

Knowledge and perceptions of birds of prey among local inhabitants in Chile: implications for the biological control of rodent pests

Conocimiento y percepción de aves rapaces en habitantes locales en Chile: implicancias para el control biológico de roedores plagas

ANDRÉS MUÑOZ-PEDREROS^{1,*}, MARCELA GUERRERO² & PATRICIA MÖLLER³

¹Núcleo de Estudios Ambientales NEA, Departamento de Ciencias Ambientales, Facultad de Recursos Naturales, Universidad Católica de Temuco, Casilla 15-D, Temuco, Chile.

²Facultad de Ciencias Agropecuarias y Forestales, Universidad de La Frontera, Chile.

³Programa de Conservación de Aves Rapaces y Control Biológico, Centro de Estudios Agrarios y Ambientales, CEA, Valdivia, Chile.

*Email: amunoz@uct.cl

ABSTRACT

The aim of this study was to understand the level of knowledge and the perceptions of a local population with a high indigenous component (38.5%) towards birds of prey in order to address wildlife conservation strategies. We determined knowledge of birds of prey and biological control of rodent pests by applying a closed questionnaire; and perceptions of these species by applying a perception survey. Our study subjects were rural and urban residents in southern Chile. The results indicate low levels of knowledge about birds of prey and mainly positive perceptions, despite the presence of superstitions about raptors. These findings show the importance of socio-cultural dimensions and their implications for environmental education – which should be oriented towards changing attitudes to target species and particularly belief systems which determine attitudes. These changes are very important for raptor conservation programmes and reliance on raptors for the biological control of rodent pests.

KEYWORDS: Biological control, knowledge, Mapuche indigenous, perception, raptors.

RESUMEN

El objetivo de este estudio fue comprender el conocimiento y la percepción de una población local con un alto componente indígena (38,5%), hacia las aves rapaces para abordar estrategias de conservación de la fauna silvestre. Determinamos el conocimiento sobre las aves rapaces y el control biológico de las plagas de roedores mediante la aplicación de un cuestionario cerrado, y la percepción mediante la aplicación de una encuesta de percepción. Nuestros sujetos de estudio fueron residentes rurales y urbanos en el sur de Chile. Los resultados indican un bajo conocimiento de las aves rapaces y las percepciones son positivas, aunque las supersticiones sobre las rapaces permanecen. Los resultados muestran la importancia de las dimensiones socioculturales y sus proyecciones sobre la educación ambiental; que debe estar orientada a cambiar las actitudes hacia las especies objetivo, especialmente en el sistema de creencias; lo que es importante en los programas de conservación de rapaces y su uso en el control biológico de plagas de roedores.

PALABRAS CLAVE: Conocimiento, control biológico, mapuche, percepción, rapaces.

INTRODUCTION

Birds of prey, raptors and owls, are important predators of many species, especially rodents. This makes them useful species for humans, since they help to reduce rodent populations, playing a prophylactic role for human health (see Korpimäki *et al.* 1991; 2002; Hanski *et al.* 2001; Gilg *et al.* 2003; Pälvi *et al.* 2010). Birds of prey are active consumers of pest rodents, favoured by territorial characteristics

(Muñoz-Pedreros & Murúa 1990; Muñoz-Pedreros, *et al.* 2010). Thus, the maintenance and/or increase of raptor populations may contribute to the biological control of pest rodents (Meyrom *et al.* 2009).

A bird of prey management plan is a set of actions carried out to protect local populations. It involves three components: ecological populations, their habitats, and the people involved (Woodroffe *et al.* 2005); the latter factor is essential for a successful bird of prey conservation and

management strategy. Understanding of the knowledge and perceptions of the local inhabitants with respect to the target fauna is essential (Gigliotti *et al.* 1992, Zinn & Pierce 2002, Manfredo 2008). We understand perception as the formation of mental representations, the function of which is to give abstractions concrete form through the qualities which define the essence of external reality (Oviedo 2004); it also includes the interpretation of these sensations, giving them significance and organization (Matlin & Foley 1996). This implies that not only the sensorial organs but also the brain is involved in perception (Feldman 1999). Various authors consider perception to be the fundamental process of mental activity, assuming that other psychological activities (e.g. learning, memory, thought) depend on the proper functioning of the perceptual organization process (see Oviedo 2004).

The inhabitants of agricultural environments may have a positive or negative perception of wildlife (e.g. birds of prey). If it is negative, conflict may be generated. Perceptions of wildlife have been studied as a way of understanding these conflicts (e.g. Mankin *et al.* 1999, Zinn & Pierce 2002, Woodroffe *et al.* 2005, Graham *et al.* 2005). According to Decker & Chase (1997), there are many situations marked by an urgent and growing demand to reduce conflicts between people and wildlife. These authors suggest that conflict occurs when: (a) people's behaviour causes negative impacts on wildlife (including impacts on the habitat), (b) the behaviour of wild species generates a negative impact, or is perceived by people as adverse, and (c) the behaviour of certain people towards wildlife creates a negative situation in others.

