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# Evaluating a Squirrel Monkey Troop in Natural Rehabilitation: An Assessment of Population and Behavior of *Saimiri sciureus* in Preparation for Relocation from Sumak Allpa to Yasuní National Park

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*Evaluating a Squirrel Monkey Troop in Natural Rehabilitation:*

**An Assessment of Population and Behavior of *Saimiri sciureus* in Preparation for Relocation from Sumak Allpa to Yasuní National Park**



("Diet/Foraging," 2016. Monkeyworld.com)

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## ABSTRACT

Natural rehabilitation and translocation of primate species provide the opportunity for recovery of individuals and repopulation of species in the wild. However, there are few successful examples of primate translocation around the world, and no successful cases in Ecuador. This study assesses the population and overall behavioral activity of a troop of *Saimiri sciureus* on Sumak Allpa Island, Orellana, Ecuador from November 6<sup>th</sup> to November 27<sup>th</sup>, 2016. This specific troop, referred to as the Yasuní troop, is scheduled to be translocated from Sumak Allpa to Yasuní National Park in March or April of 2017, and would be the first successful translocation of a primate group in Ecuador. Field observations in the natural habitat of *Saimiri sciureus* and at the platform that will be used in the translocation process were used to examine the Yasuní troop's population composition and behavioral activity, and assess whether this troop will be able to withstand the stresses of the translocation process and survive in the wild. The population of the troop was found to be stable, with healthy yearly birth and survival rates, and behavioral budgeting was found to be comparable to that of a wild troop of *Saimiri sciureus*. These observations are strong indicators that the Yasuní troop will be able to successfully function as a wild troop.

## RESUMEN

Rehabilitación natural y translocación de especies primates proveen la oportunidad para la recuperación de individuos y la repoblación de especies en la naturaleza. Sin embargo, hay pocos ejemplos exitosos del translocación de primates en todo el mundo, y no hay casos de éxito en Ecuador. Este estudio evalúa la población y actividad general de comportamiento de una tropa de *Saimiri sciureus* en la isla de Sumak Allpa, Orellana, Ecuador desde el 6 a 27 de Noviembre, 2016. Este grupo, se llama la tropa Yasuní, está programado para ser trasladadas desde Sumak Allpa al Parque Nacional Yasuní en Marzo o Abril de 2017, y sería el primer translocación exitoso de un grupo de primates en Ecuador. Observaciones de campo en el hábitat natural de *Saimiri sciureus* y en la plataforma que se utilizará en el proceso de translocación se utilizaron para examinar la composición de la población y la actividad del comportamiento de la tropa Yasuní, y para determinar si esta tropa será capaz de soportar las tensiones del proceso de translocación y sobrevivir en la naturaleza. La población de la tropa está estable, con tasas de nacimiento y supervivencia saludables, y actividad del comportamiento está comparable a una tropa de *Saimiri sciureus* salvaje. Estas observaciones son indicadores fuertes que la tropa Yasuní será capaz de funcionar con éxito como una tropa salvaje.

ISP Topic Codes: 601, 608, 614, 622

Key Words: primate rehabilitation; primate translocation; common squirrel monkey; *Saimiri sciureus*; Ecuador

## BACKGROUND

### *Sumak Allpa*

Sumak Allpa, meaning “a place with no pain” in Quechua, is a 113.5-hectare island in the Napo River located approximately 30 kilometers east of Coca Francisco de Orellana, Ecuador. The Sumak Allpa foundation focuses on conservation of indigenous cultures and the natural rehabilitation of native monkey species. In 2005, the island was purchased by Héctor Vargas, a naturalist guide, environmental activist, and director of the Sumak Allpa foundation. Before the island was purchased, it served as a small cash-crop plantation that grew cacao and coffee and also contained pasture land. After the past 11 years, the island now contains primary, secondary, and varzea habitats and houses eight different species of monkeys: woolly monkey

(*Lagothrix poeppigii*), black-mantled tamarin (*Saguinus nigricollis*), golden-mantled tamarin (*Saguinus tripartitus*), pygmy marmoset (*Cebuella pygmaea*), night monkey (*Aotus*), saki monkey (*Pithecia*), white-fronted capuchin (*Cebus albifrons*), and the common squirrel monkey (*Saimiri sciureus*). Many of the monkeys on Sumak Allpa were previously pets or trafficked in the illegal pet trade. The island creates a naturally isolated habitat in which individuals and populations can recover without the regular predation threats on the mainland. This form of protection allows the monkeys to reestablish natural behavioral patterns, which then allows for the possibility of

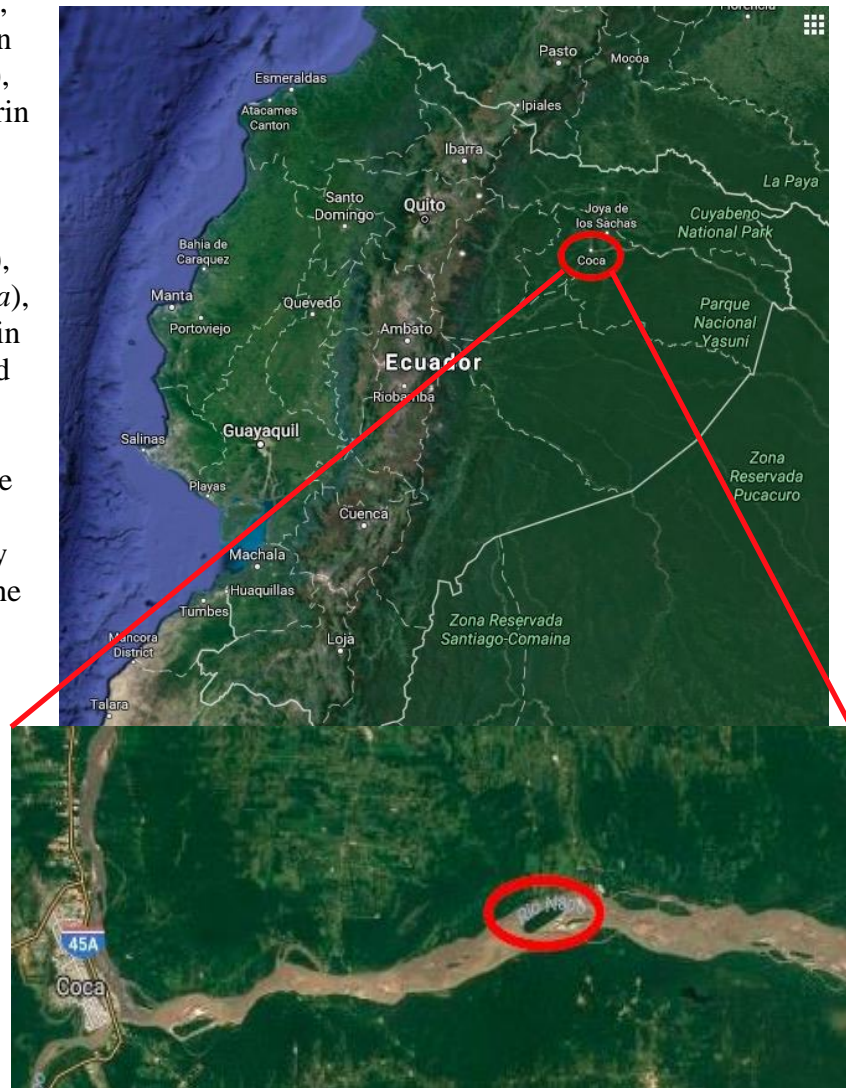


Figure 1: A map of Ecuador with the location of Coca and the island of Sumak Allpa

translocation back into the wild (Vargas, personal communication, 2016).

