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REVIEW ARTICLE

An Approach to Identifying Bird Songs: A Key to more than 300 Songs in the Pipeline Road Area, Soberanía National Park, Panama

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Abstract:

Background:

Identifying bird songs is an integral part of censusing, watching, and enjoying birds. However, doing so can be difficult due to the large variety of songs and, often, subtle differences among them. One way to facilitate this is to place songs into a descriptive key, thereby analyzing each song as well as identifying similarities and differences among songs.

Objective:

Here I present a key to bird songs in a bird-rich location in and adjacent to the Pipeline Road area, Soberanía National Park, Panama, to help researchers and birders in Panama identify and learn these songs, and, more importantly, to provide a model for a key to aid in the analysis and characterization of bird songs in other areas.

Methods:

After an unfruitful attempt to find a key I could use as a template, I developed an order of choices that groups similar songs, eliminates duplication, and optimizes the probability of correctly identifying them. The order is: trill or churr, slur (for songs that do not trill or churr), tempo, pitch, and other pertinent attributes. I followed a published system of descriptive units of bird songs (*i.e.*, element, phrase, section) and gleaned from many sources how to describe various aspects of bird songs (*e.g.*, pitch, quality, tempo). Definitions of terms and final choices are linked to recordings of songs available in www.xeno-canto.org.

Results:

This key includes 321 songs of 216 species in the intact rainforest along southern Pipeline Road and the fragmented forests and wetlands adjacent to the southern entrance to Pipeline Road. These songs include all but the most rarely heard songs of the area.

Conclusion:

This key is the first example of a descriptive key to bird songs in Central or South America, and is unique in at least the western hemisphere in its large scope, ordering of choices, and use of links to xeno-canto. It also provides a model for the construction of keys for bird songs in other areas. In addition, this work describes and utilizes many aspects of bird songs that, if employed, can improve your abilities to listen to, remember, and differentiate among songs.

Keywords: Bird song key, Panama, Pipeline Road, Soberanía National Park, xeno-canto.

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INTRODUCTION

Identifying bird songs is an integral part of censusing, watching, and enjoying birds. However, doing so can be difficult due to the large variety of songs and, often, subtle differences among them. One way to facilitate this is to place songs into a descriptive key, thereby analyzing each song as well as identifying similarities and differences among songs. Here I present a key to bird songs in a species-rich location in Soberanía National Park, Panama, to help researchers and birders in Panama identify and learn these songs, and, more importantly, to provide a model for a descriptive key to aid in the analysis and characterization of bird songs in other areas and regions. This work describes and uses many aspects of bird songs that, if employed, can improve your abilities to listen to, remember, and differentiate among songs. If you are learning the bird songs in your area, I encourage you to make a key for all of them, or at least for the ones you find to be troublesome. Doing so will identify the similarities and differences among the songs. I suggest you follow a consistent pattern of choices that works for you and the bird songs in your area. My key shows one way to approach doing this. This key is the first example of a descriptive key to bird songs in Central or South America, and is unique in at least the western hemisphere in each of three ways: its large scope, ordering of choices, and use of links to xeno-canto.

METHODS

STUDY AREA

Pipeline Road (approximately 9°8'00"N, 79°43'12"W) is a 17.5-km, single-lane, dirt road through the center of 22,100-hectare Soberanía National Park. The road is accessed from the south from the town of Gamboa, which is about 25 km northwest of Panama City, Panama. The study area includes intact rainforest along the southernmost 10 km of Pipeline Road and fragmented forests and wetlands adjacent to the southern entrance to Pipeline Road. This species-rich area contains approximately 40% of the bird species found in Panama [1, 2]. The eBird hotspot "Pipeline Road (Camino del Oleoducto)" reports a total of 450 species, more than anywhere else in Panama [3].

DEVELOPMENT OF THE KEY

In May 2013, I decided to make a key to the bird songs of the Pipeline Road area. My goals were to make a key that (1) grouped similarly sounding songs as much as possible, (2) included all of the regularly heard songs of the area, (3) differentiated among all of the presented songs, (4) used a system that others could adapt for their areas, and (5) was based on recordings in www.xeno-canto.org. To that end, I looked for other bird song keys in the western hemisphere to use as templates. I found no key for anywhere in Central America or South America, but I found two keys for North America. The first key appears to include one song from all bird species in North America north of Mexico, although no species total is presented [4]. This key did not meet my goals in two ways. Its first choice is whether the song in question has one, two, or three or more notes; choosing three or more notes, for my study area, initially would group disparate songs like the repetitive, sharp chips of Long-billed Hermit (www.xeno-canto.org/107762 by Klemens Steiof) with the complex, melodious, many-sectioned repertoires of Bay Wren (www.xeno-canto.org/92124 by William Adsett) (scientific names are provided in the Appendix), so it did not fulfill my first goal. Also, when using that key, you are left, after all choices have been made, with as many as 25 species' songs with no explanation as to how to identify them; therefore, it did not meet my third goal. The second analysis of bird songs in North America differentiates among the songs of all 56 species of warblers using complex, descriptive charts including spectrograms [5]. I believe that making such charts would be beyond the abilities of most users, so that approach did not comply with my fourth goal.

Without any established method for a bird song key to use, I adopted the traditional dichotomous key method but, like the charts in the key to warblers [5], I allowed more than two choices to be made at any one time. After many versions and reorganizations, I developed a consistent order of choices that groups similar songs, eliminates duplication, and optimizes the probability that you will correctly identify the songs. After you decide whether the song in question: (1) trills or churrs, or (2) includes trills or churrs, choices flow from most to least complex, including whether the song (3) slurs (upslurs and downslurs, upslurs only, downslurs only, does not slur), (4) has changes in tempo (accelerates and decelerates, accelerates only, decelerates only, is steady), (5) has changes in pitch (rises and falls, rises only, falls only, is steady) (see Definitions of Terms below), and (6) has other attributes, depending on the remaining songs to be compared. Often, choices terminate with two or more songs when there is no objective way to describe how they differ

(without using absolute pitch; see below); when that happens, I provide relative comparisons via text or tables to enable you to make decisions (except for a few seemingly identical, high- or very high-pitched, single-element calls in Part II). These groups of similar songs are arranged taxonomically [5]. In addition to these relative comparisons, I often parenthetically include comparisons between similarly sounding songs found in different parts of the key.

To simplify use of the key based on time of day and location, I parsed the key to address four areas. Part I concerns the diurnal birds along the southernmost 10 km or so of Pipeline Road. In Part II are the diurnal birds found in the fragmented forests, forest edges, and grassy areas adjacent to the entrance to Pipeline Road without redundantly including the species covered in Part I. Part III includes the diurnal birds associated with the wetlands and ponds adjacent to the entrance to Pipeline Road (locally called Ammo Dump Ponds) and other nearby wetlands (*e.g.*, the lake at Panama Rainforest Discovery Center), without redundancy with Parts I or II. For species found in more than one area, I placed them in their most-frequented areas. When species were found in two areas approximately equally, I placed them in the area in which most of the species in their taxonomic Order frequents in order to aid in comparisons; consequently, all doves/pigeons, parrots/parakeets, and toucans/aracaris are in Part I and all kingfishers are in Part III. Locations of songs heard in more than one area are identified in the Appendix. If you are unsuccessful in identifying a song, you might check the Appendix for another area where the song is heard and try keying it out there. Part IV covers the nocturnal birds of all three areas.

A vital part of this key is being able to hear the bird songs. This is made possible through use of a freely available, geographically based database of bird songs worldwide: www.xeno-canto.org. Definitions of terms and final choices in the key are linked to representative recordings and spectrograms from this website (spectrograms are called “sonograms” therein). Use of recordings from xeno-canto is subject to three Creative Commons licenses. Here I used the most-restrictive level (Attribution-NonCommercial-NoDerivs) in which users are free to download and distribute recordings as long as they attribute the recordist, but they are not free to use them commercially or alter them in any way; the two less-restrictive levels allow commercial use and alterations of the recordings.

SONGS AND SPECIES COVERED

This key covers 321 songs and calls of 216 species in the Pipeline Road area. One could survey this area for months without hearing any other bird songs or calls. Many species have two or more vocalizations (see Appendix). Five common, vocal migrants are included (Eastern Wood-Pewee, Great Crested Flycatcher, Northern Waterthrush, Swainson’s Thrush, Yellow-throated Vireo). The key also notes wing snaps of two species of manakins and distinctive drumming patterns of woodpeckers. In addition, the key parenthetically includes the birdlike song of the most-frequently heard frog along Pipeline Road: the Striped Rocket Frog (*Allobates talamancae*).

When choosing which recordings from www.xeno-canto.org to include in the key, I gave first priority to those taken in the study area. If none were available, I moved progressively farther away until I found songs that sounded, as far as I could tell, exactly like those in the study area. Thirty-nine percent of the 354 recordings included here were from Pipeline Road or within 8 km of Pipeline Road, 36.3% were from other parts of Panama), 7.3% were from other countries of Central America (6.2% from neighboring Costa Rica), 15.8% were from South America (9.3% from neighboring Colombia), and less than 1% each were from Mexico (0.8%) and the United States (0.6%). Five described songs did not have a representative recording.

Taxonomic changes resulting in new species recognized after the printing of Angehr and Dean (2010 [1]) included are: Crowned Woodnymph (from Violet-crowned Woodnymph), Gartered Trogon (split from Violaceous Trogon), Whooping Motmot (from Blue-crowned Motmot), Black-mandibled Toucan (from Chestnut-mandibled Toucan), Black-crowned Antshrike (from Western-Slaty Antshrike), Russet-winged Schiffornis (from Thrush-like Schiffornis), and Scaly-breasted Wren (from Southern Nightingale-Wren). In addition, Mistletoe Tyrannulet soon may be split from Paltry Tyrannulet (and is so called in www.xeno-canto.org), so that possibility is noted parenthetically.

HOW TO USE

I suggest the following methods to use and learn from this key. First, read and understand the Definitions of Terms, and listen to each of the examples provided. Then, examine the choices presented in the Table of Contents, which shows the order in which choices are made. Finally, go through the key and listen to many or all of the songs and calls. More than one song can be played at the same time, thereby allowing simultaneous comparisons between or among songs. Look carefully at the spectrograms provided with each song to see how, for example, elements downslur or upslur (see Definitions of Terms). In spectrograms, frequency (in kHz) is presented on the Y axis, time (in sec) on the X axis, and relative volume by the lightness/darkness of the image and by the lower graph; see Stephenson & Whittle (2015 [5]), McCallum (2010a, b [6, 7]), and Pieplow (undated [8]) to fully understand spectrograms.

When one tries to describe a bird song, many adjectives may come to mind in no particular order. However, within this key, one must follow its ordering of choices. Applying this approach as a model for learning the bird songs in different areas or regions could aid in identifying the similarities and differences among songs; however, a different ordering of choices may be more appropriate in other areas. A way to streamline keying-out a song is to make the first few choices via the Table of Contents, jump to the appropriate part of the key, and go from there. You can move within

the key by links to the next choice (→) for all choices listed in the Table of Contents and for all choices when the next choice is not close by. You can keep track of where you are because equal-level choices have the same indentation level and the same font, boldness, italics, and underlining, as follows:

LEVEL 1

LEVEL 2

LEVEL 3

Level 4

Level 5

Level 6

Level 7

Level 8

Level 9

Level 10

Level 11

DEFINITIONS OF TERMS

DESCRIPTIVE UNITS →

I searched the scientific literature for terms used for descriptive units of bird songs to see whether any would be suitable for my key. During that search, I found that many researchers [*e.g.*, 9-11] use three levels of units within a song. For them, the lowest level is the *note*, which is represented by a continuous trace on a spectrograph. The next level is the *syllable*, which is a sequence of one or more notes. Groupings of syllables and notes are called *phrases*. However, I found their term “note” to be counter-intuitive because it communicates a note on the musical scale, but their notes often include many notes on the musical scale (*e.g.*, slurs; see below). Also, I found their use of “syllable” to be confusing because it is not like a syllable we use when speaking or writing; it can contain several of which otherwise would be considered as syllables. Fortunately, the structural organization of bird songs presented in Stephenson and Whittle (2015 [5]) avoids these problems and is intuitively easy to use; therefore, I employ it here. Their three terms are **element**, **phrase**, and **section**. “Every separate sound you hear when listening to a song is an element. An element can be a single long note, a short note, or even a long buzz. Elements are the building blocks of songs. If it sounds like one smoothly continuous sound to our ears, it’s an element” (Stephenson and Whittle 2015:70 [5]). A phrase is “a single element or a group of two, three, or more...elements that are repeated 2 or more times without change” (Stephenson and Whittle 2015:71 [5]). Sections are groups of similar phrases. In addition, sections are grouped together into **songs**, which are “identified by the pauses between them, which are of the order of several seconds” (Thompson *et al.* 1994:273 [10]).

Vocalizations of birds often are placed into arbitrary categories such as **song**, **call**, and **scold**, which can be based on how pleasing they are to the human ear. We usually think of the prettiest vocalizations as songs, less pretty ones as calls, and burry ones as scolds or alarm calls. In addition, we generally think of a bird singing as part of a territorial display by males, calling as part of more mundane activities (*e.g.*, contact calls), scolding when disturbed, and alarm-calling when drawing attention to the presence of a predator such as a raptor or a snake. (See Baker 2001 [11] and Slater 2003 [12] for reviews of studies that examine the development and functions of songs, and Suzuki 2016 [13] for a review of studies concerning functions of alarm calls.) Many authors “point out the arbitrary distinction between calls and songs but acknowledge that the terms are probably not going to go away” Baker (2001:8 [11]). Such labels, while often accurately describing the bird’s actions, can presume we understand the bird’s motives which, in many cases, we cannot. For example, Yellow-backed Orioles vocalize a series of melodious *weo-wee* whistles as well as harsh *chink*, *chink*, *chink* sounds. One might call the former a song and the latter a call; however, sometimes these birds mix both types in an uninterrupted series (*e.g.*, *wee-weo-wee*, *chink-chink-chink*, *weo-wee-wee*, *chink-chink*). So in most cases (as in the title), I simply refer to them all as songs; in some cases, I label vocalizations as songs, calls, or scolds to communicate general musicality without ascribing motive or function.

PITCH →

Pitch categories →

To minimize confusion, I use only three **pitch categories**, and I do so only a few times. Several species here utter notes of (1) **low or very low** pitch (*e.g.*, Short-billed Pigeon www.xeno-canto.org/112914 by Sander Bot, Rufous-vented Ground-Cuckoo www.xeno-canto.org/83102 by Brian Cox, Spectacled Owl www.xeno-canto.org/92131 by William Adsett); I do not attempt to distinguish between pitches that are low or very low. Most birds sing notes of (2) **medium or high** pitch; again, I do not differentiate between these two. A few species sing notes of (3) **very high** pitch (*e.g.*, Pied Puffbird www.xeno-canto.org/113047 by Sander Bot, Olive-striped Flycatcher www.xeno-canto.org/2970 by David Bradley); to help you calibrate this pitch, a very small percentage of people can whistle very high. I use relative pitch (*e.g.*, one trill is higher than another) throughout this key rather than absolute pitch (*e.g.*, elements that are middle C vs. middle G on a piano) because it is difficult or impossible for humans, even those with “perfect pitch,” to find absolute pitch of many bird songs; this is because many birds vocalize at pitches well above the range of the human ear

and “many bird sounds are harmonically complex, comprising not a single tone but an admixture of several” (Pieplow 2007:50 [14]). **Harmonics** are pitches in addition to the fundamental pitch that are multiples of the fundamental; such harmonics create rich-sounding songs to us [5, 6, 14] (e.g., songs in Figs. 1-4), whereas we hear songs with simultaneous, non-harmonic pitches as harsh or discordant [5] (e.g., churrs of Bicolored Antbird www.xeno-canto.org/133165 by Jerome Fischer and Black-bellied Wren www.xeno-canto.org/24181 by Ken Allaire).

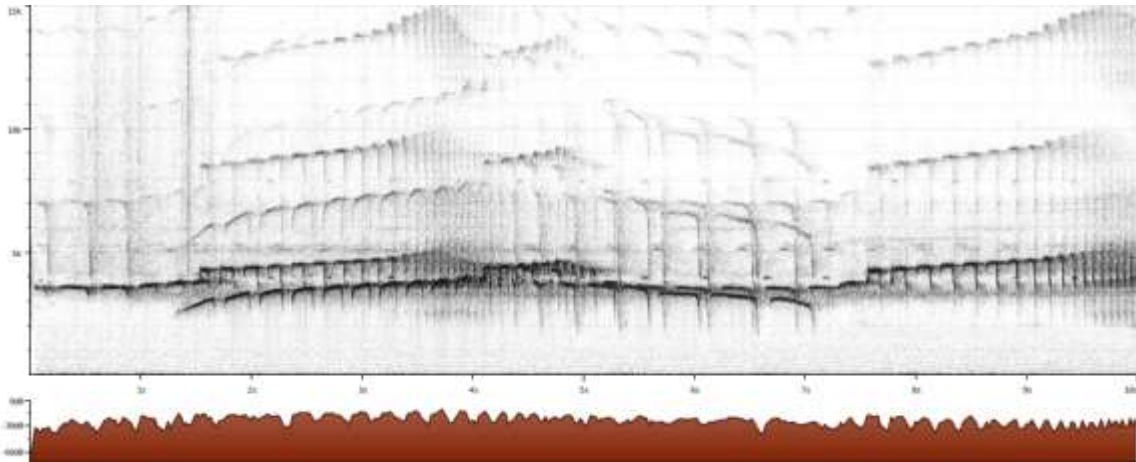


Fig. (1). Spectrogram of song of Ocellated Antbird (www.xeno-canto.org/71900 by Andrew Spencer) showing rising and falling pitches, harmonics, up/downslurring elements, and accelerating and decelerating tempos.

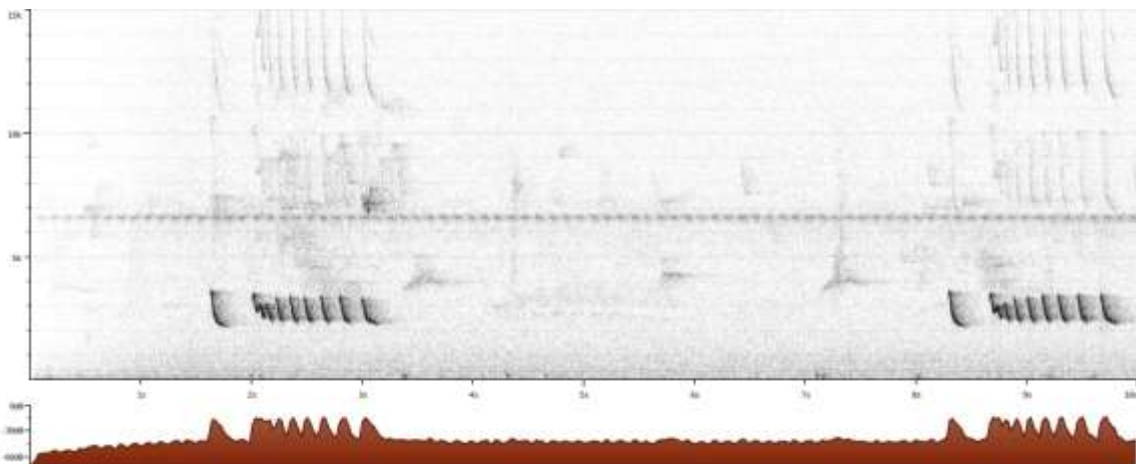


Fig. (2). Spectrogram of song of White-winged Becard (www.xeno-canto.org/107784 by Klemens Steiof) showing harmonics, up/downslurring second element, downslurring third-to-eighth elements, and a pause between the first and second elements. The horizontal line indicates background noise.

