BELIZE RAPTOR RESEARCH INSTITUTE

2010 Annual Report

The Hawk-Eagle Program
&
The Stygian Owl Project

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Executive Summary

In 2009, the Belize Raptor Research Institute initiated a long-term research program studying the three *Spizaetus* (hawk-eagle) species (Black, Ornate and Black-and-white) and the Stygian Owl, *Asio stygius robustus*, throughout Belize, focusing in Mountain Pine Ridge (MPR) and Rio Bravo Conservation and Management Area (RBCMA). Through these programs we will understand their status, population size, minimum area requirements, habitat preference and utilization, intraspecific and interspecific competition, breeding biology, movement patterns, diet, foraging habits, home range, and demographics. To date, the Hawk-Eagle Program is one of the largest full-scale studies conducted on the genus *Spizaetus* in the Neotropics, the other being The Peregrine Fund's Maya Project in Guatemala, as well as the first long-term study on the rare Stygian Owl.

During 2009 and 2010, 86 total observations of all three *Spizaetus* species were made in the MPR area, RBCMA, Chiquibul National Park, and Cerros, with 34 of Black Hawk-Eagle, 31 of Ornate Hawk-Eagle, and 21 of Black-and-white Hawk-Eagle. Of the 86 observations, 11 were in RBCMA, 6 in MPR, 39 in the transition zone from pine forest to broadleaf forest, 23 in Chiquibul, and 1 in Cerros. Five *Spizaetus* nests were monitored in 2010, 4 Ornate and 1 Black-and-white. Two new Ornate nests were located, one in RBCMA and the other near Cerros Archaeological Site in the Corozal District. All of the Ornate nests were active, whereas the Black-and-white was not.

We studied the seasonal variation in the diet of the Stygian Owl in the Mountain Pine Ridge in Belize based on 194 prey items of 145 collected pellets at a single roost site from 3 March 2009- 26 February 2010. The sample included 61.9% birds, 19.1% bats, 12.4% beetles, 6.2% lizards, and .5% frogs. Of the total prey items, 31% were nocturnal species with 69% being diurnal. On average, February-May the diet consisted of 70% birds, where June-August were comprised of 37% birds, 32% bats, and 28% beetles and November- February consisted of 81% birds. The change in diet coincides with the emergence of beetles in June-August, and the influx of wintering migrant songbirds. According to biomass and quantity of prey items consumed passerines were the most important dietary component. In 2010, five roosting sites were located, where owls were seen frequently. Two of the five roosting sites were logged with the roosting tree cut down. Only one of the logged sites was any owl observed infrequently. This suggests that logging may have grave impacts on owl populations. In December, two male Stygian Owls from two different roosting sites were trapped and radio-tagged with VHF transmitters, which is the first time this species has been radio-tagged.

THE HAWK-EAGLE PROGRAM

INTRODUCTION

Neotropical raptors are in critical need of study as basic natural history information on the nests, eggs, home-range, area requirements, demographics, and movements of over half are unknown (Cade 1989, Bierregaard 1995, Bildstein *et al.* 1998). The three hawk-eagle species (Black, Ornate, and Black-and-white) found throughout Central and South America are not common anywhere and there is a lack of baseline data to make proper management decisions for these species. In Belize, all three of the hawk-eagles are resident and were not studied prior to our research.

Figure 1. Black Hawk-Eagle.

Based on anecdotal record trends and taking into account their dwindling habitat and decreasing populations the hawk-eagles are considered "species with dangerously low populations" (Clinton-Eitniear 1986, Birdlife International 2009). All three hawk-eagle species are listed as Least Concern by the IUCN, but the Black-and-white Hawk-Eagle, *Spizaetus melanoleucus* (Fig. 2), was listed as Near Threatened from 1988 to 2000 (Birdlife International 2009). With insufficient baseline data, a proper assessment on present populations and demographic predictions can not be determined. The hawk-eagles could be more or less endangered than current estimations, so as we learn more about these species we can better quantify populations and conservation concerns.

