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RESEARCH ARTICLE

Evolving public perceptions and control preferences toward urban pigeons in a UNESCO World Heritage city: Evidence from serial cross-sectional surveys in Sucre, Bolivia (2012–2024)

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ABSTRACT

Background and Aim: Urban pigeon populations (*Columba livia*) are increasingly recognized as sources of environmental contamination, infrastructure damage, and zoonotic risk. However, few studies have examined how public perceptions and tolerance levels shift over time, particularly in historical cities where pigeons interact with tourist spaces and cultural heritage. This study assessed the changes in the perceptions, prejudices, and preferred control strategies of the pigeon populations in Sucre, Bolivia, across three time points (2012, 2017, and 2024).

Materials and Methods: Three serial cross-sectional surveys were conducted in high-traffic public areas of Sucre using a structured, anonymous questionnaire (2012: N = 213; 2017: N = 209; 2024: N = 203). Sociodemographic information, pigeon-related prejudices, and preferred control methods were collected. Differences across years and demographic groups were assessed using chi-square tests. Crude and adjusted odds ratios (95% confidence interval) were calculated to identify factors associated with a preference for pigeon eradication. Open-ended responses on control recommendations were thematically coded into lethal and non-lethal categories.

Results: A total of 625 citizens participated in this study. Over the 12-year period, the respondents consistently identified littering (66%), infrastructure damage (41%), and disease transmission (42%) as major concerns, with notable peaks in 2017. Preferences for eradication increased markedly from 20% in 2012 to 49% (2024) ($p < 0.01$). Older adults (≥31 years), individuals perceiving pigeons as dirt sources, and respondents in 2024 were significantly more likely to support pigeon eradication. Conversely, participants who reported that pigeons were "not unpleasant" had substantially lower odds of preferring eradication. Citizens proposed various non-lethal methods, including reproductive control, habitat modification, and capture–relocation strategies.

Conclusion: Public perceptions of pigeons in Sucre have become progressively less tolerant, with increasing support for eradication and persistent concerns about hygiene, public health, and cultural heritage damage. These findings underscore the need for an integrated management plan grounded in the One Health framework, which prioritizes humane, sustainable, and socially acceptable measures. Incorporating public attitudes and promoting ongoing education will be essential to balance heritage preservation, animal welfare, and urban ecosystem health.

Keywords: antimicrobial resistance, epidemiology, livestock health, One Health, public health, risk factors, slaughterhouse surveillance.

INTRODUCTION

Pigeons (*Columba livia*), which are descendants of the wild rock dove, are currently among the most abundant bird species in urban environments [1]. Their population has increased globally, particularly in large cities, where pigeons have altered their feeding behavior, becoming omnivorous and highly adapted to urban habitats, thereby colonizing new ecological niches [2–4]. Several anthropogenic factors contribute to their proliferation in cities, including the deliberate feeding of pigeons in public spaces or homes, the availability of

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water in pools or puddles, improper disposal of food waste, and easy access to shelters [5, 6]. These conditions often lead to overpopulation, allowing pigeons to become an urban plague [7].

The overabundance of pigeons generates multiple problems, including increased economic costs [8], disturbance of public spaces (e.g., fright responses and discomfort due to noise), and structural damage to buildings caused by corrosive fecal deposits [6, 9, 10]. Moreover, numerous studies have demonstrated that pigeons play a significant role in the transmission and maintenance of pathogens, acting as reservoirs for a wide range of agents, including viruses, bacteria, fungi, protozoa, endoparasites, and ectoparasites [1, 11–13]. Many of these agents are associated with zoonotic diseases and allergic conditions, representing a potential threat to human health. In addition, dense pigeon populations exert environmental pressure by competing with native bird species for resources.

Commonly applied pigeon population control strategies include: (1) culling; (2) reduction of reproductive success through nest removal or the use of contraceptive substances; (3) capture and relocation; and (4) reduction of habitat carrying capacity by limiting food availability, installing physical barriers to prevent nesting, and applying chemical, acoustic, or visual repellents [9, 14, 15]. Effective pigeon population management requires a holistic perspective, such as the One Health approach, which recognizes the interconnection between human, animal, and environmental health in urban ecosystems. This approach should consider the temporal and spatial patterns of species occurrence, the magnitude of the associated damage, and the level of public awareness [6, 16, 17], as well as social factors such as traditions, religious beliefs, cultural perceptions, and attitudes toward animals [14]. These considerations are particularly relevant given the growing public concern for animal welfare [18].

Despite the relevance of these issues, few studies have examined conflicts involving urban wildlife, such as pigeons, over time from a public perception perspective. Understanding these perceptions is essential for developing effective, socially acceptable biodiversity conservation and management strategies in urban settings [19].

