

Factors influencing establishment success in reintroduced Black-faced spider monkeys *Ateles chamek*

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10 Abstract

Establishing reintroduced primates in a suitable predetermined area has proven to be a challenge. Establishment is the first major step that has to be taken in the long process of reintroduction. When this first goal is not achieved, the chances of success decline drastically. Understanding the main determinants of establishment is therefore crucial for reintroduction success. This study examined the influence of three independent factors on the establishment success of reintroduced spider monkeys. We analysed data from the releases of eight groups of black-faced spider monkeys (*Ateles chamek*), which are part of the official reintroduction program of spider monkeys in the South Eastern Peruvian Amazon. Establishment success was measured by the proportion of individuals within groups that were found in the target area six months after release. The hours research assistants and volunteers spent with the group within the first three months after release – in the context of post-release monitoring – was shown to have a ~~strong~~ positive effect on the establishment success of the released group in the target area. The presence of an already established group in the area was found to have also a significant positive effect on establishment success. The influence of the days of post-release food provisioning had no effect. Our findings emphasize the importance of long-term monitoring programs to help increase the efficiency of primate reintroductions.

Keywords Establishment, post-release monitoring, primates, reintroduction, release, spider monkey

Introduction

Species reintroduction is known to be a very costly, labour-intensive and time-consuming conservation method (Sarrazin & Barbault, 1996). Despite these costly investments, a large number of reintroduction programs have had poor outcomes (Konstant & Mittermeier, 1982; Griffith, et al., 1989; Grey-Ross, et al., 2009) and only few turned into conservation success stories (Kierulff, et al., 2012). Reintroduction success or failure depends largely on two phases: establishment and persistence. Success will ultimately be determined by the persistence of the population, but to reach this phase a population first has to get established. This establishment should happen in a suitable area that will then function as part of their home-range. This is often the most difficult step in the process as elevated mortality and dispersal are common during the initial stage (Parlato & Armstrong, 2013). Dispersal results in a number of problems (Richardson, et al., 2015), often including the inability to conduct post-release monitoring. This is an essential, but often forgotten, part of reintroduction that is crucial to understanding the complexities of species reintroduction (IUCN/SSC Re-introduction Specialist Group, 2002; Seddon, et al., 1999) and improving animal reintroductions success (Park, et al., 2021; Steiner-Bernardo, et al., 2011).

The black-faced spider monkey, *Ateles chamek*, is considered Endangered on both the IUCN Red List (Alves, et al., 2020) and the national Red List of Peru (Cornejo, et al., 2018). Reintroduction programs can play an important role in the protection of this species (Kierulff, et al., 2012). In southern Peru, the species went locally extinct in the lower Madre de Dios area within the Tambopata region due to increasing anthropogenic activities. The Tambopata National Reserve management plan of 2004 - 2008 (INRENA, 2003) reports the local extinction of the black-faced spider monkey within this particular area and this species' absence in the area was confirmed in a study by Rosin & Swamy (2013), but Swamy (personal communication, December 17, 2020) estimates the species disappeared from the region between 1980 and 1990. The Peruvian government created the Tambopata National Reserve in 2000 as a response to the increasing anthropogenic pressure and the accompanying loss of biodiversity in the region. The protection the reserve brought to local fauna and flora, together with the overrepresentation of black-faced spider monkeys in zoos and rescue centres throughout Peru due to confiscations from the illegal pet trade, allowed a context in which reintroduction was a feasible conservation option. More importantly, it has shown that the absence of large primates, such as black-faced spider monkeys, influence the structure and diversity of the forests in this region over time (Bagchi et al. 2018). The primary objective of this program is therefore the restoration of ecological processes through the reintroduction of a keystone species.

This study analyses the effect of post-release food provisioning, the presence of resident conspecifics at the release site and post-release human presence/support within the first three months after release on the establishment of reintroduced spider monkeys within the first 6 months after release. The factors that play a role in the establishment of reintroduced spider primate groups have been rarely investigated. We believe our experiences and the results of this study could provide important information for future primate reintroduction efforts.