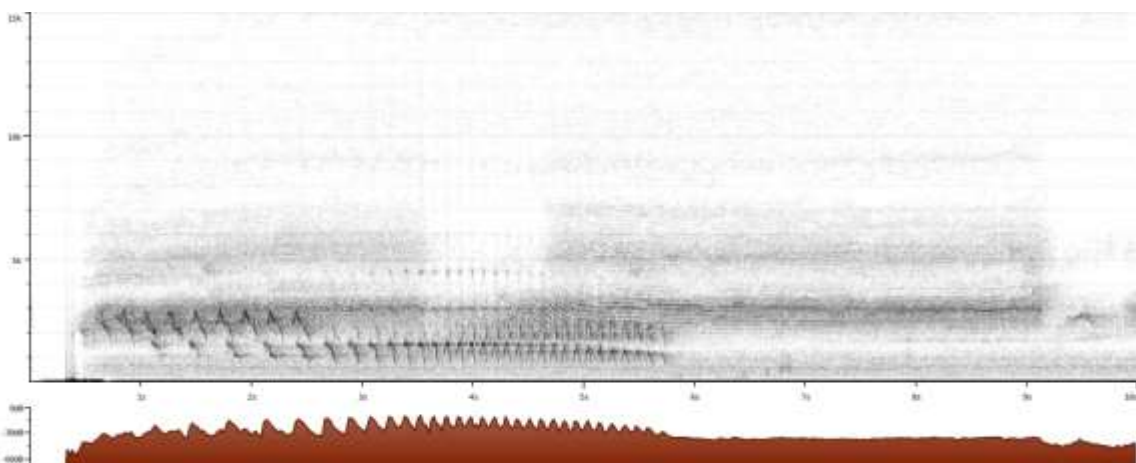


Fig. (3). Spectrogram of song of White-tailed Trogon (www.xeno-canto.org/113450 Jerome Fischer) showing harmonics, up/downslurring elements, and accelerating tempo.

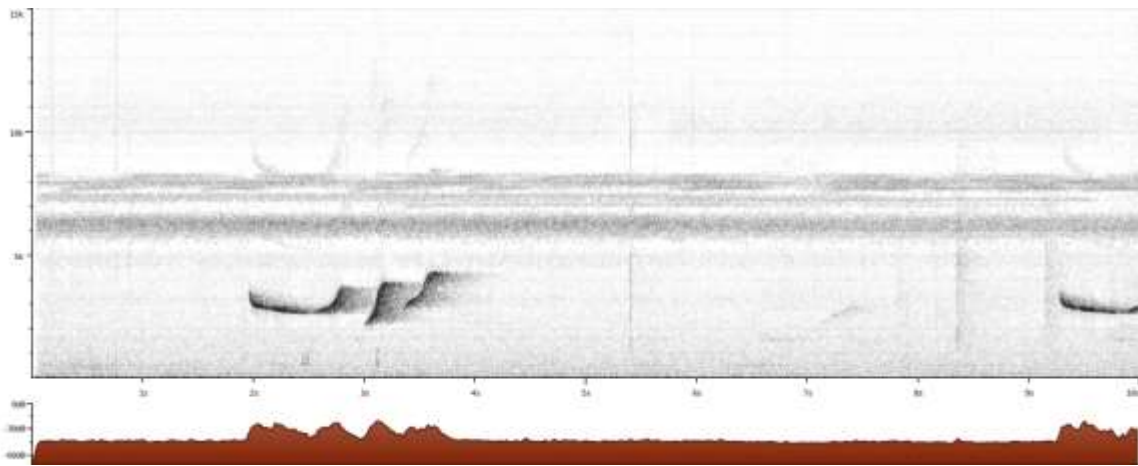


Fig. (4). Spectrogram of song of Russet-winged Schiffornis (www.xeno-canto.org/60785 by Ken Allaire) showing harmonics, a down/upslurring first element, and upslurring second and third elements. The horizontal lines indicate sounds made by insects.

Pitch changes with two or more elements →

Many songs include **changes in pitch**. Pitch **rises** when at least two successive elements, phrases, or sections ascend in pitch (*e.g.*, Tropical Kingbird www.xeno-canto.org/1123 by Robin Carter), pitch **falls** when they descend in pitch (*e.g.*, Brown-capped Tyrannulet www.xeno-canto.org/18618 by Ken Allaire) (Fig. 1), and pitch is **steady** when they do not change. Complex songs of variable pitch (*e.g.*, Gray-headed Chachalaca www.xeno-canto.org/17192 by Allen T. Chartier, Yellow-rumped Cacique www.xeno-canto.org/32050 by Andrew Spencer) are considered to be of steady pitch. To conserve space and not inflate the total number of songs presented, when a species has songs of more than one pitch-change type, the songs key-out in the more or most complex type. For example, songs of Golden-crowned Spadebill and Long-billed Gnatwren can rise then fall, fall then rise, rise, fall, or be steady, so these songs key-out as “Pitch rises and falls.” In such cases, song descriptions list all pertinent pitch-change types. This space-saving feature can be a source of error when trying to identify songs, so if you are unsuccessful at keying-out a song, you might try a more complex pitch change.

Pitch changes within an element

Elements **upslur** when they rise in pitch (*e.g.*, Squirrel Cuckoo www.xeno-canto.org/60783 by Ken Allaire; Paltry (or Mistletoe) Tyrannulet www.xeno-canto.org/46978 by Mike Nelson) and **downslur** when they fall in pitch (*e.g.*, White-winged Becard www.xeno-canto.org/107784 by Klemens Steiof) [5, 8, 14, 15] (Fig. 2). Some elements “up/down slur” [5] or “overslur” [8] when they upslur and then immediately downslur (*e.g.*, Bright-rumped Attila www.xeno-canto.org/31820 by Andrew Spencer, Red-capped Manakin www.xeno-canto.org/10085 by Ken Allaire, Slate-colored Grosbeak www.xeno-canto.org/271577 by Peter Boesman) (Figs. 1, 3). Similarly, some elements “down/upslur” [5] or “underslur” [8] when they downslur and then immediately upslur (*e.g.*, Eastern Wood-Pewee www.xeno-canto.org/94732 by William Adsett; Russet-winged Schiffornis www.xeno-canto.org/60785 by Ken Allaire) (Fig. 4). I often find it to be difficult or impossible to differentiate between elements that up/downslur vs. those that down/upslur, especially when the elements almost run together. So, to lessen user error, I do not use these complicated terms for choices in the key; I simply place such songs under “Elements upslur and downslur.” I do, however, use those terms in song descriptions. Such elements or phrases also could be classified as **warbling**, which are “vocalizations that change pitch rapidly in no simple pattern” (Pieplow 2007:51 [14]). Most songs in this key include elements that upslur and downslur. “Birding by ear, visually” [6, 7] first requires dedicating the time to listen to songs while examining their spectrograms. The biggest “ear-opening” experience for me while preparing this key was how many songs upslur and downslur when I thought they were not slurring (*e.g.*, Great Kiskadee www.xeno-canto.org/32045 by Andrew Spencer, Brownish Twistwing www.xeno-canto.org/2960 by David Bradley), were only upslurring (*e.g.*, Black-tailed Trogon www.xeno-canto.org/2947 by David Bradley, Scrub Greenlet www.xeno-canto.org/60714 by Ken Allaire), or were only downslurring (*e.g.*, Collared Forest-Falcon www.xeno-canto.org/15730 by Ken Allaire, Rufous Mourner www.xeno-canto.org/113553 by Jerome Fischer). It takes careful listening and practice to differentiate between, for example, elements that upslur (*e.g.*, Lineated Woodpecker www.xeno-canto.org/54677 by Bernabe Lopez-Lanus) and those that quickly upslur and downslur (Gray-headed Kite www.xeno-canto.org/31899 by Andrew Spencer). To learn how simple non-slurring songs sound, you might listen to each of the songs in the “Elements do not slur” sections in the four parts of the key.

QUALITY →

Quality of notes concerns how clear or nasal they are. **Clear** notes are familiar to us by many musical instruments including the flute and clarinet. Many songs in this key are clear, including those of Fasciated Antshrike (www.xeno-canto.org/60785)

canto.org/24194 by Ken Allaire) and Russet-winged Schiffornis (www.xeno-canto.org/60785 by Ken Allaire). A **trill** is a “rapid repetition of elements at a speed too fast for us to count” (Stephenson & Whittle 2015:64 [5]). In this key, trills are clear notes sung at a tempo of at least 6 per sec, like the song of Long-billed Gnatwren (www.xeno-canto.org/133152 by Jerome Fischer). (Stephenson & Whittle 2015 [5] consider notes as fast as 9 per sec to be countable, but I think that is too fast for most people.) Trills can change in tempo or pitch. Elements within trills can slur, but because it would be very difficult or impossible to discern whether such quickly voiced elements slur, trilling songs key-out first. Here, “Song trills” means the whole song is a trill, whereas “Song includes trills” means the song includes at least one phrase that trill and at least one phrase that does not. Here I call a **run** a series of the same clear notes or very similar clear notes sung quickly but at countable tempo—at about 4 notes per sec.

Clear notes can **quaver** or tremble. Quavering songs include only four species here: Little Tinamou (www.xeno-canto.org/47059 by Mike Nelson, www.xeno-canto.org/56908 by Mike Nelson), Great Tinamou (www.xeno-canto.org/131552 by Thore Noernberg), Pheasant Cuckoo (www.xeno-canto.org/83089 by Brian Fox), and Rosy Thrush-Tanager (www.xeno-canto.org/15702 by Don Jones). Some clear songs include **clucks**, as do those of Song Wren (www.xeno-canto.org/107771 by Klemens Steiof) and Black-faced Antthrush (www.xeno-canto.org/10535 by Allen T. Chartier). Some clear songs are **airy**, like those of Great Jacamar (www.xeno-canto.org/110631 by Ken Allaire) and Tropical Gnatcatcher (www.xeno-canto.org/96416 by Yair G. Molina-Martínez). The clear song of Bay Wren **repeat-bounces** as it quickly repeats the lowest notes or highest notes of phrases (www.xeno-canto.org/92124 by William Adsett). Several finches such as Thick-billed Seed-Finch (www.xeno-canto.org/72316 by Andrew Spencer) have clear songs with short, little **twittering** notes. Elements are subjectively **sweet** when they are clear, short, relatively quiet and, often, sound like *sweet* (e.g., Ruddy-tailed Flycatcher www.xeno-canto.org/6516 by Ken Allaire, Lesser Greenlet www.xeno-canto.org/78668 by William Adsett, Cinnamon Becard www.xeno-canto.org/2944 by David Bradley). **Whistles** typically are clear; the energy in whistles is concentrated on single frequencies, such that their spectrograms are represented by single lines [14]. Some songs **gurgle** or **bubble**, as if emanating from underwater; gurgles are lower-pitched (e.g., Yellow-rumped Cacique (www.xeno-canto.org/10491 by Allen Chartier; Chestnut-headed Oropendula (www.xeno-canto.org/18434 by Hernan van Oosten) than are bubbles (e.g., Blue-crowned Manakin www.xeno-canto.org/112920 by Sander Bot).

Nasal sounds by humans are made by lowering the soft palate so that air resonates in the nasal cavities and passes out the nose, like when we say the letter “n”. Birds create vocalizations that sound similarly nasal to us. However, nasal sounds by birds are “combinations of multiple simultaneous whistles on different pitches” (Pieplow undated [8]) (Figs. 1, 3) which our brains often interpret as whistles, especially if they are high-pitched [14]. Consequently, in this key, some clear and some nasal elements are referred to as whistles. Many songs in this key are obviously nasal, three of which are Black-throated Trogon (www.xeno-canto.org/1085 by Robin Carter), Plain-brown Woodcreeper (www.xeno-canto.org/1113 by Robin Carter), and Spotted Antbird (www.xeno-canto.org/108217 by Jerome Fischer). Here I refer to clear songs and nasal songs only when they obviously fit into one category or the other because there is a large “gray area” between these two categories. Songs **churr** when a bird sings a series of harsh, non-musical, usually nasal notes at a tempo of at least 6 per sec which, as described above, is about the fastest most people can count. Churrs often are described as being buzzy, burry, grating, croaking, or growling, and can sound like *rent*, *dzerrr*, or *aaarr*, but also can be less grating (e.g., *wups* of Slaty-tailed Trogon www.xeno-canto.org/31915 by Andrew Spencer) if they are sung at a tempo of at least 6 per sec. Churrs can change in tempo or pitch. Examples include scolds of Black-crowned Antshrike (www.xeno-canto.org/107779 by Klemens Steiof) and Plain Wren (www.xeno-canto.org/32047 by Andrew Spencer). In the key, “Song churrs” means the whole song is a churr, whereas “Song includes churrs” means the song includes at least one phrase that churrs and at least one phrase that does not. Here I call a **run** a series of the same nasal notes or very similar nasal notes sung quickly but at countable tempo—at about 4 notes per sec. Some nasal songs are **airy**, like those of Cinnamon Woodpecker (www.xeno-canto.org/116313 by Diego Calderon F.), Broad-billed Motmot (www.xeno-canto.org/1088 by Robin Carter), and Boat-billed Flycatcher (www.xeno-canto.org/46785 by Mike Nelson). A few nasal songs possess **clucks**, including those of Gray-necked Wood-Rail (www.xeno-canto.org/106510 by Mike Nelson), Greater Ani (www.xeno-canto.org/9314 by Allen T. Chartier), and Gray-headed Chachalaca (www.xeno-canto.org/17192 by Allen T. Chartier). “Song includes clucks” means the song includes phrases that are clucks and other phrases that are not. Some nasal songs sound **spoken**, as if a person were talking; an example is a call of Black-crowned Antshrike (www.xeno-canto.org/90394 by Leslie Lieurance). Finally, a few species have songs that **screech**: Yellow-headed Caracara (www.xeno-canto.org/199019 by Guillermo Funes), Semiplumbeous Hawk (www.xeno-canto.org/274200 by Peter Boesman), Orange-chinned Parakeet (www.xeno-canto.org/1104 by Robin Carter), and all three parrots (e.g., Red-lore Amazon www.xeno-canto.org/127524 by Thore Noernberg).

TEMPO →

Many songs of at least three elements or phrases have notes that **change in tempo**, or in number of beats per unit of time; tempo is also called “rhythm” [5] or “rate” [14]. Tempo **accelerates** when elements increase in tempo (Figs. 1, 3), **decelerates** when elements decrease in tempo (Fig. 1) (e.g., White-bellied Antbird www.xeno-canto.org/182262 by Jerome Fischer), is **erratic** when elements are sung in an irregular tempo (e.g. Fasciated Antshrike www.xeno-canto.org/133153 Jerome Fischer), and is **steady** when tempo does not change. Several songs have an introductory

element, a pause, then a series of elements of steady tempo (*e.g.*, Black-faced Antthrush www.xeno-canto.org/2959 by David Bradley, Yellow-margined Flycatcher www.xeno-canto.org/18232 by Herman van Oosten) (Fig. 2); here such songs are considered to have steady tempo.

VARIATION →

I developed a system of four song-variation categories so you will know how much variation to expect when learning the songs. **Invariable** songs are sung every time without any change in arrangement. They may have changes in pitch or tempo, but all of the elements, phrases, and/or sections are sung, and all are sung in the same order (*e.g.*, Blue-crowned Manakin www.xeno-canto.org/112920 by Sander Bot, Crimson-crested-crowned Woodpecker www.xeno-canto.org/31897 by Andrew Spencer). More than three-quarters of the songs in the key are invariable. **Variable** songs are those that sometimes delete or rearrange sections of the typical song, but do not rearrange elements or phrases within the sections that are sung (*e.g.*, Cinnamon Becard www.xeno-canto.org/2944 by David Bradley). Almost one-fifth of the songs in the key are variable. **Variable/repertoire** songs are sung so quickly, and have so many complexities, that it is difficult or impossible for most people to determine whether they merely delete or rearrange sections or whether they rearrange elements or phrases within sections (*e.g.*, Variable Seedeater www.xeno-canto.org/271589 by Peter Boesman). Here Yellow-bellied Seedeater, Ruddy-breasted Seedeater, Variable Seedeater, Thick-billed Seed-Finch, and Lesser Goldfinch have variable/repertoire songs. Finally, **repertoire** songs are non-rapid songs that obviously rearrange elements or phrases within sections; these are sung slowly enough that it is easy to discern and describe the rearrangements. Here Clay-colored Thrush, Rosy Thrush-Tanager, Tropical Mockingbird, Yellow-tailed Oriole, and most of the wrens sing repertoires. I include song variation in song descriptions, but do not use song variation in choices in the key because some birds sing only one arrangement at a time and I made this key to identify each song as it is heard.

EMPHASIS

Some elements are sung more strongly or with more emphasis than others. Such elements are termed **emphatic** [1] (*e.g.*, Rufous Nightjar www.xeno-canto.org/2954 by David Bradley, Bright-rumped Atilla www.xeno-canto.org/31820 by Andrew Spencer, Rufous Piha www.xeno-canto.org/60760 by Ken Allaire).