Sucre, Bolivia, is recognized as a United Nations Educational, Scientific, and Cultural Organization (UNESCO) World Heritage Site and is renowned for its extensive historical and architectural heritage, which attracts large numbers of international tourists and represents a major source of income for the city [20]. In this context, the growing pigeon population poses a potential threat to Sucre's sustainable development. Although Bolivia has established regulations for animal protection [21], there are no specific legal frameworks addressing the control of invasive species such as pigeons. While some local studies have reported public complaints about building damage and the perceived growth of pigeon populations [22], no research has specifically investigated public perceptions of the management of these populations. Assessing such perceptions would help to strengthen conservation and management strategies by integrating citizens' attitudes, concerns, and proposed control measures into pigeon management plans, ensuring that they are context-specific, socially acceptable, and sustainable.

The aim of this study was to evaluate public perceptions, attitudes, and concerns regarding urban pigeon populations and their management in Sucre, Bolivia. Specifically, the study sought to assess community awareness of the impacts of pigeons, identify perceived risks to public health, cultural heritage, and the urban environment, and examine public acceptance of various population control measures. By integrating social perspectives into the assessment of pigeon management, this study aimed to generate evidence-based insights to support the design of context-specific, ethical, and sustainable urban wildlife management strategies aligned with the One Health approach.

MATERIALS AND METHODS

Ethical approval and informed consent

The study was conducted in accordance with the Declaration of Helsinki and was approved by the Institutional Review Board of the Biodiversity and Natural Resources Research Center (I-BIORENA), Faculty of Agricultural Sciences, Universidad San Francisco Xavier de Chuquisaca, Bolivia (02/2012; 06/2017; 03/2024). All participants were informed about the objectives of the study, the voluntary nature of their participation, and the confidentiality of the information provided. In 2012 and 2017, informed consent was obtained verbally; in 2024, it was integrated into the online survey and included an initial screening question confirming agreement to participate. Anonymous and voluntary participation was ensured for all participants throughout the study period.

Study design, duration, and location

A serial cross-sectional study was conducted in 2012, 2017, and 2024 in the city center of Sucre, Bolivia, to

evaluate medium-term changes in public perceptions of urban pigeons and preferred population control methods. Sucre was declared a World Heritage Site in 1991 by UNESCO. The city is located in the south-central region of Bolivia at an altitude of 2750 m above sea level, with an estimated population of 356,447 inhabitants and a population density of 204/km². The intervals between surveys (5 and 7 years) were selected to balance logistical feasibility with the ability to capture meaningful medium-term changes in public perception.

Study population and sample size

The study population comprised individuals who had resided in Sucre for at least 1 year prior to each survey. Due to feasibility and resource constraints, a convenience sampling strategy was adopted. Individuals aged ≥18 years were invited to participate at five high-traffic locations within the city: the main square, the central market, the cemetery, the farmers' market, and Bolívar Park (Figure 1). These locations were consistently used across all study years. Survey days and times were selected to coincide with peak pedestrian traffic to maximize population diversity. In 2012, owing to limited resources, only residents of the city center were included. Considering the number of variables analyzed and recommendations for non-probabilistic sampling, a minimum sample size of 200 participants per study year was targeted [23].

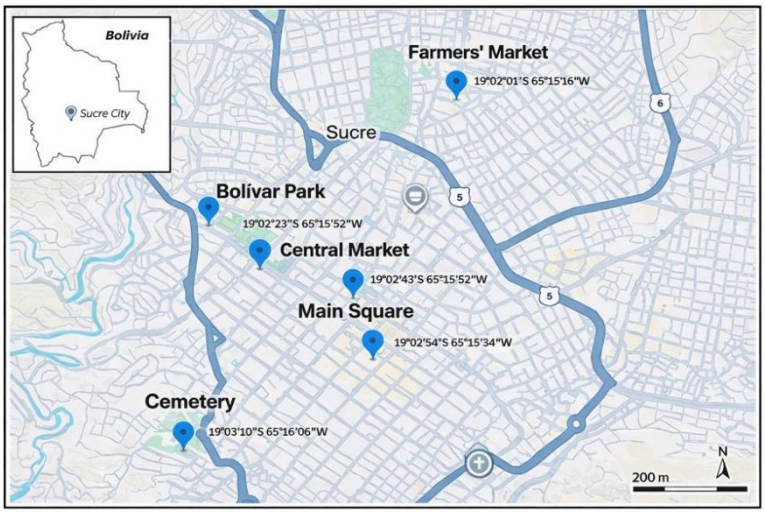

Figure 1: Map showing the geographic locations of sampling sites within Sucre, Bolivia. The map illustrates the spatial distribution of the selected sampling locations, including the Farmers' Market, Central Market, Main Square, Bolívar Park, and the Cemetery. Geographic coordinates for each site are indicated, providing spatial context for sample collection within the urban area of Sucre.

