UNIVERSIDADE FEDERAL DE OURO PRETO
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DEPARTAMENTO DE BIODIVERSIDADE, EVOLUÇÃO E MEIO AMBIENTE
PROGRAMA DE PÓS-GRADUAÇÃO EM ECOLOGIA DE BIOMAS TROPICAIS

AVALIAÇÃO DE TÉCNICAS DE MANEJO NA SOBREVIVÊNCIA E COMPORTAMENTO DE PAPAGAIOS-VERDADEIROS (*Amazona aestiva*, PSITTACIDAE) TRANSLOCADOS

ALICE RABELO DE SÁ LOPES

2016

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Área de concentração: Comportamento de aves.
Orientador: Prof. Dr. Cristiano Schetini de Azevedo

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"Avaliação de técnicas de reabilitação na sobrevivência e comportamento de papagaios-verdadeiros (*Amazona aestiva*, Psittacidae) translocados".

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"Uma agenda positiva

A meta da refaunação me entusiasma muito. Afinal, se há uma coisa triste na luta da conservação, é essa nossa sensação de que estamos sempre travando uma batalha de retirada. Sempre lutando desesperadamente apenas para impedir que percamos mais alguma coisa. Está mais do que na hora de a conservação adotar uma postura mais agressiva, no bom sentido. A refaunação é uma perspectiva maravilhosa, um objetivo de vida maravilhoso, justamente porque oferece uma agenda positiva - fazer o mundo melhor, não apenas impedir que ele se torne pior. Acho que breve vai chegar o dia em que eu vou ver, numa floresta, uma espécie de cuja reintrodução eu mesmo participei. Não sei se vai ser tão emocionante quanto seria ver um mamute, vivinho, na minha frente. Porém, ao contrário do mamute, é um sonho possível, que vale a pena sonhar."

Fernando Fernandez

Fonte: O ECO http://www.oeco.com.br/fernando-fernandez/22378-preenchendo-a-floresta-vazia.

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APRESENTAÇÃO

O Brasil reúne uma das maiores riquezas em avifauna do mundo, com 1889 espécies descritas, das quais mais 278 (15%) são endêmicas, o que torna o país um dos mais importantes em relação aos investimentos em conservação (Sick, 2001; Piacentini *et al*. 2015). Os psitacídeos possuem uma grande representatividade no país, que abriga 23% (87 espécies) de todas as espécies encontradas no mundo, sendo que 23 delas são endêmicas e ocorrem apenas no Brasil (Piacentini *et al*. 2015). O grupo é conhecido pelas grandes araras, belos papagaios capazes de imitar as vozes humanas e os coloridos periquitos (Sick, 2001).

O papagaio-verdadeiro, *Amazona aestiva* é um dos psitacídeos mais popularmente conhecidos e é encontrado nas regiões Nordeste, Sudeste, Centro-oeste e Sul do Brasil, além do leste da Bolívia, norte da Argentina e sul do Paraguai (Sick, 2001; Seixas & Mourão, 2002b). Nessa ampla área de distribuição, ocupa biomas distintos como a Caatinga, Cerrado, Pantanal e Chaco e consomem flores, polpa de frutos, folhas e, sobretudo, sementes de frutos secos, podendo ser considerados granívoros das copas das árvores (Shunck *et. al*., 2011). Essa ave distingue-se de outras espécies de papagaios pela fronte e loros azuis, com amarelo na cabeça, ao redor dos olhos e na bochecha, penas da nuca, laterais do pescoço e ventre com margem escura, penas de vôo verde-azuladas, espelho e bases das retrizes externas vermelhas e bico negro (Sick, 2001). Devido à grande variação individual do colorido da cabeça, nunca são encontrados dois indivíduos iguais (Shunck *et. al*., 2011). São reconhecidas duas subespécies: *A. aestiva aestiva*, que possui o encontro vermelho e ocorre na região oriental do Brasil, e *A. a. xanthopteryrix*, que possui o encontro amarelo e ocorre na região da Bolívia, norte da Argentina e Brasil ocidental (Darrieu, 1983; Shunck *et. al*., 2011). Segundo Sick (2001), papagaios-verdadeiros vivem

em bandos, adotam um comportamento monogâmico e atingem a maturidade sexual a partir do terceiro ou quarto ano de vida. Eles reproduzem durante a primavera e início do verão, nidificando em cavidades, frequentemente em árvores, aproveitando-se daquelas já existentes (Sick, 2001; Seixas, 2009). Quanto à longevidade, na natureza estima-se que seja em torno de 20 anos e no cativeiro já foram registrados indivíduos de 50 a 80 anos (Sick, 2001).

A grande riqueza de espécies da avifauna brasileira gera uma ideia de abundância, porém muitas espécies de aves apresentam números populacionais relativamente pequenos e associados a expressivos endemismos, o que a torna frágil perante aos impactos de desmatamento, tráfico e caça (Mittermeier *et al*., 1992; Aveline & Costa, 1993). O Brasil está entre os que mais perdem sua diversidade biológica para o comércio ilegal de animais silvestres (Lacava, 2000; RENCTAS, 2001). Os psitacídeos, devido à habilidade de imitar a voz humana, combinada com a inteligência, beleza e docilidade, estão entre as aves mais populares e procuradas como animal de estimação no mundo (Lacava, 2000; RENCTAS, 2001; Sick, 2001). Por esse motivo estão entre os animais mais comercializados ilegalmente, pertencendo ao grupo com maior número de espécies constantes na lista da Fauna Brasileira Ameaçada de Extinção (Snyder *et al*. 2000; Machado *et al.*, 2008; Francisco & Moreira 2012).

Declínios populacionais de *A. aestiva* já são evidentes na Argentina (Collar, 1997; Rabinovich 2004) e no Brasil podem chegar a uma situação crítica se não evitada a forte exploração ilegal (Seixas & Mourão, 2002a; Shunck *et. al*, 2011). A contínua diminuição no recrutamento de filhotes nas populações nativas, aliada a perda de ninhos e descaracterização dos ambientes naturais, afeta negativamente as populações de papagaios-verdadeiros (Seixas & Mourão, 2002b). Embora a espécie ainda não esteja ameaçada de extinção, considerando toda a

sua área de ocorrência, não se sabe ao certo qual a situação da espécie localmente na grande maioria dos estados brasileiros. Devido a essa enorme pressão de captura a espécie foi incluída no Plano de Ação Nacional para Conservação dos Papagaios da Mata Atlântica (Seixas & Mourão, 2002b; Shunck *et. al*, 2011).

Dentro deste contexto, Minas Gerais sofre de maneira significativa com a perda de exemplares da fauna silvestre, sendo que apenas em 2009, o Centro de Triagem de Animais Silvestres (CETAS) em Belo Horizonte do Instituto Brasileiro do Meio Ambiente e dos Recursos Naturais Renováveis (IBAMA), recebeu mais de 16 mil animais silvestres oriundos direta ou indiretamente do tráfico de animais e de recolhimentos de animais debilitados em áreas urbanas (Vilela, 2012). Desse total, cerca de 80% foram aves e o papagaio-verdadeiro esteve entre as espécies mais recebidas; cerca de 330 papagaios-verdadeiros são recebidos por ano no CETAS de Belo Horizonte (Vilela, 2012; Souza et al. 2014; Freitas et al. 2015).

O papagaio-verdadeiro torna-se então um desafio especial para os gestores de fauna silvestre devido à dificuldade de destinar os espécimes recebidos no CETAS (Vilela, 2012). As possíveis destinações para os animais confiscados são: 1) criadouros legalizados; 2) devolução dos animais à natureza; 3) eutanásia (IUCN, 2002). Encontrar locais apropriados para os papagaios-verdadeiros é demorado, são necessárias grandes instalações e o manejo a logo prazo desses animais em cativeiro representa um alto custo financeiro (Vilela 2012). A eutanásia não é popularmente aceita (IUCN, 2002). Consequentemente, os papagaios-verdadeiros geralmente permanecem por anos nos CETAS em condições não ideais, ou são soltos na natureza sem qualquer avaliação comportamental ou de saúde, e sem monitoramento após a soltura (Marini & Garcia, 2005; Vilela 2012).

A soltura de animais criados em cativeiro na natureza representa uma série de riscos tais como: a) introdução de agentes causadores de doenças juntamente com os animais soltos; b) alterações deletérias na constituição gênica da população residente com a soltura de animais

com padrão genético desconhecido; c) competição com outros animais silvestres de vida livre pelos, quase sempre escassos recursos disponíveis; d) morte dos animais soltos em decorrência do despreparo para a sobrevivência no ambiente natural após período em cativeiro (Griffith *et al.* 1989; Beck *et al*. 1994; Snyder *et al.* 1996; Iucn, 2002; Brightsmith *et al.* 2005; Vilela, 2012). Desse modo, é urgente a necessidade do monitoramento desses papagaios que são frequentemente soltos pelas autoridades ambientais no Brasil sem nenhum critério, bem como o desenvolvimento de pesquisas cientificas para criação e aprimoramento de técnicas de reabilitação, avaliação sanitária pré-soltura e que as solturas sempre sejam realizadas respeitando a distribuição geográfica natural da espécie. Os resultados dessas pesquisas servem para fundamentar as decisões dos gestores de fauna silvestres quanto à destinação dos espécimes recebidos nos CETAS.

A translocação tem sido considerada uma importante ferramenta de manejo para a conservação de animais e plantas (Campbell, 1980; Falk, 1992) e pode ser considerada uma alternativa para as espécies constantemente apreendidas, como *A. aestiva,* retornarem à natureza. É crescente o número de estudos teóricos e de trabalhos publicados refletindo a quantidade de iniciativas desta natureza, tanto no Brasil como no restante do mundo (Griffith *et al*., 1989; Seddon, 1999; Teixeira *et al.* 2007). A IUCN (1995) define translocação como "a movimentação de organismos vivos, pelo homem, de uma determinada área para outra, com soltura nesta última", a qual pode ser de três tipos: 1) introdução: soltura intencional ou acidental de um organismo em área fora da distribuição geográfica conhecida daquela espécie; 2) reintrodução: soltura intencional de um organismo em área que se encontra dentro da distribuição geográfica da espécie, mas onde a espécie foi localmente extinta como resultado de atividades humanas ou catástrofes naturais; e 3) revigoramento populacional: soltura de indivíduos de uma espécie com a intenção de aumentar o número de indivíduos de uma população em seu habitat e distribuição geográfica originais. Diversos são os objetivos

conservacionistas dos processos de translocação: 1) restabelecer uma espécie à sua área de distribuição geográfica original; 2) aumentar o núcleo reprodutivo de uma população em declínio; 3) introduzir um controle biológico; 4) aumentar a variabilidade genética de uma população; 5) estabelecer novas populações, e 6) salvar indivíduos de áreas a serem destruídas (Campbell, 1980; Scott & Carpenter, 1987).

No Brasil, levando-se em consideração o enorme número de espécies e espécimes animais apreendidos anualmente (Vilela, 2012; Souza *et al.* 2014; Freitas *et al.* 2015), há poucos estudos publicados que analisem programas de reintrodução/translocação destes animais, especialmente aves (Marini & Garcia, 2005). Poucos são os projetos de reintrodução/translocação bem-sucedidos no mundo (Griffith *et al*., 1989; Wolf *et al*., 1996; Fisher & Lindenmayer, 2000). No Brasil, dados categóricos sobre o número e taxas de sucesso de programas de reintrodução/translocação de espécies são inexistentes na literatura científica (Marini & Garcia, 2005). A implantação de projetos com embasamento técnico-científico que abordem a translocação de animais silvestres apreendidos representa uma importante ferramenta de manejo, além de auxiliar na produção de instrumentos para a conservação de espécies ameaçadas. Animais criados em cativeiro podem ser a única alternativa para conservação de espécie em riscos de extinção, como a ararinha azul, *Cyanopsitta spixii* (Scott & Carpenter 1987; Griffith *et al*. 1989; Clout & Merton 1998; Sanz & Grajal 1998; Collazo *et al.* 2003; Robertson *et al.* 2006), e utilizar uma espécie não ameaçada como o *A. aestiva* para o desenvolvimento de técnicas de manejo, reabilitação e monitoramento de psitacídeos criados em cativeiro é essencial para não colocar em risco os poucos espécimes existentes de espécies ameaçadas com testes de metodologias.

Animais que permanecem em cativeiro durante longos períodos podem perder a capacidade de encontrar alimento, abrigo e parceiros, e de reconhecer e fugir de predadores, o que pode diminuir as chances de sobrevivência dos animais (Shepherdson *et al*., 1998; Griffin *et al.*,

2000; Young, 2003). A falta de estímulos pode causar a diminuição da diversidade de comportamentos expressados e o aparecimento de comportamentos anormais e estereotipados, diminuindo o bem-estar dos animais (Young, 2003). O treinamento dos animais para reconhecer e evitar predadores é uma das alternativas para contornar esses problemas, pois promove habilidades necessárias para sobrevivência dos animais soltos na natureza com a estimulação de comportamentos típicos da espécie (Griffin *et al.*, 2000; Young, 2003).

O treinamento de animais para o reconhecimento de predadores tem crescido nos últimos anos e já existem alguns resultados preliminares animadores, como nos trabalhos de Azevedo e Young (2006a/b), Alonso *et al*. (2011), Gaudioso *et al*. (2011) e Rodrigues (2013). Um substancial número de pesquisadores vem demonstrando em seus experimentos que animais que inicialmente não se sentem ameaçados perante predadores podem ser condicionados a responder adequadamente a eles, tanto à predadores vivos, quanto à modelos taxidermizados (McLean, et al. 1999; Azevedo & Young, 2006a/b; Alonso et al. 2011; Gaudioso et al. 2011; Rodrigues, 2013; Cortez et al. 2015).

Outro aspecto importante a ser considerado em trabalhos de translocação de fauna é a personalidade de cada animal, porém, normalmente, esses traços comportamentais individuais não são avaliados no momento de seleção de indivíduos para soltura (Teixeira *et al*., 2007). Personalidade pode ser definida como a variação de comportamento entre indivíduos e é avaliado com base na propensão do indivíduo em assumir riscos (Wilson *et al*., 1994; Carter et al. 2013). Alguns indivíduos são mais ousados em situações de risco e novidade (indivíduos corajosos), enquanto outros são mais cautelosos em uma mesma situação (indivíduos tímidos) (Wilson *et al*., 1994). Alguns estudos indicam que a personalidade pode influenciar em comportamentos-chave para a sobrevivência e reprodução na natureza, como na habilidade de caça, estratégia reprodutiva e de aversão a

predadores (Costantini et al., 2005; Hollander et al., 2008; van Oers et al. 2008). Animais mais corajosos provavelmente não possuem desconfiança suficiente para evitar predadores e podem ser mail facilmente predados, porém em outro contexto, eles podem estar mais dispostos a explorar o ambiente e encontrar o alimento (Coleman & Wilson 1998; Watters & Meehan 2007). Azevedo e Young (2006c) sugeriram que a situação ideal em programas de reintrodução/translocação seria selecionar indivíduos nem muito tímidos e nem muito corajosos.

O gênero dos animais é outro parâmetro importante que não é normalmente avaliado em programas de conservação (Ball & Ketterson 2007; Teixeira *et al*., 2007; Lambertucci *et al.*, 2013). O sexo dos indivíduos pode estar ligado à personalidade, estresse, dispersão, reprodução e, consequentemente, em como esses animais vão responder ao ambiente após serem soltos (Jones *et al.*, 2003; Schuett & Dall 2009; Cohen & Yehuda 2011; Titulaer *et al.*, 2012; Clutton-Brock & Huchard 2013; Tecot *et al.*, 2013; Keller *et al.*, 2015). Em um programa de translocação de raposas (*Vulpes velox*) no Canadá, fêmeas apresentaram menores taxas de sobrevivência do que os machos, assim, os pesquisadores sugeriram que deve ser translocado uma maior proporção de fêmeas em comparação aos machos, a fim de estabelecer relações de sexo equilibradas na população solta (Moehrenschlager & Macdonald, 2003). Sendo assim, pode ser importante avaliar as influências de gênero na taxa de sobrevivência e no comportamento dos indivíduos soltos, a fim de determinar a proporção sexual adequada para a espécie que será translocada.

