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Context matters: Community knowledge about owls along an urban-rural gradient in Patagonia

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Abstract

1. Human perceptions and knowledge are relevant to the management of environmental conflicts involving wildlife. At the forest-urban interface of northern Patagonia, expanding human settlements increase contact with wildlife, including owls and hantavirus reservoir rodents, altering habitat for both predators and prey, and exposing owls to toxicological threats due to rodent-control practices.

2. We evaluated knowledge, perceptions and attitudes toward owls, as well as knowledge of rodents, health risks and rodent-control practices, among residents of the Comarca Andina del Paralelo 42, Argentina. We conducted 150 semi-structured interviews with adults from three residential zones: rural, suburban and urban. The questionnaire assessed recognition of four owl species through photographs and sounds, ecological knowledge, valuation and perceptions of owls and rodents, and rodenticide use.

3. In line with our predictions, species recognition was higher among rural residents, despite their lower level of formal education. Contrary to our predictions, valuation of Strigiformes was positive and homogeneous across zones, regardless of educational level or access to technical information. Knowledge of diet and nesting sites was also relatively homogeneous. Most respondents rejected the association of owls with fear (87%) or bad luck (84%) and expressed support for the presence of owls near homes for rodent control (85%). However, 39% reported using rodenticides and a substantial proportion were unaware of the effects of rodenticides on predators. Contrary to our predictions, awareness of these effects was not associated with residential zone, education or access to technical information.

4. These results reveal a mismatch between the positive valuation of Strigiformes and rodent-control practices that may affect them, highlighting the need for environmental education and integrated rodent-management strategies to reduce the risks associated with rodenticide use at the forest-human settlement interface.

[Keywords: ethnozoology, zoonoses, environmental education, secondary poisoning, rodenticides, biological control, strigiformes, forest-urban interface]

Resumen. El contexto importa: Conocimiento comunitario sobre búhos en un gradiente urbano-rural en la Patagonia

1. Las interacciones entre las personas y la fauna silvestre son relevantes para gestionar problemas ambientales que la involucran. En la interfaz bosque-urbana de nor-Patagonia, la expansión humana incrementa el contacto con la fauna silvestre, incluidos los búhos y los roedores reservorios de hantavirus, modificando el hábitat de ambos y exponiendo a los búhos a intoxicación derivada de las prácticas de control de roedores.

2. Evaluamos conocimiento, percepciones y actitudes hacia los Strigiformes y roedores, y el manejo del riesgo sanitario en habitantes de la Comarca Andina del Paralelo 42, Argentina. Realizamos 150 entrevistas semiestructuradas a adultos de tres zonas: rural, suburbana y urbana. Evaluamos el reconocimiento visual (fotos) y auditivo (audios) de cuatro especies de lechuzas y el conocimiento ecológico, la valoración y las percepciones sobre lechuzas y roedores, y el uso de rodenticidas.

3. En línea con nuestras predicciones, el reconocimiento de especies fue mayor entre residentes rurales, pese a su menor nivel de educación formal. Por el contrario, la valoración de los Strigiformes fue positiva y homogénea entre zonas, independientemente del nivel educativo o acceso a información técnica. El conocimiento sobre dieta y sitios de nidificación también fue relativamente homogéneo. La mayoría rechazó asociar los búhos con temor (87%) o mala suerte (84%) y manifestó valorar su presencia cerca de las viviendas para controlar roedores (85%). Sin embargo, 39% utilizaba rodenticidas y una proporción importante desconocía sus efectos sobre los depredadores. Contra lo predicho, tal desconocimiento no se asoció con la zona de residencia, educación o acceso a información técnica.

4. Estos resultados evidencian una discrepancia entre la valoración positiva de los Strigiformes y prácticas de control de roedores que pueden afectarlos, y destacan la necesidad de estrategias de educación ambiental y manejo integrado de roedores que reduzcan los riesgos asociados al uso de rodenticidas en la interfaz bosque-asentamientos humanos.

[Palabras clave: etnozoología, zoonosis, educación ambiental, envenenamiento secundario, rodenticidas, control biológico, strigiformes, interfaz bosque-urbana]

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Introduction

Human-wildlife interactions often lead to conflicts with direct implications for conservation and public environmental health. These conflicts typically involve species historically associated with fear or mystery (e.g., spiders, snakes or owls). Therefore, addressing the perceptions and attitudes underlying these conflicts is essential for promoting coexistence with wildlife. In this context, environmental education can play a key role in transforming negative perceptions and mitigating human-wildlife conflicts (UNESCO and PNUMA 1978; Rodríguez Sanabra 1986; Decker and Chase 1997; Muñoz-Pedreros 2014). Understanding people's knowledge, perceptions and attitudes toward animals is essential for designing effective education and conservation strategies: perceptions guide evaluative judgments and influence willingness to act and attitudes are also shaped by culture, mythology and personal experiences (Kingston 2016; Iñiguez-Gallardo et al. 2024). Far from being merely anecdotal, human perceptions should therefore be integrated into pragmatic conservation approaches as they influence behaviors, responses and levels of support for management actions (Slovic 2000; Pretty 2011; Adams and Sandbrook 2013; Clayton et al. 2013; Klöckner 2013; Legge 2015; Bennett 2016). Accordingly, guiding interventions in human-nature landscapes require a pluralistic approach integrating ecological and social data, including community and traditional knowledge (Muñoz-Pedreros et al. 2019).

Owls are important nocturnal predators of small mammals, particularly rodents, which makes them relevant as potential providers of regulating ecosystem services (König et al. 1999; Bellocq 2000; Formoso et al. 2025). Despite these roles, owls have historically been associated with persecution and fear in many regions worldwide (Mikkola 2000; Cardona and Enríquez 2014). Their nocturnal habits and distinctive appearance have been associated with negative myths in various cultures, contributing to a mismatch between their ecological importance and their often-negative social valuation (Charpentier Astudillo and Martínez Martínez 2007; Roa and Alvarado 2011; Rincón Hernández et al. 2017).

