2013

Solitary Eagle Project Report

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and

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Cover photo: Adult female Solitary Eagle soaring above the nest in Mountain Pine Ridge, Belize. (R. Phillips)

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The Belize Raptor Research strives to protect Neotropical raptors in Belize through research, education and partnerships. BRRI conducts long term scientific research to learn about the status and needs of raptors in the wild, while building local capacity, working with policy makers and educating local and international communities about raptor conservation.

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Abstract

In 2013, the Solitary Eagle Project attempted to monitor the full breeding cycle at the only known active nest of the species, including tagging a juvenile or adult individual. Nest monitoring was initiated on 13January and continued until 24 May with over 200 hours of observations. The adult eagles were observed near the nest on 9 occasions from 20 February to 20 October. On 16April, an immature eagle flew into the nest area and perched 400 m from the nest where there was an adult. This juvenile fledged on 4 August 2011, making the dependency period of 21 months after fledging the second longest recorded dependency period for any Neotropical raptor species; the Harpy Eagle having the longest. This is a significant observation as nesting, at most, occurs every 2-3 years of a single juvenile *(n =2)* having significant conservation implications. The eagles did not nest in 2013 due to the dependence of an offspring. Therefore there was not an opportunity to radio-tag any individuals. We suspect that nesting will occur in 2014, in which we will again monitor and have the opportunity to radio-tag an individual. Our nest observations from the 2011 nesting are also included in this report.

Introduction

The Neotropical region, which spans Central and South America, holds one of the richest yet least understood raptor communities anywhere, and basic natural history information is lacking for many species (Bierregaard 1995, Bildstein et al. 1998), despite recent progress (Whitacre 2012). Scientific knowledge regarding the biology and status of the Solitary Eagle, *Buteogallus solitarius,* in particular, is negligible. This is due in part to its low abundance throughout its range, as well as the difficult terrain which this species inhabits. The Solitary Eagle is therefore a 'priority species' for scientific study by BRRI.

There are fewer than 80 confirmed Solitary Eagle sightings between the 1800's and today, over its known distribution, from northern Mexico to northwest Argentina, where it is considered to be a very rare and local resident (Ferguson-Lees and Christie 2001). It is currently classified as Near Threatened by the IUCN and in Belize it is listed as Critically Endangered (Meerman 2005). Reliable information on Solitary Eagle population size is lacking, though estimates range between 250-999 individuals (Birdlife International 2013). Based upon further evidence of population trends it may be up-listed to Vulnerable, but currently there is insufficient data on the species to properly assess its status (Birdlife International 2013).

There have only been 4 nests (2 nests in Sonora, Mexico in 1947 and 1958, 1 in Ecuador in 2010 and 1 in Peru in 1989) (Harrison and Kiff 1977, R. Ridgley pers. comm., M. Sanchez pers. comm.) documented for this species prior to the nest discovered in Belize in 2011, none of which were studied. This Belize nest represents the only known active nest of the species. Only seven papers have been published strictly on the Solitary Eagle, including one BRRI published with The Peregrine Fund in September 2011 in the Journal of Raptor Research tided, 'Observations of the post-fledging

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behavior and prey of the Solitary Eagle *(Harpyhaliaetus solitarius)'* (Seminario et al. 2011, GRIN 2013). The other six were on identification; the nest and egg; possible occurrence in the United States; status; and systematics, respectively. Not a single paper has been published on its breeding biology, behavior, or population demographics.

Study Area

Observations were made in the Cayo District of Belize in the Mountain Pine Ridge Forest Reserve (17° 03' N, 88° 50' W) 4.5 km northwest of Baldy Beacon (Fig. 1). The terrain was a combination of a gently rolling upland plateau and a rugged escarpment with steep slopes and deep canyons. The area was sparsely populated by humans, with low human disturbance, except for the occasional training exercises carried out by the British military. Observations were made in the transition zone between submomane pine forest and submontane broad-leaved forest at an elevation of 667 m during the rainy season (Tune-January) and dry season (Februa1y-May). The habitat in the nest area was categorized as submontane pine forest (Meerman and Sabido 2001) and had a mean annual precipitation of 2003 mm (Means).