Este estudo foi divido em dois capítulos e teve como objetivos: Capítulo 1: Descrever e avaliar técnicas de manejo e monitoramento pós-soltura de um grupo de papagaios-verdadeiros procedentes de cativeiro, descrevendo os resultados do processo de adaptação à natureza através da avaliação dos comportamentos dos indivíduos; Capítulo 2: Avaliar a

influência do treinamento anti-predação, personalidade e sexo dos papagaios-verdadeiros na sobrevivência, comportamento e dispersão dos indivíduos após a soltura;

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Capítulo 1

Translocation and post-release monitoring of captive-raised blue-fronted Amazon parrots (*Amazona aestiva*) in Brazil.

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Translocation and post-release monitoring of captive-raised blue-fronted Amazon parrots (*Amazona aestiva*) in Brazil

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Abstract

Translocation has constantly been mentioned as an alternative to the conservation of endangered species. The use of captive-raised animals in these processes is sometimes the only option to recover a declining population. The Blue-fronted Amazon parrot (*Amazona aestiva*) is one of the most popular worldwide captivity species; consequently, it is among the most received species by the Wild Animal Triage Centers in Brazil. Brazilian wildlife managers frequently release the received parrots into nature without any behavioral or

health evaluation, and with no post-release monitoring. Thirty-one parrots were soft released and monitored during 13 months in a *Cerrado* area of Minas Gerais State, Brazil. Three (10%) released parrots dead and five (16%) disappeared soon after release and no behavioral recordings or data about their destinations were available. Ten parrots (32%) showed behaviors that suggest adaptation to wildlife and 13 individuals (42%) expressed behaviors more linked to the life in captivity. One released pair and one female paired with a wild male, reproduced. The number of recorded behaviors increased significantly over time after release. There was a tendency of decrease in all captive-related behaviors and of increase in wildlife-related behaviors. Supplementary food use diminished as the parrots explore natural food resources. This study indicates that confiscated ex-pets parrots can be good candidates to translocation, but a training program should be applied to them prior to the release in order to diminish undesirable behaviors and the chance to approach and be re-captured by humans. To release the parrots in areas with native populations can increase the behavioral skills of the birds, since native parrots can act as teachers for the naïve birds. Besides, the use of not-endangered species in conservation programs can be interesting to create protocols to conservation programs of rare and endangered species.

Keywords

Behavioral skills, captivity, conservation, ex-pets, Psittacidae, soft-release.

Introduction

Reintroduction and translocation have constantly been mentioned as alternatives to the conservation of endangered species' populations (Wilson et al. 1994; Sanz & Grajal 1998; Wanless et al. 2002; Collazo et al. 2003; Brightsmith et al. 2005; Seddon et al. 2012; Oliveira et al. 2014). However, there are few well documented reintroduction/translocation studies where the methodologies are systematically described, which sometimes make them difficult to be replicated. Besides, normally the mistakes and successes of the post-release processes are missing on these studies (Scott & Carpenter 1987; Griffith et al. 1989; Beck et al. 1994; Brightsmith et al. 2005; Marini & Filho 2005; Mathews et al. 2005; Earnhardt et al. 2014).

The use of captive-raised animals for reintroduction/translocation programs is being commonly discussed, and the major concerns are that these animals can transmit diseases for wild population, can present high levels of consanguinity (inbreeding depression can be a genetic risk for wildlife populations), and probably lost the necessary behavioral skills to survive and reproduce in the wild (Griffith et al. 1989; Beck et al. 1994; Snyder et al. 1996; Brightsmith et al. 2005). However, it is necessary to study the process of adaptation to wildlife of these captive-raised individuals, because they can be the only option for conservation programs of endangered or extinct species in the wild (Scott & Carpenter 1987; Griffith et al. 1989; Beck et al. 1994; Clout & Merton 1998; Sanz & Grajal 1998; Collazo et al. 2003; Robertson et al. 2006).

Brazil has one of the most diverse avifauna of the world (Mittermeier et al. 2005), but loses much of it to the illegal trade of wild animals (Lewinsohn & Prado 2006; Vilela 2012; Souza et al. 2014; Freitas et al. 2015). Wild Animal Triage Centers (CETAS) are the Brazilian facilities responsible for receiving wild animals seized, rescued or voluntarily

handed out by the citizens (Marini & Filho 2005; Vilela 2012). A study conducted by Vilela (2012) recorded the impressive number of 234,595 specimens received by all Brazilian CETAS during a period of three years (2008 to 2010), most of them being birds (86%) and originated by police apprehension (67,7%). The main destination (80%) of these animals are the release into the wild (Renctas 2001; Vilela 2012). According to Marini and Filho (2005), most of the specimens illegally caught are released in inappropriate places without adequate health and behavioral evaluations and without any monitoring program after release.

The adequate destination of wild animals received in CETAS according the rules of the International Union for Conservation of Nature (IUCN) (IUCN, 2002) is a challenge for wildlife managers in Brazil. Find appropriate places in captive for the various animals is time-consuming and the CETAS/breeders/zoos are crowded; to keep them in the CETAS for a long period of time has high financial costs and requires larger facilities (which is not the case in many CETAS) (Vilela 2012); euthanasia of healthy animals is not socially acceptable (IUCN, 2002), which make the simple non-monitored release into nature the most viable destination, despite all the risks involved in this action (Vilela 2012).

The Blue-fronted Amazon parrot (*Amazona aestiva*) is one of the most popular species kept in captivity in the world (Seixas & Mourão 2002), consequently, it is among the species most received by the CETAS (Vilela 2012; Souza et al. 2014). In Brazil, it is found in the Northeast, Southeast, Midwest and South, in addition to eastern Bolivia, northern Argentina and southern Paraguay (Sick, 2001), inhabiting distinct biomes such as the *Caatinga*, *Cerrado*, *Pantanal* and *Chaco* (Schunck et al. 2011). Normally, nestlings are captured direct from the nests, which decreases the recruitment of individuals in wild populations, and decreases reproductive sites, since parrots abandon disturbed reproductive

sites (Seixas & Mourão 2002). Although not considered endangered, the species was included in the "National Action Plan for the Conservation of Threatened Parrots of the Atlantic Forest" in Brazil, due to the high pressure that this species suffers from the trafficking of wild animals (Schunck et al. 2011).

The CETAS of Belo Horizonte City, capital of Minas Gerais State, southeastern Brazil, receive on average 327 Blue-fronted Amazon parrots per year (Vilela 2012; Souza et al. 2014; Freitas et al. 2015). This species is considered a special challenge for wildlife managers, because it is very difficult to find legalized creators that want to receive the parrots, with suitable facilities and can afford the high maintenance costs of the specimens in captive. Thus, they usually remain for years in the CETAS, in conditions less than ideal, or are released into nature without any behavioral or health evaluation, and with no post-release monitoring (Vilela 2012). Thereby, there is an urgent need for researches focus on the post-release monitoring program for these parrots to help evaluate how these animals behave and survive when back to the wild, highlighting failures in the processes that could be improved in future release programs. These answers are very important to generate empirical information to support the decisions of wildlife managers about destination of these birds in the CETAS and to create and evaluate management, rehabilitation and monitoring techniques for captive-raised parrots. Using not endangered species as test subjects, we can develop and improve protocols that can be used in conservation programs of species facing the risk of extinction.

The goals of the present study were to evaluate techniques of management and monitoring employed in the translocation of a group of captive-raised Blue-fronted Amazon parrots, describing the parrot's adaptation process to wildlife and discussing the viability of using captive-bred specimens in parrots conservation programs

Methods

Study area

The study was conducted in a particular farm located in the metropolitan region of Belo Horizonte city, Minas Gerais State (MG), southeastern Brazil. This area belongs to the ASAS project (wild animals release area project) of the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA), and it is located near an Environmental Protection Area (APA). The mean annual temperature is 23°C, and the mean annual rainfall is 1,380 mm, with the dry season ranging from May to September and a rainy season ranging from October to April (Botelho 2008). The site was a mix of savanna vegetation (*Cerrado*) and pasture areas, composed of farms, urban areas and a State Park. In the release site there is a high rocky wall that wild parrots uses as dormitories. Release was authorized by the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) under the license n° 170/2012; release site register: IBAMA-ASAS 005/2010.

Selection of release subjects and artificial markings

Thirty-six Blue-fronted Amazon parrots were pre-selected in the CETAS of Belo Horizonte, to participate in the translocation study. All individuals were voluntarily handed out or seized from particular owners and captured from the wild as chicks, thus their ages and birth areas were unknown. Veterinarians conducted general health exams, attesting that 31 of the 36 birds were healthy and able to participate in the translocation program, then, 31 parrots were transferred after a quarantine period to two acclimatization aviaries located at the release site (17 males and 14 females).

All parrots were painted on the chest with a non toxic Expo® low odor dry-erase marker (right side for females and left side for males), received a microchip and two leg bands: an

aluminum colored leg band and a stainless steel leg band, with an identification number and the IBAMA's telephone number. Six parrots also received a VHF signal transmitter radio collar, model TXE304CP, Telenax Company®. Forehead color patterns were also used on the parrot identification; researchers had an identification card of each released parrots, with a photograph of their foreheads and all individuals' information.

Acclimatization aviaries and pre-release training

Parrots were held in two acclimatization aviaries for at least 10 months: 15 birds in one aviary and 16 birds in the other. The acclimatization aviaries had 12 m length, 4 m width and 3.5 m height each, and were placed 2 m distant from each other, away from human interferences and surrounded by natural habitat. The aviaries were partially shaded and had six fixed perches, placed far from each other to encourage birds to fly. Water was provided *ad libitum* and the food, a mixture of industrialized food for parrots (Megazoo®), sunflower seeds and fruits of the season, was provided every day at 8:00 AM. Occasionally, it was also provided native fruits and seeds found in the release area.

Flight training: most of the parrots were held in minuscule cages or had no opportunities to fly when kept by their owners. Thus, flight needed be stimulated prior to release. To stimulate flight and muscle development, perches were positioned far from each other inside the aviaries and food were positioned far from the cage wire, forcing parrots to fly to perch and to reach the feeders.

Soft release

The soft release technique allows animals to have an acclimatization period in the release area before release into nature; the enclosures are open and animals leave them in a

spontaneous form (Mitchell et al. 2011); this technique was adopted in the present study. Supplementary food was provided in five artificial feeders distributed in the release area during the entire monitoring period; some researchers consider essential to provide supplementary food for a long period after release (Brightsmith et al. 2005) or until the animals become self-sufficient in food acquisition (Snyder et al. 2000).

After the acclimatization period (10 months), the upper windows of the aviaries were opened to allow the spontaneous exit of the parrots . To facilitate the process of rehabilitation to the wild, during the first year of parrot monitoring, seven artificial nests were distributed through the release site.

Monitoring

The monitoring campaigns were performed by a team of five people who were trained to identify and observe the behavior of the released parrots. These campaigns began just after the opening of the aviaries and were performed for 13 months, totaling 26 campaigns. The first one lasted ten days and the others lasted four days each. The intervals between the three first campaigns were of five days and to the others were fifteen days.

The radio-collared parrots were tracked using a portable VHF signal receiver (model: RX-TLNX of Telenax® company), a manual three-element Yagui directional antenna, a compass (Nautika® Tour 30170) and a GPS (Garmin® Etrex Legend), using the triangulation method (Piovezan & Andriolo 2004). The other parrots were tracked with the support of binoculars (Bushnell H^2O 10X42 m) and a camera (Canon 60D with 70-300mm lens) and they were identified by the artificial markings and the natural markings in their faces.

Data collection

After the first month, it were collected data on the behavior of each released individual found, its distance from the release site, and if the parrot was alone or in a flock (when in a flock, all individuals of the flock were identified). Data collection occurred in three different periods: in the two hours after sunrise (5:00-7:00 AM), in the two subsequent hours (7:00-9:00 AM), and in the two hours before the sunset (4:00-6:00 PM). Each bird found had his behavior recorded for 25 minutes in each period. Therefore, whether the individual was found during the campaign in the three periods, it would have 75 minutes of his behavior recorded. Focal sampling with instantaneous recording of behavior every minute was used in behavioral recordings (Altmann, 1974; Martin and Bateson, 2007). An ethogram for *A. aestiva* (Table 1) was prepared before the release based on Andrade & Azevedo (2011) and in 80 hours of preliminary behavioral observations of captive parrots using the *ad libitum* method (Altmann, 1974).

_____Insert Table 1_____

Dispersion zones were created to determine how far individuals moved from the release point and the frequency that these areas were used by the released parrots: 0-50m from the release point = yard (Y); 51-100m = nearby (N); 101-500m surroundings (S); greater than 500m = distant (D).

It was also evaluated the use of the artificial feeders by counting the number of parrot visits during the first six months of monitoring. The evaluation was performed twice a day (morning – 7:00 AM and afternoon – 3:00 PM) for one hour in each period, during the four days of the monitoring campaign. The five feeders were distributed 0 to 50 m away from

the aviaries and the food was always offered before the beginning of the observation sessions of the feeders' use, both in the morning and in the afternoon (6:45 AM and 2:45 PM). When there was no monitoring campaign, the food was offered only once a day, in the morning (6:45 AM).

Environmental education

An education programme was launched before and during the release/monitoring of the parrots with the community around the release site. The project team went to all houses in the vicinities to explain about the project, the importance of the Blue-fronted Amazon parrots in the region and the need for the community to support the project. Flyers containing information about the project, artificial markings of the parrots, contact phones and an invitation to the community to support and participate in the project were distributed in the region. Teachers from two public schools were invited to discuss with their students issues related to conservation biodiversity and consequences of illegal trade of wild animals. Before release the animals, an event was organized to talk about biodiversity conservation, the Blue-fronted Amazon parrot, the release and monitoring project and community involvement in environmental issues. In this event, activities such as theatrical performances, games, dance, poetry, and lectures were used to leave the message.

Data analysis

For the analysis, a parrot that dispersed away from the release site and disappeared was not considered a dead parrot. Parrots were considered dead if the carcasses were found or if evidences of predation were found (feathers, parts of the body, etc.). For the missing

parrots, we carried out analysis of their behavior until the last campaigns before disappearing and inferences were made about their survival or not.

A simple linear regression was used for parametric data analysis: to evaluate if the number of behaviors expressed increased over time and if the number of parrots using the feeders decreased over time.

Spearman correlation was used for non-parametric data analysis: to evaluate if the number of interaction with humans was related to the time each parrot spent feeding on the feeders; if the expression of captive-related behaviors, such as human vocalizations, captivity vocalization, feeding in feeders, interaction with human, inactive, and abnormal behaviors, decreased over time; if the expression of natural behaviors, such as feeding in nature, interacting with wild parrots, foraging and flying increased over time. Furthermore, Spearman correlation was also used to evaluate if the behavior "interacting with parrots of the same group" (others released parrots) decreased over time. To these latter analysis 14 parrots that have their behavior recorded for a longer period (eighth months) were selected.

Differences in the use of each dispersion zone were evaluated using the Kruskall-Wallis test, with the Mann-Whitney's test as a post-hoc test. The evaluation of the frequency of use of these areas over time was also evaluated using the simple linear regression.

All analysis were run using Statistica® and with a significant level of 95% ($\alpha = 0.05$) (Zar, 1999).

Results

Soft release

The release of the Blue-fronted Amazon parrots took place on June 6, 2013, when the windows of acclimatization aviaries were opened, allowing the birds to come out spontaneously. Fruits were placed in the windows to encourage the approach of individuals to the enclosure exit. The first individual of *A. aestiva* to venture to life outside the aviaries was a female (id number 1147), which came out flying to a tree about 40 meters away from the aviary, 1 hour and 20 min after opening the windows.