PART I: KEY TO SONGS OF DIURNAL BIRDS IN THE FORESTS ALONG PIPELINE ROAD →

SONG IS A TRILL OR CHURR →

TEMPO ACCELERATES AND DECELERATES →

Plain-brown Woodcreeper. A rapid, long series of nasal, “loud churring” [1:196] that accelerates then decelerates. Can repeat the series uninterrupted once or many times; song can include hundreds of elements and last more than 1 min. Invariable. www.xeno-canto.org/1113 by Robin Carter

TEMPO ACCELERATES →

Plain Xenops. A “rapid series of 8 to 12 high *chik* notes, accelerating slightly” [1:192] and stopping abruptly. Invariable. www.xeno-canto.org/46983 by Mike Nelson

TEMPO DECELERATES →

Notes are bubbly

Blue-crowned Manakin. A series of about 6–12 bubbly notes in about 1 sec, last few notes decelerate. Invariable. www.xeno-canto.org/112920 by Sander Bot

Notes are sharp

Song lasts less than 15 sec →

Squirrel Cuckoo. A series of nasal, chattering elements lasting about 6–12 sec; decelerates from about 10 to about 3 elements per sec. Invariable. Sharper than song of Plain-brown Woodcreeper. www.xeno-canto.org/37847 by Oswaldo Cortes

Plain-brown Woodcreeper. A shortened, decelerating version of this species’ song that accelerates and decelerates; includes about 20–30 elements. Invariable. www.xeno-canto.org/271222 by Peter Boesman

Olivaceous Woodcreeper. “Song a high, fast musical trill” [1:194]; the last few notes decelerate. Invariable. Higher than songs of Squirrel Cuckoo and Plain-brown Woodcreeper. www.xeno-canto.org/271585 by Peter Boesman

Song lasts at least 30 sec

Ruddy Woodcreeper. A fast churring of sharp, nasal notes lasting 30 sec or more, abruptly decelerating at the end. Invariable. www.xeno-canto.org/137727 by Paul Driver

TEMPO IS STEADY**Pitch rises and falls** →**Pitch is very high** →

White-whiskered Puffbird. A trilling, very “high, thin, hissing” song [1:170]: *eeee-uuuu!* or *eee-uuu-eee!* Can be sung individually or in a series of several phrases at about 1 per sec. Pitch can fall, fall and rise, be steady, *etc.* Variable. www.xeno-canto.org/2818 by David Bradley, www.xeno-canto.org/107783 by Klemens Steiof

Golden-crowned Spadebill. A quiet, very high, clear, insect-like trill lasting about 2 sec. Pitch can rise then fall, fall then rise, rise, fall, or be steady. Sweeter and clearer than song of White-whiskered Puffbird. Invariable. www.xeno-canto.org/93679 by Tom Stevens, www.xeno-canto.org/16166 by Ken Allaire

Pitch is medium or high**Song trills**

Long-billed Gnatwren. A clear, sweet trill lasting about 2 sec. Pitch can rise then fall, fall then rise, rise, fall, or be steady. Invariable. www.xeno-canto.org/133152 by Jerome Fischer

Song churrs***Elements alternate between two pitches***

Bay Wren. A rapid churring of about 5–8 sharp notes mixed with higher, single sharp notes; each churr is sung within about one-half sec. Variable. www.xeno-canto.org/31892 by Andrew Spencer

Elements do not alternate between two pitches

Hook-billed Kite. A nasal, “whinnying *whi-hi-hi-hi-hi-hii-uh* [1:38]. Invariable. More nasal and airy than churr of Black-throated Trogon. www.xeno-canto.org/83465 by David Geale

Black-throated Trogon. A churr of nasal, falling, almost bubbly notes lasting about 1 sec, often sung in a series with pauses of about 1 sec between churrs. Can start with a burst of sharp, nasal, rising notes *Brrr-deet-deet-deet!*, especially when the birds flush from a perch. Falling or rising songs can be sung together or separately. Variable. www.xeno-canto.org/6005 by Ricardo Gagliardi

Pitch rises →

Blue-headed Parrot. A fast, two-phrased churr of strong, rising elements; a “shrill...*zher-renk!*” [1:116]. Invariable. Higher and more shrill than songs of Keel-billed Toucan and Blue-crowned Manakin. (Highest-pitched song of the parrots, and the only one with only a rising pitch. Similar in pitch to song of Orange-chinned Parakeet.) www.xeno-canto.org/57152 by Bernabe Lopez-Lanus

Keel-billed Toucan. A loud, rising, “frog-like, croaking” *Kreek!* “often repeated for long intervals” [1:176] of 1–2 mins. Each “croak” is composed of about 6 rough elements; about 1–2 croaks per sec. Invariable. www.xeno-canto.org/15689 by Don Jones

Blue-crowned Manakin. A “doubled, croaking, frog-like *ku-wheek!*” [1:270] or *ku-WEEK!*, with the accent on the second, higher phrase, which is composed of about 6 elements; about one “croak” every 2 sec. Usually preceded by a few bubbly elements. Invariable. Each croak is composed of two phrases, unlike song of Keel-billed Toucan. www.xeno-canto.org/18617 by Ken Allaire

Pitch falls →**Song is composed of one trill or churr** →

Southern Bentbill. A nasal, falling, “rolling, burry...*bwrrrrrrr*” [1:256] (1) and a clear, falling, rolling, trilly *eeerrr* (2) (Table 1). Invariable (both). (1) www.xeno-canto.org/1031 by Robin Carter, (2) www.xeno-canto.org/24329 by Thomas Donegan

Bicolored Antbird. A falling, “harsh, grating *gwarrrr!* and a thin, falling *zhrooo*” [1:214] (Table 1). Invariable. www.xeno-canto.org/133165 by Jerome Fischer

Ocellated Antbird. A falling, “sharp *dzerrr*” [1:214] (Table 1). Invariable. www.xeno-canto.org/31922 by Andrew Spencer

Black-bellied Wren. A falling, harsh *aaarr!* (Table 1). Invariable. www.xeno-canto.org/24181 by Ken Allaire

Table 1. Comparison of the songs in Part I that are a trill or churr, tempo is steady, and: (1) pitch falls, song is composed of one trill or churr; (2) pitch is steady, song trills, song is composed of one trill, each trill lasts 1 sec or less; or (3) pitch is steady, song churrs, song is composed of one churr.

Species	Pitch rises and falls (RF), falls (F), or is steady (S)	Trill (T) or churr (C)	Relative pitch (1–5; 1 = lowest)	Relative sharpness (1–5; 1 = least)	Relative “spokenness” (1–5; 1 = least)
Spotted Antbird	S	T	3	4	1
Dusky Antbird	RF	C	3	1	4
Chestnut-backed Antbird	RF	C	4	1	5
Bicolored Antbird	F	C	1	3	4
Ocellated Antbird	F	T	5	5	1
Southern Bentbill (burry)	F	C	2	1	3
Southern Bentbill (trilly)	F	T	5	1	1
Black-capped Pygmy-Tyrant	S	T	5	1	1
Olivaceous Flatbill	S	T	4	3	1
Red-capped Manakin	S	C	2	3	1
Black-bellied Wren	F	C	3	1	4
White-breasted Wood-Wren (more spoken)	S	C	5	5	3
White-breasted Wood-Wren (less spoken)	S	C	3	4	1

Song is composed of three or more churrs

Cinnamon Woodpecker. An airy, nasal, sharp, fast series of about 7–10 elements, falling slightly in the last few elements: *kik ik ik ik ik ik keu*. Invariable. Sharper than songs of Golden-collared Manakin. www.xeno-canto.org/116313 by Diego Calderon F.

Golden-collared Manakin. A churring, falling, “shrill *whee-you!*” [1:268], strung together into a song with other similar, churring phrases such as *keruu kyonk-kyonk* (1). Variable. “Displaying males make rapid, loud snapping noises with their wings, like a string of firecrackers going off” [1:268] (2). The wing snaps differ from those of Red-capped Manakins in that they are about twice as loud, and they are done in single burst only, not as a series of bursts. (1) www.xeno-canto.org/31898 by Andrew Spencer (not the loud White-breasted Wood-Wren song in sec 23–27), (2) www.xeno-canto.org/10078 by Ken Allaire

Pitch is steady

Song trills →

Song is composed of one trill →

Each trill lasts 1 sec or less →

Spotted Antbird. A rapid, sharp trill, often sung when at army-ant swarms (Table 1). Invariable. www.xeno-canto.org/113042 Sander Bot

Black-capped Pygmy-Tyrant. A trilling, “sharp, high-pitched *cheet!* [or *cheleet!*] given singly or repeated at intervals of 1 or 2 sec (easily mistaken for call of an insect)” [1:230]. Invariable. Faster and shorter than calls of Spotted Antbird and Olivaceous Flatbill (Table 1). www.xeno-canto.org/107745 by Klemens Steiof, www.xeno-canto.org/17186 by Allen Chartier

Olivaceous Flatbill. A trilling “short, harsh...*khrrrt!*” [1:234] (Table 1). Invariable. www.xeno-canto.org/17201 by Allen Chartier

Each trill lasts 2–3 sec →

Whooping Motmot. A series of about 8–16 whoops within about 2 sec, sometimes starting with a sharper *whop!* Invariable. Song whoops, unlike that of Streak-chested Antpitta. www.xeno-canto.org/10069 by Ken Allaire

Streak-chested Antpitta. A series of about 8–20 sweet, downslurring notes sung at about 6–8 per sec, accented on the top of each downslur. Sometimes the song decelerates a little. Invariable. www.xeno-canto.org/3309 by David Bradley

Each trill lasts at least 4 sec

White-necked Puffbird. A loud, high, clear trill lasting several sec. Invariable. www.xeno-canto.org/66639 by Jeremy Minns

Song is composed of two or three trills

Fulvous-vented Euphonia. “Call a short rolling *churrit* that is often doubled or tripled” [1:386]. Invariable. www.xeno-canto.org/18649 by Ken Allaire

Song churrs**Song is composed of one churr →**

Dusky Antbird. A harsh *aarr* (Table 1). Invariable. www.xeno-canto.org/2805 by David Bradley

Chestnut-backed Antbird. A cat-like *aaahr* (Table 1). Invariable. www.xeno-canto.org/329125 by Kent Livezey

Red-capped Manakin. A rough churr that can be sung alone or as the last section of its upslurring and downslurring song; the churr can be heard at much farther distances than the rest of its song. Sometimes the churr is doubled, with the first one higher in pitch than the second. Some churrs are harsher, louder, and longer than others (Table 1). Variable. www.xeno-canto.org/271229 by Peter Boesman at sec 27, 30

White-breasted Wood-Wren. Two harsh calls, one of which is more spoken (1) than the other (2) (Table 1). Invariable (both). (1) www.xeno-canto.org/107782 by Klemens Steiof, (2) www.xeno-canto.org/94744 by William Adsett

Song is composed of two churrs →

Lineated Woodpecker. A “rattling *ke-YUrrrr!*” [1:184] (1). Song “rattles” (each element can be heard) more than calls of White-breasted Wood-Wren. Invariable. Drumming is a series of taps that slightly accelerate (2). (1) www.xeno-canto.org/48880 by Bernabe Lopez-Lanus, (2) www.xeno-canto.org/112919 by Sander Bot, www.xeno-canto.org/54588 by Bernabe Lopez-Lanus

White-breasted Wood-Wren. A rough, burry *bur DEEP* accented on the second, burry phrase (1). Also a *KE haw* with the first phrase clear and the second one hoarse and rough, accented on the first phrase (2). Invariable (both). (1) Not in xeno-canto. (2) Not in xeno-canto.

Song is composed of three or more churrs

Slaty-tailed Trogon. A rapid series of nasal *wups*, about 7–8 per sec (Table 2). Invariable. Fewer elements per sec than all other songs in Table 2. www.xeno-canto.org/31915 by Andrew Spencer

Broad-billed Motmot. Call is a series of 5 or more low, grating churrs, about 1 churr per sec (Table 2). Invariable. www.xeno-canto.org/76409 by Roger Ahlman

Black-cheeked Woodpecker. Two loud, churring, rattling songs, each of about 4–8 elements. One song is lower and rougher (1) than the other (2) (Table 2). Invariable (both). (1) www.xeno-canto.org/78587 by William Adsett, (2) www.xeno-canto.org/106090 by Mike Nelson

Bright-rumped Attila. About 5–7 very rapid, rattling, nasal elements (Table 2). Invariable. www.xeno-canto.org/32043 by Andrew Spencer

Masked Tityra. A series of “dry, raspy, croaking *kwirrk* [calls] (often doubled or repeated in a longer series)” [1:262]. Males with lower-pitched croaks than females (Table 2). Invariable. www.xeno-canto.org/274185 by Peter Boesman

Black-crowned Tityra. Song is “similar to that of Masked Tityra, but thinner and not as rasping” [1:262]: *kih-rr-rr-rit* (Table 2). Invariable. www.xeno-canto.org/71403 by Andrew Spencer

White-breasted Wood-Wren. A very rapid series of about 8–12 sharp notes sung within one-half sec (Table 2). Invariable. www.xeno-canto.org/111802 by Thore Noernberg

Red-throated Ant-Tanager. A series of “raspy notes that sound like tearing paper” [1:366] (Table 2). Invariable. www.xeno-canto.org/32041 by Andrew Spencer

Red-crowned Ant-Tanager. A series of raspy calls “much less harsh and grating than those of Red-throated [Ant-Tanager]” [1:366] (Table 2). Invariable. www.xeno-canto.org/126065 by Mike Nelson

Yellow-backed Oriole. Mechanical, grating *oink! oink! oink! oink!* Higher than call of Yellow-rumped Cacique. (Table 2). Invariable. (About the same pitch as the *kink!* of Yellow-tailed Oriole in Part III.) www.xeno-canto.org/113043 by Sander Bot

Yellow-rumped Cacique. A grating *rent! rent! rent!* Lower than call of Yellow-backed Oriole (Table 2). Invariable. (About the same pitch as the *onk* of Yellow-tailed Oriole in Part III.) www.xeno-canto.org/78378 by William Adsett

Table 2. Comparison of the songs in Part I that are trills or churrs, tempo is steady, pitch is steady, song churrs, and song is composed of three or more churrs.

Species	Relative pitch (1–5; 1 = lowest)	Relative sharpness (1–5; 1 = least)
Slaty-tailed Trogon	4	1
Broad-billed Motmot	1	1
Black-cheeked Woodpecker (low)	2	2
Black-cheeked Woodpecker (high)	5	5
Bright-rumped Attila	5	5
Masked Tityra	3	3
Black-crowned Tityra	3	1
White-breasted Wood-Wren	4	3
Red-throated Ant-Tanager	2	3
Red-crowned Ant-Tanager	3	2
Yellow-backed Oriole	4	4
Yellow-rumped Cacique	3	4

SONG INCLUDES TRILLS OR CHURRS →**SONG INCLUDES TRILLS →****Song is composed of two or three sections →**

Brown-capped Tyrannulet. A series of about 10–14 clear, high-pitched whistles; the first one or two upslurred notes are followed by a distinct pause, a falling trill, then an upslurred *weet!* Variations include skipping the first note, the pause, or the last note, and singing only the first note. Variable. Elements fall much more than those in song of Cinnamon Becard. Song terminates in an upslurring element, unlike song of Cinnamon Becard. www.xeno-canto.org/92095 by Mike Nelson, www.xeno-canto.org/18618 by Ken Allaire

Cinnamon Becard. A series of about 10–16 clear, sweet whistles, typically in two sections, one of which is a high trill, and the other is a series of lower, downslurring elements: *deedeedeedeedeedeede*, *dew dew dew dew*. Variations include singing fewer elements per section (e.g., *deedeedeede*, *dew dew*) and singing the sections in reverse order (e.g., *dew dew, deedeedeede*). Variable. www.xeno-canto.org/2944 by David Bradley

Song is composed of one section

Spot-crowned Antvireo. About 20–25 whistles that rise slightly, then accelerate into a trill while falling. Invariable. www.xeno-canto.org/98347 by Jerome Fischer

Moustached Antwren. A series of about 12–20 “high-pitched chirps, accelerating at the end” [1:206] into a trill while falling. Invariable. Elements downslur, unlike the nonslurring elements in song of Spot-crowned Antvireo. www.xeno-canto.org/2714398 by Peter Boesman

SONG INCLUDES CHURRS**Tempo accelerates →**

Buff-throated Foliage-gleaner. A nasal, sharp, accelerating, “rapid, descending series of sharp notes *ki-ki-kikikikikrrrr*” [1:190], ending in a churr. Invariable. www.xeno-canto.org/60662 by Ken Allaire

Black-crowned Antshrike. A nasal, “rapid, accelerating series of [about 12–16] nasal *henh* notes, ending on a longer harsh *hu-henk!*” [1:204] or ending on a one-noted *henk!* Invariable. (Compared to similar, accelerating song of Barred Antshrike in Part II: less nasal, slightly higher in pitch, slightly more rushed, elements do not fall before last one, and last element is squeaky.) www.xeno-canto.org/49856 by J. Patrick Kelley

Tempo is steady**Song includes gurgling →**

Yellow-rumped Cacique. A “variety of liquid whistling and bubbling calls, as well as grating churrs, squeaks, and sharp notes” [1:380]. Variable. Smoother and less crackly than songs of Chestnut-headed Oropendula. www.xeno-canto.org/32050 by Andrew Spencer

Chestnut-headed Oropendula. A “variety of calls including a gurgling rattle followed by a churr, and explosive resonant *whhhuurk!* and other chortling and bubbling notes” [1:382]. Variable. www.xeno-canto.org/32050

canto.org/18434 by Herman van Oosten, www.xeno-canto.org/31895 by Andrew Spencer

Song does not include gurgling

All sections of the song are similar

Violet-bellied Hummingbird. Each of the 3–10 sections of this song starts with an up/downslurring element (*zee*) immediately followed by a falling churr (*uurrr*), at about 1 per sec: *zeeuurrr zeeuurrr zeeuurrr*. Invariable. www.xeno-canto.org/271220 by Peter Boesman

All sections of the song are not similar

Black-crowned Antshrike. A nasal, “abrupt *ak!* followed by a rolling *kur-r-r-r-r*” [1:204]. Variable. (Somewhat like the reverse of the other accelerating song of this species, but the elements in the churr in this song are sung much faster.) www.xeno-canto.org/107779 by Klemens Steiof

SONG IS NOT A TRILL OR CHURR AND DOES NOT INCLUDE TRILLS OR CHURRS

ELEMENTS UPSLUR AND DOWNSLUR →

Tempo accelerates and decelerates →

Sections are without pauses between them →

Song is spoken

Collared Forest-Falcon. A series of about 12 nasal, spoken, up/downslurring *aoww* calls that accelerate from about 1 to 2 per sec, then, for the last few notes, decelerate and fall. Invariable. www.xeno-canto.org/15730 by Ken Allaire

Song is not spoken

White-tailed Trogon. A series of about 20–30 nasal “resonant *awwp*” [1:160] elements that accelerate from about 3 to 6 per sec, then, for the last few elements, decelerate and fall. Each *awwp* upslurs and downslurs. Invariable. www.xeno-canto.org/113450 by Jerome Fischer

Cocoa Woodcreeper. About 6–16 sharp, nasal whistles that rise while accelerating then fall while decelerating. Birds usually sing individual songs (1) but also string many songs together (2). Invariable (both). Elements down/upslur, rather than up/downslur, unlike those of the other songs in this section. (1) www.xeno-canto.org/182101 by Jerome Fischer (2) www.xeno-canto.org/46446 by Karl Kaufmann

Bicolored Antbird. A series of about 8–12 harsh, airy whistles, “the first three of four rising sharply in pitch and intensity, then rapidly decelerating and falling off” while becoming more nasal [1:214]. Many whistles are unslurred only, but some are up/downslurred. Airier than the other songs in this section. Invariable. www.xeno-canto.org/31819 by Andrew Spencer

Ocellated Antbird. Series of about 6–16 sharp, up/downslurring, “piping notes, rising sharply in pitch and intensity” [1:214] while accelerating, then dropping in pitch while decelerating, sometimes ending in several clear notes of the same pitch. Invariable. Less airy and more musical than song of Bicolored Antbird; sharper than songs of White-tailed Trogon and Bright-rumped Attila. www.xeno-canto.org/71900 by Andrew Spencer

Bright-rumped Attila. A fast series of about a dozen nasal, “emphatic two-note whistles” [1:246]: *wedo-wedo-wedo-wedo-wedo-wedo-wedo-wedo-wedo*, *whee-dup*. The *whe* upslurs and the *do* downslurs. Phrases accelerate while the pitch rises, then decelerate as the pitch falls. Invariable. Phrases are more two-noted than those in song of White-tailed Trogon. www.xeno-canto.org/31820 by Andrew Spencer

Sections are with 1–3 sec pauses between them

Piratic Flycatcher. “A sibilant whistled *fee-eee* usually followed after a pause by a staccato *didididi*” [1:254]; the pause lasts 1–3 sec. The *fee* upslurs and the *eee* downslurs. Birds vary this by singing either part without the other. Variable. www.xeno-canto.org/1107 by Robin Carter

Tempo accelerates →

Pitch rises and falls →

Dot-winged Antwren. A “series of [about 10–12] sharp notes that first ascend in pitch and then descend more rapidly” [1:208 Can be mixed with low, scolding notes and a series of soft, airy *whitsi-whitsi-whitsi* calls.]. Infrequently repeats the song many times without pause. Variable. www.xeno-canto.org/112892 by Sander Bot

Pitch rises →

Pheasant Cuckoo. Five or six sharp, clear whistles with the first note lower than the rest. The first two whistles are sung at about 1 per sec; the remaining whistles at about 3 or 4 per sec in a hurried, accelerating manner, *huuu heee hee-it-it!* Invariable. (The pitches of the first and second whistles

sound the same as the first and second whistles of this species' three-whistled, quavering song.)
www.xeno-canto.org/60746 by Ken Allaire