Figure 2. Black-and-white Hawk-Eagle, Mountain Pine Ridge.

To date, The Peregrine Fund's Maya Project, which took place in Tikal National Park, Guatemala during the late 1980's and early 1990's is the largest full-scale study conducted on Neotropical raptors. Of the three hawk-eagle species only the Ornate Hawk-Eagle, *Spizaetus ornatus*, has been studied extensively through nest surveys and radio-telemetry (Lyon and Kuhnigk 1985, Klein et. al. 1988, Flatten et. al. 1989, J. Madrid et. al. 1991, H. Madrid et. al. 1992). During the Maya Project, three Black Hawk-Eagle, *Spizaetus tyrannus* (Fig. 1), nests were studied, which provided valuable information on nesting, diet and movement patterns, but not enough to make any population estimates (Funes et. al. 1992). Other than those located as part of the Maya Project only a few nests have been recorded throughout the Black Hawk-Eagle's global range and only one study has been conducted on its home-range and movement patterns (Smith 1970, Rangel-Salazar and Enriquez-Rocha 1993, Canuto 2008). The Black-and-white Hawk-Eagle is the least known of the three species and basic natural history information

is lacking, including incubation periods. It has never been studied extensively and only three nests have been described outside of our Hawk-Eagle Program (Strauch 1975, Anderson et. al 2004, Canuto 2008).

In 2009, the Belize Raptor Research Institute (BRRI) launched the Belize Hawk-Eagle Program as an effort to better understand all three poorly known hawk-eagle species. This minimum ten year program will focus on locating active nests of all three species of hawk-eagle, gaining information on nesting biology, home-range, movement patterns, habitat utilization, foraging ecology, and understanding intraspecific and interspecific competition through nest monitoring and radio-telemetry.

Figure 3. Ornate Hawk-Eagle, RBCMA.

The goal is to study a minimum of two nests per species through an entire breeding cycle and radio-tag a minimum of four (2 males and 2 females) adults and two juveniles (1 male and 1 female) from each species. By radio-tagging these individuals we can determine habitat requirements for juveniles and adults, home-range, juvenile dispersal, and where juveniles are taking up residence after reaching adulthood and why they are choosing to reside in particular areas.

OBJECTIVES

- Locate and map hawk-eagle nests
- Determine breeding biology such as courting behaviors, nest construction, nest type and location, nesting season and dates, incubation length, clutch size, fledging time, nest success rate and dependency length of all three hawk-eagle species
- Determine diet and foraging habits of all three hawk-eagle species
- Record habitat usage and requirements of all three hawk-eagle species
- Determine home-range of both adult, juvenile and immature of all three species
- Determine if there is interspecific or intraspecific competition (competition exclusion)
- Determine prey base and density of prey
- Determine minimum area requirements for a viable population of each species
- Determine status and population sizes in Belize of all three species
- Determine minimum area to sustain all three species
- Educate and train locals and create awareness about hawk-eagles and raptor conservation

STUDY AREA

This research was conducted within the Rio Bravo Conservation and Management Area (RBCMA), Mountain Pine Ridge Forest Reserve and surrounding private lands, which included Hidden Valley and the Headley property (Fig. 4). RBCMA is managed by the non-profit organization Programme for Belize and consists of over 260,000 acres of lowland broadleaf forest and wetlands. The Mountain Pine Ridge Forest Reserve (hereafter MPRFR) is managed by the Forest Department, in Belize's Cayo District, and approximately 106,000 acres. The MPRFR is dominated by sub-montane pine forest and is the only locality in Belize with montane pine forest. MPRFR lies on the 17° North latitude at an elevation ranging from approximately 400-950 m with an annual rainfall of 2002 mm (Means 1997).

Figure 4. Study Area, left: Mountain Pine ridge, right: Rio Bravo Conservation and Management Area.

RESULTS

In 2010, two new active Ornate Hawk-Eagle nests were located, one in RBCMA and the other near Cerros Archeological Site. We monitored a total of five hawk-eagle nests, four Ornate (Fig. 5) and 1 Black-and-white. Three Ornate nests were monitored in RBCMA, one near Cerros and the Black-and-white nest was located on the Hidden Valley private reserve.

