

Assessment of restocking blue-fronted Amazon (*Amazona aestiva*) in the Pantanal of Brazil

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RESUMO. O programa de repovoamentos de papagaio-verdadeiro (*Amazona aestiva*) no sul do Pantanal, MS, Brasil. Cerca de 30% dos psitacídeos das Américas estão ameaçados ou apresentam populações em perigo devido a desmatamentos, queimadas e tráfico ilegal de animais ou ovos. O papagaio-verdadeiro (*Amazona aestiva*) é o psitacídeo mais capturado do mundo e é a espécie mais freqüente nas apreensões efetuadas pelas autoridades no Estado de Mato Grosso do Sul. Os animais apreendidos são encaminhados ao Centro de Reabilitação de Animais Silvestres (CRAS), e muitos deles são repovoados em habitats naturais. Entretanto, o monitoramento dos animais soltos foi incipiente até este estudo e não forneceram dados suficientes para se determinar o sucesso ou fracasso do programa de repovoamentos. Neste estudo, testamos a radiotelemetria como um meio de monitoramento dos papagaios repovoados e provemos informes dos custos do programa de repovoamentos. O programa custa para o Estado uma média de US\$11.000 por ano ou US\$ 55 por papagaio, considerando os salários básicos de MS, excluindo os gastos com a fase de monitoramento. Estes custos podem chegar, em média, a cerca de US\$ 36.000 por ano ou US\$ 180 por papagaio, com base em salários internacionais. A radiotelemetria custou cerca de US\$ 2.190 por papagaio (salários básicos de MS), durante 13 meses de monitoramento, que representa 14,6 vezes mais do que observações diretas intensivas (aproximadamente US\$ 150 por animal). Entretanto, os dados resultantes de observações diretas não permitiram a estimativa da área de vida dos papagaios após a dispersão. As taxas de sobrevivência dos papagaios não foram limitantes no programa, já que cerca de 60% dos papagaios sobreviveram pelo menos 13 meses após a soltura. Contudo, os papagaios repovoados se comportaram de uma maneira diferenciada voando em um único grupo e, em geral, ocuparam áreas muito menores (<1 – 32 ha) que as de papagaios selvagens. Estudos futuros a cerca da eficiência de programas de repovoamentos de papagaios-verdadeiros devem relacionar as áreas de vida dos animais soltos com sua habilidade de encontrar alimento e, eventualmente, de reproduzir.

PALAVRAS-CHAVE: papagaio-verdadeiro, *Amazona aestiva*, repovoamento, Psittacidae, Pantanal.

ABSTRACT. Parrots are among the most threatened or endangered birds in the world, including approximately 30% of the American species. Deforestation and the illegal trade in animals are the main causes for the status of these birds. The Turquoise-fronted Amazon (or Parrot, *Amazona aestiva*) is the world's most sought after and captured bird for illegal trade, and is the species most commonly rescued by the authorities in the Brazilian state of Mato Grosso do Sul. Captured animals are sent to the Wild Animal Rehabilitation Center (*Centro de Reabilitação de Animais Silvestres*, CRAS), and many of them are returned to their natural habitats. Monitoring reintroduced birds is still in its early stages in Brazil and so does not provide data to test the efficacy of the reintroductions. Thus, this study was undertaken to examine radiotelemetry as a viable means by which reintroduced parrots can be followed and their survival and reproduction monitored. We also provide an estimate of costs associated with this methodology. This program cost the state an average of US\$11,000 per annum, or US\$55 per parrot, the sum of which was calculated based on local costs and salaries. When calculated based on international rates the costs could reach US\$36,000 per year, or US\$180 per parrot. Radiotelemetry cost US\$2,190 per parrot over (MS-salary basis) over 13 months of monitoring, 14.6 times the cost of direct observations (~US\$150 per animal). While cheaper, direct observations do not provide data that permit an estimation of the home range of the birds after dispersal. Survival rates of released parrots was apparently high, with ~60% of the parrots surviving the 13 months of the study. Released parrot behavior is apparently quite different than that of wild parrots, in that they remained in one group, and occupy a smaller home range (<1 to 32 ha). Future studies of the releasing program should examine home ranges, food availability and reproduction of released parrots.