### *Squirrel Monkeys on Sumak Allpa*

The common squirrel monkey (*Saimiri sciureus*) is the most populous of the eight species of monkey on Sumak Allpa, with a total of about 88 individuals. In 2007, eleven squirrel monkeys were brought to Sumak Allpa, which originally formed one troop, but separated into different troops in 2010. Currently, there are five different troops, each with a distinct territory, although there is some overlap between these territories. Now four out of the five troops have produced offspring, while the fifth troop is completely composed of males.

The *Saimiri sciureus* population on Sumak Allpa has reached its carrying capacity, and thus one of the five troops is scheduled for translocation to Yasuní National Park in March or April of 2017. This troop, called the Yasuní troop by Héctor Vargas, has been targeted to be relocated because its territory does not largely overlap with other troops' territories, which makes the capture of this troop easier (Vargas, personal communication, 2016). Vargas has taken various initiatives in order to prepare the Yasuní troop for translocation. The number of visitors to Sumak Allpa was reduced from 2,200 in 2014 to about 1,200 in 2016 in order to reduce the amount of stress placed on the squirrel monkeys which, in turn, will hopefully create an easier capture and translocation process (Vargas, personal communication, 2016).

### *Methods for the Rehabilitation of Primates*

The rehabilitation of animals can have one of four different outcomes: successful rehabilitation and release, non-releasable permanent educational placement, natural death as a result of the individual's condition, or euthanasia (Sanabria, 2014). A case of successful rehabilitation indicates that the animals are psychologically and physically able to function properly as wild animals. Being able to recognize and obtain proper foods, demonstrate fear of potential dangers such as cars and people, know how to avoid predation, and mate properly are all skills that indicate that an animal is able to function properly in the wild. In regards to primates, there is a large need for rehabilitation facilities due to the high number of primates that are kept as pets in their juvenile state, but then abandoned once they reach sexual maturity. The most important factor to consider when dealing with primate rehabilitation, according to Vargas, is ensuring that individuals are able to survive in the Amazon rainforest without needing a constant supply of food. Oftentimes individuals will return to human inhabited areas to obtain food once released because they are not fully prepared to live as liberated individuals in the wild (Vargas, personal communication, 2016).

Many of the primate rehabilitation centers in Ecuador function as wildlife exhibitions/zoos because of the inability to re-release individuals into the wild, thus monkeys often stay in captivity for the duration of their lives. However, Sumak Allpa functions as a rehabilitation center with the objective of releasing individuals back into the wild. While Sumak Allpa has not yet released any primates, which is due to the lack of maturity of the troops, the organization has the ability to be the first in Ecuador to successfully rehabilitate and translocate a group of primates. Due to the structure of the island, individuals and populations on Sumak Allpa have already been

able to adapt similar behaviors to those of monkeys in the wild and survive without human intervention (Vargas, personal communication, 2016).

## INTRODUCTION

### *Background on Common Squirrel Monkeys*

The common squirrel monkey (*Saimiri sciureus*) is a small new world primate, or platyrrhine, that is distributed in Central America and the Amazon basin (Zimble-DeLorenzo, 2011). *Saimiri sciureus* belongs to the family *Cebidae*, suborder *haplorrhine*, and order *primata*. Squirrel monkeys have been heavily used in laboratory studies, and thus there is a significant amount of information on their physiology, reproductive processes, nutrition, and life history (Rosenblum & Coe 1985; Roesenblum & Cooper, 1968). This high usage in laboratory studies has also lead to an increase in the amount of field research conducted on squirrel monkeys (Baldwin, 1985).

*Saimiri sciureus* have short fur with olive-gray coloring on the back and limbs and beige coloring on the face, chest, and belly. The length of their non-prehensile tails is also beige colored and has a tufted back tip. They have a white mask around the eyes, a black muzzle, tufted white ears, and a cap of grey or black. The forelimbs, feet, and hands have an orange coloring (Emmons, 1997). Sexual dimorphism is subtle, where females' hands and feet are pale whereas males are distinguished by their bright orange forelimbs, hands, and feet.

*Saimiri sciureus* is distributed through various Central and South American countries: Panama, Colombia, Peru, Ecuador, Brazil, French Guiana, Guyana, Suriname, and Venezuela. These monkeys inhabit humid tropical and subtropical forests between 200 and 1200 meters in elevation (Tirira, 2007). They are a diurnal, arboreal, and largely insectivorous and frugivorous species, but the composition of their diet is seasonally influenced. A higher degree of fruigivory occurs during the wet season while more insects are consumed during the dry season (Zimble-DeLorenzo, 2011). They will also consume flowers and nectar, although these are not their preferred food sources. Most their time is spent foraging in the subcanopy and understory, which gives the monkeys protection from aerial predators, such as hawks. They prefer areas of the forest that are dense and have many insects, thus squirrel monkeys thrive in disturbed forest and edge habitat. They also often forage and eat alongside capuchins (*Cebus*) or tamarins (*Saguinus*) and form mixed-species associations with these monkeys (Zimble-DeLorenzo, 2011).

*Saimiri sciureus* live in troops consisting, on average, of 15-20 individuals as compared to the average of 20 to 75, and up to 100, individuals in other species of squirrel monkey (Boinski et al, 2005). Males and females form a linear hierarchy in a single troop, where most males are dominant over females. Additionally, troops consist of one to two select breeding males that gain weight during the mating season in order to gain female attention. They mate during the dry season and offspring are usually born during the wet season when fruit and water are more plentiful. All parental care is carried out by females, who carry offspring on their backs for the first two to three months of their lives (Boinski, 2002).

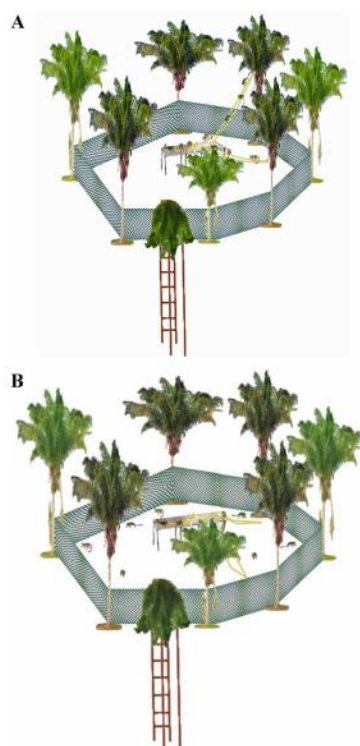
### *Threats to the Common Squirrel Monkey*

*Saimiri sciureus* is listed as Least Concern on the International Union for Conservation of Nature (IUCN) Red List, largely due to their preference for disturbed forest and edge habitat, which allows this species to be comparatively more resilient to some threats, such as poaching. While squirrel monkeys are not commonly used as bushmeat because of their small size, they are often trafficked in the illegal pet trade (Defler, 2004).

Additionally, human-induced habitat loss poses a large threat to *Saimiri sciureus*. Deforestation, forest fragmentation, and the increasing development of infrastructure in their range act as major threats to this species. The expansion of monocultures such as African palm oil, coffee, and bananas has caused large amounts of habitat fragmentation and destruction. Because these monkeys are arboreal and rarely come to the ground, the loss of trees, especially on a large scale, has an especially negative impact on *Saimiri sciureus*. Habitat fragmentation has also caused populations to be restricted to smaller areas of forest. This has inhibited their ability to find food during the dry seasons and has also caused various genetic diversity issues that threaten their conservation (Boinski, 1998).