Figure 5. Ornate Hawk-Eagle nests monitored in 2010.

On 7 March 2010, one adult Black-and-white Hawk-Eagle was observed at the nest tree, which was the only occasion an individual was observed at the nest tree in 2010. Multiple observations were made throughout the year, but there was no activity at the nest. Measurements on the nest were taken as this is the 4th nest to be discovered of the species, so all data is critical in understanding their breeding biology. The nest was located in a large Ceiba, *Ceiba pentandra*, tree at an elevation of 381 meters in sub-montane moist broadleaf forest. The nest tree was located on a steep south facing slope overhanging a creek drainage. The nest tree had a Diameter at Breast Height (DBH) of 98.1 cm. The nest was a bulky stick structure, estimated from the ground to be 1.2 meters high and 1.5 meters wide (Fig. 6).

Figure 6. Black-and-white Hawk-Eagle nest, Hidden Valley Reserve.

Ornate Hawk-Eagle nest #1 (RBCMA, main road) was first observed on 2 March where a female was observed in the alternate nest tree calling (Fig.9). The nest that was used in previous years (nest#1A, Fig. 8) was 138 meters from the new nest (nest#1B, Fig. 7) and nest 1A was no longer present as a large bromeliad had overgrown it. That may be the reason they are using an alternate nest, which had been used over ten years ago. The alternate nest (nest#1B) or 2010 nest was located on the main road through RBCMA to Gallon Jug in a large Bullet Tree, *Bucida buceras*, with a DBH of 93.3 cm. The nest was located on no slope and in a non-emergent tree. The nest was a stick structure constructed on top of a large bromeliad, approximately .3 meters high and .9 meters wide and 20 meters above the ground. On 3 March, the nest was checked again with no sign of the female. On 4 March, the female was observed calling in an adjacent tree to the nest then the male flew in and engaged in copulation for approximately 4 minutes before flying off. On 13 March, the nest was checked again, where the female was observed incubating. The eggs were estimated to be laid between 5-12 March, which is consistent with past nesting years of this pair. No observations were made after 13 March due to logistical constraints.

Figure 7. Ornate Hawk-Eagle nest #1B, alternate nest, RBCMA.

Figure 8. Ornate Hawk-Eagle nest #1A, RBCMA. Photo taken in 2006.

Figure 9. Ornate Hawk-Eagle nests located in RBCMA in 2010.

Ornate Hawk-Eagle nest #2, located in RBCMA off Warrie Camp Road (Fig. 9) was located in the same tree as 2009, but built in the main fork (Fig. 10). On 2 March the female was observed incubating. Over 10 hours of observations were made on this nest. The female conducted all of the incubating, where the male fed the female during incubation. The last observation of this nest was 13 March where the female appeared to be brooding. This nest was located in a large emergent Ceiba tree located in lowland broadleaf forest with no slope. DBH was not recorded, so that the female was not disturbed.


Figure 10. Ornate Hawk-Eagle nest #2 with female present, RBCMA.

Ornate Hawk-Eagle nest #3 was located on 14 March 2010 in RBCMA on the La Milpa Archaeological site road (Fig. 9). The nest was located by following a calling female to the nest. The nest was located on a horizontal branch with only one supporting branch in a Bullet Tree, *Bucida buceras,* with a DBH of 80.3 cm (Fig. 11). On 15 March the female was incubating and was observed bringing sprigs back to the nest. The nest was located in lowland broadleaf forest at an elevation of 155 meters. The nest was not observed after this date due to logistical constraints.

Figure 11. Ornate Hawk-Eagle nest #3, RBCMA.

Ornate Hawk-Eagle nest #4 was located on 28 March 2010 near the Cerros Archaeological Site (Fig. 9, 12). Both the female and male were observed calling. It could not be determined if they were incubating, had nestlings, or had not started nesting. This nest is well out of the known nesting range of Ornate Hawk-Eagles, as this constitutes the most coastal and lowest elevation nesting record for the species. The elevation is 16 meters and is 1 km away from the ocean.