Methods

Between 13Janua1y and 24 May 2013, the Solitary Eagle, *Buteogallus solitarius,* nest was monitored weekly, of which observations were made 2-7 days per week. Daily observation periods varied from 2 and 10 hours. Since the nest was not active observations were made from 300 m from the nest on top of a ridge line for better vantage and to increase probability of determining activity in the area. From where the observations were made there was a 200° view into the large escarpment drainage with visibility up to 2 km. If eagles were soaring in the area or going in and out of the nest they would have been observed from this observation point. Observers used 8-10 x 42 binoculars, as well as a Vortex HD Viper 20-60 x 80 spotting scope. An observation blind was set-up 40 m from the nest, but was not used because of inactivity at the nest. Also, a security camera system was installed in the nest in March 2012 in preparation for 2013, but was not used due to inactivity.

Ninety-seven hours of nest observations were made in 2011 from 30 June – 26 August using 8-10 x 42 binoculars, as well as an 82mm Nikon spotting scope. Observations were made from a pop-up hunting blind with pine-oak camouflage 70 m from the nest. Nest-site attendants recorded all behaviors, including: prey exchanges, feedings, prey species, date chick fledged, adult and juvenile interactions, and juvenile behavior after fledging.

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In March 2012, the nest was climbed into using the single-rope climbing technique to take measurements and install a security camera. Height of the nest and nest tree was measured using a meter tape after climbing into the nest. Canopy percentage was estimated using a densitometer 25 m out from the nest tree in all cardinal directions, as well as at the base of the nest tree. The slope was measured using a clinometer at the base of the nest tree by taking an average within 1 m and the average slope of the area was estimated by taking a clinometer reading at the 4 cardinal directions 25 m from the base of nest tree. Slope aspect was estimated using a Brunton compass at the cardinal directions 25 m from the nest tree. The tree density was estimated using the point-quarter method and to get a more accurate estimate trees were counted in a 100 x 100 m quadrant around the nest tree. To determine the dbh (diameter at breast height) of the nest tree and trees representing the nest-site area a dbh tape was used. Canopy height was determined using a clinometer and measuring the tallest tree in each of the 4 quadrants surrounding the nest. Ten nest sticks were randomly measured using a dbh tape to obtain average diameter of nest branches.

The GIS map was produced using Arcmap 10.1. Four km radius buffers were chosen because this was the observed range of the individuals, but this does not designate home-range or territory size. This only covers an area that the birds are most likely using or have been observed using. The home-range is much larger than these buffers and future radio-telemetry studies will better understand land use and territory sizes of Solitary Eagles.

Results

2013 Nest Observations

We received a report from Jonathan Urbina and Lee Jones, PhD, that they observed within the Solitary Eagle, *Buteogallus solitarius*, nest area an adult Solitary Eagle pair and an immature, presumably the same adults that nested in 2011 and their young, soaring together on January 12, 2013 3 km northwest from the nest. By this time we expected this juvenile to have dispersed from the natal area and the adults to be preparing for the breeding season.

The Solitary Eagle nest monitoring team first observed the adult pair soaring over the nest on February 20, which is when we expected the eagles to begin courting and nest refurbishing. They were not observed again until March 14 when our team observed an adult soaring over the nest. The adults were observed soaring over the nest again on two occasions on March 25. However, at this point no nest visits by the eagles had been observed. On April 15, the team heard a Solitary Eagle vocalizing about 0.5 km from the nest deep in a drainage. The next day the team observed the immature Solitary Eagle flying low above the nest and then perched near an adult of this species

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(Fig. 2). They then flew off together. The immature, presumably, was heard vocalizing for 1 hour. These seemed to be food soliciting calls as they had been heard during the nestling period and post-fledging period in 2011 at this same nest. Both the adult and immature then flew over the nest and out of view (Fig. 3). This was the last day the juvenile was observed in the area. A team from The Peregrine Fund hacking out Orange-breasted Falcons, *Falco deiroleucus,* 3 km from the nest was present in the area daily from June-September and did not observe the juvenile, but did observe the adults on multiple occasions Q. Urbina pers. comm.). The pair was last observed *c.* 3 km from the nest on 20 October 2013 (Table 1).