Pitch falls →

Gray Elaenia. A series of high, thin notes. The first section is composed of downslurring elements at about 2 per sec; this abruptly accelerates in the second section into about 12 upslurring elements sung at about 5 per second, while falling. Invariable. www.xeno-canto.org/22502 by Scott Olmstead

Pitch is steady

Little Tinamou. A “series of high quavering whistles, similar to that of Great Tinamou but thinner and higher pitched” [1:2] that increases in tempo and then ends abruptly. Invariable. www.xeno-canto.org/18652 by Ken Allaire

Tempo decelerates →

Pied Puffbird. A “series of high, thin, reedy two-syllable whistles, often slowing down at the end” [1:170]. The decelerating, two-noted whistles are somewhat reminiscent of the sound of a cantering horse as it slows down. Invariable. Much airier and thinner than song of White-winged Becard. www.xeno-canto.org/113047 by Sander Bot

White-winged Becard. A series of “musical notes, the first note followed by a pause, the subsequent series beginning rapidly and then decelerating: *chew, chichichichuchuchewchew*” [1:269]. Sometimes, however, there is no pause after the first *chew*. The first *chi* can up/downslur. Variable. www.xeno-canto.org/107784 by Klemens Steiof

Tempo is erratic →

Fasciated Antshrike. A series of about 5–40 erratic, sharp, single notes and runs mixed with 1–3 clear, upslurring or downslurring whistles; about 2–5 elements per sec. Variable. Notes are much more staccato than other songs in this section. www.xeno-canto.org/133153 Jerome Fischer

Dusky-capped Flycatcher. A nasal, erratic chattering, including some elements that upslur and downslur. Variable. More nasal and less sharp than song of Ochre-bellied Flycatcher. www.xeno-canto.org/11573 by Todd Mark

Ochre-bellied Flycatcher. A many-phrased song consisting of “interminable series of sharp *tsik!* notes in an irregular tempo (occasionally interspersed with two-syllable *chwik* notes)” [1:226]; about 1–2 notes per sec. Many elements up/downslur. Song lasts about 20 sec to 1 min. Variable. www.xeno-canto.org/113453 by Jerome Fischer

Tempo is steady

Pitch rises and falls →

Dusky Antbird. The male's song is “series of about 10 piping notes [elements], the first several notes ascending in pitch and the final notes descending” [1:210]. Each upslurring element of the male's song is two-parted. The female's song is one-parted; rises then falls, or simply rises; and is clearer than the male's song. His song sounds somewhat like *ku-WERK*, whereas hers sounds more like *WERR*. Songs of the lower-pitched male and the higher-pitched female of pairs often overlap as they sing together; either sex can initiate the duet. Invariable. www.xeno-canto.org/6957 by Ken Allaire, www.xeno-canto.org/164776 by James Bradley: female at 12-14, 33-34 sec

Pitch rises →

Black Hawk-Eagle. “During middle of day, often soars high and calls frequently, giving a loud whistled *whut-whut-whut-WHEER!*” [1:54], *whut-WHEER!* or simply *WHEER!*, downslurring on the *WHEER!* Variable. More emphatic than song of Rufous Mourner. www.xeno-canto.org/51334 by Bernabe Lopez-Lanus

Rufous Mourner. If Chestnut-backed Antbird whistles a clear “*Come HERE!*” [1:212], then Rufous Mourner whistles a clear, rising *Cooooome HEEEEERE!* with both elements upslurring and downslurring. Invariable. (Song of Chestnut-backed Antbird, however, is steady-pitched, and just downslurs on the second element.) www.xeno-canto.org/113553 by Jerome Fischer

Pitch falls →

Black-throated Trogon. A “descending series of two to five [or six] *caow* notes, with noticeable spacing between each note” [1:160] (Table 3). Invariable. www.xeno-canto.org/199029 by Guillermo Funes

Cocoa Woodcreeper. A nasal, falling *keuw, keuw, kuew, keuw* (Table 3). Invariable. www.xeno-canto.org/91403 by Mike Nelson

Black-striped Woodcreeper. A series of “three or four loud, sharp, evenly spaced, falling whistles: *WHEU, hew, hew, hu*” [1:198] (Table 3). Invariable. www.xeno-canto.org/106123 by Mike Nelson

Spotted Antbird. A series of about 8–10 emphatic, wheezy elements, each of which with the first part

higher and longer than the second: *WHEEEEEza WHEEza WHEEza WHEEza WHEEza...*; the *WHEEs* upslur and *zas* downslur. The first half-dozen elements remain at a steady pitch, then the last several fall in pitch (Table 3). Invariable. www.xeno-canto.org/108217 by Jerome Fischer

White-flanked Antwren. A high, squeaky *eeee*, *eeee* with the first note slightly higher than the second. Each *eeee* downslurs or up/downslurs (Table 3). Invariable. Much squeakier than the other songs in this section. www.xeno-canto.org/131555 by Thore Noernberg

White-flanked Antwren. A series of about 6–16 slightly nasal *whEEP* whistles that fall in pitch; about 3 elements per sec. Each *whEEP* up/downslurs. Songs can be repeated without pause (Table 3). Invariable. www.xeno-canto.org/112874 by Sander Bot

Brownish Twistwing. A series of about 6–8 elements that up/downslur, falling in pitch (Table 3). Invariable. www.xeno-canto.org/328067 by Kent Livezey

Bright-rumped Attila. A series of about 5–8 nasal, “emphatic two-note whistles which rise and become louder, then conclude with a single descending note: *whe-dup*, *whee-dup*, *Whee-dup*, *WHEE-dup*, *WHEE-DUP*, *WEeerrrr*” [1:246]. The *whe* upslurs and the *dup* and *eerrr* downslur; the *whe* parts are accented (Table 3). Invariable. The upslurs and downslurs are more extreme (more frequency change) than are those in the other songs in this section. www.xeno-canto.org/7354 by Ken Allaire

Golden-collared Manakin. A nasal *KEE-how!* with the *KEE* higher in pitch than the *how!* Invariable. Much less spacing between elements than the only other song in this section that can have only two elements (Black-throated Trogon). www.xeno-canto.org/31898 by Andrew Spencer: sec 9, 13, 15, 15, 18, *etc.*

Table 3. Comparison of the songs in Part I that are not a trill or churr, elements upslur and downslur, tempo is steady, and pitch falls.

Species	Relative emphasis (how emphatic) (1–5; 1 = lowest)	Relative airiness (1–4; 1 = least)	Easily audible >200 m away?
Black-throated Trogon	1	3	No
Cocoa Woodcreeper	3	2	Yes
Black-striped Woodcreeper	5	1	Yes
Spotted Antbird	3	4	No
White-flanked Antwren (two notes)	1	3	No
White-flanked Antwren (series)	4	2	No
Brownish Twistwing	2	2	No
Bright-rumped Attila	5	1	Yes

Pitch alternates higher and lower →

Olive-striped Flycatcher. A series of about 20–35 very high, thin, barely audible pairs of “*tsi* notes” that alternatively “rise and fall” [1:226]: *tsi-tsu-tsi-tsu-tsi-tsu...* Invariable. www.xeno-canto.org/2970 by David Bradley

Pitch is steady

Song quavers or includes quavers; is spoken; includes clucks and/or metallic clanks; includes screeches; or is very squeaky →

Song quavers or includes quavers →

Great Tinamou. A “series of quavering whistles, deeper and more resonant than that of Little Tinamou” [1:2]. Invariable. www.xeno-canto.org/131552 by Thore Noernberg

Little Tinamou. A ghostly *eeee-uuuur*, downslurring between the first and second elements; the second element quavers. Can be sung singly or once every few sec as a series. Variable. www.xeno-canto.org/47059 by Mike Nelson

Pheasant Cuckoo. Three sharp, clear whistles with the second one higher in pitch than the first and third, *huu hee huuuur*; the third element quavers. Invariable. (The first and second whistles are the same pitches as those of this species’ five-whistled, non-quavering song.) www.xeno-canto.org/83089 by Brian Fox

Song is spoken →

Squirrel Cuckoo. A nasal, sharp *KIK! aaaww* “with the cadence of a wolf-whistle” [1:121], up/downslurring on the spoken *aaaww*. Invariable. www.xeno-canto.org/129893 by Oscar

Humberto Marin-Gomez

Slaty-backed Forest-Falcon. A series of about a dozen, loud, long, nasal *aaannhs*; about 1.5 per sec. Invariable. www.xeno-canto.org/92172 by Dusan Brinkhuizen

Song includes clucks and/or metallic clanks →

Gray-headed Chachalaca. A variety of sharp, clucking and clanking notes, including “a high-pitched *wheek!* repeated frequently, especially when alarmed” [1:10]. Variable. www.xeno-canto.org/17192 by Allen T. Chartier

Clay-colored Thrush. A “melodious series of varied notes, including slurred whistles...and clucks” [1:304] as well as runs. Song includes clear and nasal phrases and sections. Songs can last more than 1 min. Repertoire. The song includes clucks, but is much more melodious than the clanking song of Gray-headed Chachalaca. (Similar to song of Crimson-backed Tanager in Part II, but that species’ song is less variable—not a repertoire—and is less rich.) www.xeno-canto.org/6953 by Ken Allaire

Song includes screeches →

Orange-chinned Parakeet. The “calls include loud harsh chattering and sharp *zhreet!* notes” [1:114] and runs. Often sing *CHE!chu!CHE!* with the *CHEs* higher than the *chus*. Variable. Higher-pitched and more shrill than songs of the parrots in this section. (Similar in pitch to song of Blue-headed Parrot.) www.xeno-canto.org/1104 by Robin Carter

Brown-hooded Parrot. A variable song that includes “a *chewek!, zhreeee!*” [1:114], and *chortle*. When perched, song sometimes includes a diagnostic *ker-hee* that down/upslurs. Variable. Lower-pitched and less shrill than song of Orange-chinned Parakeet. www.xeno-canto.org/8350 by Ken Allaire, www.xeno-canto.org/31894 by Andrew Spencer with *ker-hees* at sec 16–20, 31, 36

Red-lore Amazon. Loud, sharp screeches and chortles. “Calls include a distinctive *krack-co-rak...* other calls are similar to those of Mealy, but higher pitched” [1:116]. *KRACK-co-RAK* is accented on first and third elements. Variable. *krack-co-rak*: www.xeno-canto.org/10481 by Allen Chartier; other calls: www.xeno-canto.org/127524 by Thore Noernberg

Mealy Amazon. Loud, sharp screeches and chortles. “Loud calls are mostly similar to those of Red-lore Amazon (although deeper), but also include a distinctive *chop-chop* or *cheeyup-cheeyup*” [1:116]. Often, lower-pitched *chop-chops* alternate with higher-pitched *chop-chops*. Variable. Sings a three-element song similar to that of Red-lore Amazon, but it tends to be accented only on the first element (*KRACK-co-rak*) or is not accented on any element and rises at the third element like a question (*krack-co-rak?*). www.xeno-canto.org/110633 by Ken Allaire; *chop-chop*: www.xeno-canto.org/31927 by Andrew Spencer

Song is very squeaky

Snowy-bellied Hummingbird. A high, very squeaky *eee-ah, eee*. Sounds like the bird is exhaling on the *eee* and inhaling on the *ah*. Invariable. www.xeno-canto.org/6410 by Ken Allaire

Song does not include quavers; is not spoken; does not include clucks and metallic clanks; does not include screeches; is not very squeaky

Song is composed of one element →

Song is very clear →

Ruddy-tailed Flycatcher. A sweet, quiet, “high, thin *psee-it!*” [1:236] that up/downslurs; the second element can have a hint of a trill in it. Invariable. Much quieter than the other songs in this section. www.xeno-canto.org/65163 by Ken Allaire

Rufous Piha. A “loud, emphatic whistle” [1:258] of two or three elements: and upslurring *chuur-EEP!* or a down/upslurring *chu-ur-EEP!* Invariable. Much louder than the other songs in this section. www.xeno-canto.org/60760 by Ken Allaire

Lesser Greenlet. A sweet, “musical *chee-wit!* or *shr-eee-it!* (repeated almost incessantly)” [1:376]. In a typical shorter version, the *chee* downslurs and the *wit!* upslurs; in a typical longer version, the *shre* downslurs, the *eee* up/downslurs, and the *it!* upslurs. Variable. More complex than the other songs in this section. (Song is virtually identical to the three-element song of Golden-fronted Greenlet in Part II, but that species is “found in second growth and scrub” [1:276].) www.xeno-canto.org/78668 by William Adsett

Song is nasal or not very clear

Song ends in an upslur

Eastern Wood-Pewee. A nasal, emphatic, down/upslurring *uu-wee!* Migrants are present in Panama from September to November and from March to mid-May [1:240].

Invariable. www.xeno-canto.org/94732 by William Adsett, www.xeno-canto.org/153958 by Jerome Fischer

Song ends in a downslur

Cocoa Woodcreeper. A very nasal, up/downslurring *eeeer*. Invariable. www.xeno-canto.org/11213 by Allen Chartier

Dusky-capped Flycatcher. A weak, thin “*feeeer*” [1:248] that upslurs in the *fe* and downslurs in the *er*. Invariable. Flatter and less musical than the other songs in this section. www.xeno-canto.org/2613 by David Bradley

Royal Flycatcher. A nasal, “squealing, emphatic... *keheee-up!*” [1:234] that up/downslurs, singly or repeated every few sec. Invariable. Sharper and more emphatic than the other songs in this section. www.xeno-canto.org/5931 by Richard Hoyer

Brownish Twistwing. A nasal, quick, up/downslurring “*fweer*” [1:234], sung singly (1) or in pairs (2). Invariable. The downslur is shorter than that in the song of Cocoa Woodcreeper. (1) www.xeno-canto.org/2960 by David Bradley, (2) www.xeno-canto.org/131584 by Thore Noernberg

Tropical Gnatcatcher. An airy, nasal, up/downslurring, almost catlike *eeeu*. Invariable. Airier than the other songs in this section. www.xeno-canto.org/47463 by Niels Krabbe

Slate-colored Grosbeak. A catlike, “whining...*caaaah*” [1:352] that up/downslurs. Invariable. More catlike than the other songs in this section. www.xeno-canto.org/135485 by William Adsett

Song is composed of three or more elements

Song is composed of a series of simple, repeated elements →

Song is composed of clear whistles →

Russet-winged Schiffornis. Three or four sharp, clear whistles “*wheeeuuu, whi-whit, wheet!*” [1:258]; the *wheeeuuu* down/upslurs; the *whiit* and *wheet* upslur. Invariable. Fewer elements than in song of Speckled Mourner. www.xeno-canto.org/60785 by Ken Allaire

Speckled Mourner. A series of about 12 “loud, sharp, ringing two-note whistles” [1:258]: *zo000YEE! zo000YEE! zo000YEE!...*; the downslurring *zo000s* are much longer than the upslurring *YEEs*. Invariable. www.xeno-canto.org/2962 by David Bradley

Green Shrike-Vireo. A series of “constantly repeated...three short, clear whistles...: *peer-peer-peer*” [1:278]. Invariable. Much less sharp than whistles of Russet-winged Schiffornis and Speckled Mourner. www.xeno-canto.org/131558 by Thore Noernberg

Song is not composed of clear whistles

Gray-headed Kite. A series of about 12–45 nasal calls that increase in volume: “*kek-kek-kek-kek-kek-kek...*” [1:38]. The up/downslur is sung so quickly that it can sound as if the song does not slur. Invariable. The only song in this section that increases in volume. (Similar song of Lineated Woodpecker only upslurs, and does not increase in volume.) www.xeno-canto.org/24200 by Ken Allaire, www.xeno-canto.org/31899 by Andrew Spencer

Pale-vented Pigeon. “Call a mournful *WHOO! cuk-tu-COO! cuk-tu-COO! cuk-tu-COO!*” [1:102] accented on the last element of each phrase; the *WHOO* and *COO* elements up/downslur. Invariable. The only song in this section that is easily imitated well by whistling. www.xeno-canto.org/10563 by Allen T. Chartier

Slaty-tailed Trogon. A series of nasal *cahs*, about 1–2 per sec. The up/downslur elements are sung so quickly that it can sound as if they do not slur. Invariable. Lower and slower than song of Gartered Trogon. www.xeno-canto.org/133139 by Jerome Fischer

Black-tailed Trogon. About 15–25, nasal “*cwAHH*” elements; about 2 per sec. Sometimes the last couple of elements fall slightly in pitch and volume. Invariable. Each element rises in frequency more than those in similar song of Slaty-tailed Trogon, so they can sound as if they end in an upslur. www.xeno-canto.org/2947 by David Bradley

Gartered Trogon. A series of about 15–20 slightly nasal, rather high, fast, single *weh* whistles; about 2–3 per sec. Invariable. (There is no sharpness to this call, unlike the slower *chup* series of this species and the *chup* series of White-tailed Trogon.) www.xeno-canto.org/133151 by Jerome Fischer

Northern Barred-Woodcreeper. A series of about 4–6 very nasal elements, each of which is down/upslurred: “*do00-weeE, do00-weeE, do00-weeE*” [1:196]. Elements sung at

about 1–2 per sec (1). Song can speed-up into a jumbled chatter (2). Variable. More nasal than the other songs in this section. (1) www.xeno-canto.org/78670 by William Adsett, (2) www.xeno-canto.org/133164 by Jerome Fischer

Yellow-margined Flycatcher. A “series of 3 to 5 sharp, high-pitched notes, usually with a slight pause after the first note: *shrik, shrik-shrik-shrik*” [1:236], as if the second note is missing. Occasionally sings the first note a few times before voicing the complete song. Variable. Thinner and airier than the other songs in this section. www.xeno-canto.org/18232 by Herman van Oosten

Song is more complex than a series of simple, repeated elements

Song is composed of clear and nasal phrases →

Scarlet-rumped Cacique. Melodious, variable songs, typically of about a dozen, two-element phrases: *ca-lee ca-lee ca-loo ca-loo*... Songs often include a low, grating, upslurring *ooo-rah!* Variable. www.xeno-canto.org/31933 by Andrew Spencer, www.xeno-canto.org/133162 by Jerome Fischer

Song is composed of clear phrases only →

Song is sharp →

Double-toothed Kite. A few high, thin, sharp whistles “*whit-whee-up!*”; can be mixed with a simpler, rising “*wheet!*” [1:40]. Variable. Songs of this species and Semiplumbeous Hawk are airier and thinner than those of the other species in this section. www.xeno-canto.org/112868 by Sander Bot

Semiplumbeous Hawk. An airy, shrill, “whistled *wheee-EEP!*” [1:46]. The *wheee* strongly up/downslurs; the *EEP* upslurs. If repeated two or several times, the elements become more emphatic (and may rise slightly). Invariable. Squeakier than song of Double-toothed Kite. www.xeno-canto.org/274200 by Peter Boesman

Black-mandibled Toucan. A “loud, yelping *keeYOO, kedek, kedek* (sounds almost gull-like)” [1:176]. Song has a diagnostic tempo and emphasis with the upslurring and downslurring *keeYOO* accented on the *YOO* and the *kedeks* sounding somewhat like a cantering horse. Typically repeats the same song many times for many mins. Invariable. www.xeno-canto.org/112916 by Sander Bot

Gray-headed Tanager. A jumble of high-pitched, sharp, thin notes mixed with runs and sweet notes. Variable. The only song in this section that contains runs and sweet notes. (The high, thin notes are more melodic than those of White-whiskered Puffbird.) www.xeno-canto.org/1015 by Robin Carter, www.xeno-canto.org/31900 by Andrew Spencer