Figure 12. Ornate Hawk-Eagle nest #4, near Cerros.

During 2009 and 2010, 86 total observations of all three *Spizaetus* species were made in the MPR area, RBCMA, Chiquibul National Park, and Cerros, with 34 of Black Hawk-Eagle *Spizaetus tyrannus*, 31 of Ornate Hawk-Eagle *Spizaetus ornatus*, and 21 of Black-and-white Hawk-Eagle, *Spizaetus melanoluecus*. Of the 86 observations, 11 were in RBCMA, 6 in MPR, 39 in the transition from MPR and broadleaf forest, 23 in Chiquibul, and 1 in Cerros. Habitat that was utilized by the *Spizaetus* species included lowland broadleaved moist forest, submontane broadleaved moist forest, submontane pine forest, and lowland pine forest. *S. tyrannus* and *S. ornatus* were observed in both lowland and submontane broadleaved moist forest, whereas *S. melanoluecus* was observed in all habitats mentioned. Neither *tyrannus or orntus* were observed in pine forest and *melanoluecus* was observed in pine forest 11 of 21 observations.

DISCUSSION

All four Ornate Hawk-Eagles nests were located in lowland moist broadleaf forest from 16-155 meters in elevation (Fig. 13). However, the coastal nest near Cerros (Nest#04) is well out of the known nesting range of Ornate Hawk-Eagles. The Corozal District is dominated by agricultural uses with a mosaic of savannah and broadleaf forest. This nest record represents the most coastal nesting record, as well as the lowest elevation known for the species. The coastal region in both the Corozal and Belize Districts should be surveyed to determine if there is an isolated population in this region.

In general, the rarest of the three *Spizaetus* species was *melanoluecus*, with *tyrannus* being the most common and widespread. *S. melanoluecus* was the only species found in pine forest, which may be due to its aerial hunting techniques, preying upon birds. The pine forest of Mountain Pine Ridge is open and capturing prey through the air may be easier than capturing birds in the dense broadleaf forest, but more data is needed to determine if this is the reason. 45% of the *Spizaetus* observations were within the transistion zone between the pine forest of mountain pine ridge and broad leaved forest, suggesting that protection of these transition zones is important for hawk-eagle conservation. These transitions have proven to be the most productive habitat, with a high species richness and abundance not just from our research, but also from The Jaguar Project (Martinez pers. comm.). Research comparing the productivity of the transition zones and other habitats should be conducted, so priorities can be set for land preservation in Belize.

In 2011 and 2012 we will begin to continuously monitor the *Spizaetus* nests in RBCMA throughout the breeding seasons, as well as trapping and radio-tagging both adults and juveniles from the three known nests.