2011 Nest Observations

On 30 June 2011, when the nest was first located, the nestling appeared to be approximately 2 months old and was being fed by both adults (Fig. 4). The nestling was first observed wing flapping, spreading its wings and lifting up off the nest, on 10 July. The nestling spent most of its day food begging or standing at the edge of the nest during the month of July. On 4 August, the nestling made its first flight from the nest tree. We estimated the nestling fledged at approximately 3.5 mo. For all of August the juvenile was observed within 200 me from the nest, frequently food soliciting. The adults continued to bring food to the nest, where the juvenile would fly once it heard the parents vocalizing. On 16August, the juvenile began to look for prey. It was observed intently looking down at the ground at anything that moved. On 26 August, we observed its first attempt to catch prey when it attacked a Striped Basalisk, *Basiliscus vittatus,* but it was unsuccessful. The juvenile on the same day was observed carrying sticks. We presume a way of practicing to hunt, which has been observed with other species of raptors.

Nest and Nest-site Characteristics

The nest was located 3 m below the top of a *Pinus oocarpa* in a main fork of three primary branches and the trunk (Fig. 5). The nest was located 20.1 m above the ground. The nest tree height was 23.1 m with a dbh of 42.1 cm. The nest tree was 667 m a.s.L and had a significant hole through the base of the tree from a fire burn. The three primary supporting branches had a diameter of 4.3, 4.6 and 5.7 cm and the supporting truck had a diameter of 11.1 cm. The nest was a large cup-less platform with a length of 1.1 m, a width of 0.8 m and a height of 0.5 m constructed of only *Pinus* branches lined with *Pinus* needles (Fig. 5). Nest branches averaged 2.0 cm ($n = 10$) and ranged from 1.3-3.2 cm (Table 2).

The habitat in the nest area was categorized as sub-montane pine forest with steep terrain located in the transitional karst zone between pine forest and broad-leaved forest. There are two species of pines in Mountain Pine Ridge, *Pinus caribaea* and *Pinus oocarpa,* the latter restricted to the highlands and

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mush less common. The four most dominant plant species around the nest in order of abundance were *Pinus oocarpa, Pinus caribaea, Quercusperseifalia* (red oak) and *Brysonmia crassifalia* (wild craboo). The percent canopy cover of the nest area was 71.7 ±14.2 (SD) (n = 5) with an average canopy height of 17.8 m ± 1.9 (SD) (n = 4). The average slope of the nest-site was 39.2 ° (n = 5) and the slope at the nest tree was 42.0 °. The average slope aspect was 101.0 °. The average dbh of *Pinus* trees in the nest-site area were 32.7 cm ±12.8 (SD) (n = 20). *Pinus* density in the area was 173 trees per ha. The nest was located 386 m from the nearest broad-leaved forest and 166 m from the nearest water source. The water source on average was a 3 m wide, slow moving, year-around creek and tributary of Roaring Creek (Table 2).

Prey Observations

Adults would bring in prey to the nestling between 1-3 times per day (n = 20) between 09:26 and 17:52. On one occasion, both the adult male and female came into the nest from the same direction, wing tip to wing-tip each was carrying a snake. On most occasions, the male and female would bring prey to the nest at different times; rarely were both adults observed at the nest at the same time. The female brought 60 % of the observed prey item deliveries.

From direct observations we recorded twenty prey items brought to the nest by both the adult male and female. Seventeen of the twenty (85%) prey items were snakes, and the other three were a single observation of a Nine-banded Armadillo *(Dasypus novemcinctus),* Striped Basalisk *(Basiliscus vittatus),* and an unidentified mouse or rat (Fig. 6). The Tropical Rat Snake *(Spilotes pillatus)* and Brown Racer *(Dryadophis melanolomus)* were the two most abundant prey species. Tropical Rat Snake representing 20% and Brown Racer 30%, but Tropical Rat Snake had a larger biomass.