Song is not sharp

Red-capped Manakin. Song is “several short *chit* notes, then a long...whistle, followed by a final *chit*: *chit-chit, suuwwhheeeee, chit!*” [1:270] (1). The *suuwwhhe* part down/upslurs; the long *eeee* whistle downslurs. (The first few *chit* notes, if sung apart from the rest of the song (2), differ from the *chip-chip* or *chip...chip-chip* notes of Spotted Antbird in that they are sweeter (not as sharp) and do not have a pause between the first and second notes.) The final *chit* ranges from a sweet little note audible to only a few m to a loud, raspy, short churr audible to more than 50 m (the churr keys-out separately in this key). Variable. They also “make loud explosive wing-snaps” [1:270]. The wing snaps differ from those of Golden-collared Manakins in that they are about one-half as loud, and they can be done either singly or in about 3–10 rapid bursts at about 3 bursts per sec. The only song in this section of the key with a long downslurring element. (1) www.xeno-canto.org/10085 by Ken Allaire, (2) www.xeno-canto.org/271228 by Peter Boesman

Yellow-backed Oriole. A “lackadaisical series of clear mellow whistles that vary disjointedly both in pitch and in the intervals between notes” [1:378]; each whistled phrase is composed of one, two, or three elements. Variable. www.xeno-canto.org/107785 by Klemens Steiof

Bay Wren. A “rapid series of loud, ringing...whistled phrases, each variant repeated several times before changing to another” [1:290]; song repeat-bounces. Repertoire. Song is more rapid and complicated than those of Blue-black Grosbeak, Slate-colored Grosbeak, orioles, and other wrens. www.xeno-canto.org/92124 by William Adsett

Black-bellied Wren. A series of short phrases composed of deep, rich, “loud, resonant, whistled notes, often inflected upward at the end: *hooo-er, hoo-it!* Each variant is

repeated many times before being switched to another” [1:290]. Repertoire. Deeper and richer than all other songs in this section. www.xeno-canto.org/83255 by Wouter Halfwerk

White-breasted Wood-Wren. A series of about 6–10 clear whistles in about 1–4 phrases. “Typical phrases include...*cheee, churry churry*; and *chee-chee-cheery*” [1:294]; often sings *WEduWEdu* in which the *WE* notes are higher than the *du* notes. Repertoire. Unlike all other species in this key, often sings several elements or phrases at about 1 per sec, pauses for a few sec, then sings one, two, or three “encore” elements or phrases with many sec between them. Songs of this species and of Blue-black Grosbeak are sharper than those of Slate-colored Grosbeak. www.xeno-canto.org/135369 by William Adsett

Blue-black Grosbeak. A “leisurely series of sweet notes” [1:370]. Variable. Unlike all other species in this section, song almost always sounds like *ZHIT-zuu, ZHIT-zuu, zuDEdo* (or *Blue-black Grosbeak do-DE-do*). www.xeno-canto.org/46778 by Mike Nelson

Slate-colored Grosbeak. “Variable, deliberate phrases made up of loud rich whistles (rather wrenlike in quality)” [1:352]; often a sweet *WEET diu-diu-diu* that upslurs on the *WEET* and downslurs on each *diu*, or a sweet *WEET diu, WEET diu*. Variable. Unlike the other species in this section, each song includes (and often ends) with a diagnostic, downslurring *diu*. www.xeno-canto.org/271577 by Peter Boesman

Song is composed of nasal phrases only

Red-crowned Ant-Tanager. A melodic “series of loud musical notes; examples include *chee-dup, chee-dup, chee-dup* and *he-dup, he*” [1:366]. Variable. Cadence is much smoother than that in song of Red-throated Ant-Tanager. www.xeno-canto.org/92094 by Mike Nelson

Red-throated Ant-Tanager. A series of hurried, slightly erratic, “musical but somewhat squeaky notes that rise and fall in pitch” [1:366]. Variable. www.xeno-canto.org/2953 by David Bradley, www.xeno-canto.org/57507 by Ioana Chiver

ELEMENTS UPSLUR →

Tempo accelerates and decelerates →

Scaly-throated Leaftosser. A “long series (sometimes continuing for several minutes) of sharp whistles” [1:194], starting with several upslurring whistles followed by about 3–12 non-upslurring, accelerating whistles that fall then rise: *Weeep! Weeep! Weeep! Weeep! We-we-we-we-we-we*. Each section lasts about 4 sec and can blend almost seamlessly into the next as if riding a roller coaster up and down, up and down, etc. Variable. www.xeno-canto.org/16068 by Ken Allaire

Tempo is steady

Pitch rises →

Wedge-billed Woodcreeper. About 6–8, upslurring, sharp elements that rise in pitch and then end abruptly: *Clee clee clee clee clee clee clee*. Invariable. Sharper than song of Olivaceous Flatbill. www.xeno-canto.org/92916 by Tom Stevens

Olivaceous Flatbill. About 4–6 upslurring, rising, wheezy elements: *weee weee weee weee weee*. Invariable. Airier than song of Wedge-billed Woodcreeper. www.xeno-canto.org/158862 by Rodrigo Dela Rosa

Pitch falls →

Song ends in falling couplets

Black-breasted Puffbird. About 15–50 strong, nasal, fast, upslurring whistles *Wheep! Wheep! Wheep!* at about 2–2.5 per sec, followed by a series of about 8–12 “descending couplets: *whik-koo, whik-koo, whik-ku*” [1:170] at about 1 per sec. Invariable. www.xeno-canto.org/108270 by Jerome Fischer

Song does not end in falling couplets

Scaly-throated Leaftosser. A strong, sharp, fast series of about 8–12 upslurring whistles, the last 2 or 3 of which fall. About 5 elements per sec. Invariable. Faster and stronger than song of Fasciated Antshrike. www.xeno-canto.org/112873 by Sander Bot

Fasciated Antshrike. A series of about 4–8 clear, upslurring whistles, with the first two or three elements slightly higher than the rest. About 2 elements per sec. Invariable. Easily imitated by whistling, unlike songs of the other species in this section. www.xeno-canto.org/24194 by Ken Allaire

Tropical Gnatcatcher. A series of about 8–14 high, airy, thin, upslurring falling elements. Invariable. Airy, unlike songs of the other species in this section. www.xeno-canto.org/59517 by Mike Nelson

Pitch is steady

Elements are spoken →

Song sounds like whoop →

Rufous Motmot. A deep *Whoop!*, very similar to that of Whooping Motmot (1). Also a “deep, resonant, rapid *boo-bup-bup* (usually three notes, sometimes two or just one)” [1:166] (2), and a series of about 5–20 whoops, with pairs or triplets alternating between higher and lower pitches (3). Invariable. (1) www.xeno-canto.org/153250 by Wouter Halfwerk, (2) www.xeno-canto.org/93638 by Tom Stevens, (3) www.xeno-canto.org/16063 by Ken Allaire

Whooping Motmot. A deep, resonant *Whoop!*, very similar to that of Rufous Motmot (1). Also a series of *whoops* (2) but, unlike those of Rufous Motmot, are all of the same pitch. Invariable. (1) www.xeno-canto.org/46779 by Mike Nelson, (2) www.xeno-canto.org/10069 by Ken Allaire

Purple-throated Fruitcrow. “Loud, far-carrying, melodious *whoops*... [usually] rising at the end” [1:264]: *whoop, whoop, whooOOP!* Invariable. Elements are longer (*whoop* vs. *whoop*) than songs of the motmots. www.xeno-canto.org/24217 by Ken Allaire

Song does not sound like whoop

Purple-throated Fruitcrow. A spoken, upslurring, rough *oooyaah!* often mixed with a spoken, upslurring *cwaa-cwaa-cwaa-cwaa!* Invariable. www.xeno-canto.org/199009 by Guillermo Funes, www.xeno-canto.org/140768 by Nick Athanas

Elements are not spoken

Song is composed of one whistle →

Black-striped Woodcreeper. A nasal, whistled, sharp, upslurring *zuuuuu-reep!* (Table 4). Invariable. www.xeno-canto.org/11930 by Nick Athanas

Great Crested Flycatcher. A nasal, “sharp, rising *fweeeUP!*” [1:248]. Migrants are present in Panama from October to April [1:248] (Table 4). Invariable. www.xeno-canto.org/31903 by Andrew Spencer

Brownish Twistwing. A nasal, airy, upslurring *uuu-reek!* (Table 4). Invariable. www.xeno-canto.org/107753 by Klemens Steiof

Forest Elaenia. An upslurring, “emphatic, sharp *fwee-iik!*” [1:224] (Table 4). Invariable. www.xeno-canto.org/113472 by Jerome Fischer

Paltry (or Mistletoe) Tyrannulet. An upslurring, “clearly whistled *pee-yup!* [or *che-weep!*] (accented on the second syllable)” [1:230] (Table 4). Invariable. www.xeno-canto.org/46978 by Mike Nelson

Swainson’s Thrush. A “sharp, uprising *wheeik!*” [1:302]. Migrants are common in Panama in October, November, March, and April; winter residents are uncommon [1:302] (Table 4). Invariable. www.xeno-canto.org/65181 by Ken Allaire

Table 4. Comparison of the songs in Part I that are not a trill or churr, elements upslur, tempo is steady, pitch is steady, elements are not spoken, and song is composed of one whistle.

Species	Relative sharpness (1–4; 1 = least)	Relative clarity (1–3; 1 = nasal, 3 = clear)	Relative length of first element (1–4; 1 = shortest)
Black-striped Woodcreeper*	4	1	4
Great Crested Flycatcher*	3	1	2
Brownish Twistwing*	2	1	3
Forest Elaenia*	2	2	1
Paltry (or Mistletoe) Tyrannulet	1	3	2
Swainson’s Thrush	2	2	1

* Elements upslur only, unlike somewhat similar-sounding song of Eastern Wood-Pewee, which down/upslur

Song is composed of at least 10 whistles

Squirrel Cuckoo. About 10–35 loud, slightly nasal whistles *whip, whip, whip...* with a short pause between whistles; a little faster than 1 whistle per sec. Invariable. www.xeno-canto.org/60783 by Ken Allaire

Black-breasted Puffbird. About 10–50 strong, nasal, fast, upslurring whistles *Wheep! Wheep! Wheep!* at about 2–2.5 per sec (when song stops before the series of descending couplets). Invariable. Unlike song of Squirrel Cuckoo, there are no pauses between whistles. www.xeno-canto.org/108270 by Jerome Fischer: sec 0–21

Lineated Woodpecker. A series of about 15–20 upslurring, nasal calls: *whik-whik-whik-whik-whik...*; about 3 per sec. Invariable. Nasal, unlike songs of the other species in this section. (Similar song of Gray-headed Kite upslurs and downslurs as well as increases in volume.) www.xeno-canto.org/54677 by Bernabe Lopez-Lanus, www.xeno-canto.org/98901 by Thomas Donegan

ELEMENTS DOWNSLUR →**Tempo is erratic** →

Black-chested Jay. “Calls include a loud, ringing *cheoup, cheoup* and a staccato *chh-chh-chh-chowp!*” [1:280], sounding like shots from a ray-gun. Invariable. www.xeno-canto.org/113451 by Jerome Fischer

Tempo is steady**Pitch is low or very low** →

Short-billed Pigeon. A deep, whistled, easily imitated *cooo, coo-coo, coooo* with the last element downslurring. Invariable. www.xeno-canto.org/112914 by Sander Bot

Scaled Pigeon. A “very low-pitched *whooo! whut-whooo! whut-whooo!*” [1:102]; the *whooo* elements downslur. Invariable. Unlike song of Short-billed Pigeon, the first, third, and fifth elements downslur. www.xeno-canto.org/142686 by William Adsett

Pitch is medium, high, or very high**Song is spoken** →

Collared Forest-Falcon. Sings “a mournful, slowly repeated *aoww... aoww... aoww... aoww* (often given at dawn or dusk)” [1:56] with about 2–3 sec between songs. Invariable. Song of Black-crowned Antshrike is audible to about 75 m, whereas song of Collared Forest-Falcon is audible to more than 300 m. www.xeno-canto.org/271370 by Peter Boesman

Black-crowned Antshrike. A nasal *kaow, kaow-kaow* or a set of three elements, each about one-half sec apart: *kaow-kaow-kaow*. Invariable. www.xeno-canto.org/90394 by Leslie Lieurance

Song is not spoken***Each element lasts 1 sec or less*** →**Song is composed of two or three clear whistles**

Chestnut-backed Antbird. A clear, steady-pitched, two-element “*Come HERE!*” or three-element “*Come right HERE!*” [1:212], accented on the last element. Invariable. (Each element takes about one-half as long to sing as each element in the similar song of Rufous Mourner, but that song upslurs and downslurs.) www.xeno-canto.org/328700 by Kent Livezey

Song is composed of at least six sharp chips

White-necked Jacobin. A series of sharp, high chips, very quickly downslurring, sung at about 1–2 per sec. Invariable. www.xeno-canto.org/128070 by Thore Noernberg

Each element lasts 2 sec or more

Great Jacamar. A descending, “piercing, high-pitched whistle, slurred and fading away at the end: *keEEEEaaahhh* (reminiscent of some hawks)” [1:172]. Invariable. www.xeno-canto.org/110631 by Ken Allaire

ELEMENTS DO NOT SLUR**Tempo accelerates** →**Pitch rises** →

Paltry (or Mistletoe) Tyrannulet. A series of about 9 or 10 clear, sweet notes, accelerating and rising after the first two or three notes: *du, du, di-di-di-di-di-di-di*. Song lasts about 2 sec. Invariable. (Notes sound identical in pitch and quality to those in this species’ two-noted song.) Not in xeno-canto.

Pitch falls →

Cinnamon Woodpecker. A nasal, airy, falling series of whistles “*wheee, wheee, whe-wit*” [1:182], with third and fourth elements accelerated compared to the first and second. Invariable. www.xeno-canto.org/92126 by William Adsett

Pitch is steady

(Striped Rocket Frog. An emphatic, accelerating series of about 6-10, two-element phrases: *chu-deep!... chu-deep!.. chu-deep!. chu-deep! chu-deep! chu-deep! chu-deep! chu-deep!* Invariable. biogeodb.stri.si.edu/bioinformatics/dfm/metas/view/30483 by Ibáñez *et al.* undated [16])

Tempo decelerates →Song lasts a few sec

Streak-chested Antpitta. An easily imitated, “slow, mournful series of about 10 clear whistles, the first few notes rising, then leveling off for several notes, finally slowing down and descending slightly” [1:218]. Invariable. www.xeno-canto.org/128621 by Wouter Halfwerk

Song lasts at least 30 sec

Scaly-breasted Wren. A series of high, sweet whistles, starting with about 6–8 short whistles going up the scale at about 3 notes per sec, then a pause of about 1 sec, then about 8–12 longer, descending whistles with gaps between them increasing from 1 sec to 2 sec to 3 sec, *etc.* down to about 15 sec. Songs can last up to about 2 mins. Song can consist only of individual whistles about 10 sec apart. Variable. www.xeno-canto.org/70709 by William Adsett

Tempo is erratic →Song is composed of sharp chips or airy grunts →Song is composed of sharp chips →

Black-throated Mango. A series of erratic, sharp chips, usually about 1 per sec. Invariable. Not nasal, unlike songs of Rufous-tailed Hummingbird and White-vented Plumeleteer. www.xeno-canto.org/14587 by Oswaldo Cortes

Rufous-tailed Hummingbird. A long series of nasal, erratic, sharp chips, ranging from about 1–4 per sec; feeding birds can sing for more than 1 min. Invariable. More chips per second than songs of Black-throated Mango and White-vented Plumeleteer. www.xeno-canto.org/78672 by William Adsett

White-vented Plumeleteer. A series of nasal, erratic, sharp chips, usually less than 1 per sec. Invariable. A little airier and less sharp than song of Rufous-tailed Hummingbird. www.xeno-canto.org/17180 by Allen T. Chartier

Song is composed of airy grunts

Whooping Motmot. A series of erratic, airy grunts sounding like a scolding squirrel. Invariable. www.xeno-canto.org/29240 by Karl Kaufmann

Song is composed of whistles and clucks

Song Wren. Variable compositions of “sweet clear whistles of various pitches, interspersed with guttural clucks...; sounds like a haywire cuckoo clock” [1:296]. Two-noted whistles are unique in the area (first note low and second note high, or vice versa; both are included in the first recording below). Family groups often sing only the clucks, possibly as contact calls, when foraging on the forest floor (as in second recording below). Variable. www.xeno-canto.org/107771 by Klemens Steiof, www.xeno-canto.org/271210 by Peter Boesman

Tempo is steadyPitch rises and falls →

Green Shrike-Vireo. A series of about 8–15 sweet notes, each at a slightly different pitch, that slowly fall, rise, fall, *etc.*, in about 2–4 sec. Invariable. (Like a slow song of Long-billed Gnatwren.) Not in xeno-canto.