Study instrument and variables

In coordination with local authorities, a structured questionnaire in Spanish was developed based on relevant literature, the research team's prior experience, and local contextual needs. The questionnaire was reviewed by researchers at the University and piloted before implementation, with adjustments made to wording and semantics to ensure clarity and comprehension. The final instrument was anonymous and consisted of six multiple-choice questions and one open-ended question, with an average completion time of approximately 3 min.

The following variables were assessed:

- Sociodemographic characteristics: sex (male, female, other), age (18–30 years, ≥31 years), and area of residence (downtown, interurban, periurban).
- Perceptions of pigeons: assessed using binary or multiple-response items, including dirty streets and squares, damage to roofs and monuments, disease transmission, noise, and general unpleasantness.
- Preferred population control method: eradicate, do not eradicate, or undecided.
- Proposed control measures: open-ended responses subsequently categorized as lethal, non-lethal, or mixed approaches.

Data collection procedures

Surveys were administered by trained interviewers working in teams of one to two individuals. Interviewers participated in a one-day training session (4 h) prior to fieldwork, covering study objectives, informed consent procedures, questionnaire administration, response recording, and frequently asked questions. For the online

survey, participants also received guidance on the use of the Google Forms platform. Data collection took place on weekends (Saturday or Sunday) between 10:00 and 16:00, with an average daily duration of 2 h, over a period of 2–4 months in each study year. Surveys were conducted from March to July 2012, July to September 2017, and April to July 2024. Paper-based questionnaires were used in 2012 and 2017, whereas data collection in 2024 was conducted online using Google Forms. To prevent duplicate responses, a fieldwork coordinator assigned a unique code to each participant. No monetary or material incentives were provided.

Data management and statistical analysis

Paper-based surveys from 2012 and 2017 were digitized into Microsoft Excel (Microsoft Corp., Washington, USA), while data collected in 2024 were directly exported to Excel. All datasets were merged into a single Excel file (version 18) and subsequently imported into IBM SPSS (version 29, IBM Corp., NY, USA) for statistical analysis. An initial exploratory analysis was performed to identify missing values and outliers. Absolute and relative frequencies were calculated for all variables. Comparisons by year, sex, age group, and preferred control method were performed using the chi-square test for categorical variables. $p < 0.05$ was considered statistically significant.

Crude and adjusted odds ratios with 95% confidence intervals were estimated using bivariate and multiple logistic regression models to identify factors associated with preference for pigeon eradication. Variables with $p < 0.10$ in bivariate analyses and those reported consistently across the three study years were included in the multivariable model. Collinearity was assessed using the chi-square test for categorical variables and Student's t-test or analysis of variance for comparisons involving numerical variables (age).

Qualitative analysis of open-ended responses

Responses to open-ended questions were transcribed verbatim and analyzed using an inductive thematic coding approach. Initial codes were generated and subsequently grouped into coherent thematic categories, including lethal methods, reproductive control, habitat modification, and capture and relocation. Two researchers independently coded the data and then met to discuss discrepancies and reach consensus on the final thematic structure.

RESULTS

Participants' characteristics and perceptions

A total of 625 individuals participated in the survey across the three study years (2012: 213; 2017: 209; 2024: 203), with response rates exceeding 90% in all survey periods. Overall, most participants were women (54%), young adults aged 18–30 years (57%), and residents of the central area of the city (66%), with statistically significant differences in participant distribution across study years (Table 1).

The most frequently reported negative perceptions were that pigeons litter streets and squares (66%) and that they have or transmit diseases (42%). In 2017, the prevalence of all reported negative perceptions was significantly higher compared with the other years ($p < 0.01$). Paradoxically, during the same year, the highest proportion of respondents (92%) indicated that pigeons "are not unpleasant," compared with 55% in 2012 and 34% in 2024 ($p < 0.01$). Although the option "Do not eradicate" was the most frequently selected population control preference overall (42%), support for eradication increased markedly over time, from 20% in 2012 to 49% in 2024 ($p < 0.01$) (Table 1 and Figure 2).

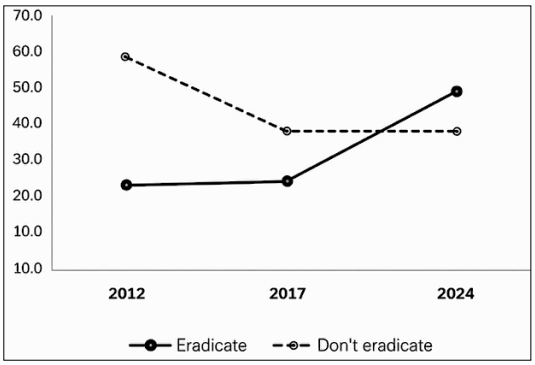

Figure 2: Trends in public preference for pigeon population control methods across three survey periods (2012, 2017, and 2024) in Sucre, Bolivia. The figure illustrates temporal shifts in support for different control strategies, highlighting changes in community attitudes over the 12-year study period.