### *Capture and Translocation Methods of Primates*

Stone et al present the method that will be used to capture and translocate the Yasuní troop from Sumak Allpa to Yasuní National Park in a paper in 2015. Stone et al used the proposed method in the eastern Amazon of Brazil in November and



(Stone, et al, "Capture Method," 2014.)

Figure 2: A diagram of the capture method used by Stone et al. (A) Monkeys entering and feeding in the capture area before ropes are dropped. (B) Monkeys enclosed after ropes are dropped.

December of 2013. Some capture methods include large baited cages, darting, tomahawk traps, and placing nets across gaps in the forest. In the study, tomahawk traps were found to be ineffective, and while baited cages were slightly more effective, only nine individuals from the troop were captured over the course of two months. Additionally, it was noted that the squirrel monkeys stopped returning to the cage location after about eight days despite the amount and type of bait being placed in the cages. From these observations, Stone et al concluded that baiting the monkeys, but capturing them in mass quantities is the ideal technique. Thus, Stone et al used a platform (2.0 m tall x 4.0 m long x 1.5 m wide) in a natural gap in the forest that mimicked a natural feeding area. Camouflaged hideout tents were also placed around the platform in order to observe the monkeys. Bananas were placed on the platform daily to bait the monkeys. In the translocation process, a large net was placed around the platform area. When the monkeys mounted the platform the ropes that act as exit routes were cut down so that the monkeys were trapped on the platform. The translocation team was able to capture the monkey on the ground and from the platform once they were trapped. In the translocation process for the Yasuní troop, a

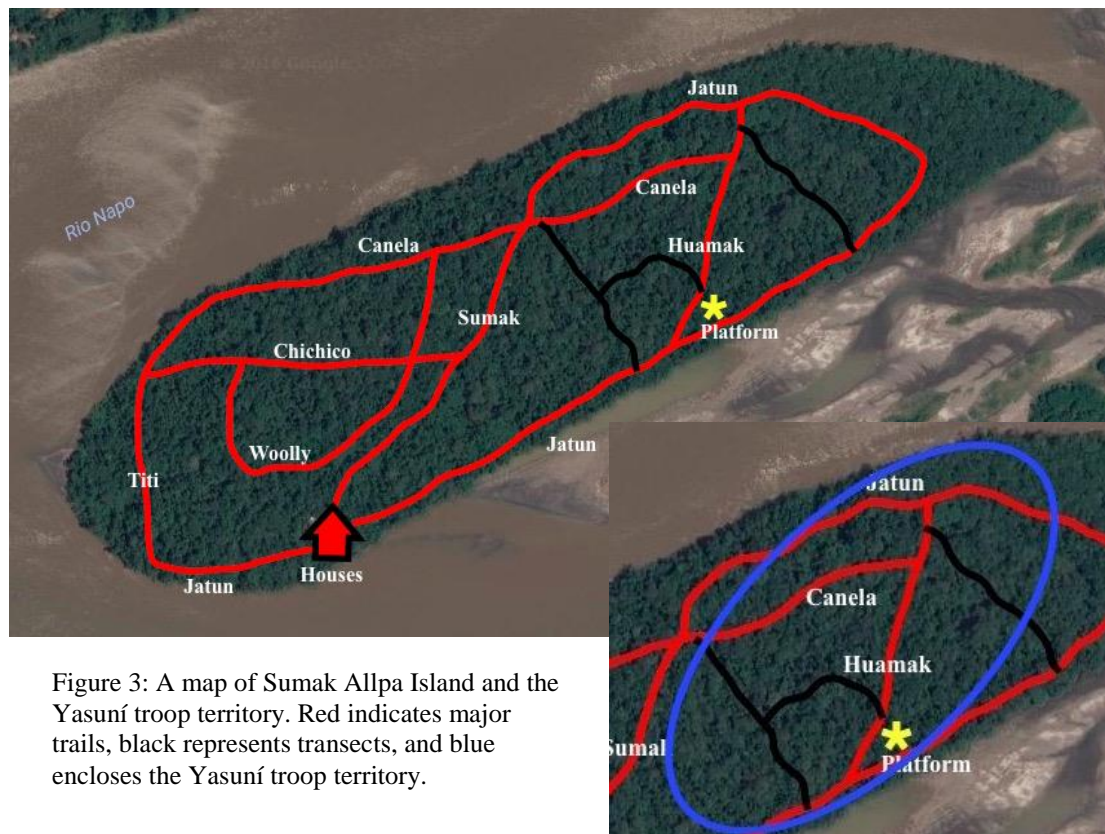
similar method will be used, with some modifications. A net will be placed around the platform area, as well as below the platform area so that some monkeys can be caught directly from the platform structure (Vargas, personal communication, 2016).

### Objectives

The Yasuní troop on Sumak Allpa is scheduled to be translocated to Yasuní National Park in March or April of 2017, and in preparation for this process, this study aims to collect data regarding the current population, general behavior, and platform activity of this troop of *Saimiri sciureus*. Behavioral data will be compared to studies of squirrel monkey troops in the wild to assess if the Yasuní troop is prepared to survive in the wild. Additionally, data collected regarding the troop's activity at the platform will inform the translocation managers at what times the Yasuní troop is most active at the platform, and thus what times would be most effective to capture the Yasuní troop. Finally, population data will be used to ensure that the entire troop is being captured during translocation process.

## METHODS AND MATERIALS

This study was carried out the 113.5 hectare island of Sumak Allpa, located approximately 18 kilometers east of the city of Coca Francisco de Orellana on the Napo River in Ecuador. In November 2016, over the course of 23 days, 2 observation periods were conducted daily, weather permitting. Each observation period lasted between 3 and 4 hours, in the morning from 5:30 to 9:30 AM or 7:00 to 10:00 AM and in the evening from 3:00 to 6:00 PM. The majority of observation days were sunny with no rain.





Huamak, Canela, Jatun trails, and the transect network were walked in order to encounter the Yasuní troop. In addition to these trails, walking off trail was often needed in order to find and follow the troop, at which times a machete was occasionally used to navigate through the dense forest more easily. Also, a compass was used to navigate back to a trail or basecamp after walking off trail. The canopy and subcanopy were scanned for movement and vocalizations were listened for in order to find the Yasuní troop. The help from Hector Vargas was also utilized occasionally to find the Yasuní troop. A camera and voice recorder (iPhone 6) were used to gather additional permanent information that could be used outside of field.

Once the troop was found, binoculars were used to better observe the monkeys from a distance. Scan, behavior, and focal sampling methods were used in order to assess both the population structure and behavior of the Yasuní troop. Focal observations were conducted in 10-minute intervals for a total of 4 focal observation periods. However, due to the troop's tendency to travel through the dense subcanopy, behavior and scan sampling methods were found to be more effective than focal observations.

In order to assess the population structure of the Yasuní troop, the total number of individuals and recent offspring were recorded in a field notebook. In addition to observations regarding population structure, behavioral observations were also recorded in order to compare the behavior of the Yasuní troop to squirrel monkey troops in the wild. Behavior was recorded and organized into the following categories:

***Movement:*** locomotion that is unable to be put in any other category

***Play:*** interaction with other individuals or objects that is not aggressive

***Rest:*** no motion, usually in close proximity to other individuals

***Groom:*** picking through and brushing other individuals' fur

***Human:*** looking at or interacting with me or other humans

***Aggression:*** specific vocalizations and large movements towards the ground

***Stress:*** specific vocalizations, unusual repetitive activity

***Eating:*** placing food in the mouth

***Foraging:*** examining or manipulating a food item but not placing it in the mouth

***Association:*** physically interacting with other monkey species

In addition to the above categories, behavior was also specified as being state (behavior occurring over a notable period of time) or event (instantaneous) (Altmann, 1974, p. 6). These categories are important in order to assess whether the troop's social behavior coincides with troops in the wild and if the troop is prepared to be located.

