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NOTA CIENTÍFICA

An unidentified nocturnal flight call from southern Mexico

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Abstract
In fall migration 2012 an avian nocturnal flight call monitoring station at Minatitlán, Veracruz, Mexico logged a previously unreported call type. The simultaneous two-toned nature of the vocalization is consistent with production from a syrinx (*i.e.* not from a bat or flying squirrel). The less than 100 ms duration of the call, the 6-10 kHz frequency range, and the characteristics we collected of its nightly and hourly periodicity are congruent with calls given by many small passerines that migrate at night across North America. Yet the call is distinct from night flight calls of neotropical migrant species that regularly traverse eastern USA in spring and fall migration. We have considered the known species that migrate through Veracruz and there are a number of candidates for the caller, but the identity has eluded us. We submit here the mystery and evidence we have gathered for review by others who may have special insight or who may carry on the investigation. Identifying the call would enable the possibility for automatically documenting nocturnal migration activity of the species across its range with specialized audio processors.

Keywords: Unidentified bird call, night migration, nocturnal flight call, North America, Mexico, Veracruz, *Parulidae*, *Emberizidae*.

Un llamado de vuelo nocturno no identificado en el sur de México

Resumen
En la migración de otoño de 2012, en una estación de monitoreo de llamados nocturnos de aves en vuelo cerca de Minatitlán, Veracruz, México, registramos un tipo de llamado, no documentado previamente. La naturaleza de dos tonos simultáneos de dicha vocalización coincide con el que produce la siringe (*i.e.* no es producido por un murciélago o ardilla voladora). Su duración de menos de 100 m.s., de entre 6 y 10 kHz en rango de frecuencia, además de sus características de periodicidad diaria y por horarios, son congruentes con muchas paserinas pequeñas que migran durante la noche y atraviesan Norte América. Sin embargo, este llamado es único y distintivo de llamados nocturnos de aquellas especies en vuelo que regularmente atraviesan la parte este de EUA, durante la migración de primavera y de otoño. Hemos considerado a las especies conocidas que migran a través de Veracruz y hay algunas que podrían tener esta vocalización, sin embargo, no están totalmente identificadas. Describimos las evidencias colectadas para aquellos que tengan un especial interés en revisarlas y deseen continuar con la investigación. Poder identificar el llamado nocturno en vuelo de una especie facilitará la documentación automática de su actividad migratoria, en su rango de distribución, a lo largo del tiempo con procesadores de audio especializados.

Palabras clave: Llamado desconocido de aves, migración nocturna, llamado de vuelo nocturno, Norte América, México, Veracruz, *Parulidae*, *Emberizidae*.

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Introduction

Descriptions of specific unidentified avian vocalizations are to our knowledge nonexistent in ornithological literature. Such reports would seem uncalled for regarding diurnal vocalizations, because with enough effort one should be able to follow the sound and identify its source. But an avian nocturnal flight call is different because it is a transient call in the night, typically from a migrating bird that one cannot simply chase down and identify. While early ornithologists in North America were puzzled regarding the identity of many night flight calls, recent advances in spectrographic analysis tools now facilitate identification. Yet even with modern recording and analysis tools, a confounding challenge for determining the identity of an unknown avian nocturnal flight call is that one needs to know all possible candidates for the sound in the region. Documenting a bird call that matches is not enough; one must also ascertain that other species do not give similar calls that need discrimination.

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Between 1986-2001, W. Evans and M. O'Brien endeavored to identify *Parulidae* and *Emberizidae* nocturnal flight calls in eastern North America. Members of both families typically migrate at night and most are now known to give short (less than 250 ms), high-pitched (5-11 kHz) calls while in nocturnal flight (Evans and O'Brien 2002). Since species identification could not be visually confirmed, the act of presuming identity proceeded inferentially over many years. Progress was primarily made by documenting flight vocalizations from species visually confirmed during the day. The possibility of similar calls from other species was evaluated and distilled over time as call characteristics of more and more species coalesced. The fact that there is no underlying difference between North American parulid and emberizid night flight calls increased the pool of potential contenders for unidentified callers. Both families have species with calls that ascend in pitch; both have species with calls that descend in pitch; both have a variety of frequency modulated calls. The only notable difference now known is that, in eastern North America, emberizids tend to have nocturnal flight calls of longer duration than parulids (Evans and O'Brien 2002).

Other types of songbirds that make annual migratory flights across eastern North America are known to give short nocturnal flight calls in the same high-pitched frequency range as parulids and emberizids. This includes the cardinalids in the genus *Passerina*: *P. caerulea*, *P. cyanea*, and *P. ciris*. In addition, *Regulus satrapa*, *Turdus migratorius*, *Anthus rubescens*, and *Bombycilla cedrorum* also give high-pitched flight calls during nocturnal migration. The remaining annual migrant songbirds in eastern North America known to vocalize in nocturnal flight generally utter lower-pitched calls, most below 5 kHz (Evans and O'Brien, 2002).