Differences in perceptions according to age group

Younger participants reported significantly higher frequencies for certain negative perceptions, including that pigeons make unpleasant noises (32% vs. 22%; $p = 0.02$) and that they have or transmit diseases (59% vs.

44%; p < 0.01), compared with older participants. At the same time, younger respondents more frequently perceived pigeons as pleasant (67%) than did the older age group (57%) (p = 0.03). Despite these mixed perceptions, younger participants showed a significantly lower preference for eradication as a population control method (30%) compared with older individuals (42%) (p < 0.01) (Table 2).

Table 1: Characteristics of the study population, perceived prejudices, and preferred pigeon population control strategies in 2012, 2017, and 2024.

Variable	Category	Missing	Total, n (%)	2012 (n = 213), n (%)	2017 (n = 209), n (%)	2024 (n = 203), n (%)	p-value*
Sex	Female	6	337 (54.4)	130 (61.0)	94 (46.3)	113 (55.7)	<0.01
	Male		282 (45.6)	83 (39.0)	109 (53.7)	90 (44.3)	
Age (years)	18–30	225	228 (57.0)	–	127 (64.5)	101 (49.8)	0.02
	≥31		172 (43.0)	–	70 (35.5)	102 (50.2)	
Area of residence	Central	1	409 (65.5)	213 (100.0)	103 (49.5)	93 (45.8)	<0.01
	Interurban		115 (18.4)	–	52 (25.0)	63 (31.9)	
	Periurban		100 (16.0)	–	53 (25.5)	47 (23.2)	
Pigeon prejudices	Dirty streets and squares	0	414 (66.2)	107 (50.2)	192 (91.2)	115 (56.7)	<0.01
	Ruin roofs and monuments	0	256 (41.0)	35 (16.4)	151 (72.2)	70 (34.5)	<0.01
	Noises	0	127 (20.3)	14 (6.6)	92 (44.0)	21 (10.3)	<0.01
	Transmit diseases	0	264 (42.2)	46 (21.6)	143 (68.4)	75 (36.9)	<0.01
	Not unpleasant	0	377 (60.3)	116 (54.5)	193 (92.3)	68 (33.5)	<0.01
Preferred control strategy	Eradicate	14	181 (29.6)	39 (19.5)	43 (20.6)	99 (49.0)	<0.01
	Do not eradicate		257 (42.1)	116 (58.0)	72 (34.4)	69 (34.2)	
	Undecided		173 (28.3)	45 (22.5)	94 (45.0)	34 (16.8)	

Data are presented as a number (percentage). Percentages were calculated within each study year unless otherwise indicated. Differences between survey years were assessed using Chi-square tests. Statistical significance was defined as p < 0.05.

Table 2: Perceived prejudices toward pigeons and preferred population control strategies according to sex and age of participants during the study period.

Variable	Category	Female (n = 337), n (%)	Male (n = 282), n (%)	p-value	18–30 years (n = 228), n (%)	≥31 years (n = 172), n (%)	p-value*
Pigeon prejudices	Dirty streets and squares	217 (64.4)	192 (68.1)	0.19	172 (75.4)	125 (72.7)	0.30
	Ruin roofs and monuments	130 (38.6)	125 (41.2)	0.09	117 (51.3)	100 (58.1)	0.11
	Noises	62 (18.4)	63 (22.3)	0.13	72 (31.6)	37 (21.5)	0.02
	Transmit diseases	145 (43.0)	115 (40.8)	0.32	134 (58.8)	76 (44.2)	<0.01
	Not unpleasant	194 (57.6)	178 (63.1)	0.09	153 (67.1)	98 (57.0)	0.03
Preferred population control strategy	Eradicate	102 (30.9)	78 (28.4)	0.69	68 (29.8)	71 (41.5)	<0.01
	Do not eradicate	141 (42.7)	113 (41.1)		93 (40.8)	44 (25.7)	
	Undecided	87 (26.4)	84 (30.5)		67 (29.4)	56 (32.7)	

Data are presented as number (percentage). Comparisons between sex and age groups were performed using the chi-squared test. Statistical significance was defined as p < 0.05.

Factors associated with preference for pigeon population control

In the bivariate logistic regression analysis, several factors were associated with a higher likelihood of preferring eradication as a pigeon population control strategy. These included the survey year 2024 (odds ration [OR] 3.0; 95% confidence interval [CI] 1.8–5.1), older age (≥31 years) (OR 1.7; 95% CI 1.1–2.5), the perception that pigeons dirty streets and squares (OR 1.6; 95% CI 1.1–2.4), and the belief that pigeons have or transmit diseases (OR 1.4; 95% CI 1.0–1.9). In contrast, living in a periurban area (OR 0.52; 95% CI 0.3–0.8) and perceiving pigeons as not unpleasant (OR 0.19; 95% CI 0.1–0.3) were associated with a lower likelihood of choosing eradication.