Discussion

The Solitary Eagle is exceptionally rare and in low densities. The 2013 birds' behavior, location and presence within the nest area was sufficiently similar to the nesting pair from 2011, therefore we presume that the immature Solitary Eagle observed on 16 April 2013 is the juvenile of the 2011 nest. This individual went through at least one molt, therefore we could not compare plumage markings between photos from 2011 and 2013. This immature eagle fledged on 4 August 2011 and we suspect that it hatched in April 2011, making this immature dependent for 21 months post-fledging. This observation of an adult Solitary Eagle pair and immature interacting through contact and vocalizations represents the second longest dependency period recorded of a Neotropical raptor, the Harpy Eagle, *Harpia harpyja,* having the longest recorded dependency period for all Neotropical raptor species of approximately 2 yrs. This is an exceptional discovery as we assumed dependency for

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this species would be about 18 months after hatching, since we observed a successful fledging of a juvenile in 2009 of the presumed same pair and they nested again in 2011. From our observations between 2009 and 2013 we have observed two successful nesting attempts of two juveniles , one juvenile per nesting cycle, of the presumed pair and nest. The first nesting cycle was 2 years (2009-2010) and the second nesting cycle was 3 years (2011-2013). This is the first data to show that at most the Solitary Eagle nests every 2-3 years and has a single young having conservation implications. The difference in dependency period between the two nesting cycles could be due to a longer dependency period for female young compared to males. This is just a hypothesis and needs to be tested, **but** has been observed in other raptors.

By the third week of April we had expected the eagle pair to be incubating eggs and the eggs near to hatching. With the juvenile from 2011 (immature) still being dependent or associating with the adults in April, which is the incubation period for most Belize raptors, as well as observed behaviors we conclude that nesting did not occur in 2013. If there was an alternate nest we would have observed the pair going in and out of the nest with prey, as well as vocalizing. We expect the pair to start courting and nest building in February 2014 and egg laying to occur in March. We will begin to make nest visits in January and once nesting commences will begin daily monitoring.

The prey observed in this study represents the first non-anecdotal data for the species. Our observations signify that Solitary Eagles are specialized reptilian feeders, but will prey on the occasional mammal (Fig. 6). However, a larger sample size and to eliminate pair bias more studies are needed from other pairs with larger sample sizes.

The 2011 nest was located in the highest fork in a *Pinus oocarpa*. Throughout 2012 and 2013 the nest became more dilapidated loosing branch by branch from each storm until in April 2013 the entire nest was no longer present. It will be interesting to see if this pair uses the same nest tree and re-builds the entire nest or chooses a different tree.

In December 2011, a juvenile was shot and eventually died near Alta Vista off the Hummingbird Highway (Fig. 7). It was food begging when it was shot. It had recently fledged and was most likely to be dependent on the adults. This location was 40 km from the nest (Fig. 1). Plumage was carefully compared with the 2011 juvenile that fledged from the nest and had considerably different markings (Fig. 8) making it a different juvenile Solitary Eagle and confirmation of a second Solitary Eagle pair in Belize. This is a new area of Belize where Solitary Eagles have not been observed prior to this record. It was on the edge of Sittee Forest Reserve.

On 31 August 2012, RM observed a juvenile Solitary Eagle (Fig. 9) in the southern extreme of the Mountain Pine Ridge Forest Reserve on the edge of the Macal River above the Chalillo reservoir,

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which is adjacent to the Chiquibul National Park (Fig. 1). A month later RM in the same location observed an adult feeding the juvenile a boa and tropical rat snake. The presumed same juvenile was observed 3 km from this area in Chiquibul National Park. This area is 23 km from the nest (Fig. 1) and this juvenile fledged in 2012 due to its fresh plumage and no molted feathers. If it were hatched in 2011 it would have gone through a molt. Therefore, this juvenile was not the 2011 nest bird, as well as juvenile plumage differences (Fig. 9). This juvenile had recently fledged and we expect the nest to be within 2 km of where this juvenile was observed as other juveniles fledged in July and August and stayed within 1 km of the nest area 2 months post fledging. This represents a second pair of Solitary Eagles in the Mountain Pine Ridge Forest Reserve and the third nest confirmation for Belize. The area was surveyed for a nest, but was not found due to the inaccessibility and steep terrain. The area will be surveyed in 2014 for a nest, as activity of the adults will assist in locating a nest.