In 2002 we started a bird of prey conservation programme in central and southern Chile, focusing our first field studies on implementing initiatives for the biological control of rodents by using barn owls (*Tyto alba* (Scopoli, 1769)) (Muñoz-Pedreros *et al.* 2010). However, we had no information on the level of knowledge and perception among local populations about birds of prey and their role as biological controllers. Our first hypothesis was that birds of prey suffer a negative perception among the rural and urban inhabitants of southern Chile, aggravated by a low level of knowledge about these species and their environmental role. The second hypothesis was that there are differences, of knowledge and perception, between rural and urban inhabitants. The objective of this work was to determine perceptions and knowledge of birds of prey among rural and urban communities in Southern Chile, and their implications for the development of a biological control programme.

MATERIALS AND METHODS

STUDY AREA

The study sites were seven rural villages and two towns in the district of Panguipulli (39°38'40" S, 72°19'50" W)

(Table 1), in Los Ríos Region, southern Chile. The area of the district is 3,332 km², with abundant rivers and lakes. It has a wet temperate climate with mediterranean influence and intense precipitation in winter. The presence of glacial beds has led to the existence of lakes which regulate river flows, while the climatic conditions maintain the humidity necessary for large tracts of native forest. The predominant land uses are livestock farming and forestry, especially plantations of the exotic species *Pinus radiata* (D. Don) and *Eucalyptus globulus* (Labill). The district of Panguipulli has a population of 33,273 inhabitants, with a high degree of rural residence (52.3%) and low population density (10.1 inhabitants per km²). A large proportion of the population (38.5%) is indigenous, belonging to the Mapuche ethnic group (higher than the proportion in the country as a whole which is 3.7%). The literacy rate in the district is 72.0% (INE 2002).

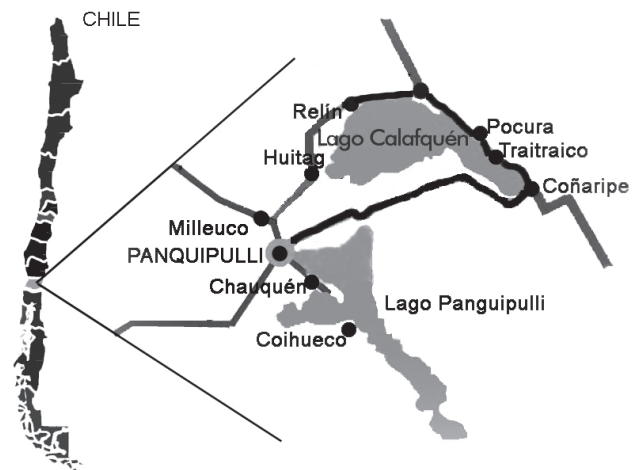


Figure 1. Study sites in Southern Chile. / Área de estudio en el sur de Chile.

RESEARCH METHODS

To determine knowledge on the two topics (birds of prey and biological control) a closed questionnaire was applied with 27 questions (two alternatives or multiple choice), with unidirectional graduation, and including general information on the respondent.

To determine perception of these topics, a descriptive survey was applied to measure qualitative variables. This took the form of a Likert (1967) attitude survey with 36 items, half of which had a favourable slant (positive item) and the other half unfavourable (negative item). The Likert scale was constructed with following the phases described in Briones (2003): (a) nominal definition of the attitude or variable to be measured, (b) compilation of items, (c) determination of points given to the item categories, (d) application of the provisional scale to an appropriate sample

and calculation of the individual scale points, (e) analysis of the items used in order to eliminate inappropriate items, (f) hierarchical categorisation of the scale, and (g) calculation of the validity and reliability of the scale. Validity and reliability were assessed, understanding validity to be the real ability of the scale to measure what it is intended to measure, and reliability to be that afforded by the scale in terms of producing equal or similar results in successive applications to the same groups in similar situations. Both factors were calculated using SPSS software Version 13. The survey used five numbered positions as follows: Strongly agree – Agree – Don't know – Disagree – Strongly disagree. In assigning points to each item, a very simple scoring system was adopted in which the responses to each statement were marked from 1 to 5. In favourable statements, the value 5 was assigned to the position "Strongly agree" and 1 to the position "Strongly disagree"; in unfavourable statements, the value 5 was assigned to the position "Strongly disagree" and 1 to the position "Strongly agree". The statements were grouped by the composition of the survey variables (dimensions) in order to analyse the total score for the answers.

The Likert (1967) scale was used because it is oriented towards the measurement of attitudes and perceptions; it is easier to evaluate than other methods and provides acceptable levels of reliability (Smith-Sebasto & D'Costa 1995; Morales 2000). From an arithmetical point of view, the Likert scale is a sum scale: the score or measurement of each person's attitude to the issue surveyed is obtained from the sum of their answers to various questions which act as stimuli.

The scale items or propositions are the stimuli to which the respondents react in one way or another. These scale elements, propositions or items not only expose and specify attitudes, they also facilitate observation of these generic and abstract attitudes by subdividing them into concrete, qualitative features and attributes. To transform them into instruments for quantitative measurements, they were quantified following Sierra (1994). The requirement for discrimination implied that the items had to be stimuli with discriminating power, capable of distinguishing and dividing persons, even at opposing extremes, for the perception surveyed. To determine the sample size, the study followed Fox (1987); the sample used in this study was sufficiently big to be representative. The instruments were designed for a homologous study in 2003 in southern Chile, and subsequently refined and validated. The sample sizes were estimated in advance using the statistical programme STATSTTM with calculation of the existing error (see Hernández *et al.* 1998). The estimated minimum

size was 250 samples, and 403 instruments (surveys and questionnaires) were applied between 2005 and 2006. The perceptions of the study groups were analysed using the XLSTAT programme, version 7.5.2.

