A Survey Of Tropical Owl Population Density And The Vocal Behavior Of The Mottled Owl (*Strix virgata*) In A Partially Fragmented Cloud Forest Habitat

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Abstract. I estimated the abundance of six species of tropical owls from their responses to broadcast pre-recorded vocalizations during the twenty-five surveys conducted between the months of September 2006 to April 2007 at Reserva Cloudbridge, San Gerardo de Rivas, Perez Zeledon, Costa Rica. The surveys covered five separate broadcasting transects, each having calling stations distributed at 100 to 200 meter intervals depending on the slope of the terrain. During the study period, I found Mottled Owls (*Strix virgata*) to be most common at .59 owls/kilometer of transect surveyed. The Andean Pigmy Owl (*Glaucidium jardinii*), Bare-Shanked Screech Owl (*Otus clarkii*), and the Spectacled Owl (*Pulsatrix perspicillata*) were classified as rare at .16 owls/kilometer of transect surveyed. Both the Unspotted Saw-Whet (*Aegolius ridgwayi*) and Vermiculated Screech Owl (*Otus guatemalae*) were non-existent during the survey. The location of each owl that was positively identified is demonstrated on an Arcview engineered digital map and can be cross referenced to environmental data at the time of each callback. Since the callbacks from the Mottled Owl comprised most of the data, I specifically chose this species to study its vocal behavior in relation to several environmental variables. There was a positive correlation between the frequency of callbacks and moon phase, with more callbacks occurring during the new moon. However, this was not shown to be significant. Callback frequency was found to have a significant association with the amount of ambient illumination. The darker the night, the more callbacks I would receive. Illumination at night is highly connected to moon phase, but I did receive callbacks during the full moon during nights when clouds obscured its light. There was no correlation between the frequency of callbacks and the time after sunset, cloud cover, or time of year. Since Reserva Cloudbridge is in the progress of reforesting habitat fragmented by agricultural practices, a long term study should be conducted to see if owl density and diversity changes along with the growth of the cloud forest habitat.

Resumen. Estimaba la abundancia de seis especies de buhos tropicales de sus respuestas para difundir vocalizations previos de antemano durante los veinticinco exámenes conducidos entre los meses de del septiembre de 2006 al abril de 2007 en Reserva Cloudbridge, San Gerardo de Rivas, Perez Zeledon, Costa Rica. Los exámenes cubrieron cinco transects que difundían separados, cada uno que tenía estaciones que llamaban distribuidas en los intervalos de 100 a 200 metros dependiendo de la cuesta del terreno. Durante el período del estudio, encontré los buhos Lechuza Café (*Strix virgata*) para ser el más común en .59 buho/kilómetro de transect examinado. El buho Mochuelo Montanero (*Glaucidium jardinii*), la Lechucita Serranera (*Otus clarkii*), y el Buho de Anteojos (*Pulsatrix perspicillata*) fueron clasificados como raros en .16 buho/kilómetro de transect examinado. Ambo la Lechucita Parda (*Aegolius ridgwayi*) y la Lechucita Vermiculada (*Otus guatemalae*) era no existente durante el examen. La localización de cada buho que fue identificado positivamente se demuestra en un mapa digital dirigido Arcview y se puede hacer una remisión a los datos ambientales a la hora de cada servicio repetido. Puesto que los servicios repetidos del buho abigarrado abarcaron la mayor parte de los datos, elegí específicamente esta especie para estudiar su comportamiento vocal en lo referente a varias variables ambientales. Había una correlación positiva entre la frecuencia de servicios repetidos y la fase de la luna, con más servicios repetidos ocurriendo durante la Luna Nueva. Sin embargo, esto no fue demostrada para ser significativo. La frecuencia del servicio repetido fue encontrada para tener una asociación significativa con la cantidad de iluminación ambiente. Cuanto más oscura es la noche, más los servicios repetidos que recibiría. La iluminación en la noche está conectada altamente con la fase de la luna, pero recibí servicios repetidos durante la Luna Llena durante las noches en que las nubes obscurecieron su luz. No había correlación entre la frecuencia de servicios repetidos y el tiempo después de la puesta del sol, de la cubierta de la nube, o de la época del año. Puesto que Reserva Cloudbridge está en el progreso de reforestar el habitat hecho fragmentos por prácticas agrícolas, lo encuentro el interesar para ver si los cambios de la densidad y de la diversidad del buho junto con el crecimiento del habitat del bosque nuboso.

