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Presence of plastic fragments in the digestive tracts of seven owl species in Southern Brazil

Ocorrência de plástico no trato digestório de sete espécies de corujas no Sul do Brasil

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Abstract

The ingestion of plastic by birds is a growing threat to wildlife, especially in urban and rural environments near urban centers. While the effects of plastic on seabirds are widely studied, there are still gaps in knowledge about the impacts on terrestrial birds, including raptors. This study aimed to address this gap by investigating the presence of plastic in the digestive tract of owls of the species: *Athene cunicularia*, *Asio clamator*, *Megascops choliba*, *Tyto furcata*, *Strix virgata*, *Asio stygius*, and *Bubo virginianus*. A total of 64 samples from individuals found dead on highways and in urban areas of Santa Catarina, southern Brazil, were analyzed. Plastic fragments were detected in all seven species studied, with a predominance of plastic fibers. *Athene cunicularia* (burrowing owl) was the species with the highest number of occurrences (33.33%), followed by *Megascops choliba* (tropical screech owl) (25.92%). The results indicate that plastic contamination is already significantly affecting nocturnal birds of prey in the region, highlighting the need for further ecotoxicological studies and actions to mitigate plastic pollution.

Resumo

A ingestão de plásticos por aves é uma ameaça crescente à fauna silvestre, especialmente em ambientes urbanos e rurais próximos a centros urbanos. Enquanto os efeitos do plástico em aves marinhas são amplamente estudados, ainda há lacunas no conhecimento sobre os impactos em aves terrestres, incluindo rapinantes. Este estudo buscou preencher essa lacuna ao investigar a presença de plástico no trato digestivo de corujas das espécies *Athene cunicularia, Asio clamator, Megascops choliba, Tyto furcata, Strix virgata, Asio stygius* e *Bubo virginianus*. Foram analisadas 64 amostras provenientes de espécimes encontrados mortos em rodovias e áreas urbanas de Santa Catarina. Fragmentos de plástico foram detectados em todas as sete espécies estudadas, com predominância de fibras plásticas. *Athene cunicularia* (coruja-buraqueira) foi a espécie com maior número de ocorrências (33,33%), seguida por *Megascops choliba* (corujinha-do-mato) (25,92%). Os resultados indicam que a contaminação por plástico já afeta significativamente as aves de rapina noturnas na região, evidenciando a necessidade de estudos ecotoxicológicos mais aprofundados e ações de mitigação da poluição plástica.
Palavras-chave: aves terrestres; ingestão de plástico; impacto ambiental.

1 | Introduction

Plastics are widely used due to their versatile properties, durability, and affordable cost. However, their long lifespan is also a significant problem, taking up to 400 years to decompose naturally (Piatti andand Rodrigues, 2005). Since the 1970s, concern about environmental contamination by plastics has gained prominence in the scientific community (Vargas et al., 2022). Despite the implementation of the National

Solid Waste Policy (PNRS), Brazil is the fourth largest producer of plastic waste in the world (Vargas et al., 2022).

The ingestion of plastics by aquatic and terrestrial organisms is a growing environmental concern, as it can impact the entire food chain, including humans (Machado et al., 2021). This phenomenon has been reported in a wide range of animals, including fish, sea turtles, seabirds, and birds of prey (Bugoni et al., 2001; Possatto et al., 2011; Vendel et al., 2017; Carlin et al., 2020). Among the harmful effects are injuries to the digestive tract, intestinal obstruction, and even death (Macedo et al., 2011). In the environment, plastic debris can degrade into smaller fragments, known as microplastics (particles <5mm), while larger fragments are referred to as mesoplastics (5 to 25mm) and macroplastics (>25mm). Microplastics, in particular, raise concern due to their potential for bioaccumulation in tissues and induction of adverse effects such as oxidative stress (Araújo et al., 2018).

Plastic pollutants are classified according to size, shape, and origin. (Andrady, 2011; Eriksen et al., 2013; Hartmann et al., 2018). The presence of these particles in the environment is increasingly recognized, highlighting the need for research on the impacts on organisms, including terrestrial birds (Carpenter and Smith, 1972; Nascimento et al., 2022; Vargas et al., 2022).