Since the release of the Flight Calls of Migratory Birds: Eastern North American Landbirds CD-ROM (Evans and O'Brien, 2002), additional flight call identification progress has not been reported for eastern North America. Lanzone et al. (2009) and Farnsworth (2011) revealed the first spectrographic portrayal of parulid flight calls in western United States. Emberizid flight calls in the West remain only partially described. Of note is that Watson *et al.* (2011) detected *Spinus pinus* calling in nocturnal migration during an eruption year. While the latter is not call identification progress, it indicates that *Fringillidae* calls need to be considered when sorting out possible identifications for unidentified night flight calls.

In 2012, William Evans (WRE) was promoting new night flight call monitoring stations in North America and Manuel Grosselet (MG), Georgia Ruiz Michael (GRM) and colleagues were operating a banding station in the state of Veracruz, Mexico, a few kilometers east of Minatitlán. MG had become interested in establishing a night flight call monitoring station to compare with their banding results. Through our mutual collaboration, a night flight call monitoring station began operation at the airport in Minatitlán in late August 2012.

We describe a distinctive nocturnal flight call from an unidentified species we first recorded in Minatitlán during the fall migration period of 2012. Thirty three calls from the unidentified caller were recorded with an automatic acoustic transient detector optimized for extracting short calls of night migrating songbirds in the 6-10 kHz range. The time-frequency characteristics of the call stood out to WRE as a call he was unfamiliar with in more than 25 years studying nocturnal flight calls across eastern North America. The unidentified call was circulated to others studying avian night flight calls in North America as well as several experts on bird sounds in Mexico, and to date remains unidentified.

Methods

Recording site

Due to prevalence of insect song in the Minatitlán region, we sought a site for the recording station with a large flat roof and little proximal vegetation. Administrators at the Minatitlán International Airport had an interest in understanding bird collision hazard in the airspace near the airport and offered their facilities for our study. We mounted the microphone on the airport terminal building (N 18° 6′ 7.7574″ W 94° 34′ 38.3664″) and located the recording equipment in an office within.

Recording equipment

We used an Old Bird 21c microphone (Old Bird, Ithaca, NY) to receive sound from the night sky. This microphone has a hypercardioid sensitivity pattern and is designed to have acute directional sensitivity in the 2-10 kHz range. 30 m of cable transferred the audio signal to the microphone input of a Turtle Beach Amigo II USB sound card, which connected to one of the airport's office PC's running Windows 7.

We ran Tseep-r software (Old Bird, Ithaca, NY) on the computer nightly from 20:00 to 06:00 h to automatically extract short transient sounds in the 6-10 kHz frequency band at 22050 Hz sampling rate and 16 bit resolution. The airport's computer operated in Central Daylight Time (CDT), which was local time for Minatitlán in August 2012. All time noted in this report is CDT (UTC -5 hours).

The resulting recording system, combined with the relatively quiet recording location, was sufficient for acquiring a consistently gathered sample of avian night flight calls for 10 hours a night from late summer through most of the fall migra-

tion period. The system operated remotely and MG performed system maintenance on occasional visits.

Call extraction and classification

WRE visually analyzed spectrograms of short transient sounds extracted by Tseep-r using GlassOFire software (Old Bird, Ithaca, NY) to separate calls from non-calls, and to classify calls to species categories. The GlassOFire spectrograms were computed with a 128-sample Hamming window, a hop size of 1 sample, and a DFT size of 256 samples. The basis for assigning calls to species categories was the Evans and O'Brien flight call CD-ROM.

Call measurement

We used Raven Pro 1.4 sound analysis software (Cornell Lab of Ornithology, Ithaca, NY) to make spectrograms of the unidentified call and measure specific characteristics. The Raven Pro spectrograms were computed with a 200-sample Blackman window, a hop size of 1 sample, and a DFT size of 256 samples. We selected examples for measurement which spectrographically appeared to show the complete call. To reduce the chances of an individual bird contributing multiple calls, we selected calls that occurred at least 15 minutes apart from one another. Initial frequency, end frequency, call duration and frequency bandwidth were measured when possible. We made manual spectrographic measurements using Raven's position markers to approximate the middle of the contour representing the call's frequency through time (Appendix A).

We estimate our accuracy of measurement to be within +/- 100 Hertz (Hz) and +/- 2.5 milliseconds (ms). For ground-based directional microphones, call frequency theoretically may vary in the range of +/- 100 Hz for small passerine night flight calls due to Doppler shift, depending on whether the vocalizing bird is approaching or moving away from the microphone. Due to these unknowns, frequency measurements noted in this report are rounded to the nearest 10 Hz and should be considered estimates, likely within 200 Hz of their actual value. Average call frequency and duration values are reported as mean ± *SD*.