Observation periods also included watching the platform that will be used to capture the troop during the translocation process. During these times, the number of individuals in the area of the platform, the number of individuals on the platform at once, and the time were recorded for the purposes of the capture and relocation process.



Figure 4: A photo of the platform from the camouflaged observation tent located on the south side of the platform.

After the 21 days of field observations, the data collected was organized and transferred into Excel to be analyzed. Most notably, data was analyzed in order to create a behavior time budget, platform time budget, and calculate the birthrate of the Yasuní troop.

## RESULTS

From November 6<sup>th</sup> to 27<sup>th</sup>, 2016, 33 observation periods were made. Of these 33 observation periods, the Yasuní troop was encountered 19 times, making 57.58% of observation periods successful.

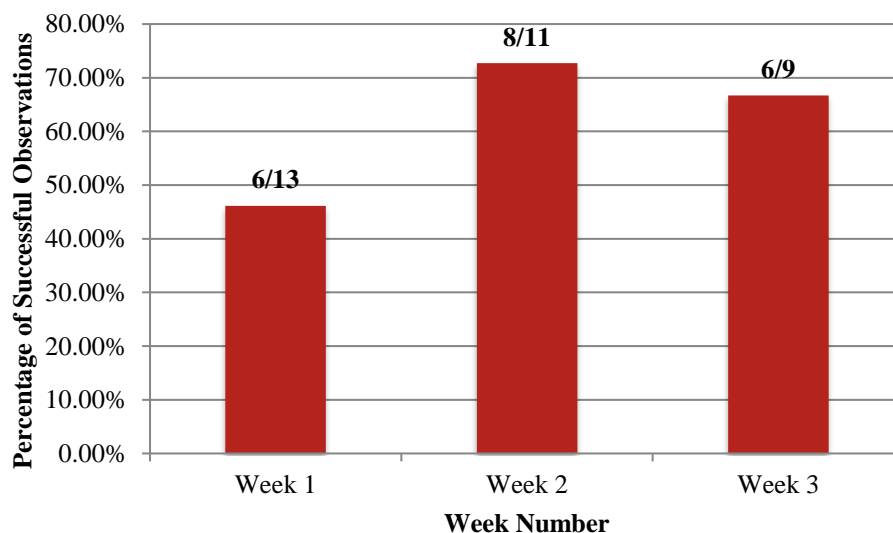


Figure 5: The percentage of successful observation periods between November 6<sup>th</sup> and November 27<sup>th</sup>, 2016 grouped by the week number.

### Population

According to a personal communication with Héctor Vargas, there were 25 individuals in the Yasuní troop in early 2016. In this study, groups of 16 to 20 individuals or 21 or more individuals were most commonly seen. It was rare to see groups of 1 to 5 individuals. The minimum number of individuals seen was 3 individuals, and the maximum amount seen was 28 individuals at once. The average number of individuals seen was 19.22 individuals.

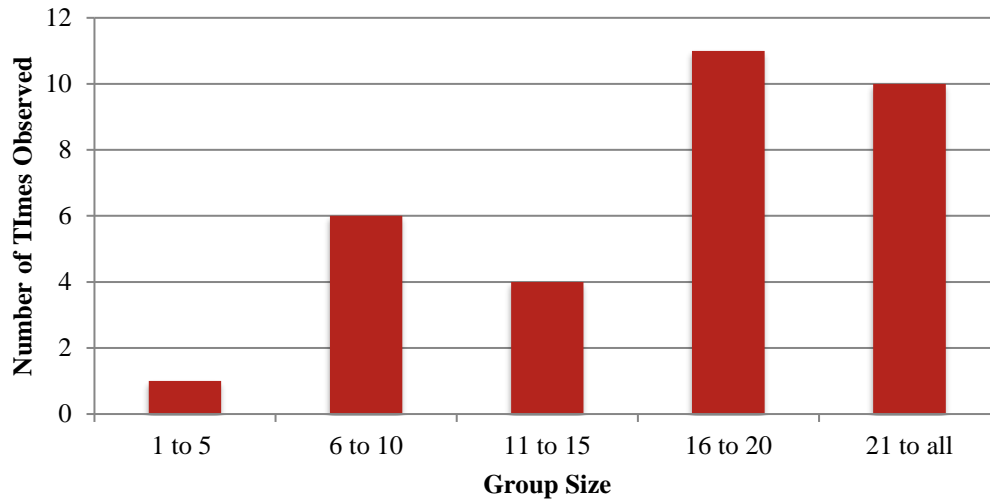


Figure 6: The number of observation periods that *Saimiri sciureus* were sighted based on group size.

In October of 2016, some females in the Yasuní troop gave birth to offspring, however, Vargas did not know the number of new offspring in the troop. During this study, offspring were seen in 13 of the 33 observation periods. The minimum number of offspring seen at once was 1 individual and the maximum seen at once was 4 individuals. The average number of offspring seen 2.69 individuals. Using the maximum number of offspring, the Yasuní troop has a birthrate of .143 births per month (number of births/total population) and a birthrate of 1.714 births per year. With these 4 births, there is a total of 29 individuals in the troop.

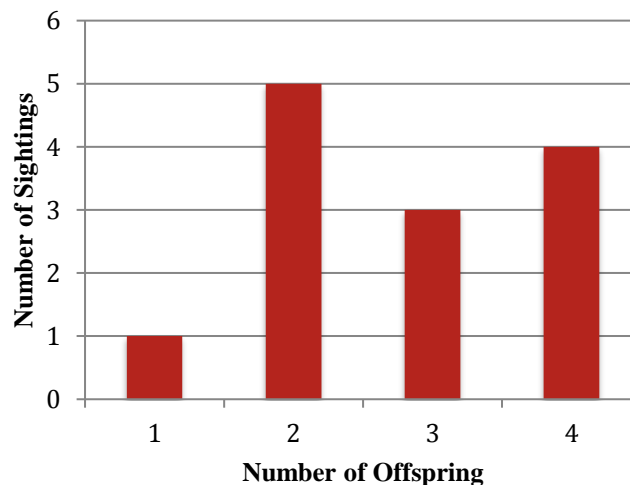


Figure 7: The number of sightings of Yasuní troop offspring grouped by the number of offspring seen.

The Yasuní troop was most commonly observed between the hours of 8:00 and 10:00 AM and 4:00 and 5:00 PM. Groups of 21 or more individuals were most commonly seen between 8:00 and 10:00 AM or in the afternoon between 5:00 and 6:00 PM. Groups of 21 or more individuals were least commonly observed between the hours of 5:30 and 7:00 AM and between 3:00 and 4:00 PM. Groups of 1 to 5 individuals were only observed once in total, which took place between 3:00 and 4:00 PM. The average number of individuals seen was 19.22, which was most common between 4:00 and 5:00 PM and did not occur between 5:30 and 7:00 AM.

