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# Management of captive Passeriformes in eastern Amazonia: the bird keepers

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## ABSTRACT

The interactions between avifauna and the environment, including relationships with humans and their role in cultural practices, are part of *ethnoornithological* studies. The main objective of this study was to describe the *ex situ* management of passerines by bird keepers for recreational and commercial purposes in a municipality in the Brazilian Amazon. Semi-structured interviews were conducted with 62 farmers who had 279 wild birds belonging to 23 species in captivity. These animals were kept in cages of different sizes. The birds' diets were obtained from specialized commercial stores and offered daily to the animals according to age group and reproductive stage. The animals were kept in environments with good air flow, and the cages were cleaned, and the water was changed daily. Worming of birds was a routine practice, but infestations and some diseases were noted. Medications for treatment were obtained from local specialized stores. The reproductive management of passerine birds, especially *Sporophila angolensis* and *Sporophila maximiliani*, was performed by only three breeders. The results provide relevant empirical knowledge about the ex situ management of passerines, which is part of local cultural habits. However, this study indicates that there may be negative effects of maintaining these birds in captivity, such as the capture of free-ranging wild animals. Socio-educational measures are necessary to improve awareness of the sustainable use of environmental resources and encourage legalized breeding of passerines to help conserve the species.

**Keywords:** Wild animals, Ethnozoology, ex situ management, Birds, Sporophila.

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## SIGNIFICANCE STATEMENT

Bird keepers of passerines from the Brazilian Amazon possess relevant empirical knowledge that can significantly contribute to the proper management of these birds, including reproductive aspects. The ethno-knowledge of bird keepers regarding the management of passerines can be a valuable source for new investigations and studies, which will significantly contribute to the understanding of the management of these birds. Cultural aspects play a significant role in the breeding and management of passerines, but the activity also brings negative aspects, such as the capture of wild animals.

## INTRODUCTION

The use of wild fauna for food, clothing, adornment, medicine, and social and recreational purposes dates back to prehistoric times, and this activity has been perpetuated over the centuries (Albuquerque et al. 2012; Barbosa et al. 2014). Among the animals most used for these practices are birds, which constitute one of the vertebrate groups with the greatest hunting importance in the world (Barbosa et al. 2014; Mercês et al. 2021). The different forms of interactions with birds provide insights into this group and the environments where they live, which translate into knowledge, beliefs, and cultural practices (Santos-Fita and Costa-Neto 2007; Alves and Souto 2011). Thus, ethnoornithology seeks to understand these relationships from cognitive, behavioural, and symbolic points of view (Farias and Alves 2007; Bonfim et al. 2021).

Ethnoornithological studies have been conducted worldwide (Agnihotri and Si 2012; Roldán-Clarà et al. 2014; 2017). These studies help to characterize the forms and preferences of use, as well as to improve understanding of the main motivations for breeding and determining ecological aspects of different bird species. This traditional ecological knowledge of wild animal management is often transmitted by cultural factors between generations (Putri et al 2021, Ramos 2022), with valuable knowledge about ecological and management aspects of these animals (Roldán-Clarà et al. 2017). Ethnoornithology is still little explored in Brazil, especially in the Amazon, even though there is considerable scientific documentation on the Brazilian avifauna (Saiki 2009; Barbosa et al. 2014), one of the richest worldwide, with a total of 1919 species already recorded. (IBRD 2015). Studies have shown that passerine breeders in northeastern Brazil, have empirical knowledge about the biology of these animals, and several uses are attributed to this group, including food consumption, pet breeding, folk medicine and the production of utensils (Galvagne Loss et al. 2014; Soares et al. 2018; Santos et al. 2019); in addition, breeders have information on the origins and migration routes of species (Fernandes-Ferreira et al. 2012; Bezerra et al. 2012; Alves et al. 2013).

In the Amazon, the family Thraupidae is frequently exploited among passerine birds due to the great appreciation for its song and its breeding motivated by cultural and economic influences (Farias et al. 2019; Oliveira et al. 2020; Silva et al. 2021). Some species of this family have high economic value on the legal and illegal markets and thus are often targeted by young adults (Mercês et al. 2021). Thus, these animals are kept in captivity as pets, for singing tournaments and to aid in the capture of other birds (Silva et al. 2021). The knowledge that passerine breeders have and how they handle these animals is important, as this information can support management and conservation plans in addition to serving as a model for breeding other species exposed to similar conditions. Therefore, the main objective of this study was to investigate the ethnozoological knowledge about the management of passerines bred in captivity in a municipality in the eastern Brazilian Amazon.

