

Feeding habits and people's perception of the Barn Owl (*Tyto alba tuidara*, J.E.Gray 1829) in urban settings of Southern Chile: Implications for conservation

Hábitos alimenticios y percepción de las personas hacia la Lechuza blanca (*Tyto alba tuidara*, J.E.Gray 1829) en un barrio urbano del sur de Chile: Implicancias para la conservación

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ABSTRACT

People's perception on birds of prey is heavily influenced by its intrinsic value, utility, myths and superstitions. In particular, negative perceptions may encourage poaching and persecution of these birds, affecting their conservation status. One nocturnal raptor species widely distributed across the world is the Barn Owl (*Tyto alba*, Tytonidae). In Chile, this species has been recorded and studied exclusively in rural and sub-urban areas. However, in the city of Valdivia Barn owls exist within the city boundaries. In this study we documented the feeding habits of Barn owls nesting in urban settings of Valdivia, and we analyze the opinions of local neighbors toward the owls. To characterize the diet of owls, we collected all pellets found around their nesting tree on a monthly basis between August 2010 and August 2011. We interviewed the neighbors using a questionnaire that included questions about the utility, ethical or aesthetic value of the owl and the tree where they nested. Our results indicate that the main prey of the Barn Owl was the Long-tailed Colilargo (*Oligoryzomys longicaudatus*). The neighbors' perception was favorable to the Barn Owl primarily for aesthetic and ethical reasons, and not utilitarian reasons. Our results suggest that people perception in urban areas is different than in rural areas, where previous studies showed the prevalence of utilitarian values. This positive perception represents a great potential to promote conservation and environmental education in the city, creating a link between people and the natural elements they have in their environment.

KEYWORDS: Environmental education, *Oligoryzomys longicaudatus*, Raptors, urban ecology, urban wildlife.

RESUMEN

La percepción que tienen las personas frente a las rapaces está fuertemente influenciada por su valor intrínseco, por su utilidad, y por mitos y supersticiones. En particular, las percepciones negativas pueden fomentar la caza furtiva y la persecución de estas aves, afectando su estado de conservación. Una rapaz nocturna distribuida a nivel mundial es la lechuza blanca (*Tyto alba*, Tytonidae). En Chile, esta especie ha sido registrada y estudiada exclusivamente en zonas rurales y sub-urbanas. Sin embargo, en la ciudad de Valdivia existen lechuzas habitando dentro del perímetro urbano. En este trabajo documentamos la composición de especies de roedores consumidos por las lechuzas blancas dentro de un barrio urbano, y evaluamos la percepción de los vecinos sobre la presencia de lechuza blanca en su barrio. Para caracterizar la dieta de las lechuzas, recolectamos egagrópilas mensualmente entre agosto de 2010 y agosto de 2011. Para conocer la percepción de los vecinos, se elaboró un cuestionario que incluyó preguntas sobre el valor utilitario, ético o estético de la lechuza y del árbol donde nidificaba. Nuestros resultados indican que la presa más consumida por la lechuza blanca fue el ratón colilarga (*Oligoryzomys longicaudatus*). La percepción de las personas resultó favorable hacia la lechuza blanca principalmente por razones estéticas y éticas, y no utilitarias. Nuestros resultados sugieren que la percepción de las personas en áreas urbanas es distinta de las zonas rurales, donde trabajos previos han mostrado que prevalecen los valores utilitarios. Esta percepción positiva podría representar un gran potencial para favorecer la conservación y la educación ambiental en la ciudad, generando un vínculo entre las personas y los elementos naturales que poseen en su entorno.

PALABRAS CLAVE: Educación ambiental, *Oligoryzomys longicaudatus*, rapaces, ecología urbana, fauna urbana.

INTRODUCTION

People's perception on birds of prey is heavily influenced by their utility, existing myths and traditions, as well as their aesthetic value within a specific social context (Silva *et al.* 2006). For example, on one side, governments and conservation agencies of different countries often promoted the utilitarian value of some raptors as rodent predators (Whittington & Allen 2008, Servicio Agrícola y Ganadero 2012). On the other hand, cultural myths may generate a negative perception encouraging poaching, persecution and hunting of these birds, affecting their conservation status, particularly in human dominated areas (Jaksic & Jimenez 1986, Martínez 1986, Martínez 2005, Silva *et al.* 2006, Guerrero 2007, Trinca *et al.* 2007, Curti & Valdes 2009, Ogada *et al.* 2012).