Comparison with parulid and emberizid nocturnal flight call timing

We compare the hour of the night when the unidentified call was detected with that of contemporaneous emberizid and parulid calling. The emberizids consist of the distinctive call types of *Ammodramus savannarum*, *Passerculus sandwichensis*, and *Melospiza lincolnii*; the parulids consist of the distinctive call types of *Seiurus aurocapillus, Parkesia noveboracensis, Mniotilta varia*, *Setophaga ruticilla*. The parulids also include one or more species from two distinct groups often referred to as the "zeep" and "double up" complexes. "Zeep" calls have a coarse modulation that gives them an audibly buzzy or trilled quality. "Double up" calls are two-toned, rising notes without audible modulation but often with a noticeable sibilance. Calls in both these groups are short, typically between 40-60 ms in duration, and high-pitched, typically between 6-10 kHz. Calls within each of these complexes are relatively similar and the grounds for making reliable spectrographic species identification from an unseen bird have not been established. Species categories are listed as "type" in that the calls in the folders spectrographically match those documented for the species in Evans and O'Brien (2002).

We use two different percentage calculations. The percent of the unidentified call that occurred by hour of the night is the number of the unidentified call detected in a specific hour between October 16 and December 3 divided by the total number of the unidentified call detected during that period. Similarly, the percent of total emberizid or parulid calls that occurred by hour of the night is the total number of calls for one family or the other in a specific hour from October 16 through December 3 divided by the total of all calls for the corresponding family detected over this seasonal period. The species or species groups representing each family are noted above. The percent of the unidentified call among all calls detected in the 6-10 kHz frequency range between October 16 and December 3 is the total number of the unidentified call detected in this period divided by the total number of all high-pitched small passerine calls detected during the period (cardinalids, emberizids, parulids). This includes calls from species in the genus *Passerina,* which are currently not reliably discriminated from one another and therefore lumped into a *Passerina* complex. Also included are calls that could not be confidently placed in a species category.

Contemporaneous banding data

To further assist in evaluating potential candidate species for the unidentified caller, we inspected contemporaneous banding data of migrant songbirds processed by the banding operation of MG, GRM and their colleagues at Observatorio de aves del Pantano de Santa Alejandrina. The banding station utilized 10 to 14 mist nets and was located in marshy habitat with vegetation generally less than 5 m high. The banding site was

located in the Santa Alejandrina wetlands east of Minatitlán, ~14 km southeast of the airport acoustic station.

Search of existing resources and querying experts

For additional species information around Minatitlán we relied on Howell and Webb (1995) and Schaldach (2003). For audio resources, we used the Evans and O'Brien flight call CD-ROM, the Macaulay Library at the Cornell Lab of Ornithology, and the Xeno-canto audio archives. We circulated audio recordings and spectrographs of the unidentified call to colleagues who have expertise in avian night flight calls and/or who have expertise in Mexican bird sounds. In addition, we posted an audio recording and spectrographs to the Nocturnal Flight Calls listserv at Cornell University and the Nocturnal Flight Call group on Facebook, inquiring whether others had encountered the unidentified call. These groups include over 350 members, many of whom monitor avian nocturnal flight calls in North America.

Results

We monitored nocturnal flight calls on 72 nights from August 28 through December 3, 2012. Ten nights were missed during this period due to heavy rain, power outage, or equipment problems. In addition, the twelve nights from November 14-25 and 4 nights from November 28 through December 1 were missed. From the results of the Tseep-r detections between October 16 and December 3, 354 calls, most apparently from warblers and sparrows were found by browsing spectrograms with GlassOFire software (Supplement 1: http://oldbird.org/pubs/S1-Evans_et_al.zip). Amidst these data, the unidentified call first began to stand out in the latter half of October 2012 when multiple occurrences were documented.