KEY WORDS: Blue-fronted Amazon, *Amazona aestiva*, restocking, Psittacidae, Pantanal.

About 30% of the 140 parrots from the Americas, present threatened or endangered populations (Collar and Juniper 1992). The decline of these populations can be attributed to deforestation, excessive burning land and illegal trade of live animals or eggs, which frequently lead to the destruction of the nest (Beissinger 1994).

Brazil is the richest country in the world for parrots with 69 species (Sick 1985). Thirteen of these species are under threat of extinction (Bernardes *et al.* 1990) and 24 species may be seen in the Pantanal wetland (Coutinho *et al.* 1997).

The Blue-fronted Amazon (*Amazona aestiva*) is the most frequently captured parrot in the world, for the pet trade (Beissinger 1994). Until the end of the 1970s, these animals were captured in small numbers, but this demand has drastically increased in the 1980s. Argentina, for instance, exported about 5,000 Blue-fronted Amazons in 1981, 30,000 between 1981 and 1987 (Beissinger 1994), and about 23,000 in 1991 (Traffic USA 1991). However, the official export quotas of Blue-fronted Amazon has stabilised to about 1000 per year during the late 1990s (Traffic USA 1996, Traffic North America 1998).

From 1988 to 1997, about 2,000 Blue-fronted Amazon nestlings were seized by police in Mato Grosso do Sul. However, this number may represent only a small portion of the birds taken from their nests. Animals seized by police were sent to the Wild Animals Rehabilitation Centre (CRAS), where they received special care. Then, many of these animals were released in areas where they were known to occur (repopulating or restocking, IUCN 1987). Until this study, animals were not monitored after release.

The aims of this study were to check the efficacy of the restocking program in the south of the Pantanal, to assess the feasibility of using radiotelemetry to monitoring the restocked parrots and to describe handling techniques in captivity and post-releasing adaptive processes employed by CRAS.

METHODS

Study area. This study was carried out in the Caiman Ranch surrounding areas, an area of about 80,000 ha in the southern Pantanal, Mato Grosso do Sul state, Brazil ($19^{\circ}51' - 19^{\circ}58'S$ and $56^{\circ}17' - 56^{\circ}24'W$). This area is located in the Pantanal of Miranda (Hamilton *et al.* 1996, figure 1) in the Paraguayan River Basin and constitutes a mosaic of floodplains, grasslands, savanna, scrub savanna, arboreal savanna, forests of riparian vegetation and man-made pastures (Pott 1997, Abdon *et al.* 1998). The dominant soils are classified as “planosolos” in the Brazilian classification, which means that a superficial layer of eutrophic sediments, containing high amount of clay is deposited on a sandy layer. The average temperature ranges from 18° to $30^{\circ}C$. Rainfall averages 1,200 and 1,400 mm. The dry season occurs from April to October and the rainy season from November to March.

The main economic activities in the study area are beef cattle raising, sometimes accompanied by removing native vegetation and introducing exotic grasses, as well as burning fields to clear and renew the pasture. Ecotourism is also a significant industry.

Pre-release Handling. To examine restocking efficacy, we chose at random 36 nestlings out of 200 animals sent to CRAS in September 97. These animals were marked with numbered tags and monitored for 4 months. During the first four weeks they were kept in small heated boxes, coated with sawdust and fed three times a day. Their diet consisted of crushed fruit and vegetables, mixed with cooked corn meal and given with the help of a spoon. Gradually the liquid diet was replaced by whole fruit and vegetables as well as seeds and grains. After their complete feathering, they were taken to an enclosure ($2.5 \times 2.5 \times 2.5$ m) subjected to environmental climatic conditions. In the last month they were taken to a larger enclosure ($5 \times 20 \times 5$ m) so that they could fly. This enclosure was equipped with perches, creeping vegetation, suspended drinking troughs and feeding stations placed on the ground.