In the northern Patagonian Region of Argentina and Chile (33°-46° S), *Andes orthohantavirus* (ANDV) —the causative agent of hantavirus cardiopulmonary syndrome in the region— represents a major public health concern because of its potential for person-to-person transmission and high case-fatality rates (~30%) (Martínez-Valdebenito et al. 2014). Human infection occurs primarily through exposure to infected rodents, with *Oligoryzomys longicaudatus* recognized as the principal reservoir of the ANDV in Patagonia (Levis et al. 1998). Risk of exposure is particularly relevant at the forest-human interface, where expanding human settlements increase contact with native rodents (Piudo et al. 2011), while masting of native plants can promote rodent population increases and outbreaks (Jaksic and Lima 2003).

The Northwestern Patagonian Region includes extensive areas of natural forest that have experienced one of the most rapid processes of urban population growth in South America in recent decades (Kitzberger 2012). This expansion has generated environmental challenges, including habitat loss, the proliferation of invasive species, and increasing overlap between human settlements and habitats occupied by wildlife —including ANDV reservoir hosts— potentially increasing opportunities for human exposure (Monteverde and Hodara 2017).

In this region, rodents constitute a major component of the diet of several owl species (Figueroa et al. 2015; Trejo and Bó 2017; Ojeda and Chazarreta 2018). A particularly striking example is the barn owl (*Tyto furcata*), whose diet in forests is overwhelmingly dominated by small mammals —especially sigmodontine rodents—, which accounted for 88.7-97.6% of prey recorded in two consecutive years (Trejo and Ojeda 2004). Notably, *O. longicaudatus* was among the rodent species consumed by barn owls. Such predation may contribute to the natural regulation of rodent populations, representing a potentially relevant regulating ecosystem service at human-wildlife interfaces where rodent-borne health risks are of concern.

However, the widespread use of chemical rodent control in these same settings may compromise this potential ecosystem service while posing risks to non-target wildlife. Anticoagulant rodenticides are used extensively in peridomestic and institutional settings along the forest-human interface, where Strigiformes are among the top predators at risk of unintentional secondary exposure. A recent study found detectable anticoagulant rodenticide residues in the

livers of nearly 20% of analyzed raptors in the region, with exposure associated with urban areas (Casalins et al. 2026). Against this backdrop, understanding people's perceptions and rodent-management practices —in particular, how residents perceive and value owls— is key to identifying socially acceptable management and education strategies that can reduce reliance on chemical rodent control and its associated risks to wildlife and human health.

In this study, we investigated knowledge, perceptions and attitudes toward owls, as well as perceptions of zoonotic disease risk and rodent reservoirs, among residents of a cluster of towns in southern Argentina with some of the highest reported incidence of ANDV-associated disease (Andreo et al. 2014). We hypothesized that knowledge and valuation of Strigiformes are shaped by interviewees' backgrounds, including their level of contact with nature, education and access to scholarly information. We predicted that rural residents would be better able to identify local owl species and would express stronger perceptions than urban or suburban residents (either positive or negative). Alternatively, we predicted that knowledge of owl ecology (e.g., diet, nesting sites) and awareness of the environmental impacts of rodent poisons (i.e., anticoagulant rodenticides) would be independent of experiential background and instead be more associated with formal education and access to technical environmental information.

Materials and Methods

Study area

The study area comprises the Comarca Andina del Paralelo 42, a cluster of mountain