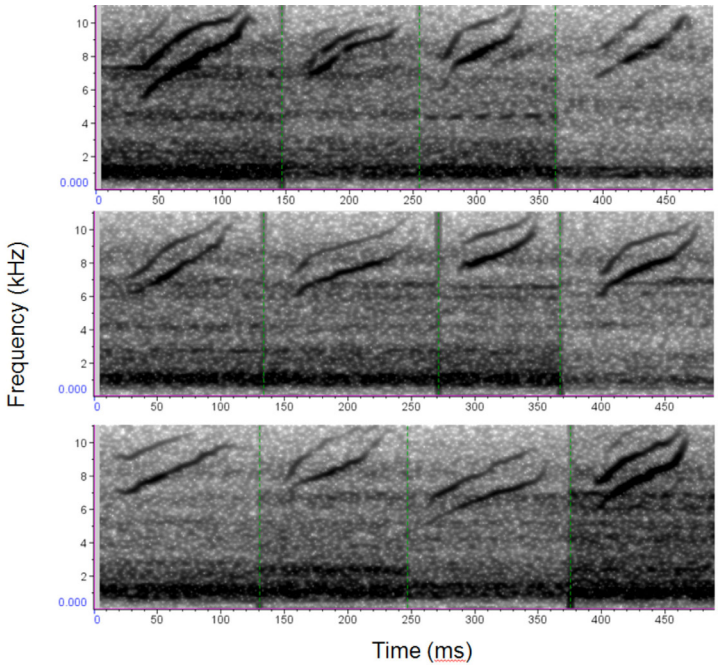

Figure 1. Spectrographic examples of the unidentified nocturnal flight call. Calls displayed occurred on nine different nights. Those that occurred on the same night were more than one hour apart.

Call description

The unidentified call consists of two contemporaneous, rising frequency components, one higher than the other. What distinguishes the call from other "double ups" known to occur across eastern North America is the combination of the call's broad frequency expanse, the relatively wide frequency gap between its component tones, and its longer overall duration. Figure 1 illustrates some of the clearest examples.

Of 16 calls loud enough to reveal the beginning of the call, the mean initial frequency is 6330 ± 865 Hz. The high frequency at the end of these calls is not measurable for 10 calls because it ascends above 11 kHz, the highest frequency we can measure with our 22050 Hz sampling rate. Six of the 16 calls exhibit high frequency points below 11 kHz with the lowest around 9575 Hz. Of 10 calls where the beginning and end are well defined, the mean duration is 86 ± 10 ms. The longest of the 10 durations is 102 ms and the shortest is 67 ms. Of five calls where the frequency bandwidth of the whole call is measurable, the mean bandwidth is 4890 ± 545 Hz. Of these five, the greatest bandwidth is 5930 Hz and the least is 4505 Hz. The mean maximum frequency between the individual rising tone components for the 12 calls shown in Figure 1 is 1805 ± 350 Hz. The largest frequency difference between contemporaneous points on the two tone components of these 12 calls is 2380 Hz and the least is 1155 Hz.

Seasonal occurrence

We documented the unidentified call type 32 times between October 16 and December 3 -- a call recorded on September 19 (nearly a month earlier than the main sequence of detections) brings the total to 33. The unidentified call comprised 9% of all avian nocturnal flight calls in the 6-10 kHz range detected over the Minatitlán Airport terminal from October 16 through December 3 (Figure 2).

Hourly occurrence

We detected the unidentified call in all 10 monitoring hours of the night, with a notable concentration (52%) between 01:00-

04:00 h (Figure 3). Calling activity of emberizids and parulids also showed an increase after 01:00 h. Of the 33 total calls, 27 occurred more than 15 minutes apart from one another. There were three cases where calls occurred within a minute of another. From November 5-11, when the majority of calling from the unidentified species was detected, apparent sunset was at 18:43 h (+/- 1 min) CDT and apparent sunrise was at 07:21 h (+/- 1 min) CDT.

Concurrent banding data

The marsh habitat of the banding station would likely favor capture of certain species over others, and we do not know whether the unidentified caller may be among those banded. Of 84 species represented, 59 species were ruled out of consideration either because their nocturnal flight call is known (44 species), there is evidence that they do not give a regular 6-10 kHz flight call in nocturnal migration (13 species), or because they are from a genus unlikely to make such a call in night flight (two species, in *Buteo* and *Falco*). The remaining 25 species are all present year-round in the vicinity of Minatitlán (Table 1).

Discussion

In Minatitlán, Veracruz during fall 2012, we recorded a type of nocturnal flight call with parameters unrecognized from our extensive nocturnal flight call investigations in the USA. While it is possible that more than one bird species is involved, there is enough apparent commonality among our sample to suspect that all the calls are from one species. It is not out of question that the unidentified call might belong to a local nonmigratory species, but its limited seasonal period of detection and its record of occurrence on nights, and in hours of the night, when other neotropical migrants were moving suggest it is from a species that was in southbound migration.

