Black Tinamou: Do distribution, climate, and vocalizations reveal more than one species?

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ABSTRACT
The Black Tinamou (*Tinamus osgoodi*) is a rare species with 2 recognized subspecies distributed locally. This is one of the most poorly known tinamous; few sound recordings exist, and few behavioral or sighting records are found in the literature or in ornithological databases. We compiled all the information on its geographic distribution and climate to provide a greater understanding of its current distribution. We also compiled all available sound recordings of the species in order to perform bioacoustic analyses to evaluate differences between subspecies. The 2 subspecies seem to be isolated by an ample distance, and each inhabits an area with a distinct climate. We also found some differences between their vocalizations. Future work should consider reevaluating the taxonomic status of the 2 subspecies. Conservation status of the resulting taxa must be reassessed, although more information on their ecology and natural history is needed.

Keywords: South America, species limit, Tinamidae, *Tinamus osgoodi*, vocalizations

El enigmatico *Tinamus osgoodi* : su distribucion, caractersiticas climaticas y vocalizacion revelan mas de una especie?

RESUMEN
Tinamus osgoodi es una especie rara y muy local con dos subespecies reconocidas. Es uno de los tinamús menos conocidos: hay pocas observaciones de su comportamiento en la literatura, pocas grabaciones de su canto y muy pocos registros en las bases de datos ornitológicas. Recopilamos toda la información de su distribución geográfica y clima para entender mejor su distribución actual. Adicionalmente buscamos todas las grabaciones de sonido disponibles de la especie para determinar si existen diferencias entre las subespecies. Las dos subespecies parece están aisladas por una distancia considerable para un tinamú y habitan áreas con características climáticas distintas. Adicionalmente existen muchas diferencias entre sus vocalizaciones. Futuras investigaciones deben reevaluar el estatus taxonómico de las dos subespecies. El estado de conservación de los taxones resultantes debe ser reevaluado, y mas información de la historia natural y ecología para las dos formas es necesaria.

Palabras clave: América del sur, limites de especie, Tinamidae, vocalizaciones

INTRODUCTION

The Black Tinamou (*Tinamus osgoodi*; Figure 1) is a very rare bird, known only from 2 small regions: the head of the Magdalena valley in southern Colombia, and east of Cusco in southern Peru (Hilty and Brown 1986, Cabot 1992, Schulenberg et al. 2007; Figure 2). In the past 2 decades, new localities and noteworthy records have been reported in the literature, such as Cerros del Tavara and Serranias Cofan in Ecuador, Antioquia in Colombia, and Reserva Megantoni in Peru (Pitman et al. 2002, Vriesendorp et al. 2004, Cuervo et al. 2008a, 2008b, Brinkhuizen and Córdova-Saeteros 2011). Although recent records indicate that its range is larger than previously thought, BirdLife International (2014) has retained this species' Red List status as Vulnerable (VU), a classification typically associated with populations undergoing rapid decline in some parts of their distribution, mainly as a result of hunting pressure and/or ongoing habitat loss and degradation.

Tinamous are sedentary, ground-dwelling birds with poor flight abilities (Cabot 1992, Bertelli et al. 2002). They are cryptic, shy, and secretive birds, but their calls are very distinctive (Cabot 1992). The vocalizations of tinamous are

FIGURE 1. Black Tinamou (*Tinamus osgoodi*) in Alto Fragua National Park, Colombia. Photo credit: Pablo Jose Negret

assumed to be innate; thus, any variation between populations may reflect genetic differences (Cabot 1992, Kroodsma and Miller 1996), which offers the possibility of using such variation in proposing species limits (Maijer 1996, Laverde-R. and Cadena 2014).

We compiled all the localities reported for this species in the literature and in biodiversity databases to evaluate climatic and elevational differences between subspecies and to assess the current geographic distribution. We also compiled and described vocalizations of Black Tinamous, highlighting the differences between *T. o. osgoodi* and *T. o. hershkovitzi*.