One raptor species widely distributed across the world is the Barn owl (*Tyto alba*, Tytonidae, Taylor 1994). This species is nocturnal and territorial, forming pairs that usually nest in tree holes, cliffs or buildings (Taylor 1994). Its adult length varies between 34-43 cm, and it preys mainly on rodents (Herrera & Jaksic 1980, González *et al.* 2004, Rivas & Figueroa 2009). In South America, the majority of published studies reported this species inhabiting rural areas or suburban settings but not urban environments (eg. Travaini *et al.* 1997, González *et al.* 2004, Trejo & Ojeda 2004, Carmona & Rivadeneira 2006). In Chile, this species is widely distributed from the coast to 1500 m in altitude, typically inhabiting mountains, shrublands and farms (Rivas & Figueroa 2009). However, no study has yet to report this species living strictly in Chilean cities. We report a Barn owl nesting pair into an old native tree within the city boundaries of Valdivia, in southern Chile. As older trees are very scarce in most Chilean cities, this nest represents a good opportunity to understand the feeding ecology of Barn owls in cities as well as to study the perception of urban people with raptors in their immediate vicinity. We predict that urban people will show a combination of negative and positive perceptions to the Barn owls, on one side because of myths and on the other side because of their utilitarian value as rodent predators. In this study, i) we document the feeding habits of Barn owls nesting in urban settings of Valdivia, ii) we analyze the opinions of the local neighbors toward the owls and their nesting tree, and iii) we discuss the potential of these owls as a subject for education and promotion of the conservation of biodiversity in urban areas.

MATERIALS AND METHODS

STUDY AREA. The study was conducted in the city of Valdivia, in Southern Chile (39°50' S, 73°14' W, Fig. 1). Valdivia is located at 20 m over sea level, 20 km east from

the coast. The city lays at the confluence of the three rivers, surrounded by wetlands and agricultural fields, and has a population of approximately 150,000 people. Climate in the area is temperate, with oceanic influence, an annual mean temperature of 11.9° C, and annual precipitation of 2,540 mm (Luebert & Plischoff 2005). We studied a pair of *T. alba* nesting in a large old native tree close to a main street in the Barrio El Bosque, Valdivia. This neighborhood was built around 1990, and surrounded by an array of remaining wetlands and urban areas. The main street has a central floe with two lines of trees, mostly exotic species of English oak (*Quercus robur*; Fagaceae). However, the nest was located in the only native tree present, a large old Roble tree (*Nothofagus obliqua*; Nothofagaceae) of 1.2 m diameter and over 300 year old (I.A. Diaz, unpublished data). According to the neighbors, the owl pair has been nesting and living there for over 20 years. To our knowledge, this is the first nest reported in strictly an urban neighborhood in Chile, where the nest is surrounded by transited avenues, electric lines, houses, schools and commercial buildings.

DIET ANALYSIS. Between August 2010 and August 2011, we collected all pellets found around the tree on a monthly basis. We analyzed the pellet's content in the laboratory, cataloguing the different preys, as they were identifiable. To define to which species the remains belonged, we separated the skulls and bones of vertebrates, classifying them following Reise (1973) and compared them with a reference collection of vertebrate skulls deposited at the Institute of Environmental and Evolutionary Sciences of the Universidad Austral de Chile. In the case of invertebrates, we were able to classify the remains either to the order or family level. Two species of the genus *Rattus* have been historically introduced in Chile, *R. rattus* and *R. norvegicus* (Jaksic 1998), and we simply classified them as *Rattus* spp. because we were not able to reliably distinguish between these two species within the remains contained in the pellets. Data were pooled by Autumn-Winter and Spring-Summer seasons. The results were expressed as a percentage of the total prey consumed (FREQ) and as a percentage of the total prey mass consumed (BIO). The following equation was used to calculate the percentage of the total prey mass consumed represented by each species in the diet, assuming that the entire body mass of each individual prey species caught was consumed by de Barn owl:

$$BIO = (100Sp_i N_i) / \sum Sp_i N_i$$

Where Sp_i is the mass of the i th species, N_i is the number of individuals of i th species consumed and BIO is the percentage of the total prey mass consumed for each season contributed by the i th species. The mass of each prey species was obtained from Diaz (1999).