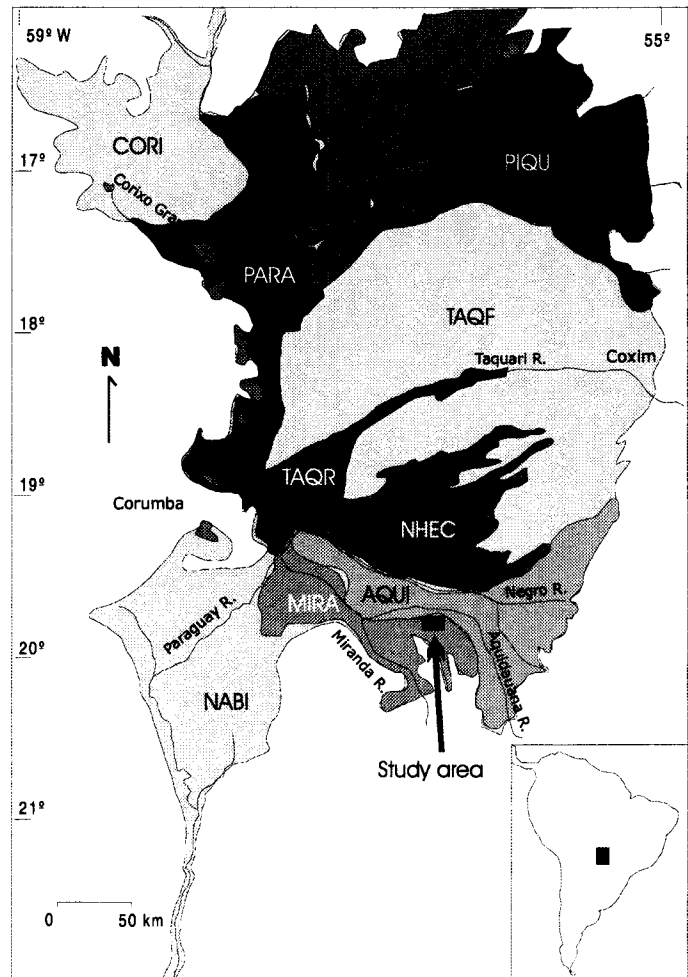


Figure 1. Pantanal map showing major rivers and boundaries of Hamilton's subregions (after Hamilton *et al.* 1996). The arrow points out the location of the study area ("Refúgio Ecológico Caiman"). Subregions are: (CORI) Corixo Grande, (CUIA) Cuiaba, (PIQU) Piquiri/São Lourenço, (PARA) Paraguay, (TAQF) Taquari Fan, (TAQR) Taquari River, (AQUI) Aquidauana/Negro, (MIRA) Miranda, (NHEC) Nhecolândia and (NABI) Nabileque.

During the time these parrots stayed at CRAS, they did not have any contact with other species – birds or mammals. Before they were released they were submitted to several macroscopic exams and a blood test to determine their sex. The feathers of their tails were dyed to ease their identification after being released in the wild.

Post-release Handling. A covered trough with perches was built to protect and preserve the parrots' food and water, at a local of easy access for food restocking. In January 1998, 36 parrots (23 males and 13 females) were released, in two groups of 18 birds, in the surrounds of this trough. During the first five weeks, food was offered once a day, always in the morning (07:30). After this period, it started being offered every other day (three weeks) and after that, every three days (two weeks) until no food was offered. Their diet consisted of fruit, vegetables and seeds, which were offered in small amounts to encourage them to search for food in nature. Once food

was no longer provided, the parrots were counted to see how many of them remained in the area. This was done at the beginning and end of the day, when the animals were active. At the time they were counted, it was possible to register the geographical coordinates, time and day, size of the group, patterns of activity and, usually, a visual evaluation of their physical condition.