In the adjusted logistic regression model, only the survey year 2024 (OR 3.0; 95% CI 1.8–5.1), the perception that pigeons dirty streets and squares (OR 1.5; 95% CI 1.0–2.5), and the perception that pigeons are not

unpleasant (OR 0.2; 95% CI 0.1–0.4) remained statistically significant (Table 3). This model explained 24% of the variance in preferred pigeon population control strategies (Nagelkerke R^2).

Table-3: Crude and adjusted odds ratios (95% CI) for eradication preference as a pigeon population control method, including sociodemographic information and perceived prejudices.

Variable	Category	OR	95% CI	AOR	95% CI
Year	2012	1	–	1	–
	2017	1.07	0.7–1.3	1.66	0.8–3.6
	2024	3.97	2.5–6.2	3.00	1.8–5.1
Age (years)*	18–30	1	–	–	–
	≥31	1.67	1.1–2.5	–	–
Sex	Female	1	–	1	–
	Male	1.13	0.8–1.6	1.12	0.8–1.7
Area of residence	Central	1	–	1	–
	Interurban	0.60	0.3–1.1	0.69	0.4–1.3
	Periurban	0.52	0.3–0.8	0.67	0.4–1.1
Pigeon prejudices (yes vs. no)	Dirty streets and squares	1.62	1.1–2.4	1.54	1.0–2.5
	Ruin roofs and monuments	1.28	0.9–1.8	1.02	0.6–1.6
	Noises	0.98	0.6–1.5	1.00	0.6–1.8
	Transmit diseases	1.36	1.0–1.9	1.05	0.7–1.6
	Not unpleasant	0.19	0.1–0.3	0.23	0.1–0.4

Data are presented as odds ratios (OR) and adjusted odds ratios (AOR) with 95% confidence intervals (CI) derived from univariate and multivariable logistic regression analyses, respectively. The reference category for each variable is indicated by an OR or AOR of 1.
*Age was not recorded in the 2012 survey and was therefore excluded from the multivariable logistic regression model.

Population-suggested methods for pigeon control

Participants proposed a range of methods for controlling pigeon populations, including eradication as well as non-lethal approaches such as reproductive control, habitat modification, and the capture and relocation of individuals. The distribution of these proposed strategies is summarized in Table 4.

Table-4: Methods proposed by participants for controlling the pigeon population.

Control approach	Method category	Actions suggested by participants
Eradication	Lethal methods	Hunting, raising pigeons for food consumption, humane killing, hunting by cats
No eradication	Control of reproduction	Use of contraceptives, sterilization, egg control (pigeon coops)
	Habitat modification	Stop feeding pigeons, city cleaning, prevention of pollution from rubbish, prevention of nesting, use of reflectors and nets, construction of dovecotes
	Capture and relocation	Habitat change, trapping and relocation, management of shelters, caging

DISCUSSION

Overview of public perception trends

This study enabled long-term monitoring of public perceptions of urban pigeon populations over a 12-year period, improving the understanding of perception dynamics and supporting the design of more effective control and educational strategies. The findings provide a valuable reference for heritage cities such as Sucre that face similar challenges associated with pigeon overpopulation. Overall, the main negative perceptions were related to environmental cleanliness and disease transmission; however, significant variations were observed according to study year, age group, and area of residence. Participants who perceived pigeons as contributors to littering streets and squares, as well as respondents surveyed in the most recent study period, were more likely to support eradication as a population control strategy, suggesting a progressive decline in public tolerance toward pigeons.

Citizens' prejudices toward pigeon populations

Participants identified several negative perceptions toward pigeons, primarily associated with environmental contamination of streets and squares and the perceived risk of disease transmission. These findings are consistent with previous studies reporting similar concerns [5, 7, 11, 24]. In comparable urban contexts, a substantial proportion of the population has linked pigeon presence with environmental pollution and zoonotic diseases. For example, Illés *et al.* reported that 31% of participants living in a historic city center believed pigeons could play an important role in spreading dangerous infections, while fecal pollution (93%) and intrusive behavior (37%) were the most frequently cited problems; despite this, 60% of respondents did not consider population reduction necessary [6]. In contrast, other studies have documented a predominantly negative attitude toward pigeons

perceived as urban pests [25].

