# How the rehabilitation of animals in captivity affects survival rates upon release

Focus on a reintroduction project with Amazonas vinacea

Karen Burk

# Abstract

The topic of rehabilitation is of special importance when concerning animals that are near extinction. Biodiversity is the variety of animals, plants, their habitats and their genes. It is a key part of the functioning of the planet; if it is changed over a large scale then major responses can be expected. Successful reintroduction projects have aided in the presence of the American bison [*Bison bison*] and the Bald Eagle [*Haliaeetus leucocephalus*]. However, there are negative impacts that could occur during reintroduction projects. These include disease transfer, increased competition, and human influence. The most successful relocation projects have involved large numbers being released, removal of the cause of decline, and a population that was originally wild. A successful reintroduction example of European hedgehog [*Erinaceus europaeus*] involved a short period of captivity, selecting specific release sites, gradual transition from captivity to the wild, and well documented monitoring following release. Failed reintroduction projects, that involved different bear species, provided insight on why projects were unsuccessful. Human contact with bears had the greatest influence across the projects; generally, failed reintroduction resulted in death or recapture of the released individuals. Through successful techniques regarding animal care during captivity, the survival rate of individuals following release could be improved. A current study regarding a project with the vinaceous Amazon parrot [*Amazona vinacea*] in Santa Catarina, Brazil has shown successful results thus far. This project is still underway, therefore, only the short term results following release are discussed. Understanding the feasibility of the project and selecting an appropriate release site was vital to success of the project. Preparation for release was vigorous but necessary. Ensuring only healthy individuals were released provided the best chance of the population's survival. By promoting natural behavior and survival techniques while in captivity, the self-sustainability of the population post-release was improved. Tests while in captivity included 'distance of flight', 'human approach', 'distance to escape' and the 'ability of flight'. These were conducted in the first and last months of the project to observe the changes during training. The actual release provided a smooth transition from captivity to the wild. Proper monitoring, by radio collars and site visits, provided useful information. This is important for gauging the success of the project and whether intervention would be necessary. There were some deaths of released individuals; however, they were natural and not a result of the project methods. Rehabilitation and reintroduction is pricey and may not be appropriate for all situations. Each circumstance is different and not every species will respond the same; proper analysis must be conducted prior to commencing any rehabilitation project. A widely accepted set of methods, proper monitoring, and a universal measure of success are important tasks that need to be completed in order to improve the current management of these projects.



Keywords: Brazil, translocation, relocation, repatriation, restocking, biodiversity, population monitoring, vinaceous Amazon parrot

# Table of Contents



# Index of Figures

# Introduction

There is an increasing concern for the state of the environment and how our actions affect the world around us. Concerns include biodiversity, habitat destruction, and the increasing number of species at risk of extinction (Cunningham 1996). Biodiversity, as defined by the International Union for Conservation of Nature [IUCN], is "the variability among living organisms – animals, plants, their habitats and their genes – from all sources including terrestrial, marine and other aquatic ecosystems and the ecological complexes of which they are part. This includes diversity within species, between species, and of ecosystems" (IUCN 2012). As the numbers of a population are altered, it has effects on the function and composition of the surrounding ecosystem (Nasi *et al.* 2011). There is a diverse and extensive list of reasons why a species may become listed, but there are methods that can be taken to improve their chance of survival. When populations reside in rehabilitation centres, or other places of refuge, it is the duty of the employees at the facilities to ensure the animals have the best chance of survival upon release.

Rehabilitation has resulted in multiple success stories including the American bison [*Bison bison*], alpine ibex [*Capra ibex*], Bald Eagle [*Haliaeetus leucocephalus*], Peregrine falcon [*Falco peregrinus*], and Bean Goose [*Anser fabalis*] (Wolf *et al.* 1996). However, it is costly and time-consuming with only 11% of reintroductions successfully establishing viable populations (Clark *et al.*2002). With better rehabilitation techniques the success of reintroduced species may improve.

In this essay, different methods of rehabilitation will be discussed. These examples include whether the methods have been successful or not. After these techniques have been discussed, the topic of population monitoring and its role in rehabilitation will also be mentioned. This report will include a specific example of a project conducted in Santa Catarina, Brazil with the vinaceous Amazon parrot [*Amazona vinacea*].

# Background

## Rehabilitation and Reintroduction

A historic trend of increasing extinctions of species has been a concern to conservationists for many years; the benefits of biodiversity to ecosystems and to human populations cannot be ignored (Price 1989). Some endangered species have the potential to be conserved through captive breeding programs (Tenhumber *et al.* 2004). However, the range of animals is generally restricted to those that peek the publics' interest (Price 1989) or those that have life history traits that leave them particularly vulnerable such as low reproduction, late maturation, and long generation times (Sarrazin and Barbault 1996). In zoos, the most popular exhibits, to both children and adults, are those that have larger animals (Ward *et al.* 1998); charismatic megafauna include elephants [*Elephantidae*], orangutans [*Ponginae*], bears [*Ursidae*], and lions [*Felidae*] (Kreger and Mench 1995). Another limiting factor for rehabilitation is the availability of space in facilities that are capable of conducting these practices (Price 1989). Improving rehabilitation is a possible solution to help protect different species while reducing the amount of time and space required.

Rehabilitation, as defined by the International Wildlife Rehabilitation Council [IWRC], is "the managed process whereby a displaced, sick, injured or orphaned wild animal regains the health and skills it requires to function normally and live self-sufficiently" (IWRC 2012). The IWRC was founded in 1972 in response to large urban development and the associated habitat loss in California during the 1970's; this increased human contact with distressed wildlife and introduced the need for more rehabilitation centres (IWRC 2012). By improving the methods used in rehabilitation centres and wildlife hospitals, welfare while in captivity can be improved as well as supporting conservation efforts (Molony *et al.* 2006). In the past, rehabilitated populations have had low chances of survival; changing handling techniques, training individuals prior to release, and an appropriate release site may be methods towards improving their survivorship (Molony *et al.* 2006).