Pitch falls →Notes are very clear, easily imitated by whistling

Black-faced Antthrush. A clear, “slow, hesitant series of plaintive whistles (usually 3 or 4, sometimes as many as 15)” [1:216], with a slight pause after the first note, which is slightly accented more than and higher in pitch than the rest of the notes. Invariable. www.xeno-canto.org/2959 by David Bradley

Notes are airy or nasal, not easily imitated by whistling

Squirrel Cuckoo. A nasal, hurried, three-element *CHICKaroo* usually sung singly but occasionally sung once every few sec in a series. Invariable. www.xeno-canto.org/87520 by Paul Rene

Pitch is steady

Pitch is low or very low →

Song is composed of one element →

Gray-chested Dove. A “low, single note *whooooh*” [1:106]. Invariable. Higher in pitch than songs of Ruddy Quail-Dove and Rufous-vented Ground-Cuckoo. www.xeno-canto.org/106491 by Mike Nelson

Ruddy Quail-Dove. A “low soft *whoooah*, given at 3- to 5-sec intervals (shorter and lower pitched than that of Gray-chested Dove)” [1:108]. Invariable. Similar in pitch to Rufous-vented Ground-Cuckoo, but shorter and less moaning. www.xeno-canto.org/81327 by Leonardo Ordóñez-Delgado

Rufous-vented Ground-Cuckoo. A “deep moaning *huuuuuuuu*” [1:120], rarely heard. Invariable. More moaning than songs of Gray-chested Dove and Ruddy Quail-Dove. www.xeno-canto.org/83102 by Brian Cox

Song is composed of two elements

White-tipped Dove. A “deep hollow-sounding *hu-huuu*” [1:106] with the second element about 4 times longer than the first. Invariable. www.xeno-canto.org/18678 by Ken Allaire

Pitch is medium or high →

Song is sharp and/or airy, squeaky, or clucky →

Song is sharp and/or airy →

Song is composed of one element →

Plain-brown Woodcreeper. A nasal, airy, sharp *eyeenk!* Invariable. Airier than songs of the other species in this section. www.xeno-canto.org/78671 by William Adsett

Northern Waterthrush. A “sharp ... *whink!*” [1:322] repeated once every few sec or so. Migrants are present in Panama from September to late April, sometimes mid-September to May [1:322]. Invariable. Flatter and more bubbly than the other calls in this section. www.xeno-canto.org/78859 by Oswaldo Cortes

Slate-colored Grosbeak. A sharp *speek!* Invariable. A bit sharper than call of Northern Waterthrush. www.xeno-canto.org/86513 by Andrew Spencer

Blue-black Grosbeak. A “sharp metallic *chirrt!*” [1:370] typically sung singly or in pairs. Invariable. More ringing than the other calls in this section. www.xeno-canto.org/80947 by Scott Olmstead

Song is composed of a series of similar elements

Song is loud, is audible to more than about 125 m →

Squirrel Cuckoo. A series of 3–5 loud, sharp, clattering notes: *chink! chink! chink!* sung within 1–2 sec. Invariable. Sharper than songs of the other species in this section. www.xeno-canto.org/11652 by Nathan Pieplow

Broad-billed Motmot. Airy “*awwnnk!* suggesting a whistle on a toy train” [1:166]. Usually sung at about 1 per 4–30 sec, but sometimes sung at a faster tempo at about 1 per sec. Invariable. Airier than songs of the other species in this section. www.xeno-canto.org/1088 by Robin Carter

Collared Aracari. A sharp, “high-pitched wheezy *khwhilk!*” [1:176] sung in a series of about 3–20 elements at about 1 per sec. Invariable. Wheezier than songs of the other species in this section. www.xeno-canto.org/28313 by Daniel Lane

Song is not loud, is audible to less than about 75 m

Long-billed Hermit. A long series of sharp chips sung at about 1–2 per sec; perched birds can sing for many mins. This species also chips at about 1 chip per 3 sec while flying through the woods. Invariable. Elements sound richer, more complex, with more ringing tonal quality, than those of Blue-chested Hummingbird and Crowned Woodnymph. www.xeno-canto.org/107762 by Klemens Steiof

Blue-chested Hummingbird. A long series of sharp chips sung at about 1–2 per sec; perched birds can sing for several mins, with short pauses between series of chips. Invariable. Notes sound flatter, with less tonal quality, than notes of Long-billed Hermit. www.xeno-canto.org/10068 by Ken Allaire

Crowned Woodnymph. A long series of sharp chips sung at about 1–2 per sec (1); perched birds can sing for several mins. Invariable. Chips are sharper and thinner than those of Blue-chested Hummingbird. Unlike the other songs in this section, sometimes sings a double-noted version (2). (1) www.xeno-canto.org/271614 by Peter Boesman, (2) www.xeno-canto.org/60789 by Ken Allaire

Spotted Antbird. A series of a few sharp, two- or three-noted *chip...chip, chip, chip* or *chip...chip-chip, chip-chip* calls. Unlike songs of the other species in this section, the series usually has a short pause (like a skipped note) after the first note. Invariable. (The first few *chit* notes of Red-capped Manakin, if sung apart from the rest of the song, differ from these notes of Spotted Antbird in that they are less sharp and do not have a pause between the first and second notes.) www.xeno-canto.org/72009 by Andrew Spencer

Checker-throated Antwren. A “series of evenly spaced, high, thin *seek* [or *cleek*] notes, all on the same pitch” [1:206]. Series can consist of a few notes and last only a few sec to more than 100 notes lasting more than 1 min. Sung at about 1–4 notes per sec. When sung quickly, notes take on an emphatic, scolding quality. Competing males sometimes sing within 20 cm of one another. Invariable. Elements are more two-noted than in songs of Long-billed Hermit, Blue-chested Hummingbird, single-noted Crowned Woodnymph, and Green Shrike-Vireo. www.xeno-canto.org/10559 by Allen T. Chartier

Song is squeaky →

Crimson-crested Woodpecker. A squeaky, airy, fast “*kehkekekekek*” [1:184] (1). Invariable. Drumming consists of a series of about 4–8 taps “the first loudest” [1:184] (2) or the first few louder than the rest (3). (1) www.xeno-canto.org/31897 by Andrew Spencer, (2) www.xeno-canto.org/24187 by Ken Allaire, (3) www.xeno-canto.org/31896 by Andrew Spencer

White-shouldered Tanager. High, chattery, “squeaky *chew* and *chut* notes (sometimes given in a series)” [1:338]. Invariable. More chattery and less squeaky than songs of the other species in this section. www.xeno-canto.org/15728 by Don Jones

Song is clucky

Black-faced Antthrush. A two-element, “sharp clucking *fweek!*” [1:216]. Invariable. www.xeno-canto.org/10535 by Allen T. Chartier

Song is not airy and/or sharp, squeaky, or clucky

Elements are sung at about 1–3 per sec →

Gartered Trogon. A series of slightly nasal, one-noted *chup* calls, a bit faster than 1 per sec. Invariable. A bit sharper than faster song of Gartered Trogon, and a little flatter than similar call of White-tailed Trogon. www.xeno-canto.org/120656 by Lars Lachmann

White-tailed Trogon. A series of slightly nasal, one- or two-noted *chup* or *chup-chup* calls, about 1–2 per sec. Invariable. All notes are of the same pitch, unlike the two-noted call of Dusky Antbird. A little sweeter and higher than the *chup* song of Gartered Trogon. www.xeno-canto.org/175166 by Juan Antonio Alonso de Juan

Dusky Antbird. Piping, two-noted *di-dit...di-dit...* calls, with the first note higher than the second. Invariable. www.xeno-canto.org/46879 by Mike Nelson, especially sec 13–18

Elements are sung at about 5 per sec

White-flanked Antwren. A scold consisting of a rapid series of about 5–10 rough, staccato notes; can be repeated with a pause of about 1–5 sec between series. Invariable. (There is no exact recording of this song in xeno-canto, but a recording with slightly longer scolds is www.xeno-canto.org/88372 by Alexandre Renaudier.)

Pitch is very high

White-whiskered Puffbird. A quiet, insect-like series of about 2–5 elements, audible to only about 10–15 m. Invariable. www.xeno-canto.org/329127 by Kent Livezey

PART II: KEY TO SONGS OF DIURNAL BIRDS IN THE FRAGMENTED FORESTS, FOREST EDGES, AND GRASSY AREAS ADJACENT TO THE ENTRANCE TO PIPELINE ROAD →

SONG IS A TRILL OR CHURR →

TEMPO ACCELERATES →

Song is composed of one churr

Plain Wren. A rough scold starting with a few elements that rapidly accelerates. Invariable. www.xeno-canto.org/32047 by Andrew Spencer

Song is composed of several churrs

House Wren. Burry, barking calls *arrrr! arrrr, ee-ee-et!* Invariable. www.xeno-canto.org/94736 by William Adsett

TEMPO IS STEADY

Pitch rises →

Boat-billed Flycatcher. A nasal, airy, rising churr, lasting about 1 sec. Invariable. www.xeno-canto.org/46785 by Mike Nelson

Pitch falls →

Pitch is very high →

Blue-black Grassquit. Males sing a series of a very high, falling, very fast trill *zeeee-uuu!* “from an exposed perch...often jumping up a few feet during the song before returning to the same perch or one nearby” [1:352]. Invariable. www.xeno-canto.org/16029 by Ken Allaire

Pitch is medium or high

Song is a trill →

Common Tody-Flycatcher. “A rapid descending trill” [1:232], given individually or in a series of about 1 per sec; also sing trills with steady pitch. Invariable. www.xeno-canto.org/24190 by Ken Allaire

Gray-breasted Martin. Sharp, slurpy trills that fall in pitch or keep a steady pitch. Variable. More complex than song of Common Tody-Flycatcher. www.xeno-canto.org/2807 by David Bradley, www.xeno-canto.org/271539 by Peter Boesman

Song is a churr

Boat-billed Flycatcher. A nasal, sharp, falling churr, lasting about 1 sec. Invariable. Much sharper than call of Yellow-throated Vireo. www.xeno-canto.org/32033 by Andrew Spencer

Yellow-throated Vireo. Call is a falling series of about eight raspy notes *reur-reur-reur-reur-reur-reur-reur-reur*. Invariable. www.xeno-canto.org/130041 by Oscar Humberto Marin-Gomez

Pitch is steady

Song is a trill →

Pitch is very high

Plain-colored Tanager. A very high, twittering trill. Invariable. www.xeno-canto.org/271605 by Peter Boesman

Pitch is medium or high

White-bellied Antbird. Scold is a sharp but somewhat bubbly trill of about 4–8 notes in less than 1 sec, often repeated several or many times in rapid succession. Invariable. www.xeno-canto.org/112886 by Sander Bot

Song is a churr

Barred Antshrike. “Call a growling *arrrrh!*” [1:202]. Invariable. Call sounds growling, unlike the other songs in this section. www.xeno-canto.org/2602 by David Bradley

House Wren. A rough burst of identical notes, lasting about one-half sec. Invariable. Much thinner, more insect-like, and shorter than scold of Buff-breasted Wren. www.xeno-canto.org/106554 by Mike Nelson

Buff-breasted Wren. A rapid series of rough, raspy notes, typically lasting several sec. Invariable. www.xeno-canto.org/92398 by Oswaldo Cortes

SONG INCLUDES TRILLS OR CHURRS →

SONG IS COMPOSED OF A SERIES OF SIMPLE ELEMENTS →

Tropical Kingbird. The rising “dawn song consists of a few short notes followed by an undulating trill: *pip-pip-*

pip-deetdididideet" [1:254]. Invariable. Song always follows this simple pattern, unlike the song of Thick-billed Euphonia. www.xeno-canto.org/1123 by Robin Carter

Thick-billed Euphonia. A mix of trills, buzzes, single clear notes, and upslurring two-noted clear phrases, each separated by 1–3 sec, including “a sweet clear *fweet*, a burry *brreet*, and a clear *dee-dit*, the latter softer and faster than common [*beem-beem*] call of Yellow-crowned Euphonia” [1:384]. Variable. www.xeno-canto.org/78748 by William Adsett

SONG IS COMPOSED OF A COMPLICATED SERIES OF VARIABLE PHRASES

Yellow-bellied Elaenia. “Very active and noisy; one common call is a descending series of hoarse notes: *FWEER-fweer-fwir*; also gives a harsh descending *fwirrr!*” [1:226]. The *FWEER* is an up/downslurring churr, the *fweer* upslurs, and *fwir* is a trill. Also sings any of these sections individually. Variable. Complete song is nasal, unlike the other songs in this section. www.xeno-canto.org/16088 by Ken Allaire

House Wren. “Song a variable series of rapid musical notes, about 2 or 3 sec in duration, often interspersed with short trills” [1:294]. Repertoire. Song includes nasal, buzzy phrases, unlike songs of Yellow-bellied Seedeater and Lesser Goldfinch. www.xeno-canto.org/2614 by David Bradley, www.xeno-canto.org/101813 by Jeremy Minns

Tropical Mockingbird. A “long, melodious series of varied, whistling trills and warbles, some repeated several times” [1:306]. Typically includes some nasal phrases. Repertoire. Songs often last for many mins without pause, unlike the others in this section. www.xeno-canto.org/199020 by Guillermo Funes

Yellow-bellied Seedeater. “A rapid musical warbling, often ending with a buzzy” churr [1:354]. Variable/repertoire. This version of this species’ song ends in a buzzy churr, unlike the others in this section. www.xeno-canto.org/24248 by Ken Allaire

Lesser Goldfinch. A mix of “high-pitched warbles and twitters” [1:388]. Variable/repertoire. www.xeno-canto.org/55021 by Bernabe Lopez-Lanus

SONG IS NOT A TRILL OR CHURR AND DOES NOT INCLUDE TRILLS OR CHURRS

ELEMENTS UPSLUR AND DOWNSLUR →

Tempo accelerates →

Black-striped Sparrow. “Distinctive song is a series of mellow [downslurring] *cho* notes that last 15 to 20 sec; initially slow and then gradually accelerating (like sound of a ball bouncing to a halt)” [1:362] (1). Also sings the downslurring, harsher “*cho!* and [upslurring, sweeter] *wheet!* calls, singly or in short series” without accelerating [1:362] (2). Invariable. (1) www.xeno-canto.org/31942 by Andrew Spencer, (2) www.xeno-canto.org/128619 by Wouter Halfwerk

Tempo is steady

Pitch is very high →

Song is composed of paired elements alternating up and down

Blue-gray Tanager. Very high, paired “squeaky notes rising and falling in pitch” [1:342] *seet-suu*, *seet-suu*, as if the bird is breathing in-out, in-out as it sings. Paired elements often are mixed with high notes in a squeaky chatter. Variable. www.xeno-canto.org/2813 by David Bradley

Song is not composed of paired elements alternating up and down

Palm Tanager. “Song like that of Blue-gray Tanager, but faster and with sharper and less squeaky notes” [1:342]. Variable. www.xeno-canto.org/15700 by Don Jones, www.xeno-canto.org/271627 by Peter Boesman

Plain Wren. A very high, shrill song which upslurs and/or downslurs. Sounds somewhat like a violin. Invariable. Simpler than than songs of Palm Tanager and Yellow-crowned Euphonia. www.xeno-canto.org/83092 by Brian Cox, www.xeno-canto.org/18658 by Ken Allaire

Yellow-crowned Euphonia. “Song consists of phrases of [very] high-pitched, sputtering notes” [1:384]. Variable. Sweeter than songs of Blue-gray Tanager and Palm Tanager. www.xeno-canto.org/15573 by Don Jones

Pitch is medium or high

Song is composed of one element →

Roadside Hawk. “Call a nasal, shrill whistle *kee-YOOuuu*” [1:50] that upslurs on the *kee* and downslurs on the *YOOuuu*. Invariable. www.xeno-canto.org/60757 by Ken Allaire, www.xeno-canto.org/114173 by Raul Rene

Gray-lined Hawk. A nasal, shrill, up/downslurring whistle “*KEEEeer*” [1:50]. Invariable. Song slightly less nasal than song of Roadside Hawk; in addition, pitch often remains steady longer between the *KEEE* and the *eer* of Grey-lined Hawk than between the *kee* and *YOOuuu* of Roadside Hawk. www.xeno-canto.org/6419 by Ken Allaire, www.xeno-canto.org/117314 by

Mauricio Álvarez Rebolledo

Social Flycatcher. A quick, up/downslurring, “piercing *chi-wiww!*” [1:230]. Invariable. Squeakier than the other songs in this section. www.xeno-canto.org/10094 by Ken Allaire

Rusty-margined Flycatcher. A nasal, up/downslurring, “sharp, plaintive, prolonged *feeeeeerrrr* (lasting a second or more)” [1:250]. Invariable. Not as whistled as song of Gray-lined Hawk. (Song is longer and more emphatic than similar song of Dusky-capped Flycatcher in Part I.) www.xeno-canto.org/15714 by Don Jones

Great Kiskadee. A loud, nasal *Yeang!* that up/downslurs. Invariable. Not shrill, like the hawks in this section; more nasal than songs of Social and Rusty-margined flycatchers. www.xeno-canto.org/32045 by Andrew Spencer

Clay-colored Thrush. A down/upslurring “nasal *nyyaowk!*” [1:304]. Invariable. The only song in this section that down/upslurs. www.xeno-canto.org/78592 by William Adsett

Crimson-backed Tanager. Call is a rough, barking *aaui!* that quickly (and somewhat imperceptibly) up/downslurs. Invariable. Sounds barking, unlike the other songs in this section. www.xeno-canto.org/164783 by James Bradley

Song is composed of a series of identical or nearly identical elements →

Song screeches

Yellow-headed Caracara. A series of about 3–8 airy, “high, grating, whistling screech[es] *khyeeeee!*” *khyeeeee!* *khyeeeee!* [1:58]. Invariable. Each screech can upslur and downslur, upslur, downslur, or not slur; a bit slower than 1 per sec. www.xeno-canto.org/199019 by Guillermo Funes, www.xeno-canto.org/199046 by Guillermo Funes

Song does not screech

Roadside Hawk. A nasal series (run) of up/downslurring elements, elements; about 4 per sec. Invariable. Squeakier than song of Panama Flycatcher. www.xeno-canto.org/110758 by Thore Noernberg

Southern Beardless-Tyrannulet. A “series of three to six high-pitched, plaintive *pwee* notes, descending slightly” [1:222], sung within 1–2 sec. Each *pwee* up/downslurs. Occasionally sings just the first element or first two elements. Variable. Airier than songs of the other species in this section. www.xeno-canto.org/166043 by Mike Nelson, www.xeno-canto.org/212875 by Manuel Espejo

Panama Flycatcher. A nasal run of up/downslurring elements, the most-distinctive of which is a *Wee-du-du-du-du-du-du*; about 5–6 per sec. Variable. www.xeno-canto.org/45131 by Scott Olmstead

Scrub Greenlet. A “series of 10 to 20 mellow two-note whistles: *du-wee, du-wee, du-wee, du-wee, du-wee*” [1:276]; each *wee* element up/down/upslurs. About 2–3 elements per sec. Invariable. Elements end with upslurs, and song is clear, unlike songs of the other species in this section. www.xeno-canto.org/60714 by Ken Allaire

Song is composed of a simple, two- or three-element phrase →

Great Kiskadee. A loud, nasal, two-element *KE-haaw!*; the *haaw!* up/downslurs. Invariable. www.xeno-canto.org/32046 by Andrew Spencer: sec 4-6, 12-13, 15-16

Great Kiskadee. A loud, nasal, three-element *KISK-a-DEE*; the *DEE* up/downslurs. Invariable. www.xeno-canto.org/32046 by Andrew Spencer: sec 0-1, 7-8

Song is composed of a complex series of elements and phrases

Song includes quavers

Rosy Thrush-Tanager. Variable songs with a distinctive trembling or quavering quality. “One of Panama’s best songsters; the rich, resonant, wrenlike song...is sung antiphonally, with each member of a pair giving part of the song; gives a rhythmic *che-ow-whedup, chuwee-dup* and variants. Has a variety of other calls, including a sharp *wheet, chu-wu* and a falling *whiwhiwiwivi* that alternates with single or double melodious whistles” [1:334]. Repertoire (1). Also sing a long series of two-element, quavering phrases, each about 1 or 2 sec apart, which is invariable (2). (1) www.xeno-canto.org/15702 by Don Jones and www.xeno-canto.org/31939 by Andrew Spencer, (2) www.xeno-canto.org/2616 by David Bradley

Song does not include quavers

Phrases are sung with a 1–3-sec pause between them →

Streaked Flycatcher. At dawn and dusk, sings a nasal, “musical *wheet!-fididi-wheet!*” [1:252], with about 2–3 sec between phrases. Invariable. More emphatic than songs of

Crimson-backed Tanager and Golden-fronted Greenlet. www.xeno-canto.org/121509 by Leslie Lieurance

Crimson-backed Tanager. “Song, given at dawn, a musical whistled *chid-dee-chew* or *chit, dew, dew*” [1:340] with about 1 sec between phrases; phrases can alternate upslurring and downslurring. Invariable. Richer than song of Golden-fronted Greenlet. (Similar to song of Clay-colored Thrush in Part I, but that species’ song is more variable—a repertoire—and is richer.) www.xeno-canto.org/31823 by Andrew Spencer

Golden-fronted Greenlet. A “rapid, musical series of four (sometimes three or five) whistled notes: *chit-ee-che-ew* or *che-eet-er-chew*” [1:276] with about 2 sec between phrases. Invariable. Not nasal, unlike song of Streaked Flycatcher. Sharper than song of Crimson-backed Tanager. (The three-element version is virtually identical to the three-element song of Lesser Greenlet in Part I, but that species is “found in middle and upper levels of forest” [1:276].) www.xeno-canto.org/182280 by Jerome Fischer

Phrases are sung without pauses between them

Song is composed of repeated, single, slurred elements →

Buff-breasted Wren. “A rapid, rollicking series of musical whistled notes [elements], each...repeated several times before changing to another; *chiri-chi, chiri-chi, chiri-chi, chiri-chi* and *chi-dit, churwee, chit-dit, chi-dit, churwee* [1:292]. Repertoire. More musical, less sharp, and usually faster than song of Plain Wren; unlike song of Plain Wren, can include a diagnostic, downslurring element (which, when sung alone, also keys-out separately in this key). www.xeno-canto.org/46865 by Mike Nelson (two-element phrase is near the end of this recording)