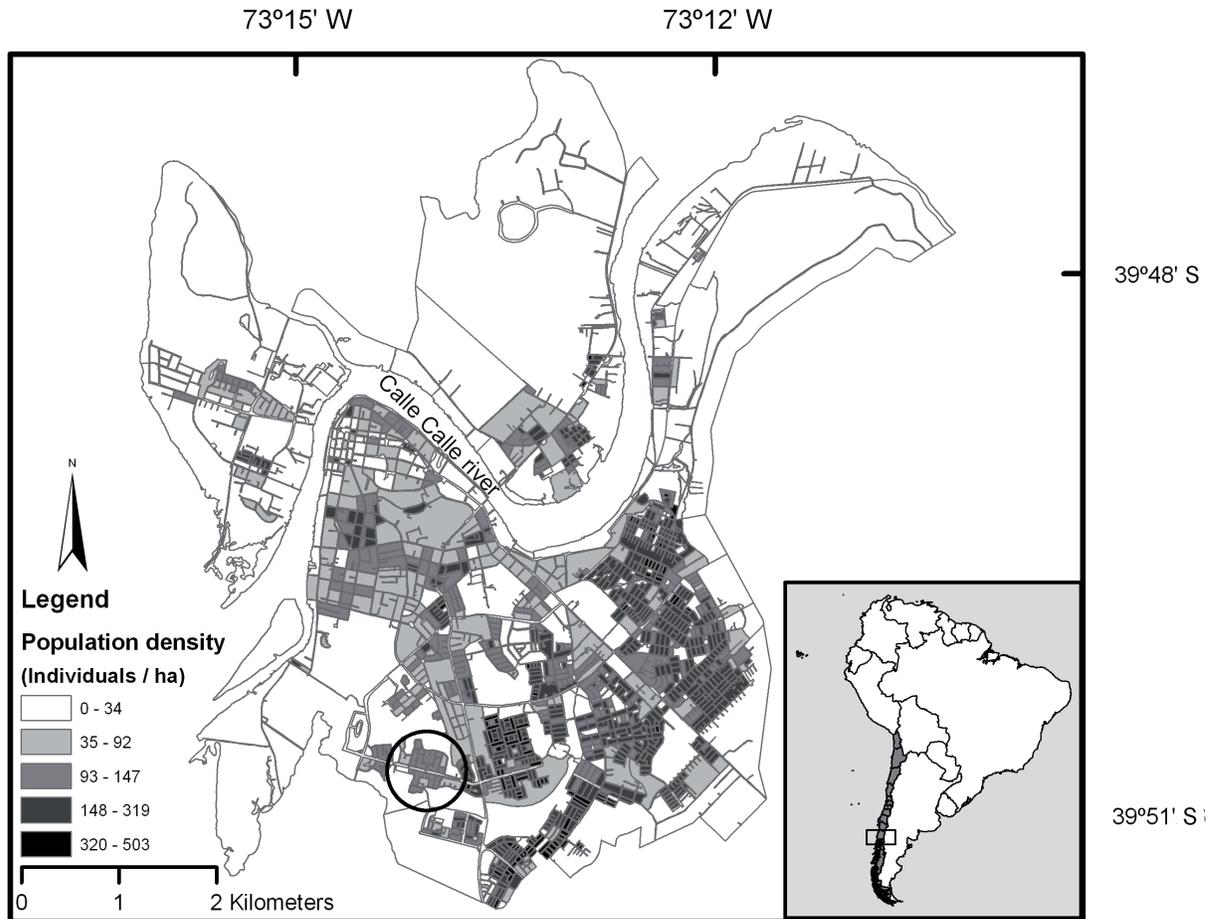


FIGURE 1. Location of study area in the city of Valdivia, southern Chile. The circle indicates the neighborhood where the owl nested. / Ubicación del área de estudio en la ciudad de Valdivia, sur de Chile. El círculo indica el barrio del anidamiento de la lechuza

PEOPLE'S PERCEPTIONS. To document whether the neighbors manifested either a positive or negative perception towards the owls and their nesting tree, we interviewed all the households at a 200 m radius around the nesting tree. The survey was conducted in August 2011, and we asked to only one member within each household to answer three questions regarding the owls. The questions were: 1) Are you aware or have you ever seen the Barn owls that nest in the neighborhood? 2) Do you think owls are a worthy asset, detrimental or do not matter? 3) Can you please explain us why? These same questions were rephrased to know the perception to the owls' nesting tree. We further classified the answers to the third question "why" as three different arguments following Kellert (1994) with modifications. These were defined as "utilitarian" if the answer was based on the owls' specific and direct utility to the neighbors (such as preying on rodents), "ethical" if the answers argued about the right of existence of the owls and their nesting tree, and "aesthetical" if the answers focused on the physical attractiveness and magnificence of the owls and their tree.