Brazil stands out for having an avifauna composed of 1971 species (Pacheco et al., 2021) including land and water birds. Terrestrial birds are exposed to plastic mainly in urban and coastal areas, where waste is common and can be ingested accidentally (Castañeta et al., 2020; Galindo et al., 2023). Among the avian groups, owls represent the order Strigiformes, which is divided into two families: Tytonidae and Strigidae. The Tytonidae family has 19 species known worldwide and differ from each other in that they have a "heart-shaped disc" on their faces (Sick, 1997). The Strigidae family, in turn, is represented by around 212 species distributed worldwide and have a "round-shaped" facial disc (Sick, 1997; Sigrist, 2013; Menq, 2018). In Brazil, the family is represented by 24 species (Motta-Junior, 2004; Menq, 2018). The order Strigiformes, together with Accipitriformes, Falconiformes and Cathartiformes are considered birds of prey due to their feeding habits and the way they search for food (active hunting), and are characterized as carnivores, diurnal or nocturnal (Zilio, 2006; Soares et al., 2008). Although there are these similarities, the orders mentioned and characterized as birds of prey do not form a monophyletic group (Sick, 1997; Soares et al., 2008). Due to their morphological, anatomical and physiological similarities, they have an important ecological function, mainly with regard to the control of populations of invertebrates, small mammals and even other birds (Azevedo et al., 2003; Barros et al., 2011). The diet also varies according to seasonality, increasing in colder seasons, making them more generalist and opportunistic (Motta-Junior, 2006).

The ingestion of plastic waste by birds can occur for several reasons, with food misidentification being one of the most common. In this context, birds can mistake plastic fragments for real prey, a behavior already observed in other groups of animals, such as sea turtles, which mistake plastic bags for jellyfish (Schuyler et al., 2012), and fish, which ingest microplastics by associating them with natural food particles (Jovanović, 2017). Ivar do Sul and Costa (2014) and Wilcox et al. (2015) have reported that the ingestion of plastic fragments by animals can occur indirectly, mainly through food. This contamination can happen when animals consume prey that is contaminated by plastic or when they ingest plastic particles suspended in the environment. This scenario is a growing concern, as highlighted by Araújo and Malafaia (2021a). In addition, the transport of plastic debris to remote areas affects species in seemingly untouched environments, such as Brazilian oceanic islands (Fernandino, 2012; Petersen et al., 2016). Ingesting plastic can cause digestive problems and compromise the immune system of birds, affecting their health and reproduction (Ryan, 1988; Costa, 2014).

While plastic ingestion by seabirds is widely studied, there is a significant gap in the understanding of the impacts on terrestrial birds, including raptor species (Araújo and Silva-Cavalcanti, 2016; Carlin et al., 2020). Studies in this area are essential to assess the consequences on the health and ecology of these species. It is therefore important to expand research focused specifically on terrestrial birds and to develop environmental management policies aimed at mitigating this issue. In this context, this study aims to identify the presence of macroplastics—plastic fragments larger than 5 mm—in the stomachs of seven owls, providing data that may contribute to a better understanding of plastic pollution among terrestrial predators.

2 | Materials and Methods

For this study, 64 carcasses of seven owl species from the biological collection of the Universidade da Região de Joinville (Iperoba Biological Collection - ABI/UNIVILLE) were analyzed. All the owls originated from conflict situations, such as attacks by other species, roadkill, collisions, or even unknown causes, and were collected along the route between the municipalities of Garuva and Palhoça, both in the state of Santa Catarina.

The carcasses were found on the banks of the BR 101 Federal Highway, on the north coast of Santa Catarina, and were from animals that had been victims of collisions with cars and were collected by different institutions from 2006 to 2021 (Figure 1). They were transported and deposited at ABI/UNIVILLE in accordance to Chapter VI, item 6.1.10 of Normative Resolution CONCEA No. 30, of February 2, 2016 (Brazilian Guideline for the Care and Use of Animals – DBCA), saying that the use of material obtained from animals that have already been euthanized or slaughtered or parts thereof does not require prior approval from the institutional Animal Use Ethics Committee (CEUA). The owls collected included: 19 *Athene cunicularia* (Molina 1782) (burrowing owl), 14 *Asio clamator* (Vieillot 1817) (long-eared owl), 12 *Megascops choliba* (Vieillot 1817) (wood owl), nine *Tyto furcata* (Temminck 1827) (barn owl), five *Strix virgata* (Cassin 1851) (spotted owl), three *Asio stygius* (Wagler 1832) (devil owl), and two *Bubo virginianus* (Gmelin 1788) (golden owl). The carcasses were stored frozen at -20°C, each in an individual plastic bag.

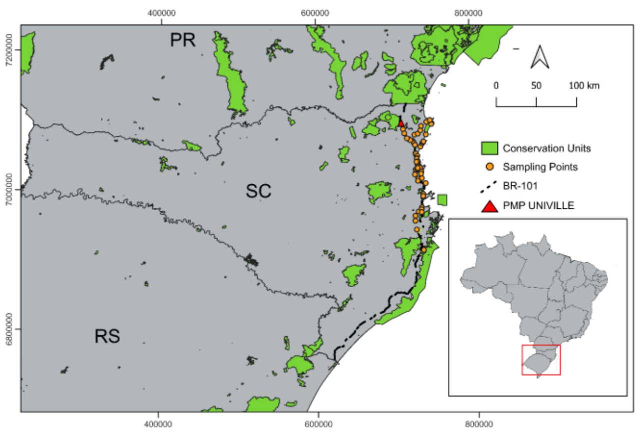

Figure 1. Location of the headquarters of the partner institution and the municipalities where the data were collected