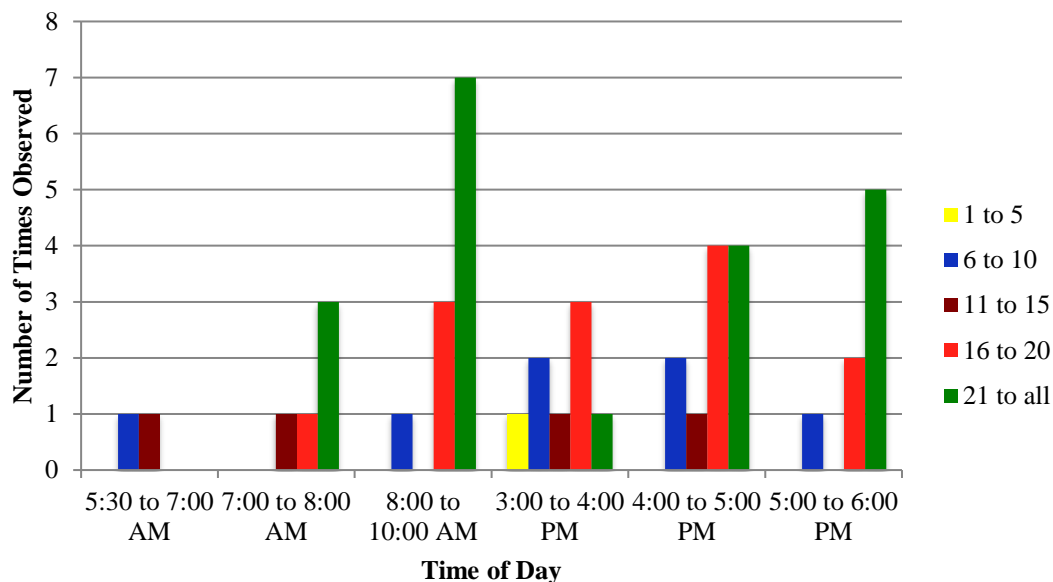


Figure 8: The number of times different group sizes of *Saimiri sciureus* were observed based on the time of day.

### *Platform Activity*

This study heavily focuses on Yasuní troop's activity at the platform that will be used for the translocation of the troop from Sumak Allpa to Yasuní National Park. Knowing when the troop is active at the platform will make the translocation process easier and put less stress on the monkeys (Vargas, personal communication, 2016). Using the data from this study, the Yasuní troop was most commonly found at the platform between the hours of 8:00 and 10:00 AM. However, a volunteer named Kaila observed the Yasuní troop from April 11<sup>th</sup> to May 8<sup>th</sup>, 2016. Using the data that she collected, the troop was most often at the platform between 2:00 and 3:00 PM. The troop was never observed at the platform between 5:30 and 7:00 AM or 10:00 AM and 12:00 PM. Additionally, according to both sets of data, it was rare to observe the Yasuní troop at the platform between 5:00 and 6:00 PM.

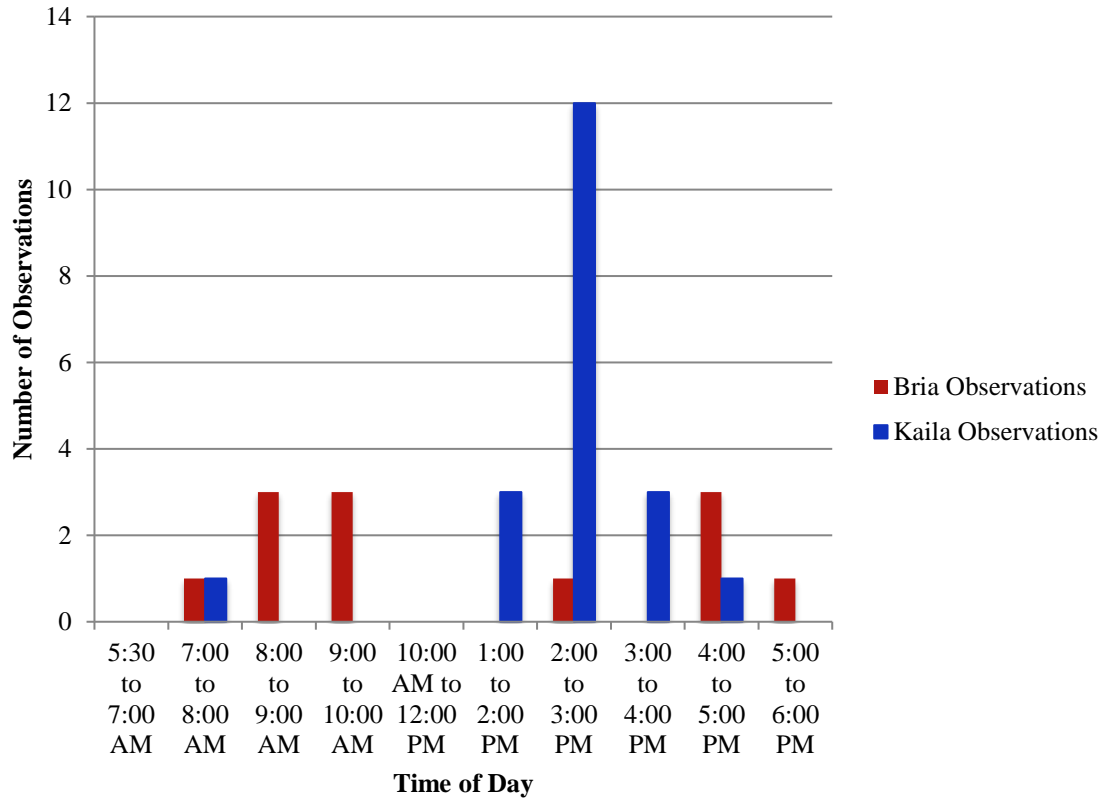


Figure 9: The number of observations of the Yasuní troop at the platform grouped by time of day, including data collected during this study and another data collected by a Sumak Allpa volunteer during April and May of 2016.

In addition to the peak times of activity at the platform, the number of individuals at the platform during these times is also critical information for the translocation process (Vargas, personal communication, 2016). The troop often moved to the platform, but only some individuals actually mounted the structure. On average, using the data from this study, there were 23.14 individuals in the platform area, and an average of 7.43 individuals on the platform structure. The minimum number of individuals seen in the platform area was 19 individuals and there was a maximum of 27 individuals in the area at once. The minimum number of individuals seen on the platform was 8 and there was a maximum of 14 individuals on the structure at once. It should be noted that there were a total of 2 observation periods that the Yasuní troop went to the area surrounding the platforms and climbed partway down the ropes, but never actually mounted the structure.

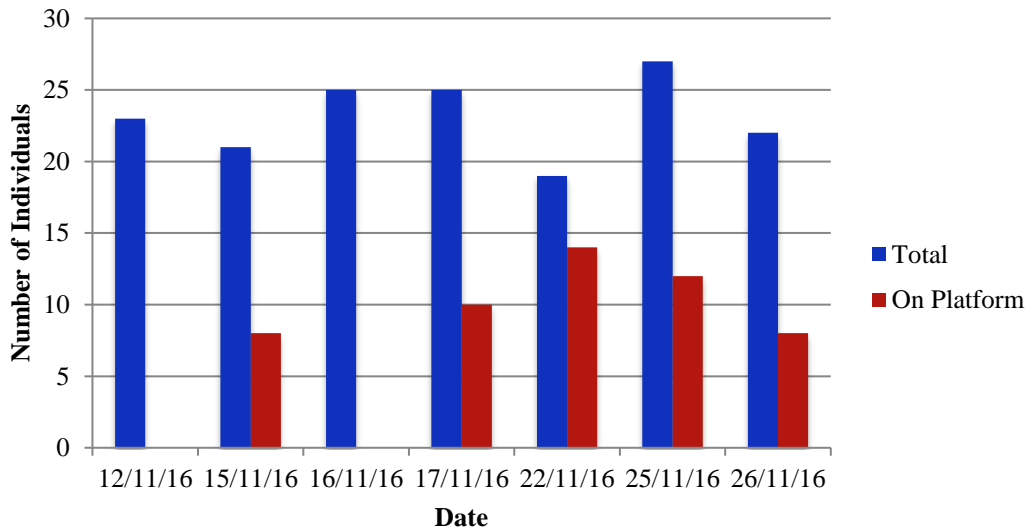


Figure 10: The total number of *Saimiri sciureus* from the Yasuní troop in the platform area as compared the number of individuals that mounted the platform structure.