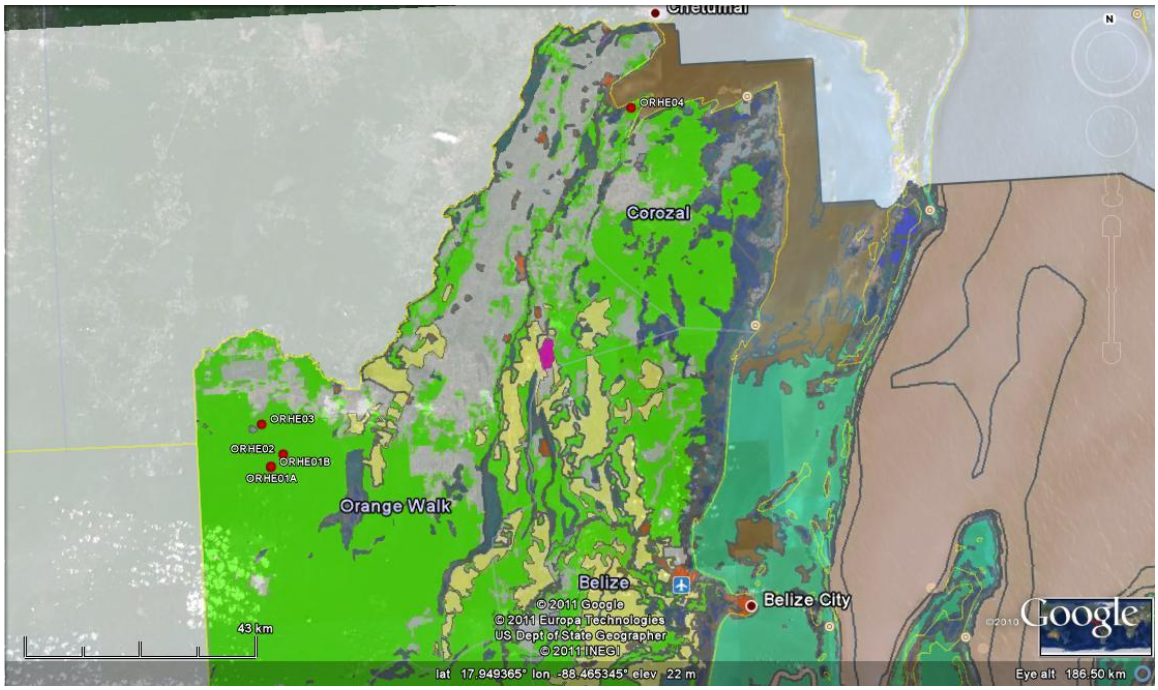

Figure 13. Ornate Hawk-Eagle nests over-layed on Meerman's Belize Ecosystem map. Green represents lowland moist broadleaved forest and grey represents agricultural use.

THE STYGIAN OWL PROJECT

INTRODUCTION

The Stygian Owl, *Asio stygius robustus*, (Fig. 14) occurs patchily throughout the pine forest and pine savanna of Mexico and northern Central America where it is poorly known. The status of the Stygian Owl is considered Least Concern by the IUCN due to its large home range (Birdlife International 2009), but is probably threatened by deforestation of pine forest (Konig and Weick 2008). In Belize, it is considered Vulnerable due to it being prosecuted as a perceived pest (Meerman 2005). Its breeding biology, distribution and geographical variation are poorly known making this one of the least understood owls in the Neotropics.

Figure 14. Adult Stygian Owl, MPR.

In Belize, the Stygian Owl is considered a rare resident throughout the pine belt, but there are few records due to its nocturnal and shy habits (Jones 2003). The largest population is located in Mountain Pine Ridge with a few records from the Belize Zoo and Hill Bank (pers. observ., Jones 2003).

This study will determine diet habits throughout the different seasons, relative density, habitat utilization, movement patterns, home-range, effects of logging and fires, breeding biology, and dispersal patterns of Stygian Owls. Stygian Owls are known to have high roost-site fidelity. At these roost sites is where they will regurgitate pellets (prey mass that cannot be digested), so locating these roost sites is critical in the success of this project. To date, we have located at least 3 different pair's roost sites and have found a total of five areas that have been or are being used as roost sites.

The objectives of this study are to locate a minimum of 3 adult pair's roosting sites throughout the study area to compare seasonal diets, prey species, number of prey taken in each season, prey biomass, habitat preference, density, movement and home-range. With this data we can better determine diet, foraging habits, habitat preference, relative density, home-range, area requirements, movement patterns and the potential effects of deforestation or logging on Stygian Owl populations. In the future, the Stygian Owl in Belize could be a similar situation to the Spotted Owl in the United States, where they have dramatically declined due to heavy logging of the conifer forests, which they are specialists of. The Stygian Owl could be a good indicator species of the health of the pine forests throughout Mexico and Central America.

STUDY AREA

This research was conducted within the Mountain Pine Ridge Forest Reserve and surrounding private lands, which included Hidden Valley and the Headley Property (Fig. 15). The Mountain Pine Ridge Forest Reserve is managed by the Forest Department and consists of over 120,000 acres of sub-montane to montane pine forest bordered by sub-montane broadleaf forest.

