METHODS FOR CAPTURING WILD SQUIRREL MONKEYS IN A FLOODPLAIN FOREST: A COMPARISON OF TWO TECHNIQUES AND TWO SPECIES

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Abstract

Field studies of primates often require the capture and marking of individuals in order to monitor behavior, health and population parameters. However, there have been few field studies in which squirrel monkeys (genus *Saimiri*) have been successfully captured. Here we report results obtained using two different trapping methods to capture *Saimiri vanzolinii* and *S. cassiquiarensis* in Central Amazonia, Brazil. We constructed 20 trapping stations, each one consisting of a platform containing a pair of Tomahawk traps, which were monitored by camera traps and baited with half a bunch of bananas, daily (at 6:00h and removed at 17:00h), during three months preceding the capture. We captured eight individuals of *S. vanzolinii* in two stations during five days (capture rate of 1.6 individuals/day). We were unable to capture individuals of *S. cassiquiarensis* using the Tomahawk traps; thus, we manually captured the individuals while they were foraging on the ground. To capture them, these individuals were first corralled and then captured with dip nets and leather gloves. We captured twelve individuals in seven days (capture rate of 1.7 individuals/day). We believe that both of these methods can be used for trapping squirrel monkeys, since they take into account the foraging strategies of the species, use of space, the presence of other competitive species such as capuchin monkeys, and the ecological features of the study area.

Key Words: *Saimiri*, trapping methods, Tomahawk trap, primates.

Resumo

Estudos de campo com primatas frequentemente requerem a captura e marcação de indivíduos para monitoramento do comportamento, saúde e parâmetros populacionais. Entretanto, existem poucos estudos de campo em que os macacos-de-cheiro (Gênero *Saimiri*) foram capturados com sucesso. Aqui nós relatamos os resultados obtidos através de dois métodos usados para capturar *Saimiri vanzolinii* e *S. cassiquiarensis* na Amazônia Central, Brasil. Nós construímos 20 estações de captura, cada uma consistindo de uma plataforma contendo um par de armadilhas Tomahawk, as quais foram monitoradas por armadilhas fotográficas e provisionadas com metade de um cacho de bananas diariamente (o qual era colocado às 6:00h e removido às 17:00h), durante os três meses anteriores à captura. Nós capturamos oito indivíduos de *S. vanzolinii* em duas estações durante cinco dias (taxa de captura de 1.6 indivíduos/dia). Nós não conseguimos capturar indivíduos de *S. cassiquiarensis* usando as armadilhas Tomahawk; Portanto, nós manualmente capturamos os indivíduos enquanto eles forrageavam no chão. Para capturar os animais, eles foram encurralados e então contidos com puçás e luvas de couro. Nós capturamos 12 indivíduos em sete dias (taxa de captura de 1.7 indivíduos/dia). Acreditamos que ambos os métodos podem ser usados para capturar macacos-de-cheiro, desde que sejam consideradas as estratégias de forrageio das espécies, uso do espaço, presença de outras espécies competidoras como os macacos-prego, e as características ecológicas da área de estudo.

Palavras-Chave: *Saimiri*, métodos de captura, Tomahawk, Primatas.

Introduction

The trapping and immobilization of primates are sometimes necessary for the collection of biological material, which in turn can be useful to understand the population's health, genetics and behavior patterns. However, the literature contains little information regarding techniques and protocols used to capture wild Neotropical primates (Mitchell, 1990; Glander et al., 1991; Rocha et al., 2007; Stone et al., 2014). In Santa Rosa National Park, Costa Rica, Glander et al. (1991) captured *Alouatta palliata*, *Ateles geoffroyi* and *Cebus capucinus* using a blowpipe and CO_2 gun. The authors emphasized the issue of safety in relation to the capturing method employed, since the only safe body area for darting are the hindquarters. More recently, Rocha et al. (2007) described techniques and trap models for the capture of *Sapajus nigritus*, in three study sites in Paraná, southern Brazil. A large cage trap (2 × 2 ×

3m) was used, with bananas as bait to attract the primates. The process of baiting and habituating the animals to the traps lasted seven months.