Between the hours of 8:00 and 9:00 AM, 21 or more individuals were most commonly active at the platform. The least common time of day to see 21 or more individuals was between 10:00 AM and 4:00 PM. Between 2:00 and 3:00 PM, many different group sizes were observed multiple times at the platform, with an average of 7 to 11 individuals being observed in the platform area during that time of day.

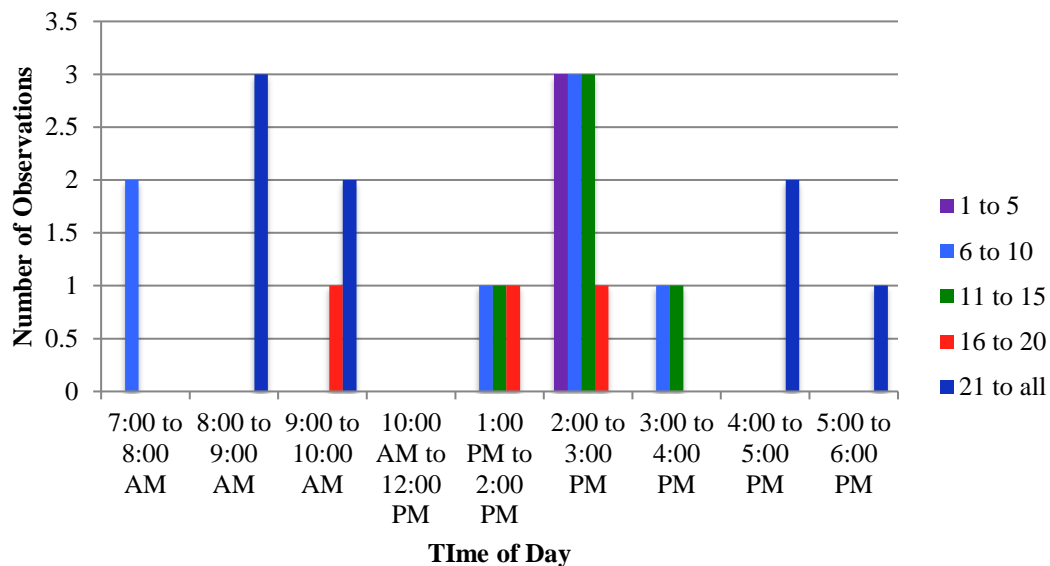


Figure 11: The number of observations of different group sizes of the Yasuní troop found in the platform area based on the time of day. This includes data from this study and data collected in April and May of 2016. These numbers reflect the total number of individuals found in the platform area, not the number of individuals to mount the platform structure.

The highest number of individuals that mounted the platform structure at once were most commonly observed between the hours of 9:00 and 10:00 AM or 4:00 and 5:00 PM. Between 1:00 and 4:00 PM, individuals from the Yasuní troop were often observed on the platform structure, however these observations usually only included 1 to 5 individuals.

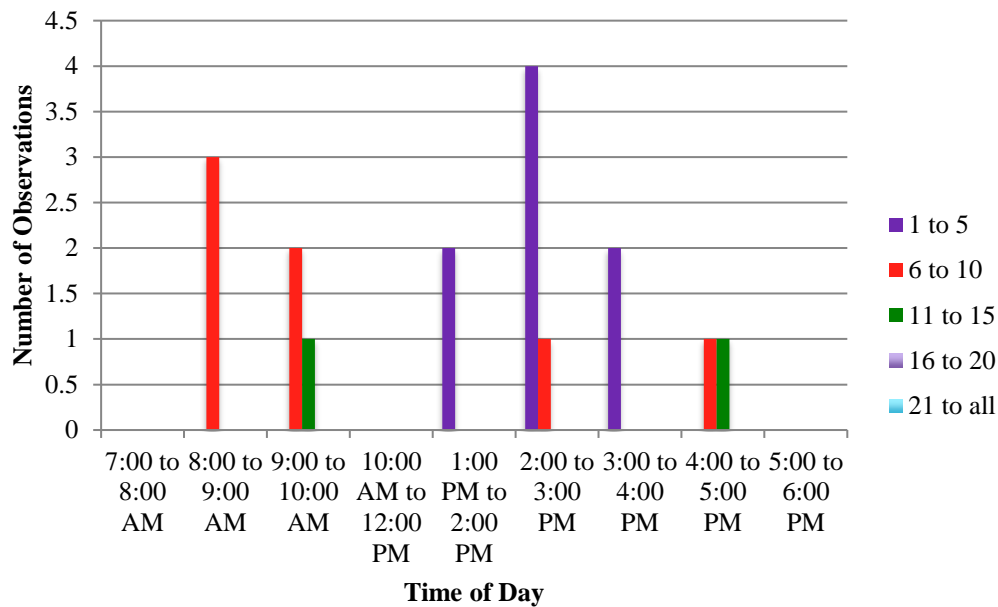


Figure 12: The number of observations of different group sizes of the Yasuní troop found on the platform structure based on the time of day. This includes data from this study and data collected in April and May of 2016.

### Behavior

Over the course of the 33 observation periods, there was a total of 15.42 contact hours (15 hours and 25 minutes). Of these, 13 hours and 30 minutes of continuous types of behavior were observed, also called state behavior. Spontaneous, or event, behaviors were observed for a total of 1 hour and 50 minutes.

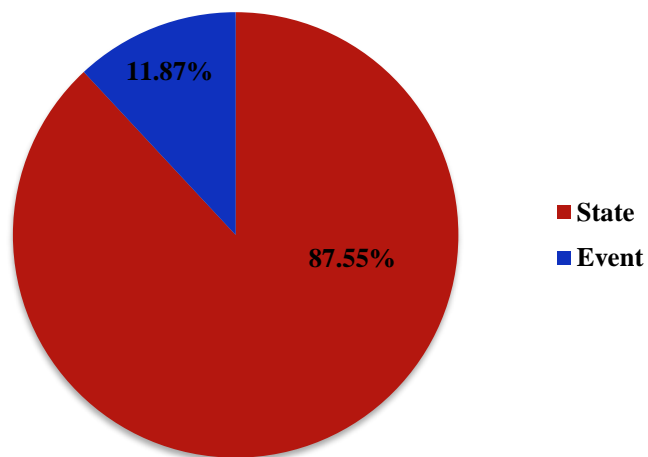


Figure 13: Contact hours with the Yasuní troop broken down between state and event behavior types, represented as percentages.

The daily activity of the Yasuní troop primarily consisted of foraging, movement, and eating. On average, associations with other monkey species, mostly black-mantled tamarins (*Saguinus nigricollis*) and occasionally a single male white-fronted capuchin (*Cebus albifrons*). On a daily basis, aggressive instances were common, however these events are so short in terms of time that they look insignificant as compared to other behaviors.