Study Area and Methods

Reserva Cloudbridge is located in San Gerardo de Rivas, Perez Zeledon Province, Costa Rica. Cloudbridge borders Chirripo National Park to the east, a mosaic of agricultural land to west, and relatively intact forested tracts of land both north and south. The reserve covers approximately 1000 acres between the elevations of 1500 to 2800 meters. Within the reserve there are several habitat types including primary and secondary forests, riparian regions, abandoned agricultural lands, and the tree plantations that are replacing them. The ecotone can be best described as a mid to high altitudinal cloud forest. The study took place during two distinct seasons. September through December is the wet season and experiences on average 474 mm of rain per month during this time, while very little rain falls between the months of January and April (Giddy 2006). The average daily high temperatures range from 25° C in March to 21.1° in October (Giddy 2006).

I estimated the occurrence of owl species by listening and recording the responses to the broadcast of prerecorded owl calls. Nineteen broadcasting stations were distributed at 100 to 200 meter intervals over five calling transects. Each transect was surveyed on five separate nights for a total of twenty-five repetitions between the months of September 2006 and April 2007. Each transect was chosen for its accessibility, habitat diversity and for the ability to hear owl responses from at least 400 meters away. The chosen transects also resemble one another in the fact that they begin in a tree plantation and end in either secondary or primary forest gaining elevation as they proceed. However, they did differ in slope and aspect.

To determine the presence and general coordinates of an owl, I would broadcast a prerecorded owl call and listen for a response. The calls for each species of owl thought to be in the region according to Alexander Skutch's *A Guide To The Birds of Costa Rica* were downloaded from the internet onto a Sony MyMusic MP3 player. I downloaded the regional vocalizations of the Andean Pigmy Owl (*Glaucidium jardinii*), Unspotted Saw-Whet Owl (*Aegolius ridgwayi*), Vermiculated Screech Owl (*Otus guatemalae*), Bare-Shanked Owl (*Otus clarkia*), Mottled Owl (*Strix virgata*), and the Spectacled Owl (*Pulsatrix perspicillata*). A 10 watt Radioshack Powerhorn 32-2038A megaphone was used to broadcast the calls up to a distance of 800 meters.

The survey started at local twilight time (1730-1830 hours) and continued for approximately four hours. At each station I started by broadcasting the call of the smallest species first in order not to frighten a small species of owl away by broadcasting the call of a larger species first and thereby losing a possible positive identification of an individual owl. I broadcasted each conspecific call in four different directions which took approximately two minutes. After the broadcast period I would listen for a callback for approximately five minutes. If there was a positive response, I recorded the bearing using a Garmin eTrex Vista GPS unit and estimated the distance of the owl from the calling station. I also used the bearing of the responding owls to avoid counting the same owl twice, especially when receiving a callback from the same owl at different calling stations. Additionally, if I received a positive response, I broadcasted the same call and recorded the necessary data until I no longer received a response. At that time I would begin calling the next largest species. When all six species calls were broadcast at a

calling station, I moved on to the next calling station. Travel time to each station varied depending on slope and weather conditions, but generally took ten to fifteen minutes.

I recorded the coordinates of each calling station with the GPS unit for the use of building an ESRI ArcView layer onto an existing mapping project currently underway at Reserva Cloudbridge. In addition, I took the bearing of every callback and estimated the distance the owl and the station. The resulting coordinates of the owls were added to the digital mapping layer. Each owl shapefile received its own identification number which can easily be cross referenced to the environmental variables at the time of the callback.

At each station I recorded the following temporal and environmental conditions: moon phase (new, 1/4 moon, 2/3 moon, full), moon shine (from 0 for totally dark to 5 for complete illumination of distant objects), cloud cover (from 0 for totally clear skies to 5 for dense low-lying cloud cover), precipitation (0 for no rain to 5 for a complete downpour), wind (0 for no wind to 5 for heavy sustained winds), and the time was recorded at each station. Other environmental conditions noted were moon rise and set and wind direction.

My sampling unit was a single transect surveyed any single night, and I have expressed my owl occurrence index as the average number of individuals heard per kilometers of transect surveyed (Brower et al. 1990). To identify an association or trend between environmental variables with callbacks, I used the Spearman correlation analysis with a 95% confidence level.