Reintroduction is an effort towards species conservation through the establishment of a population in an area where they existed previously; this may follow rehabilitation methods such as captive breeding or through translocation programs (Sarrazin and Barbault 1996). This deliberate movement of wildlife may also be termed relocation, repatriation, or restocking (Wolf *et al.* 1996). Reintroduction of different species has been taking place since the early 1900's (Seddon *et al.* 2007), the purpose of which can be varied but is generally for the overall goal of conservation (Fischer and Lindenmayer 2000). Reasons for reintroductions, other than conservation purposes, include: restocking populations for hunting, addressing human-wildlife conflicts, or to support eco-tourism (Seddon *et al.* 2007). If reintroduction is going to succeed, there must be rigorous planning, health assessments and records, support from the community, and media coverage if possible (Seddon *et al*. 2007). The preparation of reintroduction can be broken into four general phases: feasibility, preparation, release, and post-release (Price 1989). The preparation phase is where the importance of rehabilitation technique begins.

## Impacts of Rehabilitation and Reintroduction

There are many roles that rehabilitation and reintroduction can play, and various benefits associated with each. Increasing the natural biodiversity, acting as keystone species in an ecosystem, and creating the public and political connections that are important for habitat restoration or species protection projects are some of the benefits that can be achieved (Seddon 1999). Focus here is given to the importance of reintroduction for the purpose of protecting biodiversity.

### *Protecting Biodiversity*

The International Union for Conservation of Nature [IUCN], founded in 1948, is the largest and oldest global environmental organization dedicated to conserving biodiversity (IUCN 2012). The IUCN has defined biodiversity as the wide variety of life on earth from different organisms' habitats down to their genes (IUCN 2012). On a species level, biodiversity is important to ensure that there is a diversity of genes within a species; this reduces the risk of wide-spread disease and increases the potential to adapt to a changing environment, which is becoming increasingly important with climate change (IUCN 2012). On a landscape level, biodiversity affects many of the processes within an ecosystem which are dependent on the presence of multiple species and their respective activities; pollinators, seed dispersers, and predators play vital roles for plant regeneration and diversity which demonstrates how species or groups depend on the presence of others (Nasi *et al.* 2011). Ultimately, life on Earth is reliant on the complexities of biodiversity and it existing in a unique physical and chemical relationship in the atmosphere, geosphere, and hydrosphere (IUCN 2012).

Despite the importance of biodiversity, the current species extinction rate is estimated between 1,000 and 10,000 times what would occur naturally (IUCN 2012). This current state of emergency is due to issues such as species extinction, habitat destruction and conversion, pollution, invasive alien species, and over-exploitation of resources (IUCN 2011). Habitat loss is directly related to the increasing pressure on resources because of the continually growing human population; expansion of urban landscapes and conversion to meet agricultural needs has affected approximately 86% of threatened birds, 86% of threatened mammals and 88% of threatened amphibians (IUCN 2011).

The IUCN has an ordered system for classifying the degree of risk associated with each listed species. It includes least concern, near threatened, vulnerable, endangered, critically endangered, extinct in the wild, and extinct (IUCN 2011). Without changing the current course, or without taking some preventative measures, there will be more species entering the higher severity classes of risk. Improving rehabilitation and reintroduction could be the first step towards achieving this change.

### *Potential Negative Impacts of Rehabilitation*

Although there are many benefits that could be achieved through rehabilitation and reintroduction, there are potential adverse effects that need to be discussed. Disease transfer, competition, and human influence must all be considered.

During rehabilitation and reintroduction practices, it is common for release to take place through translocation; this means that wildlife is released to a new site and has potential to introduce diseases or pathogens (Cunningham 1996). This can be especially detrimental to a project if an unknown parasite is introduced to the species during the process (Cunningham 1996). When time is spent at rehabilitation centres prior to translocation, the species may be at higher risk of contracting alien diseases (Cunningham 1996). The introduction of a disease may not be detrimental on its own, but it invites susceptibility to predation, other diseases, or lower reproduction (Cunningham 1996).

The reverse situation can also take place regarding disease, where the released individuals are more susceptible to diseases than the wild population (Cunningham 1996). There are steps that can be taken in order to minimize these risks. Health tests, necropsies, keeping the animals in captivity for a minimum amount of time, and maintaining a naturally acceptable level of parasites are all methods to reduce the risk of contracting diseases (Cunningham 1996).

Beyond the health risks, there are behavioral factors to consider as well. The introduction of groups into an existing population can increase the competition and aggression within the species (Molony *et al.* 2006). This risk will depend on the release site capacity, the number of individuals being released and the population of the wild group. Endangered species are generally the focus for reintroduction projects, but they are also the least understood, which makes it difficult to ensure that the conditions are optimal for each species (Sarrazin and Barbault 1996).

Despite the benefits while in captivity it is important to minimize the amount of time spent in rehabilitation centres. Not only does the length of time increase the risk of infections, it can also introduce human dependencies (Sarrazin and Barbault 1996). If the conditions are not set up in a way that promotes foraging and other natural behaviors, over time individuals may not be able to recognise natural foods or predators to be aware of, and may lose other instinctual behaviours (Molony *et al.* 2006). Some deficiencies can include social interactions, breeding and nesting, and locomotory skills (Jule *et al.* 2008). For some research, however, monitoring may be made easier and could be less stressful for individuals who are accustomed to the presence of humans (Molony *et al.* 2006). Becoming used to human interactions is only a benefit if humans are not one of the risks to the population; for *A. vinacea*, the illegal pet trade makes human involvement a factor to avoid and will be discussed later.

## Population Monitoring After Release

In order to assess whether a rehabilitation project is successful, it is essential to measure indicators following release and to establish whether post-release intervention will be necessary (Seddon 1999). These can include the survival of the release group, breeding by both the released individuals and their offspring, and persistence of the re-established population; it is important for these parameters to be monitored over the long-term (Seddon 1999). However, these indicators can be difficult to measure.