Many individuals left the enclosure walking in the screen until the roof and then flew to some near tree. Others came to the windows, ate the fruits and returned to the enclosure. An individual had to be recaptured (id number 362) after flying and falling to the ground. At the end of the day, six parrots (20%) had left the acclimatization aviaries and explored the surroundings. During the first campaign, at dusk, the windows were closed again to prevent any predator to enter the enclosure and attack the parrots. After ten days of the first campaign monitoring, only two parrots (id numbers 600 and 781) had not left the aviaries, but many individuals returned to the aviaries to spend the night inside of them.

Most parrots showed good flight condition after release. Most started with short flights, but soon flew for longer distances. However, all parrots showed difficulty at the time of landing, probably because in the acclimatization aviaries, perches were fixed and did not had the wind-provoked swing of natural perches.

During the seventh campaign, three months after the release, three parrots still spent most of their time inside the aviaries (id numbers 600, 906 and 781). The team decided to close the windows of the aviaries in this campaign, so these parrots were forced to live

outside. Even after the closure, at least seven parrots remained on the top of the enclosure or in trees close to them, always using its roof as dormitories.

Survival

The survival results were described according to the events and behaviors observed (Table 2). Three released parrots (10%) were confirmed dead. The first one, a male (id number 521) was preyed 75 days after release, apparently when defending its nest, since its feathers and the radio collar were found near the nest entrance. The second one, a male (id number 781), left the enclosure three months after the opening and it was found dead one month later, probably by starvation. The third individual, a female (id number 237), disappeared nine months after release, and only its leg ring was found. Another five individuals (16%; id numbers 600, 906, 326, 693, 853) disappeared soon after release and no behavioral recordings or data about their destinations were available. Ten parrots (32%) showed behaviors that suggest adaptation to wildlife, such as to feed most of the time in nature, to avoid humans, to explore natural nests, and to disperse from the release site, integrating wild flocks (id numbers: 298, 299, 425, 313, 988, 257, 682, 513, 176 and 904). Of these, only four individuals were monitored until the last monitoring campaign (id numbers 299, 988, 682 and 904); all the others dispersed with the wild flocks during the monitoring period. The other 42% (13 individuals) expressed behaviors more linked to the life in captivity, preferring to consume food from the feeders, interacting with humans more than with wild parrots, remaining closer to the release aviary and sometimes walking on the ground near the aviary (id numbers: 442, 362, 349, 376, 242, 403, 816, 432, 1147, 902, 755, 992 and 374). Of these, seven individuals were monitored until the last monitoring campaign (id numbers 442, 362, 432, 403, 902, 992 and 374).

_____Insert Table 2_____

Behavior

The number of recorded behaviors increased significantly over time after parrots' release (Fig. 1).

_____Insert Figure 1_____

The expression of four behaviors decreased over time: captivity vocalization ($r = -0.13$, $p<0.05$), inactive ($r = -0.19$, $p<0.005$), foraging ($r = -0.17$, $p<0.05$), and negative interaction with parrots from the same group ($r = -0.14$, $p<0.03$). The first two behaviors were related to the life in captivity and the two formers were related to the adaptation to the wild.

Some of the other behaviors showed a slight decrease over time (human vocalization, feeding in feeders, positive interaction with humans, positive interaction with parrots from the same group, abnormal behaviors, active and moving) or a slight increase over time (feeding in nature, positive interaction with wild parrots, flying and cleaning), but no statistical changes occurred ($p > 0.05$).

The behaviors natural vocalization, negative interaction with humans, negative interaction with wild parrots, avoiding predators, reproduction behaviors, parental care and other behavior were not sufficiently expressed to be analyzed.

The dispersion zones most frequented by the parrots were: yard (34.5%), nearby (13.4%), distant (4.8%), and surroundings (1%), and the use of each dispersion zone differed statistically ($H=43.49$, $p < 0.0001$, $DF = 3$, $N = 111$; *post-hoc*: $U=219$, $p<0.008$, yard X nearby; $U=40.5$, $p<0.0001$, yard X surroundings; $U=101$, $p<0.0001$, yard X distant; $U=195$,

$p<0.005$, nearby X surroundings; $U=274.5$, $p<0.05$, nearby X distant; $U=280.5$, $p<0.05$, surroundings X distant) (Fig.2).

_____Insert Figure 2_____

The frequency of use of each zone by the monitored parrots did not change over time (yard: $R^2= 0.027$, $F(_{1,22})=0.61$, $p<0.44$; nearby: $R^2= 0.021$, $F(_{1,22})=0.48$, $p<0.49$; distant: $R^2= 0.037$, $F(_{1,22})=0.86$, $p<0.36$). The zone "surroundings" were not sufficiently used to be analyzed. Overall, no data were available for 39% of the parrots, since these birds were not located during the monitoring.

Supplementary food

The number of released parrots using the artificial feeders decreased over time (Fig. 3). Six months after release, less than 50% of the parrots were feeding on the feeders. There was no relation between the use of the artificial feeders and the number of interactions with humans ($r = -0.17$, $p>0.37$).

_____Insert Figure 3_____

Pair bonding and breeding behavior

During the study, it was recorded four same-sex (29% of the released parrots; one pair of males: id numbers 349-362; one trio of males: id numbers 988-682-904; and two pairs of females: id numbers 992-902 and 403-442); and four different-sex pairs of parrots (26% of the released parrots; 299-298; 299-wild parrot; 521-442; 257-853). The other parrots formed flocks with native (16% of the released parrots; id numbers: 425, 313, 298, 816,

176) or remain alone (26% of the released parrots; id numbers: 376, 242, 432, 237, 1147, 755. 374, 781); from the “alone” parrots, they remained close and interact with each other, normally in a group distant 100m from the acclimatization aviaries. One of the different-sex pairs was formed by two released parrots (id numbers: male 298 and female 299), and this pair was formed before the release, during the acclimatization period. In the first month after the release, this pair was seen copulating, and in the third month, the pair was seen exploring cracks on the cliffs presented in the area, places normally used by this species to build nests (Sick, 2001). In the fourth month after release, male 298 was seen flying away with a mixed group of up to five individuals of both released and wild parrots, and no recordings for this male was done ever since. After this, female 299 paired with a native male and reproduced (in February 2016, this female was seen feeding a juvenile parrot in a nest).

Another different-sex pair (id numbers: male 521 and female 442) was also formed in the aviary during the acclimatization period. One month after the release, this pair was observed exploring an artificial nest near the release point. The female laid three eggs on the artificial nest, but only one chick was born. Parental care was provided only by the female, because the male was predated days before the chick was born. However, the nestling died 15 days after birth and the cause of death was not determined. After the death of the nestling, the female paired with another female (id number 442) and remained together until the last monitoring campaign.

All same-sex pairs were recorded paired during the entire period of the study, except for the male trio. The monitoring team was forced to separate the same-sex trio of males after they begin to attack people in the release site; males 988 and 682 were captured and re-released into another farm near the original release point. This pair remained together

during the entire monitoring period; male 904, which was not captured, begin to interact with a native individual (sex not determined), pairing and remaining with it until the last monitoring campaign.

Environmental education and captured individuals

The environmental education activities were considered positive since there was a major involvement of the community in the protection of the released birds. Three females (299, 992 and 242) were captured and spontaneously returned to the translocation project by members of the community. According to the residents who captured the parrots, they seemed to be hungry and approached them, facilitating the capture. After their delivery to the researchers, these parrots had their healthy re-evaluated and were re-released on the area. One of the parrots (female 242) was not seen anymore and the other two remained in the vicinity of the release site until the last monitoring campaign.

Monitoring techniques and artificial markings

The use of behavioral recordings to obtain information about the adaptation process to wildlife by the released individuals was considered very important. However, to find, identify and observe the behavior of each parrot in three different time periods by a team of five people in a four-day campaign was a difficult and overwhelming task.

Another difficulty of the monitoring team was to identify the released parrots after the disappearing of the chest ink marks. This occurred by the third month, when the parrots were scattered, living in the cliffs with groups of native parrots. The chest ink markings, the colored leg rings and the identity card were essential for the identification of individuals in the first three months of monitoring. The only mark possible to visualize at long distances

and during the parrots' flight was the radio collar that only 20% of the parrots received. The collar battery lasted for eleven months, but its signal suffered interference in the release area due to the high cliffs and the proximity to small urban centers. Native parrots seemed to not reject released parrots wearing radio collars, since all collared individuals interacted with wild parrot flocks. One collared female (id number 299) paired with a native parrot.

Discussion

Soft release and food supplementation

The soft release process applied in the present study was considered positive, as well as in several other wild animal translocation studies (Bright and Morris, 1994; Wanless et al., 2002; Teixeira et al., 2007; Mitchell et al., 2011). The acclimatization period, obligatorily used in the soft release method, was considered fundamental for the initial adaptation of the Blue-fronted Amazon parrots to their new habitat. During this period, parrots were able to exercise their flight abilities, as well as to get used to the temperature and humidity of the area. Besides, even after their release, the acclimatization aviaries were used many times by many parrots, especially to roost and feeding. This result was also observed in other parrot and macaw releases (Sanz & Grajal 1998; Seixas & Mourão 2000; Brightsmith et al. 2005; Oliveira et al. 2014).

The large acclimatization aviaries, with spaced perches and without perches accessing the feeders, improved the physical condition and flight abilities of the parrots. When kept in CETAS, parrots were unable to fly due to the small size of the aviaries. However, in the field it was observed a certain difficulty of parrots in landing; tree branches are flexible usually swing due the wind in a way parrots find difficult to perch. This was also observed in the reintroduction of the Yellow-shouldered Amazon parrot (*Amazona barbadensis*) on

Margarita Island, in Venezuela (Sanz & Grajal 1998). This problem may be minimized using not-fixed perches, with varying diameters, inside the acclimatization aviaries, but this technique was not tested yet. It is important to release parrots with good physical and flight conditions since this can influence the post-release survival rates, as observed in the study of reintroduced Hispaniola parrots, *Amazona ventralis* (Collazo et al. 2003).

Supplementary food was considered very important in this study because it provided additional energetic resources for the parrots in the early months after the release, when the birds were most vulnerable to hunger due to the unfamiliarity with the new area and the location of its food resources. Supplementary food was also used during the reintroduction/translocation programs of other parrot species (Clout & Merton 1998; Brightsmith et al. 2005; White et al. 2005b). Some researchers believe that supplementary food should be maintained even when there is no more need for nutritional support (Brightsmith et al. 2005). It was observed that some animals have become accustomed to the food offered in the artificial feeders, staying close to the supplementary food sites (100m of distance) even after months after release. An interesting observation was that two males that often fed in the artificial feeders (id numbers 988 and 682), when removed for a new area without artificial feeders, began to explore the environment, dispersing for longer distances to find food resources. These individuals started to feed only in fruits found in the area. For this reason, this study corroborate the findings of Snyder et al (2000), that the supplementary food should be gradually reduced as the animals will recognize the area and discover its resources. In the present study, there was a significant decrease in the use of artificial feeders by the released parrots, thus, six months after release should be an adequate period of time to offer supplementary food. After that, supplementary food should be gradually reduced.

The dispersal zones "yard" and "nearby" were the most frequented by monitored parrots, which means that these parrots spent most of their time at a distance of only 100 meters from the release point. This can be beneficial in the establishment phase when they are adapting to wildlife and have the support provided by the project team (food supplementation and artificial nest). However, for the long-term viability of the translocated population, it is necessary that the individuals explore others areas in order to find food, nest and interact with wild conspecifics, due to limited resources in a small area of life (Le Gouar et al. 2012). This fact was not observed in this study for the parrots that were being monitored, as the frequency of use of the areas did not change over time. The other dispersal zones ("surroundings" and "distant") were used only in 6% of the time by the monitored parrots, almost only by birds that interacted with wild parrots. Yellow-shouldered Amazon parrots released in Margarita Island began to disperse from the release points 20 days after release, covering more and more distant areas, but always returning to the release site (Sanz & Grajal 1998). This was also observed in the present study, wherein parrots attending distant areas were frequently observed in areas near the release point too.

Individuals that dispersed far away from the release area will not contribute demographically to the translocated population and the consequences of dispersing towards urban areas or to areas without the necessary resources to survive could be negative (Tweed et al. 2003; Le Gouar et al. 2012). Overall data about the use of dispersal zones were not collected for 39% of the parrots, since these birds were not found during the monitoring campaigns. Disappearances could be due to death, re-capture by humans or dispersion, which suggests that the frequency of individuals using distant areas may be higher. It is important to distinguish dispersal from mortality and understanding the factors influencing dispersal is crucial in managing the trade-off between site fidelity and adaptive dispersal

(Tweed et al. 2003; Le Gouar et al. 2012). To solve this problem, an effort to use GPS radio-collars should be done in future releases (GPS radio collars are still very expensive devices in developing countries, which makes them difficult to acquire).

Skills needed to survive and maladaptive behaviors

Many of the released Blue-fronted Amazon parrots disappeared along the study or expressed captive-related behaviors. Captive-related behaviors should be avoided by training the parrots to behave adequately: aversive training against humans, the use of local fruits offered in tree branches instead of feeders (to simulate the conditions found in nature), and the use of environmental enrichment to diminish abnormal behaviors are possible measures to increase the expression of normal behaviors (Griffin et al. 2000; Reading et al. 2013).

More than 30% of the released parrots expressed behaviors that suggest adaptation to wildlife, also dispersing from the release site, integrating wild flocks. We suggest to release ex-pet parrots in areas with natural populations, because wild parrots can act as teachers to the captive birds, helping in the enhancement of their skills to live in nature (Sanz & Grajal 1998; Seixas & Mourão 2000; Oehler et al. 2001; Brightsmith et al. 2005). Released individuals require a wide range of behavioral skills and cognitive abilities to survive (Mathews et al. 2005; Teixeira et al. 2007; Azevedo et al. 2012; Reading et al. 2013). The tendency of decrease of all captive-related behaviors and of increase of almost all wildlife-related behaviors suggest that Blue-fronted Amazon parrots were developing these skills and cognitive abilities to survive over time. Furthermore, the increase in the number of displayed behavior and the decrease of inactivity demonstrated that the released parrots were responding in a proper manner to natural stimuli. Similar results were found in the

study of Yellow-shouldered Amazon parrots (*Amazona barbadensis*) released on Margarita Island, in Venezuela, where in the first eight months after release some parrots still approaching humans, but over time, they began to keep a safe distance from humans due to the pairing with native parrots (Sanz & Grajal 1998).

As being a species heavily targeted by animal trafficking due to its ability to imitate human voice (Schunck et al. 2011), the significant reduction of captivity vocalization and the reduction tendency of human vocalizations is of utmost importance because it may decrease the chances of the released parrots of being recaptured by humans. Many species of parrots are vocally flexible in adulthood and this flexibility may therefore allow parrots to meet the communicative needs of a frequently-changing social network (Scarl 2009). The use of natural parrot vocalization playbacks prior to release could help in the diminution of unwanted vocalizations, but this needs to be carefully tested, especially because studies about the social context of vocalizations of the Blue-fronted Amazon parrot are rare (Fernandez-juricic et al. 1998; Fernandez-juricic & Martella 2000).

Breeding and social integration

Reproduction is one of the success indicators of reintroduction/translocation programs and it is a fundamental parameter for any given animal population (Wilson et al. 1994; Wright et al. 2001; Brightsmith et al. 2005; Brightsmith & White 2012). The four different-sex paired parrots expressed reproductive behaviors, and two indeed reproduced. The first chick was born just three months after the release, despite having not survived. In a study about the reproductive biology of *A. aestiva* in nature, Seixas and Mourão (2002) recorded a complete litter loss in 46% of the monitored nests (28% of the losses occurred in the incubation phase and 18% in the hatchling phase). Thus, the low success in the

reproduction of this species is normal, and efforts to increase the rate of success should be conducted for the reintroduced/translocated birds. The distribution of artificial nests through the release area can be a good measure and it has been successfully used in an effort to mitigate the paucity of suitable nest sites for the critically endangered Puerto Rican parrots (*Amazona vittata*), (White et al. 2005a), for the Red-spectacled Amazon parrots (*Amazona pretrei*) (Kilpp et al. 2014) and for the Hyacinth Macaws (*Anodorhynchus hyacinthinus*) (Guedes 2004). In the present study, artificial nests were constantly explored and one was used by the pair who reproduced in the first months after release.