Figure 15. Stygian Owl Project Study Area, Mountain Pine Ridge.

METHODS

Pellet Analysis

We collected pellets at a known year-around roosting site of an adult pair of Stygian Owls in a grove of Caribbean Pines, *Pinus caribaea*, in the northwestern corner of MPRFR. During pellet collections at the roost site, a recently fledged juvenile Stygian Owl was observed on multiple occasions, the first being on 30 May 2009. The habitat is dominated by pine forest and is approximately .5 km from broadleaf forest. From 3 March 2009- 26 February 2010 pellets were collected monthly at regular intervals to avoid biases in seasonal variation. A total of 145 pellets were analyzed using the dry method. Prey remains were identified by the presence of feathers, fur, cartilage, beetle wings, or skulls. We recorded the minimum number of individual prey items for each pellet by the number of skull, radius, ulna, humorous, femur, fibula or tibula depending on what bones were present in the pellet. All prey items were classified into five broad categories; birds, bats, reptiles, amphibians and invertebrates. All bird prey items were identified to the Order Passeriformes, but were not identified to family or species because of the limited number of identifiable remains in the pellets. We identified to Passeriformes due to feather coloration, size of bones and the occasional beak and skull. Bats were not identified past Order because of the lack of knowledge to identify to species or family, as well as over 30 species being present in our study area (Miller and Miller 2010). However, we calculated bat biomass by estimating the mass of the bats through the size of the skull of species that have been found within our study area. By skull size we estimated all bat prey items to have less than 75 mm head and body length. We then calculated the mean of all possible species mass, which was 10.5 g. We estimated biomass of all other taxa by calculating a mean mass of all species found within our study area that were potential prey.

Trapping/Handling

Stygian Owls were trapped at known roost sites of two different pairs. If adults are trapped at the nest site then they will not be trapped until nestlings are at least one week old in order to minimize disturbance of the nest and the chance of desertion by the adults. The ideal time to trap a nesting adult is during the nestling period of the breeding cycle due to adults becoming more territorial and needing more prey to feed the nestlings and themselves, thus increasing trapping success. If juveniles are trapped they will be near fledging or near the post-fledging period at the nest site once they are fully grown and they begin to hunt on their own. This will allow the transmitter to fit properly and will increase trapping success.

Individuals were trapped using a mist-net at the roost site, as described by Thorstrom (1996). When the owls were trapped the individuals were restrained and hooded over the head and eyes to reduce stress. Once they were restrained they were weighed, measured, photographed and fitted with a backpack radio transmitter weighing no more than 3.5% of the bird's mass. Holohil Systems SI-2B backpack transmitters weighing 16 grams and

lasting 12-30 months (average 24 months) were fitted using Teflon Ribbon sewn together by thread. (view transmitter and specs. at http://www.holohil.com/ai2b.htm). Once the transmitter was securely fastened the bird was released and the field crew observed the individual from as far a distance as possible, while still being able to view the bird until it was confirmed that the bird was safe.

Tagged individuals will be re-trapped once the transmitter's battery gets close to the minimum estimated battery life (~ 12 months) and either the transmitter will be removed or replaced depending on how much more data is needed.

Radio-telemetry

We will follow the radio-tagged individuals during both the non-breeding and breeding season using standard triangulation techniques (Mech 1983). Tracking began in December 2010. A Wildlife Materials TRX-1000 receiver with a 3-Element Yagi directional antenna will be used (view at http://wildlifematerials.com/research/products). If the individual is in close range and accessible then a visual will be made on the bird. The number of points taken per week will depend on the bird's location, available personnel and number of tagged birds that are being studied. Ideally, four points per day will be taken for each tagged individual; one at dusk, one at midnight, one at dawn and one mid-day. However, to determine nightly movements at least once a week a full night of points will be recorded. All locations will be recorded using Universal Transverse Mercator (UTM) points, which will be generated into Arcmap 9.1 or Ranges 8 software program to estimate home-range and habitat utilization (Mohr 1947). Our goal is to radio-tag three adult males, three adult females, and four juveniles (2 males and 2 females) over the 3 year study period.