## MATERIAL AND METHODS

The study was conducted in Abaetetuba (01°43'24"S - 48°52'54"W), Pará, Brazil (Figure 1). This municipality covers 1,611 km$^2$ and an estimated population of 160,439 inhabitants (IBGE 2021). The climatic typology of the municipality of Abaetetuba (Martorano et al. 2011) is Af3, indicating an average annual rainfall above 60 mm. The mean annual air temperature can vary between 26.5 and 27.5 °C, with maximum temperatures of 32.0 to 32.5 °C and minimum temperatures of 21.5 to 22.0 °C. The average relative humidity was greater than 85%. The study was conducted between December 2017 and September 2018. Informal dialogues and free interviews were conducted with local residents to identify passerine breeders using the snowball technique (Bailey 1994; Albuquerque et al. al. 2014). This technique provided a sequence of suggestions that allowed the identification and recognition of key interlocutors, who are those people in the community who have greater experience or knowledge about a particular subject of interest to the research (Albuquerque et al. 2014). The study objectives were explained to the potential interlocutors whom had agreed to participate in accessible language. Semi-structured interviews were conducted with 62 breeders. Data on socioeconomic and cultural profiles (sex, age, education, professional occupation, and income) and duration of animal

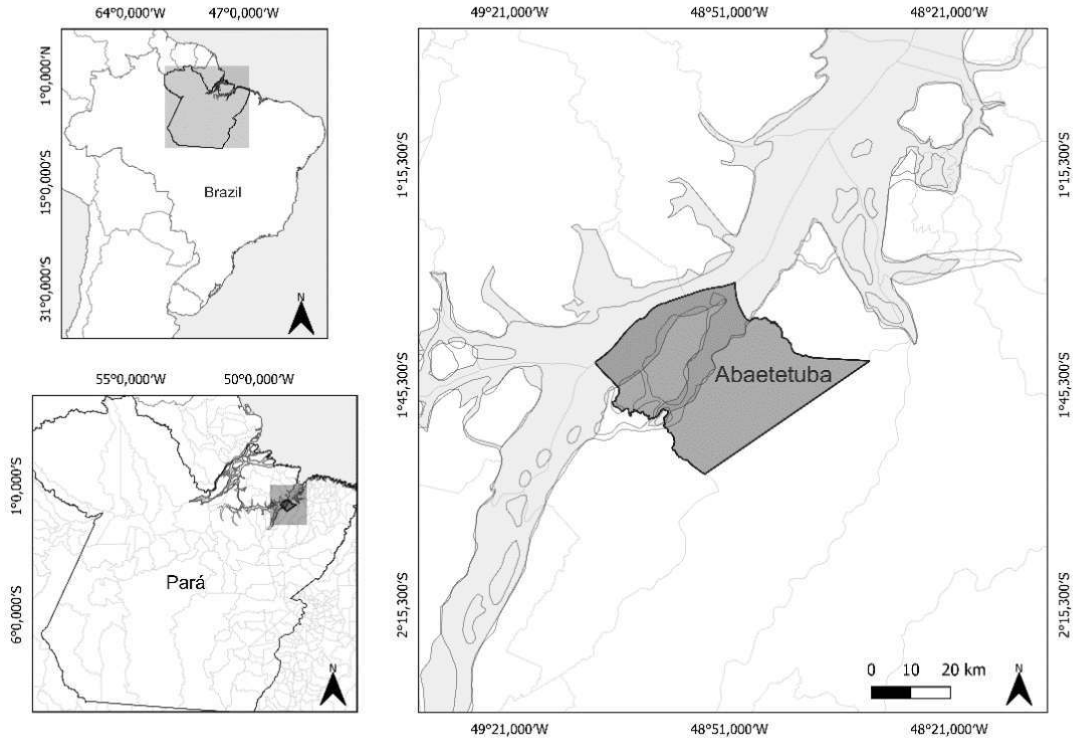


**Figura 1.** Location of the municipality of Abaetetuba, Pará, Brazil.

handling (less than five years, six to ten years; 11 to 15 years; 16 to 20 years; 21 to 25 years; over 25 years) were obtained in addition to the ethnoornithological knowledge (food, reproductive and sanitary management) of birds in captivity. The semi-structured interviews were used to provide guidance on the subject to be addressed while at the same time allowing the informant to feel free to express themselves in their own terms and provide additional information (Albuquerque et al. 2014).

The identification of passerine species was performed by an ornithologist at the Museu Paraense Emilio Goeldi (Belém, Pará, Brazil) based on photographic records. The Sigrist guide (2009) was used in the field, and the scientific nomenclature established was that of the Brazilian Committee of Ornithological Records (CBRO 2015).

## Data analysis

The data were analysed qualitatively and quantitatively and organized into tables, and the recorded interviews were transcribed. Exploratory qualitative analysis is characterized by researching phenomena that occur at a study site and considering existing empirical knowledge (Vergara 2012). Thus, based on the data from interviews, photographic records and participant observations, the species used were identified and the knowledge breeders had about the birds was compiled. In addition, we estimated the abundance of managed species using the ggplot2 package for R software (Wickham 2016; R Core Team 2021).