METHODS

Study Species

The Black Tinamou has 2 recognized subspecies and 1 unassigned population: *T. o. osgoodi* (Conover 1949), which ranges from Peru to Bolivia; *T. o. hershkovitzi* (Blake 1953), located in northern Ecuador and southern Colombia; and the isolated population of unknown taxonomic affinities found in 1998 in the northern Cordillera Central of the Colombian Andes (Cuervo and Toro 2002, Cuervo et al. 2008a, 2008b). This species inhabits humid forest in tropical and subtropical zones (foothills) of the eastern Andes, where epiphytes, tree ferns, bromeliads, and mosses are abundant (Cabot 1992, Brinkhuizen and Córdova-Saeteros 2011)—features that characterize the tall primary forest in this part of the mountains.

Compilation of Localities

We collected geographic data from the literature, sound libraries, and biodiversity databases (eBird, GBIF, xeno-canto, and Macaulay Library of Natural Sounds; see Acknowledgments). We used the Latin and English name

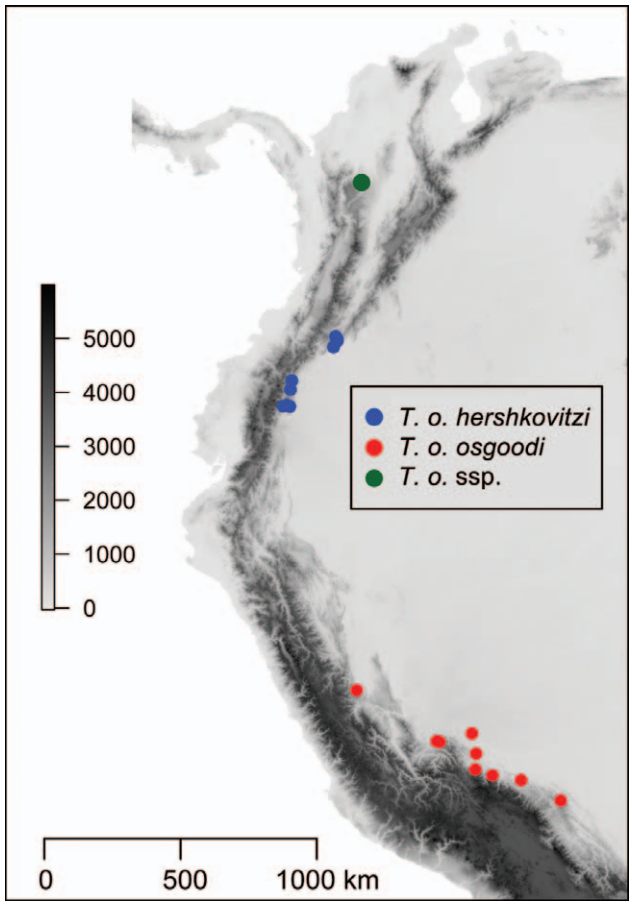

FIGURE 2. Map with all geographic records of *Tinamus osgoodi* compiled, used for climatic analyses.

of the species for searching records in databases and libraries. Also, we asked researchers and birders who work in these areas for recent, unpublished records. We posted an e-mail to the Peruvian bird discussion list (INCASPI-ZA) to contact researchers from Peru; Juan Freile provided some information from Ecuador, and personal contacts helped us find researchers with some information from Colombia (see Table 3 in the Appendix).

Distribution, Elevational, and Climatic Analyses

Using records found in the literature and in the biodiversity databases, we assessed variability in the species' elevational range. Some records gave a range of elevation instead of an exact value; in these cases, we used the mid-elevational point for the analysis. We extracted bioclimatic data used in WorldClim version 1.2 (Hijmans et al. 2005; see Table 1) from all the records and conducted a principal component analysis (PCA) to condense the information into fewer variables. Finally, we plotted and analyzed the first 2 components. We tested for differences between subspecies in elevational and climatic data using Student's *t*-test for unpaired observations.

