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SQUIRREL MONKEY (*SAIMIRI SCIUREUS*) REHABILITATION IN FRENCH GUIANA: A CASE STUDY

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Introduction

Rehabilitation can be an effective conservation tool (Kleiman, 1989). Although controversial (Soave, 1982; Harcourt, 1987), some experiences are undoubtedly positive (Rijksen, 1974; McGrew, 1983; Dillon Morin, 1994; Nogueira *et al.*, 1994; Ades, 1998; Harding, 1998). One of the difficulties of rehabilitation attempts is the lack of available referenced case studies, whatever their success. Since the late seventies, the Pasteur Institute of French Guiana has used the squirrel monkey (*Saimiri sciureus*) as an experimental model for the study of human malaria. In addition to the captive colony, the Institute managed an island where 150 wild monkeys originating from French Guiana and Suriname were introduced in 1981 (de Thoisy and Contamin, 1998). To date, the resident population totals approximately 100 animals (de Thoisy *et al.*, 2002). The initial aim of this study, requested by the manager of the colony of the Pasteur Institute, was to conduct a rehabilitation experiment with a group of common squirrel monkeys in order to assess the reliability of this management option for unwanted individuals, either post-experimental or old breeders.

Basic recommended rules, as indicated for any primate transfers (Konstant and Mittermeier, 1982), concern (i) *the release area*: suitability of the habitat, availability of feeding resources for both the resident population and the introduced animals, (ii) *the candidate animals' potential for successful rehabilitation*: ability to support the inherent stress, ability to feed according to needs, and (iii) *the release protocol*: methodology, accounting for ecological features such as seasonality and phenological patterns (for instance, fruiting patterns in the area). Since optimal conditions were indicated for this case study, this attempt also aimed to contribute to the knowledge of the ability of primates to be rehabilitated.

Methods

The release area was a 56-ha island offshore from Cayenne (4°54'N, 52°12'W), French Guiana. The island is covered with dense secondary forest. The resident squirrel monkey population was studied prior to the release (de Thoisy *et al.*, 2002) and is organized in four permanent troops, each comprising 23 to 25 individuals. No other primates are present, nor any perceived competitors and predators of the squirrel monkeys.

Rehabilitation protocol: The release animals
A group of 14 monkeys was formed, consisting of post-experimental and old breeders. The group included three males and nine females, two of them pregnant. Males were born in the colony from wild-born parents and were 9 to 12 years old; six of the females were wild-born (they had been caught in the wild between 1986 and 1988, for the establishment of the colony); the others were captive-born.

Rehabilitation protocol: Chronology
November 1998 to February 1999: the 14 animals were put together in an isolated cage in the Pasteur Institute colony. During this period, the two pregnant females gave birth. Monkeys were fed with their customary pellets.

February 1999 to May 1999: the monkeys were transferred to the island, and maintained in a large enclosure (6 m x 4 m x 4 m) in an area unoccupied by resident monkeys. There were small trees in the cage. During the first two months, monkeys were fed *ad libitum* with pellets, fruits from the forest and insects. During the following two months, artificial food was reduced. To train the squirrel monkeys, food was irregularly thrown in the cage, and artificial sprinkling reproduced rain. The scan-sampling method (Altmann, 1974) was used to assess their behavior, for a total of 78 hrs of observation.

May 1999: the enclosure was opened. Follow-up observations lasted 15 weeks (247 hrs). The following behaviors were noted: feeding, foraging, rest, locomotion, and social interactions. Feeding items were: fruits, flowers, insects, and leaves. Ranging was recorded by noting the individuals' presence in ¼-ha grid cells. Vertical use of the forest was recorded by height categories: level 1 - ground, level 2 - less than 3 m high, level 3 - from 3 to 10 m, level 4 - 10 to 20 m, and level 5 - upper canopy.

Results

First stage: Prior to release
As soon as the troop reached the enclosure on the island, strong differences were noticed between wild- and captive-born monkeys. For example, captive-born monkeys feeding mainly on pellets, spent 40% of their time foraging, *vs.* 65% for wild-born, which fed much more on insects. In the same way, the captive-born animals spent over 70% of their time on the ground *vs.* only 25% for wild-born. During the two months in this cage, no improvement was observed in captive-born monkeys, and two males died from starvation. By contrast, the wild-born monkeys continuously increased their locomotion and foraging efficiency.