# RESULTS AND DISCUSSION

## Socioeconomic profile of breeders

Most respondents were from Abaetetuba (95%, n=59), and others were from the nearby municipalities of Belém (1.6%, n=1) and Moju (3.2%, n=2). The most frequent age group of respondents was 21 to 30 years old (38.7%, n=24), followed by 31 to 40 years old (25.8%, n=16) and older than 50 years old (19.4%, n=12). The other common age groups were younger than 20 years and between 41 and 50 years (both with 8.1%, n=5). In several studies on the hunting and trade of vertebrates, most of which were wild birds (Alves et al. 2016; Guimarães et al. 2019) and passerines (Mercês et al. 2021; Rocha et al. 2006), the respondents were most frequently economically active young people and adults. A similar result was observed by Oliveira and Pigozzo (2017) in a study conducted with legal bird keepers in the state of Bahia;

breeders were most frequently young adults, contrary to the common sense that the elderly have a greater affinity for this activity. However, the author emphasizes that different results can be observed in locations far from the metropolitan region.

An important aspect observed in this study was the small number of women associated with this activity (n = 2). Although family profiles were not the main target of this study, given the historical and cultural context of the study topic, it is known that there is a predominance of men in economic fields. Thus, this observation could be associated with a traditional model of division of labour, in which women are commonly linked to domestic tasks and child rearing, and men are responsible for financially supporting the family (Hirata and Kergoat 2007). In a study on the ethnoecology of Psittacidae, Saiki et al. (2009) emphasized that most women (86%) defined themselves as "housewife" when asked about their occupation. In another study, they stated that the knowledge they acquired about breeding and marketing birds came from observing their partners (Barbosa 2010).

All respondents (100%, n = 62) reported having learned regarding about the breeding and marketing of passerines from older family members (parents or grandparents); this knowledge is undergoes generational transmission, passed through observation and orally (Diegues et al. 2000). Oliveira and Pigozzo (2017) and Rocha et al. (2006) found that most respondents received their knowledge about birds through intergenerational transmission. Gama and Sassi (2008) also reported the sharing of knowledge among friends or neighbours, allowing this knowledge to be improved upon over time and space.

Regarding socioeconomic activities, (Figure 2 A) the commercialization of poultry was identified as a relevant source of complementary income for the interviewees, with activities related to local trade at fairs; the automotive maintenance sector was the main economic activity, which was justified by the fact that the study was conducted in an urban area. In rural regions, the main economic activities are related to agriculture and field work (Barbosa et al. 2010; Barbosa et al. 2014; Santos et al. 2018; Mercês et al. 2021). Analysis of the level of education revealed that most informants had a high school education (Figure 2B). A similar result was observed by Costa (2014) in the municipality of Santa Barbara, Pará, where despite the higher frequency of informants who had completed high school, there was great variability in education level, i.e., the breeding of wild birds was independent of academic level, suggesting that the activity is mainly influenced by culture. In contrast, Barbosa et al. (2010) noted that there was a relationship between low education and wild bird trade, with participants stating that sales were made to supplement the family income; consequently, the trade was associated with regions of poverty and a low human development index (HDI).

Most of the people interviewed received a monthly income that was lower than US$ 191.97 (27.4%, n=17) or between US$ 191.97 and US$ 603.67 (35.5%, n=22), with a large proportion who chose not to respond (Figure 2 C). In a study conducted at the open-air market in Abaetetuba, Pará, 75% of the participants stated that the poultry trade was their main source of income (Farias et al. 2019). Studies conducted in several locations in the Northeast region, such as those by Gama and Sassi (2008) in João Pessoa, Paraíba; Mercês et al. (2021) in Aldeia Altas, Maranhão; and Rocha et al. (2006) in Campina Grande, Paraíba, indicated low values of income when compared to the present study.

Time spent managing birds had the following distribution: less than 5 years (11.3%, n=7), 6 to 10 years (19.4%, n=12), 11 to 15 years (22.6%, n=14), 16 to 20 years old (17.7%, n=11), 21 to 25 years old (4.8%, n=3) and over 25 years (24.2%, n=15). There was a wide distribution in the categories, with many participants performing the activity throughout their lives. As found by Barbosa et al. (2014), this is a practice that commonly begins in childhood and extends throughout life.

When asked about registering with the System for the Control and Monitoring of Amateur Bird Rearing (SisPass), none of the interviewees was regularly registered. Three were irregularly registered (4.8%, n=3), and most did not have a record (95.2%, n=59). Considering the findings by Ruas et al. (2017), generalist measures, which disregard immense sociocultural diversity, tend to marginalize populations that use hunting for subsistence purposes or for self-esteem. Studies indicate the approval involved in the process of breeding passerines and the lack of communication between regulatory agencies and breeders (Gama and Sassi 2008; Garcia and Garcia 2012; Gondim 2015; Alves et al. 2016). This demonstrates the need to promote initiatives that address the biological heritage of the populations that breeders are managing and evaluate strategies that help breeders manage passerines in a regulated manner (Lorieri and Robis 2018) because understanding the reality of the people who rely on environmental resources and their main motivations may allow for the establishment of more efficient conservation strategies.