WRE has not detected the unidentified call in 25 years of spectrographic analysis of nocturnal flight calling from across the eastern USA. This includes large migration season datasets from Florida, south Texas (lower Rio Grande Valley), northwestern Louisiana, eastern Missouri, north-central Nebraska, southeastern Minnesota, northeastern Wisconsin, northern Indiana, northern Ohio, multiple sites across New York, north-central Pennsylvania, Massachusetts, and eastern Vermont. In addition, the call has not been noted by WRE in the western USA in full migration season datasets from south-central Arizona (Ajo,

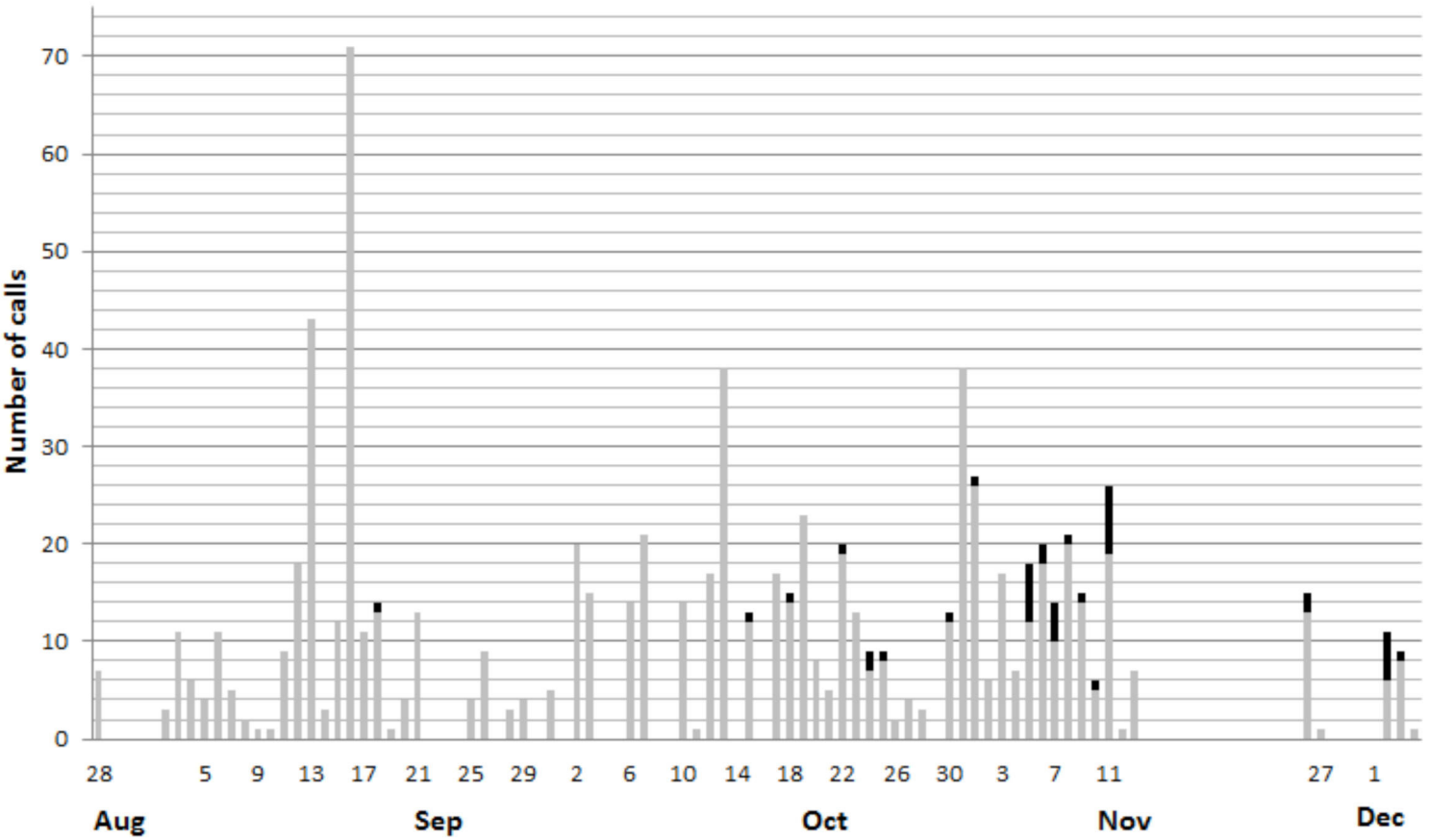

Figure 2. Nightly totals of emberizid and parulid flight calls (gray bars) and comparative numbers of the unidentified call (black bars).

AZ) and southeastern Arizona (Nogales, AZ). Our consultation with other night flight call researchers in North America has not led to any information about the call and we are aware of no other cases where it has been documented. Furthermore, our consultation with several Mexican bird sound experts has not led to any clues to the species' identity.

Circumstantial reasoning suggests the call may be from a neotropical migrant species that breeds somewhere in the western half of North America north of our Minatitlán monitoring site. A review of Howell and Webb (1995) reveals only a small number of species that meet this criterion and that are known to migrate through the Minatitlán region. Ten of these are kingbirds and flycatchers in the family *Tyrannidae*. After extensive study of night flight calls in eastern North America, Evans and O'Brien (2002) reached a conclusion suspected previously by others that members of the tyrannids of eastern North America do not often call in nocturnal migration. Furthermore, except for the distinctive "ka-zeer" of the Eastern Kingbird (*Tyrannus tyrannus*), the flight calls they have been documented or suspected to give are below 6 kHz. So, it seems unlikely that the unidentified caller would be one of the 10 species of western tyrannids that migrate through the Minatitlán region.