TABLE 1. Principal components (PC1 and PC2) of bioclimatic variables (from WorldClim version 1.2) associated with localities of *Tinamus osgoodi hershkovitzi* and *T. o. osgoodi*. Values for the 2 most important variables in each component are in bold.

Bioclimatic variable	PC1	PC2
BIO1 = Annual mean temperature	0.00	−0.07
BIO2 = Mean diurnal range (mean of monthly [maximum temperature − minimum temperature])	−0.04	−0.03
BIO3 = Isothermality (BIO2/BIO7) (*100)	0.04	0.08
BIO4 = Temperature seasonality (SD*100)	−0.22	**−0.65**
BIO5 = Maximum temperature of warmest month	−0.01	−0.07
BIO6 = Minimum temperature of coldest month	0.06	−0.04
BIO7 = Temperature annual range (BIO5–BIO6)	−0.08	−0.11
BIO8 = Mean temperature of wettest quarter	0.00	−0.08
BIO9 = Mean temperature of driest quarter	0.02	−0.04
BIO10 = Mean temperature of warmest quarter	0.00	−0.08
BIO11 = Mean temperature of coldest quarter	0.01	−0.05
BIO12 = Annual precipitation	0.21	−0.26
BIO13 = Precipitation of wettest month	0.16	−0.30
BIO14 = Precipitation of driest month	**0.50**	−0.13
BIO15 = Precipitation seasonality (coefficient of variation)	−0.25	−0.18
BIO16 = Precipitation of wettest quarter	0.15	−0.28
BIO17 = Precipitation of driest quarter	0.45	−0.13
BIO18 = Precipitation of warmest quarter	0.14	**−0.42**
BIO19 = Precipitation of coldest quarter	**0.55**	0.23

Vocalizations

We compiled all available recordings of Black Tinamous from commercial CDs, xeno-canto, and the Macaulay Library of Natural Sounds (Table 4 in the Appendix). Three previously unpublished vocalizations of *T. o. hershkovitzi* were recorded by P.J.N. using a Zoom H4N Handy Portable Digital Recorder in the Indi-wasi National Park in southern Colombia. The birds were recorded, then they were identified by asking local people, and also vocalization identification was confirmed by P.J.N. in the field by observing the birds calling. We measured the number of notes, the length and bandwidth of vocalizations, the maximum and minimum frequencies, and the peak frequency and bandwidth of notes. Vocalizations were processed in Raven version 1.5 (Cornell Lab of Ornithology, Ithaca, New York, USA), using the following combination of settings: FFT window = 512, window type = Hann, and window overlap = 50%. Maximum and minimum frequencies were measured using a threshold set at −20 dB from the maximum amplitude of peak frequency. To explore differences in vocalizations between subspecies, we made sonograms in R (R Development Core Team 2013), using the "seewave" package (Sueur et al. 2008). Because of the small sample size for *T. o. osgoodi*, we tested for differences between populations using the Mann-Whitney nonparametric *U*-test for 2 independent samples.

RESULTS

Distribution, Elevational, and Climatic Information

In total, we obtained 25 geographic records for the Black Tinamou: 13 corresponding to *T. o. osgoodi*, 11 to *T. o. hershkovitzi*, and 1 to the Central Andean population (Figure 2; Table 3 in the Appendix). There is an evident gap in the records, with ~1,100 km between the northernmost record of *T. o. osgoodi* and the southernmost record of *T. o. hershkovitzi*. The locality of the northern Central Andean population is on the western slope of the Andes, ~600 km north of the northernmost record of *T. o. hershkovitzi*. Nevertheless, this record has not been confirmed: Over the

TABLE 2. Results of analyses of vocalizations of *Tinamus osgoodi osgoodi* and *T. o. hershkovitzi*. *P* values in bold emphasize the significant differences between subspecies.