Results

During the twenty-five survey repetitions, I covered 10 kilometers of calling transects in total. Throughout the study, I found Mottled Owls to be most common at .59 owls every kilometer of transect surveyed. The mean monthly Mottled Owl callback occurrence was 3.83 +/- 2.31 SD. Other species including the Spectacled, Bare-Shanked Screech, Andean Pigmy were considered rare at the occurrence of .16 owls per kilometer of transect.

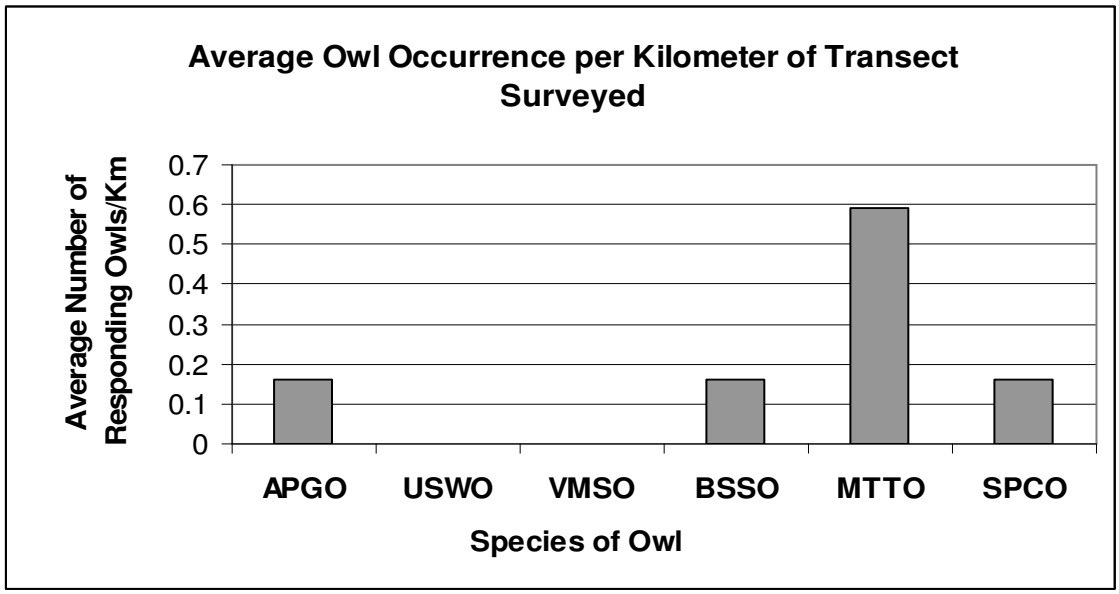

Figure 1. The average owl occurrence per kilometer of calling transect classified by the species thought to be living in the region.

I did not receive a positive response from either the Vermiculated Screech Owl or the Unspotted Saw-Whet Owl (Figure 1).

The Arcview map layer shows that almost all callbacks I received originated in the vicinity of secondary and primary growth forest whereas there were no callbacks coming from the areas that were once used for agriculture and are lacking large trees (Map 1). Also, most callbacks were received from calling stations actually located within the secondary and primary forests (Figure 2).