The other reproduction event observed in the released group of parrots in the present study took place two years after the release, and it occurred between one translocated female (id number 299) and one native male. This reproduction event was reported by the local community after the end of the systematic monitoring campaigns. The chick survived and fledges. The female approached humans many times, but the male never did. This is probably an imprinting issue, since the female was captured in the wild when she was only a chick, being raised by human caretakers. According to Ratner and Hoffman (1974), the critical period for the social imprinting to occur in birds is generally during early postnatal development. Although the number of reproduction events involving the released parrots was rare, they show that even ex-pets can produce offspring in nature, contributing to the increase of individuals in nature and for the maintenance of self-sustaining population.

For the increase of translocation success, it is important to maintain the social relationships established between the individuals of the flock, especially those established by the most social parrots of the group (Snyder et al. 2000). The released Blue-fronted Amazon parrots maintained a social structure similar to that observed in native groups, forming pairs or small groups, including mixed groups with native parrots. This result is

contrary to what was found for the same species in a release program in Pantanal (Brazil) by Seixas and Mourão (2000), which found that the released parrots formed just one major group.

The number of interactions with parrots of the same group (released parrots) decreased over time and the number of interactions with native parrots increased over time, but not significantly. This result may imply that a post-release management for those individuals who are not developing their skills and properly interacting with the environment and wild conspecifics may be necessary, as it was done with the trio of males and generated good results. Brightsmith et al. (2005), in his study with Scarlet macaws (*Ara macao*), also observed that ex-pets macaws showed inappropriate social behavior, socializing less with the other released macaws and approaching humans regularly. Human contact was responsible for problems in other species conservation program as well, such as the golden lion tamarins (*Leontopithecus rosalia*) conservation program in Brazil, and the greater rheas (*Rhea americana*) conservation program in Argentina (Beck et al. 1991; Vera Cortez et al. 2015). These problems can be overcome by training the animals before release focusing mainly on the dissociation of human and positive things, like food, what could minimize human contact after release, making the animals less vulnerable to capture and death (Griffin et al. 2000).

Local community involvement

Community involvement with the parrot translocation project was very important because it allowed the evaluation of how vulnerable the parrots were to be recaptured by humans after release. Three parrots were recaptured by people of the community and were spontaneously retrieved to the project, but probably seven other released parrots have been captured by

locals and not retrieved to the project, since they were tamed and stood near the release point. Thus, environmental education activities should be done during the entire project, aiming more involvement of locals.

Two important studies with endangered species in Brazil involving local communities should be mentioned: 1) The critically endangered Brazilian Merganser (*Mergus octosetaceus*) conservation program involved the realization of environmental education activities for different audiences in the local communities of the Espinhaço mountain range in Minas Gerais State, recognizing the bird as a heritage of the region to be valued and protected. The environmental educational program was one of the most important strategies used for the conservation of this species (Lins et al. 2011); 2) As a result of the involvement of the local inhabitants in ecotourism and in craft work, the Hyacinth Macaw (*Anodorhynchus hyacinthinus*) population more than doubled in the South Pantanal region and started to expand to other areas of the center-west Brazil (Guedes 2004). Other researches believed that the key to the success of species conservation programs is the support by local communities (Black 1991; Sanz & Grajal 1998; Oehler et al. 2001; Brightsmith et al. 2005), and these two examples corroborate to this idea.

Thus, parrot reintroduction/translocation programs should be accompanied by a strong involvement of the local communities. Actions such as the creation of birdwatching groups in the release region, the encouragement of ecotourism (with studies about its impact); the capacitation of local tourist guides and craftsmen, the invitation of local people to plant trees that will produce food and nests for the protected species, the encouragement of residents to monitor the released animals, the implementation of activities and discussions in local schools about the subject species and why and how to protect them, the involvement of local authorities in monitoring and the protection of species habitats

through public policies and educational campaigns should be carried out. It is important to conduct periodic reviews of the results achieved by every interventions aiming to ameliorate the conservation programs. Environmental educational activities should be planned and appear on the programs' budget.

Monitoring techniques

Monitoring the animals after release is essential to define the program's results, but it is expensive and needs to be done for longer periods to know if the released population has stabilized or not in the area (Black 1991; Collar 1996; Marini & Filho 2005; Batson et al. 2015). In the present study, it was possible to follow the parrots for only 13 months due to the lack of financial resources, and a reproduction event that occurred during the second breeding season could not be accompanied, being reported to the researchers by individuals of the local community, which reinforces the importance of the involvement of the local communities in the conservation programs.

The proportion of six parrots per observer during four days campaigns was considered exhaustive and sometimes insufficient when the animals were scattered away from the release area. Maybe it should be used at least one observer for every four parrots and the campaigns should last eight days. Being so, more data could be collected, especially for those parrots dispersed for longer distances.

The acquisition of radio collars (VHF or GPS) is costly for conservation programs that release larger numbers of animals. In this project, due to signal interference, VHF collars were not very useful to locate the dispersed parrots. The monitoring team could not find an individual with collar (id number 257) during four consecutive campaigns (two months), which emphasizes the idea that a missing individual may not be dead. In a monitoring of

two individuals of Lear's Macaws *Anodorhynchus leari* released in a *Caatinga* area in Bahia state, researchers also had difficulties to find the birds using the conventional (VHF) radio telemetry (Oliveira et al. 2014). Nevertheless, it was easy to identify a parrot wearing a collar at great distances or even during flights. Since there was not rejection of parrots that used collars by the other parrots, it is suggested that all individuals should be marked by "false collars", devices similar in shape and size to the real signal transmitters but with no electronics within, to facilitate parrot localization and behavioral recordings during monitoring campaigns.

Captive-raised parrots and reintroduction/translocation programs

Captive-raised parrots are commonly seen as the worst candidates for release because they lose the ability to recognize predators, to find food in the wild and to socialize with conspecifics (Brightsmith et al., 2005; Azevedo et al., 2012; Snyder et al., 1996). This is one of the reasons why many researchers do not recommend the release of captive-raised animals, except when there is no other option in species conservation programs (Griffith et al. 1989; Beck et al. 1994; Snyder et al. 1996). Our study indicates that confiscated ex-pets Blue-fronted Amazon parrots can be good candidates to translocation, but a training program should be applied to them prior to the release in order to diminish undesirable behavior and decreases the chance of the parrot to approach and be re-captured by humans. Behavior problems can be overcome by training the animals before release and implementing techniques of environmental enrichment (Griffin et al. 2000; Reading et al. 2013).

The soft release technique proved to be efficient in the acclimatization of the parrots to the new area. Supplementary food resources were extensively used by the released parrots,

but its use diminished as the parrots explore the food resources of the release area. To release the parrots in areas with native populations can increase the behavioral skills of the birds, since native parrots can act as teachers for the naïve birds. Besides, the use of not-endangered species in conservation programs can be interesting to create protocols to conservation programs of rare and endangered species. Finally, this study can improve the management techniques of CETAS and assist wildlife managers to take better decisions about the destiny of the large quantity of Blue-fronted Amazon parrots annually received by these Institutions.

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Table 01 – Ethogram for *A. aestiva* prepared before based on Andrade & Azevedo (2011) and on 80 hours of preliminary behavioral observations of captive parrots using the *ad libitum* method (Altmann, 1974).

Behavior	Description
Active	Behaviors: pecking (leg rings, feeders, perches, branches, wires), defecating, alert (neck stretched and eyes wide open, focusing on something).
Inactive	Parrot is inactive or sleeping.
Cleaning	Behaviors: preening, beak cleaning (parrot rubs its beak on a perch/wire to remove food wastes) or water or dust bath.
Moving	Behaviors: walking and climbing the wire/tree.
Flying	Parrot is flying.
Natural vocalization	Parrot emits natural vocalizations, similar to those of the wild parrots.
Human vocalizations	Parrots emit human vocalizations, like whistles, words, phrases, songs, animals' imitations (barks, mews, etc.).
Captivity vocalization	Parrots emits grunt, loud vocalizations, different from natural and human vocalizations.
Feeding in nature	Parrot eats fruits collected from the trees.
Feeding in feeders	Parrot eats fruits from the artificial feeders.
Foraging	Parrot search for food in the area.
Positive interaction with parrots from the same group	Parrot positively interacts with other parrot of the same group (released parrots).
Negative interaction with parrots from	Parrot negatively interacts with other parrot of the same group (released parrots).

the same group	
Positive interaction with wild parrots	Parrot positively interacts with wild parrots.
Negative interaction with wild parrots	Parrot negatively interacts with wild parrots.
Positive interaction with humans	Parrot positively interacts with humans.
Negative interaction with humans	Parrot negatively interacts with humans.
Abnormal behaviors	Abnormal behaviors: swinging upside down, rotating head, making repetitive movements, and pacing.
Avoiding predators	Parrot flies away from potential predators or lower his head in the presence of a predator.
Reproduction behaviors	Behaviors: nest building, nest defense (when a parrot lowers his head and raises its tail to another individual), courtship, and mating.
Parental care	Behaviors: nesting, interaction with nestlings, feeding nestling and cleaning nestling.
Other behaviors	Behaviors not previously described.
Not visible	When the parrot is not visible.

Table 2: Results of the survival of the 31 Blue-fronted Amazon parrots (*A. aestiva*) released in an area of *Cerrado* of Minas Gerais, Brazil, after 13 months of monitoring.

Situation	Number of released parrots	Proportion (%)
Parrots released into nature	**31**	**100**
Confirmed survival	**11**	**35.48**
Presented natural behaviors after release	4	12.90
Presented behaviors associated to captivity	7	22.58
Confirmed missing	**17**	**54.84**
Presented natural behaviors after release	6	19.35
Presented behaviors associated to captivity	6	19.35
No data	5	16.12
Confirmed dead by predation	**2**	**6.45**
Confirmed dead by not adaptation to wildlife	**1**	**3.23**

Figures legends

Figure 1: Number of behaviors expressed by the Blue-fronted Amazon parrots over time after release (linear regression: R^2= 0.59028449 F(1,46)=68.714 p<0.0001).

Figure 2: The frequency of use of the dispersion zones by monitored Blue-fronted Amazon parrots. Different letters represent statistical differences between the areas.

Figure 3: The use of the supplementary food by the Blue-fronted Amazon parrots over time after release (linear regression: R^2= 0.69; $F_{(1,8)}$ = 21.25; p=0.001).

Figures

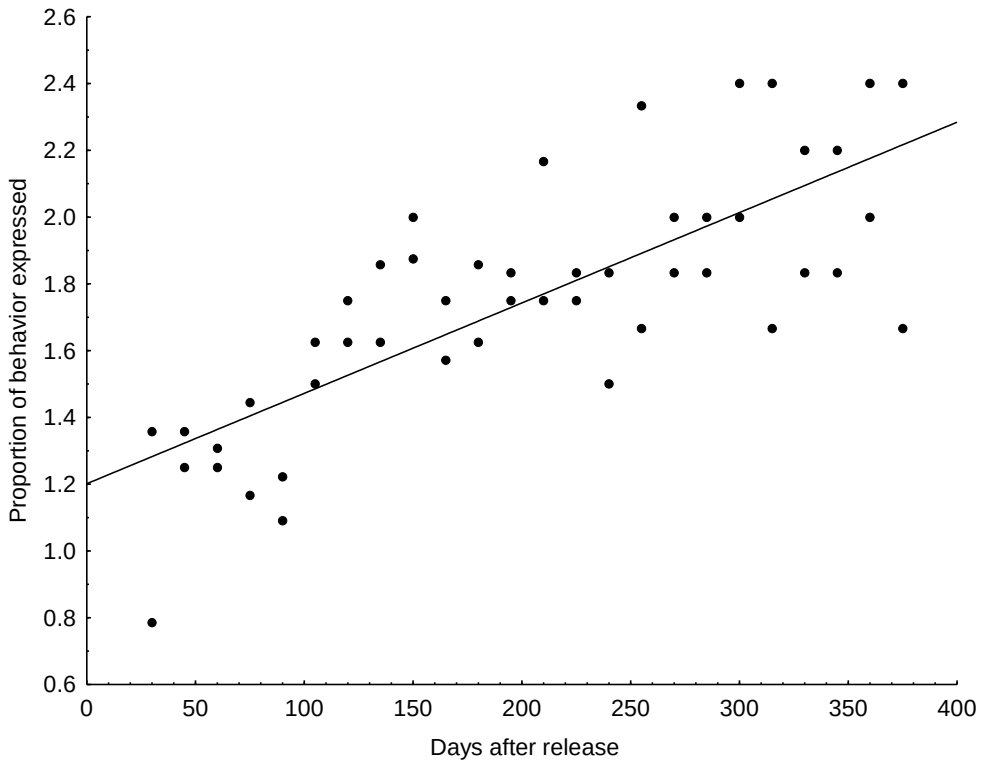

Figure 1

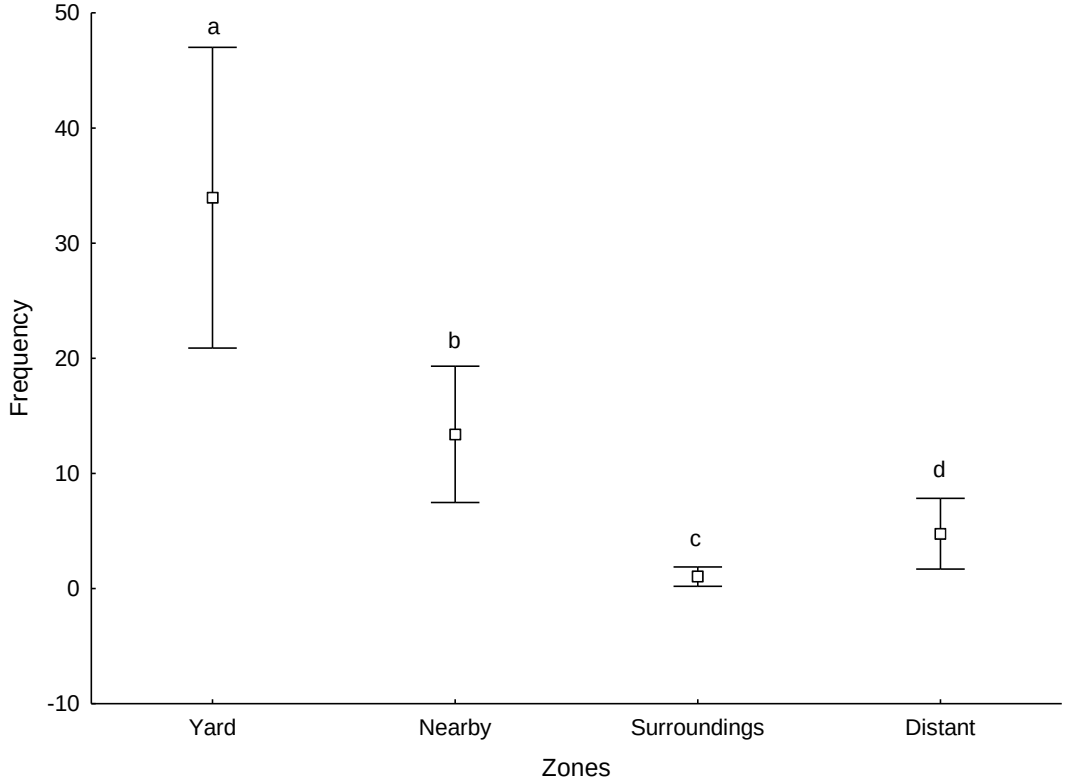
50
40
30
20
10
0
-10
Frequency
a
b
c
d
Yard
Nearby
Surroundings
Distant
Zones