## Structural characteristics and animal management

The 62 breeders interviewed kept 279 specimens in captivity, belonging to 23 species of 5 different families (Icteridae, Cardinalidae, Fringillidae, Thraupidae and

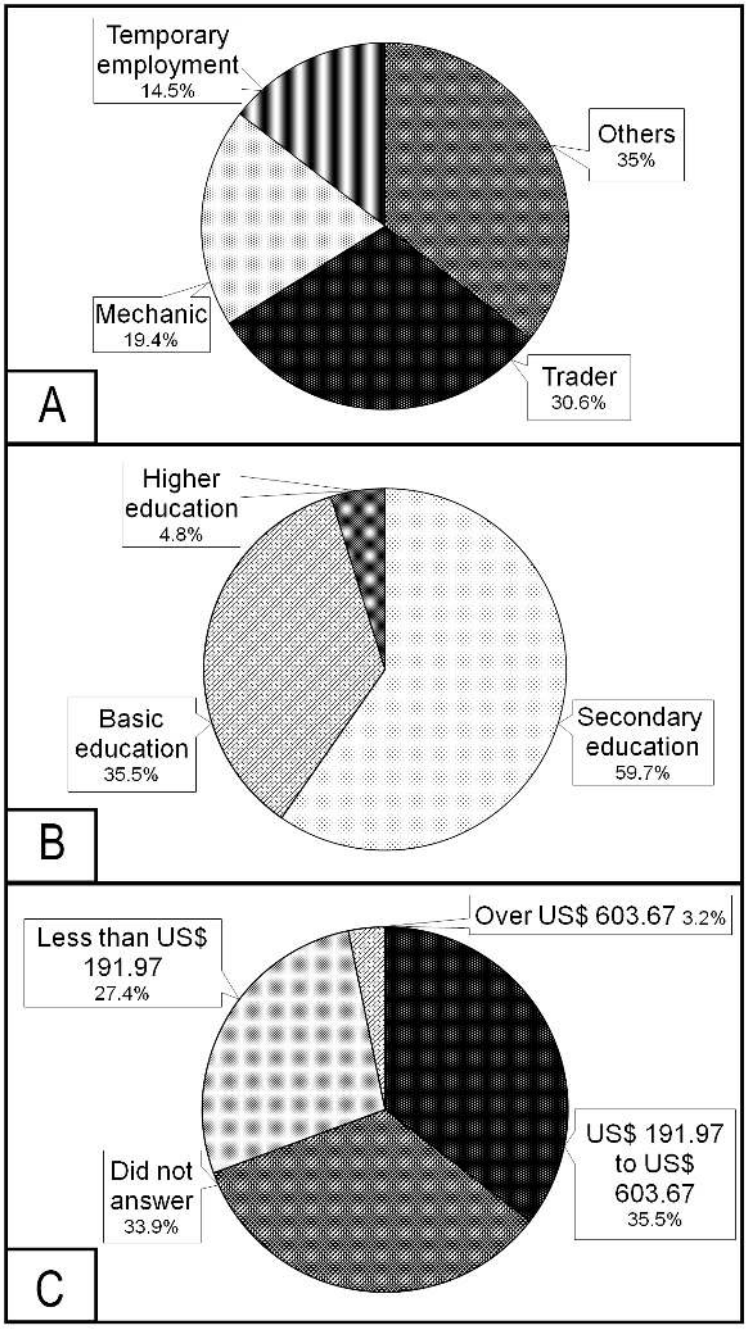


**Figura 2.** Socioeconomic activities of bird keepers from Abaetetuba, Pará, Brazil. A) Economic activities. Other: Student and retired (8.1%); mason, fisherman and teacher (3.2%); housewife, mining employee and farmer (1.6%). B) Education. C) Monthly income, US$1.00 = R$4.97 on 05/08/2023.

Turdidae) (Figure 3). *Sporophila angolensis was* the most common captive bird at the time of the study. This species was also the most representative of sales at the open-air market in Abaetetuba, Pará (Farias et al. 2019), and tradition was identified as the largest factor in the breeding of these animals.

The species included in Figure 3 were reared in cages of different sizes made of iron, wood or fibre extracted from the miriti palm (Mauritia flexuosa L. f.). The dimensions of the cages ranged from 20 cm × 15 cm × 25 cm to 60 cm × 30 cm × 50 cm. The cages were made by breeders or obtained from local businesses, such as *pet shops*, fairs and municipal markets, with values ranging from US$ 8.05 to US$ 140.86.