In the laboratory, a ventral incision was performed from just below the beak to the cloaca to access the gastrointestinal tract. The stomach was removed and its contents were placed in individual storage jars containing 70% alcohol, then kept under refrigeration for further analysis, following the procedures described by Bugoni et al. (2001) and Silva et al. (2020). The gastrointestinal tract was segmented into esophagus, proventriculus, and ventricle, and each section was processed separately. The food content from each part was also preserved in 70% alcohol. For analysis, the material was screened using a Zeiss stereomicroscope, as per the methodology adapted from Bugoni et al. (2001) and Silva et al. (2020).

Even though this study did not focus on microplastics, and therefore did not require a more specific and rigid protocol, the entire protocol adopted was prioritizing the non-use of plastic materials and maintaining caution to avoid any type of contamination. The experimental room was kept closed and free of circulation throughout the analysis period and all materials were properly washed with deionized water and left to dry with the mouth facing down. 100% cotton aprons were used and glassware was prioritized during the experiment. To ensure the integrity of the analyses, Petri dishes containing filtered and deionized water were kept inside and outside the fume hood. These plates were inspected before and after the analysis, and the results were recorded in the control sheet. In the external control procedure, the Petri dish was washed with deionized water and left to dry with the mouth facing down. Prior to placing the stomach contents samples for the first screening, the plate was visually inspected under a stereomicroscope.

During the screening of owl stomach content samples, careful observation was performed to identify and remove possible plastic particles present, with a size of at least 5 mm, characterized as mesoplastics and above. A caliper was used to assist in size determination. The particles were stored in glass tubes numbered with the drop number and preserved in 70% ethanol for further characterization.

To collect and fix the plastics, the Petri dish was washed again with deionized water and left to dry with the mouth facing down. Before starting the procedures, contaminants were checked under the stereomicroscope. The material stored in the glass tubes was transferred to clean Petri dishes filled with deionized water. The plastic particles were individually separated and fixed on slides with glue and coverslips to facilitate further characterization. All slides were stored in a specific slide box. It is important to emphasize that all procedures were performed inside the fume hood, with the Petri dish properly closed to avoid any type of contamination during the analyses.

The characterization and measurement of the fragments were performed using a stereomicroscope. Through visual observation, it was possible to determine the shape of the plastics: fiber, film, pellets, hard plastic, nylon; Color: blue, green, red, beige, transparent; and size: macroplastics (>20–100mm) and mesoplastics (>5–20mm) (Provencher et al., 2017). After the morphotyping stage, a caliper was used to measure the plastics. Each plastic particle was carefully measured to obtain accurate information about its size. In addition, to explore the results in more depth, graphs have been created that illustrate the observed frequencies of the different categories of plastics. The graphs were generated using the statistical software Past.

The observed frequencies of plastic categories were compared with the expected proportions using a chi-square goodness-of-fit test, considering the number of particles and the number of species. Expected proportions were defined based on the theoretical distribution adopted in the study. The significance level was set at 5% ($\alpha = 0.05$), and the p-value was obtained from the statistical test.

3 | Results and Discussion

The results of this research revealed the presence of plastic in the stomachs of all seven owl species investigated (Table 1). Of the 64 stomachs analyzed, 42.19% (n=27) were contaminated with at least one type of plastic (Table 2, Figures 2 and 3).

Table 1. Frequency of Occurrence (FO) of plastic particles found in seven species of owls in southern Brazil

Owl species	Habit	Sample number	Number of stomachs with	FO plastics by species %
Tyto furcata	C	9	2	22,22
Megascops choliba	I	12	7	58,33
Bubo virginianus	C	2	1	50
Strix virgata	C	5	3	60
Athene cunicularia	I	19	9	47,36
Asio clamator	C	14	3	21,49
Asio stygius	C	3	2	66,66
Total		**64**	**27**	

C: Carnivore. I: Insectivore.

Table 2. Number and size (Min-Max. mean) of plastic particles found in the stomach of 27 specimens of seven owl species in southern Brazil

Scientific name	Fiber	Nylon	Films	Hard plastics	Total	Total Min and Max (mm)	Size average (mm)
Tyto furcata	2	0	0	1	3	5-9	3
Megascops choliba	15	0	1	0	16	5-8	6
Bubo virginianus	1	0	0	0	1	9	-
Strix virgata	3	1	0	0	4	5-8	6,25
Athene cunicularia	16	1	2	0	19	5-16	6,88
Asio clamator	3	1	0	0	4	5-18	4,5
Asio stygius	6	0	0	0	6	5-7	5,5
Total	**46**	**3**	**3**	**1**	**53**	**5-18**	**4,98**