	T. o. osgoodi			*T. o. hershkovitzi*			Statistics	
	n	Mean	SD	*n*	Mean	SD	*U*	*P*
Number of notes in songs	7	1	0.0	7	6	5.2	49	**<0.0001**
Length of song (s)	7	1.7	0.5	7	6.4	2.9	49	**<0.001**
Bandwidth of songs (Hz)	7	227	114	7	401	134	38	0.09
Length of notes (s)	7	1.7	0.5	24	1.1	0.8	32	**<0.01**
Maximum frequency of notes (Hz)	7	1,171	53	24	1,227	72	151	**<0.05**
Minimum frequency of notes (Hz)	7	943	69.0	24	926	75	89	0.638
Peak frequency of notes (Hz)	7	1,056	24.2	24	1,081	48.5	127	0.283

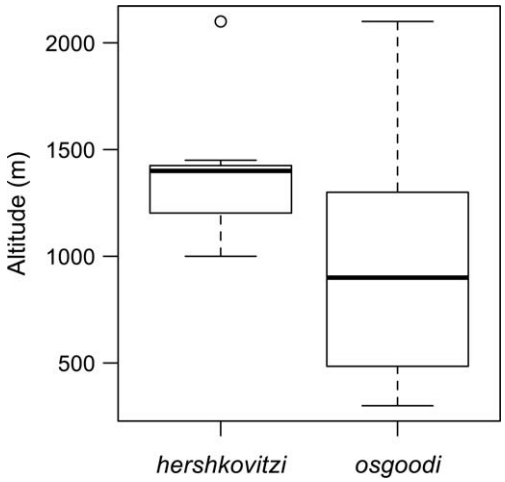

FIGURE 3. Box plot of elevational ranges of *T. o. osgoodi* and *T. o. hershkovitzi*.

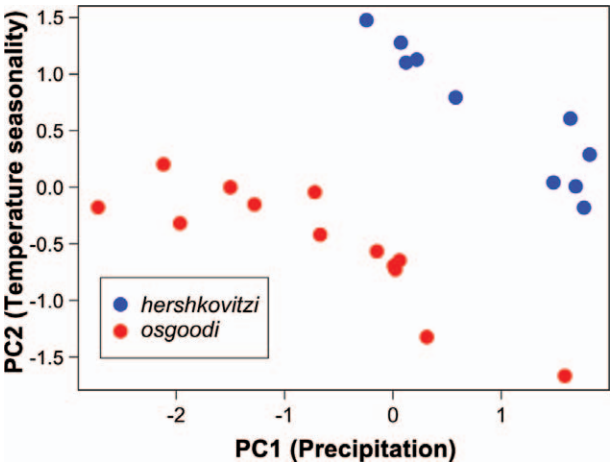

FIGURE 4. Principal component analysis of bioclimatic data associated with localities of the Black Tinamou.

past few years, the many birders and ornithologists who have visited this area have not reported any sightings or collected specimen or voice records of the species (A. Cuervo personal communication). Future expeditions and recordings of vocalizations are necessary to clarify (1) the presence of the species in the area; and (2) if present, the status and identity of this very local and isolated population. The record from Cerros del Sira in Huanaco, central Peru, mentioned by Gastañaga et al. (2007), was a misidentification: The bird in the photographs (Gastañaga et al. 2007: figure 2) turned out to be a Gray Tinamou (*T. tao*; D. Lane personal communication).

The elevational limits of all the historical and recent records of the Black Tinamou over its whole geographic range are 300 and 2,100 m. We found a significant difference in elevational ranges between subespecies (Figure 3; $t = 2.43$, $P = 0.027$): *T. o. osgoodi* was registered at lower altitudes (300 m in Cosha Cashu, Cusco, Peru), where 2 nests were found (G. Londoño personal communication); the lowest elevation where *T. o hershkovitzi* has been recorded is 800 m, in southern Colombia (Table 3 in the Appendix).