The rural inhabitants of the villages (Fig. 1) formed a stratified sample of persons aged between 22 and 80 years, all beneficiaries of a local development programme for the district. This development programme includes 56.4% of the rural population of these villages. The confidence level of the sample was 90% in the survey, with a standard error of 7%; in the questionnaire the confidence level was 95% with an admissible error of 6%. Age ranges: 12.5% of the sample were young people (15-29), 60.4% were adults (30-59) and 27.1% senior citizens (>60 years). The sex ratio was 1:2 in favour of women. The principal economic activities were farming (67.6%) and household work (54.5%). In terms of education, 46.4% had not completed primary education, and only 7.3% had completed secondary education.

For urban inhabitants, a chance random sample was taken, where the survey had a confidence level of 90% and a standard error of 10%, and the questionnaire a confidence level of 90% and standard error of 6.9%. The age range was between 18 and 71 years, with 20% young people (15-29), 50% adults (30-59) and 30% senior citizens (>60 years). The sex ratio was 1:2 in favour of women. The predominant economic activities were commerce (51.4%) and household work (21.8%). The education levels were 18.7% with complete primary education, 54.7% with secondary education and 26.6% with higher education.

The piloting process was conducted with pre-testing of both instruments. Before the instruments were applied, the concepts involved in the study (e.g. birds of prey, biological control) were defined and explained; during application the respondents were shown drawings and photographs of the birds of prey which could be observed in the study area, to ensure that less educated participants understood the questions correctly. The answers were given orally, in face-to-face interview form, and the interviewer ticked the preferences on the survey form.

RESULTS

A total of 25 species of birds of prey were considered for the study area, five nocturnal and twenty diurnal. Knowledge of the diversity of birds of prey in rural inhabitants was low, with 50% knowing fewer than five species. Among urban inhabitants, 61.9% said that they know fewer than five species and only 4.3% more than 10 species (Table 1).

TABLE 1. Knowledge about birds of prey in rural and urban inhabitants in Southern Chile. 2006. (Values expressed in %). / Conocimiento de aves rapaces en habitantes rurales y urbanos del sur de Chile. 2006. (Valores expresados en %).

	RURAL INHABITANTS										URBAN INHABITANTS		
	PUCURA	HUITAG	TRAITRAICO	CHAUQUÉN	RELIN	MILLEUCO	COIHUECO	TOTAL RURAL	PANGUIPULLI	COÑARIPE	TOTAL URBAN		
Knowledge	39°30'43"S 72°03'45"W	39°31'59"S 72°18'32"W	39°32'59"S 72°01'54"W	39° 40' 46"S 72° 18' 30"W	39° 30' 23"S 72° 16' 35"W	39° 29' 24"S 72° 16' 50"W	39°38'39"S 72°12'32"W	39°38'00"S 72°20'00"W	39°34'11"S 72°00'15"W				
Number of species of birds of prey identified													
< 5	50.9	52.4	41.7	37.5	66.7	80	38.9	50.0	64.5	56.5	61.9		
> 5	45.5	47.6	50	56.3	33.3	20	50	45.7	29	43.5	33.8		
> 10<14	3.6	0	0	0	0	0	11.1	2.9	6.5	0	4.3		
> 15	0	0	0	0	0	0	0	0	0	0	0		
Species erroneously considered as birds of prey													
<i>Egretta thula</i>	10.9	14.3	8.3	0.0	0.0	20.0	11.1	10.1	6.5	0.0	4.3		
<i>Fulica armillata</i>	10.9	9.5	8.3	0.0	0.0	0.0	11.1	8.0	6.5	0.0	4.3		
<i>Plegadis chihui</i>	12.7	38.1	16.7	6.3	0.0	0.0	27.8	16.7	17.2	50.0	28.1		
<i>Megaceryle torquatus</i>	50.9	42.9	41.7	18.8	33.3	50.0	50.0	44.2	17.2	21.7	18.7		
<i>Cygnus melancorhyphus</i>	9.1	23.8	41.7	6.3	0.0	0.0	27.8	15.2	23.7	13.0	20.1		
<i>Sterna</i> spp.	20.0	19.0	16.7	25.0	0.0	10.0	27.8	19.6	11.8	10.9	11.5		
Nesting sites of some species of birds of prey													
RUFIOUS LEGGED OWL													
Correct	23.6	38.1	50	75	0	33.3	32.6	17.2	30.4	21.6	27.1		
Wrong	10.9	9.5	8.3	12.5	50	27.8	15.9	6.5	21.7	11.5	13.7		
Don't know	65.5	52.4	41.7	12.5	50	38.9	51.5	76.3	47.8	66.9	59.2		