There are many difficulties regarding how to accurately monitor a population over a landscape level (Field *et al.* 2005). Recording all the individuals present is not likely and results in false-negative errors, practices are expensive, and overall statistical results suffer (Field *et al.* 2005). Despite the difficulties, it has been recommended that following a reintroduction, there should be time allocated for continued monitoring of the individuals; this can be highly beneficial but is often ignored or not documented with enough emphasis (Sarrazin and Barbault 1996). Monitoring a population after release provides information about the animals' response to the surroundings and can aid in adjusting methods for other projects (Price 1989).

When deciding whether to visit more sites with less visits, or less sites with more visits, it is important to consider the statistical power of the results. Monitoring less often was found to have a larger impact on statistical power over visiting fewer sites in the paper by Field *et al.* (2005). This means that if there are limited resources, and a compromise between number of sites or visits has to be made, the better decision is to visit frequently to fewer sites (Field *et al.* 2005). Overall, Field *et al.* (2005) found that 2 to 3 visits to every site would be suitable for many species.

Different methods can be used for collecting data in the field including: Distance sampling, mark-recapture, and repeat site visits (Field *et al.* 2005). Detectability can be an issue when trying to monitor a species because of cryptic behavior, temporary absence from the site, and other parameters making it difficult to guarantee siting all individuals residing in the area (Field *et al.* 2005). Radio-collars and other locating devices can be used to aid in locating the animals of interest; this method was used in the rehabilitation of *A. vinacea* discussed below.

Some methods can be done pre- and post-release to observe potential population trajectories (Seddon et al. 2007). These steps can display short-term outcomes of different approaches, establish population persistence information, and consider the population feasibility over a long-term period (Seddon et al. 2007). In order to compare potential management options to each other with quantitative evaluation, population viability analysis [PVA] can by utilized (Seddon et al. 2007). VORTEX is an example of a commercially available program that aids in reintroduction plans and population modeling after release (Seddon et al. 2007). Using different modeling methods can show varying results due to limiting factors that may not have been considered previously; this allows for alterations in the reintroduction methods prior to release (Seddon et al. 2007).

Another assessment that can be completed prior to release, and can be beneficial to the project, involves finding suitable habitat. Using geographic information systems [GIS], data regarding the geography and spatial information of the land-base can be assessed, and maps can be created to demonstrate the findings; this can aid in making a decision of what area possesses the most suitable habitat for the species (Seddon et al. 2007).

## Assessment

In a paper by Fischer and Lindenmayer (2000), a review of different relocation projects over a period of 20 years was reported. Results found that success was more often when the population being released was originally wild, when large numbers were released, and the original cause of decline was removed. A different review of over 400 translocation programs revealed that having release sites within the historic range, high quality habitat, larger release groups, and an omnivorous diet all improved the success of the project (Wolf *et al.* 1996). Some factors that did not show to have an impact on the success of translocation projects included: reproductive potential, frequency and duration of releases, and whether individuals were wild-caught or captive-bred (Wolf *et al.* 1996). In this section two different projects are summarized displaying areas that provided success or failure during each reported project. Following these examples is a rehabilitation project still underway in Santa Catarina, Brazil, with *A. vinacea*.

### Successful Example of European Hedgehog Reintroduction

In Britain, the most common mammal occurring in the wildlife hospitals are hedgehogs [*Erinaceus europaeus*]; this is because they are often released with the idea that they will easily adapt to different environments (Molony *et al.*2006). Although they have been frequently released, there is little statistical data or formal results about translocation of the hedgehog (Molony *et al.*2006). In the paper by Molony *et al.* (2006), proper experimental design was used to measure the effects of different reintroduction methods on the survival of the population. The following is a summary from the aforementioned paper:

Release sites were chosen based on criteria outlining characteristics such as the nearest road, presence of predators, intra-species competition, potential risks, and other physical features of the area. For the first week following release the individuals were provided with food. The five different treatment groups included: rehabilitated, directly translocated, translocated after some captivity, wild populations at the release site, and a wild control group. Monitoring was made possible through radio-transmitters glued to their spines and took place every two to three days for eight weeks. Every ten days each individual was recaptured in order to be weighed and examined for ticks, mites, injuries or trauma.

The results showed that direct translocation decreased chances of survival, but a short period of captivity before release improved those chances. The benefit of having refuge in captivity was also seen among the individuals that had been nursed from an injury or illness. Captivity may have provided several benefits that can explain the superior survival including weight gain prior to release, becoming accustomed to the presence of humans, and reducing weight loss related to stress during monitoring. Overall, the use of rehabilitation increased the survival rate of the hedgehogs following release.

## Failed Examples of Bear Reintroductions

Many bear species have faced distribution and population reductions due to habitat loss, overexploitation, or a combination of the two (Clark *et al.* 2002). There are many challenges regarding reintroduction projects with bears due to a range of factors; low population growth with high variance, environmental variation, great travel distances, and low genetic variability are all issues that create challenges (Clark *et al.* 2002). In the paper by Clark *et al.* (2002), methods of bear reintroduction projects are examined. An overview of release findings and suggestions for future management is provided in the paper. The following is a summary from the aforementioned paper:

Brown bears [*Ursus arctos*] were locally extinct in Bialowieza, Poland, in the late 1800's. A reintroduction project took place with seven hand-raised cubs in 1938 but was unsuccessful; all of the bears were killed by poachers or recaptured after coming in contact with local communities. In the same year, a pregnant bear from Poznan Zoo was provided a partial cage in the forest where she gave birth to two cubs. This enclosure had spaces between the bars that were big enough that the cubs were able to come and go as they pleased. Eventually, access to the cage as restricted to the cubs and they had to rely solely on wild resources. The mother was later released with another previously captive bear, however this also failed. These bears had human conflict that resulted in fatalities. The bears were shot as a consequence of this incident.