In 2014, the nest will be monitored through the entire breeding cycle if active, the area in southern Mountain Pine Ridge will be surveyed for a nest and monitored if located, the area of Alta Vista where the juvenile was shot will be surveyed for a nest and presence of adults in the area and a juvenile of the nest, if successful, will be radio-tagged with a GPS transmitter.

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Table 1. Solitary Eagle observations during the 2013 monitoring season.

Date	Time	Adult/Immature Observation	Distance from Nest (m)
20 February	17:43	Adult pair soaring over nest from the north and departing out of site to the west	400 - 2000
14 March	11:28	Single adult soaring over nest area from northwest to southeast	300
25 March	09:20	Single adult soaring high from west to east	1000 - 3000
25 March	10:10	Single adult soaring low over ridge above nest then dropped into valley	600
15 April	09:00	Immature heard only food soliciting south of nest in valley	1000
16 April	12:04	Immature flew in from north and perched 400 m from the nest, where a single adult was perched 1 tree over. The adult was vocalizing and mantling They then flew south and out of sight. The immature was heard vocalizing for an hour (fig. 3)	400
16 April	14:10	Immature and adult soaring north of nest, immature continued to the north and out of sight and adult went south out of sight (fig. 2)	800
17 April	10:05	Immature heard vocalizing for 90 minutes south of the nest	1100
20 October	-	Adult pair soaring	3000

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Table 2. Nest and nest-site characteristics collected in March 2012.

ATTRIBUTE	MEAN	SD[1]	SE[2]	RANGE	N
Elevation *a.s.l* (m)	667	-	-	-	1
Nearest broad-leaved forest (m)	386	-	-	-	1
Nearest water source (m)	166	-	-	-	1
Nest height (m)	20.1	-	-	-	1
Nest tree height (m)	23.1	-	-	-	1
DBH of nest tree (cm)	42.1	-	-	-	1
Canopy height (m)	17.8	1.8	0.9	15.6-19.7	4
Canopy cover (%)	71.7	14.2	5.8	49.9-85.3	5
Tree density (ha)	173.0	-	-	-	1
DBH of trees in the area (cm)	32.7	12.8	2.9	15.0-60.2	20
Slope (°)	39.2	4.8	2.1	35.0-46.0	5
Slope aspect (°)	101.8	25.7	11.5	72.0-142.0	5
Diameter of supporting branches (cm)	6.4	3.2	1.6	4.3-11.1	4
Diameter of nest branches (cm)	2.0	0.6	0.2	1.3-3.2	10

[1]Standard deviation
[2]Standard error

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Figure 1. Location of the Solitary Eagle nest and two other nesting areas with a 4 km radius buffer.