BARN OWL													
Correct	10.9	0	16.7	0	0	0	0	0	5.8	11.8	19.6	14.4	10.1
Wrong	47.3	52.4	58.4	81.4	66.7	40.0	72.2	56.6	58.0	39.1	39.1	51.7	54.1
Don't know	41.8	47.6	25	18.8	33.3	60	27.8	37.7	30.1	41.3	41.3	33.8	35.7
BURROWING OWL													
Correct	49.1	62.7	52	68.6	60.3	73.6	54.7	56.7	64.5	37	37	55.4	56.0
Wrong	16.4	0	0	0	0	20	11.1	9.4	17.2	19.6	19.6	18.0	13.7
Don't know	34.5	37.3	48	31.4	39.7	6.4	34.1	33.9	18.3	43.5	43.5	26.6	30.2
AUSTRAL PYGMY OWL													
Correct	60	33.3	41.7	43.8	100	40	55.6	52.2	11.8	19.6	19.6	14.4	33.2
Wrong	3.6	19.1	0.0	25.1	0.0	20.0	38.9	13.8	35.5	19.5	19.5	30.2	22.0
Don't know	36.4	47.6	58.3	31.3	0	40	5.6	34.1	52.7	60.9	60.9	55.4	44.8
Total surveys	55	21	12	16	6	10	18	138	93	46	46	139	277

Diurnal birds of prey were better known than nocturnal ones by rural inhabitants (60.1% vs. 45.7%); the following were the best-known (in descending order): *Parabuteo unicinctus* (Temminck, 1842) Harris’s hawk (88.4%), *Milvago chimango* (Vieillot, 1816) Chimango caracara (86.2%) and *Caracara plancus* (Miller, 1777) Southern caracara (82.6%). The best-known nocturnal species were *T. alba* (73.2%), *Glaucidium nana* (King, 1828) Austral pygmy owl (58.7%), *Strix rufipes* King, 1828 Rufous legged owl (47.1%) and *Asio flammeus* (Pontoppidan, 1763) Short-eared owl (3.6%). Among urban inhabitants also, diurnal raptors were more frequently mentioned than nocturnal ones (47.0% vs. 38.3%). The best known of the former being (in descending order): *P. unicinctus* Harris’s hawk (71.2%), *M. chimango* Chimango caracara (59.7%), *C. plancus* Southern caracara (58.3%), *Geranoaetus polyosoma* Variable hawk (54.7%) and *Athene cunicularia* (Molina, 1782) Burrowing owl (51.8). The best-known nocturnal species were *G. nana* (51.1%), *T. alba* (50.4%), *S. rufipes* (43.9%) and *A. flammeus* (7.9%).

Rural inhabitants erroneously classified the following as raptors: *Megaceryle torquata* (Linnaeus, 1766) Ringed kingfisher (44.2%), *Sterna* spp. terns (19.6%), *Plegadis chihi* (Vieillot, 1817) White-faced ibis (16.7%), *Cygnus melancoryphus* (Molina, 1782) Black-necked swan (15.2%), *Egretta thula* (Molina, 1782) Snowy egret (10.1%) and *Fulica armillata* Vieillot, 1817 Red-gartered coot (8.0%). Among urban inhabitants classification errors were generally lower (14.5% versus 19%), with the following mistakes: *P. chihi* (28.1%), *C. melancorhyphus* (20.1%), *M. torquatus* (18.7%), terns (11.5%), *E. thula* (4.3%) and

F. armillata (4.3%). There was great ignorance with respect to the nesting sites of raptors among both rural (73.2%) and urban inhabitants (73.6%), except for *A. cunicularia* and *G. nana*.

The perception of birds of prey in the largest proportion of rural inhabitants was positive (47.2%), higher than negative (31.9%) and neutral perceptions (16.7%) (Table 2). In almost all areas there was an intention to take care of these birds; however this was contradicted by the wish to kill Harris’s hawks (75.7%), justified by predation of farmyard fowls. 76.7% of the participants believe that birds of prey are beneficial because they eat rodents.

The majority of urban inhabitants have a positive perception of birds of prey (65.6%) (Table 2) and expressed a desire to protect and not to harm them (70.3%), although 26% consider them predators of farmyard fowl. Even so, 21.6% do not find that a justification for eliminating them, and 88.9% believe they are beneficial because they consume rodents.

Among rural inhabitants there is a superstitious perception of these birds (> 55%), although only 22.1% state that they “bring bad luck”. Of this population, 59.2% claim to have seen or heard a “tuetué” (a mythological bird associated especially with *S. rufipes*), and the majority recognise it as evil (56%). Among urban inhabitants, perceptions vary: in Coñaripe only a minority (< 22%) associate these birds with ill-omen or evil, while in Panguipulli the superstitious perception is even higher than in rural locations (> 59%); this difference is significant (in a z-test for two proportions with $\alpha = 0.05$, $p < 0.0001$).

TABLE 2. Perception of birds of prey in rural and urban inhabitants in Southern Chile. 2006. (Values expressed in %). / Percepción de aves rapaces en habitantes rurales y urbanos del sur de Chile. 2006. (Valores expresados en %).