The first 2 principal components explained 92.5% of variation in climatic information for *T. o. osgoodi* and *T. o. hershkovitzi* (see Table 1 and Figure 4). The first component (PC1; 67.4%) loaded mainly precipitation variables (BIO19: precipitation of coldest quarter; BIO14: precipitation of driest quarter), and the second component (PC2; 25.1%) loaded temperature seasonality (BIO4). We found strong significant differences between subspecies in precipitation data (PC1; $t = 4.08$, df = 21.30, $P < 0.001$) and temperature seasonality data (PC2; $t = 4.7386$, df = 20.24, $P < 0.001$). *Tinamus o. osgoodi* lives in areas where temperature is more seasonal, which is related to higher latitudes; and *T. o. hershkovitzi* prefers more humid areas, in the Amazon foothills between Ecuador and Colombia.

Vocalizations

We obtained 3 recordings with 6 vocalizations of *T. o. osgoodi* and 5 recordings with 8 vocalizations of *T. o. hershkovitzi* (Table 4 in the Appendix). We found 3 different types of vocalizations in recordings of *T. o. hershkovitzi*. The first type (presumably the territorial song, which was the most common vocalization) is a song of 2 or 3 notes, from 2.66 to 5.11 s long, with a narrow frequency bandwidth of 400 Hz (range: 156–566 Hz; Figure 5A). The second type is a longer vocalization of 5 notes, the first of which is a U-shaped, slightly modulated note; this call was given when 2 birds close together were disturbed by the presence of a researcher—the birds flew away and then started to call each other (Figure 5B). This vocalization was also recorded in Sumaco, Ecuador, and was repeated every ~2 min, but the context was not very clear (Dušan M. Brinkhuizen; http://www.xeno-canto.org/forum/topic/8559). The third type is the longest call ($n = 1$), with 17 nonmodulated notes (Figure 5C); this vocalization was not included in the analyses. In *T. o. osgoodi*, we found only 1 type of vocalization with a single note, which lasted 1.32 to 2.32 s, occupying a very narrow frequency bandwidth of 87 to 311 Hz (Figure 5D, 5E). Acoustic analyses (Table 5 in the Appendix) found differences between the 2 forms: *T. o. hershkovitzi* has longer vocalizations with more, but shorter, notes than *T. o. osgoodi*. In the spectral domain, maximum frequency was significantly different between populations: *T. o. hershkovitzi* produces vocalizations with higher maximum frequency than *T. o. osgoodi* (Table 2).

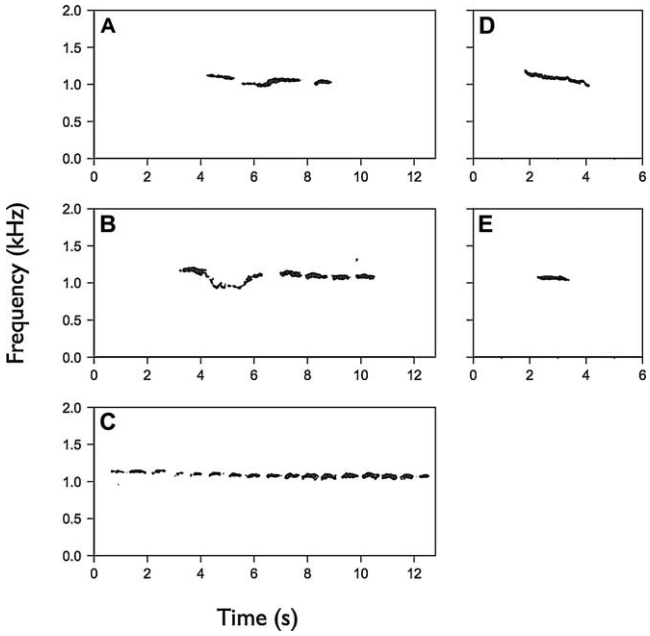

FIGURE 5. Spectrograms of vocalizations from (**A**–**C**) *T. o. hershkovitzi* and (**D**, **E**) *T. o. osgoodi*.

