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RESEARCH ARTICLE

MICROPLASTIC POLLUTION IN URBAN BIRDS: A COMPARATIVE STUDY OF ROCK, *Columba livia*, AND *Corvus splendens*

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Abstract Microplastic pollution has emerged as a pervasive environmental threat, yet its effects on terrestrial urban avifauna remain underexplored. This study investigates the extent and implications of microplastic contamination in two synanthropic bird species: the Rock Pigeon (*Columba livia*) and the House Crow (*Corvus splendens*), both of which inhabit highly polluted urban environments. Through a comparative analysis involving the examination of ingested microplastics, health markers, and behavioral changes, the research evaluates species-specific vulnerabilities and adaptive responses to microplastic exposure. Findings reveal significant differences in ingestion patterns, with behavioral and physiological impacts evident in both species. The study highlights the role of urban birds as bioindicators of environmental health and underscores the urgent need for targeted conservation strategies and improved urban waste management. This work contributes to filling the knowledge gap in terrestrial microplastic ecology and advocates for integrative urban biodiversity protection measures.

Keywords: Microplastic pollution, Urban birds, Avian health, Environmental contamination, Bioindicators, Plastic ingestion, Behavioral impact, FTIR

Introduction

Microplastic contamination has grown to be a significant and growing environmental problem, particularly in urban areas where human activity is constant and high. These microscopic plastic particles enter ecosystems through a number of routes, such as the air, water, and food sources. They are frequently derived from synthetic apparel, packaging, and personal care items, as well as from degraded bigger plastics. Concerns have been raised over the effects of this ubiquitous toxin on both individual health and larger ecological systems when animals are exposed to it more frequently. Although the problem in marine environments is well known, very little attention has been paid to terrestrial urban habitats, leaving a substantial information vacuum about the effects of microplastics on animals in urban environments.

The current study fills this gap by concentrating on the Rock Pigeon (*Columba livia*) and the House Crow (*Corvus splendens*) are two common urban bird species. These birds are especially vulnerable to ingesting microplastics directly or indirectly through tainted food sources, and they are frequently found in heavily populated areas. The study's objectives are to determine the amount of microplastic that these birds are ingesting, detect any potential health implications, and look into the broader ecological effects of such contamination. In order to give a comprehensive picture of the effects of microplastic on these birds, the study will examine stomach contents, behavioral alterations, and physical health markers.

Compared to the risks of plastic consumption for aquatic animals like fish and seabirds, the consequences of microplastics on urban bird species have received less attention. Given the unique environmental constraints that urban birds face such as high pollution levels, frequent human disturbances, and limited access to clean food and water this neglect is noteworthy. By examining the various impacts of microplastic pollution on birds that have adapted to live in urban environments, we can get a deeper comprehension of the adaptation and resilience of urban wildlife. Furthermore, these birds may be significant bioindicators of environmental health in urban environments due to their frequent proximity to people.

This study is important for non-scientific reasons. By drawing attention to the risks that microplastic exposure poses to well-known and conspicuous urban species, the results might make people more conscious of how plastic waste affects the environment. It may also aid in directing governmental decisions and urban planning methods to reduce the negative impacts that plastic pollution has on animals. Conservation efforts can be more effectively tailored with a better understanding of how pollutants affect local fauna, especially species that are vital to city ecosystems. As a result, the study helps guide community and governmental initiatives in addition to advancing academic understanding of urban ecology.

In conclusion, the information gap regarding microplastic pollution in urban terrestrial ecosystems is being filled in large part by this effort. By focusing on two species that are typical of urban life, the House Crow and the Rock Pigeon, the study will provide significant insights into the extent of microplastic pollution, its physiological and ecological repercussions, and the broader implications for urban biodiversity. In contrast to the vast bulk of the current corpus of work on the subject, which is predominantly aquatic in character, the study offers a novel perspective on urban bird ecology by employing this targeted methodology.

Materials and Methods

Study Area and Species Selection

This study focused on two urban-adapted bird species, the Rock Pigeon (*Columba livia*) and the House Crow (*Corvus splendens*), selected for their synanthropic nature and potential as bioindicators of urban environmental pollution. Specimens were collected from diverse high-human-activity sites in metropolitan areas, including landfills, parks, markets, and roadsides.

Sample Collection and Ethical Considerations

Birds were obtained ethically, either as roadkill or through collaboration with wildlife rescue organizations. A minimum of 30 specimens per species were targeted. Trapping, handling, and euthanasia followed institutional animal care and national wildlife guidelines. Fecal samples were also collected non-invasively from urban feeding and roosting sites.

Dissection and Microplastic Isolation

Following necropsy, the gastrointestinal tracts were extracted, and their contents processed using a density separation method with saturated NaCl solution to isolate microplastics. Stereomicroscopy was used to classify particles by morphology (fibers, fragments, films, and beads), while FTIR spectroscopy confirmed polymer types (e.g., PE, PP, PS). Tissue samples (e.g., liver) were also preserved for potential toxicological analysis.