Plain Wren. “Song similar to that of Buff-breasted Wren but sharper and less musical” [1:292]. Repertoire. www.xeno-canto.org/59516 by Mike Nelson, www.xeno-canto.org/135235 by William Adsett

Song is not composed of repeated, single, slurred elements

Song is clear and sweet →

Song lasts about 1–2 sec

Yellow-bellied Seedeater. “A rapid musical warbling” [1:354]. Variable/repertoire. Song can include churrs and trills, unlike song of Ruddy-breasted Seedeater. www.xeno-canto.org/16079 by Ken Allaire,

Ruddy-breasted Seedeater. “Song consists of deliberate series of sweet whistles, often with some notes doubled” [1:354]. Most or all elements upslur or downslur. Variable/repertoire. Song is slower than song of Yellow-bellied Seedeater. www.xeno-canto.org/16057 by Ken Allaire

Song lasts about 10–30 sec

Variable Seedeater. “Song consists of sweet twittering and warbling notes that rise and fall in no particular sequence” [1:354]. Variable/repertoire. Compared to song of Thick-billed Seed-Finch, a little less melodic and each song fades away more at the end. www.xeno-canto.org/24238 by Ken Allaire, www.xeno-canto.org/271589 by Peter Boesman

Thick-billed Seed-Finch. “Song a prolonged, jumbled series of sweet chirps, whistles, and twitters” [1:356]. Variable/repertoire. www.xeno-canto.org/72316 by Andrew Spencer, www.xeno-canto.org/16767 by Frank Lambert

Song is nasal and sharp

Rusty-margined Flycatcher. A bouncing chatter of many nasal, sharp notes mixed with clear, sweet notes. Variable. www.xeno-canto.org/92252 by Oswaldo Cortes

Social Flycatcher. A bouncing chatter of many nasal, sharp notes mixed with clear, sweet notes (1). Variable. Unlike song of Rusty-margined Flycatcher, often includes a diagnostic, downslurring *chi-iww!* call (2). (1) www.xeno-canto.org/73196 by Ezekiel S. Jakub, (2) www.xeno-canto.org/10094 by Ken Allaire

ELEMENTS UPSLUR →

Great-tailed Grackle. “Has a wide variety of calls, including a strident *wheek-wheek-wheek*, and rising *whuREEEK*, and various other shining and chattering vocalizations” [1:376], many of which upslur. Variable. www.xeno-canto.org/56187 by Mike Nelson

ELEMENTS DOWNSLUR →**Tempo accelerates** →

Barred Antshrike. “Song a rapid, accelerating series of soft *heh* notes, ending in a longer nasal *hu-hek!*” [1:202]. Invariable. (Compared to similar, accelerating song of Black-crowned Antshrike in Part I: more nasal, slightly lower in pitch, slightly less rushed, notes fall before last element, and last element is not squeaky.) www.xeno-canto.org/24174 by Ken Allaire

Tempo decelerates →

White-bellied Antbird. “Song a series of loud chirps, beginning very rapidly, then gradually slowing down and finally trailing off (often likened to sound made by mechanical wind-up bird)” [1:212]. Invariable. www.xeno-canto.org/182262 by Jerome Fischer

Tempo is steady**Song is composed of simple, non-warbled phrases** →**Song is composed of phrases with two elements**

Yellow-crowned Tyrannulet. A clearly whistled *heeEER!* Invariable. Easily imitated by whistling, unlike song of Buff-breasted Wren. www.xeno-canto.org/47090 by Mike Nelson

Buff-breasted Wren. A sweet, downslurring, two-noted song. Invariable. www.xeno-canto.org/46862 by Mike Nelson

Song is composed of phrases with three to five elements

Streaked Saltator. “Song consists of three to five sweet whistled notes, the last one (sometimes two) slurred [downward] and longer [than the first notes]: *tew-tew-tew-teeuuw*” [1:350]. Invariable. www.xeno-canto.org/93039 by Oswaldo Cortes

Song is composed of complex, warbled phrases

Streaked Saltator. Longer version of this species’ three- to five-element song, with short, sweet runs and strong, clear, downslurring elements. Variable. Richer and less sharp than song of Buff-throated Saltator. www.xeno-canto.org/16069 by Ken Allaire

Buff-throated Saltator. “Song consists of variable warbled phrases of mellow whistles, such as *chuweet, cheet, choo-a-wheet*” [1:350], typically downslurring at the end. Variable. www.xeno-canto.org/110593 by Ken Allaire

ELEMENTS DO NOT SLUR**Tempo accelerates** →

Golden-hooded Tanager. “Call a thin...*chit*...[typically] accelerated into a rapid chatter [1:346]. Invariable. www.xeno-canto.org/31943 by Andrew Spencer

Tempo is steady**Pitch is very high** →

Streaked Saltator. Call is a very high-pitched, sharp *tsit*. Invariable. www.xeno-canto.org/57295 by Bernabe Lopez-Lanus

Buff-throated Saltator. Call is a very high-pitched, sharp *tsit*. Invariable. www.xeno-canto.org/10073 by Ken Allaire

Plain-colored Tanager. “Call a [very] high-pitched...*dziit*” [1:342]. Invariable. www.xeno-canto.org/83082 by Brian Cox

Blue Dacnis. “Calls include a very high-pitched sharp *tsit*” [1:346]. Invariable. www.xeno-canto.org/168605 by Martin St-Michel

Red-legged Honeycreeper. “Calls include a thin *dzt* and a piercing *chuweet!*” [1:348]. Invariable. www.xeno-canto.org/11157 by Doug Knapp

Pitch is medium or high**Song is composed of one element**

Streaked Flycatcher. A nasal, “sharp *chik!*” [1:252]. Invariable. More nasal than calls of Blue Dacnis and Green Honeycreeper. www.xeno-canto.org/138161 by William Adsett

Blue Dacnis. Calls include a thin, sharp “*chu*” [1:346] sung about 1 per sec. Invariable. www.xeno-canto.org/37432 by Charlie Vogt

Green Honeycreeper. “Call a chirping *cheet!*” sung about 1 per sec. [1:348]. Invariable. www.xeno-canto.org/65156 by Ken Allaire

Song is composed of two or three elements

Yellow-crowned Euphonia. “Constantly gives a sharp, high-pitched *beem-beem* or *beem-beem-beem*” [1:384]. Invariable. www.xeno-canto.org/31839 by Andrew Spencer

Song is composed of many elements

Common Tody-Flycatcher. A series of “sharp *tchk!*” [1:232] calls sung about 1–3 per sec. Invariable. Much quieter and simpler than song of Tropical Kingbird. www.xeno-canto.org/56455 by Mike Nelson

Tropical Kingbird. A “high-pitched...chittering” [1:254] of identical or almost-identical notes. Invariable. www.xeno-canto.org/135489 by William Adsett

PART III: KEY TO SONGS OF DIURNAL BIRDS IN THE WETLANDS ADJACENT TO THE ENTRANCE TO PIPELINE ROAD →**SONG IS A TRILL OR CHURR →****TEMPO DECELERATES →**

Amazon Kingfisher. A burst or series of bursts of high, sharp notes, decelerating from about 12 to about 4 notes per sec. Invariable. www.xeno-canto.org/31704 by Mike Nelson

TEMPO IS ERRATIC →

Barn Swallow. Rough, quickly upslurring calls sung at about 1 per sec; sung while in flight. Invariable. Dr. Livezey_TOOENIJ.docx www.xeno-canto.org/327328 by Antonio Xeira

TEMPO IS STEADY**Pitch rises and falls →**

Lesser Kiskadee. Call is a nasal, “hoarse, buzzy *wheeeerrr-bik!*” [1:248] in which the pitch rises in the *wheeeerrr* and falls to a lower note for the *bik*. Invariable. www.xeno-canto.org/10082 by Ken Allaire

Yellow-tailed Oriole. A burry *kink! onk kink! onk kink!* with *kink!*s higher and more emphatic than the *onks*. Invariable. www.xeno-canto.org/148337 by Gary Stiles

Pitch falls →

White-throated Crake. A mechanical, churring, “abrupt descending *chuuuuurrrrrr*, given at frequent intervals” [1:62]; song lasts several sec. Invariable. www.xeno-canto.org/59285 by Frank Lambert, starting at sec 9

Pitch is steady

Snail Kite. “Call a harsh creaky” [1:42] *krhrhrhrhr*. Invariable. About same pitch as song of Ringed Kingfisher, but notes in the trill are sung about twice as fast. www.xeno-canto.org/127155 by Thore Noernberg

Mangrove Swallow. A sharp, rapid trill in one-half sec, usually with about 1–3 sec between them. Invariable. Higher in pitch than the other songs in this section except American Pygmy Kingfisher; about same pitch as song of American Pygmy Kingfisher, but is weaker and less sharp. www.xeno-canto.org/274356 by Peter Boesman

Green-and-rufous Kingfisher. A sharp, rapid churr in one-half sec, with several or many sec between them. Invariable. Songs of Green-and-rufous and American Pygmy kingfishers are shorter than those of Red-crowned Woodpecker and Ringed Kingfisher. www.xeno-canto.org/154634 by Oswaldo Cortes at sec 10, 14, 18, etc.

American Pygmy Kingfisher. A sharp, rapid churr in one-half sec, with several or many sec between them. Invariable. Higher in pitch than the other songs in this section except Mangrove Swallow; about same pitch as song of that species, but is stronger and sharper. www.xeno-canto.org/133539 by John van Dort

Red-crowned Woodpecker. A churr of harsh, burry notes in less than 1 sec: a “loud harsh *churr-r-r-r*” [1:178]. Invariable. Higher, more rolling, and less sharp than song of Ringed Kingfisher. www.xeno-canto.org/31835 by Andrew Spencer: first three songs

Ringed Kingfisher. A strong churr of harsh, burry notes. Churrs are of two types: one lasts about 1 sec (1) and the other lasts about 1/4 sec and is typically sung in a series of about 1 churr per sec for up to about 15 sec (2). Invariable. (1) and (2) www.xeno-canto.org/43234 by Joe Klaiber

SONG INCLUDES TRILLS OR CHURRS →**SONG INCLUDES TRILLS**

Barn Swallow. A busy chattering mixed with upslurring elements and trills of about 12–15 elements per sec; sung while perched. Variable. www.xeno-canto.org/317544 by Manuel Grosselet

SONG INCLUDES CHURRS

Yellow-billed Cacique. “Sings one or two slurred whistles followed by a churr” [1:380]. Invariable. www.xeno-canto.org/11328 by Doug Knapp, www.xeno-canto.org/10776 by Nick Athanas

SONG IS NOT A TRILL OR CHURR AND DOES NOT INCLUDE TRILLS OR CHURRS**ELEMENTS UPSLUR AND DOWNSLUR →****Song includes clucks**

Gray-necked Wood-Rail. “Call a loud ringing series of clucks and hoots: *kuk kuk, kuk-WHOOT kuk-WHOOT kuk-WHOOT kuk-WHOOT kuk-whooot-whooot-whooot-whooot*” [1:62]. Variable. www.xeno-canto.org/106510 by Mike Nelson

Greater Ani. “Calls include a clucking *gw’hu-gw’uh-gw’uh*” [1:122]. Invariable. www.xeno-canto.org/9314 by Allen T. Chartier

Song does not include clucks

Black-bellied Whistling-Duck. A “series of shrill somewhat harsh whistles, *whit-WHEE-chi-chi-chi* (variable in stress and number of syllables), given mainly in flight” [1:4]. Invariable. Higher and airier than the other songs in this section. www.xeno-canto.org/92096 by Mike Nelson

Southern Lapwing. “Frequently gives loud raucous alarm calls...: *KEER KEER KEER KEER*” [1:68]. Invariable. Sharper and more emphatic than the other songs in this section. www.xeno-canto.org/57435 by Bernabe Lopez-Lanus

Wattled Jacana. Calls are nasal, harsh, and somewhat squeaky: *hee, hee, hee* that sound like a person laughing. Invariable. More muffled and nasal than the other songs in this section. www.xeno-canto.org/65177 by Ken Allaire

Yellow-tailed Oriole. A “series of short, mellow phrases, each one repeated several times before changing to another” [1:378]. Song sounds wren-like. Repertoire. More rollicking than the other songs in this section. www.xeno-canto.org/39248 by Mike Nelson, www.xeno-canto.org/260045 by John V. Moore

Yellow-billed Cacique. “Song includes variable phrases composed of mellow, slurred whistles, including *wheeee-heuuu*” [1:380]. Variable. Simpler than the other songs in this section. www.xeno-canto.org/11328 by Doug Knapp, www.xeno-canto.org/10776 by Nick Athanas

ELEMENTS UPSLUR →

Smooth-billed Ani. “Call a shrill shining *ooooo-ik!*, rising at the end” [1:122]. Invariable. Shrill and whistled, unlike nasal call of Red-crowned Woodpecker. www.xeno-canto.org/46971 by Karl Kaufmann

Red-crowned Woodpecker. A “rapid *whicka-whicka-whicka*” [1:178]. Invariable. www.xeno-canto.org/31835 by Andrew Spencer: sec 3–5

ELEMENTS DOWNSLUR →

Western Osprey. A downslurring, sharp *seeuup!* Invariable. www.xeno-canto.org/109038 by Andrew Spencer

ELEMENTS DO NOT SLUR**Notes are very flat, are not nasal**

Green Kingfisher. A series of sharp notes, about 1–3 per sec, somewhat like the sound made by tapping two rocks together. Invariable. www.xeno-canto.org/108678 by Taylor Brooks

Notes are not flat, are nasal

Purple Gallinule. A nasal, “sharp *kik!*” [1:66] and a quick series of similar notes that sound like a person laughing. Invariable. (Lower pitched than laughing calls of Wattled Jacana.) www.xeno-canto.org/166168 by Mike Nelson

Common Gallinule. Nasal, single-noted, piping calls. Invariable. Does not sing a quick series of notes as does Purple Gallinule. www.xeno-canto.org/327112 by David Ricardo Rodriguez Villamil

PART IV. KEY TO SONGS OF NOCTURNAL BIRDS IN THE FORESTS ALONG PIPELINE ROAD, AND THE FRAGMENTED FORESTS, FOREST EDGES, GRASSY AREAS, AND WETLANDS ADJACENT TO THE ENTRANCE TO PIPELINE ROAD**SONG IS A TRILL OR CHURR OR INCLUDES TRILLS OR CHURRS →****TRILL OR CHURR TERMINATES WITH A LOUD FINAL ELEMENT**

Tropical Screech-Owl. “Call a burry trill, usually terminating in a loud final note: *kukukukukuKU!* The final note is sometimes doubled: *kukukukukuKUH!-koo!* (or occasionally tripled)” [1:126]. Invariable. www.xeno-canto.org/94741 by William Adsett

TRILL OR CHURR DOES NOT TERMINATE WITH A LOUD FINAL ELEMENT**Churr lasts about 1 sec**

Crested Owl. “Call a deep, resonant *bwoorr*” [1:124]. Invariable. Much lower than song of Common Nighthawk. www.xeno-canto.org/76145 by Ken Allaire

Common Nighthawk. “Flight call (frequently given) is a nasal buzzy *peent!* or *beezhnt!*; during courtship, males in dive display produce a whooshing or booming sound with wings” [1:128]. Invariable. www.xeno-canto.org/75590 by William Adsett

Trill lasts 5–7 sec

Vermiculated Screech-Owl. “Call a ... froglike... *kurrrooooh*” [1:126] lasting about 5–7 sec. Invariable. www.xeno-canto.org/190370 by Euclides Campos Cedeño

Trill lasts more than 30 sec

Lesser Nighthawk. An even or “evenly pitched froglike trill” [1:128] that can last 1 min or more. Invariable. www.xeno-canto.org/42861 by Andrew Spencer

SONG IS NOT A TRILL OR CHURR AND DOES NOT INCLUDE TRILLS OR CHURRS**ELEMENTS UPSLUR AND DOWNSLUR →****Tempo accelerates →**

Black-and-white Owl. Calls are “an accelerating series of deep notes, accented on last or next-to-last syllable: *buh-buh-bu-bu-bu-BWA!* or *buh-buh-bu-bu-bu-BWH!-bu*” [1:124] (1) and a single hooting *woAo!* (2). Invariable. (1) www.xeno-canto.org/2966 by David Bradley, (2) www.xeno-canto.org/87798 by Leslie Lieurance

Tempo is steady**Song is a run of similar, simple elements**

Spectacled Owl. “Call is a...series of short notes that become softer toward the end (sounds like muffled knocking on wood): *bubububububuhbuh*” [1:124]. Invariable. www.xeno-canto.org/92131 by William Adsett

Song is not a run of similar, simple elements**Song is composed of a high, thin whistle; or is spoken →*****Song is composed of a high, thin whistle***

Striped Owl. Call is “a shrill, high-pitched *heeAH!*” [1:124]. Invariable. www.xeno-canto.org/123771 by Kristhian Castro

White-tailed Nightjar. “Call consists of a short introductory note followed by a thin high-pitched whistle that rises and then falls, *chik-fWHEeee*” [1:130]. Invariable. Higher and clearer than song of Striped Owl. www.xeno-canto.org/118595 by David Bradley and Sandra Valderrama

Song is spoken

Mottled Owl. “Gives a variety of calls, including a muffled *hWHOO*, often repeated two or more times” [1:124]. Invariable. (Lower in pitch and less nasal than song of Pauraque.) www.xeno-canto.org/78669 by William Adsett, at sec 2, 4, 11, 12, etc.

Song is not composed of a high, thin whistle; is not spoken***Song is a simple, catlike meow, weakly up/downslurring***

Mottled Owl. A nasal “catlike...*keeyow*” [1:124]. Invariable. www.xeno-canto.org/113027 by Sander Bot, at sec 2 and 5

Song is a complex arrangement of notes, strongly up/downslurring

Rufous Nightjar. A nasal, “rapid...*chuck, wik-wik-WHEeoh!*” [1:130], repeated many times. Invariable. More hurried than song of Pauraque with only about 1 sec between sections and with the *WHEeohs* lasting about one-half as long as the *HEERrs* of Pauraque. Also, more emphatic than song of Pauraque with stronger emphasis of *chuck, wik-wik* than on the *wik-wik-ik* of Pauraque. www.xeno-canto.org/2954 by David Bradley

Pauraque. “Call a buzzy whistling *woHEERrr!* (1), sometimes preceded by several upslurring phrases: *wik-wik-ik-wHEERrr!*” [1:128] (2). When repeated, about 2–3 sec between sections. Invariable. (1) www.xeno-canto.org/105500 by William Adsett, (2) www.xeno-canto.org/60738 by Ken Allaire

ELEMENTS DO NOT SLUR**Pitch falls** →

Common Potoo. “Call a haunting, melancholy series of wailing notes, loud at first, becoming gradually softer and falling in pitch: *WHEEUU*, *whu*, *hu*, *hu*, *hu*” [1:132]. Invariable. www.xeno-canto.org/90477 by Leslie Lieurance

Pitch is steady**Song is composed of one element** →**Song is a low roar**

Great Potoo. “Call an explosive roar: *bWARRRR!*” [1:132]. Invariable. www.xeno-canto.org/144211 by Michel Giraud-Audine

Song is a short, sharp whistle

Short-tailed Nighthawk. “Flight call is a sharp *chwit!*” [1:128]. Invariable. www.xeno-canto.org/93187 by Tom Stevens

Song is composed of a series of similar elements

Lesser Nighthawk. A series of calls, each of which is a “bleating whinny” [1:128]. Invariable. www.xeno-canto.org/66590 by Jeremy Minns: starting at sec14

Central American Pygmy-Owl. “Call a series of evenly spaced whistled notes that varies from 2 to 18 notes: *pew pew pew pew*” [1:126], about 2 per sec. Invariable. More whistled than song of Lesser Nighthawk. www.xeno-canto.org/60670 by Ken Allaire

CONFLICT OF INTEREST

The author confirms that this article content has no conflict of interest.