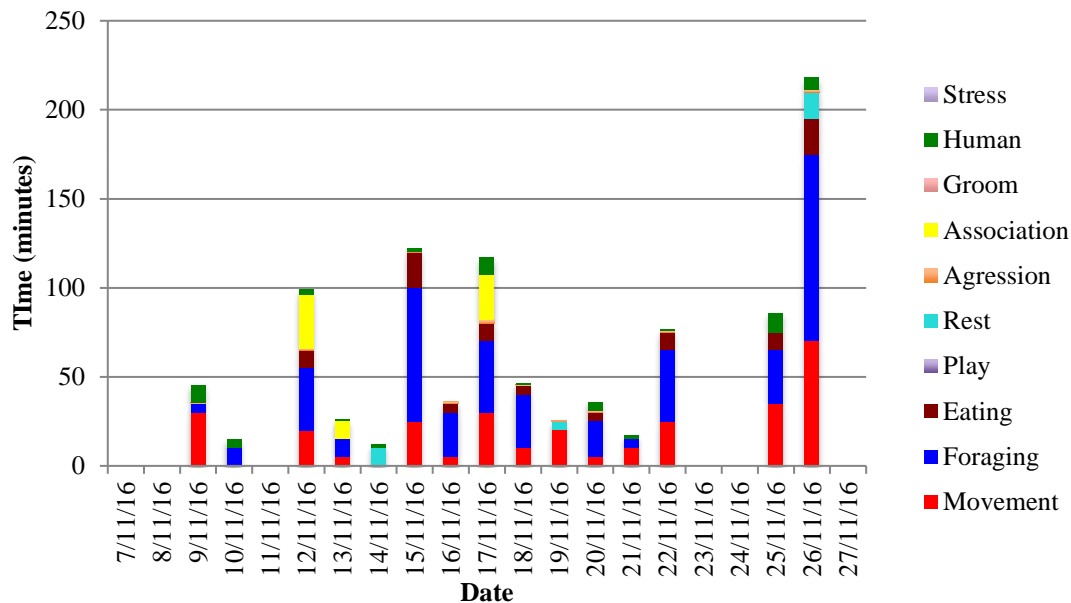


Figure 14: The daily behavioral time budget of the Yasuní troop. All observation days are represented, regardless if the troop was seen or not.

Of the 15 hours and 25 minutes of contact with the Yasuní troop, 7 hours and 20 minutes were spent foraging, 4 hours and 50 minutes were spent moving, and 1 hour and 35 minutes were spent eating. These were the three most time consuming behaviors of the troop. The troop also spent a total of 3 hours and 25 minutes of the

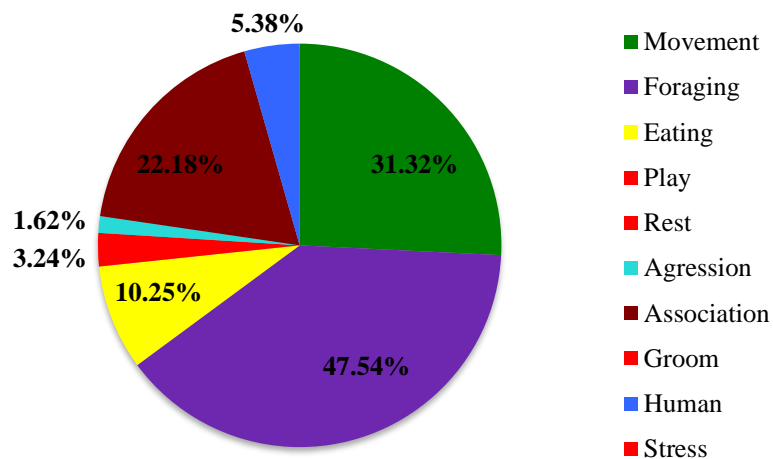


Figure 15: Overall behavioral activity broken down by behavior type and represented as percentages of the total amount of contact hours.

contact hours in associations with other monkey species. The squirrel monkeys spent a total of 50 minutes engaging with humans, which usually consisted of staring and vocalizing. Aggression was common on a daily basis but only accounted for 15



minutes of the total time. Play, stress, and grooming were not observed during this study.

## DISCUSSION

Over the course of the three-weeks of field research, the Yasuní troop was seen more and more frequently. Different indicators of the monkeys' presence were learned such as specific vocalizations, and a better understanding of the troop's territory was acquired. The combination of these different skills made finding the troop easier as time went on. In the last 10 days of field research the amount of days with rain increased, which led to fewer observation periods during that time.

### *Population*

Previous to this study, Héctor Vargas believed that there were 25 adults and juveniles in the Yasuní troop, but was unsure of the number of new offspring. This study has confirmed that the Yasuní troop consists of 29 individuals, including 4 offspring that were born in October of 2016, and 25 adults and juveniles. It was most common to encounter a group of 16 to 20 individuals, however 25 adults were counted at once on 3 different occasions. It was uncommon to encounter only groups of 1 to 5 individuals. While fission-fusion dynamics do occur in *Saimiri sciureus* troops, in the months of November and December the amount of rainfall begins to increase in the Amazon basin. Average rainfall in November is 161.0 mm as compared to 111.0 mm in October and 63.0 mm in September (Jukofsky, 2002). This increase in rainfall leads to higher amounts of available food in the forest, which decreases the need for troops to segment into groups and forage separately. Thus, larger groups are more commonly found during this wet season because the entire troop is more easily able to forage together.

This increase in rainfall is also a contributing factor to the 4 births within the Yasuní troop in October. Births of *Saimiri sciureus* often occur near the start of the wet season when water and food are more abundant and easily accessed for both mothers and their offspring (Vargas, personal communication, 2016). In previous years, there have been between 4 and 6 births within the Yasuní troop, with 5 births in 2015 (Vargas, personal communication, 2016). During this study, all 4 offspring were encountered at once, on 4 different occasions. It was most common to encounter 2 offspring at once, however this occurred 5 times, on only one more occasion than when all of the offspring were encountered.

The most common times of day to encounter the entire troop together were between 8:00 and 10:00 AM and 5:00 and 6:00 PM. Peak foraging activity also occurred between the hours of 8:00 and 10:00 AM, which made it much easier to encounter the troop because the monkeys usually made more rustling noises during this time. Between 5:30 and 7:30 AM, the troop was either at rest or only starting to move and forage. This made it difficult to both find the troop and count individuals. For these reasons, there were often fewer contact hours between 5:30 and 7:30 AM. However, because all individuals in the Yasuní troop would sleep in close proximity to one another, when the troop was encountered between 5:30 and 7:30 AM, groups were larger, averaging between 8.5 and 12.5 individuals.

Additionally, afternoon observation periods started at 3:00 PM, and most often the troop was not encountered within the first hour of afternoon observations, unless the troop was at or near the platform. Thus, there were fewer contact hours between

the hours of 3:00 and 4:00 PM. However, when the troop was encountered during this hour, it was often in varying group sizes. Fission groups are more likely to occur during the midday and afternoon hours because the troop does not need to be congregated to rest or sleep, as *Saimiri sciureus* is active throughout the entire day. Because of this, it is not surprising that the entire troop was not often found during this time of the day.

### *Platform Activity*

The most important part of this study is to report the activity of the Yasuní troop at the platform in order to inform the team that will be working to translocate the troop from Sumak Allpa to Yasuní National Park in March or April of 2017. Using both data collected in the 3 weeks of field research from this study and data collected by a Sumak Allpa volunteer, Kaila, during April and May of 2016, certain trends in the troop's activity at the platform can be identified. The most common times for the troop to be active at the platform were between 8:00 and 10:00 AM and 2:00 and 3:00 PM. However, in this study, the platform was observed everyday but the troop was only seen at the platform 7 out of 21 observation days, or 33% of observation days. In Kaila's study, the Yasuní troop was encountered 9 of 17 observation days, or 52.94% of the observation days. This difference in the amount of platform observation may be accounted for in methodologies. In Kaila's study, platform activity was often watched without first finding the troop. In this study, the platform was never watched without first finding the Yasuní troop. It is possible that in this study, the Yasuní troop was at the platform while other areas within the territory were being searched.