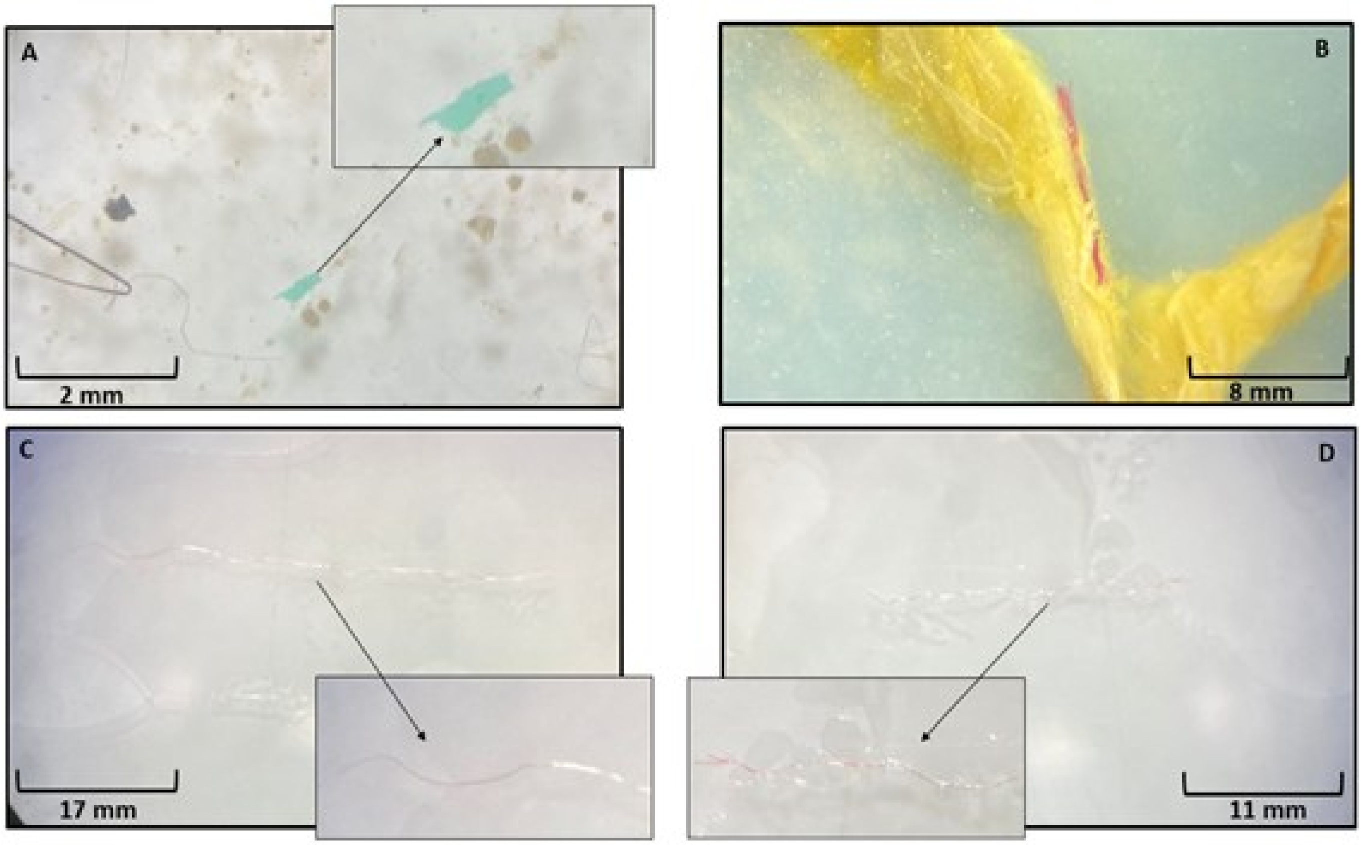

Figure 2. Plastic items found in the stomach of owls. (A) Transparent plastic fiber assemblies with green spots. (B) Red nylon. (C) White plastic fragment. (D) Set of red plastic fibers that resemble a rope.