Second stage: Post- release
Behavioral differences increased between the wild-born and captive-born monkeys. After one month, captive-born individuals were feeding on the ground on fallen fruits and leaves, and mushrooms. The wild-born animals, on the other hand, increased their diet diversity. For instance, only one fruit species was consumed during the first week, four after the second week, and nine after six weeks. They became increasingly efficient in their foraging and hunting of arthropods, larvae, bird's eggs, and lizards, and in approximating the foraging patterns observed in the residents (de Thoisy *et al.*, 2002; F. Bayard *et al.*, unpubl. data).

While wild-born monkeys spent 75% of their time in the upper levels, the captive-born spent only 47% of the time up to 10 m high, and during 25% of the activity time they were on the ground. No progress was perceptible in their feeding behavior. After one month, the decision was taken to stop the re-introduction of the captive-born section; the animals were caught and brought back to the colony. The study then focused on the wild-born monkeys which remained. During the two first months, the group exhibited an intense exploratory behavior resulting in the regular use of 7 ha; during the second part of the follow-up, their range size remained stable at 9.5 ha for the entire study period.

Contacts with resident squirrel monkeys were rare, and recorded only 12 times during the 15 weeks of follow-up. Although no aggressive interactions were observed, we believe that a male of the re-introduced group was killed by residents. In the 11th week two males which came from the resident population entered the rehabilitated group.

Discussion

Release of captive primates in the wild, once accepted for conservation (see for instance Beck *et al.*, 1991), political, or ethical reasons (Harcourt, 1984), has to deal with a number of problems. They include certifying the suitability of the habitat and making sure it is protected (Konstant and Mittermeier, 1982), besides training to give the animals the necessary skills to live in the forest. The use of islands may help to increase the success rate of rehabilitation (Agoramoorthy and Hsu, 1999). In our case, previous studies confirmed the suitability of the release site (de Thoisy *et al.*, 2002) in terms of the habitat and the lack of predators (Beck *et al.*, 1991). The two main difficulties facing the squirrel monkeys were the search for food, and the necessary socialization to form a coherent group (Rijksen, 1974; Kessel and Brent, 2001). In our study case, the pre-release period was long, and we focused on these two critical points: we conclude that our protocol and methods allowed for a successful rehabilitation of the wild-born females and their offspring. Their capacity to locate feeding resources and forage efficiently reemerged successfully despite 10 to 15 years spent in captivity. The status of the reproductive

females may also have contributed to this success, allowing these introduced animals not to be rejected by residents (Agoramoorthy, 1995). After four months, however, the diet diversity was still lower than that of the residents, and the home range was smaller (de Thoisy *et al*., 2002), but the constant improvement in their ranging and foraging, and the fact that two resident males had entered the group, allow us to predict an optimistic outcome.

By contrast, the rehabilitation attempt was definitively a failure for the captive-born individuals. Despite the fact that they were in a group with wild-born animals, their incapacity to learn from them was notable. Aveling and Mitchell (1981) emphasized that a captive existence in the infant and early juvenile stages severely restricts the chances of learning to adapt fully to a free-ranging life. Greater efforts may be required, but costs of such rehabilitation programs may be incompatible with their effectiveness in conservation terms.

This experiment showed that (i) with current procedures, rehabilitation cannot be considered as a management option for the captive-born component of the colony; (ii) at least in the case of such a highly adaptable species as the common squirrel monkey, rehabilitation can be surprisingly successful for wild-born animals, with an adequate training pre-release period, knowledge of the release area and knowledge of the ecoethological patterns of the resident population; (iii) even with optimized conditions, primate rehabilitation has its own limitations: costs and conservation relevance have to be evaluated and confronted prior to undertaking such controversial and risky programs.

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News

The 2002 IUCN Red List of Threatened Species

In the wake of the World Summit on Sustainable Development, with the state of the environment fresh in the minds of the global community, on 8 October, 2002, IUCN released its updated Red List of Threatened Species, one of the key tools used to determine the status of the Earth's biodiversity. It marks the first of what will be annual updates to the List. The figures will change each year as new species assessments are included, currently-listed species are re-assessed, and species undergo taxonomic revisions. An information package is available on the SSC website <iucn.org/themes/ssc> in English, French and Spanish, including a news release outlining several significant additions to the Red List and notable shifts in status.