Figure 2

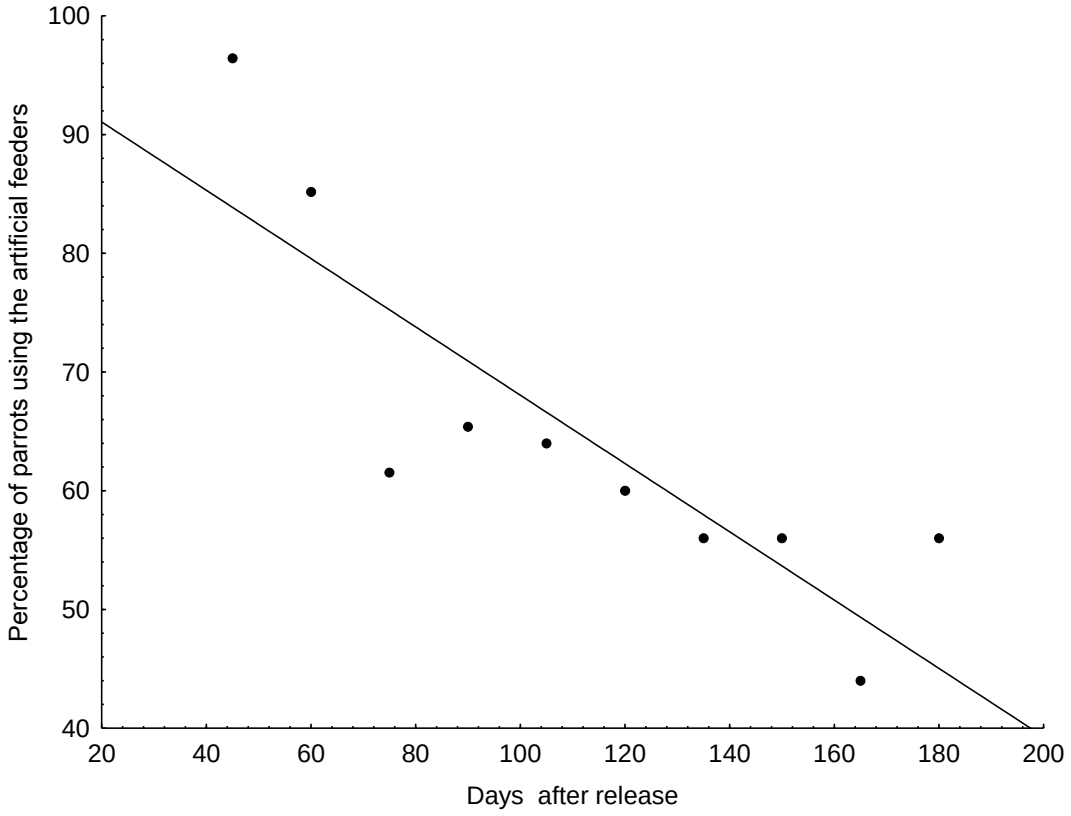
Percentage of parrots using the artificial feeders
100
90
80
70
60
50
40
20
40
60
80
100
120
140
160
180
200
Days after release

Figure 3

Capítulo 2

Efficiency of anti-predator training and the influence of personality and gender in the behavior, dispersion and survival rates of translocated captive-raised Blue-fronted Amazon parrots (*Amazona aestiva*).

Artigo será submetido a **Conservation Biology**.

Efficiency of anti-predator training and the influence of personality and gender in the behavior, dispersion and survival rates of translocated captive-raised Blue-fronted Amazon parrots (*Amazona aestiva*)

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Abstract

The Blue-fronted Amazon parrot *Amazona aestiva* is one of the most trafficked and seized species in Brazil. Predation is one of the main factors responsible for the failure of conservation programs due mainly to the loss of anti-predator skills of captive-bred animals. Animal's personality and gender can also influence key behaviors for survival and reproduction. Anti-predator conditioning and personality tests are now being used to increase survival rates in conservation programs. This study aimed to evaluate the influence of anti-predator conditioning, personality and gender on the survival and behaviors of translocated parrots. Thirty-one captive-raised parrots were translocated to a *Cerrado* area of Minas Gerais State, Brazil. Parrots were separated into two groups: anti-predator trained group (ATG – 15 individuals) and control group (CG – 16 individuals). Personality tests were performed with individuals of the ATG group. Data were collected using focal

sampling with instantaneous recording of behavior every minute. Anti-predator training, personality and gender did not influenced parrots' survival after release. However, anti-predator training promoted the exhibition of more behaviors by the ATG group. Shy individuals and males showed to be more sociable than bold individuals and females. Despite the anti-predator training did not resulted in more survival of the trained parrots, this technique proved to be efficient in eliciting more natural behaviors in parrots after release. Personality and gender did not influence survival and behavior exhibition, but shy individuals and females lived a bit longer than bold individuals and males after release. Training session closer to the release date should be tried and shy animals should be chosen to be released. Behavioral data and not just survival rates should be used to evaluate the efficiency of the techniques, because behavior can give clues about the adaptation of the individuals to the new habitat, increasing the success of the conservation program.

Keywords: Bold, female, male, Psittacidae, shy.

Introduction

Reintroductions and translocations are important tools for the management of animal species facing the risk of extinction (Griffith et al. 1989; Brightsmith et al. 2005; Teixeira et al. 2007; Seddon et al. 2012). Some studies registered that the mortality caused by predation is one of the main factors responsible for the failure of the conservation projects (Beck et al. 1991; Miller et al. 1994; Cortez et al. 2015), and the predation of the released animals is due mainly to the loss of skills in recognizing and responding to a predator, especially if the released animals are captive-bred (Griffin et al. 2000; Aaltonen et al. 2009). Anti-predator training techniques have being used to reduce this problem and increase appropriate behavioral responses to predators (Maloney & McLean 1995; Azevedo & Young 2006a, 2006b), however, studies that evaluated the effectiveness of anti-predator training after the release are rare. Red-legged partridges (*Alectoris rufa*) that were subject to a pre-release anti-predator training program showed statistically higher mean values of survival, home range, and dispersion when compared to untrained partridges (Gaudioso et al. 2011b). Anti-predator training using classical or Pavlovian conditioning trials for juvenile little owls (*Athene noctua*) was positive in maximizing survival after the release; 71.4% of the trained owls survived, while only 33.3% of the untrained group were alive after six weeks from the release (Alonso et al. 2011). In a study with a captive-bred greater rheas reintroduced into the wild, the prerelease training program did not increase survival of the birds because of the failure to consider other potential predators, such as dogs or humans (Cortez et al. 2015).

Animal personalities can be defined as behavioral variation between individuals (Carter et al. 2013). Individuals' personalities are normally not considered in conservation programs when selecting the animals for release (Teixeira et al. 2007), although some

studies indicate that personality can influence key behaviors for survival and reproduction in nature. A study with kestrels (*Falco tinnunculus*) in a Mediterranean area suggested that the hunting skills and the feeding behavior of kestrels were likely to represent a trait characterizing a behavioral type (Costantini et al. 2005); a study with Great Tits (*Parus major*) showed that individuals with different personalities varied in their anti-predator and reproductive investment strategies (Hollander et al. 2008); another study with Great Tits indicated that partner preference was based not only on morphological characteristics, but also on personality.

Personalities can be classified in a shy-bold continuum, based on the propensity to take risks of each individual: some individuals seem to thrive on risk and novelty (boldness) while others shrink from the same situations (shyness) (Wilson et al. 1994). Released individuals with inappropriate levels of boldness can theoretically survive less in nature (Azevedo & Young 2006c; Teixeira et al. 2007; Oers & Naguib 2013; Reading et al. 2013). The animals in the wild are frequently faced with a trade-off between acquiring benefits (e.g. food or mates) and protecting themselves from danger (e.g. predators or intraspecific aggressors) (Wilson et al. 1994). Bolder animals probably have insufficient wariness of predators and this can be a non-adaptive response, but, in another context, they can be more willing to explore the environment and find food, which can be seen as an adaptive response (Coleman & Wilson 1998; Watters & Meehan 2007; Reading et al. 2013). In a swift fox *Vulpes velox* study, bolder animals died faster than shyer ones because they get closer to roads and were run over by cars (Bremner-Harrison et al. 2004). Personality tests can be used as a method to better chose the animals in conservation programs, helping in the avoidance of choosing animals that scored higher on traits linked to risky behaviors (Bremner-Harrison et al. 2004; Azevedo & Young 2006c). It is suggested that shyer

animals should be reintroduced first since it has more chance to survival in the long term than bolder ones; bolder animals should be used to reinforce the reintroduced population (Smith & Blumstein 2013).

The animals' gender is another important parameter that is not usually evaluated in conservation programs (Ball & Ketterson 2007; Lambertucci et al. 2013), once gender can be linked to personality (Feingold 1994; Gosling & John 1999; Schuett & Dall 2009; Titulaer et al. 2012), stress (Teixeira et al. 2007; Cohen & Yehuda 2011; Keller et al. 2015), dispersion (Jones et al. 2003; Tecot et al. 2013), and reproduction (Ball & Ketterson 2007; Clutton-Brock & Huchard 2013). In a translocation program of swift foxes in Canada, females presented lower survival rates than males, thus researchers suggested that it should be translocated a greater proportion of females in comparison to males, in order to establish balanced sex ratios in the released population (Moehrenschlager & Macdonald 2003). Thus, it is important to evaluate the influences of gender in the survival rate and in the behavior of the released individuals, since this type of information would help in the selection of better individuals to be released.

Post-release dispersal could affect negatively the translocation success during the establishment phase (Moehrenschlager & Macdonald 2003; Tweed et al. 2003; Le Gouar et al. 2012). If the habitat around the release site are not protected or present an insufficient quality, released individuals will disperse due to difficulties to find food and places to rest and reproduce, increasing the chances to encounter and have conflicts with human (van Heezik et al. 2009; Le Gouar et al. 2012). Individual's gender, personality, origin and history, as well as environmental and social factors, can potentially affect post-release dispersal (Le Gouar et al. 2012). In some species, the males tend to disperse more than females, like as in Great Bustards *Otis tarda* (Alonso & Morales 2000; Martín et al. 2002),

but in many other avian groups, dispersal may be biased towards females (Greenwood 1980). Bolder individuals disperse further than shy ones, but they can disperse to unsuitable areas (Fraser et al. 2001; Dingemanse et al. 2003; Cote et al. 2010); to release only shy, slow-exploring individuals, could also lead to reintroduction failures if individuals are unable to forage in nature or to disperse (Watters & Meehan 2007; Le Gouar et al. 2012).

The habitat where animals are released can also influence their dispersion; if there are not sufficient resources or it has many predators, released animals will tend to disperse more, seeking habitats more suitable to live (Stamps & Swaisgood 2007; Le Gouar et al. 2012). The intensity of post-release dispersal could also be influence by conspecific density: if many individuals are released in the same area and at the same time, then dispersal might be high due to competition (Le Gouar et al. 2012). However, if few individuals are released, individuals might disperse to search for a mate or to join a bigger group (Le Gouar et al. 2008).

The Blue-fronted Amazon parrot (*Amazona aestiva*) is found in eastern Bolivia, northern Argentina, southern Paraguay and central-southern Brazil (Sick 2001), inhabiting the *Caatinga, Cerrado, Pantanal* and *Chaco* biomes (Schunck et al. 2011). It is one of the parrot species most removed from the wild by the world legal (Argentina e Paraguay) and illegal (Brazil) trade (Seixas & Mourão 2002; Schunck et al. 2011). In Brazil, it is among the most received species in the Wild Animal Triage Centers (CETAS), governmental facilities destined to receive animals rescued from the illegal trade (Vilela 2012; Souza et al. 2014; Freita et al. 2015). Rescued parrots are normally released into nature without any systematic study or monitoring (Marini & Filho 2005).

In this study, it was examined the influences of the anti-predator training, personality and gender of the captive-raised Blue-fronted Amazon parrots on the survival, behavior and dispersal of the individuals after release.

Methods

Animals, housing and maintenance

Thirty-one Blue-fronted Amazon parrots were selected from the Wild Animal Triage Center (CETAS) of the Brazilian Institute of Environment and Renewable Natural Resources (IBAMA) of Belo Horizonte City, Minas Gerais State, southeastern Brazil. These parrots were illegally removed from the wild while chicks and were raised in captivity, thus, their ages and places of birth were unknown. All parrots lived for at least 5 years in captivity. After the veterinarian evaluation, these individuals were considered able to be released into the wild. They were separated into two groups: the anti-predator trained group (ATG), with 15 parrots **(**seven males and eight females); and the control group (CG), with 16 parrots (ten males and six females) (Table 1).

_____Insert Table 1_____

Each parrot were marked on the chest with a non-toxic Expo® low odor dry-erase marker; the ink marks indicated the sex and the group of the individual (right side for females and left side for males; blue color for ATG and red color for CG). Parrots also received one colored leg ring and one stainless steel leg ring, with an identification number and the IBAMA's telephone number. Finally, each individual received a microchip for

identification. Three individuals from each group also received a VHF radio collar; model TXE304CP, Telenax Company®.

Parrots were kept in two similar aviaries for at least ten months before the release. The aviaries were partially shaded and had 12 m length, 4 m width and 3.5 m height each, and were placed 2 m distant from each other in the release area, away from human interferences and surrounded by natural habitat. Perches inside the aviary were placed distant from each other to stimulate flight and muscles hypertrophy.

Birds were daily fed at 8:30 AM with a mixture of industrialized parrot food (Megazoo®), sunflower seeds and seasonal fruits; fruits and seed of plants found in the release site were offered to the birds whenever available. Diet was provided in a feeder placed 1.5m height and with no perches attached, forcing the parrots to fly in order to consume food. No visual barriers existed between the keeper and the parrots during food provisioning. Water was provided *ad libitum*.

Anti-predator training

During the anti-predator training, the birds were held in a test enclosure with 7.10 m length x 1.80 m width x 2.45 m height, delimited by a wire mesh in one side and by a concrete wall of 2.45 m high on the other side. The enclosure was covered with black plastic to isolate the birds visually from their surroundings. An opening on the front of the enclosure was made on plastic canvas, to allow the researcher to observe and video record the behaviors of the birds inside the enclosure. The enclosure had a bush, which worked as an escape point for parrots during the training sessions. The ATG received predator aversion training using stuffed models (ocelot - *Leopardus pardalis,* and Harris' hawk - *Parabuteo unicinctus)* and a human being as potential predators. The human predator was represented

by a person who always wore the same clothes (red shirt and straw hat) during the tests. A chair was used as a control model. Predators were associated to an aversive stimulus – persecution by a camouflaged man carrying a net, simulating a capture. Anti-predator training protocol followed Griffin et al. (2001) and Azevedo & Young (2006a,b): the stimulus (predator) appeared to the animals for 15 seconds before a human carrying a net entered the enclosure and began a simulated capture procedure (aversive experience). The catch has always been simulated, not real; persecutions were ran by a human wearing a "Scream movie" costume, which had the sole function the guise of human silhouette. The birds were persecuted by the man for 30 seconds. After the exit of the man from the enclosure, the predator model was again shown to the parrots for 15 seconds. All the models were presented to the parrots in the same way but the chair were not paired to the aversive stimulus (simulation of a capture procedure). Memory tests were carried out 30 and 60 days after training in order to evaluate the effectiveness of the training. These tests consisted of presenting the predator models (ocelot, hawk and human) to the birds, not associating them to the aversive stimulus. Each test lasted 18 minutes as in training. Each group was tested only once each with predator. More details can be found in Rodrigues (2013).

Anti-predator training sessions were conducted on February 2012; reinforcement occurred on October 2013, eight months prior to release. Results showed that the parrots enhanced their aversion to humans and to predators, displaying appropriated anti-predator behaviors even two months after the test (Rodrigues 2013). CG did not received anti-predator training.

Personality tests

Personality tests were performed only with individuals of the anti-predator training group (15 individuals). Tests were conducted before and after the application of the anti-predator training sessions to the parrots, and the final scores were used in the analysis (Rodrigues, 2013). For personality tests, two objects unknown to the parrots were used: a traffic signaling beacon and a combination of a pot of chips connected to a milk bottle. In the center of the enclosure stood a pedestal where the objects were exposed to the parrots. There were four perches in the enclosure containing markings indicating the approximate distance from the object. The enclosure was separated into two quadrants: one closer to 1.30 m from the object (quadrant 1), another distance above 1.30 m object (quadrant 2). Boldness scores were calculated for each parrot followed Bremner-Harrison et al. (2004) according to their behavior (number of recordings of shy and bold behaviors) in front of novel objects.