In the Trentino area of the Italian Alps there were three different brown bear reintroduction projects. The first project took place in 1960 and involved two captive born Carpathian brown bears from the Vienna zoo. Methods included providing semi-natural conditions to the bears. This attempt failed and the two bears were returned to captivity. The second project was in 1969 with two more Carpathian brown bears from the Zurich zoo. During recapture the female was fatally injured and the male was relocated to the Verona zoo. The third project was in 1974 with another two bears from a private enclosure at Este Castle. One was illegally shot two years after release and the other died in an avalanche four years after release. This project was the most successful of the three reported.

More recent projects with American black bears [*Ursus americanus*] observed the effect of soft and hard release on survival rates in Pennsylvania and Virginia respectively. The rate of mortality was higher with hard release. No reproduction took place in the first year and homing behavior was evident in majority of the release group. Soft release methods involved an acclimation period prior to release and specific den sites selected for pregnant females. Site fidelity was improved because of the combination of hibernation, parturition, and cub rearing involved in these release methods.

Although there have been a number of failed projects, there have been many lessons learned that has since led to successful reintroduction projects. Information has been gained on factors that influence homing in bears and how age, sex, food availability, and geographic barriers can affect the success of a project. A major issue regarding reintroduction of bears is human conflict. With many conservation projects there is plenty of public opinion. The negative connotations that could be associated by communities regarding bear reintroduction projects need to be addressed. On the contrary, there are also those who support these projects, which ought to be encouraged. Public involvement is a necessity for project success. There is also the issue of hand-raised animals; becoming habituated to humans makes release attempts more difficult because they may be more dependent on human food sources or experience reduced wild behaviors. There has been success seen in projects involving a training period for individuals prior to release in order to learn essential skills. These include behaviors needed in the wild such as foraging, navigating the forest, and interacting with other bears. The idea of training individuals while in captivity can also be observed in the project with *A. vinacea* in Brazil.

## Vinaceous Amazon Parrot [*A. vinacea*]

### *History of* A. vinacea

The lowland and highland Atlantic forests, up to 2 000 m (BirdLife International 2009), in southeastern Brazil, eastern Paraguay and parts of Argentina are the native range of *A. vinacea*; now however, these parrots are found only in a few locations within these countries (Cockle *et al.* 2007). *A. vinacea* are generally found in large groups and roost communally except during the breeding season; from February to July *A. vinacea* is found in pairs or small groups (BirdLife International 2009). Nesting takes place in tree cavities and follows the breeding season from September to January (BirdLife International 2009).

Threats to *A. vinacea* include nest poaching, being killed as a crop pest, capture for the animal trade, and habitat conversion (Cockle *et al.* 2007). In 1984-1991 there was a 38% loss of the Atlantic forests of Paraguay due to deforestation; studies show some correlation between the reduced numbers of *A. vinacea* and the decrease of Araucaria forests that are common in their ranges (BirdLife International 2009). A study regarding Brazilian vertebrate's potential correlation between increasing severity of risk status and increasing threat factors found that 60% of bird species with increased severity between 2002 and 2006 were attributed to the increase in the threat factors (Paglia and Fonseca 2009). In Argentina, a study of 12 nests between 2006 and 2007 resulted in only one chick fledging the nest, three or more predated, two or more damaged during flood events, and capturing for the animal trade occurring at three nests (BirdLife International 2009). Nests are more often in large, shallow cavities prone to flood damage because of the limited sites with appropriate nest cavities; *A. vinacea* return to nests for multiple consecutive years, this results in continually low survival rates (BirdLife International 2009). In addition, there is always competition for these nest sites that add to the difficulties already in place (BirdLife International 2009).

Trade of wild animals without a license is illegal, especially regarding species that are listed by the IUCN (Herrera and Hennessey 2007). *A. vinacea* was up-listed from vulnerable to endangered due to estimates of the global population being smaller than previously indicated (IUCN 2011). The population trend is decreasing, and is expected to keep this course, largely because of habitat loss and fragmentation (IUCN 2011). In a study done in Bolivia, including two parrot species that had been exported from Brazil, the majority of individuals were captured from the wild (Herrera and Hennessey 2007).

Habitat loss and fragmentation is often related to converting the landscape for other goods; when we modify an ecosystem to improve a service it provides, changes to other ecosystem services are generally observed (IUCN 2012). Of the species listed as threatened in the IUCN Red List, 80% had associated issues regarding the loss of habitat (Paglia and Fonseca 2009). Conversion of land for agriculture combined with a deficiency of protected areas is a major threat for biodiversity in Brazil (Silva *et al.* 2006). Specific to the cerrado region, in the centre of Brazil, the alteration of the landscape began when Brasilia was being constructed in the 1950's; highways and railways created links between the new capital and other Brazilian cities (Silva *et al.* 2006). At this time new policies regarding agriculture and land conversion were also put in place (Silva *et al.* 2006). Subsidized credit, tax breaks, and new technologies all facilitated the transformation of forest land for crops and pastures (Silva *et al.* 2006). Colinization projects promoting agriculture expansion also occurred in areas of the Amazon and across Brazil increasing the amount of forest conversions (Guild *et al.* 2004). In Rondonia, Brazil, there was a highway built in 1984; this led to intense deforestation for cultivation, cattle pastures, timber exploitation and mining along the highway (Guild *et al.* 2004). Consequences of these actions are vast. Landscape fragmentation, biodiversity loss, biological invasion, soil erosion, water pollution, change in the fire regime, and land degradation is only the beginning (Silva *et al.* 2006). This pattern is similar in many states and different forest types; these changes to the landscape can be detrimental to the species composition within the forest as well as animals that rely on the forests, including *A. vinacea.*

## *Report on the Activities of the Reintroduction of* A. vinacea *in the Araucárias National Park, Santa Catarina, Brazil*

The following section is a summary from the methods followed during the reintroduction project of *A. vinacea* in Santa Catarina, Brazil; it has been translated by Karen Burk and approved by Vanessa Kanaan. [1]