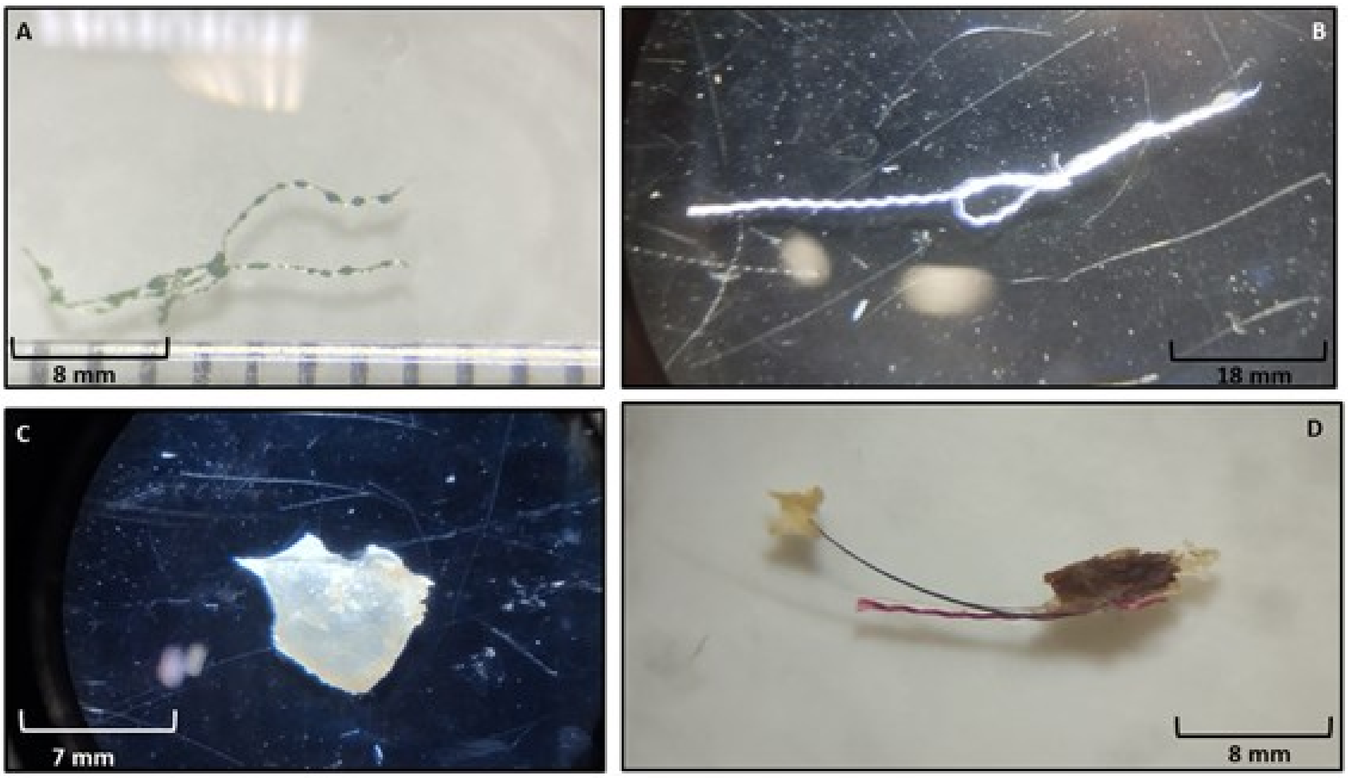

Figure 3. Plastic items found in the stomachs of owls. (A) Transparent/green plastic fragment. (B) White rope. (C) Hard plastic. (D) Red plastic fiber.

Although plastic ingestion has been recorded in several bird groups around the world, reports involving owls remain scarce in the scientific literature. One of the few known examples was documented by Carlin et al. (2020), who reported the presence of plastic fragments in the stomach of *Megascops kennicottii* (wood owl) in North America. To date, however, there are no records of this occurrence in Brazil, which makes the present study the first to document plastic ingestion by owls in the country and one of the rare evidences of this interaction at a global level.

All owl species studied were contaminated by some type of plastic, with *A. cunicularia* (burrowing owl) being the species with the highest number of occurrences (9/27; 33.33%), followed by *M. choliba* (tropical screech owl) (7/27; 25.92%) (Table 1). The results showed the frequency of plastics in the stomachs of different species of owls, detailing the number of samples collected and the frequency of occurrence (FO) of plastics per species in percentage.

Plastic fibers, often originating from synthetic fabrics and textile products (Ferraz et al., 2020), have also been found in the digestive tracts of owls. These fibers can be ingested through food, either by consuming contaminated prey or by ingesting particles suspended in the environment. All owls had plastic fragments of varying sizes, with *A. cunicularia* being the species that presented both the largest quantity of fragments (n=19) and the largest mean fragment size (6.88mm) (Table 2, Figure 4).