There are four other neotropical migrant songbirds that meet the previously noted criterion: *Icterus cucullatus*, *Vireo flavoviridis*, *Cyanerpes cyaneus* and *Peucaea botteri*. The flight call of *I. cucullatus* is a distinctive lower pitched "veek", which WRE is familiar with and is widely known. Regarding *V. flavoviridis*, after extensive study of night flight calls in the eastern USA, Evans and O'Brien (2002) came to the conclusion that if Vireonids do call in nocturnal migration, the calls are uncommon and below 6 kHz. So *V. flavoviridis* is not a likely candidate. The northern population of *C. cyaneus* reportedly migrates southward out of regions to the north of Minatitlán. The species has not been banded or observed by MG, GRM and their team at banding sites in the Minatitlán region, and little is reported on its migration behavior. Schaldach (2003) indicated the species migrates diurnally, but this does not rule out that it may also make nocturnal movements. No calls of this species in the Macaulay Library at the Cornell Lab of Ornithology (ML) and Xeno-canto (XC) audio archives matched our unidentified call.

Regarding the secretive *P. botteri*, we found little concrete information to ascertain the migratory status of the three subspecies that range north of Minatitlán (*arizonae*, *botterii*, and *petenica*). The evidence that some northern populations are migratory seems to have originated from the paucity of detections in northern locales during the winter months. That may have changed in southeastern Arizona where *P. b. arizonae* now appears to winter in numbers, perhaps due to the incursion of non-native grass species (Schmierer 2013). A night flight call monitoring station that operated near Nogales, AZ