> The project began in August 2011 with 22 *A. vinacea* candidates for release at the Centro de Triagem de Animais Silvestres [CETAS] in Santa Catarina, Brazil. During captivity there was a data sheet used to collect information about each individual's time budget in relation to the group. The parrots were trained daily during a four month period prior to release; training included how to fly from one end of the enclosure to the other in order to develop wing muscles and improve the ability to fly. If a parrot approached a human it was

[1] The translated document in whole can be found in Appendix 1 of the report.

presented with an adverse, but non-invasive, stimulus so individuals learned to avoid humans. The food, including those items that are natural for the species, was presented in its natural form to promote foraging behavior. The location of the food was strategically placed so that it would make the parrots spend less time on the ground, where there is a high risk of terrestrial predators in the wild, and stimulate searching for sustenance. Food was placed on platforms, near the top of the enclosure, in hollow logs and hanging throughout the nursery. Individual weights were recorded every 15 days and the diet was adjusted as needed.

Three behavioral tests [distance of flight, human approach test, and the ability of flight] were performed in the first and last month of the experiment; the objective was to evaluate the possible behavioral changes resulting from the daily training sessions. Six parrots did not improve in flight abilities during the training period and did not pass the behavioral tests; consequently they were not released. All of the individuals achieved the requirements necessary for the 'distance to escape' test and the 'human approach' test. Eight of the parrots were equipped with mock radio-collars thirty days prior to release in order to become accustomed to the weight of the equipment; four were given the real radio-collars three days prior to being taken to the release site.

**Figure 1: *A. vinacea* equipped with fake radio collar prior to release [Karen Burk 2011]**

Clinical and laboratory veterinary exams were conducted for all the parrots; a 3 ml blood sample was collected along with biological material from cloacal and tracheal swabs. The samples were sent immediately after collection, along with feces that were attained from a pool of samples, for analysis. The results of the laboratory tests were either negative or within the range considered normal for Psittacidae for all the parrots except one; the individual had hemoparasites and it was not released. Two individuals died while in captivity; one due to the bacterium *Escherichia coli gama hemolitico*, and the other by an unidentified parasite.

Fifteen parrots received metal identification bands transferred from the National Centre of Research for the Conservation of wild Birds [Centro Nacional de Pesquisas para Conservação das Aves Silvestres, or CEMAVE]. Following banding, transportation to the release site was provided by the Polícia Militar Ambiental de Santa Catarina [Environmental

Military Police of Santa Catarina]. The parrots were then placed in a temporary enclosure at the release site for four days before one side of the enclosure was opened allowing them to leave as they chose. The side of the enclosure was put back in place every night and subsequently removed the next morning providing a safe place overnight for the animals that chose to stay inside. Behavioral and physical data was collected in order to monitor how the parrots were adjusting during this period. For the first ten days after release, food was provided in the morning and afternoon on platforms built high up in the nearby trees. Following this period, the food was offered on scattered days for a month and then stopped completely.

During monitoring in the field various findings were reported. On the first visit a group of four were seen flying together but could not be recognized accurately. A pair was seen by the release site, two individuals were found up to 1 km away from the release site on different occasions, and individuals seen on repeated visits were often at the same sites they were observed initially. Throughout the monitoring phase, there was an individual that was reported captured but could not be positively identified as being involved in the project following recovery. There was another parrot that was attacked by a hawk and was later reported dead after being displaced from the release site.

On two different occasions, the two researchers responsible for the project gave lectures to the children at the Zumbi dos Palmares school about the project. There has not been any other monitoring since then.

## *Discussion About the Project*

In the past, the translocation of birds has been less successful at achieving a population that is self-sustainable than mammals (Wolf *et al.* 1996). The paper by Price (1989), as mentioned earlier, introduced four phases for successful reintroduction. Although the people involved with the reintroduction project of *A. vinacea* did not model the methods to follow those outlined by Price (1989), it has none-the-less taken these necessary steps. Because of vigorous planning and attention to detail, there has been a potentially positive response to release.

The feasibility of the project was achieved by having an appropriate site selected. The Araucárias National Park in Santa Catarina, Brazil once had *A. vinacea* present in the past. Since then, however, *A. vinacea* has been locally extirpated. Because it was previously suitable habitat for the parrots and because of National Park status, this fit as an area with high potential for survival.

The preparation for release involved many steps. First, ensuring that only healthy individuals were included in the program provided the best chance for survival. This combined with the daily training ensured that they had the necessary skills to survive on their own and shortened the time required for them to remain in captivity. What sets this project apart from other techniques used is the training to avoid humans. This aspect, in conjunction with supporting natural foraging behavior, helped to prepare the individuals for maximum survival potential.

The actual release was carefully planned and monitored to ensure a smooth transition from captivity to the wild was provided. This was accomplished through the gradual removal of food and the safe place to reside in the beginning. This provided a trial period where if the individuals were failing the transition they had the potential to be taken back to the pre-release phase.

Post-release strategies were also in place, both by monitoring the population and by continuing to speak in the community. The radio-collars were vital to be able to locate and identify individuals following release and facilitated the monitoring process. Although not every individual was equipped with a radio-collar, they were still able to help locate where they were. On one occasion the location of an individual was known even though it could not be seen from the ground. Educating the community about the species' in their area was also included in the post-release methods. This is critical for the success of any project because without the support and understanding of the locals, the same issues facing the population prior to release will most certainly continue to persist.

Although there were some deaths observed during the project I do not believe they were due to any failure of the methods. The individual that was captured helps demonstrate how frequently this species is recruited by people for pets or for trade. The individual that was displaced from the area by a hawk attack was a natural threat that is faced in the wild for *A. vinacea.* The steps taken throughout the project have all been vital to the success of the group following release.