Field studies involving the capture of wild squirrel monkeys are even rarer, due to their small body size and, especially, the lack of described and published trapping methods. Mitchell (1990) conducted the first successful trapping effort in Peru, where she trapped 39 individuals of *S. boliviensis*, within eight months. She utilized Tomahawk traps, anesthetic darts and a large cage (2 × 2 × 3 m). The first method, widely used for capturing small and medium-sized mammals, was not very successful because brown capuchins (*Sapajus apella*) would arrive first at the traps. Mitchell (1990) did not recommend the second method, due to the difficulty of aiming for animals high in the canopy and the risk of injury. The large-cage approach was the most adequate at the site, and yielded the highest capture rate. Recently, Stone et al. (2015) captured 21 individuals of *Saimiri collinsi*, with a new method developed by the authors. They implemented a large platform located in a 123.5 m² area enclosed by a green net (3 m high), where several individuals could be captured. However, this method is better suited to capture large groups, but not single individuals.

One of the areas in Brazil where wild squirrel monkeys are being studied is in the region of the middle Solimões River, state of Amazonas, within the Reserva de Desenvolvimento Sustentável Mamirauá (RDS Mamirauá) (Paim et al., 2013). Three *Saimiri* species occur within the reserve: *S. cassiquiarensis*, *S. macrodon* and *S. vanzolinii*. The first two are widely distributed in Amazon; however *S.vanzolinii* has the smallest geographic distribution of any Neotropical primate (approximately 870 km²) and is endemic to the reserve (Ayres, 1985; Paim et al., 2013). *S. vanzolinii* is listed as vulnerable in the IUCN Red List of Threatened Species (Boubli & Rylands, 2008) due to its high degree of endemism and its sympatric distribution with the other two species (Paim et al., 2103). The threats to this species led us to build a sample design to collect biological samples from these species, which would be used to conduct genetic studies and identify hybrids in the *S. vanzolinii* population. Thus, we would need to capture a few individuals of *S. vanzolinii* and *S. cassiquiarensis* from as many groups as possible, over a wide area. Here we describe two methods that were used to capture squirrel monkeys at RDS Mamirauá.

Methods

Study area

Trapping was conducted in the RDS Mamirauá, along the Jarauá river (2°51'7.4''S, 64°57'41.9"W), a channel that is considered the limit of the distribution of *S. vanzolinii* and *S. cassiquiarensis* (Paim et al., 2013). The RDS Mamirauá (1,124,000 ha; Ayres, 1993; Sociedade Civil Mamirauá, 1996) is a *várzea* ecosystem located at the junction of the rivers Solimões, Japurá, and Auatí-Paraná, and is one of the best-preserved regions in the Amazon. The reserve is influenced by variation in river levels between a dry (October to December) and a high water period (May to July) (Pires, 1973; Ramalho et al., 2009). Water level is likely the most important climactic factor in the region (Ayres, 1993), and its annual variation can surpass 12 meters (Junk et al., 1989; Ramalho et al., 2009).

Trapping methods

We constructed 20 trap stations along the Jarauá River: ten located in the range of *S. vanzolinii*, and ten in the range of *S. cassiquiarensis*. Capture stations on the same margin were spaced at least 2 km apart (Fig. 1). Each station consisted of a wooden platform (4–8 m high), each with two Tomahawk traps of 70 × 40 × 40 cm (Fig. 2A). Captures were carried out during the first week of November, 2012 (dry period). Each trap station was baited with five bananas for three months preceding the capture. Bait was placed daily starting at 06:00 h, and removed before sunset, at approximately 17:00 h. During the first month of habituation, the bananas were placed on top of the traps; in the second month, at the entrance of the traps; and in the last month, inside the traps, suspended by a metal hook. The traps were locked open during the habituation period.