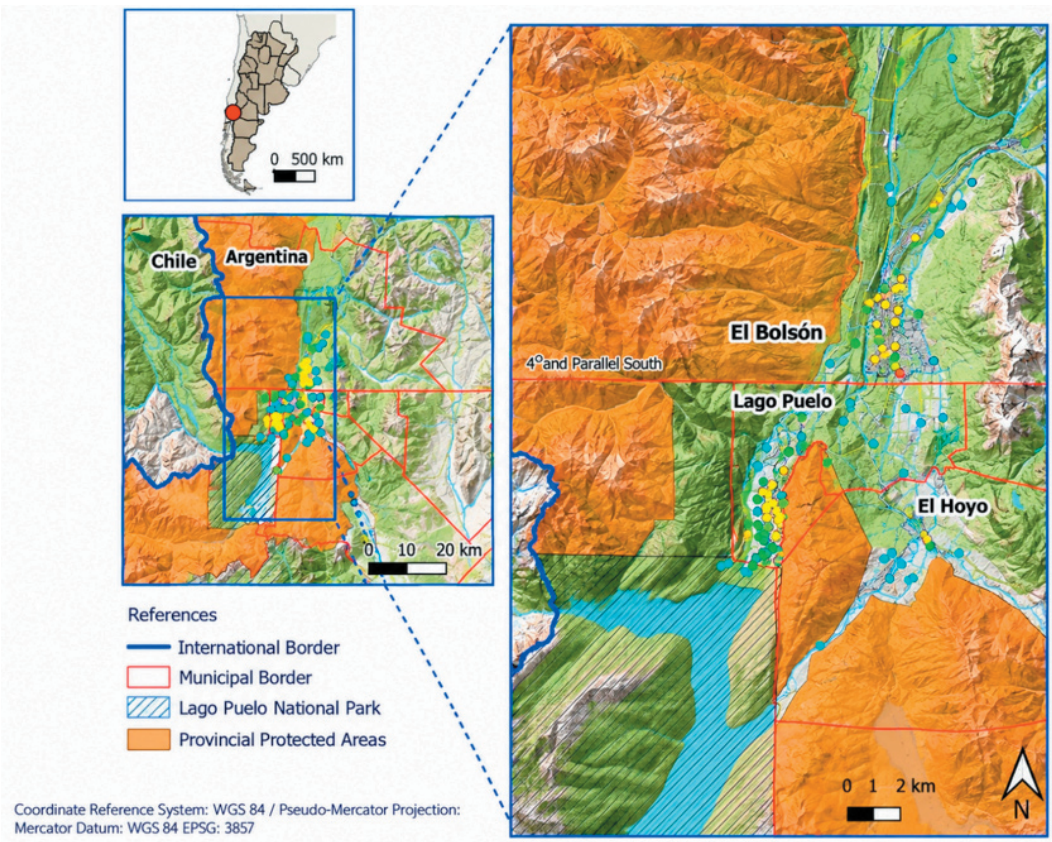


Figure 1. Location of the study area in the Comarca Andina del Paralelo 42, northern Patagonia. The map on the left shows the regional context near the Argentina–Chile border. The map on the right shows the distribution of survey points across the Rural (light blue), Suburban (red) and Urban (yellow) gradients. Colored polygons represent protected areas, including Lago Puelo National Park (green) and provincial and municipal nature reserves (orange) within the municipalities of El Bolsón, Lago Puelo and El Hoyo.

Figura 1. Ubicación del área de estudio en la Comarca Andina del Paralelo 42, norte de la Patagonia. El mapa de la izquierda muestra el contexto regional, próximo a la frontera entre Argentina y Chile. El mapa de la derecha muestra la distribución de los puntos de encuesta a lo largo de los gradientes Rural (celeste), Suburbano (rojo) y Urbano (amarillo). Los polígonos coloreados representan áreas protegidas, incluido el Parque Nacional Lago Puelo (verde) y las reservas naturales provinciales y municipales (naranja) dentro de los municipios de El Bolsón, Lago Puelo y El Hoyo.

towns spanning the provinces of Chubut and Río Negro along the 42nd parallel south, near the Argentina-Chile border (Figure 1). This region is part of the Argentine Nor-Patagonian Andean Biosphere Reserve, which includes several national protected areas (e.g., Lago Puelo National Park) as well as provincial reserves, along with smallholdings and agricultural lands, thus incorporating a strong rural component that further increases landscape heterogeneity. Natural habitats are dominated by *Nothofagus* forests and shrublands, with varying understory cover (e.g., with or without bamboo). The study area includes several adjacent municipalities, such as Lago Puelo, El Hoyo and El Bolsón. These towns do not have a clear urban-natural boundary; rather, each locality consists of a few densely populated blocks surrounded by extensive anthropogenic-natural interfaces (e.g., smallholdings, orchards, green neighborhoods, campgrounds, etc.).

In this area, raptors, mostly diurnal, are frequently observed approaching populated zones (Kovacs et al. 2005). Information on nocturnal birds is much more limited, although they are also known to occur within the urban-natural matrix (Wallace 2010; Trejo et al. 2011; Bocelli et al. 2026; Ale et al. in preparation and records from eBird and other citizen-science platforms). The species selected for this research, rufous-legged (*Strix rufipes*), lesser horned (*Bubo magellanicus*), austral pygmy (*Glaucidium nana*) and american barn owls, represent the most common Strigiformes in the southern Andean forests as well as in their ecotone with the Patagonian steppe (Kovacs et al. 2005; Trejo and Ojeda 2015). Scientific names and taxonomy follow BirdLife International (datazone.birdlife.org/about-our-science/taxonomy).

Study design and data collection. From March 2023 to June 2024, we conducted a cross-sectional study using semi-structured in-person interviews. The survey included three main components: 1) personal information, 2) a section on knowledge, perceptions and attitudes regarding owls, and 3) a section addressing knowledge, perceptions and attitudes toward rodents and associated ANDV sanitary risks (Supplementary Material 1).

The survey targeted the adult general population (i.e., aged 16 or older), stratified into 3 zones based on landscape and cadastral data from Lago Puelo, El Hoyo and El Bolsón. Zones were defined as: Rural (varying degrees of forest cover, minimal human infrastructure, parcel size ≥2 ha), Suburban (presence of green infrastructure, with or without native vegetation, parcel size <2 ha) and Urban (densely populated areas with little to no green infrastructure). The final sample consisted of 150 residents equally distributed across the three strata (n=50 per zone).

Participants were recruited opportunistically across neighborhoods and locations within each study zone following a spatial sampling strategy designed to ensure broad spatial coverage while minimizing clustering. In urban and suburban areas, households were approached at a minimum distance of 100 m from the previous respondent, whereas a minimum distance of 1 km was maintained in rural areas. Only one adult resident per household or family was surveyed, and no more than three interviews were conducted within the same neighborhood. In cities, participants were also recruited in queues at public institutions and frequently visited locations as a complementary strategy. Eligibility required participants to be adults, residents of the study area and not previously surveyed. Their home location was recorded using Google Maps to verify residency and avoid spatial overlap with previous respondents.

Before completing the survey, all participants were informed that they could respond anonymously or voluntarily provide contact information for follow-up purposes. They were assured that all responses would be anonymized during analysis and that any contact information would remain confidential and be used solely by the researcher.

Questionnaire development and validation

Preliminary research was conducted to assess the validity and internal consistency (reliability) of the survey instrument (Hernández Sampieri et al. 2018). Content validity was established through critical review by a panel of three regional experts: an anthropologist, an owl biologist and an education specialist. These subject-matter experts assessed the relevance, clarity, coherence and conceptual adequacy of the survey components, providing suggestions that allowed refinement of the wording and focus of the questions.

To ensure reliability, the questionnaire was pretested with 10 adult residents from a

nearby location (the city of Bariloche) prior to its full implementation. Based on these responses, reliability was assessed using Cronbach's alpha coefficients for the two main thematic sections, yielding values of 0.73 for the owls section and 0.71 for the rodents and health risks section (Oviedo and Campo-Arias 2005).