## Critical Thinking

If there were environmental education systems and law enforcement in place then the threat to species in populated areas could be reduced (Cockle *et al.* 2007). This could begin to be established by protecting more areas of forest land; some reserves suggested for *A. vinacea* are General Carneiro in Santa Catarina, Itaipú in Alto Paraná, and forested areas beyond reserves in multiple states (BirdLife International 2009). This needs to have firm implementation on the ground if it is to succeed, requiring properly trained rangers patrolling the area as well as resolutions regarding land tenure issues in reserves of Brazil and Paraguay (BirdLife International 2009). Areas that need to be patrolled for trafficking include places known for capturing birds, roads from reserves, border crossings, and ports (BirdLife International 2009). Public awareness is important to educate the locals about the effects of nest-robbing as well as the importance of nest-site conservation (BirdLife International 2009). Farmers must also receive support technically, financially, and logistically to promote the end of converting forests for agricultural purposes (Cockle *et al.* 2007); an example of how to conserve forests on small farms is by promoting soil conservation (BirdLife International 2009). Although *A. vinacea* has been able to nest and reside in areas outside of their natural habitat it does not necessarily provide the best environment; studying the dispersal behavior, nesting requirements, and habitat preferences is important for understanding the needs of *A. vinacea* (Cockle *et al.* 2007).

This is an expensive practice and needs to be carefully planned to optimize resources and to have the best success rates possible (Tenhumber *et al.* 2004). There are clearly multiple strategies that could work and are often subject to changes depending on factors like how large the wild population is and how many individuals are in captivity (Tenhumber *et al.* 2004).

Fischer and Lindenmayer (2000) suggest that applying five steps could improve the success of relocation programs. These include: more rigorous testing for the methods in the project, creating a common criteria for determining whether it was a success or failure, better monitoring after release, better financial accountability, and more publications of the results of the project. Success has been measured by breeding of the first wild-born generation, a three-year breeding population with recruitment greater than adult death rate, a wild population exceeding 500 animals, or a self-sustaining population; the issue with these measures is the limit of each criterion to be applied to many species because of different life history traits (Seddon 1999).

Depending on the state of the species in the wild and the requirements that need to be satisfied for successful release, rehabilitation methods can be beneficial to the chances of survival following reintroduction. If done correctly, improving these practices may not require increasing the funding for these projects. With improved rehabilitation methods, less time will be needed in rehabilitation centres, meaning less resources, as well as higher survival rates as a result of the better practices. A higher turn-over rate of animals in captivity can be established while improving the state of wild populations of concern. What is needed is more time conducting research about the feasibility of the project and what is going to work best for the population given the number of individuals in the wild, limiting factors to success, and other variables.

## Conclusions

Although rehabilitation methods prior to reintroduction may be able to improve the survival rates of a population following release, it might not always be necessary or appropriate. If the issues that were experienced in the wild prior to rehabilitation have not been resolved, then there is little opportunity for success. On the contrary, if these concerns can be handled without intervention, then the potential for recovery on its own may be possible. In some circumstances, even with correcting the source of the problem facing the population, the numbers might be too low and require additional help from rehabilitation methods.

As mentioned throughout the essay, each circumstance is different and needs to have proper analysis before entering the project. Methods must be appropriately adjusted for each project depending on factors like the number of wild individuals, how many are in captivity, appropriate release site, proper monitoring, and an overall understanding of the needs of the particular group. With improved rehabilitation methods and more published results, whether positive or negative, continued improvements can be made. Developing a widely accepted form of methods developed from past results, which are adjustable to account for individual species, would be a valuable task to undertake. This, along with a solidified way to measure the success of a project, should be made priorities for conservation globally. If these steps were to be completed and then combined with other conservation techniques, there could be major improvements made toward maintaining the biodiversity of the world.

## References


BirdLife International 2009. *Amazona vinacea*. In: IUCN 2011. IUCN Red List of Threatened Species. Version 2011.2. [online]. Available from www.iucnredlist.org [accessed 22 February 2012].

Clark, J.D., Huber, D. and Servheen, C. 2002. Bear reintroductions: lessons and challenges. Ursus **13**: 335-345. [online]. Available from http://www.jstor.org/stable/3873214 [accessed 7 April 2012].

Cockle, K., Capuzzi, G., Bodrati, A., Clay, R., Del Castillo, H., Velázquez, M., Areta, J. I., Fariña, N. and Fariña, R. 2007. Distribution, abundance, and conservation of Vinaceous Amazons (*Amazona vinacea*) in Argentina and Paraguay. Journal of Field Ornithology **78**: 21–39. DOI: 10.1111/j.1557-9263.2006.00082.x

Cunningham, A.A. 1996. Disease risks of wildlife translocations. Conservation Biology **10**(2): 349-353. DOI: 10.1046/j.1523-1739.1996.10020349.x

Field, S.A., Tyre, A.J. and Possingham, H.P. 2005. Optimizing allocation of monitoring effort under economic and observational constraints. Journal of Wildlife Management **69**(2): 473-482. DOI: 10.2193/0022-541X(2005)069[0473:OAOMEU]2.0.CO;2

Fischer, J. and Lindenmayer, D.B. 2000. An assessment of the published results of animal relocations. Biological Conservation **96**(1): 1-11. DOI: 10.1016/S0006-3207(00)00048-3

Guild, L.S., Cohen, W.B. and Kauffman, J.B. 2004. Detection of deforestation and land conversion in Rondônia, Brazil using change detection techniques. International Journal of Remote Sensing **24**(4): 731-750. DOI: 10.1080/01431160310001598935

Herrera, M. and Hennessey, B. 2007. Quantifying the illegal parrot trade in Santa Cruz de la Sierra,Bolivia, with emphasis on threatened species. Bird Conservation International **17**(4): 295-300. DOI: 10.1017/S0959270907000858

International Union for Conservation of Nature. 2012. [online]. Available from www.iucn.org [accessed 22 February 2012].

International Union for Conservation of Nature. 2011. IUCN Red List of Threatened Species. Version 2011.2. [online]. Available from www.iucnredlist.org [accessed 22 February 2012].

International Wildlife Rehabilitation Council. 2012. [online]. Available from www.theiwrc.org [accessed 22 March 2012].