Installation of radiotransmitters and tracking. Six of the 36 released birds were equipped with radio transmitters, being four males (R1, R3, R4 and R5), and two females (R2 and R6). The transmitters were acquired from HOLOHIL Systems S.A. (Canada), following the specifications recommended for use in parrots (Meyers 1996). Transmitters consisted of a small steel collar with antenna (whip type) weighing nine grams, and a battery designed to last for 12 months.

For tracking, a TELONICS receptor (TR4 with scanner) was used with a portable directional antenna. Tracking was carried out at the best reception time of the signal (6-10 AM. and 4-7 PM.). On average, each trip covered 150 km in the study area by a 4x4 truck, boat, and on foot. An overflight was carried out for aerial tracking in May 1998, in 10 km long transects, covering about 2,500 km².

Animals were located by visualisation (with the help of 10x50 binoculars) or triangulation. Every time a parrot was located, its geographical coordinate, date, hour and size of the group was registered, as well as its physical condition and activity.

Home range was calculated as a minimum convex polygon, using the software MACPAAL (version 1.2.), developed by Stuwe and Blohowiak (1985) and maps were plotted with a Geographic Information System.

RESULTS

The CRAS' restocking program. From 1988 to 1998, CRAS received 1,853 individuals of Blue-fronted Amazon (*A. aestiva*), 31 orange-winged parrots (*A. amazonica*), 25 yellow-faced parrots (*A. xanthops*), one mealy parrot (*A. farinosa*) and one yellow-crowned parrot (*A. ochrocephala*). Most of these parrots were seized by the authorities (85%), but some of them (15%) were spontaneously turned in by the local people. About 85% of the parrots were at the early stage of feathering and remained at CRAS for 6-12 months. About 43% of all parrots were restocked in natural habitats, and the other 57% were sent to zoos or died.

Radiotelemetry. Parrot R1 flew several directions soon after release, covering a life area of approximately 1,600 ha during the first eight weeks (figure 2). The bird was seen alone in the morning (8-10 AM), eating fruits of "embaúba" (*Cecropia pachystachya*) at the border of a forest patch. Its life area included pastures, scrub savanna, and arboreal savanna. After eight weeks, it disappeared.

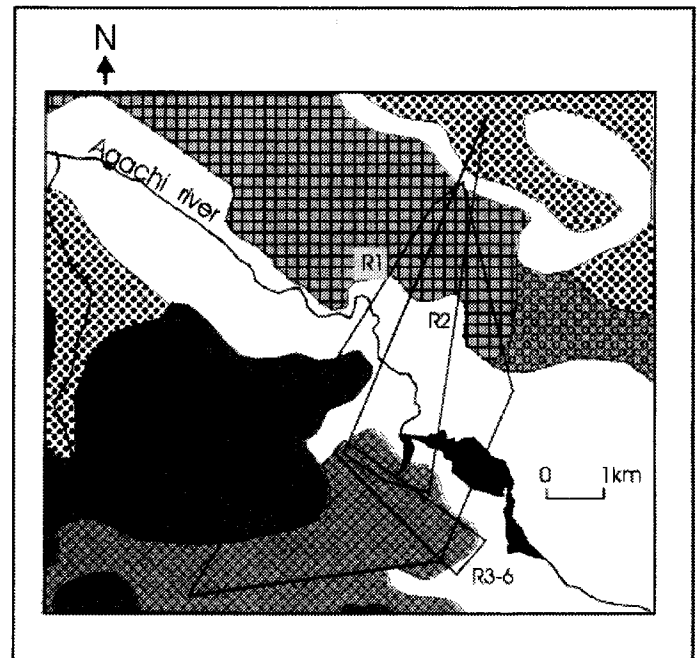


Figure 2. Home range of two restocked parrots (R1-2) and the combined home range of four restocked parrots (R3-6) in the "Refúgio Ecológico Caiman" (19°51' - 19°58' S and 56°17' - 56°24' W), Pantanal of Brazil (January of 1998 to January of 1999).

Figure 2. Home range of two restocked parrots (R1-2) and the combined home range of four restocked parrots (R3-6) in the "Refúgio Ecológico Caiman" (19°51' - 19°58' S and 56°17' - 56°24' W), Pantanal of Brazil (January of 1998 to January of 1999).