According to the breeders, the most suitable cages are wooden, as they support the welfare of the

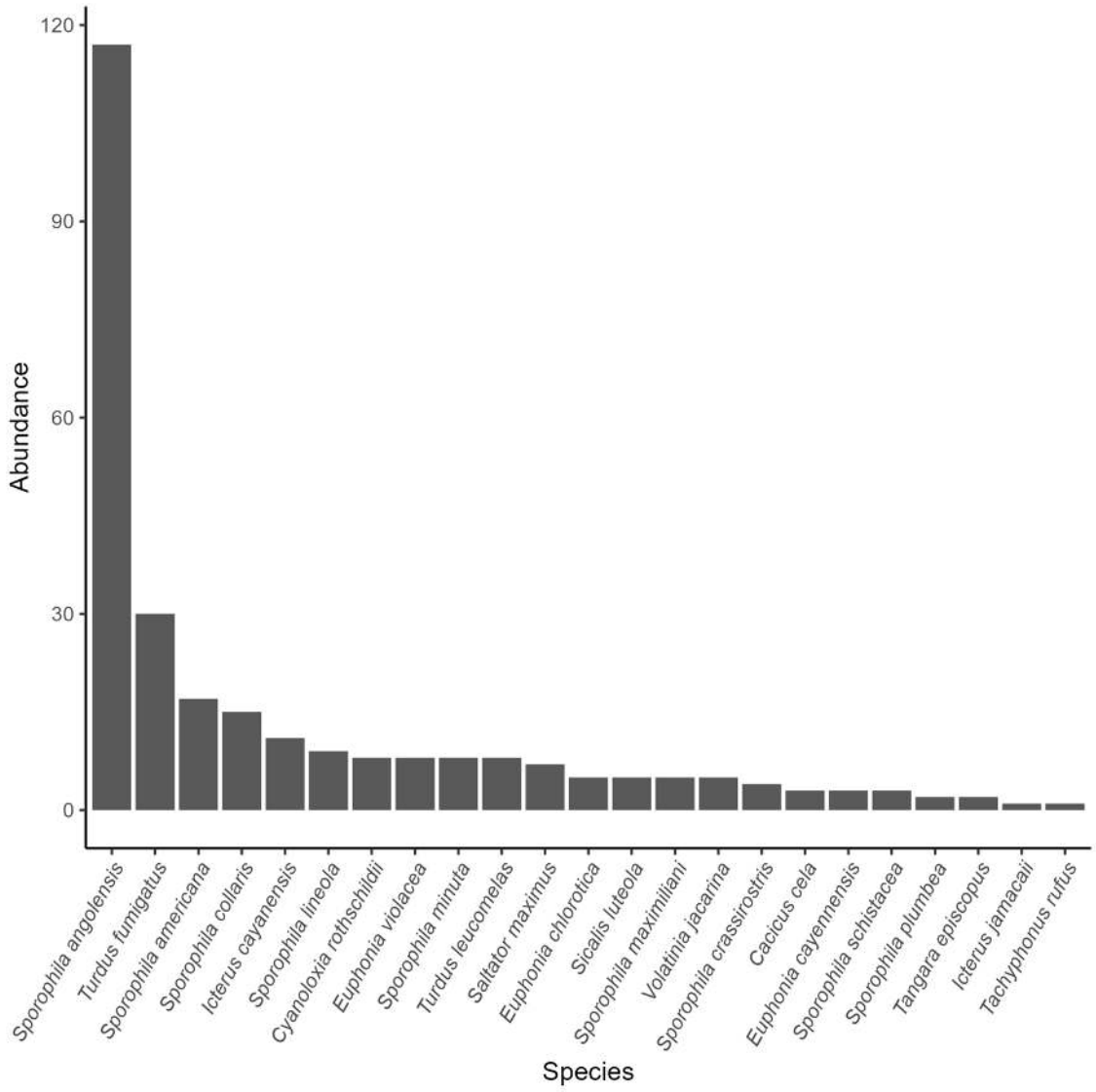


**Figura 3.** Abundance of species managed at the time of interviews with bird keepers in Abaetetuba, Pará, Brazil.

birds. Metal structures were reported to "get very hot" because they are good thermal conductors, and miriti fibre (Çengel and Ghajar 2012) are less suitable because it releases a porous material after sanding, which can harm the airways of birds. The choice of cage size usually depends on the size of the bird, the location where the cage will be on the property and the personal taste of the breeder. Smaller cages are usually used for transporting birds, while larger cages are preferred for reproduction. In a study on the use and management of birds by fowlers in northeastern Brazil, the use of small cages to facilitate transport was described (Souto et al. 2017). To support the welfare of the animals, some precautions were taken during *ex situ* management:

1. The birds were placed in ventilated areas that were protected from sun and rain, allowed sunbathing during the early morning and late afternoon, and were occasionally showered with light rain throughout the day.

2. The cages were covered with fabric when the birds were very agitated and at night to decrease light exposure, to prevent the animal from being bitten by insects, and to protect from the cold night-time temperatures (Figure 4 A).

3. The birds were transported to a wild location at least once every 15 days, with the interval increasing until the animal was adapted to captivity (Figure 4 B).