Jule, K.R., Leaver, L.A. and Lea, S.E.G. 2008. The effects of captive experience on reintroduction survival of carnivores: a review and analysis. Biological Conservation **141**(2): 355-363. DOI: 10.1016/j.biocon.2007.11.007

Kanaan, V. Relatório de atividades do projeto de reintodução do papagaio-de-peito-roxo (*Amazona* vinavea) no Parque Nacional das Araucárias, Santa Catarina (2010-2011). Report on the Activities of the Reintroduction of A. vinacea in the Araucárias National Park, Santa Catarina, Brazil. [Personal Communication 27 February 2012].

Kreger, M.D. and Mench, J.A. 1995. Visitor-animal interactions at the zoo. Anthrozoos **8**(3): 143-158. DOI: 10.2752/089279395787156301

Molony, S.E., Doowding, C.V., Baker, P.J., Cuthill, I.C. and Harris, S. 2006. The effect of translocation and temporary captivity on wildlife rehabilitation success: An experimental study using European hedgehogs (*Erinaceus europaeus*). Biological Conservation **130**(4): 530-537. DOI: 10.1016/j.biocon.2006.01.015

Nasi, R., Taber, A. and Van Vliet, N. 2011. Empty forests, empty stomachs? Bushmeat and livelihoods in the Congo and Amazon Basins. International Forestry Review **13**(3): 355-368. DOI: 10.1505/146554811798293872

Paglia, A.P. and Fonseca, G.A.B. 2009. Assessing changes in the conservation status of threatened Brazilian vertebrates. Biodiversity Conservation **18**: 3563-3577. DOI: 10.2752/089279395787156301

Price, M.R. Animal Re-introductions: the Arabian Oryx in Oman. New York: Cambridge University Press, 1989. 1-24. Print.

Sarrazin, F. and Barbault, R. 1996. Reintroduction: challenges and lessons for basic ecology. Trends in Ecology and Evolution **11**(11): 474-478. DOI: 10.1016/0169-5347(96)20092-8

Seddon, P.J. 1999. Persistence without intervention: assessing success in wildlife reintroductions. TREE **14**(12): 503. [online]. Available from http://www.nwrc.gov.sa/NWRC_ENG/Gazelles_publications_files/1-1999-009.pdf [accessed 7 April 2012].

Seddon, P.J., Armstrong, D.P. and Maloney, R.F. 2007. Developing the science of reintroduction biology. Conservation Biology **21**(2): 303-312. DOI: 10.1111/j.1523-1739.2006.00627.x

Silva, J.F., Fariñas, M.R., Felfili, J.M. and Klink, C.A. 2006. Spatial heterogeneity, land use and conservation in the cerrado region of Brazil. Journal of Biogeography **33**(3): 536-548. DOI: 10.1111/j.1365-2699.2005.01422.x

Tenhumber, B., Tyre, A.J., Shea, K. and Possingham, H.P. 2004. Linking wild and captive populations to maximize species persistence: optimal translocation strategies. Conservation Biology **18**(5): 1304-1314. DOI: 10.1111/j.1523-1739.2004.00246.x

Ward, P.I., Mosberger, N., Kistler, C. and Fischer, O. 1998. The relationship between popularity and body size in zoo animals. Conservation Biology **12**(6): 1408-1411. DOI: 10.1111/j.1523-1739.1998.97402.x

Wolf, C.M., Griffith, B., Reed, C. and Temple, S.A. 1996. Avian and mammalian translocations: update and reanalysis of 1987 survey data. Conservation Biology **10**(4): 1142-1154. DOI: 10.1046/j.1523-1739.1996.10041142.x

# Appendix 1

## Report on the Activities of the Reintroduction of *Amazona vinacea* in the Araucárias National Park, Santa Catarina, Brazil

Translated by: Karen Burk March 1, 2012
Edited by Vanessa Kanaan March 8, 2012

The project began in August 2011 with 22 vinaceous Amazon (*Amazona vinacea*) parrots as candidates for release. During the period when the group was in captivity there was a data sheet used to collect information about each individuals' time budget in relation to the group. The parrots were trained daily during the four months prior to release regarding how to fly from one end of the enclosure to the other in order to develop their wing muscles and improve their ability to fly. If a parrot approached a human it was presented with an adverse, but non-invasive, stimulus so individuals learned to avoid humans. The food, including those items that are natural for the species, was presented in its natural form to promote foraging behavior. The location of the food was strategically placed so that it would make the parrots spend less time on the ground, where there is a high risk of terrestrial predators in the wild, and stimulate searching for sustenance. Food was placed on platforms, near the top of the enclosure, in hollow logs and hanging throughout the nursery. Individual weights were recorded every 15 days and the diet was adjusted as needed.

Three behavioral tests (distance of flight, human approach test and the ability of flight) were performed in the first and last month of the experiment; the objective was to evaluate the possible behavioral changes resulting from the daily training sessions. Six parrots did not improve their flight abilities during the training period and consequently did not pass the behavioral tests and therefore were not released. All of the individuals achieved the requirements necessary for the distance to escape test and the human approach test. Eight of the parrots were equipped with mock radio-collars thirty days prior to release in order to become accustomed to the weight of the equipment. The radio-collars weigh less than 5% of their body weight. Four of the eight were given the real radio-collars three days prior to being taken to the release site.

To conduct the clinical and laboratory veterinary exams the parrots were caught individually using nets; 3 ml of blood was collected by venipuncture from the brachial vein and biological material was collected through cloacal and tracheal swabs. The samples were sent immediately after collection along with feces that were collected from a pool of samples for analysis. The following tests were performed: Fecal, complete blood count, serum biochemistry, research for hemoparasites, gram stained feces smear, isolation of *Salmonella sp., E.coli, Candida sp.* and *Aspergillus sp., Cryptococcus sp.,* PCR of Newcastle Disease, Pacheco Disease, Clamydophila psittaci, Mycoplasma, Influenza Virus, Poxvirus, Coronavirus, Circovirus and Polyomavirus, Sorology Clamydophila psittaci, Newcastle virus, and Influenza type A. The results of the laboratory tests were either negative or within the range considered normal for Psittacidae, for all the parrots except one; the individual had hemoparasites and was not released. During the period of captivity two individuals died; one due to the bacterium Escherichia coli gama hemolitico, and the other by an unidentified parasite.