DISCUSSION

The distribution of the Black Tinamou shows that the 2 recognized subspecies may deserve species status, supported by 5 types of evidence. (1) There is a clear gap of 1,100 km between the edges of the distributions, and tinamous are not good dispersers. Nevertheless, a geographic barrier between populations does not seem to exist, because there is "continuous" habitat between subspecies ranges. (2) Bioclimatic information shows differences in temperature seasonality and precipitation. *Tinamus o. hershkovitzi* lives closer to the equator, where the climate is more tropical, but at higher altitude, whereas *T. o. osgoodi* lives in areas with more climatic variation throughout the year (Figure 4). (3) Elevational ranges differ between subspecies; *T. o. hershkovitzi* has not been recorded below 800 m and is very common between 1,400 and 1,500 m, whereas *T. o. osgoodi* has been recorded at lower elevations (300 m) but is more common between 1,000 and 1,350 m (Pitman et al. 2002, Vriesendorp et al. 2004, Brinkhuizen and Córdova-Saeteros 2011). (4) Vocalizations are very different between subspecies (Figure 4); however, we still need more recordings from both populations to understand variation within and between subspecies. (5) We did not examine the specimens stored at the Chicago Field Museum, but differences in plumage between subspecies were evident, given that they were described as different forms. In general, the plumage of *T. o. osgoodi* is darker, with distinct speckling, vermiculation, or barring (Traylor 1952, Blake 1953); and the feathers of *T. o. hershkovitzi* are more or less edged with black, but without dark vermiculation or speckling (Blake 1953).

The north-central Andes record has not been confirmed. During recent years, birders and ornithologists have been watching and looking for rare birds around the area, without any sight, specimen, or voice recordings (A. Cuervo personal communication). Recordings of vocalizations and/or specimens are necessary to confirm the presence and the status of such a local, isolated population. Pictures are not reliable proofs in some cases; one misidentified record comes from a picture taken at Cerros del Sira in Huanaco, central Peru, but the bird in the picture (Gastañaga et al. 2007: figure 2) is actually the Gray Tinamou (D. Lane personal communication).

The Black Tinamou is considered one of the rarest tinamous; this new information on the differences between subspecies should be taken into account, not only in future taxonomic work, but also in future conservation assessments and management plans for the species. Song differences in vocal nonlearners, including Tinamous, have been used for rapid assessment of taxonomic limits (Maijer 1996, Laverde-R. and Cadena 2014), but we need more studies to better understand the relationship between species limits and song differences in this special family.

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APPENDIX

TABLE 3. Geographic records of *Tinamus osgoodi* subspecies.