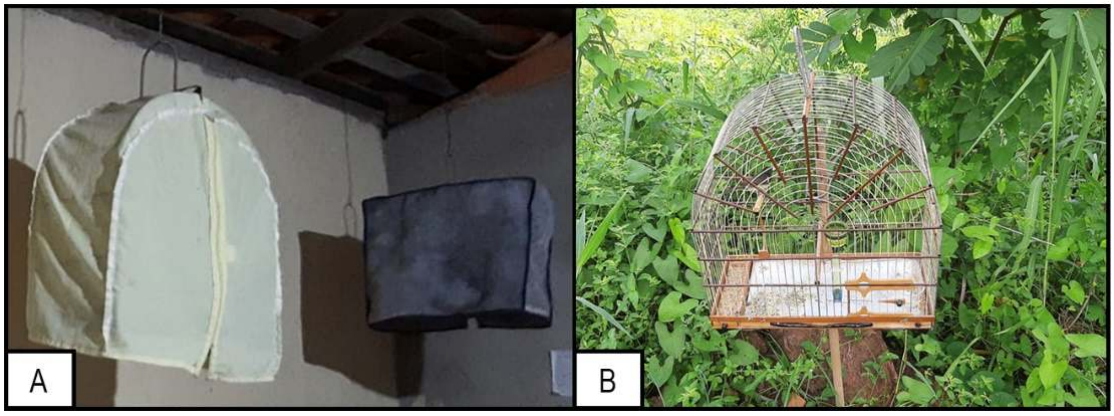


**Figura 4.** Measures adopted for the welfare of animals. A. Cages are covered to reduce light exposure. B. Animals are transported to the forest.

4. Cages were maintained and cleaned daily.
5. All birds were wormed.
6. Clean water and foods that met the nutritional needs of each species, according to life stage, were provided, with special given attention to females in the reproductive season.
7. The behaviour of the animals was observed to identify pathologies and stress.

The knowledge and management practices carried out by bird keepers demonstrate a relevant empirical understanding of these animals, and this can significantly contribute to the improvement of the management of this group of animals. The management of these animals in cages is common for most passerine breeders in Brazil, who keep their animals in cages (Alves et al. 2013; Soares et al. 2020). Additionally, as for the bird breeders in this study, it was observed that they take care and understand the importance of providing certain features in the cages to ensure the well-being of the animals, such as: 1) sufficient space with wooden or other material perches to allow balanced perching and enough room for short flights; 2) proper ventilation, mild temperature, and protection against sun, cold, wind, and rain (IBAMA 2011); and 3) hygienic maintenance of the cages with clean water and removable trays if necessary. These instructions align with some management standards, although these breeders are not yet practicing in a legalized manner (IBAMA 2011; Oring et al. 1988).

## Nutrition

The birds' diets were formulated specifically for each species, with *ad libitum*, ingestion. The dietary components were obtained directly from nature, from family farms, from local stores and street markets or specialized stores. The diets varied according to the life stage of the birds, which agrees with the information presented by Zardo et al. (2014). The chicks were offered soft food consisting of warm water mixed with kibble. For adults, the main food offered every day was a commercial balanced extruded feed for passerines. In addition, maize flour supplemented with hard-boiled eggs was made available once or twice a week. At this same frequency, supplementary foods were offered, such as seeds (sunflower (*Helianthus* spp.), sedge (*Cyperus* spp.), canary seed (*Phalaris* spp.), millet (*Panincum* spp.), oat (*Avena* spp.), maize (*Zea mays*,) and wild rice (*Zizania* spp.); fruits such as apple (*Malus domestica*), orange (*Citrus* spp.), banana (Musa spp.), papaya (*Carica papaya*), acerola (*Malpighia emarginata*), avocado (*Persea americana*,) and guava (*Psidium guajava*,); vegetables such as cabbage stalk (*Brassica oleracea*),, cucumber (*Cucumis sativus*), chayote (*Sechium edule*,) and pumpkin (*Cucurbita* spp.); and invertebrates such as mealworms (*Tenebrio* spp.), crickets (Gryllidae), locusts (Caelifera), and earthworms (Lumbricina).

For *Sporophila angolensis*, and *Sporophila maximiliani*,, a commercial premium product (Biotron CC2030) and a mixture of dry and nutritious food specific for chicks were used in addition to a mix of minerals obtained from pet stores. These two species of the Thraupidae family are the only ones for which reproduction was observed in captivity, which necessitated greater attention to the provision of more nutritious foods. This is important information about the management of these animals, because in the literature, one of the problems encountered during bird husbandry is the lack of knowledge about the nutritional requirements of birds and the nutritional composition of the feed used in the diet, which can cause problems

such as obesity, low immunity, stress and reduced life expectancy in captive birds (Cubas et al. 2007). Birds raised in a captive environment do not perform much physical activity, which is one of the factors that leads to modified nutritional requirements. However, food is often supplied constantly and in excessive amounts (Saad et al. 2007).

The feeding strategy that consists of providing seeds, vegetables, greens, and fruits is considered secondary to exclusive feeding with balanced rations that meet the nutritional requirements of the birds. The extrusion process used in the production of animal feed has several benefits, such as the elimination of undesirable fungi and bacteria, increased availability and digestibility of nutrients, and extension of the shelf life of the feed (Kill et al. 2008; Machado). et al. 2018). However, feeds are often formulated to meet the nutritional requirements of a specific category of bird and may not be perfectly balanced for a single species (Hirano 2010). Feeds for wild birds must contain nutrients in appropriate amounts, considering the quality of each ingredient or the raw material used in the preparation of the diet, without decreasing the palatability (Sousa 2016).