The release and monitoring campaigns

The individuals were released in June 2013 using the soft release method (Mitchell et al. 2011). Seven artificial nests and five feeders were distributed through the release site to facilitate the rehabilitation process and they were maintained throughout the first year of the project.

Four-day field trips were conducted during 12 months, with an interval of 15 days between each trip, totaling 24 field trips. Parrots were tracked using one portable VHF-signal receiver (model: RX-TLNX of Telenax company), connected to a manual three-element Yagui directional antenna, a compass (Nautika Tour 30170) and a GPS (Garmin Etrex Legend); binoculars (Bushnell H^2O 10X42 m) and a digital camera (Canon 60D with 70-300mm lens) were used to locate and record parrots' behaviors. It was used the

triangulation method to locate the parrots (Piovezan & Andriolo 2004). Birds were identified using the artificial markings (ink, leg bands) and the natural markings on the face of each individual.

Post-release data collection

Behavioral data recordings started one month after release. At this moment, only 14 individuals of each group were considered for data analysis, because three parrots disappeared soon after release (id numbers 906, 600 and 326). In each field trip, it was registered the number of parrots found, their distance from the release site, their behavior and group (ATG or CG). Data were recorded in three different time periods: 5:00-7:00h AM; 7:00-9:00 AM, and 4:00-6:00h PM. Data were collected using focal sampling with instantaneous recording of behavior every minute, during 25 minutes in each time period (Altmann, 1974). Therefore, if an individual was found during the three time periods, than it would have 75 minutes of his behavior recorded. An ethogram was created before the release, based on Andrade & Azevedo (2011) and 80 hours of behavioral observations of the captive parrots using the *ad libitum* method (Altmann, 1974; Table 2).

_____Insert Table 2_____

Dispersion zones were created to determine how far individuals moved from the release point and the frequency that these areas were used by the released parrots: 0-50m from the release point = yard (Y); 51-100m = nearby (N); 101-500m surroundings (S); greater than 500m = distant (D). All dispersion zones were visited equally during the field monitoring campaigns.

Data analysis

T-tests (parametric data) and Mann-Whitney tests (non-parametric data) were performed to evaluate differences in the number of exhibited behaviors and in the use of the dispersal zones between ATG and CG, male and female, and bold and shy parrots. Differences in the use of each dispersion zone by ATG and CG groups were evaluated using the Friedman ANOVA test with Dunn's post-hoc. The Kaplan-Meier Log-rank test was run to evaluate if the survival of the parrots differ between these groups (Kaplan and Meier, 1958). Comparisons on the survival of the ATG and CG parrots were run considering two possibilities for the missing parrots: as if they were alive and as if they were dead. For all statistical analyses, the confidence level was 95% ($\alpha = 0.05$) (Zar, 1999).

Results

Survival after release

No significant differences were found between the survival rates of the ATG and CG parrots neither considering missing parrots as alive ($\chi2 = 0.173$, df = 1, $p = 0.67$, mean ATG: 338 days, mean CG: 345 days) nor considering missing parrots as dead ($\chi2 = 0.001$, df = 1, $p = 0.97$, mean ATG: 230 days, mean CG: 214 days).

No differences were found between the survival rates of bold and shy parrots neither considering missing parrots as alive ($\chi2 = 0.633$, df = 1, $p = 0.42$) nor considering missing parrots as dead ($\chi2 = 0.372$, df = 1, $p = 0.54$, mean bold: 199 days, mean shy: 243 days).

No differences were found between the survival rates of males and females neither considering missing parrots as alive ($\chi2 = 0.001$, df = 1, $p = 0.97$, mean female: 335 days, mean male: 329 days) nor considering missing parrots as dead ($\chi2 = 1.469$, df = 1, $p = 0.22$, mean female: 252 days, mean male: 197 days).

Behavior

ATG parrots exhibited more behaviors than CG parrots after release ($t = 3.19$, $df = 26$, $p < 0.004$) (Fig. 1). Females exhibited the same number of behaviors than males ($t=0.20$, $df=26$, $p=0.83$), and bold parrots exhibited the same number of behaviors than shy parrots ($t=0.80$, $df=12$, $p=0.43$) after release (Fig. 1).

_____Insert Fig. 1_____

ATG parrots flew more ($t = 2.16$, $df = 46$, $p = 0.035$), stood more active ($t = 2.49$, $df = 46$, $p = 0.016$), fed more on the feeders ($t = 2.88$, $df = 46$, $p = 0.005$), expressed more positive ($U = 78.000$, $Z = 4.33$, $p < 0.001$) and negative ($U = 200.500$, $Z = 1.80$, $p = 0.008$) interactions with parrots of the same group, expressed less positive ($U = 50.000$, $Z = -4.89$, $p < 0.001$) and negative ($U = 222.000$, $Z = -1.99$, $p < 0.05$) interactions with parrots of the other group, interacted more with wild parrots ($U = 180.000$, $Z = 2.22$, $p < 0.05$) and exhibited more reproductive behaviors ($U = 181.000$, $Z = 2.20$, $p < 0.05$) than CG parrots (Fig. 2).

_____Insert Fig. 2_____

ATG parrots fed more upon the artificial feeders than upon native fruits ($t = -4.39$, $df = 23$, $p < 0.001$); CG parrots fed equally on both native and provided fruits ($t = 0.48$, $df = 23$, $p = 0.063$) (Fig. 3).

_____Insert Fig. 3_____

Bold parrots emitted more human vocalizations ($U = 187.000$; $Z = 2.14$; $p < 0.04$) and interacted positively ($U = 176.000$; $Z = -2.30$; $p < 0.02$) and negatively ($U = 219.500$; $Z = -2.17$; $p < 0.03$) less with parrots of the ATG and positively less with native parrots ($U = 209.000$; $Z = -2.21$; $p < 0.03$) than shy parrots (Fig. 4).

_____Insert Fig. 4_____

Females preened ($U = 124.000$; $Z = 3.51$; $p < 0.001$), moved ($U = 155.000$; $Z = 2.90$; $p < 0.005$) and fed both in the feeders ($U = 125.500$; $Z = 3.49$; $p < 0.001$) and upon natural fruits ($U = 178.000$; $Z = 2.44$; $p < 0.001$) more than males, but males interacted positively more with parrots of the control group than females ($U = 176.500$; $Z = -2.47$; $p < 0.02$) (Fig. 5). Males also escaped ($U = 250.000$; $Z = -2.10$; $p < 0.03$) and exhibited human vocalizations ($t = -2.06$; $df = 47$; $p < 0.05$) more than females (Fig. 5).

_____Insert Fig. 5_____

Dispersion zones

There were no differences in the frequency of use of each dispersal zone between ATG and CG (yard: $U = 82.000$, $Z = 0.73$, $p > 0.46$; nearby: $U = 80.500$, $Z = 0.80$, $p > 0.42$; surroundings: $U = 83.000$, $Z = 0.68$, $p > 0.49$; distant: $U = 83.500$, $Z = -0.66$, $p > 0.50$); shy and bold (yard: $U = 16.500$ $Z = 0.49$, $p > 0.62$; nearby: $U = 17.000$, $Z = 0.42$, $p > 0.67$; surroundings: $U = 18.500$, $Z = 0.21$, $p > 0.83$; distant: $U = 14.000$, $Z = 0.84$, $p > 0.39$, and female and male parrots (yard: $U = 65.500$, $Z = 1.47$, $p > 0.14$; nearby: $U = 94.000$, $Z = -0.16$, $p > 0.87$; surroundings: $U = 93.000$, $Z = 0.20$, $p > 0.83$; distant: $U = 67.500$, $Z = -1,38$, $p > 0.16$).

Both ATG and CG groups differed in the use of the dispersion zones (ATG = $\chi2$ = 28.783, df = 3, $p < 0.001$; CG = $\chi2$ = 21.530, df = 3, $p < 0.001$), being the yard more used than the other zones (Table 3). Yard was the zone most used by shy and bold parrots (Shy = $\chi2$ = 19.520, df = 3, $p < 0.001$; Bold= $\chi2$ = 9.727, df = 3, $p < 0.05$), and by males and females (Female = $\chi2$ = 27.548, df = 3, $p < 0.001$; Male = $\chi2$ = 22.565, df = 3, $p < 0.001$) (Table 3). Overall, no data were available for 39% of the parrots, since these birds were not located during the monitoring.

_____Insert Table 3_____

Discussion

Anti-predator training

Anti-predator training did not prove to be efficient in the elevation of the survival rates of translocated parrots, since mortality was similar between trained and control groups. Predation is considered a problem in reintroduction/translocation programs, especially those using captive-raised animals, since most of the release animals are naïve and do not recognize or respond properly to predators (Beck et al. 1991; White et al. 2005; Cortez et al. 2015). Anti-predator training was an effective tool to diminish this unwanted captivity effect in conservation programs of little owls (*Athene noctua*), red-legged partridges (*Alectoris rufa*) and prairie dogs (*Cynomys ludovicianus*) where the trained animals survived longer than untrained animals (Shier & Owings 2006; Alonso et al. 2011; Gaudioso et al. 2011b). In the present study, however, this technique was not effective, although the trained group survived a little longer than the untrained group only when the missing parrots were considered dead (16 days longer). In fact, only two parrots (6,4%) were confirmed killed by predators both from the trained group (id number: 237 and 521).

For species that have great commercial value, like *A. aestiva*, humans represent the most important potential predator (Rabinovich 2004). Twelve parrots (38.7%) (eight from ATG and four from CG) exhibited interactions with humans after the release, and three individuals were even captured by people from the local community after the release. Despite anti-predator training had elicited appropriate behavioral responses by the parrots (to avoid humans) in captive, and these responses were maintained for two months after the end of the training sessions (Rodrigues, 2013), one session of reinforcement occurred eight months prior to the release, and this time may have been too long for the parrots to still remember the conditioning. Besides, the fact that no visual barrier existed between the trained parrots and its keeper may had messed the conditioning against humans, since parrots could be associating the humans with food. Thus, anti-predator training sessions near to the release date should be preferred and visual barriers between the parrots and their keepers should existed, and both strategies should be tested in future translocation programs.

The anti-predator training is a technique created to stimulate appropriate behavioral responses in individuals raised in captivity (Griffin et al. 2000), and it promoted the exhibition of a wider range of behaviors by the ATG group once released. Moreover, essential behaviors related to adaptation to the wild, such as alert, flying, reproduction and interaction with wild parrots, were more recorded in ATG than in CG. This means that, somehow, the anti-predator animal training influenced the triggering of positive behavioral responses in the released Blue-fronted Amazon parrots. These positive results may be achieved because anti-predator training may acted as environmental enrichment for the parrots. Providing strategic enrichment programs increases survival by improving physical condition, behavioral expression, and other skills (Miller et al. 1990; Miller & Mench 2005;

Reading et al. 2013). Important behavioral changes are associated with enriched environments: an increase in the cognitive capacity, a quantitative and qualitative increase in exploratory behaviors, and changes in brain morphology, such as increase in cortical thickness and weight, in the size, number and complexity of nerve synapses, in the amounts of acetylcholinesterase and cholinesterase, and in the ratio of RNA to DNA (Widman et al. 1992; Shepherdson et al. 1994). Environmental enrichment is not only associated with good experiences, but also with stressful events that imitate real natural situations, as the encounter with predators (Yu et al. 2009). Besides, this acute stress event could be responsible for the release of so many different hormones in the parrots' bodies that increased the condition of the birds, preparing them to cope with a variety of stressors later in life (Crofton et al. 2015). These factors may be explaining the effects of anti-predator training in the behavior elicitation of ATG.

The origin and history of an individual can also influence post-release dispersal patterns (Le Gouar et al. 2012). The anti-predator training seemed to not affect the dispersion of individuals, since no differences were found between the frequencies of use of the different dispersal zones by trained and untrained parrots. Besides, ATG and CG groups used more the areas near the aviaries. This result was the contrary of what was found in the study with red-legged partridges, where trained birds dispersed more and presented a bigger home range than untrained ones (Gaudioso et al. 2011b). The authors of this study concluded that captive-bred partridges that survive longest tend to have a wider dispersion and a bigger home range (Alonso et al. 2005; Gaudioso et al. 2011a, 2011b). For Blue-fronted Amazon parrots, survival was equal, and this could explain why no differences in dispersion rates were found between ATG and CG groups.

Behavior

Blue-fronted Amazon parrots are normally seen flying alone, in pairs or in small groups; these groups come together to spend the night in specific roosting places (Seixas & Mourão 2000; Carrara et al. 2007). In a recent study about the sociality of captive Blue-fronted Amazon parrots, it was shown that the basic unit of social organization in the species is a dyad, and that the dyads interact with other parrots of the group (Matos 2016). The released parrots interacted more, positively or negatively, with individuals of its own group (ATG interacted more with ATG and CG interacted more with CG), alone, in pairs or in small groups. The biggest social interaction with individuals of their own group could be due to the establishment of agonistic and affiliative relations between the individuals during the captivity period. These relationships have the function to maintain the group cohesion and hierarchy (Matos 2016). Another interesting point is that birds can learn from observing what other birds are doing (McLean et al. 1999; Gaudioso et al. 2011b). This kind of learning by observing a conspecific was also registered in a study with New Zealand Robins *(Petroica australis*) (McLean et al. 1999) and in a study with Blue and Gold Macaws (Oehler et al. 2001). Thus, interacting with members of its own group can be beneficial by enhancing individuals' skills, and parrots should be translocated in groups.

Blue-fronted amazon parrots tend to use scattered food resources and passing crops, which are difficult to monopolize and defend (Matos 2016). Throughout the monitoring period, the parrots received food in artificial feeders, easy places to access and monopolize, which was done by ATG parrots. The behavior "feeding in feeders" was more observed in the trained group (ATG). This monopolization of feeders by parrots of the ATG group forced the parrots of CG to sought more food resources in nature, feeding more upon native fruits than in the feeders. This fact was not seen as a negative point, since there was no

difference in the survival rate of both groups. However, the gradual decrease in the food available in the feeders, as suggested by Snyder et al. (2000), could also stimulated parrots of ATG to sought more natural food resources.

The dispersal zones were used in the same way by the parrots of different groups, personalities and gender. The zones “yard" and "nearby" were the most used, which means that these parrots spent most of their time at a distance of only 100 meters from the release point. This should be beneficial in the establishment phase when they are adapting to wildlife and have the support provided by the project team (food supplementation and artificial nest). However, data about the use of dispersal zones were not collected for 39% of the parrots, since these birds were not found during the monitoring campaigns, which may mean death, re-capture by humans or dispersion far from the release area. All these possible results are considered negative for translocation projects, because individuals that dispersed far away from the release area will not contribute demographically to the translocated population and the consequences of dispersing towards urban areas or to areas without the necessary resources to survive could be negative (Tweed et al. 2003; Le Gouar et al. 2012).

As it was not found relationship between the dispersion and individual characteristics and history, the habitat where parrots were released could has influenced most in their dispersion, death or re-capture. The released area, despite being an area where the species naturally occur, is near to small urban centers; this proximity could attract human-raised parrots. Two things can be done to solve this problem in future translocations: 1) choose an area far from urban centers; 2) create some cues in captive (e.g., lights, colors, structural features, odor, wild conspecific sounds) similar to the release area, which can make the captive-bred animals associate those cues with favorable experiences in captivity, and then

prefer to settle in new habitats that contain those same cues after being released into the wild (Stamps & Swaisgood 2007). For example: if mammals are to be released in a habitat dominated by a plant species which produces a strong, distinctive odor, raising animals with that odor might improve their chances of accepting the new habitat (Stamps & Swaisgood 2007).