RESULTS

BARN OWL'S FEEDING HABITS. Overall, 201 pellets were collected during one year, which included 276 individual preys (Table 1). Rodents were the most consumed preys, representing more than 90% of their diet in both seasons of study, whereas only one pellet had invertebrate remains (Gryllidae, Table 1). In addition, the rodents represented 99% of prey biomass in the Barn owl diet (Table 1). The Barn owls preyed upon three native species of rodents: *O. longicaudatus* (Cricetidae), *Abrothrix olivacea brachotis* (Cricetidae) and *Abrothrix longipilis apta* (Cricetidae), in addition to the exotics *Rattus* spp. (Muridae). The results showed similar proportions of rodent consumption by the Barn owl in both seasons (Table 1). *O. longicaudatus* was the most consumed prey of the total diet of the owl, representing 80% of their diet in autumn-winter and 76% in spring-summer (Table 1). In addition, *O. longicaudatus* represented the highest biomass for both seasons, representing 54% of the total biomass prey in autumn-

winter and 51% in spring-summer (Table 1). *Rattus* spp. was the second most consumed and was the second most important biomass, representing 46% of the total biomass prey, while *A. longipilis apta* and *A. olivacea brachotis* were represented in lower proportions (Table 1). The remaining 4.4% corresponded to unidentified material (Table 1).

PEOPLE’S PERCEPTION. The majority of the neighbors (67.7%) were unaware of the existence of the owls, but half of them (50.8%) were aware of the existence of the ancient native tree used for nesting (Table 2). Those people aware of the owl’s existence showed a positive perception towards the birds (31%), however people who didn’t know of the owls’ presence were mostly indifferent to them (Table 2). None of the people surveyed expressed a negative perception towards the owls. Most answers indicated a positive opinion about this species. People gave a variety of opinions including

utilitarian, ethical and aesthetical reasons; from “being important as a pest control” to “having the right to exist”. One family answered that “children like them”. Overall, 30% of the people interviewed gave an utilitarian reason while 45% gave a combination of ethical and aesthetical reasons for valuing the owls (Table 3).

All of the surveyed people had a positive perception towards the old native Roble tree, regardless if they were or not aware of the tree’s presence (Table 2). Only one person expressed concern about the risk of the tree to falling over the neighboring houses (Table 2). In general, more people (67%) expressed ethical or aesthetical reasons to value the Roble tree (Table 3). The principal reason was appraising the value that the Roble is a native tree. None of the interviewed people manifested utilitarian reasons as a form of evaluating the tree presence (Table 3).

TABLE 1. Food habits of the Barn owl (*T. alba*) in Valdivia, Southern Chile. The data were grouped in Autumn-Winter and Spring-Summer. N total= 276 individuals in a total of 201 pellets. FREQ is the percentage of each prey calculated over the total prey items consumed. BIO is the percentage of total prey mass consumed. / Hábitos alimenticios de la lechuza blanca (*T. alba*) en Valdivia, Sur de Chile. Los datos fueron agrupados en temporada Otoño-Invierno y Primavera-Verano. N total= 276 individuos en un total de 201 egagrópilas. FREQ es un porcentaje calculado sobre el número total de ítems consumidos. BIO es el porcentaje del total de la biomasa de las presas consumidas.

Prey	Mass (g) ^a	Autumn-Winter		Spring-Summer		Total	
		FREQ	BIO	FREQ	BIO	FREQ	BIO
Rodents			96.0		94.0		95.0
<i>Abrothrix longipilis apta</i>	76	-	-	0.8	1.0	0.4	0.4
<i>Abrothrix olivacea brachotis</i>	40	0.4	1.0	0.4	1.0	0.4	1.0
<i>Oligoryzomys longicaudatus</i>	45	54.3	80.0	51.0	76.0	52.7	78.0
<i>Rattus</i> spp.*	189	45.2	16.0	47.6	17.0	46.3	16.0
Insects			1.0		-		0.4
Orthoptera	3.2	0.03	1.0	-	-	0.02	0.4
Unidentified material			3.0		6.0		4.0
Unidentified			3.0		6.0		4.0
Total prey Items			145		131		276
Total Prey Mass			9610		8729		18339

* Exotic species; ^a Prey biomass obtained from Díaz (1999).