Some studies have been conducted with the aim of creating a diet that meets the nutritional needs of Passeriformes bred in captivity as well as maintaining the hygienic-sanitary quality of the feed as a measure to control the spread of pathogens. For example, Paiano et al. (2011) reported that rice (*Oryza sativa*, L.) millet (*Panicum miliaceum*, L.) barnyardgrass (*Echinochloa*, spp) and canary seed (*P. canariensis*, L.) can be consumed; in particular, *P. canariensis*, contains higher protein content and yields more metabolizable energy. Campos et al. (2017) also consider the mixture of these grains (canary seed, rice, and millet) to be a good option for *S. maximiliani*, feeding.

Suitable feeding is essential to maintain the longevity of captive birds (Kill et al. 2008). This is because nutritional deficiencies are the most common cause of diseases in birds in captivity, both because commercially available foods are based on mixtures of seeds with multiple deficiencies and because of the selective feeding behaviour of birds (Lumeija et al. 1996). Thus, offering a varied menu, in addition to contributing to the welfare of the birds, contributes to the prevention of nutritional disorders (Machado et al. 2018). The knowledge that bird keepers have about the diet of birds was obtained through *in situ* observation, passed between generations and between breeders, and obtained from internet searches and/or referrals from specialized stores, corroborating the findings of Ferreira et al. al. (2013). In this study, the breeders demonstrated that they have satisfactory empirical knowledge, and based on their own experiences, they strive to provide suitable foods for their birds, aiming to promote the welfare of the animals.

## Reproduction

This study shows that in the Amazon region, although there are several bird keepers, few perform reproductive management of animals in captivity. Reproduction was observed only in the species *S. angolensis*, and *S. maximiliani*,. These are species with highly appreciated songs and high commercialization values (Silva et al. 2021) which motivates the reproductive management of these birds, especially *S. angolensis*.

Bird keepers who perform breeding in captivity reported that during the reproductive period of females, vitamin and calcium supplements are provided for a period of seven days. Calcium and phosphorus are essential for adequate nutrition for bird growth in addition to playing a crucial role in eggshell production (Pinto et al. 2012). However, supplements and diets aimed to support animals in the reproductive phase should be implemented approximately two months before the laying period (Lima et al. 2019). It was also reported that a lack of calcium could cause females to lay only one egg, rather than the average of two eggs per clutch (Johnson and Barclay 1996). In addition, the interviewees stressed that the lack of other micronutrients could affect embryonic development. Extruded feed created with a specific balance for the species and supplemented with fruits, vegetables and other foods rich in fat and carbohydrates have been identified as fundamental to the diet of birds in the reproductive phase (Lima et al. 2019).

Birds should be encouraged to incubate and raise their young naturally, which is an essential behaviour for maintaining good reproductive behaviours. In addition to promoting animal welfare, it allows birds to practice parenting skills and prevents frustration caused by continuous egg removal (Allgayer and Cziulik 2007; Lima et al. 2019). Bundles of straw or grass were placed at the top of the cage to encourage females to nest, a process that occurs in preparation for reproduction and is the first sign that a bird is entering its reproductive period (Campos et al. 2017).

During the reproductive period, usually from September to November, the male's cage is placed next to the female's cage, as observed for the method adopted in commercial *S. maximiliani*, breeding (Campos et al. 2017). Directed pairing is an activity that guarantees the breeder genetic control of his flock by selecting desired traits, as described in a study on parrot reproduction (Lima et al. 2019). This process is usually repeated three times to ensure reproduction. Eggs are laid in approximately three days, ranging from one to three days, and the incubation period is 12 days (Figure 5 A, B). The breeding season in the




**Figura 5.** Female *S. angolensis* in a cage prepared for reproduction with an artificial nest. B. Nest with two *S. angolensis* eggs. *C. Offspring* of *S. angolensis* born in captivity.

state of Goiás (Brazil) occurs from August to March, with greater reproductive activities in the months of November and October (Campos et al. 2017).

According to the breeders, the females acquire food and clean the chicks and the nest (Figure 5 C). After 13 to 15 days, the chicks begin to train for flight with the help of their mother. When the young can feed themselves, they are separated from their mothers and placed in new cages for a period lasting approximately ten days. The entire process, from mating to separation, lasted approximately 40 days. Three clutches per reproductive period are desired to prevent physical exhaustion of females.

The reproductive aspects of passerine birds vary according to the species (Sick 2001). Among the few studies found in the literature on how to manage the reproduction of passerines in captivity, it is reported that the site must have a specific space for reproduction; a similar protocol has been reported by breeders (Lopes 1974; Johnson and Barclay 1996; Coutteel 2003; Cabral 2016), consistent with the reports of participants of this study. Evidencing the importance of the knowledge these breeders have about the animals, in view of the growing demand for captive breeding programs of endangered species, which, in turn, face difficulties and require an extensive source of financial resources (Hammer and Watson 2012; Francisco et al., 2020).