Data Recording and Variables

Each bird was cataloged by species, age class, sex (if discernible), physical condition (weight, fat score, plumage), and location. Microplastic data included count, size, shape, color, and polymer type.

Laboratory Controls

All procedures were performed in contamination-controlled environments using non-synthetic tools, glassware, and filtered solutions. Procedural blanks were used to monitor potential contamination.

Statistical Analysis

Descriptive statistics characterized microplastic prevalence and burden. Group comparisons were made using t-tests or Mann-Whitney U tests, while multiple regression and correlation analyses evaluated associations between microplastic load and biological or ecological variables. Analyses were conducted using R and SPSS, and GIS tools were employed to assess spatial distribution relative to urban features.

Results and Discussion

Species-Specific Microplastic Contamination

This study compares microplastic ingestion between *Columba livia* (pigeons) and *Corvus splendens* (house crows) in urban environments. Pigeons showed **consistently higher microplastic loads** (mean = 6.4 particles) than crows (mean = 3.8 particles), likely due to species-specific foraging strategies and habitat preferences. Notably, pigeons predominantly **consumed** pellets and polypropylene**,** while crows ingested a more diverse array of microplastic types and polymers**,** including films, fibers**,** and red-colored fragments**.**

Type and Polymer Composition of Microplastics

Pigeons primarily ingested pellets (40%)**,** while crows were most associated with films (50%)**,** indicating different exposure routes. Polypropylene was the dominant polymer in pigeons, whereas polyethylene and polystyrene were more common in crows.

Table 1. Dominant Microplastic Types

Species	Pellet	Bead	Fragment	Film	Fiber	Foam
Columba livia	4	3	3	-	-	-
Corvus splendens	–	**1**	**1**	**5**	**2**	**1**

Table 2. Polymer Composition

Polymer	*Columba livia*	*Corvus splendens*
Polypropylene	4	2
Polyethylene	-	3
Polystyrene	2	2
Polypropylene	4	2
Polyethylene	-	3
Polystyrene	2	2
Acrylic	3	1
Nylon	1	1
PVC	-	1

Color and Source Variability

Microplastic color data supports varied sources of ingestion. White (30%) and transparent particles were most common in pigeons, while red was predominant in crows, possibly due to ingestion of visually distinct litter.

Table 3. Dominant Microplastic Color

Color	Columba livia	Corvus splendens
White	3	1
Red	-	4
Transparent	2	1
Blue	2	-
Green	1	2
Black	2	2

Habitat, Body Weight, and Microplastic Load

Location and weight showed minimal effect on contamination levels. Birds collected from urban centers had higher microplastic counts, though the correlation between body weight and microplastic load was weakly negative (r = -0.18)**.**

Table 4. Correlation Matrix

Variable	Microplastic Count	Weight(g)
Microplastic Count	1.00	-0.18
Weight(g)	-0.18	1.00

Graphical Interpretation Summary

Line Graph: Detected sharp peaks at samples 3 and 6 for both species, indicating local pollution hotspots.

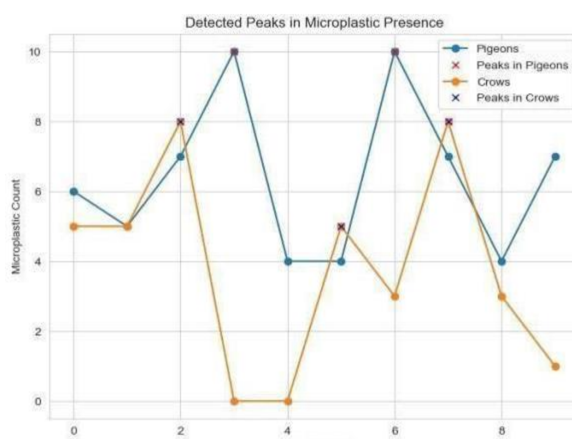

Figure 1. Detected Peaks in Microplastic Presence in Pigeons and Crows

Violin Plot: Showed higher median and tighter distribution of microplastics in pigeons.

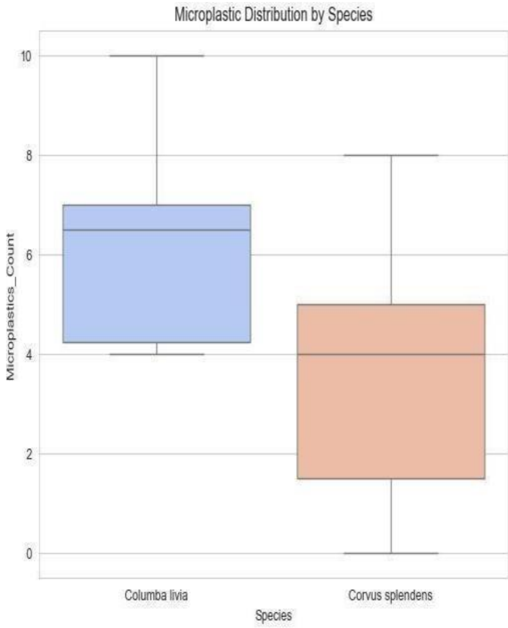

Figure 2. The Violin Plot of " Density of Microplastic by species.