We installed ten camera traps (model Reconyx PC800), on a rotational basis among the 20 platforms, in order to monitor primate visitation to the platforms and assess the success of the baiting. Camera trap images were used to determine the frequency of use of the feeding stations during the habituation period and to estimate the probability of capture. Each event detected by the camera was scored as a "visit" when the animal only visited the platform, and, "entry", when the animal visited the platform and entered the trap to obtain the bananas (Fig. 2B). We calculated the frequency of use of the stations during the monitoring period by dividing the number of "visits" by the number of days monitored in each station. In order to calculate the probability of capture at each station used, we divided the number of "entries" by the number of "visits" detected.

After three months of habituation, the traps were unlocked and we initiated the capture. As during the habituation period, we placed the bananas in the morning and removed them at dusk. We checked the stations twice a day (around 10:00 h and 14:00 h) to verify if any animals had been captured. At dusk, after the bait was removed, we closed each trap to avoid capturing nocturnal animals. Once a captured squirrel monkey was found, we removed the trap from the platform and the animal was restrained with a wooden board (Fig. 2C), so it could be anesthetized by a veterinarian. Males were anesthetized with an intramuscular mixture of ketamine+xylazine (15+1mg/kg), whereas the females were anesthetized with Zoletil50© (4.4mg/kg), both given to the lower limb (Araújo et al., 2009; Oliveira et al., 2010; Spolti et al., 2013). After sedation, we collected morphometric data and biological samples. Each animal received a microchip (Microchip Partners©) in the