RESULTS

The seasonal variation in the diet of the Stygian Owl, *Asio stygius robustus*, in the MPRFR in Belize was based on 194 prey items of 145 collected pellets at a single roost site from 3 March 2009- 26 February 2010. The sample included 61.9% birds, 19.1% bats, 12.4% beetles, 6.2% lizards, and .5% frogs. Of the total prey items, 31% were nocturnal species with 69% being diurnal. On average, February-May the diet consisted of 70% birds, where June-August were comprised of 37% birds, 32% bats, and 28% beetles and November- February consisted of 81% birds (Fig. 16).

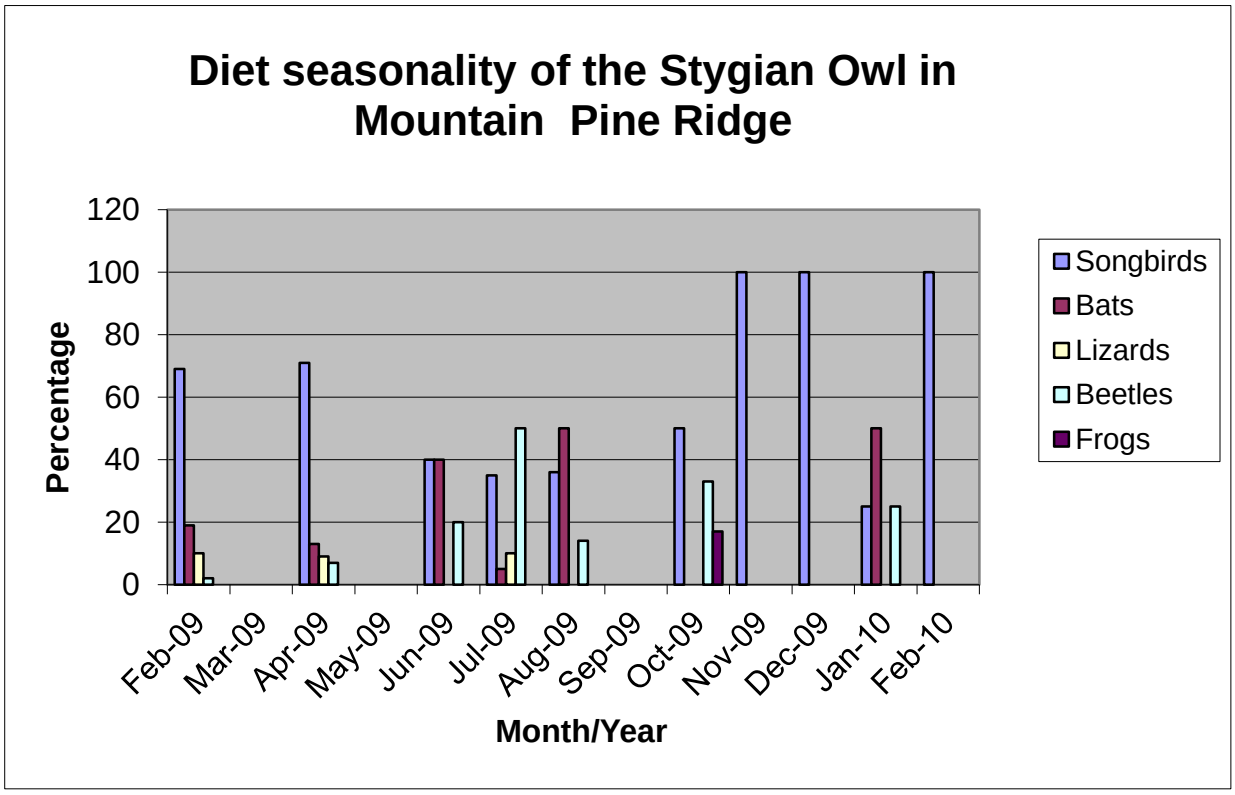

Figure 16. Diet seasonality of the Stygian Owl in Mountain Pine Ridge.