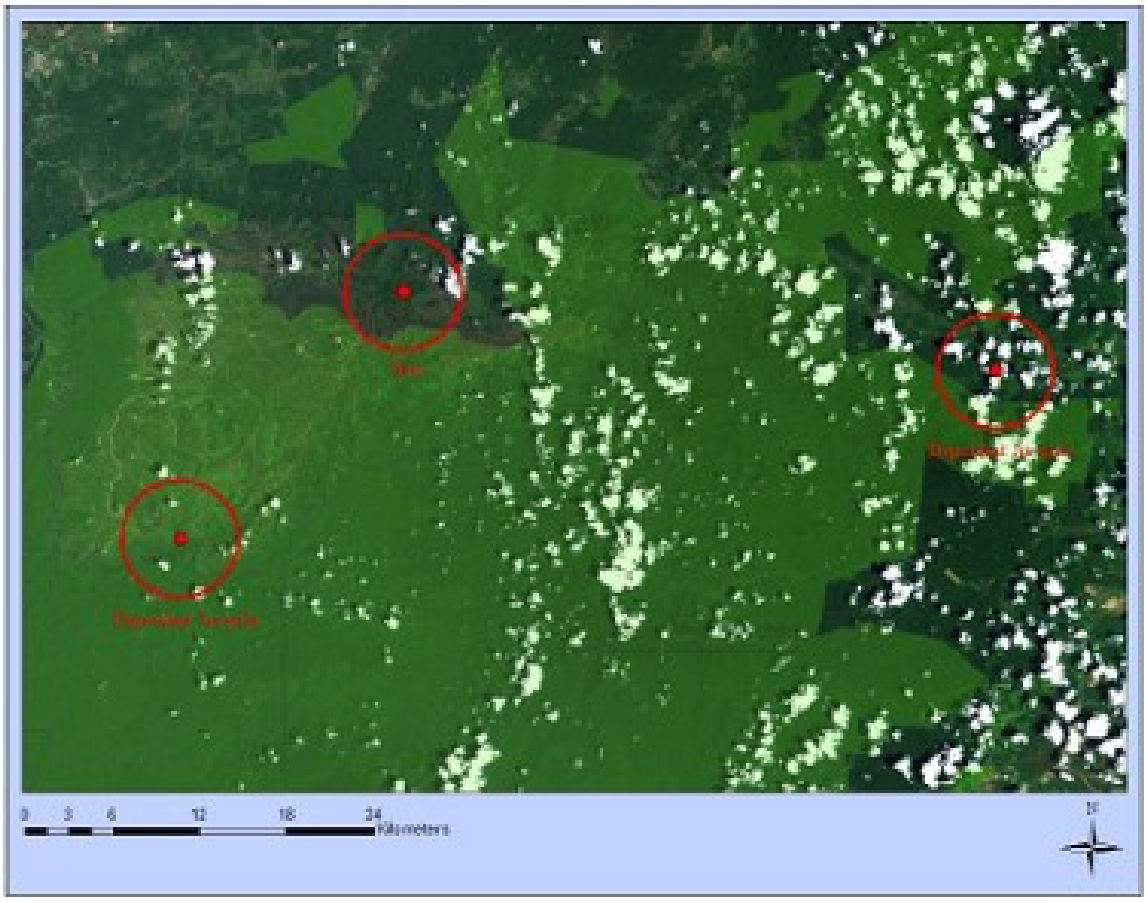

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Figure 2. Left: Adult mantling near immature on 16 April 2013. Right: Immature perched near adult on 16 April 2013. (Photos R. Bourbour)

Figure 3. Adult and immature Solitary Eagle soaring together on 16 April 2013 near the nest. (Photo R. Bourbour)

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Figure 4. Adult female and nestling on nest when nest was first discovered on 30 June 2011. (Photo R. Martinez)

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Figure 5. Solitary Eagle nest on 21 March 2013. (Photos M. Cordova and R. Phillips)

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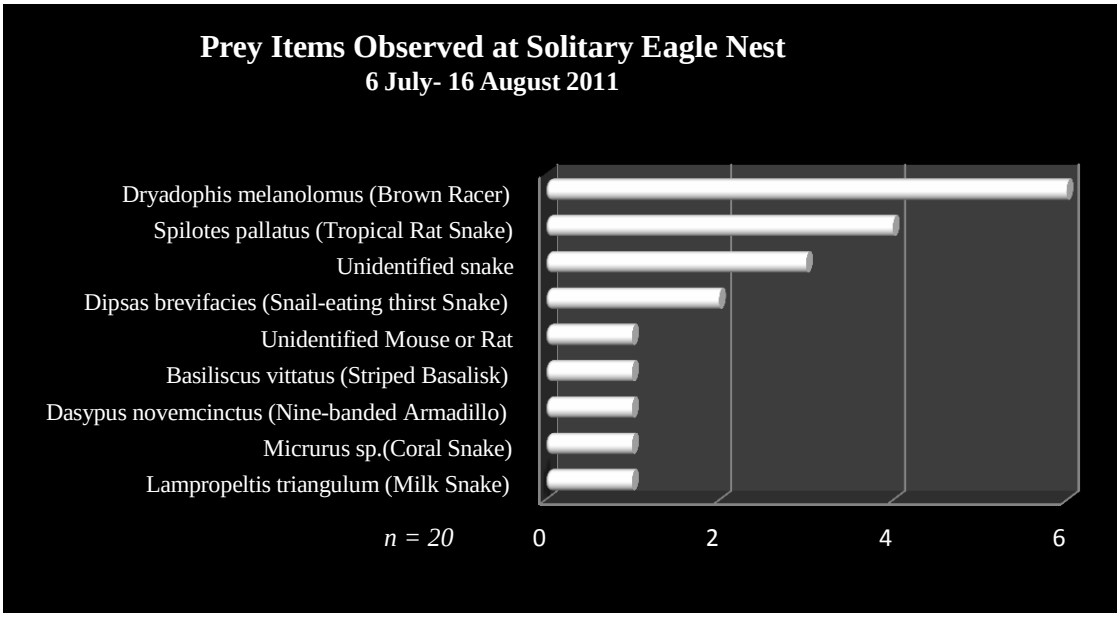
Figure 6. Prey items observed at the nest from June through August 2011.