TABLE 2. People perception (%) about Barn owl (*Tyto alba*) and the Roble (*Nothofagus obliqua*). N surveys= 65 houses. / Percepción de la población (%) sobre la lechuza blanca (*Tyto alba*) y el roble (*Nothofagus obliqua*). N encuestas=65 casas.

	Total	Positive	Negative	Indifferent	No answer
Owl: aware	32.3	30.8	0.0	0.0	1.5
Owl: not aware	67.7	20.0	0.0	16.9	30.8
Tree: Aware	50.8	44.6	0.0	6.2	0.0
Tree: not aware	49.2	20.0	1.5	3.1	24.6

TABLE 3. Answers (%) provided by the interviewed neighbors about their perception of the Barn owl and the native nesting tree. Answers were classified as aesthetical, ethical or utilitarian value. / Respuestas (%) proporcionadas por los vecinos entrevistados sobre su percepción hacia la lechuza blanca y hacia el árbol nativo en donde nidificó. Las respuestas fueron clasificadas como valor estético, ético o utilitario.

SPECIES	NEIGHBORS ANSWERS	%	CLASSIFICATION
Barn owl	Pest control	30.3	Utilitarian
	Beauty	9.1	Aesthetical or ethical
	Children like them	6.1	Aesthetical or ethical
	Native value	24.2	Aesthetical or ethical
	Right of existence	15.2	Aesthetical or ethical
	Not answering	15.2	
Roble tree	Beauty	11.9	Aesthetical or ethical
	Interesting	2.4	Aesthetical or ethical
	Old	4.8	Aesthetical or ethical
	Native value	47.6	Aesthetical or ethical
	Falling risk	7.1	
	Not answering	26.2	

DISCUSSION

FEEDING HABITS OF THE BARN OWL. The primary prey consumed by the Barn owl in Valdivia was *O. longicaudatus*, in concordance with diet analyses from rural areas in Chile and Argentina (Herrera & Jaksic 1980; Gonzalez *et al.* 2004; Udrizar *et al.* 2005). This study is the first one to report the food habits of Barn owls in urban settings in Chile. Most studies in the southern cone have been carried out in rural and suburban areas, showing that Barn owl also consume a larger variety of animal preys in addition to *O. longicaudatus*, such as birds, bats, reptiles, amphibians and invertebrates (Romano *et al.* 2002; Gonzalez *et al.* 2004; Carmona & Rivadeneira 2006). In Valdivia, the diet of Barn owl was based almost exclusively on rodents in both seasons, maintaining similar proportions of consumption, which is very intriguing. We found only four species of rodent within the owls' pellets examined (considering *Rattus* spp. as one species). We argue that three non-mutually excluding possible causes may explain the prevalence of rodents as preys, and particularly on *O. longicaudatus* in Valdivian Barn owls: i) *O. longicaudatus* may be the most abundant species in urban and rural areas, ii) their behavior makes them more visible to the owls, and iii) Barn owls may select for a specific type of prey.

Several studies have proposed that the most abundant rodents in urban settings, should be *Rattus rattus*, *Rattus norvegicus* and *M. musculus*; at least in Chilean cities

(Jaksic 1998; Torres-Pérez *et al.* 2004, González *et al.* 2004; Fernández & Simonetti 2012). Unfortunately, studies that assess the diversity and abundance of rodents in urban areas of Chile are scarce (Fernández & Simonetti 2012) and just one ongoing study in the nearby city of Temuco (170 km north of Valdivia) has found a large variety of rodent species in urban settings, including *O. longicaudatus* (Muñoz-Pedrerros *et al.* unpublished data). If Barn owls prey based on abundance, then *O. longicaudatus* should be an abundant species in Valdivian urban settings contrary to that is widely believed or accepted for Chilean rodents despite the lack of studies (Iriarte 2007, Fernández & Simonetti 2012). On the other hand, the foraging ranges of Barn owls are around 4 km around the nest (Smith *et al.* 1974) and *O. longicaudatus* is a rodent with large home ranges (Murúa *et al.* 1986), which could favor the consumption of *O. longicaudatus* by Barn owl. Valdivia is located within a matrix of natural wetlands densely covered by large grasses such as *Cyperus* spp. and *Juncus* spp., and surrounded by a mix of native or exotic shrubs. Most urban wetlands are immerse in an urban matrix of residential and commercial development, and are threatened by a strong pressure for urbanization (González *et al.* 2003). Barn owls could easily prey within the surrounding wetlands, however the lack of populations' studies about rodents living in these wetlands limited our ability to understand where and how this species is feeding on rodents.