In the translocation process, it is necessary to capture as much of the troop as possible so that group dynamics and behavior are not significantly changed when the troop is moved to Yasuní National Park (Vargas, personal communication, 2016). The data from both studies shows that the troop was most commonly observed at the platform between 2:00 and 3:00 PM. However, it was uncommon to observe the majority or entire troop in the platform area during this time. On average, only 7 to 11 total individuals were seen in the platform area and 2 to 6 individuals were seen on the platform structure. However, between the hours of 8:00 and 10:00 AM, the average number of individuals in the platform area was between 20.17 and 27.5 individuals and an average between 6.83 and 10.83 individuals were observed on the platform structure. So while it was more common to encounter the troop at the platform between 2:00 and 3:00 PM, this time slot did not yield many individuals as compared to the next most common time to observe the Yasuní troop at the platform.

Additionally, every time that the Yasuní troop was encountered at the platform area between the hours of 4:00 and 6:00 PM, 21 individuals to the entire troop were present. Individuals were only encountered on the platform structure during this 2-hour period between 4:00 and 5:00 PM with an average between 8.5 and 12.5 individuals. This is a relatively high number of individuals to be on the platform structure in comparison to other time slots. The large number of individuals around and on the platform between 4:00 and 6:00 PM is likely attributed to the proximity of the platform to the Yasuní troop's sleeping location. The Yasuní troop sleeps in a bamboo patch slightly west of the intersection of Huamak and Jatun, close to the platform on the south side of the island. In the evenings, the troop would often travel from the northeast, near the intersection of Huamak and Canela, to this general area. Because the platform is in the general path that the monkeys would take to travel

southwest towards their usual sleeping location, the troop would go to the platform area. The troop congregates during the evening and night to sleep, which accounts for the high numbers of individuals in the platform area. However because this occurs during the evening, most of the foraging and eating is completed for the day, which accounts for the low number of individuals to actually mount the platform during these hours. Additionally, the platform is in a large open and exposed area, which exposes the monkeys to many predators, which creates an unneeded risk at the end of the day.

### *Behavior*

Evaluating the behavioral composition of the Yasuní troop is important in order to assess whether the troop will be able to withstand the stress of the translocation process and act as stable troop in the wild. According to Pinherio et al, *Saimiri sciureus* spend an average of 49.15% of their daily time foraging (2013). In this study, the Yasuní troop spent 47.5% of their time foraging. Additionally, *Saimiri sciureus* spend 28.9% of their time moving and 13.5% eating (Pinherio et al, 2013, p. 303). According to the data collected in this study, the Yasuní troop spent 31.32% of their time moving and 10.25% eating. Comparatively, there is not significant difference between the percentages presented by Pinherio and the behavioral activity of the Yasuní troop.

Additionally, aggressive instances were observed in 9 of the 19 successful observation periods and totaled to 15 minutes of the total 15.42 contact hours. While in terms of overall time aggression is insignificant, the number of instances, totaling to 21 instances and occurring in 47.37% of successful observation periods, aggression is prevalent in the behavior of the Yasuní troop. According to Héctor Vargas, this amount of aggressive instances in *Saimiri sciureus* troops is normal and the Yasuní troop is not comparatively more aggressive than troops in the wild (personal communication, 2016).

When individuals from the Yasuní troop were encountered, they often took interest the presence of a human. Oftentimes, the monkeys would make warning vocalizations and then flee into a denser area of the forest on the approach of the observer. However, individuals also expressed interest in the observer and would spend 1 to 2 minutes observing the human observer. According to Baldwin, the reaction of squirrel monkeys to humans is quite variable (1971). However, because most of the individuals in the Yasuní troop were pets or part of the pet trade before arriving to Sumak Allpa, they are more aware and cautious of humans than wild troops in Yasuní National Park (Vargas, personal communication, 2016).

*Saimiri sciureus* often associate with other monkey species, such as various species of tamarins and capuchins, in order to find better food sources (Zimble-DeLorenzo, 2011). The squirrel monkeys also use these mixed-species associations as a way to avoid predation (Lang, 2006). During the observations for this study, the Yasuní troop was associated with black-mantled tamarins (*Saguinus nigricollis*) for a total of 2 hours and 55 minutes, or 85.38% of the total association time of 3 hours and 25 minutes. During the other 30 minutes of association time, the Yasuní troop was associated with a single male white-fronted capuchin (*Cebus albifrons*). While there is not an estimated amount of time that *Saimiri sciureus* spends associated with other species in the wild, it is reported that *Saimiri sciureus* will maintain associations with capuchins (*Cebus*) for multiple days at a time (Lang, 2006). The Yasuní troop has demonstrated that it is capable of making these associations, however because risk of

predation is much lower and food is more abundant within their territory on the island, there is not as much of a need to make these associations. However, associations were common between the Yasuní troop and *Saguinus nigricollis* when the troop was at the platform. Oftentimes, the squirrel monkeys would wait for the tamarins to mount the platform first, and would then follow suit. The Yasuní troop was associated with tamarins 4 times of the 8 successful platform observations.

## CONCLUSIONS

This study, conducted from November 6<sup>th</sup> to November 27<sup>th</sup>, 2016, served to assess the population, platform activity, and overall behavior of the Yasuní troop in preparation for translocation from Sumak Allpa to Yasuní National Park. The data collected in this study has provided important information that will help inform the team that will aid in the translocation process of this troop.

The population of the troop has proven to be stable with continually successful reproductive behavior. The birthrate and survival rate of the Yasuní troop is healthy for a troop of this size (Vargas, personal communication, 2016). These factors will help the Yasuní troop withstand the stress of relocation. Additionally, the overall behavioral activity of the Yasuní troop indicates that the troop is acting comparably to a wild *Saimiri sciureus* troop. While play and grooming were not observed, these are normally insignificant behaviors in terms of time in wild troops (Pinherio et al, 2013). Overall, the behavioral activity of the Yasuní troop indicates that the troop will be able to survive in the wild.

Finally, the data collected regarding the troop's activity at the platform indicates that the method presented by Stone et al, using a large net below and around the platform structure and trapping the monkeys on the platform but cutting off the exit points is the best option for the translocation process. However, there is not a clear time of day that the troop is most active, with a high percentage of the troop's individuals, at the platform. While there is strong evidence to suggest that peak activity occurs between the hours of 8:00 to 10:00 AM, this is not certain. Because of the delicate nature of the translocation process, it is important to be sure of the time of peak platform activity in order to cause the least amount of stress to the monkeys and capture as many individuals as possible. Additionally, according to Vargas, the Yasuní troop's activity at the platform will likely continue to change in the coming months as they continue to familiarize themselves and become more comfortable with the platform. In order to have a successful translocation process, it is necessary to continue to monitor the platform in the coming months leading up the planned translocation date.

After the Yasuní troop is relocated to Yasuní National Park, the troop will need continual monitoring in order to assess if the translocation process is successful and the troop is able to survive in the wild. Some of the individuals in the troop will have monitoring collars, which will provide Vargas and the Sumak Allpa foundation with such information. With the removal of the Yasuní troop from Sumak Allpa island, it is likely that the other troops of *Saimiri sciureus* will spread out and decrease the amount of territory overlap. This will allow other troops to access the platform and make additional translocation project possible in the future.

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