Five roosting sites of what we assume are of two different pairs were located throughout the MPRFR and private lands surrounding the MPRFR (Fig. 17). Two roost sites were occupied nearly every day or frequently by both the female and male during the non-breeding season. During the start of the breeding season in January the owls were only observed occasionally at the roost site. When egg laying occurred the owls were never observed at the non-breeding season roost site and nested about 1 km away from the roost site. At the other roost sites only individual owls were observed and only occasionally observed on consecutive days. Two of the five roost sites were logged with the roosting tree cut down. At one of the cut roost sites the owls did not use the roost site again, whereas the other cut roost site occasionally had a single owl roosting.

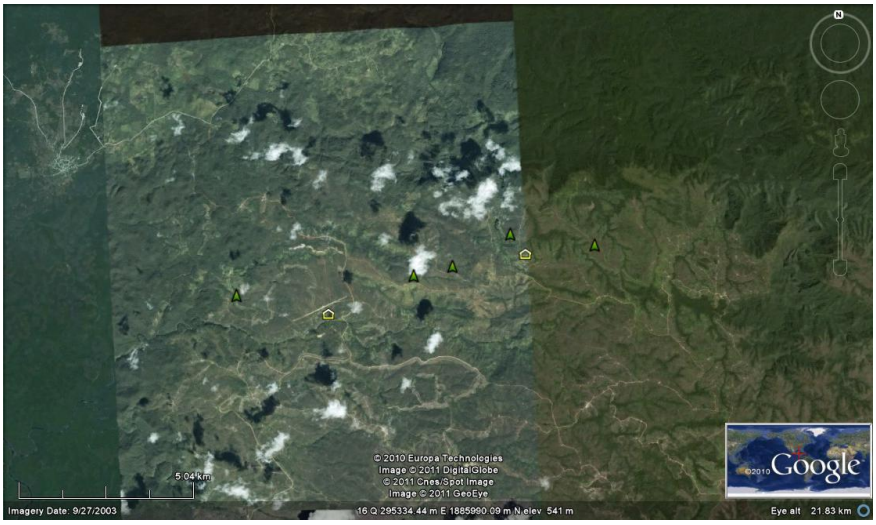

Figure 17. Five Stygian Owl roosting sites located in 2010.

DISCUSSION

Stygian Owls are the least understood Neotropical owl. To date, very few studies have been conducted on the species and the BRRI Stygian Owl Project is the largest full-scale study conducted. Limited studies have been conducted in Brazil, Cuba, and Belize on foraging ecology and nesting. Only three confirmed nests have been recorded through the owl's range, which include one in Belize, Brazil, and Cuba.

Diet has been analyzed in Brazil, Cuba, and Belize. Motta Junior and Taddei (1992) observed 90.2% birds, 6.1% bats, 3.6% insects, and .1% frogs, which are similar to our findings, except a higher percentage of bats were found in our data. Franz (1991) observed aerial captures of birds, bats, and insects, but noted that prey remains in pellets consisted primarily of bats. Our findings are similar to the other studies on prey, but there is a significant prey percentage between areas. This may be a result of prey abundance in a given area or individual preference for a given taxa. Further studies on habitat prey abundance will give us more insight into why there is a variation in diet. Knowing what the prey base of the Stygian Owl population in Belize is will assist in making proper management decisions and understanding fluctuations in population size.

In 2001, the infestation of the Southern Bark Beetle in Mountain Pine Ridge destroyed a large portion of the Pine Forest. The effects on the Stygian Owl population due to the loss of forest are unknown, but accounts suggest that there were more Stygian Owls in the Mountain Pine Ridge pre bark beetle infestation. With the altered Pine Forest and limited pine trees, logging may have an impact on Stygian Owl populations. As we observed in 2010 logged roosting sites disturbed owls and pushed them to other areas. As we study the owls in more depth we can begin to understand the effects of logging and fires on the population.

The radio-telemetry data will be included in our 2011 Annual Report, as most of the data to present has been collected in 2011.

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