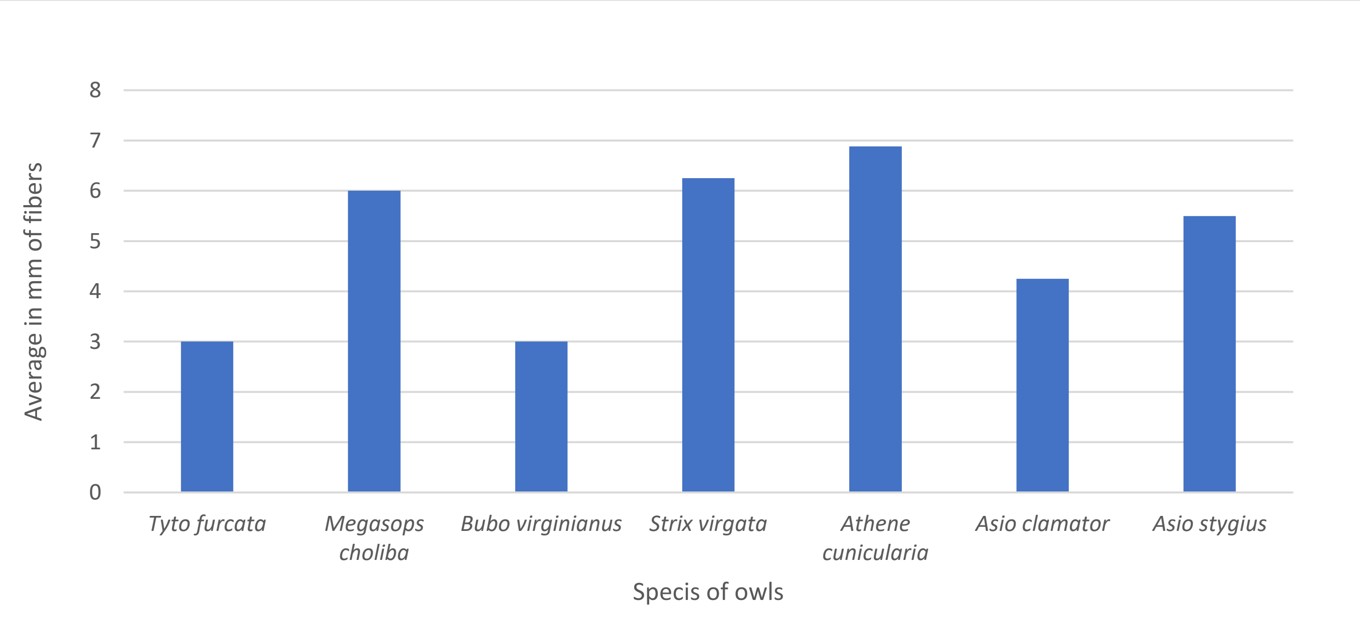

Figure 4. Average in millimeters of fibers found in seven species of owls in southern Brazil

The possible presence of fibers which originate. for example, from washing clothes or airborn particles, indicates that the ingestion of these fibers may be associated with the ecological role played in the environment by each species of owl studied here. According to Santos et al. (2017), this species has generalist eating habits and easily adapts to anthropized spaces, where it consumes a variety of prey and often ends up ingesting non-food materials, such as plant fibers and fragments of anthropic origin. This characteristic can be explained by the greater exposure to residues in these environments, which contributes to the high occurrence of fibers in the digestive tract of the species, especially in regions close to urbanized areas, proven by the number of fibers found in the stomach of *A. cunicularia,* for example.

After the morphotyping stage, the plastics were classified into different categories, including fibers, films, spheres and larger particles, and their different colors were also recorded. Regarding plastic fragment color, blue was the most prevalent (55%; n=29), followed by transparent (23%; n=12) and red (15%; n=8) (Figures 2, 3, and 5). The results indicate that the birds ingested plastic, probably as a direct result of environmental pollution. This ingestion may occur through two main pathways. First, it can occur due to food confusion, when birds mistake plastic for their real prey, as previously reported for turtles (Schuyler et al., 2012) and fish (Jovanović, 2017). Second, ingestion may occur indirectly through the consumption of prey contaminated with plastic particles, as suggested by Olivatto et al. (2018).

Plastics ranged in size, color, and type, from mesoplastics to macroplastics (Table 2, Figures 4 and 5). The visual analysis revealed a remarkable diversity in the composition of the plastics present in the collected samples. Statistical analysis showed that the observed frequencies of plastic categories did not differ significantly from the expected proportions (χ^2 test; $p = 0.398$), considering both the number of particles and the number of species.

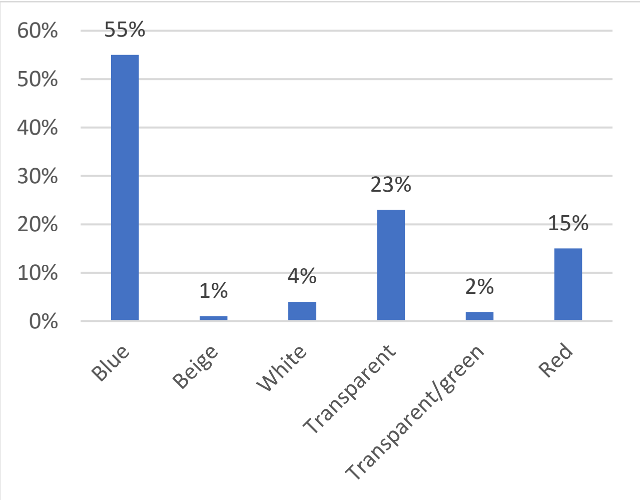

Figure 5. Percentage of the colors of the plastic items found in the seven species of owls.