Data analysis

Independent variables (i.e., those derived from the survey) were organized and, where necessary, re-categorized based on response frequencies, their conceptual relevance to the study objectives and the need to ensure sufficiently represented and analytically meaningful categories for statistical comparison. Variables were grouped into thematic dimensions following the framework established by Canavelli et al. (2013). These included sociodemographic factors, knowledge, perceptions and attitudes toward owls, factors related to rodents and sanitary risk and awareness of secondary poisoning.

Knowledge of the four focal species was assessed through visual and auditory recognition using a standardized set of photographs and playback recordings for all interviewees. Participants were shown two photographs of each species, depicting individuals in typical poses, all obtained in southern Argentina (Supplementary Material 1). Playback stimuli consisted of vocalizations considered by the authors, based on their field experience, to be the most typical and commonly heard vocalizations of each species. Sound files were obtained from the Macaulay Library of Natural Sounds (Cornell Lab of Ornithology, Ithaca, New York, USA) or were provided by local recordists who had contributed recordings to Xeno-canto (xeno-canto.org). Recordings were uncompressed and unedited, except for the removal of prominent vocalizations of other species.

The final operationalization of the original survey variables and the response categories used for analysis are presented in Table 1. Here, operationalization refers to the process of translating broader theoretical concepts into measurable empirical indicators (Hernández Sampieri et al. 2018). In practice, this involved coding survey responses into analytical categories and, where appropriate, numerical values (e.g., 1-5 for Likert-scale responses) or composite variables.

To test our hypothesis, four analytical dimensions were used to distinguish explanatory from response variables: a) Experiential and Cultural Background; b) Access to Technical Environmental Information; c) Valuation, and d) Knowledge. Experiential and Cultural Background and Access to Technical Environmental Information were treated as explanatory dimensions. Experiential Background included residential zone, contact with nature during childhood, residency status and residency antiquity, whereas Access to Technical Environmental Information was represented by educational level and professional background. Valuation and Knowledge were treated as response dimensions. Valuation included residents' emotional attitudes toward owls (fear and associations with good luck) and their functional appreciation of owls as biological controllers. Knowledge comprised species recognition, based on visual and auditory identification of the four focal species, and ecological and technical knowledge, including knowledge of diet and nesting sites and awareness of the environmental effects of rodenticides. The specific explanatory-response comparisons used to evaluate each prediction, together with the corresponding statistical tests, are summarized in Supplementary Material 2-Table S1.

Associations between categorical explanatory and response variables (e.g., species identification and knowledge of ecological roles across different urbanization zones) were assessed using chi-square tests of independence. When more than 20% of cells had expected frequencies below five, Fisher's exact tests with Monte Carlo simulation (2000 iterations) were used instead. Kruskal-Wallis tests were used for comparisons involving ordinal responses or non-normally distributed continuous variables. Analyses were designed to match the categorical structure of the questionnaire and the specific associations addressed by each survey question. We prioritized parsimonious and directly interpretable comparisons over multivariable models, given the descriptive and exploratory aims of the study and the relatively small number of observations in some response categories. This approach allowed us to characterize patterns of knowledge, perceptions and practices and to assess specific associations between them without implying predictive or causal relationships.

All tests were evaluated at a 5% significance level. Statistical analyses were conducted using

Table 1. Survey variables operationalized from the questionnaire, grouped by analytical dimension (i.e., sociodemographic factors; knowledge, perceptions and attitudes toward owls, rodents and sanitary risk and ecological knowledge) in northwestern Patagonia, Argentina, and their corresponding categories.

Tabla 1. Variables operacionalizadas a partir de las preguntas del cuestionario, agrupadas por dimensión analítica (i.e., factores sociodemográficos; conocimientos, percepciones y actitudes hacia las aves rapaces nocturnas, roedores y riesgo sanitario y conocimiento ecológico) en el noroeste de la Patagonia argentina, y sus correspondientes categorías.

Operationalized variables grouped by thematic dimensions	Categories included	Original variable(s)[1]
Sociodemographic factors		
Residency status	Native, non-native	Personal data section
Residency antiquity	<5 y, 5-10 y, 10-20 y, >20 y	Personal data section
Education level	Elementary school, high school, tertiary, university	Personal data section
Contact with nature during childhood	Much, little, none	Personal data section
Field of training / Professional background	11 categories[2]	Personal data section
Knowledge, perceptions and attitudes of owls		
Personal experience with owls in any context	Yes, no, not sure	1 y 2
Home-based visual and auditory identification	Yes, no, not sure	4, 5
Attitudes toward owls (fear, bad luck, etc.)	Likert scale[3]	3
Knowledge of local legends and myths	Open response	17
Knowledge of diet and nesting sites	Yes, no, don't know	6, 7
Awareness/involvement in owl persecution	Open response	8
Rodents and sanitary risk		
Knowledge about rodents	Yes, no, don't know	9
Perceptions of rodents	Likert scale[2]	10
Rodents as a problem in natural areas	Yes, no, don't know	11, 12
Risk factors	Yes, no, don't know	13
Rodent control methods (poisons, cats, etc.)	Control, no control (if positive, which means)	14
Knowledge about effects of rodenticides	Yes, no	—
Ecological knowledge		
Knowledge of secondary effects on owls	Open response	18

[1] Number of question or assertion used in the questionnaire (see Supplementary Material 1).
[2] Professional backgrounds of the interviewees were grouped into eleven categories: Education, Health, Environmental Sciences, Administration, Technology, Communication, Design, Security, Tourism, Social Fields and Transport.
[3] Likert scale variables were measured from 1 (strongly disagree) to 5 (strongly agree).