Age-related differences in perceptions were also evident. Younger participants (18–30 years) more frequently reported that pigeons generate unpleasant noise (32% vs. 22%; $p = 0.02$) and transmit diseases (59% vs. 44%; $p < 0.01$) compared with older participants. Paradoxically, this same age group more often reported that they did not find pigeons unpleasant (67% vs. 57%; $p = 0.03$). This apparent contradiction aligns with findings from urban parks in Costa Rica, where empathy toward pigeons, particularly among men, was identified as a motivating factor for feeding these birds [14].

Public preferences for pigeon population control

Across the study period, the most frequently reported preference for pigeon population management was non-eradication; however, a clear downward trend in this preference was observed. Previous studies have similarly reported public support for non-lethal control measures, including the use of contraceptives [14, 26] and discouraging feeding practices. Restricting food availability has been shown to reduce life expectancy and reproductive capacity in pigeons [14, 27], leading to population reductions of up to 77% in some settings [11], particularly when such interventions are sustained over time [15].

Other studies recommend integrating additional strategies, such as capture and relocation away from urban centers [11], contraceptive or medicinal approaches [14], or targeted eradication in areas with low pigeon density [3]. Research conducted in Paraná, Brazil, has also demonstrated the adaptive response of predatory birds to pigeons as prey, indirectly supporting population control [28]. Furthermore, studies from Spain emphasize the importance of incorporating biodiversity considerations into urban planning to support balanced bird population management [29]. Nevertheless, the effectiveness and potential unintended consequences of different control methods, including pharmaceutical or contraceptive interventions, require careful evaluation.

In the present study, both negative perceptions and support for eradication increased over time. In 2024, the likelihood of preferring eradication was three times higher than in 2012, independent of sex, area of residence, or specific prejudices. This trend may be partly explained by the absence of a structured pigeon management plan, particularly in the city center, where damage associated with pigeons remains unmitigated [1, 5]. Additionally, heightened public awareness of zoonotic risks following the COVID-19 pandemic, which was associated with widespread culling of bats as a preventive measure [11], and concerns about emerging zoonoses such as avian influenza may have influenced public attitudes. Conversely, other studies suggest that advances in animal rights discourse may lead segments of the population to oppose lethal control methods, even when pigeons are perceived as pests [19].

Implications for sustainable pigeon management

The implementation of a sustainable pigeon management strategy based on a One Health approach is essential. Such a strategy should integrate continuous monitoring of pigeon health, public perceptions and values, and the interactions between human, animal, and environmental health. In parallel, sustained public education programs are critical to promote awareness and responsible behaviors [1, 14, 30, 31]. Practical measures should include informing citizens about proper food waste management to reduce food availability for pigeons, limiting nesting, perching, and resting opportunities through habitat modification, and protecting buildings using physical barriers such as fences or nets [25].

Study limitations

Several limitations of this study should be acknowledged. Due to resource constraints, convenience sampling was used, which may limit the representativeness of the findings across all urban areas. However, this limitation was partially mitigated by maintaining consistent sampling locations across all study years, particularly within the historic city center, where administrative and cultural activities are concentrated. Population characteristics remained relatively stable over time, supporting comparability of results.

In 2012, only residents of the city center were included, potentially introducing selection bias, as these residents generally have higher socioeconomic status and educational levels than the broader population, which may influence perceptions of pigeon-related issues. Additionally, although results are summarized in Table 1, the survey instrument was not formally validated in the study population, raising the possibility of information bias. The study also did not explore other factors that may influence perceptions, such as educational level or religious beliefs. Furthermore, limited information was available on pigeon overpopulation and its ecological impact on other species. Given the public health implications, further research is needed to investigate diseases potentially

transmitted by pigeons and to evaluate the effectiveness of different control measures, including food supply management, on pigeon population dynamics [11, 32].

CONCLUSION

This 12-year serial cross-sectional study provides comprehensive evidence on how public perceptions of urban pigeon populations and their management have evolved in Sucre, Bolivia. The findings demonstrate that negative perceptions related to environmental cleanliness and disease transmission remain predominant, while support for eradication as a population control strategy increased substantially over time, rising from 20% in 2012 to nearly half of respondents in 2024. Multivariable analysis showed that participation in the most recent study year and the perception that pigeons dirty streets and squares were strong predictors of preference for eradication, whereas perceiving pigeons as not unpleasant significantly reduced the likelihood of supporting lethal control. These results indicate a progressive decline in public tolerance toward pigeons in the absence of an implemented management plan.

The study highlights the urgent need for structured, evidence-based pigeon management strategies in heritage cities. Management approaches should move beyond reactive measures and adopt an integrated One Health framework that simultaneously addresses public health concerns, animal welfare, and environmental sustainability. Practical actions include reducing food availability through improved waste management, modifying urban habitats to limit nesting and roosting opportunities, protecting historical buildings with physical barriers, and implementing sustained public education programs. Importantly, integrating citizen perceptions into decision-making processes can enhance public acceptance, compliance, and long-term sustainability of control measures.