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APPENDIX

Appendix. Counts of species and songs, and scientific names of birds in the key. x = a song often heard while the bird is in or flying over this area in addition to its primary area.

Group	Scientific name	Common name	Counts			
			Part I (Pipe-line)	Part II (fragmented forests)	Part III (wetlands)	Part IV (nocturnal)
Tinamous						
	<i>Tinamus major</i>	Great Tinamou	1	x		
	<i>Crypturellus soui</i>	Little Tinamou	2	x		
Ducks						
	<i>Dendrocygna autumnalis</i>	Black-bellied Whistling-Duck			1	
Curassows, Guans, and Chachalacas						
	<i>Ortalis cinereiceps</i>	Gray-headed Chachalaca	1	x		
Hawks, Eagles, and Kites						
	<i>Pandion haliaetus</i>	Osprey			1	
	<i>Leptodon cayanensis</i>	Gray-headed Kite	1	x		
	<i>Chondrohierax uncinatus</i>	Hook-billed Kite	1	x		

	<i>Harpagus bidentatus</i>	Double-toothed Kite	1	x		
	<i>Rostrhamus sociabilis</i>	Snail Kite			1	
	<i>Leucopternis semiplumbeus</i>	Semiplumbeous Hawk	1	x		
	<i>Buteo magnirostris</i>	Roadside Hawk	x	2		
	<i>Buteo nitidus</i>	Gray-lined Hawk	x	1		
	<i>Spizaetus tyrannus</i>	Black Hawk-Eagle	1			
Falcons and Caracaras						
	<i>Micrastur mirandollei</i>	Slaty-backed Forest-Falcon	1			
	<i>Micrastur semitorquatus</i>	Collared Forest-Falcon	2	x		
	<i>Milvago chimachima</i>	Yellow-headed Caracara		1		
Rails, Gallinules, and Coots						
	<i>Laterallus albigularis</i>	White-throated Crake			1	
	<i>Aramides cajanea</i>	Gray-necked Wood-Rail	x	x	1	
	<i>Porphyrio martinicus</i>	Purple Gallinule			1	
	<i>Gallinula chloropus</i>	Common Gallinule			1	
Plovers and Lapwings						
	<i>Vanellus chilensis</i>	Southern Lapwing			1	
Jacanas						
	<i>Jacana jacana</i>	Wattled Jacana			1	
Pigeons and Doves						
	<i>Patagioenas nigrirostris</i>	Short-billed Pigeon	1			
	<i>Patagioenas cayennensis</i>	Pale-vented Pigeon	1	x	x	
	<i>Patagioenas speciosa</i>	Scaled Pigeon	1			
	<i>Leptotila verreauxi</i>	White-tipped Dove	1	x		
	<i>Leptotila cassini</i>	Gray-chested Dove	1			
	<i>Geotrygon montana</i>	Ruddy Quail-Dove	1			
Parrots						
	<i>Brotogeris jugularis</i>	Orange-chinned Parakeet	1	x	x	
	<i>Pionopsitta haematotis</i>	Brown-hooded Parrot	1	x	x	
	<i>Pionus menstruus</i>	Blue-headed Parrot	1	x	x	
	<i>Amazona autumnalis</i>	Red-ored Parrot	1	x	x	
	<i>Amazona farinosa</i>	Mealy Parrot	1	x	x	
Cuckoos						
	<i>Piaya cayana</i>	Squirrel Cuckoo	5	x		
	<i>Dromococcyx phasianellus</i>	Pheasant Cuckoo	2			
	<i>Neomorphus geoffroyi</i>	Rufous-vented Ground-Cuckoo	1			
	<i>Crotophaga major</i>	Greater Ani	x	x	1	
	<i>Crotophaga ani</i>	Smooth-billed Ani			1	
Owls						

	<i>Lophotrix cristata</i>	Crested Owl				1
	<i>Pulsatrix perspicillata</i>	Spectacled Owl				1
	<i>Ciccaba virgata</i>	Mottled Owl				2
	<i>Ciccaba nigrolineata</i>	Black-and-white Owl				2
	<i>Pseudoscops clamator</i>	Striped Owl				1
	<i>Megascops choliba</i>	Tropical Screech-Owl				1
	<i>Megascops guatemalae</i>	Vermiculated Screech-Owl				1
	<i>Glaucidium griseiceps</i>	Central American Pygmy-Owl				1
Nightjars						
	<i>Lurocalis semitorquatus</i>	Short-tailed Nighthawk				1
	<i>Chordeiles acutipennis</i>	Lesser Nighthawk				2
	<i>Chordeiles minor</i>	Common Nighthawk				1
	<i>Nyctidromus albicollis</i>	Pauraque				1
	<i>Caprimulgus rufus</i>	Rufous Nightjar				1
	<i>Caprimulgus cayennensis</i>	White-tailed Nightjar				1
Potoos						
	<i>Nyctibius grandis</i>	Great Potoo				1
	<i>Nyctibius griseus</i>	Common Potoo				1
Hummingbirds						
	<i>Phaethornis longirostris</i>	Long-billed Hermit	1			
	<i>Florisuga mellivora</i>	White-necked Jacobin	1	x		
	<i>Anthracothorax nigricollis</i>	Black-throated Mango	1	x		
	<i>Thalurania colombica</i>	Crowned Woodnymph	1			
	<i>Damophila julie</i>	Violet-bellied Hummingbird	1			
	<i>Amazilia edward</i>	Snowy-bellied Hummingbird	1			
	<i>Amazilia tzacatl</i>	Rufous-tailed Hummingbird	1	x		
	<i>Amazilia amabilis</i>	Blue-chested Hummingbird	1			
	<i>Chalybura buffonii</i>	White-vented Plumeleteer	1			
Trogons						
	<i>Trogon viridis</i>	White-tailed Trogon	2	x		
	<i>Trogon caligatus</i>	Gartered Trogon	2	x		
	<i>Trogon rufus</i>	Black-throated Trogon	2			
	<i>Trogon melanurus</i>	Black-tailed Trogon	1	x		
	<i>Trogon massena</i>	Slaty-tailed Trogon	2	x		
Motmots						
	<i>Baryphthengus martii</i>	Rufous Motmot	3	x		
	<i>Electron platyrhynchum</i>	Broad-billed Motmot	2	x		

	<i>Momotus subrufescens</i>	Whooping Motmot	4	x		
Kingfishers						
	<i>Megaceryle torquatus</i>	Ringed Kingfisher		x	1	
	<i>Chloroceryle amazona</i>	Amazon Kingfisher			1	
	<i>Chloroceryle americana</i>	Green Kingfisher	x		1	
	<i>Chloroceryle inda</i>	Green-and-rufous Kingfisher	x		1	
	<i>Chloroceryle aenea</i>	American Pygmy Kingfisher	x		1	
Puffbirds						
	<i>Notharchus hyperrhynchus</i>	White-necked Puffbird	1	x		
	<i>Notharchus pectoralis</i>	Black-breasted Puffbird	2	x		
	<i>Notharchus tectus</i>	Pied Puffbird	1			
	<i>Malacoptila panamensis</i>	White-whiskered Puffbird	2			
Jacamars						
	<i>Jacamerops aureus</i>	Great Jacamar	1			
Barbets and Toucans						
	<i>Pteroglossus torquatus</i>	Collared Aracari	1	x		
	<i>Ramphastos sulfuratus</i>	Keel-billed Toucan	1	x		
	<i>Ramphastos ambiguus</i>	Black-mandibled Toucan	1	x		
Woodpeckers						
	<i>Melanerpes pucherani</i>	Black-cheeked Woodpecker	2	x		
	<i>Melanerpes rubricapillus</i>	Red-crowned Woodpecker			2	
	<i>Celeus laricatus</i>	Cinnamon Woodpecker	2	x		
	<i>Dryocopus lineatus</i>	Lineated Woodpecker	2	x		
	<i>Campephilus melanoleucos</i>	Crimson-crested Woodpecker	1	x		
Ovenbirds and Woodcreepers						
	<i>Automolus ochrolaemus</i>	Buff-throated Foliage-gleaner	1			
	<i>Xenops minutus</i>	Plain Xenops	1	x		
	<i>Sclerurus guatemalensis</i>	Scaly-throated Leaf-tosser	2			
	<i>Sittasomus griseicapillus</i>	Olivaceous Woodcreeper	1			
	<i>Dendrocincla fuliginosa</i>	Plain-brown Woodcreeper	3	x		
	<i>Dendrocincla homochroa</i>	Ruddy Woodcreeper	1			
	<i>Dendrocolaptes sanctithomae</i>	Northern Barred-Woodcreeper	2			
	<i>Xiphorhynchus susurrans</i>	Cocoa Woodcreeper	4	x		
	<i>Xiphorhynchus lachrymosus</i>	Black-striped Woodcreeper	2			
	<i>Glyphorhynchus spirurus</i>	Wedge-billed Woodcreeper	1			

Typical Antbirds					
	<i>Cymbilaimus lineatus</i>	Fasciated Antshrike	2	x	
	<i>Thamnophilus doliatus</i>	Barred Antshrike		2	
	<i>Thamnophilus atrinucha</i>	Black-crowned Antshrike	3	x	
	<i>Dysithamnus puncticeps</i>	Spot-crowned Antwren	1		
	<i>Epinecrophylla fulviventris</i>	Checker-throated Antwren	1		
	<i>Myrmotherula ignota</i>	Moustached Antwren	1		
	<i>Myrmotherula axillaris</i>	White-flanked Antwren	3		
	<i>Microrhopias quixensis</i>	Dot-winged Antwren	1		
	<i>Cercomacra tyrannina</i>	Dusky Antbird	3	x	
	<i>Myrmeciza exsul</i>	Chestnut-backed Antbird	2	x	
	<i>Myrmeciza longipes</i>	White-bellied Antbird		2	
	<i>Hylophylax naevioides</i>	Spotted Antbird	3	x	
	<i>Gymnophrys leucaspis</i>	Bicolored Antbird	2	x	
	<i>Phaenostictus mcleannani</i>	Ocellated Antbird	2		
Anthrushes					
	<i>Formicarius analis</i>	Black-faced Antthrush	2	x	
Antpittas					
	<i>Hylopezus perspicillatus</i>	Streak-chested Antpitta	2		
Tyrant Flycatchers					
	<i>Ornithion brunneicapillus</i>	Brown-capped Tyrannulet	1	x	
	<i>Camptostoma obsoletum</i>	Southern Beardless-Tyrannulet		1	
	<i>Tyrannulus elatus</i>	Yellow-crowned Tyrannulet		1	
	<i>Myiopagis gaimardii</i>	Forest Elaenia	1	x	
	<i>Myiopagis caniceps</i>	Gray Elaenia	1		
	<i>Elaenia flavogaster</i>	Yellow-bellied Elaenia		1	
	<i>Mionectes oleagineus</i>	Ochre-bellied Flycatcher	1		
	<i>Mionectes olivaceus</i>	Olive-striped Flycatcher	1		
	<i>Zimmerius vilissimus</i>	Paltry Tyrannulet	2		
	<i>Myornis atricapillus</i>	Black-capped Pygmy-Tyrant	1		
	<i>Todirostrum cinereum</i>	Common Tody-Flycatcher		2	x
	<i>Oncostoma olivaceum</i>	Southern Bentbill	2	x	
	<i>Cnipodectes subbrunneus</i>	Brownish Twistwing	3		
	<i>Rhynchocyclus olivaceus</i>	Olivaceous Flatbill	2		
	<i>Onychorhynchus coronatus</i>	Royal Flycatcher	1		
	<i>Tolmomyias assimilis</i>	Yellow-margined Flycatcher	1	x	
	<i>Platyrrinchus coronatus</i>	Golden-crowned Spadebill	1		
	<i>Terenotriccus erythrus</i>	Ruddy-tailed Flycatcher	1		

	<i>Myiobius atricaudus</i>	Black-tailed Flycatcher	x	1		
	<i>Contopus virens</i>	Eastern Wood-Pewee	1	x		
	<i>Attila spadiceus</i>	Bright-rumped Attila	3	x		
	<i>Rhytipterna holerythra</i>	Rufous Mourner	1			
	<i>Myiarchus tuberculifer</i>	Dusky-capped Flycatcher	2	x		
	<i>Myiarchus panamensis</i>	Panama Flycatcher	x	2		
	<i>Myiarchus crinitus</i>	Great Crested Flycatcher	1	x		
	<i>Pitangus lictor</i>	Lesser Kiskadee		x	1	
	<i>Pitangus sulphuratus</i>	Great Kiskadee		3	x	
	<i>Megarynchus pitangua</i>	Boat-billed Flycatcher		2	x	
	<i>Myiozetetes cayanensis</i>	Rusty-margined Flycatcher		2	x	
	<i>Myiozetetes similis</i>	Social Flycatcher		2	x	
	<i>Myiodynastes maculatus</i>	Streaked Flycatcher		2		
	<i>Legatus leucophaeus</i>	Piratic Flycatcher	x	1		
	<i>Tyrannus melancholicus</i>	Tropical Kingbird	x	2	x	
Becards, Tityras, and Others						
	<i>Schiffornis stenorhyncha</i>	Russet-winged Schiffornis	1			
	<i>Lipaugus unirufus</i>	Rufous Piha	1			
	<i>Laniocera rufescens</i>	Speckled Mourner	1			
	<i>Pachyramphus cinnamomeus</i>	Cinnamon Becard	2			
	<i>Pachyramphus polychopterus</i>	White-winged Becard	1			
	<i>Tityra semifasciata</i>	Masked Tityra	1	x		
	<i>Tityra inquisitor</i>	Black-crowned Tityra	1	x		
Cotingas						
	<i>Querula purpurata</i>	Purple-throated Fruitcrow	3			
Manakins						
	<i>Manacus vitellinus</i>	Golden-collared Manakin	2	x		
	<i>Pipra coronata</i>	Blue-crowned Manakin	2			
	<i>Pipra mentalis</i>	Red-capped Manakin	2			
Vireos						
	<i>Hylophilus flavipes</i>	Scrub Greenlet		1		
	<i>Hylophilus aurantifrons</i>	Golden-fronted Greenlet		1		
	<i>Hylophilus decurtatus</i>	Lesser Greenlet	1	x		
	<i>Vireolanus pulchellus</i>	Green Shrike-Vireo	2	x		
	<i>Vireo flavifrons</i>	Yellow-throated Vireo		1		
Jays and Crows						
	<i>Cyanocorax affinis</i>	Black-chested Jay	1	x		
Swallows						
	<i>Tachycineta albilinea</i>	Mangrove Swallow			1	

	<i>Hirundo rustica</i>	Barn Swallow		x	2	
	<i>Progne chalybea</i>	Gray-breasted Martin		1	x	
Wrens						
	<i>Thryothorus fasciatoventris</i>	Black-bellied Wren	2	x		
	<i>Thryothorus nigricapillus</i>	Bay Wren	2			
	<i>Thryothorus leucotis</i>	Buff-breasted Wren		2	x	
	<i>Thryothorus modestus</i>	Plain Wren		3	x	
	<i>Troglodytes aedon</i>	House Wren		2		
	<i>Henicorhina leucosticta</i>	White-breasted Wood- Wren	6			
	<i>Microcerculus marginatus</i>	Scaly-breasted Wren	1			
	<i>Cyphorhinus phaeocephalus</i>	Song Wren	1	x		
Gnatwrens and Gnatcatchers						
	<i>Ramphocaenus melanurus</i>	Long-billed Gnatwren	1	x		
	<i>Poliotilta plumbea</i>	Tropical Gnatcatcher	2	x		
Thrushes						
	<i>Catharus ustulatus</i>	Swainson's Thrush	1			
	<i>Turdus grayi</i>	Clay-colored Thrush	2	x		
Mockingbirds and Allies						
	<i>Mimus gilvus</i>	Tropical Mockingbird		1		
Wood-warblers						
	<i>Seiurus noveboracensis</i>	Northern Waterthrush	1	x		
Tanagers						
	<i>Rhodinocichla rosea</i>	Rosy Thrush-Tanager	2	x		
	<i>Eucometis penicillata</i>	Gray-headed Tanager	1			
	<i>Tachyphonus luctuosus</i>	White-shouldered Tanager	1	x		
	<i>Ramphocelus dimidiatus</i>	Crimson-backed Tanager	x	2		
	<i>Thraupis episcopus</i>	Blue-gray Tanager	x	1		
	<i>Thraupis palmarum</i>	Palm Tanager	x	1		
	<i>Tangara inornata</i>	Plain-colored Tanager	x	2		
	<i>Tangara larvata</i>	Golden-hooded Tanager	x	1		
	<i>Dacnis cayana</i>	Blue Dacnis	x	1		
	<i>Chlorophanes spiza</i>	Green Honeycreeper	x	1		
	<i>Cyanerpes cyaneus</i>	Red-legged Honeycreeper	x	1		
Seedeaters, Finches, and Sparrows						
	<i>Volatinia jacarina</i>	Blue-black Grassquit		1		
	<i>Sporophila americana</i>	Variable Seedeater		1		
	<i>Sporophila nigricollis</i>	Yellow-bellied Seedeater		1		
	<i>Sporophila minuta</i>	Ruddy-breasted Seedeater		1		
	<i>Oryzoborus funereus</i>	Thick-billed Seed-Finch		1		

	<i>Arremonops conirostris</i>	Black-striped Sparrow		2		
Saltators						
	<i>Saltator striatipectus</i>	Streaked Saltator		3		
	<i>Saltator maximus</i>	Buff-throated Saltator		2		
	<i>Saltator grossus</i>	Slate-colored Grosbeak	3			
Grosbeaks, Buntings, and Allies						
	<i>Habia rubica</i>	Red-crowned Ant-Tanager	2			
	<i>Habia fuscicauda</i>	Red-throated Ant-Tanager	2	x		
	<i>Cyanocompsa cyanooides</i>	Blue-black Grosbeak	2	x		
New World Orioles and Blackbirds						
	<i>Quiscalus mexicanus</i>	Great-tailed Grackle		1		
	<i>Icterus chrysater</i>	Yellow-backed Oriole	2	x	x	
	<i>Icterus mesomelas</i>	Yellow-tailed Oriole		x	2	
	<i>Amblycercus holosericeus</i>	Yellow-billed Cacique			2	
	<i>Cacicus uropygialis</i>	Scarlet-rumped Cacique	1	x		
	<i>Cacicus cela</i>	Yellow-rumped Cacique	2	x		
	<i>Psarocolius wagleri</i>	Chestnut-headed Oropendola	1	x		
Goldfinches and Euphonias						
	<i>Euphonia luteicapilla</i>	Yellow-crowned Euphonia		1		
	<i>Euphonia lanirostris</i>	Thick-billed Euphonia		1		
	<i>Euphonia fulvicrissa</i>	Fulvous-vented Euphonia	1	x		
	<i>Carduelis psaltria</i>	Lesser Goldfinch		1		
		TOTALS	208	70	24	19
	Total species count	Total song count				
	216	321				

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