[1] Número de pregunta o aseveración en la encuesta utilizada para las entrevistas presenciales (ver Material Suplementario 1).
[2] Los antecedentes profesionales se agruparon en once categorías: Educación, Salud, Ciencias Ambientales, Administración, Tecnología, Comunicación, Diseño, Seguridad, Turismo, Áreas Sociales y Transporte.
[3] Las variables con escala de Likert se midieron entre 1 (totalmente en desacuerdo) y 5 (totalmente de acuerdo).

SPSS v. 20.0 and R v. 4.5.0 within the RStudio environment. Graphical representations and exact tests were performed in R.

Results

Sociodemographic data

Analysis of residency showed that 46% of respondents were native, while 54% were non-native. Among non-natives, 65% had lived in the region for over a decade (N=150). The proportion of natives peaked in rural (58%) and urban (52%) areas, while the suburban zone showed the lowest native population (28%). Regarding experiential background, 77% of respondents reported a high level of contact with nature during childhood, with no significant differences detected among the three residential zones (P>0.05). Educational level showed that 58% of the total sample had completed secondary education or higher. However, a significant difference was detected in educational levels across the three zones (P=0.0015), with residents in the Rural zone exhibiting a lower educational profile —predominantly primary education— compared to those in Urban and Suburban areas. The most represented professional field among participants with completed tertiary or university studies was Education (43%), followed by Health (15%) and Envi-

ronmental and Social Sciences (10% each); Administration, Design and Tourism represented 5% each, and Technology, Security, Transport and Communication comprised 3% each. The professional profile showed no significant variation across the gradient (P>0.05). Consequently, formal educational level emerged as the only sociodemographic variable with a significant heterogeneous distribution across the urban-rural gradient.

Knowledge about owls

A 69% of respondents had seen or heard an owl at least once in their lives (i.e., general owl sightings, regardless of species or geographic location), with higher reporting in urban areas (88%) than in rural areas (56%). However, visual identification of all four species was significantly higher in rural areas than in urban and suburban settings (Figure 2). This consistent decline in biological recognition with increasing urbanization was statistically confirmed for all taxa (listed in order from most to least recognized overall): the austral pygmy-owl (54% in rural vs. 32% in urban; P=0.019), the rufous-legged owl (44% vs. 16%; P=0.001), the lesser horned owl (38% vs. 18%; P=0.010) and the american barn owl (38% vs. 16%; P=0.035). Auditory recognition followed a similar but less pronounced pattern and was significantly higher in rural zones for most species (P<0.05), except for the lesser horned owl (Figure 3).

Regarding owl diet, 81% of respondents overall indicated that owls consume rodents (the primary and most accurate response), with no differences among zones (P=0.3693). Differences were detected only for items plants (P=0.0165) and birds (P=0.0235). Plants (incorrect option) were mentioned least in rural areas (4%) and more frequently in suburban (22%) and urban (26%) zones. Birds (correct option, although not the most common food type) were least frequently mentioned in suburban areas (2%), compared to both rural (16%) and urban (16%) zones. Finally,

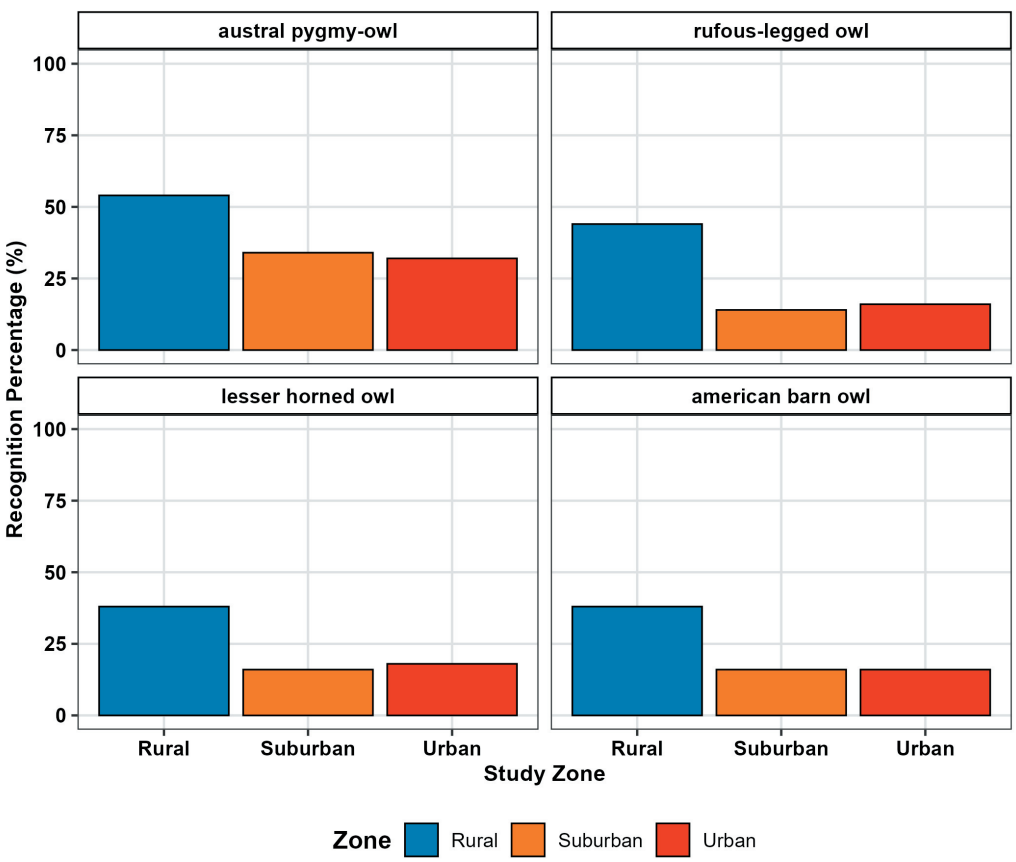


Figure 2. Comparative graph showing the proportion of surveyed participants (N=50 per zone) who visually recognized each owl species.