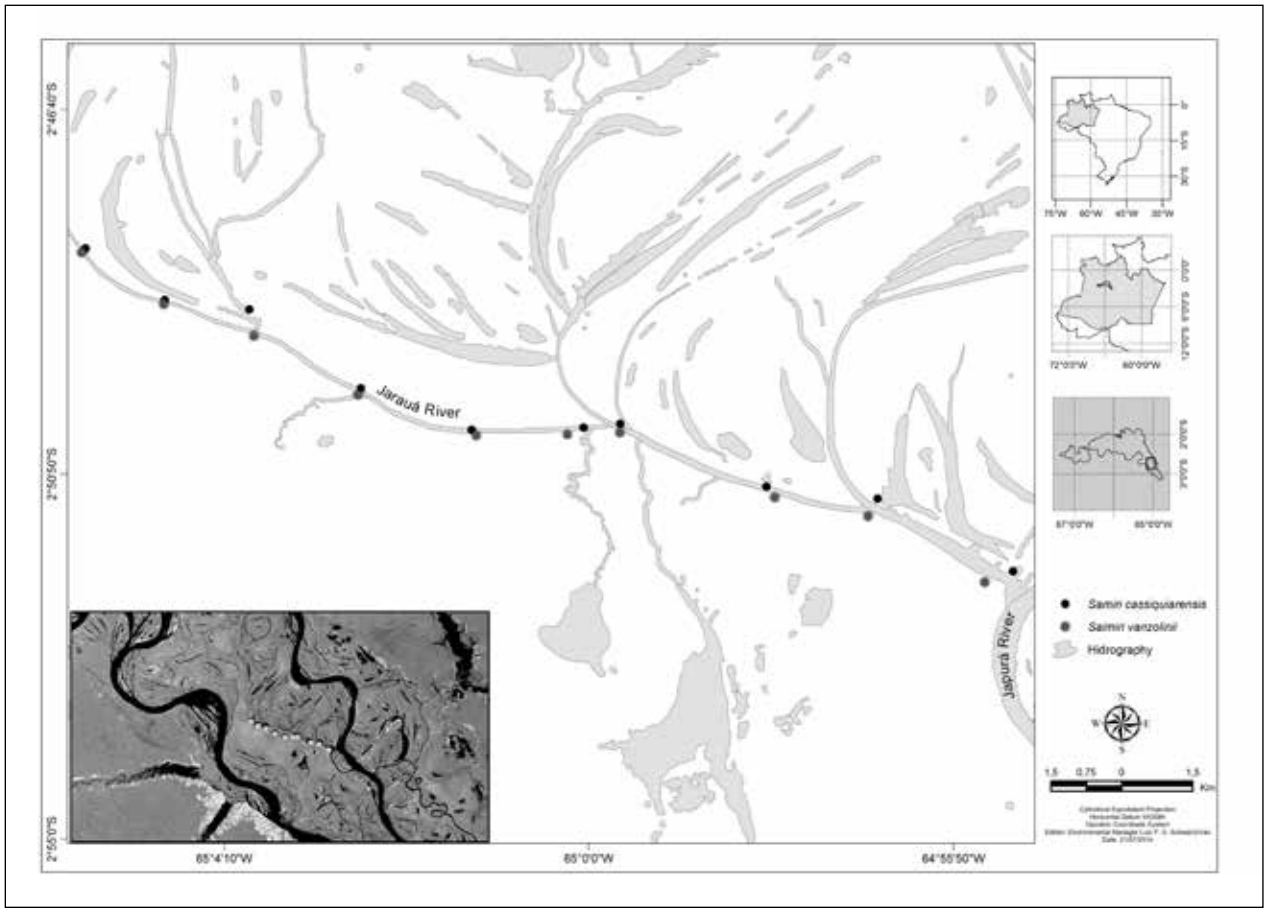

Figure 1. Distribution of trapping stations along the Jarauá River.

subcutaneous space between the shoulder blades. This was done with the purpose of identifying the individual in case we recaptured it. We also shaved the proximal end of the tail of each animal, in order to determine if trapped animals were re-visiting the trapping stations (as monitored by the camera traps). All procedures were conducted at the trapping site; once the animals had recovered, we released them at the same location of capture.

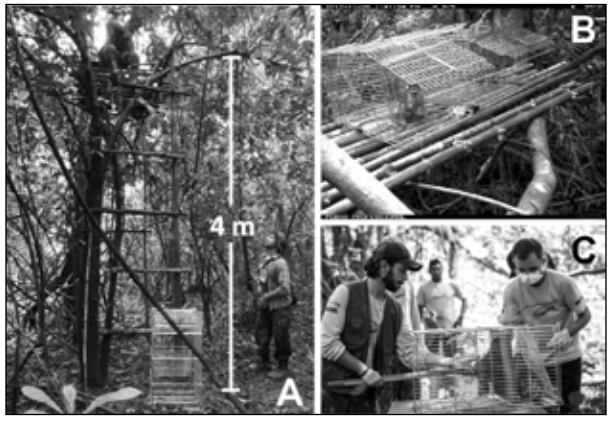

Figure 2. Capture of squirrel monkeys in RDS Mamirauá. (A) Construction of the trapping station; (B) "entry" event of *S. vanzolinii* registered by camera trap; (C) physical containment with the aid of a wooden board. Photos by: Fernanda Paim (A), Projeto Saimiri (B) and Sonia Vill (C).

Since the individuals of *S. cassiquiarensis* did not enter the Tomahawk traps (see Results and Discussion), we had to capture them manually, with the aid of a dip net and leather gloves. All captures were conducted on the margins of the river channels, between the forest edge and the river, while the animals foraged on the ground. Upon seeing a foraging subgroup, two researchers would corner the animals, until an individual was captured. Despite the fact that the animals showed an escape response, we did not observe any aggression toward the researchers. Captures were done as quickly as possible, in order to avoid stress to the other group members, but we avoided abrupt maneuvers that might stress the captured individual. The animals were immediately anesthetized and taken to the research base, near the capture area. The anesthetic protocol was the same as for *S. vanzolinii*. As soon as the animals had recovered from anesthesia, they were released at the capture site.

Results

As we had ten cameras to monitor the 20 stations on a rotational basis, each trapping station was monitored for 34 days with the camera traps. *S. vanzolinii* was detected at three of the stations and *S. cassiquiarensis* at four. However, the species differed in their frequency of use of the stations (Table 1). At the stations used by the species, *S. vanzolinii* visited on average 0.41 of the 34 days, while

Table 1. Capture stations used by *Saimiri* species. "Visit" refers to the events when the animals only visited the platforms without entering the traps. "Entry" refers to the number of events when the animals visited and entered the traps. No individuals of *S. cassiquiarensis* were captured in the trap stations.