Parrot R2 remained in the release area during the first three days, after which it disappeared and then reappeared 32 weeks later in good condition and rejoined the group, that remained in the releasing area during the whole period of study.

During the monitoring period (13 months), the other equipped parrots (R3-R6) remained in the release area, using a life area of ~1-32 ha, and staying only at the areas used for raising cattle.

Monitoring by Direct Observation. During the first five days, the parrots were attracted by the food placed in the trough. After eating, they usually stayed on the trees near the employees' houses located beside the trough. At night, they stayed at a communal sleeping place of about 20 mango trees, situated in front of the employees' houses.

Some animals searched for food in the houses, where residents offered food. To decrease this interference, we explained the goals of our project to the local residents.

The frequency of parrots' visits to the trough decreased from the fifth week on, when the food started being offered every other day. From this period on, most of the animals flew towards another small village, about 2 km away. At night, they rested in the communal sleeping place close to the trough area and early in the morning they would move towards the other village.

Interaction with the native Blue-fronted Amazons took place at the time they rested and while feeding on the raised fruits (oranges, guavas, mangos, and avocado), mainly close to the houses of the farm's employees. No agonistic interaction were observed between the animals.

Soon after the animals were released, two parrots went to another farm, 10 km north of the releasing area, where they stayed for three weeks. Once it was confirmed that home made food had been given to these animals, they were captured and taken back to the releasing area.

Survival. During the 10 weeks of supplementary food, on average, 16 parrots (1-27 parrots) visited the trough. After this period, about 15 to 21 parrots remained around the releasing site.

Five parrots died, four rings and two skeletons were recovered. According to the residents, 3 animals died because they were attacked at night by an spectacled owl (*Pulsatrix perspicillata*), however it was not possible to make an autopsy. One parrot died when it drowned in a water tank, while another died of unknown causes. Two other animals were injured by dogs and taken back to CRAS.

Cost of the Restocking Program. The restocking program included cost of accompaniment (food, veterinary procedures and sanitarian handling) of the animals in CRAS and costs of reintroduction. Mean food consumption was about 3.6 kg per restocked parrot, plus medication and vitamins. About 16.8 hours of field assistance labour and 3.6 hours/ornithologist was used per animal. The trip cost was of about US\$80, not including the vehicle maintenance. The cost of monitoring the animals after release was determined for each method of tracking used (radiotelemetry or direct observation).

Cost of monitoring after release. To monitor all the restocked animals, a researcher and a field assistant performed 33 trips, which usually lasted for three days. To track the parrots with radiotransmitters, an average of 150 km per trip was performed, while direct observation demanded, in general, less than three hours and around 8 km per day of effort (table 1).

DISCUSSION

Biodiversity is being seen as an strategic resource for developing countries in the next decades (Magnusson *et al.* 1998) and for this reason, there is an increasing interest in the development and use of techniques for the conservation of wildlife. Projects of reintroduction and restocking have been constantly mentioned as an alternative for the conservation of species populations under the threat of extinction (Cade 1988, Foose 1986, Sanz and Grajal 1998, Seal 1988), while authors such as Dodd and Seigel (1991) and Synder *et al.* (1996) have been skeptical and critical in relation to the efficiency of these programs. Perez (1996) pointed out the economical limitations of these tools. However, few projects have analysed the costs, considering time and financial support needed for long-term programs. We estimate that for each parrot restocked in the South Pantanal, from 1988 through 1998, cost approximately US\$20 in food and medicine and required about 16.8 hours of work by a field technician and 3.6 hours of work by an ornithologist. Considering the salaries and charges in Mato Grosso do Sul State (MS), the average cost of the pre-release phase of the program was about US\$11,000 per year or US\$55 per parrot per year, but this amount may increase to US\$36,000 per year or US\$180 per parrot, if salaries were on the same magnitude as does of international level (US\$6.88/hour for a field technician and US\$13.00/hour for an ornithologist, The wildlifer 1999).