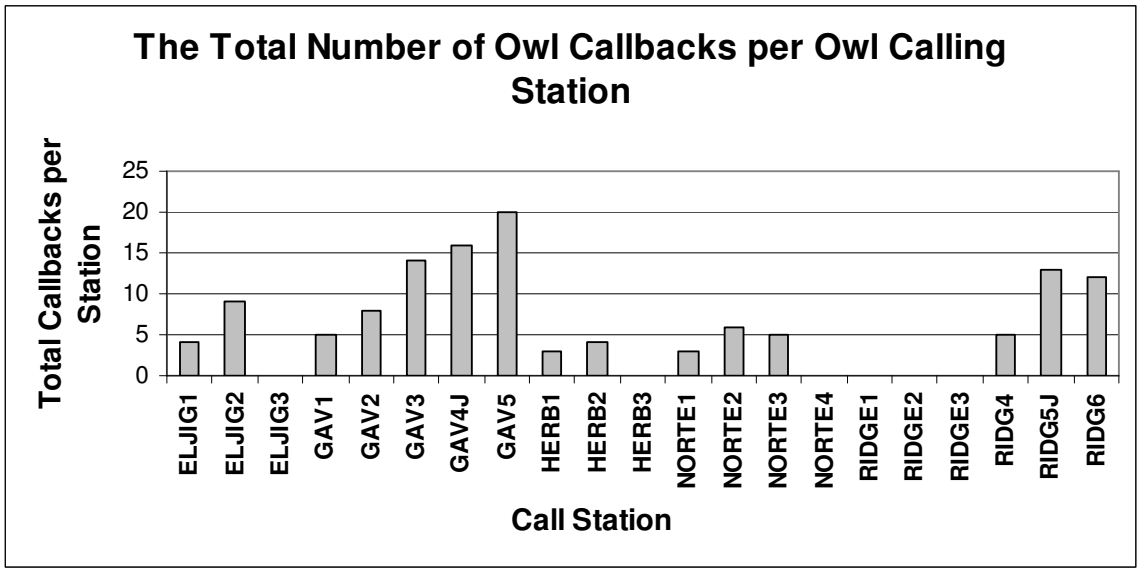

Figure 2. The total number of owl callbacks per station over the course of twenty-five separate surveys.

There was a positive association between moon phase and the amount of callbacks received (Figure 3). The majority of callbacks were detected during the new moon phase, however it was not found to be a significant trend for Mottled Owls (Table 1).

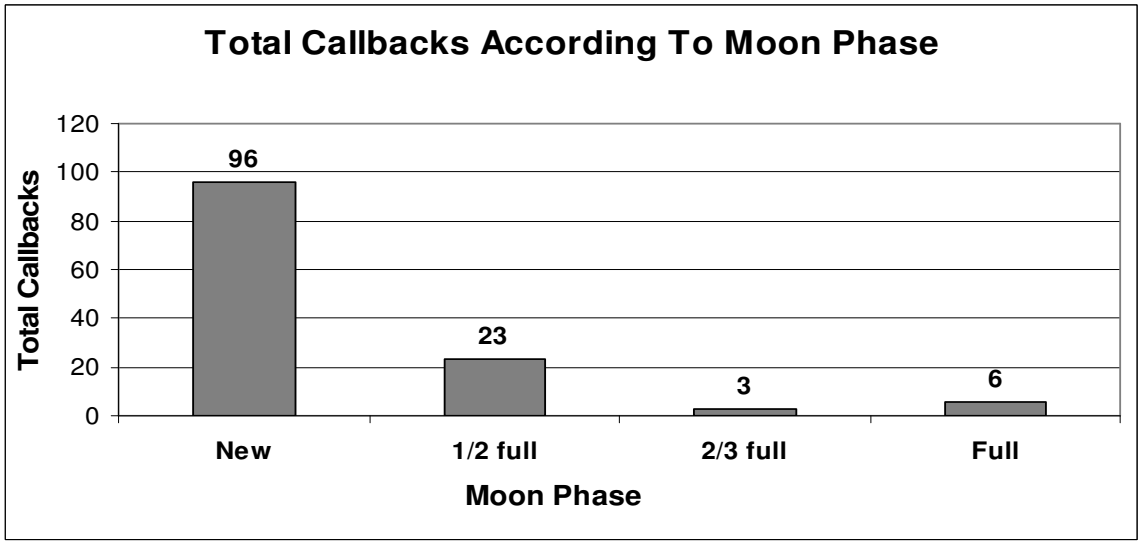

Figure 3. The total callbacks detected according to the moon phase on the night of the survey.

The frequency of callbacks was negatively associated with the amount of ambient illumination due to moonshine (Figure 4). Owl callbacks were detected most during zero illumination and tended to decrease during highly illuminated nights. This association was statistically significant for Mottled Owls (Table 1).