Used stations	Visit	Entry	Frequency of use	Probability of capture	# of animals captured
S. cassiquiarensis					
SC2	3	0	0.09	0.00	0
SC4	1	0	0.03	0.00	0
SC9	3	1	0.09	0.33	0
SC10	3	0	0.09	0.00	0
S. vanzolinii					
SV1	29	28	0.85	0.97	4
SV6	12	7	0.35	0.58	4
SV8	1	0	0.03	0.00	0

S. cassiquiarensis visited on average 0.08 of the monitoring period. The probability of capture was calculated for each station and species. For *S. vanzolinii*, the probability was of 0.97 at one of the stations and 0.58 at another. At the third station at which this species was detected, it did not enter the trap. *S. cassiquiarensis* had a probability of 0.33 at one of the four stations used. At the remaining stations used by the individuals, only "visits" rather than "entries" were recorded.

In November 2012, we captured 20 squirrel monkeys: eight were *S. vanzolinii* and 12 were *S. cassiquiarensis*. The eight *S. vanzolinii* individuals were captured at two of the ten stations (four in each station): three adult males, three immature males and two adult females. The eight individuals were captured in five days, with a capture rate of 1.6 individuals/day. Despite the fact that platform construction, baiting and monitoring were conducted in the same manner on both margins of the Jarauá River (i. e. for both species), only *S. vanzolinii* were trapped in the Tomahawks, as predicted by the camera trap monitoring. Then, we manually captured twelve individuals of *S. cassiquiarensis* in seven days (capture rate of 1.7 individuals/day). The animals were captured near four of the ten trapping stations. We captured four adult males, four immature males and four adult females.

Discussion

This trapping effort is the first documented for squirrel monkeys in Central Amazonia. In our study area, both squirrel monkey species showed different patterns of trapping station usage, which could indicate they have different foraging strategies. During the dry season in the *várzea* forests, the ground margins of the river channels are colonized by annual and perennial grasses and terrestrial herbaceous vegetation (Junk et al., 2012). In an ecological study of *S. cassiquiarensis* at RDS Mamirauá, Araujo and Stone (in prep.) observed that the animals engaged in terrestrial activities during 8.6% of observations (5.9% of these were foraging and feeding activities). On the other hand, during six months of systematic data collection also during dry season, *S. vanzolinii* was never observed on the ground (F. Paim, pers. obs.).

Despite reaching our objectives with a satisfactory capture rate, it is possible that the visits of *Sapajus macrocephalus* to the stations (0.74 in the area of *S. vanzolinii* and 0.21 in the area of *S. cassiquiarensis*) led to a lower capture rate than expected. As discussed by Mitchell (1990), capuchin monkeys are a potential competitor for food, and their presence may have inhibited the use of the stations by squirrel monkeys. On the other hand, we highlight that this method may also be efficient for trapping capuchin monkeys in the future.

In October 2013, we replicated our methodology in another area of RDS Mamirauá, to capture *S. vanzolinii* and *S. macrodon* individuals, also within the limit of their geographic distributions. We captured nine individuals of *S. vanzolinii* and eight of *S. macrodon* in three days, with capture rates of 3 and 2.7 individuals/day, respectively. All animals were captured using Tomahawk traps. The capture rate for *S. vanzolinii* was almost double that of 2012. Both expeditions (in 2012 and 2013) were carried out during the dry season with different capture rates, which indicates that efficiency of the trapping techniques for congeneric species may vary among areas due to their particular ecological conditions.

Management implications

Trapping wild primates is essential to access information about population's health and genetics and has implications for conservation medicine. Efficient described methods are particularly important when the species of interest is endemic or prone to extinction, as *S. vanzolinii*, and require prompt management measures. We believe that our

Tomahawk trapping technique may be efficient, as long as certain factors are considered. Capture techniques for squirrel monkeys must be carefully evaluated, considering the risks to the animals, research objectives, and number of individuals and groups to be captured. Factors such as the species' foraging patterns, spatial use patterns, presence of competitor species and characteristics of the study area can affect the efficiency of the trapping methodology, and must be considered when planning a trapping expedition.

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