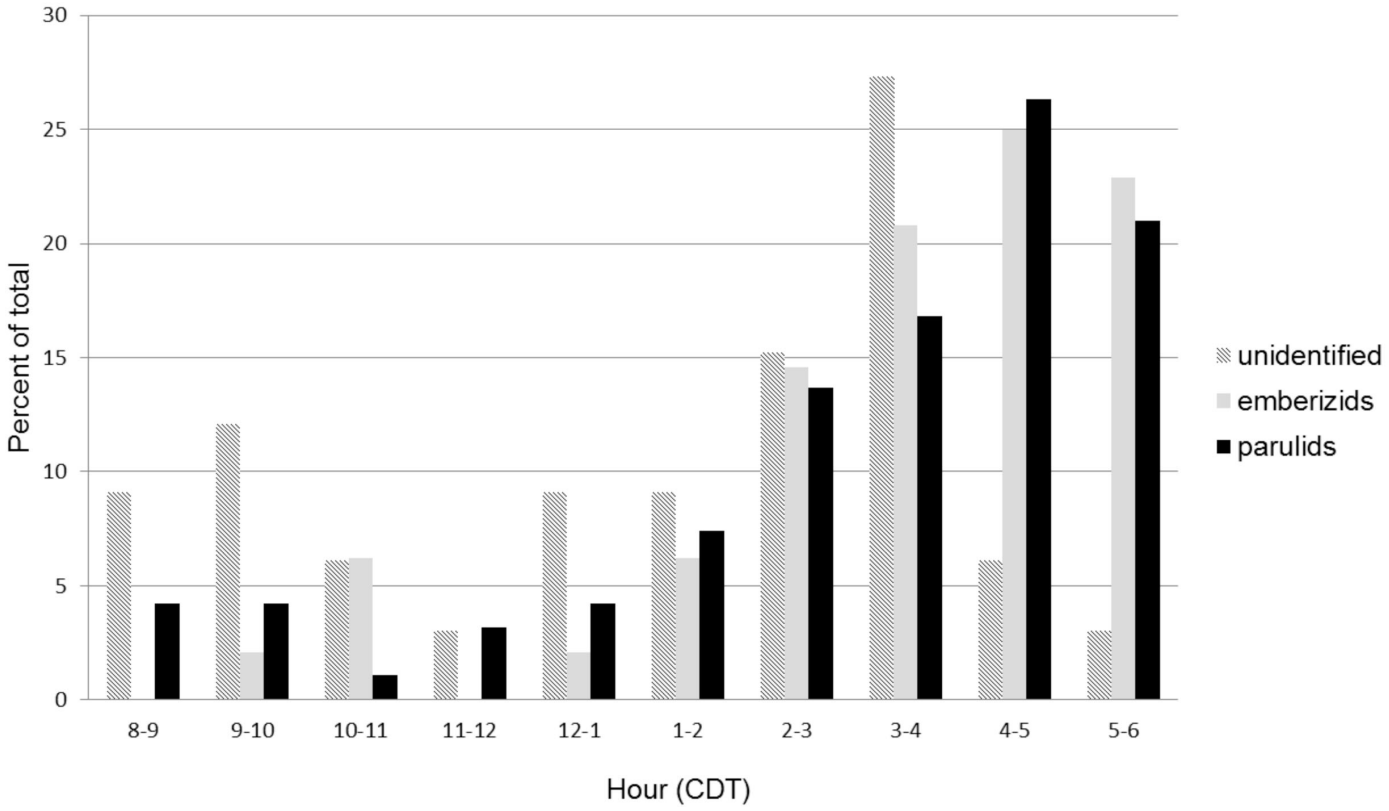

Figure 3. Percent calling by hour of the night for the unidentified caller, emberizids, and parulids from October 16 – December 3.

Table 1. Banding results contemporaneous with the acoustic monitoring (16 October – 3 December 2012).*

Species	Migration status	NFC status	# banded
Dendrocygna autumnalis	resident & migrant	known	2
Columbina passerina	resident	unknown	1
Columbina talpacoti	resident	unknown	1
Butorides virescens	resident & migrant	known	3
Piaya cayana	resident	unknown	1
Coccyzus americanus	migrant	known	1
Crotophaga sulcirostris	resident & migrant	unknown	17
Nyctidromus albicollis	resident	unknown	1
Archilochis colubris	migrant	unknown	9
Amazilia candida	resident	unknown	1
Amazilia tzacatl	resident	unknown	4
Amazilia yucatanensis	resident	unknown	8
Porzana carolina	migrant	known	1
Fulica americana	migrant	known	2
Jacana spinosa	resident	unknown	2
Buteo magnirostris	resident	no call	1
Falco columbarius	migrant	no call	1
Synallaxis erythrothorax	resident	unknown	1
Myiopagis viridicata	resident	unknown	1
Todirostrum cinereum	resident	unknown	1
Empidonax traillii	migrant	no call	1
Empidonax albigularis	resident	unknown	1
Empidonax minimus	migrant	no call	12
Tyrannus melancholicus	resident	unknown	2
Tyrannus forficatus	migrant	unknown	1
Pachyramphus aglaiae	resident & migrant	unknown	1
Vireo griseus	migrant	no call	56
Vireo bellii	migrant	no call	1
Vireo flavifrons	migrant	no call	1
Vireo solitarius	migrant	no call	1
Vireo philadelphicus	migrant	no call	3
Vireo gilvus	migrant	no call	1
Vireo olivaceus	migrant	no call	1
Hirundo rustica	migrant	known	6
Troglodytes aedon	migrant	no call	3
Campylorhynchus zonatus	resident	unknown	1
Catharus ustulatus	migrant	known	1
Hylocichla mustelina	migrant	known	2
Turdus grayi	resident & migrant	unknown	21
Dumetella carolinensis	migrant	no call	2943
Seiurus aurocapilla	migrant	known	30
Helmitheros vermivorum	migrant	known	2
Parkesia noveboracensis	migrant	known	103
Vermivora chrysoptera	migrant	known	1

Species	Migration status	NFC status	# banded
Vermivora cyanoptera	migrant	known	4
Mniotilta varia	migrant	known	26
Protonotaria citrea	migrant	known	1
Oreothlypis peregrina	migrant	known	16
Oreothlypis celata	migrant	known	11
Oreothlypis ruficapilla	migrant	known	7
Geothlypis poliocephala	resident	unknown	3
Geothlypis tolmiei	migrant	known	2
Geothlypis philadelphia	migrant	known	2
Geothlypis formosa	migrant	known	1
Geothlypis trichas	migrant	known	687
Setophaga citrina	migrant	known	21
Setophaga ruticilla	migrant	known	97
Setophaga americana	migrant	known	64
Setophaga magnolia	migrant	known	105
Setophaga petechia	migrant	known	188
Setophaga pensylvanica	migrant	known	3
Setophaga coronata	migrant	known	13
Setophaga dominica	migrant	known	1
Setophaga virens	migrant	known	4
Cardellina pusilla	migrant	known	60
Icteria virens	migrant	no call	22
Volatinia jacarina	resident	unknown	12
Sporophila corvina	resident	unknown	2
Sporophila torqueola	resident	unknown	60
Spizella pallida	migrant	known	1
Ammodramus savannarum	migrant	known	2
Melospiza lincolnii	migrant	known	442
Piranga rubra	migrant	known	9
Piranga ludoviciana	migrant	known	3
Pheucticus ludovicianus	migrant	known	52
Cyanocompsa parellina	resident	unknown	1
Passerina caerulea	resident	known	25
Passerina cyanea	migrant	known	571
Passerina ciris	migrant	known	199
Spiza americana	migrant	known	1
Agelaius phoeniceus	resident & migrant	known	3
Icterus spurius	migrant	Known	245
Icterus gularis	resident	Unknown	1
Icterus galbula	migrant	Known	61

* NFC status indicates whether the species' nocturnal flight call is known (known), or whether it is known not to or is unlikely to give a call in the 6-10 kHz range (no call), or whether it is not known if the species gives a call or what that call is (unknown).

from April 17 through June 19 and August 7 through November 18, 2015 logged 20,000 small passerine night flight calls; however, our unidentified call was not among them though *P. b. arizonae* was a common nester in proximity. No calls of this species in the ML and XC audio archives matched our unidentified call.