70 **Methods**

Since 2010, eight different groups of black spider monkeys have been released within the Tambopata National Reserve with mixed results (Table 1). All the released individuals have a history as a pet. They were either confiscated by the government from the illegal pet trade or were voluntarily handed over to the Taricaya Rescue Centre by people who kept them as pets, but were no longer able/willing to take care of them. They went through an extensive rehabilitation process at the Rescue Centre, before being incorporated into the reintroduction program (Bello et al., 2012). During the rehabilitation process, all individuals underwent extensive veterinary controls to exclude the risk of any zoonotic diseases related to human interaction spilling over to other wildlife. Furthermore, behavioural evaluations were conducted to obtain a better understanding of the intragroup dynamics and relationships before release.

Each release took place in the presence of local authorities to ensure proper protocols were followed and coincided with the start of the rainy season, when there is more food available in this type of forest (Medina, 2009). Additional food was only supplied during the first few days/weeks after release if the post-release monitoring had shown that the released individuals were struggling to find enough to eat. The aim of this post-release monitoring program was to check the overall wellbeing of the animals through observations and the collection of behavioural data to evaluate the adaptation process. This allowed us to recapture individuals in case they are unable to adapt to their new surroundings, separate from the group or show issues related to their health. The intensity of the monitoring program varied between groups, depending on the available funds for that particular year, but ideally aimed to track and monitor the released individuals on a daily basis for the first month after release and at least once a week until the third month. The frequency was further reduced to sporadic monitoring of the group after the third month of release. Telemetry equipment VHF (TelenaxTM) and radio collars (TXE-311CB) were used to facilitate tracking the groups (Trayford & Farmer, 2012) released in 2013, 2014, 2016, 2017. Due to a lack of funding, we were unable to use these materials for the releases in 2018 and 2019.

The reintroduction zone is located within the historical distribution of the species and consists of seasonally flooded primary subtropical wet forest according to Holdridge life zones system (Holdridge, 1967). It is situated within the Tambopata National Reserve and its buffer zone, within the following coordinates: 12°32'11.882" S, 69°00'14.227" W. The different release sites were placed as far away as possible from any human settlement or activity, but within reasonable distance from the rescue centre to maintain the feasibility of the post-release monitoring. They also had to be located within either the limits of Taricaya Ecological Reserve or Tambopata National Reserve.

In order to investigate our questions, we ran a Generalized Linear Model (GLM) with a binomial probability distribution and logit link function using the proportion of individuals within the group that remained in the target area 6 months after release as the response variable and hours of post-release monitoring during the first 3 months, days of post-release food provisioning, and presence of resident groups in the release area (present/absent) as predictors.

The intensity of post-release monitoring was measured as the total number of hours field researchers/assistants/volunteers spent with the released group within the first three months after release (Table 1). These hours had to be logged by staff and volunteers. Days of food provisioning was measured as the number of days additional food was provided to the group after release (Table 1). The presence of resident groups in the release area was determined by whether the release site fell within the estimated home range of an already established reintroduced group (Table 1). These home ranges or territories of previously released groups were estimated by taking GPS points every 30 minutes during the post-release monitoring program of a group, and placing a buffer of 30m around these points in ArcGIS (source).

Results

In total, 8 groups, involving 32 individuals and 43 releases have taken place over the years. The number of individuals and releases is not the same due to the fact that issues related to the health of some individuals (broken limbs after falling out of trees) or adaptation problems (individuals that remained on the ground instead of in the trees) led to the recapture of these individuals. They were then released again the following year, with the next group. 41.8% of the releases were successful, meaning they remained in the target area for at least 6 months after their release.

The model indicates that the post-release monitoring hours had a significant effect on the proportion of individuals per group establishing themselves successfully within the area 6 months after the release, with this predictor increasing of 1.001 the odds for a successful re-introduction. The presence

of an already established group at the release site showed also a significant positive effect on establishment success, with this predictor increasing of 1.608 the odds for a successful re-
130 introduction. The days of food provisioning were found to have no significant effect on the establishment success (Table 2).