	RURAL LOCATIONS					TOWNS			TOTAL URBAN
	TRAITRAICO	HUITAG	RELÍN	MILLEUCO	COIHUECO	TOTAL RURAL	COÑARIPE	PANGUIPULLI	
PERCEPTION OF BIRDS OF PREY									
Positive perception	61.4	52.9	39.6	35.0	47.2	47.2	66.3	64.8	65.6
Negative perception	21.6	29.4	43.8	28.8	36.1	31.9	20.2	16.4	18.3
Neutral perception	17.0	17.6	16.7	36.3	16.7	20.9	13.5	18.8	16.2
PERCEPTION OF BIOLOGICAL CONTROL									
Positive perception	76.4	44.7	43.3	62.0	60.0	57.3	65.4	68.4	66.9
Negative perception	16.4	22.4	43.3	20.0	33.4	27.3	22.3	14.2	18.3
Neutral perception	7.3	32.9	13.3	18.0	5.6	15.4	12.3	17.4	14.9

Knowledge of biological control is high among rural and urban inhabitants. The majority know that raptors consume rodents (84.4% in rural and 82.7% in urban inhabitants) and rabbits (61.3% rural and 61.6% urban). The majority of rural (72.1%) and urban inhabitants (61.6%) perceive that there are more rodents in the environment, detect their presence around their houses (73.0% rural and 24.7% urban) and control them with poison, despite the fact that the majority believe that barn owls die from eating poisoned rodents (90.8% rural and 79% urban). The perception of biological control was positive (57.3% in rural inhabitants and 66.9% in urban), 14.5 and birds of prey are considered to be pest controllers (Table 2).

DISCUSSION

Knowledge of birds of prey is low in both rural and urban inhabitants; only 10 of the 25 species documented for this zone were recognised. The most familiar species include *P. unicinctus*, *C. plancus* and *M. chimango*, which were the most noticeable and abundant. Nocturnal species are less known, being more difficult to sight (e.g. *S. rufipes*, *T. alba*). Their natural history, except for a few species, was unknown (e.g. reproduction, diet and habitat). The low level of knowledge of birds of prey among rural inhabitants was recorded in a similar study done in 2001 (Muñoz-Pedrerros 2019).

The perception of birds of prey in urban and rural locations was positive among the majority, with people clearly interested in protecting them, even if they are not doing so. In some locations this contradicts the general perception; this may be explained by the fact that there is no desire to protect some species perceived as harmful (e.g. Harris's hawk *P. unicinctus*). Despite this positive perception, the majority put down poison to eliminate rodents, although they know that this will have the collateral effect of eliminating birds of prey. Harris's hawk is identified as a harmful animal; however, its common name "peuco" is applied to various species of raptor, and therefore the negative perception extends to other species considered predators of farmyard fowls. Other studies have shown that, in general, the negative attitude of rural inhabitants to birds of prey is rooted in their predation of farmyard fowls, with a small percentage indicating that they are of evil omen or bring bad luck (Muñoz-Pedrerros 2018). Vera (2017) documented that urban inhabitants surveyed in Santiago, Chile, presented a low level of knowledge about birds, although their perception was positive. In the case of the barn owl, perception among the urban inhabitants of the city of Valdivia was positive for non-utilitarian, aesthetic and ethical reasons (Godoy *et al.* 2017). In a rural locality in southern Chile, Silva-Rodríguez (2006) reported that the inhabitants generically group several species as Harris's

hawk and consider them harmful because of their alleged predation on poultry; they also have a negative perception of the Rufous legged owl, which they consider a bad omen.

Negative perceptions of certain species of wildlife may be explained by: (a) they are considered pests, like *Puma concolor* (Linnaeus, 1771) (Verdade & Campos 2004; Lucherini & Merino 2008); *Lycalopex culpaeus* (Travaini *et al.* 2000; Lucherini & Merino 2008; García *et al.* 2010), *Lycalopex griseus* (Silva-Rodríguez *et al.* 2009), *Leopardus jacobitus* (Lucherini & Merino, 2008), *Canis lupus* (Treves *et al.* 2004); (b) superstitious fear because they are considered to be of ill omen (Waag 1982); and (c) fear of animals either perceived as potentially dangerous, like bats (Davey *et al.* 1998, Prokop & Tunnicliffe 2008), or because of their repulsive appearance, like snakes and worms (Prokop *et al.* 2009), or because of association with dirt and disease, like spiders.

Some raptor species in Chile suffer a negative perception for the first two reasons. Rural and urban inhabitants believe in mythological beings of zoomorphic appearance associated with bad luck and death. In the indigenous Mapuche culture, the concept of "wekufü" identifies the forces of evil and the material cause of disease; it is also the generic spirit of evil and more specifically the diabolic (Métraux 1973, Grebe 197, Waag 1982, Casanova 1994). Other authors (Schindler 1988) suggest that "wekufü" became more feared and negative due to Spanish colonial influence, through syncretism with the Christian notion of the devil. "Kalku" are witches who cause disease and death; they are feared, hated and segregated, and the community suffers from their actions (Coña 1984). "Wekufü" and "kalku" are responsible for disaster, disease and death (Grebe 1975). A powerful "wekufü" for the Mapuche was the "chonchón" or "tuetué", the head of a "kalku" which flew through the night using its enormous ears as wings. It is the wandering spirit of the malevolent witch, who removes her head to fly in search of her victim. Thus for the Mapuche all birds of nocturnal habits are ill-omened (Aukanaw 2004). Miguel de Olivares (1864) described this superstition recorded in around 1770: "... the passage of large bird over the house means that a witch has come to smite them. The "chonchón" is an owl-like bird in form and colour, which abhors the light, sings in the night and never lives in the villages... the indigenous treat them superstitiously as chimeras." Thus the "chonchón" is the archetypical bird which announces the negative (Aukanaw 2004).