Figura 2. Gráfico comparativo que muestra la proporción de participantes encuestados (N=50 por zona) que reconocieron visualmente cada especie de ave rapaz nocturna.

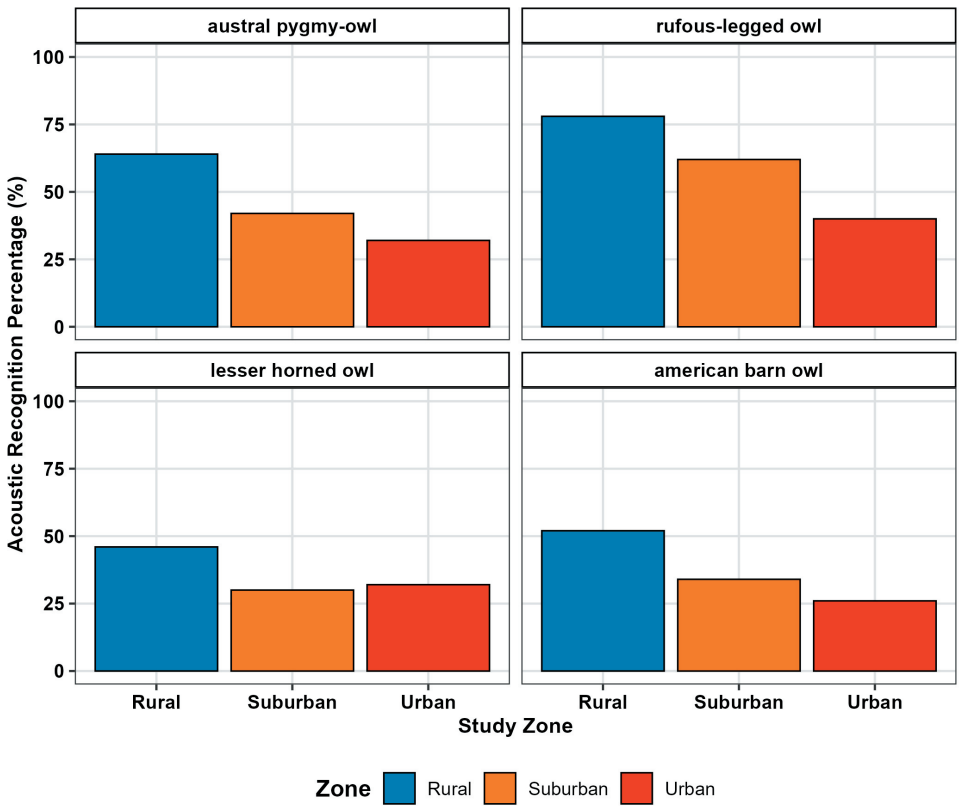


Figure 3. Comparative graph showing the proportion of surveyed participants (N=50 per zone) who aurally recognized each owl species. Three species (rufous-legged owl, austral pygmy-owl and american barn owl) were significantly more recognized among rural than urban inhabitants (although with no differences with suburban inhabitants), whereas lesser horned owl, the largest of the species, showed no significant differences among zones.

Figura 3. Gráfico comparativo que muestra la proporción de participantes encuestados (N=50 por zona) que reconocieron auditivamente cada especie de ave rapaz nocturna. Tres especies (concón, chuncho o caburé grande y lechuza de campanario) fueron significativamente más reconocidas entre los habitantes rurales que entre los urbanos (aunque sin diferencias con los habitantes suburbanos), mientras que el tucúquere, la especie de mayor tamaño, no mostró diferencias significativas entre zonas.

variation in ecological knowledge of owls was not explained by professional background or educational level (P>0.05) (Figure 4).

Knowledge of nesting sites (primarily tree cavities) was high. It ranged from 70% to 86% across all zones, with no differences among zones or across other variables tested (i.e., profession, childhood contact with nature or educational level; P>0.05).

Perceptions and attitudes toward owls

Perceptions of owls were predominantly positive. Overall, 87% of respondents strongly disagreed that owls evoke fear and 84% rejected the belief that they bring bad luck. Nearly half of the participants (45%) agreed that their presence is beneficial, while only 31% reported being aware of legends associated with owls. Attitudes were similarly favorable: 90% of participants reported not knowing anyone who had killed an owl, and in the few reported cases, the stated reason was that the owl had been killed "for fun". In addition, 85% of respondents indicated that they would like to have owls near their homes for rodent control. These patterns were consistent across zones, with no significant association detected between perceptions or attitudes and educational level (P>0.05) or access to technical information.

Knowledge, perceptions and practices regarding rodents and sanitary risk

Overall, 57% of respondents recognized the ecological roles of rodents in natural areas. Regarding species identification, a significant knowledge gap was observed concerning the origin of rodents: most participants were unable to differentiate between native species and invasive species (e.g., *Rattus rattus*, *Rattus norvegicus* and *Mus musculus*) or even