A major strength of this study is its long-term design, which allowed medium-term monitoring of changes in public perceptions across three time points over 12 years. The consistent use of the same high-traffic sampling locations enhanced comparability across study periods. In addition, the combined use of quantitative analyses and qualitative thematic assessment of open-ended responses provided a more nuanced understanding of public attitudes and proposed control strategies.

Several limitations should be considered when interpreting the findings. The use of convenience sampling may limit the generalizability of the results to the entire urban population, particularly residents of peripheral areas. In 2012, sampling was restricted to the city center, potentially introducing selection bias related to socioeconomic and educational differences. The questionnaire was not formally validated in the study population, which may have introduced information bias. Moreover, the study did not assess other potentially influential factors, such as educational level, religious beliefs, or detailed knowledge of zoonotic diseases, nor did it directly evaluate pigeon population size or health status.

Future studies should incorporate probabilistic sampling designs and validated survey instruments to improve representativeness and internal validity. Integrating ecological data on pigeon population density, health status, and pathogen carriage would allow a more comprehensive One Health assessment. Longitudinal evaluations of specific control interventions, including food restriction, habitat modification, contraceptive methods, and public education campaigns, are needed to assess effectiveness, cost-efficiency, and social acceptance. Additionally, exploring the role of post-pandemic zoonotic risk perception in shaping public attitudes toward urban wildlife could provide valuable insights for future risk communication strategies.

Overall, this study underscores that public perception is a critical, yet often underutilized, component of urban wildlife management. In the context of Sucre, the increasing preference for eradication reflects growing frustration with unmanaged pigeon populations rather than a rejection of animal welfare principles. Implementing a coordinated, transparent, and participatory pigeon management strategy grounded in a One Health approach is essential to balance heritage conservation, public health protection, and ethical wildlife management in historic urban settings.

DATA AVAILABILITY

The supplementary data can be made available from the corresponding author upon request.

AUTHORS' CONTRIBUTIONS

FP, KR, and MS: Conceptualization and methodology. FP: Investigation and data curation. FP, KR, and MS:

Formal analysis and visualization. FP: Original Draft Writing. KR and MS: Supervision, writing, and editing. FP: Funding acquisition and project administration. All authors have read and approved the final version of the manuscript.

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COMPETING INTERESTS

The authors declare that they have no competing interests.

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REFERENCES

1. Ramos-Gorbeña JC, Jerí-San Miguel IR, Villar-Mondalgo JR. La paloma (*Columba livia* Gmelin, 1789): biología, deterioro estructural y principales enfermedades zoonóticas. Biotempo. 2021;18(2):235–252.
2. Farfan Aguilar MA, Duarte J, Díaz-Ruiz F. Source areas as a key factor contributing to the recovery time of controlled feral pigeon (*Columba livia* var. *domestica*) colonies in low-density urban locations. Animals. 2022;12(9):1056.
3. Farfán MÁ, Díaz-Ruiz F, Duarte J, Real R. Feral pigeon (*Columba livia* var. *domestica*) management in low-density urban areas: prevention is better than cure. Urban Ecosystems. 2019;22:1027–1035.
4. Soh MC, Goh MW, Ng BX, Han HZ, Khoo MD, Leong DY, *et al.* Urban bird commensals maintain coexistence under extreme food shortages. Journal of Applied Ecology. 2024;61(11):2822–2836.
5. Zúñiga E, León D, Falcón N. Plagas urbanas: las palomas y su impacto sobre el ambiente y la salud pública. Revista de Ciencias Veterinarias. 2017;33(1):5–12.
6. Illés A, Nagy E, Nagy RR, Tari T. The environmental impact of the feral pigeon (*Columba livia* f. *domestica*) in the historical city centre of Sopron. Analecta Technica Szegedinensia. 2023;17(4):69–76.
7. Pulido V. A cinco siglos de la introducción de la paloma de Castilla (*Columba livia* Gmelin, 1789) en el Perú. Revista Peruana de Biología. 2023;30(4).
8. Evans T, Angulo E, Bradshaw CJA, Turbelin A, Courchamp F. Global economic costs of alien birds. PLoS One. 2023;18(10):e0292854.
9. Giunchi D, Albores-Barajas YV, Baldaccini NE, Vanni L, Soldatini C. Feral pigeons: problems, dynamics and control methods. In: Integrated pest management and pest control: current and future tactics. London: InTechOpen; 2012. p. 215–240.
10. Mousa M. Risk assessment and mitigation of feral pigeons droppings on heritage sites: case study of Habu Temple (Luxor-West Bank). Int J Herit Museum Stud. 2021;3:102–115.
11. Arteaga MdC, Asmat I, León D, Falcón N. Percepciones acerca de la presencia de palomas en espacios públicos y su importancia en la salud pública en un distrito de Lima, Perú. Revista de Investigaciones Veterinarias del Perú. 2023;34(1).
12. Adamczyk K, Ledwoń A, Czopowicz M, Szeleszczuk P. The course of rotavirus A infection in young racing pigeons during the racing season. BMC Vet Res. 2024;20(1):305.
13. Mia MM, Hasan M, Hasnath MR. Global prevalence of zoonotic pathogens from pigeon birds: a systematic review and meta-analysis. Heliyon. 2022;8(6).