Among rural inhabitants, knowledge about biological control is high, since the majority know that raptors consume species which are disease reservoirs and pests (e.g. rodents and rabbits). The perception recorded agrees with the levels of knowledge detected, i.e. it is recognised that raptors control pests and clean up the environment.

Considering that perceptions are learnt and underlying, techniques can be applied to produce a change in perceptions

which can translate into a change in attitudes. The rural inhabitants of the study area lack specific knowledge; if this existed, it might reduce the percentage of people who have a negative perception of birds of prey and their role.

Thus, environmental educators should balance contents, design suitable ways of transmitting them, and suit their language and time to the socio-cultural reality of the target population, in this case country-dwellers in southern Chile (Solano 2001). Discussing the best way to deliver this information to the public, Bath (2000) indicates that if it is desired to achieve a change in attitude towards target species through effective and efficient communication and public education campaigns, better understanding is needed of the system of beliefs and the fundamental factors affecting attitudes. As Sherif & Sherif (1978) say, attitudes are not psychologically self-generated; they are formed or learnt in relation to identifiable references, whether taken from persons, groups, institutions, objects, values, social concerns or ideologies.

Once this change in perception has occurred, it will facilitate management activities oriented towards wildlife (e.g. barn owls), causing a positive impact due to the proximity between this species and the human population with which it shares its habitat (c.f. Ojasti 2000; Meyrom *et al.* 2009).

In this study no contradictions were detected between the known and the perceived, although these two dimensions are not always in agreement. Thus the diagnosis made on the basis of the knowledge and perception of the inhabitants of the study site supports our assertion that there is a need to carry out conservation campaigns for birds of prey which are threatened (e.g. *S. rufipes*), or whose habitat is degraded (e.g. *T. alba*); and to implement biological control strategies against rodent pests.

Negative contacts between humans and wildlife are frequent, because human populations and urban boundaries are expanding, threatening wildlife in general and birds of prey in particular (Birdlife International 2000). These negative interactions should stimulate research into human attitudes towards the target species, contribute to management plans (see Sillero 2000, Travaini *et al.* 2000) and be addressed in environmental education programs. Studies of changes in attitude, the final goal of studies on environmental knowledge and perception, will help to conceptualise the affective, cognitive and behavioural factors in attitudes. It is therefore important to have conceptual frameworks which integrate the ecological dimension with the social, the economic and the cultural, in order to resolve conflicts between human beings and wildlife (see White *et al.* 2009). For example, if rural inhabitants clearly identified the species of birds of prey of which they have a negative perception (e.g. Harris's hawk, Rufous legged owl), this might reduce pressure on other species that are not a source of conflict with humans.

ACKNOWLEDGMENTS

The authors thank C. González and P. Contreras for their assistance at various stages of field work. This work was supported financially by the World Bank Development Marketplace through the project "Barn owls reinforce rural tourism in Southern Chile" (DM 05-5195), granted to the Centro de Estudios Agrarios y Ambientales (CEA).

REFERENCES

- AUKANAW, M. 2004. La ciencia secreta de los mapuches. Biblioteca Nueva Era Rosario, Argentina.
- BATH, A. 2000. Human dimension in wolf management in Savoie and des Alpes maritimes, France. Report for France life-nature project and the large carnivore initiative project for Europe. Memorial University of Newfoundland, St. Johns, Canada.
- BIRDLIFE INTERNATIONAL. 2000. Threatened birds of the world. Barcelona and Cambridge, UK: Lynx Editions and Birdlife International.
- BRIONES, G. 2003. Métodos y técnicas de investigación para las ciencias sociales. Editorial Trillas, Ciudad de México.
- CASANOVA, H. 1994. Diablos, brujos y espíritus maléficos. Chillán, un proceso judicial del siglo XVIII. Ediciones Universidad de la Frontera, Temuco.
- COÑA, P. 1984. Testimonio de un cacique mapuche. Pehuén Editores, Santiago de Chile.
- DAVEY, G.C.L., McDONALD, A.S., HIRISAVE, U., PRABHU, G.G., IWAWAKI, S., JIM, C.I., MERCKELBACH, H., DE JONG, P.J., LEJNY, P.W.L., REIMANN, L. 1998. A cross-national study of animal fears. Behaviour Research and Therapy 36(7-8):735-750.
- DE OLIVARES, M. 1864. Historia militar, civil y sagrada del reino de Chile. Colección de Historiadores de Chile (1ª edición 1760. Imprenta El Ferrocarril, Santiago de Chile.
- DECKER, D.J., CHASE, L.C. 1997. Human dimensions of living with wildlife, a management challenge for the 21st century.
- FELDMAN, R. 1999. Psicología. Mc Graw Hill, México D.F
- FOX, D.J. 1987. El proceso de la investigación en educación. Universidad de Navarra, Pamplona.
- GARCÍA, A., ZAPATA, S.C., PROCOPIO, D.E., MARTÍNEZ, R., TRAVAINI, A. 2010. Evaluación del interés de productores ganaderos en el control selectivo y eficiente de predadores en la Patagonia Austral. Acta Zoológica Mexicana 26(2):303-321.
- GIGLIOTTI, L.M., DECKER, D.J. 1992. Human dimensions in wildlife management education: pre-service opportunities and in-service needs. Wildlife Society Bulletin 20:8-14.
- GILG, O., HANSKI, I., SITTLER, B. 2003. Cyclic dynamics in a simple vertebrate predator-prey community. Science 302:866-868.
- GODOY-GUINAO, J., DÍAZ, I.A., LLANOS-PINEDA, M., ALO, D. 2017. 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. Gayana 81(1):9-16.
- GRAHAM, K., BECKERMANA, A.P., THIRGOODA, S. 2005. Human-