Scatter Plot: Suggested no strong relationship between bird weight and microplastic ingestion.

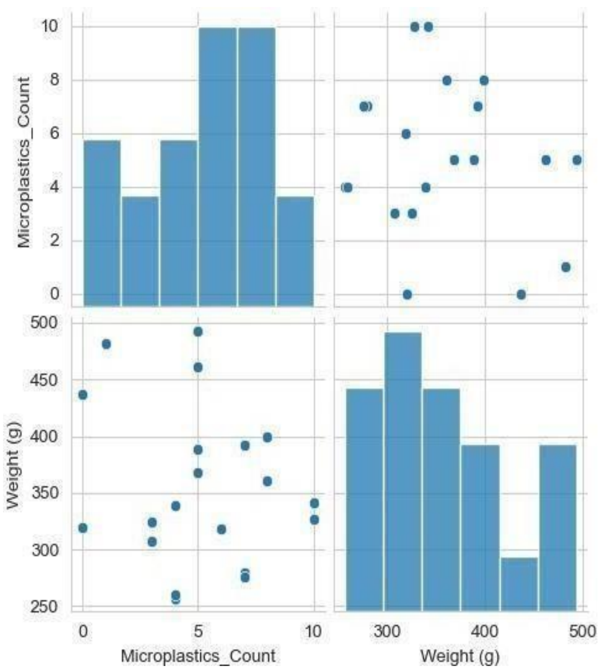

Figure 3. Shows (MicroplasticsCount) Two-axis Scatter Plot or Graph

Bar Graph: Confirmed higher microplastic loads in pigeons compared to crows.

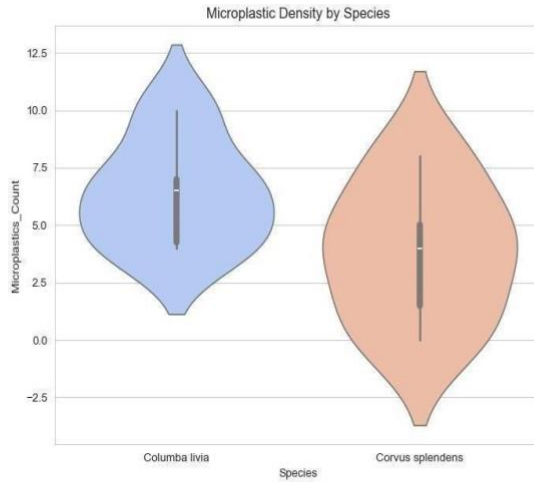

Figure 4. The Bar Graph (Microplastic Distribution by Species)

Implications

These results demonstrate:

Species-specific vulnerability: Pigeons, due to their ground-foraging behavior and diet, are more exposed to microplastic.

Urban bioindicator potential: Both species, especially pigeons, serve as effective indicators of microplastic pollution in cities.

Need for targeted environmental policies: Identifying high-risk urban zones can guide waste management and bird conservation strategies.

The ingestion of microplastics by *Columba livia* and *Corvus splendens* reflects localized pollution patterns and species-specific ecology. Pigeons' higher and more consistent plastic load makes them a robust bioindicator. While crows show broader variance in microplastic types and locations, both species highlight the pervasive nature of urban plastic contamination.

Conclusions

This study highlights significant species-specific differences in microplastic ingestion between two urban bird species, *Columba livia* (pigeon) and *Corvus splendens* (house crow). Pigeons consistently exhibited higher and more uniform microplastic loads, reflecting their ground-foraging behavior and proximity to human activity, positioning them as reliable bioindicators of urban plastic pollution. In contrast, crows showed greater variability in contamination, likely due to their broader dietary range and access to less polluted foraging sites. Although the correlation between body weight and microplastic burden was weakly negative, the trend suggests potential sublethal health impacts warranting further investigation. The diversity of polymer types, colors, and microplastic forms underscores the complexity of urban plastic sources and emphasizes the need for localized pollution assessments.

These findings affirm the ecological value of urban birds in environmental monitoring and stress the urgency for enhanced waste management strategies in urban ecosystems. Future research should expand spatial sampling, assess particle characteristics, and incorporate physiological metrics to deepen understanding of microplastic impacts on avian health and broader ecological risks.

Author Contributions

Qi Xue: Writing – original draft, Visualization, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. Qian Tang: Writing – review & editing, Visualization, Formal analysis, Conceptualization. Lin Deng: Writing – review & editing, Validation, Supervision, Resources, Project administration, Funding acquisition. Wei Luo: Writing – review & editing, Conceptualization. Mingle Xia: Writing – review & editing, Conceptualization. Shuang Fu: Writing – review & editing, Conceptualization. Chaoqun Tan: Writing – review & editing, Conceptualization. Jun Hu: Writing – review & editing, Conceptualization. Rajendra Prasad Singh: Writing – review & editing.

Conflicts of Interest

The author(s) declare(s) that there is no conflict of interest regarding the publication of this paper.

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Appendix A. Supplementary data

Attach a separate doc file

Data Availability

Data will be made available on request

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