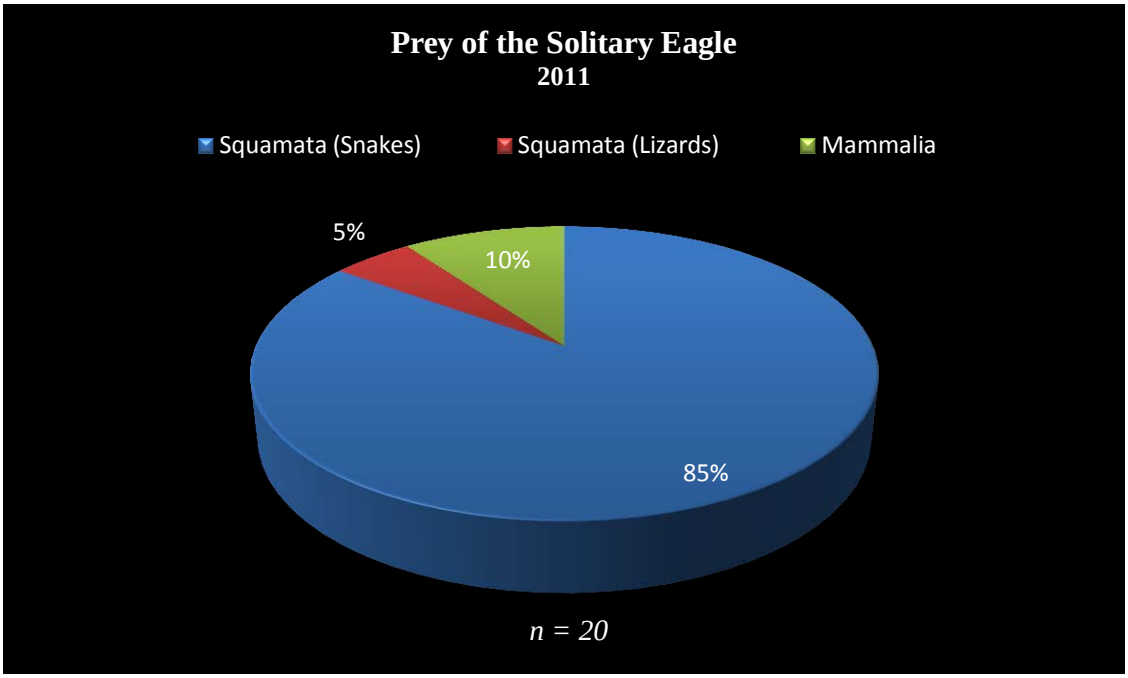


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Figure 7. Juvenile Solitary Eagle shot and deceased in December 2011, which was received by Belize Bird Rescue from Rick Dewart. (Photo R. Martinez)

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Figure 8. Above: Right wing of the shot juvenile near Alta Vista on 6 December 2011. Below: right wing of the juvenile from the nest on 26 August 2011.Note the pattern differences of the underwing covert feathers, as well as both birds being in full juvenile plumage and no feathers have been molted.
(Photos R. Martinez)

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Figure 9. Left: juvenile from the nest on 26 August 2011. Right: juvenile observed on 31 August 2012 in southern Mountain Pine Ridge Forest Reserve.

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