- predator-prey conflicts: Ecological correlates, prey losses and patterns of management. *Biological Conservation* 122(2):159-171.
- GREBE, M.E. 1975. Taxonomía de enfermedades mapuches. *Nueva Época* 2:27-39.
- HANSKI, I., HENTTONEN H., KORPIMAKI E., OKSANEN L., TURCHIN P. 2001. Small rodent dynamics and predation. *Ecology* 82:1505-1520.
- HERNÁNDEZ, R., FERNÁNDEZ, C., BAPTISTA, P. 1998. Metodología de la investigación. 2da. Edición. Editorial McGraw Hill, Ciudad de México.
- INE. 2002. Comisión Nacional del XVII censo de población y VI de vivienda. Instituto Nacional de Estadísticas, Santiago, Chile.
- KORPIMÄKI, E., NORRDAHL, K., KLEMOLA, T., PETTERSEN, T., STENSETH, N.C. 2002. Dynamic effects of predators on cyclic voles: Field experimentation and model extrapolation. *Proceedings of the Royal Society B-Biological Sciences* 269:991-997.
- KORPIMÄKI, E., NORRDAHL, K., RINTA-JASKARI, T. 1991. Responses of stoats and least weasels to fluctuating food abundances: Is the low phase of the vole cycle due to mustelid predation? *Oecologia* 88:552-561.
- LIKERT, R. 1967. Una técnica para medir actitudes. 182-193 pp. Editorial Trillas, México.
- LUCHERINI, M., MERINO, M.J. 2008. Perceptions of human-carnivore conflicts in the High Andes of Argentina. *Mountain Research and Development* 28:81-85.
- MANFREDO, M.J., VASKE, J.J., BROWN, P.J., DECKER, D.J., DUKE, E.A. 2008. *Wildlife and Society: The Science of Human Dimensions*. Island Press.
- MANKIN, P., WARNER, R., ANDERSON, W. 1999. Wildlife and the Illinois public: A benchmark study of attitudes and perceptions. *Wildlife Society Bulletin* 27:465-472.
- MATLIN, M., FOLEY, H. 1996. *Sensación y percepción*. Prentice Hall, México D.F.
- METRAUX, A. 1973. *Religión y magia indígenas de América del Sur*. Ediciones Aguilar, Madrid.
- MEYROM, K., MOTRO, Y., LESHEM, Y., AVIEL, S., IZHAKI, I., ARGYLE, F., CHARTER, M. 2009. Nest-Box use by the Barn Owl *Tyto alba* in a Biological Pest Control Program in the Beit She'an Valley, Israel. *Ardea* 97(4):463-467.
- MORALES, P. 2000. *Medición de actitudes en psicología y educación*. Universidad Pontificia de Comillas, ICAI-ICADE. Madrid, España.
- MUÑOZ-PEDREROS, A. 2019. Educación ambiental y control biológico con aves rapaces. In: Muñoz-Pedrerós, A., Rau, J., Yáñez, J. (Eds.) *Aves Rapaces de Chile*. 505-520 pp. CEA Ediciones, Valdivia, Chile.
- MUÑOZ-PEDREROS, A., MURÚA, R. 1990. Control of small Mammals in a pine plantation (Central Chile) by modification of the habitat on predators (*Tyto alba* Strigiforme and *Pseudalopex* spp Canidae). *Acta Oecologica Applicata* 11(2):251-261.
- MUÑOZ-PEDREROS, A., GIL, C., YÁÑEZ, J., RAU, J. 2010. Raptor habitat management and its implication on the biological control of the Hantavirus. *European Journal of Wildlife Research* 56(5):703-715.
- OJASTI, J. 2000. Manejo de Fauna Silvestre Neotropical. In: Dallmier, F. (Ed.) *SIMAB Series No. 5*. Washington, D.C.: Smithsonian Institution/MAB Program.
- OVIEDO, J. 2004. La definición del concepto de percepción en psicología con base en la teoría Gestat. *Revista de Estudios Sociales* 18:89-96.
- PÁLVI, S., BANKS, P.B., DICKMAN, C.R., KORPIMÄKI E. 2010. Predator manipulation experiments: impacts on populations of terrestrial vertebrate prey. *Ecological Monographs* 80:531-546.
- PROKOP, P., TUNNICLIFF, S.D. 2008. Disgusting animals: Primary school children's attitudes and myths of bats and spiders. *Eurasia Journal of Mathematics, Science and Technology Education* 4(2):87-97.
- PROKOP, P., ÖZEL, M., UŞAK, M. 2009. Cross-Cultural Comparison of Student Attitudes toward Snakes. *Society and Animals* 17:224-240.
- SCHINDLER, H. 1988. Pillán 3. *Actas de lengua y literatura mapuche* 3, 183-204. Temuco, Chile.
- SHERIF, M., SHERIF, C.W. 1978. La actitud como la categoría personal del individuo: el enfoque de implicación y juicio social de la actitud y del cambio de actitud. In: Summers, G. (Ed.), *Medición de actitudes* (pp. 361-387). Editorial Trillas, Ciudad de México.
- SIERRA, R. 1994. *Técnicas de investigación social: teoría y ejercicios*. Editorial Paraninfo, Madrid.
- SILLERO, C.L. 2000. Resolución de conflictos entre los grandes carnívoros y el hombre. *Mastozoología Neotropical* 7:69-72.
- SILVA-RODRÍGUEZ, E., ORTEGA-SOLÍS, G., JIMÉNEZ, J. 2006. Aves silvestres: actitudes, prácticas y mitos en una localidad rural del sur de Chile. *Boletín Chileno de Ornitología* 12: 2-14.
- SILVA-RODRÍGUEZ, E.A., SOTO-GAMBOA, M., ORTEGA-SOLÍS, G.R., JIMÉNEZ, J. 2009. Foxes, people and hens: human dimensions of a conflict in a rural area in southern Chile. *Revista Chilena de Historia Natural* 82:375-386.
- SMITH-SEBASTO, N.J., D' COSTA, A. 1995. Designing a Likert-Type Scale to Predict Environmentally Responsible Behavior in Undergraduate Students: A Multistep Process. *The Journal of Environmental Education* 27:14-20.
- SOLANO, D. 2001. Comunicación y Generación de Conciencia Ambiental. *Tópicos en Educación Ambiental* 3(7):52-57.
- TRAVAINI, A., ZAPATA, S.C., MARTÍNEZ, P., DELIBES, M. 2000. Percepción y actitud humanas hacia la predación de ganado ovino por el zorro colorado (*Pseudalopex culpaeus*) en Santa Cruz. *Mastozoología Neotropical* 7:117-129.
- TREVES, A., NAUGHTON-TREVES, L., HARPER, E.K., MLADENOFF, D.J., ROSE, R.A., SICKLEY, T.A., WYDEVEN, A.P. 2004. Predicting human-carnivore conflict: a spatial model derived from 25 years of data on wolf predation on livestock. *Conservation Biology* 18:114-125.
- VERA, P. 2016. El rol del conocimiento, percepciones y conductas en la conservación del patrimonio biológico Estudio de caso de la avifauna urbana de la comuna de San Bernardo, Santiago. Memoria para optar al título de Geógrafa Universidad de Chile.
- VERDADE, L.M., CAMPOS, C.B. 2004. How much is a puma worth? Economic compensation as an alternative for the conflict between wildlife conservation and livestock production in Brazil. *Biota Neotropical* 4:1-4.
- WAAG, E.M. 1982. Tres entidades wekufü en la cultura mapuche.