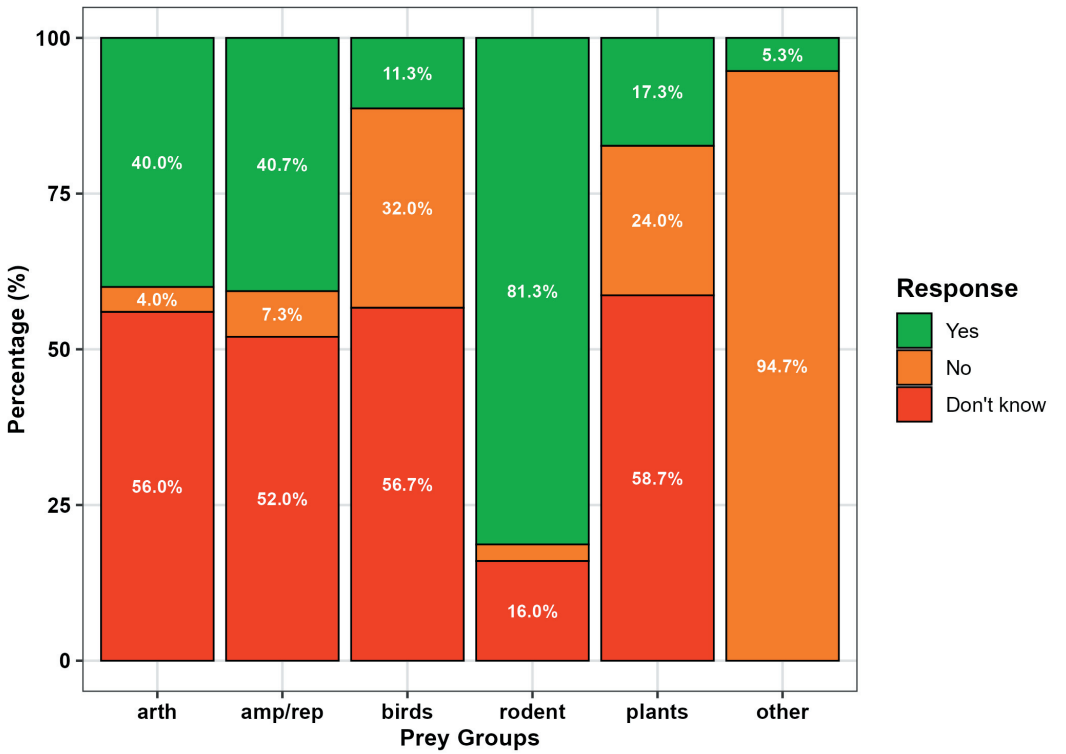


Figure 4. Graph comparing knowledge of owl diet across zones. Category labels correspond to prey groups as follows: artth=arthropods; amp/rep=amphibians and reptiles; birds=birds; rodent=rodents; plants=plants; other=other.

Figura 4. Gráfico que compara el conocimiento sobre la dieta de las aves rapaces nocturnas a lo largo de las distintas zonas. Las etiquetas de las categorías corresponden a los siguientes grupos de presas: arthropods=artrópodos; amp/rep=anfibios y reptiles; birds=aves; rodent=roedores; plants=plantas; other=otros.

to recognize the presence of non-native species in the area. This lack of differentiation was consistent across the urban-rural gradient and showed no association with residents' education level or experiential background (P>0.05). Additionally, 66% considered the presence of rodent's natural predators near households desirable. However, 81% were willing to eliminate rodents if present in their homes or yards. Regarding risk factors, participants identified abandoned buildings (97%) and garbage accumulation (94%) as the main conditions favoring rodent presence, along with the removal of natural predators (94%), deforestation (86%) and shrubland presence (67%). Additionally, 39% viewed rodents in nearby natural environments as problematic, mainly due to concerns about zoonotic diseases such as hantavirus.

Regarding control practices, the most frequently reported method to keep rodents away was the presence of cats (48%), followed by the use of poisons (39%), yard cleaning (31%) and traps (17%). These patterns were consistent across the urban-rural gradient and showed no association with residents' education level, professional background or access to technical information (P>0.05). Regarding awareness on secondary poisoning of predators, 45% of respondents using rodenticides were aware of the negative effects on owls and other predators. In contrast, 32% were unaware and 23% believed there was no impact on the food chain.

Discussion

Our results partially support the proposed hypotheses. As predicted, knowledge related to species recognition —encompassing both visual and auditory identification— was significantly more accurate among rural residents, despite their significantly lower formal educational profile than urban and suburban residents. This pattern is consistent with the possibility that greater everyday contact with natural environments contributes to familiarity with local owl species, although our interview-based design does not allow us to isolate the mechanisms underlying this difference. Rural inhabitants also showed

greater accuracy in identifying owl diet, whereas knowledge of nesting sites was relatively homogeneous across zones.

In turn, valuation patterns —defined as emotional attitudes (fear and associations with good luck) and functional appreciation (perceived utility)— also diverged from expectations. Rather than being stronger in rural areas, these evaluations were consistently positive and showed no significant variation along the urban-rural gradient, indicating that positive valuations of owls were shared across the communities surveyed.

As predicted, awareness of the impacts of anticoagulant rodenticides was independent of experiential background (i.e., rural or urban lifestyle). Contrary to expectations, it was also unrelated to formal education level or access to information.

Knowledge-owls

The high percentage of respondents reporting having seen an owl at least once in their lives (in any location) suggests a relatively high level of general familiarity with these birds, consistent with previous studies (Salgado Suquilanda 2017; Bohigas-Amaya 2023; Iñiguez-Gallardo et al. 2024). However, because the spatial context of these observations was not specified, the elevated values recorded in urban areas may reflect sightings made outside the residential environment rather than within the urban core, particularly among more recent residents. Thus, while this finding can be interpreted positively in terms of general (or at least superficial) owl knowledge, it does not provide insight into owl presence or interactions within the immediate surroundings of respondents' homes.

Conversely, recognition of typical local species, both visually and auditorily, was higher in rural areas, consistent with previous reports (Rocha and Salazar 2004; Muñoz-Pedreros et al. 2018). Identification was particularly strong for the rufous-legged owl in rural settings, especially through aural recognition, in keeping with its ecological profile as a highly vocal forest specialist. The same pattern was observed for the other two facultative forest species, the american barn owl and the austral pygmy-owl; the latter was also the most frequently recognized species overall, which may be related to its conspicuous vocal activity and partly diurnal habits (e.g., Figueroa et al. 2015). These patterns are compatible with differences in familiarity with local wildlife, but the present study cannot determine whether they reflect differences in habitat use, species abundance, detectability or other ecological factors. Taken together, these findings suggest that ecological knowledge in the region may be associated with direct interaction with well-preserved native habitats, rather than being determined primarily by institutionalized schooling.