Year	Subspecies	Country	State	Municipality	Latitude	Longitude	Minimum	Maximum	Mean	Reference	Source
1953	*hershkovitzi*	Colombia	Huila	Acevedo	1.714166667	−76.03111111	1,400			Blake 1953	Literature
2000	*hershkovitzi*	Colombia	Caquetá	San José de Fragua	1.3486111	−76.1030556	1,400			Umaña (in Cuervo and Toro 2002)	Literature
2013	*hershkovitzi*	Colombia	Caquetá	Belén de los Andaquíes	1.615194444	−75.97497222	860	1,600	1,230	P. J. Negret	Present study
2013	*hershkovitzi*	Colombia	Caquetá	Belén de los Andaquíes	1.560305556	−75.975	800	1,545	1,172.5	P. J. Negret	Present study
2002	*hershkovitzi*	Ecuador	Sucumbíos	Sisicho Ridge	0.200361111	−77.53175	1,000	1,350	1,175	Pitman et al. 2002	Literature
2002	*hershkovitzi*	Ecuador	Napo	San Rafael	−0.104166667	−77.57861111	1,400	1,500	1,450	Pitman et al. 2002	Literature
2011	*hershkovitzi*	Ecuador	Napo	Narupa Reserve	−0.634497222	−77.70345833	1,000			Brinkhuizen and Córdova-Saeteros 2011	Literature
2011	*hershkovitzi*	Ecuador	Napo	Cordillera de Huacamayos	−0.673611111	−77.82805556	1,450			Brinkhuizen and Córdova-Saeteros 2011	Literature
2002	*hershkovitzi*	Colombia	Huila	PNN Cueva de los Guácharos	1.583333333	−76	2,100			Cuervo and Toro 2002	Literature
2014	*hershkovitzi*	Ecuador	Napo	Wildsumaco, 5km NW Guagua Sumaco	−0.6873	−77.5992	1,400			D. M. Brinkhuizen	xeno-canto
1994	*hershkovitzi*	Ecuador	Napo	Km 13 on Narupa - Loreto road	−0.716666667	−77.73333333	1,350			N. Krabbe (in Boesman 2009)	CD
2000	*osgoodi*	Bolivia	La Paz	Parque Nacional Madidi	−14.19860833	−68.3283	NA			Valqui (in Vriesendorp et al. 2004)	Literature
1949	*osgoodi*	Peru	Cusco	Marcapata	−13.333333	−70.666667	1,000			Conover 1949	Literature
1994	*osgoodi*	Peru	Puno	Távara	−13.5	−69.68333333	800			Parker and Wust 1994	Literature
2004	*osgoodi*	Peru	Cusco	Kapiromashi	−12.16216667	−72.57438889	900	1200	1,050	Vriesendorp et al. 2004	Literature
2004	*osgoodi*	Peru	Cusco	Katarompanaki	−12.18716667	−72.47052778	1,400	1650	1,525	Vriesendorp et al. 2004	Literature
1981	*osgoodi*	Peru	Cusco	Pilcopata	−13.13333333	−71.25	1,390			Field Museum Skin	GBIF
2001	*osgoodi*	Peru	Pasco	Yanachaga-Chemillén National Park	−10.40985278	−75.31132222	419			O. Gonzalez (in BirdLife International 2014)	Literature
2000	*osgoodi*	Peru	Cusco	Panticalloa Lodge	−12.5833333	−71.22341667	400			G. Londoño	Personal communication
2000	*osgoodi*	Peru	Cusco	Cosha Cashu	−11.9	−71.36666667	300			G. Londoño	Personal communication
2012	*osgoodi*	Bolivia	La Paz	Tokoaque	−14.606	−68.94097222	2,100			S. Herzog, T. Guerrero Vallejos, J. Quillen Vidoz	eBird
2006	*osgoodi*	Peru	Cusco	Cock of the Rock Lodge, Manu Road	−13.06522222	−71.56163889	1,400			T. Renzo Zeppilli	eBird
2011	*osgoodi*	Peru	Cusco	Manu Road - lower section	−13.02922222	−71.49122222	1,000			K. Rosenberg	eBird
2011	*osgoodi*	Peru	Cusco	Carretera a Manú - Pilcopata a Atalaya	−12.90158333	−71.38522222	500	600	550	G. Péron	eBird
2002	ssp.	Colombia	Antioquia	Anori	6.987722222	−75.14294444	1,500	1,700	1,600	Cuervo et al. 2008b	Literature

TABLE 4. Geographic information on vocalizations of *Tinamus osgoodi* subspecies.

Collection [a]	Number	Subspecies	Country	State	Recordist
BSA	14739	*hershkovitzi*	Colombia	Caqueta	P. Negret
BSA	14740	*hershkovitzi*	Colombia	Caqueta	P. Negret
BSA	14741	*hershkovitzi*	Colombia	Caqueta	P. Negret
XC	168351	*hershkovitzi*	Ecuador	Napo	D. Brinkhuizen
Birds of Peru	1	*hershkovitzi*	Ecuador	Napo	N. Krabbe
XC	87826	*osgoodi*	Peru	Cusco	D. Geale
XC	62895	*osgoodi*	Peru	Cusco	D. Lane
MLS	60456	*osgoodi*	Peru	Cusco	J. Fitzpatrick

[a] Abbreviations: BSA = Banco de Sonidos Animales, Instituto Alexander von Humboldt; MLS = Macaulay Library of Natural Sounds; Birds of Peru = Boesman 2009, and XC = xeno-canto.

TABLE 5. Acoustic measurements of vocalizations of *Tinamus osgoodi* subspecies.