Personality

Personality (shyness and boldness) involves the propensity to take risks and may vary adaptively within populations (Wilson et al. 1994). In the wild, individuals face many situations that require different adaptive responses and these responses can determine if the individuals will survival and have reproductive success (Bremner-Harrison et al. 2004). Azevedo and Young (2006) suggested that the ideal situation in reintroduction/translocation programs would be selecting individuals with intermediary values of boldness scores, because they would not be shy enough to avoid exploring the environment, finding food or mates, and also would not be bold enough to take fatal risks. In the present study, however, it was not found any significant differences between the survival, number of expressed behaviors and distance of dispersion between bold and shy parrots, thus, intermediate individuals survived for the same time as individuals with the lower and higher boldness scores.

In the shy parrots group, two parrots (18%) died by predation (id numbers: 521 and 237), two parrots (18%) was recapture by humans (id numbers: 299 and 242) and five (45%) disappeared during the study (id number: 326; 298; 425; 349 and 313). In the bold parrots group, tree parrots (75%) disappeared during the study (id number: 376; 242 and 1147). Some studies suggest that companions had a complex effect on subjects' response to a

startle, where slow explorers of both sexes became more bold in the presence of a companion, whereas the response of fast explorers depended on sex, with females becoming less bold in the presence of a companion (Van Oers et al. 2005). This may explain the fact that we found no significant differences between survival of bold and shy parrots; once we had a blended group, bold individuals may have influenced shy individuals and vice versa.

The social structure of a population will influence an individual's access to resources and information, like finding and choosing a sexual partner, developing and maintaining cooperative relationships, foraging and avoiding predators (Krause et al. 2007). Behavioral traits can influence social structures of animals (Croft et al. 2009), but there are few empirical studies of the role of personality in social interactions (Aplin et al. 2013). Shy individuals tend to have stronger associations with a few other individuals, maintaining these associations over a relatively longer period of time; in contrast, bold animals have more social associations, but these tend to be weak and persist over a relatively shorter period of time (Croft et al. 2009; Aplin et al. 2013). In the present study, it was observed that shy parrots exhibited more social behaviors than bold individuals, interacting more with individuals of their own group and with native parrots; one shy female (id number: 299) even paired with a native male parrot and remained paired for at least eight months. Similar results were found for Trinidadian guppies (*Poecilia reticulata)* and great tits (*Parus major*), wherein shy animals had more stronger network connections than bold animals (Croft et al. 2009; Aplin et al. 2013). This result indicates that shy parrots could be preferred than bold parrots to release, because they have a greater ability to interact socially with conspecific. However, studies using social networks associated with personality evaluations could be run to test such hypothesis.

“Human vocalization” was more performed by bold parrots than by shy ones. This behavior may represent a highly plastic trait shaped by experience and influences from the vocal environment (Garamszegi et al. 2007). Individuals of both groups were raised by humans in captivity, passing through the song imprinting period with direct contact with them (Marler 1970; Bateson 1979). Bold adult individuals had the propensity to approach their caretakers more often than shy individuals (Coleman & Wilson 1998; Jolles et al. 2014), besides, their high cognitive abilities allows them to quick learn vocalizations that increases the chances of being rewarded with food by humans (Sick 2001; Scarl 2009). However, individuals who vocalizes more becomes more exposed to predators when in nature (Garamszegi et al. 2008). Thus, it seems that bold parrots learned better the human vocalizations, which is not a good behavior to express after the release. However, due to the small sample of the present study, further experiments are needed to assess whether there is a relationship between this behavior and personality of Blue-fronted Amazon parrots.

Gender

Studies of species’ translocation and reintroduction considered sex differences only in terms of sex ratios of released groups (Teixeira et al. 2007), but it would be important to consider other aspects of the biology of males and females (how they cope with stress, how they interact with the environment and with other individuals, etc.), since these aspects could influence the survival of the released individuals and, ultimately, the establishment of viable populations. Significant differences associated to gender were found in the present study for some behaviors: “preened”, feeding in nature”, “feeding in feeders” and “locomotion” were more exhibited by females; “interaction positive with parrots of CG”, “escape” and “human vocalization” were more exhibited by males. Despite these behavior

variations, no differences were found in the survival, number of expressed behaviors and dispersion related to gender, thus, for conservation programs of Blue-fronted Amazon parrots, the proportion of males and females should be equal. A study with griffon vultures *Gyps fulvus* in France explain the absence of sex bias in mortality and dispersal by low competition between sexes and equal investment in reproduction by males and females (Bosé et al. 2007), what can also be used to explain the lack of differences of these aspects found in the present study (Seixas 2009; Matos 2016).

Reproduction for females is usually more energetically costly than for males, even in species considered monogamous and with bi-parental care, like the Blue-fronted Amazon parrot (Trivers 1972; Seixas 2009). The female's clutch size was determined by the size of her nutrient reserves and females might be expected to be selected for consistency in their foraging intensities (Ankney & Macinnes 1978; Schuett & Dall 2009). Thus, this can explain why females fed more than males in the present study, wherein these can be interpreted from an adaptive perspective, resulting from both viability and sexual selection (Schuett & Dall 2009). The behaviors “preened” and “locomotion” could be related to “feeding”, because when feeding, parrots can become dirty and need to spend time cleaning their beaks and feathers. In the same way, most of the parrots accessed the feeders walking towards them.

It was observed in this study that parrots interact more with parrots of their own captive group. The CG group was composed of 67% of males, discarding the individuals who disappeared soon after the release; in addition CG had a male trio, which justifies a higher interaction of males with the CG group than females, which represents only 35% of the group. Therefore, there was a higher probability of males to have a higher number of social interactions in the group where they were more abundant. A study with Blue-fronted

Amazon parrots in captive showed that, on average, males occupy a position higher in the hierarchy than females, and to maintain this hierarchy, they build affiliative networks (Matos 2016). This could also explain a higher positive number of interactions by the males of the CG group, where they were majority.

While both males and females produced vocalizations, anecdotal evidence from captive birds suggests that in many species, males are more adept at modifying their vocalizations in captive settings (Scarl 2009). This may explain why males exhibited more "human vocalization" than females in the present study. However, it is important to note that in this analysis, the relationship of the variables sex and personality was not considered, because there were no personality data of the individuals of the CG group. Some studies showed that behavioral traits could be sex dependent and may be influenced by social context (Dingemanse et al. 2004; Van Oers et al. 2005; Schuett & Dall 2009). For example, in a study with great tit, bold males sang at a lower rate, longer songs and songs with higher element rates than did shy males (Amy et al. 2010); in a study with ravens (*Corvus corax*), the social context had facilitating or delaying exploratory effects depended of the relatedness or social relationship among the companions (Stöwe & Kotrschal 2007). Thus, future research needs to take personality linked with both sexes and the social context of the groups.

In conclusion, despite the anti-predator training in the present study did not resulted in more survival of the trained parrots, this technique proved to be efficient in eliciting more natural behaviors in parrots after release. Personality and gender did not influence survival, dispersion or behavior exhibition, but shyer and females lived a bit longer than bold and males after release. Training session closer to the release date should be tried and shy animals should be chosen to be released. It is really important to document failures in

rehabilitation techniques in reintroduction/translocation programs to avoid wasting efforts, time and money, and to think better strategies to enhance survival of the released animals. Moreover, it is necessary to conduct such studies with not-endangered species, because if the technique proves to be inadequate, the study will not compromise specimens of a rare species. Another relevant point is the use of behavioral data to evaluate the efficiency of the techniques and not just survival rates, because behavior can give clues about the adaptation of the individuals to the new habitat and where the technique should be changed to achieve/enhance the expected results, i.e., the success of the conservation program.

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Table 01 – Identification and characteristics of the thirty-one Blue-fronted Amazon parrots released in Pedro Leopoldo (Minas Gerais, Brazil). ATG: anti-predator group; CG: control group. Personality of each parrot where calculated by Rodrigues (2013).

Parrot id number	**Group**	**Sex**	**Personality**
299	**ATG**	Female	Shy
298	**ATG**	Male	Shy
521	**ATG**	Male	Shy
442	**ATG**	Female	Shy
425	**ATG**	Female	Shy
362	**ATG**	Male	Shy
349	**ATG**	Male	Shy
326	**ATG**	Male	Shy
313	**ATG**	Male	Shy
376	**ATG**	Male	Bold
242	**ATG**	Female	Bold
432	**ATG**	Female	Shy
403	**ATG**	Female	Bold
237	**ATG**	Female	Shy
1147	**ATG**	Female	Bold
902	**CG**	Female	No data
988	**CG**	Male	No data
257	**CG**	Male	No data

755	**CG**	Male	No data
816	**CG**	Male	No data
693	**CG**	Male	No data
682	**CG**	Male	No data
853	**CG**	Female	No data
513	**CG**	Female	No data
781	**CG**	Male	No data
176	**CG**	Male	No data
904	**CG**	Male	No data
992	**CG**	Female	No data
374	**CG**	Female	No data
906	**CG**	Female	No data
600	**CG**	Male	No data

Table 02 – An ethogram for *A. aestiva* based on Andrade & Azevedo (2011) and on 80 hours of preliminary behavioral observations of captive parrots using the *ad libitum* method (Altmann, 1974).

Behavior	Description
Active	Behaviors: pecking (leg rings, feeders, perches, branches, wires), defecating, alert (neck stretched and eyes wide open, focusing on something).
Inactive	Parrot is inactive or sleeping.
Preened	Behaviors: preening, beak cleaning (parrot rubs its beak on a perch/wire to remove food wastes) or water or dust bath.
Moving	Behaviors: walking and climbing the wire/tree.
Flying	Parrot is flying.
Natural vocalization	Parrot emits natural vocalizations, similar to those of the wild parrots.
Human vocalizations	Parrots emit human vocalizations, like whistles, words, phrases, songs, animals' imitations (barks, mews, etc.).
Captivity vocalization	Parrots emits grunt, loud vocalizations, different from natural and human vocalizations.
Feeding in nature	Parrot eats fruits collected from the trees.
Feeding in feeders	Parrot eats fruits from the artificial feeders.
Foraging	Parrot search for food in the area.
Interacting positively with parrots from ATG	Parrot positively interacts with parrot of the ATG.

Interacting negatively with parrots from ATG	Parrot negatively interacts with parrot of the ATG.
Interacting positively with parrots from CG	Parrot positively interacts with parrot of the CG.
Interacting negatively with parrots from CG	Parrot negatively interacts with parrot of the ATG.
Positive interaction with wild parrots	Parrot positively interacts with wild parrots.
Negative interaction with wild parrots	Parrot negatively interacts with wild parrots.
Positive interaction with humans	Parrot positively interacts with humans.
Negative interaction with humans	Parrot negatively interacts with humans.
Abnormal behaviors	Abnormal behaviors: swinging upside down, rotating head, making repetitive movements, and pacing.
Escape	Parrot flies away from potential predators or lower his head in the presence of a predator. Using also when they flies away in agonistic interaction with other individuals.
Reproduction behaviors	Behaviors: nest building, nest defense (when a parrot lowers his head and raises its tail to another individual), courtship, and mating.

Parental care	Behaviors: nesting, interaction with nestlings, feeding nestling and cleaning nestling.
Other behaviors	Behaviors not previously described.
Not visible	When the parrot is not visible.

Table 03 – Percentage of use of each dispersion zone by parrots trained against predators (ATG) and control group (CG), shy and bold, and females and males.

	Dead	**Yard (0-50m)**	**Nearby (51-100m)**	**Surroundings (101-500m)**	**Distant (> 500m)**	**No data**	**Total**
ATG	8,92%	38,09%	14,58%	1,48%	2,67%	34,22%	100%
CG	5,65%	30,96%	12,20%	0,59%	6,85%	43,75%	100%
Shy	12,5%	40,02%	15,41%	1,66%	3,33%	27,08%	100%
Bold	0%	33,34%	12,50%	1,04%	1,04%	52,08%	100%
Female	2,88%	48,39%	12,20%	1,28%	2,24%	33,01%	100%
Male	11,12%	22,50%	14,45%	0.83%	6,94%	44,16%	100%

Figures legends

Figure 1: Mean number of behaviors exhibited by parrots trained against predators (ATG) and parrots of the control group (CG) (A), female and male parrots (B), and bold and shy parrots after release (C). * = $p < 0.01$.

Figure 2: Comparisons between the mean numbers of behavioral recordings of parrots trained against predators (ATG) and parrots of the control group (CG). * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$.

Figure 3: Comparisons between the mean number of "Feeding in nature" and "Feeding in feeders" recordings according to the parrot group (anti-predator trained group - ATG and control group - CG). Different letters indicate significant differences according to the Mann-Whitney tests.

Figure 4: Comparisons between the mean number of behavioral recordings according to the parrot personality (bold and shy). * = $P < 0.05$.

Figure 5: Comparisons between the mean number of behavioral recordings according to the parrot gender (female and male). * = $p < 0.05$; ** = $p < 0.01$; *** = $p < 0.001$.

Figures

Figure 1

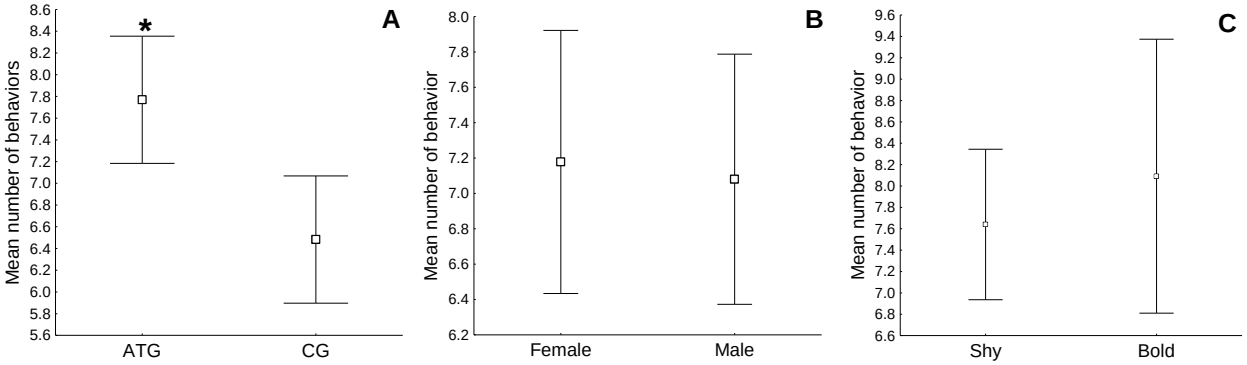

Figure 2

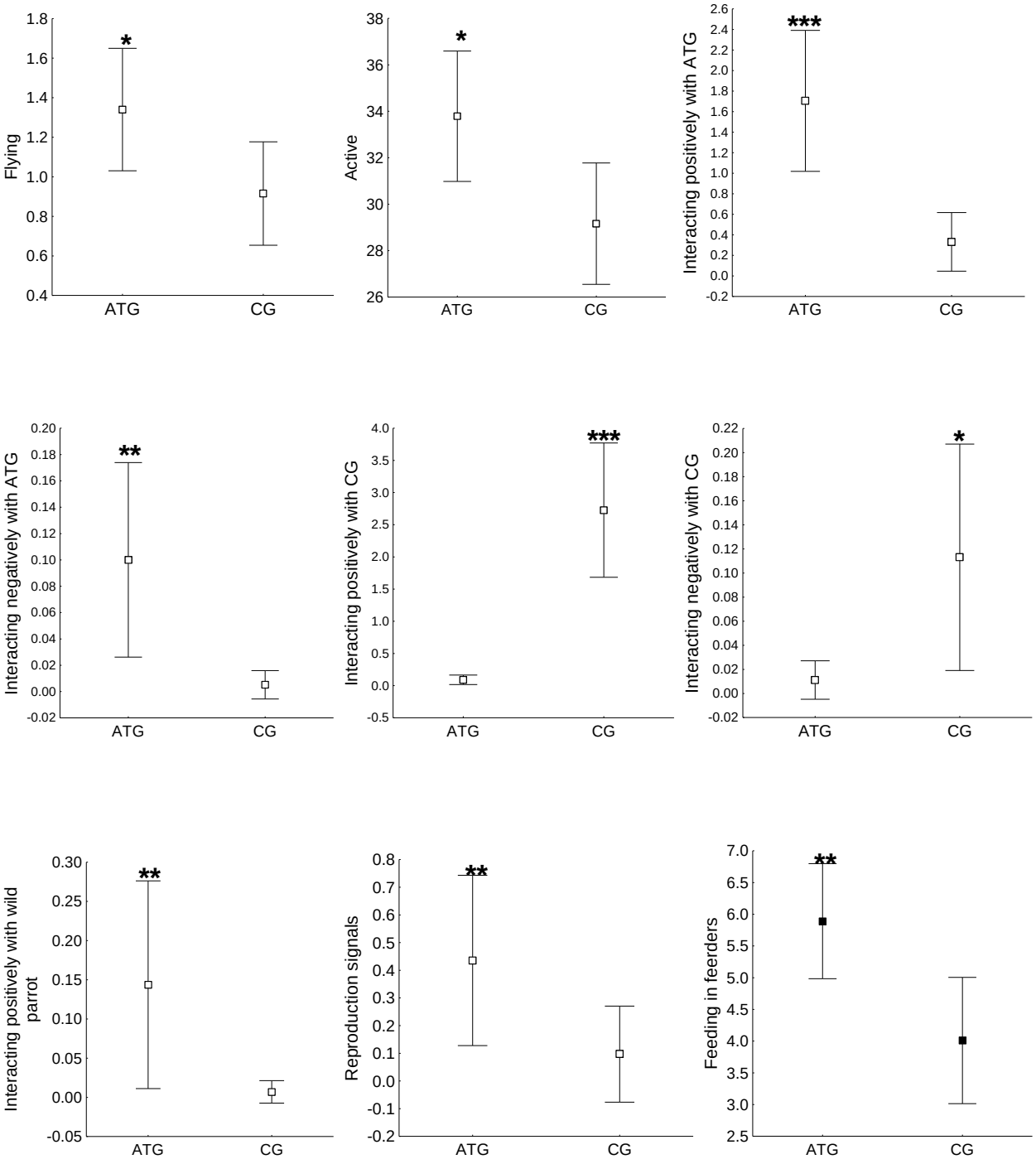
Flying
Active
Interacting positively with ATG
Interacting negatively with ATG
Interacting positively with CG
Interacting negatively with CG
Interacting positively with wild parrot
Reproduction signals
Feeding in feerders
ATG
CG
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Figure 3