Differences among zones (i.e., greater owl familiarity in rural areas than in urban and suburban areas) were less pronounced for auditory than for visual identification. Although urban noise can interfere with natural soundscapes (Patricelli and Blickley 2006), our data did not measure acoustic conditions or owl abundance, so the relative contribution of these factors cannot be established from the present study. Despite recent advances in understanding how anthropogenic noise affects the vocalizations of diurnal Patagonian birds (Bahia et al. 2024), the relative contributions of acoustic pollution and owl abundance across zones remain unclear in this region and warrant further evaluation.

Additional insight into this apparent paradox may be provided by the lesser horned owl, whose auditory recognition remained consistently low across the gradient despite significant differences in visual recognition. This pattern may reflect ecological or perceptual factors that were not measured here; distinguishing among them would require species-specific ecological and acoustic data.

Rodents were correctly identified as the primary prey of Strigiformes across all zones, matching broader Latin American studies (Rocha and Salazar 2004; Cardona and Enríquez 2014; Molares and Gurovich 2018; Iñiguez-Gallardo et al. 2024). Nonetheless, misidentifications regarding plant and bird consumption were noted in urban and suburban areas, consistent with errors reported in other perception studies (Rocha and Salazar 2004). Finally, knowledge of nesting sites (primarily tree cavities) was adequate and consistent with Strigiformes biology and prior research (Figueroa et al. 2015; Muñoz-Pedreros et al. 2019; Bohigas-Amaya 2023; Iñiguez-Gallardo et al. 2024).

Perceptions and attitudes toward owls

Perceptions toward owls were predominantly positive, with a broad rejection of beliefs

associated with fear or bad luck, a pattern consistent with studies conducted in European and some Latin American contexts (Rocha and Salazar 2004; Godoy-Güinao et al. 2017; Muñoz-Pedreros et al. 2018; Bontzorlos et al. 2023; Bohigas-Amaya 2023; Iñiguez-Gallardo et al. 2024). In our study, positive valuations were independent of formal education, contrasting with findings from Tierra del Fuego, where social representations and the valuation of endangered mammals were more closely linked to scientific knowledge and formal education levels (Claverie et al. 2025). The broad consistency of positive valuations across the urban-rural gradient may indicate that favorable views of owls are not restricted to particular educational or socioeconomic groups, although the mechanisms underlying this pattern cannot be established from the present data.

The lower awareness of traditional legends, particularly in urban areas, may reflect differences in the persistence or transmission of traditional ecological knowledge across zones. It may also be consistent with broader changes in how owls are perceived, including a reduced prominence of traditional or superstitious interpretations (Ortiz 2017; Cardona and Enriquez 2014).

Although the local population generally expresses favorable attitudes toward the presence of owls near households and recognizes their role as biological control agents, instances of negative behavior toward these birds —including intentional harm— were still reported by some interviewees. These contrasting attitudes highlight the importance of environmental education strategies that integrate scientific knowledge with local cultural perceptions, particularly when addressing persistent negative perceptions or practices. Experiences from other contexts suggest that targeted interventions and community engagement can contribute to more positive attitudes toward wildlife (Buthelezi et al. 2026).

Knowledge, perceptions and practices regarding rodents and sanitary risk

Our findings indicate that residents were generally familiar with wild rodents and recognized several anthropogenic conditions associated with their presence. However, a significant knowledge gap exists regarding the differentiation between native and invasive species such as *R. rattus*, *R. norvegicus* and *M. musculus*, reflecting a common trend in environmental knowledge studies (Capdevila-Argüelles et al. 2013; Ale 2023; Lenz et al. 2024) with implications for zoonotic risk management and conservation. While residents generally acknowledge the ecological roles of rodents as seed dispersers and prey (Vélez-García and Pérez-Torres 2010; Grenha et al. 2010; Rumiz 2010), domestic aversion remains high due to concerns over diseases such as hantavirus. Participants also correctly identified anthropogenic risk factors such as abandoned buildings and garbage accumulation (Feng and Himsworth 2014; Duh et al. 2017).

Value-practice mismatch

Ultimately, a marked disconnect was identified: although residents value owls as biological control agents, nearly half of the interviewees across the urban-rural gradient remained unaware of the harmful effects of rodenticides on raptors. This lack of awareness did not vary significantly across the gradient, despite the higher formal educational profile of urban and suburban residents. A similar pattern has recently been reported in Bariloche, a nearby Andean city, where Bocelli et al. (2026) found that rodenticide use could persist despite awareness of owls as rodent predators, also suggesting a disconnect between ecological knowledge and peridomestic rodent-control practices. Recent evidence from the same broader region supports the potential consequences of rodenticide use: Casalins et al. (2026) documented anticoagulant rodenticide residues in raptors sampled in northern Patagonia, with the highest hepatic concentrations occurring in Strigiformes.

These findings suggest that limited awareness of the ecological consequences of rodenticide use may be a broader issue in the region, particularly where rodent control is partly driven by concerns about hantavirus and may inadvertently expose natural rodent predators to these compounds. Addressing this issue may require context-specific environmental education alongside appropriate regulatory and integrated rodent-management strategies to promote safer alternatives, reduce reliance on rodenticides and strengthen recognition of the ecological role of owls.

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Ethical compliance

The research reported in this article did not involve animal practices which may require wildlife handling permits, animal research licenses, or approval from institutional review boards. The study was based exclusively on surveys and the collection of data on human participants' perceptions and knowledge. Authorization to conduct the surveys within the study areas was obtained from the relevant authorities of the provinces of Río Negro and Chubut and from the Administración de Parques Nacionales (#1847 - Dirección Regional Patagonia Norte).

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