Subspecies	Recording [a]	Song	Notes (*n*)	Note	Low frequency (Hz)	High frequency (Hz)	Delta frequency (Hz)	Delta time (s)	Peak frequency (Hz)	Length of song (s)	Bandwidth of song (Hz)
osgoodi	MLS 60456	1	1	1	980.3	1,137.5	157.2	2.23	1,093.8	2.23	157.2
osgoodi	MLS 60456	2	1	1	975.7	1,193.9	218.2	2.316	1,125	2.316	218.2
osgoodi	MLS 60456	3	1	1	1,018.5	1,105.4	87	1.388	1,062.5	1.388	87
osgoodi	MLS 60456	4	1	1	1,013.5	1,124.9	111.4	1.327	1,062.5	1.327	111.4
osgoodi	XC 62895	1	1	1	853.6	1,164.8	311.2	2.246	1,033.6	2.246	311.2
osgoodi	XC 87826	1	1	1	997.9	1,116.7	118.8	2.255	1,046.9	2.255	0.519
herskovitzi	Birds of Peru_01	1	2	1	1,074.4	1,153.6	79.3	0.978	1,109.4	2.657	152.9
herskovitzi	Birds of Peru_01	1	2	2	1,003.7	1,093.2	89.5	1.182	1,046.9		
herskovitzi	Birds of Peru_01	2	3	1	1,079.3	1,155.6	76.3	1.192	1,125	3.044	155.9
herskovitzi	Birds of Peru_01	2	3	2	1,001.9	1,063.1	61.2	0.603	1,046.9		
herskovitzi	Birds of Peru_01	2	3	3	1,011.3	1,094.4	83.1	0.876	1,046.9		
herskovitzi	BSA 14740	1	3	1	768.8	1,200.1	431.3	2.187	1,033.6	4.094	426.2
herskovitzi	BSA 14740	1	3	2	882	1,182.3	300.3	0.701	1,033.6		
herskovitzi	BSA 14740	1	3	3	781.2	1,195.9	414.8	0.544	1,033.6		
herskovitzi	BSA 14740	2	3	1	942.7	1,266.8	324.1	1.118	1,119.7	4.717	405
herskovitzi	BSA 14740	2	3	2	865.4	1,199.9	334.5	2.282	1,033.6		
herskovitzi	BSA 14740	2	3	3	889.2	1,171.7	282.5	0.682	1,033.6		
herskovitzi	BSA 14741	1	3	1	963.1	1,257.5	294.4	1.287	1,119.7	5.118	367
herskovitzi	BSA 14741	1	3	2	888.8	1,214.4	325.6	2.387	1,033.6		
herskovitzi	BSA 14741	1	3	3	893.2	1,183.1	289.9	0.804	1,033.6		
herskovitzi	BSA 14739	1	5	1	867.4	1,365.1	497.8	3.159	1,205.9	7.206	507.1
herskovitzi	BSA 14739	1	5	2	983.5	1,282.1	298.5	0.735	1,119.7		
herskovitzi	BSA 14739	1	5	3	963.5	1,252.6	289.1	0.768	1,119.7		
herskovitzi	BSA 14739	1	5	4	926.7	1,249.5	322.7	0.625	1,119.7		
herskovitzi	BSA 14739	1	5	5	955.1	1,253.7	298.5	0.68	1,119.7		
herskovitzi	BSA 14739	2	5	1	825.3	1,378.3	553	3.005	1,205.9	7.14	566.3
herskovitzi	BSA 14739	2	5	2	1,020.8	1,237.9	217.1	0.812	1,119.7		
herskovitzi	BSA 14739	2	5	3	953.9	1,252.7	298.8	0.548	1,119.7		
herskovitzi	BSA 14739	2	5	4	869.9	1,281.7	411.8	0.658	1,119.7		
herskovitzi	BSA 14739	2	5	5	927.8	1,271.3	343.4	0.702	1,119.7		

[a] Abbreviations: BSA = Banco de Sonidos Animales, Instituto Alexander von Humboldt; MLS = Macaulay Library of Natural Sounds; Birds of Peru = Boesman 2009, and XC = xeno-canto.