On the other hand, *O. longicaudatus* has a fleeing behavior characterized by alternating running and jumping (Kittlein 1994, Iriarte 2007), which may render this species much more visible to the Barn owls compared to other rodents (Kittlein 1994). Furthermore, *O. longicaudatus* activity occurs at the same time as the Barn owl, which may also explain their prevalence in the Barn owls' diet (Kittlein 1994, Iriarte 2007, Rivas & Figueroa 2009).

Last, Barn owls may actively select their prey as suggested by Simonetti & Walkowiak (1979). Bozinovic & Medel (1988) analyzed the energetic requirements of this and other raptors, proposing that preys of the size of *O. longicaudatus* provide the best energetic return at minimal effort for the Barn owl. This reason may explain why Barn owl was preying mainly on *O. longicaudatus*, and this owl may prey on other items when the abundance of *O. longicaudatus* decreases below a threshold level despite the larger biomass of other preys such as *Rattus* spp. which is more aggressive than smaller native rodents (Simonetti & Walkowiak 1979, Muñoz & Murúa 1990).

These results correspond to the first records of the diet of Barn owls in urban settings in Chile, and until our knowledge, no other nest of Barn Owl have been found inside the urban perimeter of this or another Chilean city. Our results should be complemented with further studies focused on finding and documenting other owls' nests inside the urban perimeter, and to characterize the rodent communities that live in urban areas.

PEOPLE'S PERCEPTION. Our result showed that the Barn owl provides an important ecosystem service in the city of Valdivia, by preying an important amount of rodents, particularly *O. longicaudatus*; the main vector of Hantavirus in Chile (Castillo *et al.* 2000, Figueroa *et al.* 2001, Table 1). Therefore, we expected that Barn owl were strongly valued by its utilitarian importance. The neighbors' perception to the owls pair and to the nesting tree was mostly favorable (Table 2), however it was driven mainly from aesthetic and ethical reasons, and not by utilitarian reasons (Table 3). This is contrary to the strong utilitarian value reported for this species in rural areas of Chile (Silva *et al.* 2006) and evidence a different type of relationships between wildlife in urban settings vs. rural settings. The fact that most neighbors were unaware of the owls' presence in their neighborhood is similar to that reported for other urban areas in the world, where people living in urbanized areas are more likely to be uninformed about the wildlife that surrounds them (Clergeau *et al.* 2001, Gilbert 2012). People who were not aware of the owl's presence in their neighborhood expressed indifference, whereas everybody else had a positive opinion about the owls (Table 2), suggesting that exposure and interaction with biodiversity would influence the people appreciation towards local wildlife (Clergeau *et al.* 2001, Gilbert 2012).

IMPLICATIONS FOR CONSERVATION. In Chile, no previous study have showed Barn owls living in urban settings, despite this is a common factor in European and North American cities (Smith *et al.* 1974, Ramsden 1998, Kasprzykowski & Golawski 2006). The subspecies inhabiting southern Chile is of different color, and maybe the local species are not use to live in cities. In fact, urban settings of Valdivia are very different of what is known and assumed for urban areas in the developed world (Silva *et al.* 2015). Based in our field observations and data from Silva *et al.* (2015), we hypothesize that the presence of Barn owls in this city is strongly influenced by the matrix of wetlands and the remnants of native forest vegetation such as the old native tree where owls were nesting. Then, legacies and the local matrix can provide and explanation of why this species is nesting in the middle of a street.

Therefore, the owls and the nesting tree can represent important biological legacies in this city, and in addition valued by the neighbors mainly for aesthetical reasons independently of the utilitarian reasons. These biological legacies should be protected as a local and unique patrimony of the city, and emphasized as first-hand contacts with nature and wildlife in urban areas. As several studies suggest, first-hand positive experience with wildlife contribute to develop concern and participation to the protection of species and ecosystems (e.g., Mittelstaedt *et al.* 1999, Hine *et al.* 2009). In the future, most of the human population will concentrate in urban areas (United Nations 2011), then biological legacies including relevant, charismatic native species in cities can provide these first-hand experience to the neighbors, increasing their awareness for wildlife, favoring a positive relationships between the natural environment and people (e.g., Llanos-Pineda 2013). These legacies represent an opportunity to develop integrative educational programs, focused on species and ecosystems, favoring the awareness for local wildlife such as the raptors in places where people conduct their daily lives.

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