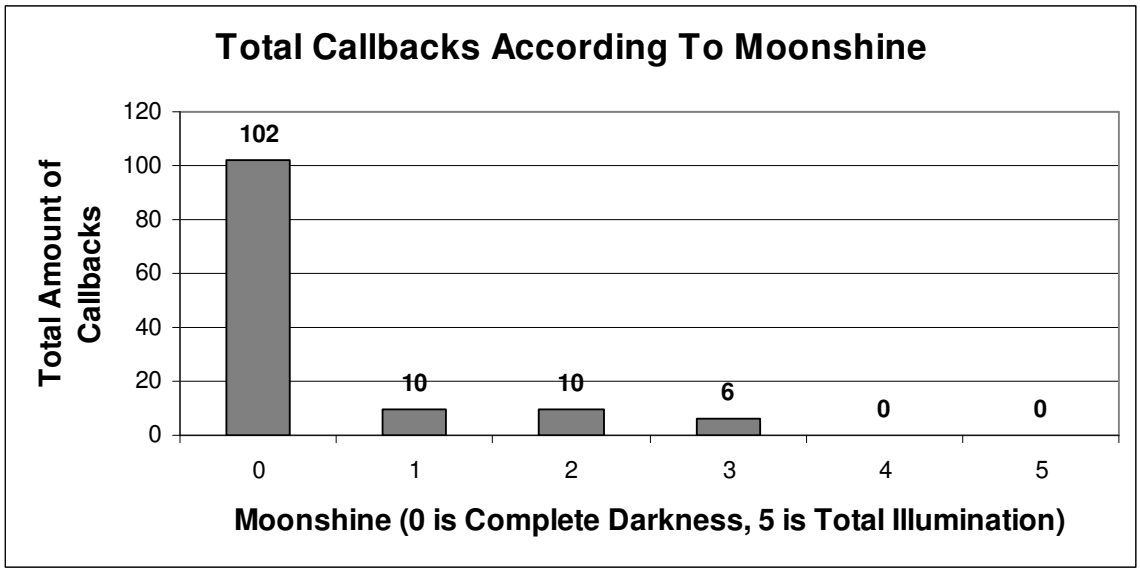

Figure 4. The total number of owl callbacks according to the amount of ambient illumination caused by the moon at the time of the survey.

There was no correlation between Mottled Owl callbacks and any of the other environmental parameters studied such as cloud cover and time from sunset (Table 1). Also, there was no significant monthly variation in the frequency of callbacks.

Table 1. Spearman correlation coefficients of respondent calls made by the Mottled Owl in association with environmental variables from September 2006 to April 2007 at Reserva Cloudbridge, Perez Zeledon, Costa Rica. NS=Non-significant.

	Mottled Owl	
Variables (N)	Correlation Coefficient	P Value
Moon Phase (4)	0.801	NS
Illumination (6)	-0.972	0.0018
Cloud Cover (6)	-0.373	NS
Hour (6)	-0.257	NS
Month (6)	-0.12	NS

Discussion

The Mottled Owl (Strix virgata) is widely distributed through the neotropics from Mexico to northeastern Argentina (Gerhardt 1991). Since it is the most common owl at Reserva Cloudbridge and I detected each of the Spectacled, Andean Pigmy, and the Bare-Shanked Screech Owl only once, I will concentrate my discussion on the Mottled Owl. Previously, it has been reported in studies that illumination has a negative affect with the calling activity of all tropical owl species in which calling occurs more during dark nights

and dark periods of otherwise bright moonlit nights (Roncha and Salazar 2001). In my studies, I found this to be true for Mottled Owls as well.

During a Mottled Owl study conducted by Gerhardt in Guatemala, it was reported that Mottled Owls respond to a broadcasted conspecific calls with a higher frequency than any other tropical owl (1991). Including the Mottled Owl callbacks that I received once a bird was initially detected until it no longer responded, I received callbacks 52% of the time. On two separate occasions, I received a positive response from a Mottled Owl while broadcasting the call of the Andean Pigmy Owl. However, unlike the more common 4 to 6 note hoo-hoo call, the response made to interspecific broadcast resembled the cat-like screech described by Gerhardt (2001).

Although there was no clear correlation between the time of the year and the frequency of callbacks, Mottled Owls seemed to be more aggressive towards the broadcasted calls during the months of January through March. This happens to coincide with the Mottled Owl breeding season in Costa Rica. Mottled Owls would readily approach my position in search of the origin of the broadcasted calls. This phenomenon is clearly shown in the owl callback data set (Appendix 1).

Mottled Owls are considered tolerant to some deforestation, and can be found near forest edges, semi-open areas, and secondary mature forests (Stiles and Skutch 1989). This seems to be the case at Reserva Cloudbridge where a relatively new reforestation effort has begun. The reserve contains every habitat mentioned above, although its long term goal is to facilitate a large, continuous cloud forest. My results show that Reserva Cloudbridge can support a healthy population of Mottled Owls and I suggest a long term study be conducted to see if owl density and diversity change along with the growth of the cloud forest habitat.

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