14. Cabalceta A, Barrientos Z. Tradición: una nueva razón para alimentar las palomas urbanas (*Columba livia*; Columbiformes: Columbidae) y cómo controlarlas de manera sostenible. UNED Research Journal. 2019;11(3):361–368.
15. Senar JC, Montalvo T, Pascual J, Peracho V. Reducing the availability of food to control feral pigeons: changes in population size and composition. Pest Manag Sci. 2017;73(2):313–317.
16. Valente-Neto F, Roque FdO, Pauliquevis CF, Oliveira AKMd, Provete DB, Szabo JK, *et al.* Loss of cultural and functional diversity associated with birds across the urbanization gradient in a tropical city. Front Ecol Evol. 2021;9:615797.
17. Caula S. Actualización de los registros de aves en la provincia de Imbabura, ubicada en los Andes tropicales de Ecuador. El Hornero. 2024;39(1):79–89.
18. Baker SE, Maw SA, Johnson PJ, Macdonald DW. Not in my backyard: public perceptions of wildlife and pest control in and around UK homes, and local authority pest control. Animals. 2020;10(2):222.
19. Basak SM, Rostovskaya E, Birks J, Wierzbowska IA. Perceptions and attitudes to understand human–wildlife conflict in an urban landscape: a systematic review. Ecol Indic. 2023;151:110319.
20. Laguna DR, Fernandez BX. El impacto del turismo en Bolivia y los determinantes para su dinamismo. Cochabamba: Universidad Privada Boliviana; 2024.
21. Bolivia. Ley 700: Ley para la defensa de los animales contra actos de crueldad y maltrato. La Paz: Gaceta Oficial del Estado Plurinacional de Bolivia; 2015.
22. ¿Qué parásitos tienen las palomas en Sucre? Correo del Sur. 2024 Feb 26.
23. Rahman MM. Sample size determination for survey research and non-probability sampling techniques: a review and set of recommendations. J Entrep Bus Econ. 2023;11(1):42–62.
24. Yu C-L, Huang Y-L. Prevalence and pathology of endoparasitic infections of rock pigeons (*Columba livia*) in Taiwan. Thai J Vet Med. 2024;54(3):1–13.
25. Ramírez-Alán Ó, la O-Castro D, Bolaños-Picado D, Queen-Blanco M, Karl J. Evaluación de la abundancia relativa y percepción de la presencia de palomas *Columba livia* (Columbiformes: Columbidae) en la Universidad Nacional de Costa Rica. 2017.
26. Dobeic M, Pintarič Š, Vlahović K, Dovč A. Feral pigeon (*Columba livia*) population management in Ljubljana. 2011.
27. Soh MC, Pang RY, Ng BX, Lee BP-H, Loo AH, Er KB. Restricted human activities shift the foraging strategies of feral pigeons (*Columba livia*) and three other commensal bird species. Biol Conserv. 2021;253:108927.
28. Mendes GC, Esclarski P, Zawadzki CH. Predation of two species of Columbidae by the burrowing owl *Athene cunicularia* (Strigiformes: Strigidae) in an urban environment. Ornithol Res. 2024;32(4):388–392.
29. Buenaño-Mariño CdP, Sabán J, Barba E, García-Esparza JA. Urban form shapes bird niches: insights from the European Green Capital 2024. Biodivers Conserv. 2025:1–23.
30. Cabodevilla X, Malo JE, de Cárcer DA, Zurdo J, Chaboy-Cansado R, Rastrojo A, *et al.* Zoonotic potential of urban wildlife faeces assessed through metabarcoding. Sci Total Environ. 2024;952:175866.
31. Redondo JM, Ibarra Vega D, Rojas Forero AYV. Modelamiento del control de población de palomas (*Columba livia*) en la Plaza de Bolívar de Bogotá. Rev Lasallista Investig. 2018;15(1):8–15.
32. Latif SH, Akram MT, Tehlwani D, Jhamandas K, Raza SMZ, Nisar M. Cross-sectional assessment of pigeon-associated environmental exposure pathways and their potential risk for zoonotic disease transmission to humans in urban areas of Sindh. ACADEMIA Int J Soc Sci. 2025;4(2):1745–1754.

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