## Sanitation

The most frequently cited diseases were colds, hoarseness, or other respiratory disease (100%, n=62), diarrhoea (87%, n=54), lice and mites (79.0%, n=49), and coccidiosis (45.2%, n=28).

To treat captive birds, farmers reported using drugs obtained in pet shops, such as tinctures of eucalyptus (*Eucalyptus*, sp.), lobelia (*Lobelia*, sp.), grindelia (*Grindelia*, sp.) or guaco (*Mikania glomerata*,) for colds or hoarseness; antibiotics (oxytetracycline, sulfaquinoxaline and neomycin) for cases of diarrhoea, respiratory diseases, and coccidiosis; and permethrin and precipitated sulfur for ectoparasites. These treatments involve commercial drugs and have been adopted by other bird breeders in Brazil (Zardo et al. 2014; Stehling 2019).

The approaches for preventing and treating the most common diseases in birds showed in the present work are similar as observed in the literature; these diseases include nutritional disorders and viral, bacterial, mycotic, and parasitic diseases (Dorrestein 2003). Diseases of parasitic and bacterial origin are of great importance in Passeriformes and can lead to death in affected individuals (Sanches and Godoy 2014). In addition, they interfere with the behaviour and reproduction of birds by leading to malnutrition, stress, and the emergence of secondary infections (Vasconcellos et al. 2013).

To treat colds and hoarseness, the present study found only the administration of phytotherapeutic compounds, whose results in symptomatic treatment have not yet been described for the identified birds. The use of these herbal medicines in birds is justified in the case of eucalyptus (*Eucalyptus*, sp.), as its components, such as eucalyptol and citronellol, make secretions more fluid and easier to eliminate, while its tannins reduce the amount of mucus (Caliari et al. 2021). Guaco (*Mikania glomerata*,) has antimicrobial

and anti-inflammatory actions and can relieve symptoms of bronchitis, asthma, and cough in acute cases of respiratory diseases (Ueno and Sawaya 2019). Lobelia (*Lobelia*, sp.) has an extensive history of use as a medicinal herb and is used in the treatment of various respiratory diseases, such as bronchitis, pneumonia, and asthma (Wilson 2018). Recent investigations of the pharmacological activity of grindelia (*Grindelia*, sp.) have reported anti-inflammatory, antibacterial, antiviral, and spasmolytic properties, in addition to treating diseases of the upper respiratory tract (Wilson 2018). However, if the farmers knew the causative agent of the disease, a more *suitable* ,treatment would be possible (Spanamberg 2012; Santos et al. 2014).

For the prevention of diseases, farmers emphasize the importance of cleaning cages, feeders, and waterers. This is essential because, for the proper treatment of diarrhoea, in addition to appropriate antiparasitic therapy, preventive measures should include hygiene and changes in management to avoid reinfections (Cubas et al. 2014). The systematic cleaning and disinfection of cages and/or enclosures should be prioritized through periodic washing of the cages with neutral soap and drying in the sun to destroy eggs and oocysts of gastrointestinal parasites. In addition, the flooring substrate should be removed and replaced. Furthermore, the use of acaricides/insecticides in the environment is essential to control the free-living stages of ectoparasites (Santos et al. 2015). Thus, the use of permethrin and sulfur recommended in the literature for combating ectoparasites of passerine birds is appropriate for rearing birds in captivity.

## CONCLUSION

This study highlights the relevant empirical knowledge of passerine breeders on the *ex situ*, management and that the activity is related to local cultural and economic factors. The transmission of knowledge about the management of passerine birds occurs mainly through observation and orally among breeders within social circles who share similar interests and is passed between generations. Breeders have important information on the *ex situ*, management of wild birds bred in captivity; although there are some discrepancies, this information is generally in line with the established knowledge in the area. However, there are still few studies on the reproductive management of passerines in captivity, and thus, the knowledge that breeders have can contribute to improving the captive management of these birds. *Sporophila angolensis*, is one of the species of captive-bred birds most valued by breeders and is considered of great importance in the management of birds in the Amazon. Noting that the ethno-knowledge of bird keepers regarding the management of passerines can be a valuable source for new investigations and studies, significantly contributing to the understanding of the management of these birds.

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## DATA AVAILABILITY

The data used to support the findings of this study are available from the corresponding author upon reasonable request.

## CONFLICT OF INTEREST

The authors have no conflicts of interest to declare.

## CONTRIBUTION STATEMENT

Conceived of the presented idea: SRS, PCBJ, DAAG.
Carried out the experiment: SRS, BSSB.
Carried out the data analysis: SRS, BSSB, MCR.
Wrote the first draft of the manuscript: SRS.
Review and final write of the manuscript: SRS, BSSB, JSC, MCR, DLC, MGZ, DAAG.
Supervision: BSSB, DAAG.

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