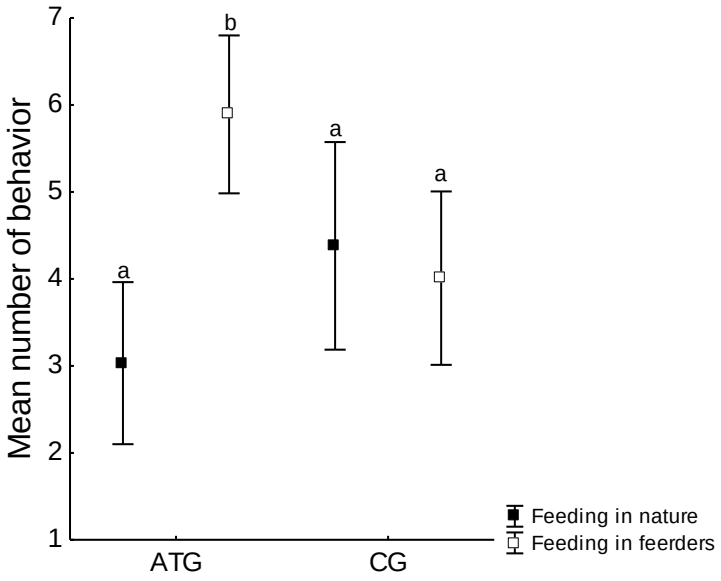

Mean number of behavior
7
6
5
4
3
2
1
b
a
a
a
ATG
CG
Feeding in nature
Feeding in feerders

Figure 4

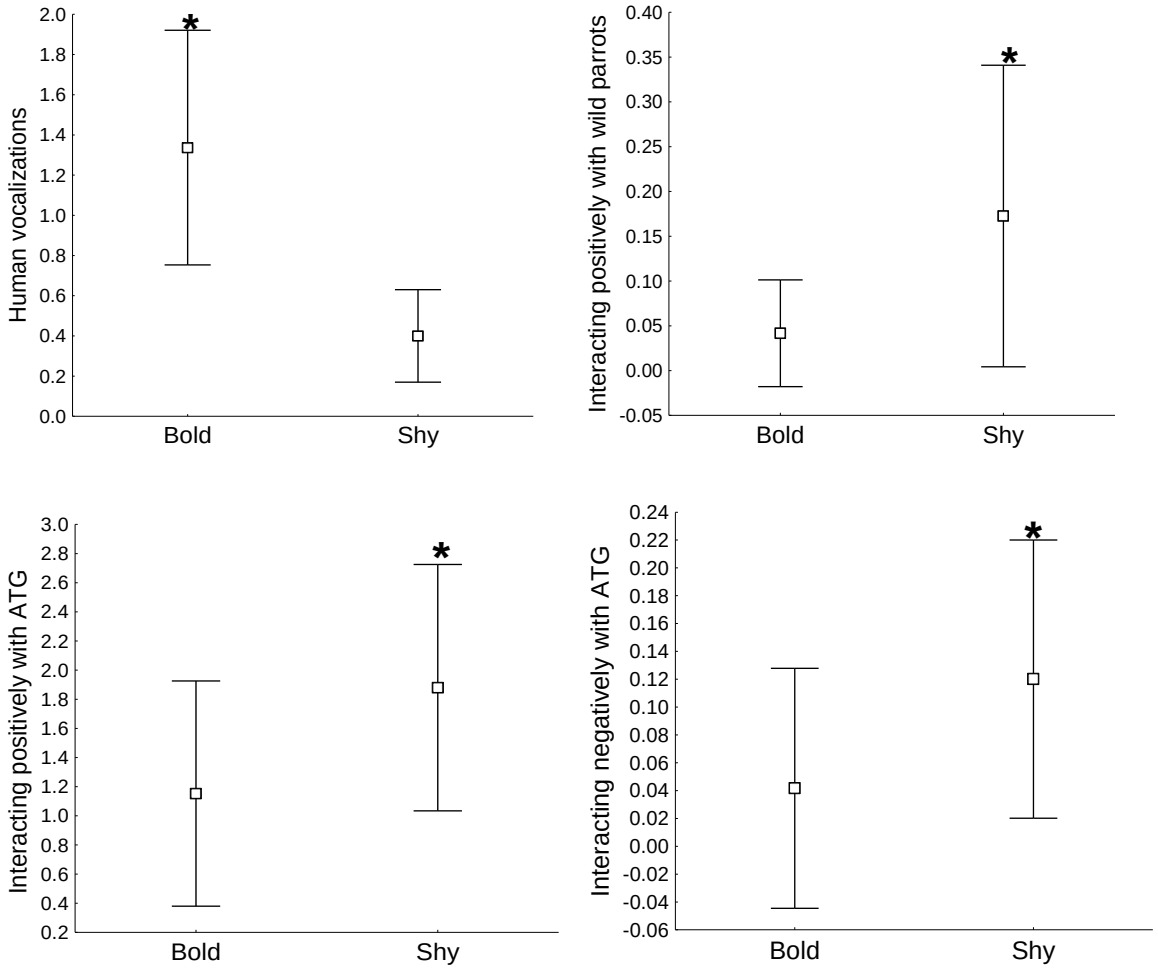
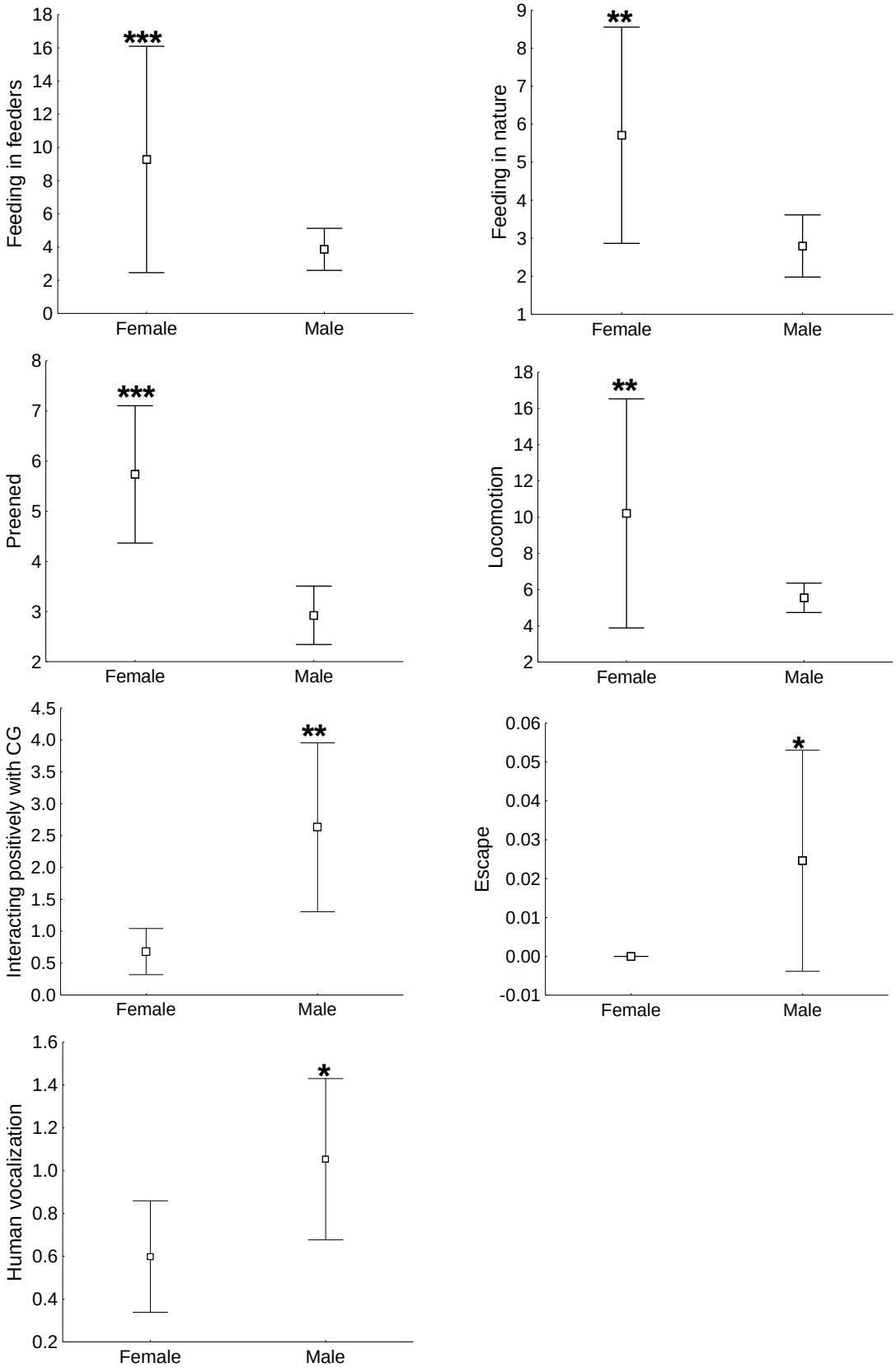

Human vocalizations
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
0.0
*
Bold
Shy
Interacting positively with wild parrots
0.40
0.35
0.30
0.25
0.20
0.15
0.10
0.05
0.00
-0.05
*
Bold
Shy
Interacting positively with ATG
3.0
2.8
2.6
2.4
2.2
2.0
1.8
1.6
1.4
1.2
1.0
0.8
0.6
0.4
0.2
*
Bold
Shy
Interacting negatively with ATG
0.24
0.22
0.20
0.18
0.16
0.14
0.12
0.10
0.08
0.06
0.04
0.02
0.00
-0.02
-0.04
-0.06
*
Bold
Shy

Figure 5


Feeding in feeders
***
Female
Male
Feeding in nature
**
Preened
***
Locomotion
**
Interacting positively with CG
**
Escape
*
Human vocalization
*

Conclusões finais

Apesar do treinamento anti-predador não ter resultado em uma maior sobrevivência dos papagaios treinados, esta técnica mostrou-se eficiente na indução da exibição de comportamentos mais naturais nos papagaios-verdadeiros após a soltura. Personalidade e sexo também não influenciaram na sobrevivência e quantidade de comportamentos exibidos, mas indivíduos tímidos e fêmeas viveram um pouco mais do que os indivíduos corajosos e machos após a soltura. O treinamento anti-predação deve ser realizado o mais próximo da data de soltura quanto possível e o contato com tratadores deve ser evitado, inclusive nos horários de alimentação. Indivíduos tímidos devem ser preferencialmente selecionados para solturas nas etapas inicias, pois são menos propensos a correrem riscos e serem predados ou capturados por humanos.

Esse estudo demonstrou que papagaios-verdadeiros criados como animais de estimação podem ser bons candidatos para programas de translocação, porém recomenda-se que um programa de reabilitação seja realizado antes da soltura. O programa deve abranger um treinamento de voo, alimentar, vocalização e anti-predação para evitar os predadores naturais e, principalmente, evitar o homem, já que esses animais possuem grande afinidade com seres humanos por terem sido criados em cativeiro. Técnicas de enriquecimento ambiental devem ser aplicadas a fim de diminuir comportamentos anormais e indesejáveis e aprimorar comportamentos naturais da espécie. Além disso, devem-se utilizar recursos que imitem ou que lembrem o ambiente onde os animais serão soltos, pois isso pode favorecer que os animais permaneçam na área de soltura por se sentirem familiarizados com o novo ambiente. Mesmo animais que não se adaptam completamente ao ambiente natural após meses de soltura são potenciais reprodutores e seus descendentes nascerão e serão criados

pelos pais em vida livre, favorecendo o estabelecimento de uma população em vida livre oriunda de cativeiro.

A soltura branda, alimentação suplementar e ninhos artificias devem ser utilizados, pois auxiliam os indivíduos no processo de adaptação à natureza, que deve ocorrer de forma gradual e não abrupta, para aumentar as chances de sobrevivência dos animais soltos. Essas ferramentas também são importantes para que os animais não se dispersem da área de soltura para habitats não adequados e onde não é possível acompanhá-los. Contudo, a alimentação suplementar deve ser diminuída gradualmente, uma vez que, os papagaios podem se tornar dependentes dessa alimentação e deixarem de explorar os recursos naturais, interagir com indivíduos selvagens ou exercer suas funções ecológicas na natureza.

Finalmente, programas de reintrodução e translocação são considerados ferramentas importantes para conservação de espécies ameaçadas de extinção, porém são raros os estudos que apresentam metodologias de como realizar esses programas com sucesso. É imprescindível documentar as falhas em técnicas de reabilitação em programas de translocação para evitar o desperdício de esforços, tempo e dinheiro, e pensar melhores estratégias para aumentar a sobrevivência dos animais soltos. Reintroduzir espécies ameaçadas sem técnicas adequadas de manejo, reabilitação e monitoramento significa comprometer ainda mais o *status* dessa espécie e utilizar os escassos indivíduos em cativeiro para testar metodologias de reabilitação é, no mínimo, uma grande imprudência. Sendo assim, enfatizamos a necessidade de pesquisas científicas com espécies não ameaçadas para elaboração de técnicas de reabilitação que irão aumentar as chances de sobrevivência e reprodução após a soltura na natureza de espécies cujo programa de reintrodução utilizando indivíduos criados em cativeiro seja a única alternativa. Os inúmeros animais recebidos nos CETAS do Brasil anualmente são fontes viáveis e

disponíveis que podem ser utilizadas para essa finalidade, além de contribuir com uma destinação mais criteriosa desses animais. Os dados sobre comportamento, e não apenas as taxas de sobrevivência, devem ser utilizados para avaliar a eficiência das técnicas, porque o comportamento pode dar pistas sobre a adaptação dos indivíduos ao novo habitat, aumentando o sucesso do programa de conservação.