This finding is of great relevance, as it suggests the existence of specific sources of plastic pollution, as well as possible variations in the physical characteristics of plastics in different environments. This discrepancy between the observed and expected frequencies highlights the complexity and dynamics of the processes of degradation and transport of plastics in different ecosystems. Understanding these disparities is critical to formulating effective strategies to mitigate and control plastic pollution in our natural environments.

Considering that owls are predators and occupy high trophic levels, they may ingest plastic fragments directly andbe affected by bioaccumulation and biomagnification through the trophic chain, since the prey may have ingested small plastic particles (Ivar do Sul and Costa, 2014; Wilcox et al., 2015; Silva et al., 2021; Carrillo et al., 2023). This scenario is a growing concern, as highlighted by Araújo and Malafaia (2021b). These processes can lead to the progressive accumulation of plastics at higher and higher levels in the food chain, increasing exposure and risks for several species of animals, such as the birds of prey in the study, which occupy high trophic levels.

The plastic fibers that have been found in the digestive tract of owls are widely distributed in the environment, and often originate from synthetic fabrics and textile products (Doucet et al., 2021). According to Zhang et al. (2020) fibers and fragments are the most frequently reported forms and the types of plastic pollution that generally align with the worldwide demand for plastic. In addition, it is suggested that the accidental ingestion of plastic waste can be potentiated by bioaccumulation and/or biomagnification, as highlighted by Silva et al. (2021). These processes can lead to the progressive accumulation of plastics at higher and higher levels in the food chain, increasing exposure and risks for wide range of animals, including birds.

Another concerning factor is that, due to their light weight and their ability to float in the air, some plastic particles can also be inhaled by animals (Gasperi et al., 2018). This type of exposure can be a relevant factor for the presence of micro and macroplastics in the body, leading to adverse consequences for the health of animals, especially those living in highly polluted environments. The ingestion of plastic fibers, depending on the amount, can also cause physical damage to the gastrointestinal tract of birds, as they can accumulate, causing irritation, inflammation, or blockage of the digestive tract (Barcelos, 2016). In addition, just like any plastic particles, fibers can release toxic chemicals, increasing health risks to birds (Lavers and Bond, 2016). Considering the fiber intake by different animals such as fish (Possatto et al., 2011; Vendel et al., 2017), sea turtles (Bugoni et al., 2001; Petry et al., 2021), seabirds (Fonseca et al., 2001; Petry et al., 2009; Petry and Benemann, 2017; Zhu et al., 2019; Bresesti Dalmás, 2020) owls are also affected by fiber contamination, likely through indirect ingestion via prey, or through inhalation of small particles, such as microplastics.

The possible presence of fibers, for example, from washing clothes or present in the air, indicates that the inhalation and/or ingestion of these fibers may be associated with the ecological role played in the environment by each species of owl studied here. This explains why *A. cunicularia,* being an owl found in fields, pastures, plains, and urban areas (Sick, 1997;

Antas and Cavalcanti, 1998), had the highest amount of fiber in the stomach, precisely because of its proximity to human beings.

Carlin et al. (2020) studied birds of prey collected in central Florida, USA, and found plastic particles present in the gastrointestinal tract of 100% of the specimens. The study used eight species of birds of prey: *Pandion haliaetus* (osprey), *Buteo lineatus* (red-shouldered hawk), *Buteo jamaicensis* (short-tailed hawk), *Accipiter cooperii* (round-tailed hawk), *Falco femoralis* (collared hawk), *Buteo platypterus* (broad-winged hawk), *Strix varia* barred owl and *Megascops asio* (eastern screech owl). In them, fibers, as in our study, represented the majority (86%) of plastic fragments, followed by microfragments (13%), macroplastics (0.67%) and microspheres (0.33%). *Strix varia* and *B. jamaicensis* had the lowest number of average fibers per gram of gastrointestinal tract tissue. Our study evidenced plastic polymers present in seven owl species, corroborating the study by Carlin et al. (2020) allowing a comprehensive understanding of plastic consumption in animals in habitats and food webs, ultimately reaching the apex predators.

Although the present study did not perform chemical analyses to identify the specific types of plastic ingested, polypropylene (PP) is frequently reported in the literature as one of the main polymers found in the digestive tracts of birds. For instance, Ryan et al. (2009) and Rochman et al. (2015) documented the presence of PP in the stomach contents of various bird species, highlighting its widespread environmental availability. Polypropylene, due to its non-biodegradable nature, can remain in the digestive system for extended periods, potentially causing intestinal blockage, reducing nutrient absorption, and consequently affecting the health and survival of birds.