Discussion

The analyses showed that the intensity of the post-release monitoring has a significant positive effect
135 on the establishment success of reintroduced spider monkeys (Table 2). A possible explanation for this result is the fact that the vast majority of these released spider monkeys were raised as pets in a captive setting, meaning that their strongest social bond growing up was not with another spider monkey, but with a human on whom they depended for food and protection. Even though all these individuals went through a long process of rehabilitation, this is unlikely to transform a pet into a
140 wild animal within a captive setting -in this case a rescue centre. This continued dependence on humans becomes problematic during releases, as this is a very stressful period for the animal (Meyer & Hamel, 2014) that can no longer rely on humans for their basic needs. Individuals will often disperse within the first days or weeks after release as a stress response to their new environment (Dickens, et al., 2010) and they often end up finding their way back to the rescue centre. This is also
145 why, at least in our experience, it is important to have people with the released individuals during these first weeks after release. The monkeys tend to stay around the release site in those first days and weeks as long as there is a human presence at site with them. This is especially true for people ~~that~~ the released individuals are familiar with. This seems to give them a bit more confidence during a stressful period where everything is new to them.

150 It is also important to note that upon reaching adulthood, females may disperse naturally in search of a new group to ensure genetic diversity within the population (Shimooka et al.,2008). On the other hand, male immigration may also occur under certain demographic circumstances, but is less common as they generally stay within their natal groups (Aureli et al., 2013). This tendency of a higher probability of female dispersion in comparison to males was not observed in this study, as females
155 were found to be less likely to disperse within the first 6 months after release than males. This could be related to the females displaying a stronger social bond between them than males during pre-release observations.

The fact that the presence of an already established group gave a significant positive result (Table 2) is more complicated to explain. Clearly, this factor is important in our model as the odd ratio indicates
160 an effect size stronger than post-release monitoring. The groups released in 2013 and 2014 seemed to

benefit from the presence of an already established group that may facilitate their adaptation process, as regular fusion events were observed with the group released in 2011, especially during feeding and foraging bouts. However, we also witnessed intergroup aggression from the already established group towards newly released individuals in 2016 and 2017, complicating their chances of successful establishment. Intergroup aggression is well documented in spider monkeys (REF). On one hand, the observation that some newly released groups were received with a welcoming attitude than others is probably related to the group composition, as resident adult males will be more likely to conduct aggressive behaviour towards other released adult males than to females or juveniles (Valero, et al., 2006). On the other hand, groups that were in close contact with each other in the rescue centre before release are already more accustomed to one another and appear less likely to conduct aggressive behaviour when they encounter each other after release, as was the case for the groups released in 2011, 2013 and 2014. It is therefore important that post-release monitoring in the future takes place and more data can be obtained to confirm the importance of this variable.

It is important to note that there are many more different variables that may have an influence on an individual successfully establishing itself in a predetermined area (Parlato & Armstrong, 2013). For example, Bello et al (2018) showed in a preliminary study that the conditions under which the release and the post-release monitoring are conducted have an influence on the establishment success of these spider monkeys. Nonetheless, there have been releases where the conditions of the release and post-release monitoring were more than adequate, but not successful (as was the case for the release in 2013). This shows that each individual's response to release is different and that factors related to life history are also affecting primates in their establishment (Cheyne, 2009). Furthermore, predation can play a significant role in the successful establishment of a group. For example, both the groups released in 2011 and 2013 suffered losses from predation by harpy eagles *Harpia harpyja*, which are known predators of spider monkeys (Everton, 2018).

Our findings emphasize the importance of post-release human presence/support on the success of primate reintroductions and the presence of resident groups in the release area, although this should be viewed within the context of this specific reintroduction program where the released individuals have a history as a pet. We acknowledge the limitations of our study due to the small sample size and therefore underline the importance of a thorough post-release monitoring program. This will provide the scientific community with more data and will aid reintroduction programs in their decision-making process, which in turn will help increase the efficiency of these programs.

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