The banding data involved 25 species that have flight calls unknown to us, but all these species are present and banded year round in Minatitlán and none are listed as migratory in Howell and Webb (1995). Two of these species are now known to undertake migrations, at least among their northern populations, *Crotophaga sulcirostris* (Bowen 2002) and *Turdus grayi* (MG personal observation). No calls of either species in the ML and XC archives matched our unidentified call.

These latter two species bring up the fact that it is difficult to gain migration information in Mexico for Mexican breeding species in which a portion of the population may migrate relatively short distances at night to a region where the species has permanent residents. Changes in local populations due to influxes of migrants may not be easily noticed for species that tend to wander about or which are secretive. And there is little public information from collisions with tall man-made structures in Mexico to give us clues to nocturnal movements, so it is possible there are migration patterns yet to be discovered.

Though we obtained a small sample of calls, the apparent pattern of more calling in the latter hours of the night for the unidentified was shared by migrant emberizids and parulids. This is consistent with the idea that the unidentified call is from a migrant bird and not nocturnal flight behavior from a local nonmigrant species. This late-night calling pattern might correspond with increased density of low-altitude migration associated with a diminishing sea breeze in the coastal region of eastern Mexico as the night progresses. Overall, the quantity of emberizid and parulid calling detected from our quiet Minatitlán recording site was relatively low compared to similar acoustic monitoring stations across inland eastern USA. Yet, banding data by Rodríguez Ramos *et al*. (2015) indicate that large numbers of many species of neotropical migrants cross the region. Perhaps the main flow of southbound migrants occurs at altitudes too high to be detected with our acoustic monitoring system, and the increased calling toward the end of the night was from individuals transitioning down from nocturnal migration.

Besides the work represented in Evans and O'Brien 2002, the only previous publication tackling the identification of a cryptic nocturnal flight call is a paper by WRE speculating and providing supporting evidence that a set of nocturnal flight calls recorded from eastern Florida in 1989 and 1991 were from *Catharus bicknelli* (Evans 1994). Of course, in some cases, the night flight call of a species is so distinctive that identification is largely not in question, for example the flight call of *Spiza americana*. Larkin et al. (2002) developed a simple algorithm incorporating parameters of this call's bandwidth, modulation rate, and duration to automatically detect it with a high rate of efficiency. This enabled a 200-km east-west running transect of 10 flight call monitoring stations targeting *S. americana* calls to be operated in near real-time across the Rio Grande Valley of Texas.

While acoustic monitoring does not provide precise information on the numbers of a species passing, monitoring calling activity can be useful for elucidating periods and geographic scope of migration, as well as potentially serving as an index for abundance. Therein lays the utility in learning the identity of our unknown nocturnal flight call.

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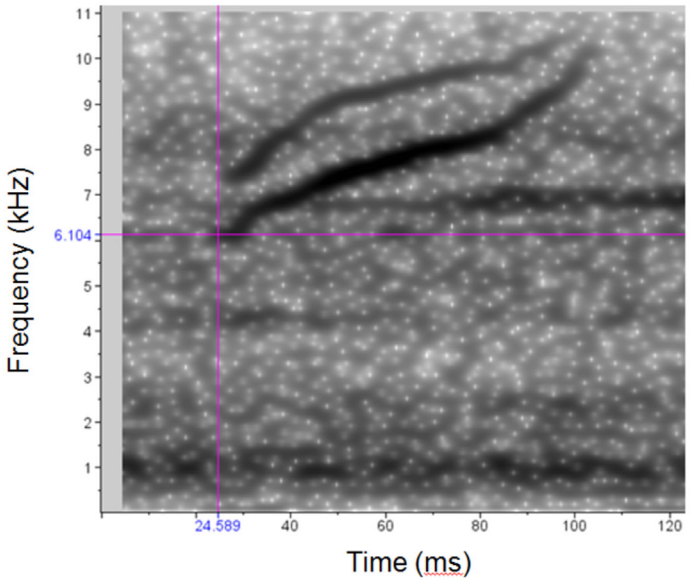
Appendix A. Spectrogram of the unidentified nocturnal flight call. Pink lines show the manually-determined low frequency point and beginning of call.



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