The cost of the radiotelemetry program was about US\$13,140 for monitoring 6 parrots for a period of 13 month at MS-salary basis or about US\$2,190 per parrot, but this amount could reach about US\$3,900 per parrot or US\$23,390 the six monitored parrots at international salary basis. The direct intensive observations generated, at cheaper costs (US\$5,300 for 36 monitored parrots or about US\$150 per parrot in a MS-salary basis or US\$9,800 for a total of 36 monitored parrots or US\$275 per parrot at international-salary basis), data about various aspects of the parrots' biology, but did not allow us to estimate their life area after dispersion.

Table 1. Allocated resources and resulting information by means of radiotelemetry and direct observation (1).

Technic	Allocated resources	Resulting information
Radiotelemetry	Receiver (2) (US\$ 3,300); 6 radiotransmitters (US\$ 1,440); 4h of flights (US\$800); 4.950 km traveled (US\$300); 1.386 work-hours (US\$3,550 or US\$13,800); diaries and living expenses (US\$3,750).	Partial information on life area and movements for 6 parrots (1 parrot monitored for 8 weeks, 1 for 20 weeks, and 4 parrots for 52 weeks).
Direct observation	792 km traveled (US\$50); 594 work-hours (US\$1,500 or US\$6,000); diaries and living expenses (US\$3,750).	Information about 5 obits, 2 injured parrots, survival of 21 parrots, use of a communal dormitory, movements, interaction between restocked and wild parrots, interaction between restocked parrots and dwellers, and searching for food. Eight out the 36 parrots missed.

1) In addition to the resources above mentioned, both techniques demanded that two professionals made 33 trips between Campo Grande city to the study area using a 4X4 truck, totaling 99 days and 18.480km of travels; 2) Included directional antennas designed for hand use, truck use and for aircraft use.

Although many psittacids reintroduction programs have faced problems due to the low survival rate of the animals (Derrickson and Snyder 1992, Wiley *et al.* 1992, Synder *et al.* 1994) it did not seem to be a limitation on this program. Approximately 60% of the parrots survived for at least 13 months after being released. However, five of the six parrots equipped with radiotransmitters joined the majority of the restocked parrots and stayed in a small area (< 1-32 ha) inhabited by humans, even though there were potentially habitable areas nearby. Animals stayed close to the main house of the ranch, possibly seeking for protection against predators or because of the fruit trees available in the area. Sanz and Grajal (1998), working with *Amazona barbadensis* on Margarita island, observed that the restocked parrots that successfully joined native groups, occupied larger areas (1,000-3,000 ha) than those that did not join the groups (< 10 ha). In our study, at least one parrot occupied a large area (~ 1,600 ha), including areas of savanna, scrub savanna, arboreal savanna, forests of riparian vegetation and man-made pastures, but did not join any group. The restocked parrots showed some behaviour in common with the native ones, as the use of the same sleeping area and feeding on the same trees. However, they usually flew in the same group, while native birds flew alone, in pairs, or in small groups. This result suggests that in restocking programs for parrots, survival is not the only factor determining success, other factors such as size of the used area, type of habitats visited, interaction with native parrots and closeness to humans may affect the parrots' behaviour and their settling in the area. Species in which the young birds learn from the old ones, as seems to happen with most parrots, interaction with the native populations may increase the probability of success, improving the young birds' skills at find food and resting places, avoiding predators and to using larger areas. According to Lindsey *et al.* (1994), restocked birds must be able to avoid predators, specially birds of prey, or the restocking program will not succeed. In this study, three out of five deaths were probably caused by predators. Future studies about the efficiency of these programs should relate the life areas of the released animals to their ability to find food and eventually, to reproduce.

Restocking programs should follow the criteria established by IUCN (1987), to minimize problems such as the transmission of diseases or lack of adequate habitats for the handled species. This program lasted 10 years during which just 60% of the birds sent to the Environmental Secretary of Mato Grosso do Sul state met to the criteria established by IUCN (1987) and were effectively restocked.

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