Fifteen parrots, including two that were not released due to failing the behavioral tests and clinical trials, received metal identification bands transferred from the National centre of research for the Conservation of wild Birds (Centro Nacional de Pesquisas para Conservação das Aves Silvestres, or CEMAVE). The identification on the bands included: S41401, S41402, S41403, S41404, S41405, S41407, S41408, S41409, S41410, S41411, S414112, S41413, S41414, S41415 and S41416. Transportation to the release site was provided by the Polícia Militar Ambiental de Santa Catarina (Environmental Military Police of Santa Catarina) in an air conditioned truck, accompanied by a veterinarian on the project team. The parrots were placed in a temporary enclosure with the dimensions of 4 m by 2 m by 2 m (L X W X H) at the release site for four days before one side of the enclosure was opened allowing them to leave as they chose (coordinates S26°44.983'; HO51°58.593'; elevation 985 m). The side of the enclosure was put back in place every night and subsequently removed the next morning providing a safe place overnight for the animals that chose to stay inside. Behavioral and physical data was collected in order to monitor how the parrots were adjusting during this period. For the first ten days after release, food was provided in the morning and afternoon on platforms built high up in the nearby trees. Following this period the food was offered by the owner of the property on scattered days for a month and then stopped completely.

The first monitoring took place in February 2011, the month following release, however the radio-transmitter did not work and the individuals could not be located through displays or vocalizations. The second monitoring was on the 19th of March 2011; this time four parrots were sighted flying in a flock (coordinates S26˚44.215'; HO51˚56.942'; elevation 1038 m). None of these individuals were equipped with a radio-collar though so the identification of the individuals was limited. In the same location, but distanced from the group, was parrot S41411 with radio-collar frequency 283. On the 20th of March 2011 parrot S41401 with radio-collar frequency 242 was located 1 km from the release site (coordinates S26°44.796'; HO51°59.345'; elevation 968 m). Two other individuals, S41415 and S41413, were sighted together near the release site (S26°45.144'; HO51°58.686'; elevation 976 m).

During this month, residents coming to the release site reported that a parrot in the project had been captured by an employee who was working on a plant under construction in Passos Maias, SC. The related authorities, IBAMA, the Environmental Military Police in Santa Catarina and ICBio were alerted; it was made a research priority to investigate the facts. The following monitoring of parrot S41411 with frequency 283 took place on the 16th of April 2011 at the same location as the previous month (coordinates S26˚44.215'; HO51˚56.942'; elevation 1038 m). A worker in the plant, possibly the one who captured the individual, gave the parrot to Juliano Oliveira who is the official at ICMBio responsible for the Parque Nacional das Araucárias. Juliano remained with the parrot until it was transferred to the care of the Environmental Military Police of the State. The identification band had been removed and its wing feathers were cut off making it impossible to identify the individual visually. The animal was returned to the Centro de Triagem de Animais Silvestres (CETAS), the rehabilitation centre that it was at previously, in the city of Florianopolis. Despite requesting that the parrot remain separate from the nursery with other individuals of the same species, that was exactly what took place; this made it impossible to carry out a DNA examination to identify the individual. Because there was no positive identification of the parrot it could not be determined whether it was among the group that was released for the project.

Parrot S41413 was also spotted at the site of previous monitoring (coordinates S26˚45.144'; HO51˚58.686'; elevation 976 m) however S41415 was not located. According to reports from local residents S41415 was attacked by a hawk and was not seen after the event. The signal from parrot S41404 with frequency 202 was located 1 km from the site of release (coordinates: S26˚44.796'; HO51˚59.345'; elevation 968 m) but the individual was not spotted from the ground. On the 15th of

May 2011 parrot S41411 with frequency 283 and parrot S41413 were found at the same location as the previous month (coordinates S26˚44.215'; HO51˚56.942'; elevation 1038 m and S26˚45.144'; HO51˚58.686'; elevation 976 m respectively).

On the 16th of May 2011 the two researchers responsible for the project gave a lecture given to the children in the 5th and 6th grade at the Zumbi dos Palmares school about the project (coordinates S26˚45.401'; HO51˚55.159'; elevation 1038 m). After the presentation, they went to the house of a person who had reported the death of parrot S41415 after possibly hitting the side of their house and being attacked by a dog (coordinates S26˚47.743'; HO52˚00.153'; elevation 885 m). The identification band of this individual was recovered. They concluded that the parrot migrated to this residence after the report of a hawk attack that displaced it from its previous habitat (S26˚45.144'; HO51˚58.686'; elevation 976 m).

The last monitoring began on the 18th of June 2011 where parrot S41411 with frequency 283 was sighted at the same location as the previous monitoring (coordinates S26˚44.215'; HO51˚56.942'; elevation 1038 m) but the battery of its radio-collar had expired. The following day, the 19th of June 2011, they held another lecture for the children in the 4th and 5th grades at the Zumbi dos Palmares school. There has not been any other monitoring since then.

**Rotation of Monitoring**: S26˚51.305', HO52˚01.905' (elevation 1.041m) ◊ S26˚44.796', HO51˚59.345' (elevation 968m)◊ S26˚45.144', HO51˚58.686' (elevation 976m) ◊S26˚44.983', HO51˚58.593' (elevation 985m)◊ S26˚44.215', HO51˚56.942' (elevation 1.038m)◊ S26˚45.401, HO51˚55.159' (elevation 1.038m)◊ 26˚42'31"S, 51˚55'11"W S26˚47.743', HO52˚00.153' (elevation 885m)◊ S26˚51.932', HO52˚01.308 (elevation 998m).