Among the species analyzed, *A. cunicularia* (burrowing owl) and *M. choliba* (tropical screech owl) were the ones with the highest rates of plastic contamination. They feed mainly on arthropods and small mammals, but can also consume amphibians, reptiles, smaller birds, leaves, sticks, and seeds (Vieira and Teixeira, 2008; Holt et al., 2014; Santos et al., 2017). Throughout this process, owls use different tactics, such as perch hunting, ground hunting, sifting and aerial hunting (Martins and Egler, 1991). The feeding of owls based on insects indicates the existence of a phenomenon of biological amplification, in which the insects may have been exposed to contamination not only through the accumulation of microparticles around their body, but also through the ingestion of microparticles and contaminated food (Ribeiro-Brasil et al., 2022).

According to Motta-Junior (2006), *Asio clamator* has a diet with large proportions of vertebrates, mainly small mammals (rodents and marsupials), while *Asio stygius* has an almost strictly carnivorous diet and differs from practically all other owls ever studied in the world. The species feeds almost exclusively on birds, with rodents being negligible in their diet. In addition, the species also has one of the highest bat consumptions among owls. This diet pattern, presented by these owl species, is also reflected in the amount of plastics found, being relatively smaller than the species with a more insectivorous diet since insects, when walking on the ground, end up aggregating plastics in their body (Caixeta et al., 2022).

Blue and red fibers are the most frequently reported (Hidalgo-Ruz et al., 2012), which corroborates the results of the present study, where most of the samples collected were within the aforementioned color parameters. This information is relevant for identifying the origin of plastics found in the environment and for understanding their possible sources of contamination. The analysis of morphological characteristics – such as color and size – of the plastic fragments found in this study, which were predominantly macroplastics, is relevant for environmental research. Such information can aid in inferring possible sources of contamination and contribute to future efforts in monitoring and mitigating plastic pollution in terrestrial ecosystems.

The present study corroborates previous findings, where blue and red fibers are the most frequently reported (Hidalgo-Ruz et al., 2012). The staining of plastic fibers proves to be valuable information for the identification of potential sources of polymeric residues, as well as for the recognition of possible contamination during the sample preparation process. In this context, Caixeta et al. (2022) points out that the colors most commonly found in the analyses are: red, orange, yellow, brown, beige, off-white, white, gray, blue, and green. Such information is essential for environmental monitoring studies and understanding the impacts of plastics on fauna.

Regarding coloration, Carlin et al. (2020), in their research, observed similar pigmentation patterns, where the vast majority of the fibers analyzed were transparent or blue in color. Carrillo et al. (2023) corroborated these findings by finding that the most abundant fibers in contamination in common terns (*Sterna hirundo*) were the transparent, black, and blue fibers, which are also composed of plastics. Our study confirms the coloration pattern found in the research, since blue was the highest percentage found. Blue-colored plastics are commonly present in a variety of products, such as water bottles, cleaning product containers, and textiles. On the other hand, although less frequent, red plastics can be found in items such as toys, food packaging, and also textiles. However, it is important to note that discoloration of microplastics can occur during wear and also during sample preparation, which must be considered when documenting and interpreting the data obtained.

4 | Conclusion

This study reports for the first time the ingestion of plastics by owls in Brazil, highlighting the ocurrence of this residue in wildlife. The results reveal the exposure of owls to plastics in their habitat, with possible adverse consequences for the health of these birds and the stability of ecosystems. The presence of plastics in the stomach of owls suggests a possible transfer of these particles through their diet, which consists mainly of insects and small non-flying mammals.

The ingestion of plastic particles, fibers, films, and spheres poses a threat to the health and survival of birds. Adverse effects include obstruction of the digestive tract, malnutrition, exposure to toxic chemicals, and physical harm, with implications that extend to health and population stability, affecting the ecosystem as a whole. Therefore, the data obtained through the visual characterization of these wastes, combined with the graphical representation, provide a comprehensive and valuable view on the presence and distribution of plastics in the collected samples, underscoring the continued importance of research in this area for the conservation of our ecosystems.

This pioneering study reveals the alarming presence of plastic contamination in owls in Brazil, warning of the seriousness of plastic pollution and its impacts on wildlife. The protocol adopted for identifying and extracting plastic particles from the digestive tract of the birds was adapted from methodologies proposed by Bugoni et al. (2001) and Silva et al. (2020) and adjusted to suit the specific conditions of this study. Mitigating this problem requires comprehensive actions, including reducing the use of plastics, environmental awareness and education, and collaboration between governments, industries, and civil society. Protecting owls and their habitats is critical to preserving biodiversity and ensuring a healthy environment for future generations.

5 | Conflict of Interest Statement

The authors declare no conflict of interest.

6 | Ethics Committee

The analyses conducted in this study were derived from the examination of carcasses of deceased animals. Thus, this project was not submitted to the animal ethics committee.

7 | Acknowledgments

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