Editorial Universitaria de Buenos Aires.
WHITE, R.M., FISCHER, A., MARSHALL, K., TRAVIS, J.M.J., WEBB, T.J., DI FALCO, S., REDPATH, S.M., VAN DER WAL, R. 2009. Developing an integrated conceptual framework to understand biodiversity conflicts. *Land Use Policy* 26(2):242-253.

WOODROFFE, R., THIRGOOD, S.J., RABINOWITZ, A. 2005. *People and wildlife: conflict or co-existence?* Cambridge University Press.
ZINN, H., PIERCE, C. 2002. Values, gender, and concern about potentially dangerous wildlife. *Environment and Behavior* 34:239-256.

APPENDIX 1

Knowledge Survey

Name:

Years living in the village:

Date:

Age:

Institution:

1. How many birds of prey do you know?

.... < 5; > 5; > 10; >10.

2. Have you seen birds of prey near your house?

.... You see them all the time; Sometimes; Occasionally; Never

3. Do you think birds of prey are harmful?

.... No; Yes Why?

4. Do you think birds of prey are beneficial?

.... No; Yes Why?

5. Do you know what birds of prey eat? (Mark all the answers which you think apply)

lizards chickens and other farmyard fowl; seeds and fruit; mice; smaller birds; baby lambs; rabbits and hares;

6. Different birds of prey nest in different places, some in trees, some in hollow tree-trunks, others in holes in the ground. Do you know where these species nest?

Rufous-legged owl? Burrowing owl? Barn-owl? Austral pygmy owl?

7. Among the threats faced by these birds are the destruction of the environments where they nest and dying from eating poisoned animals. How do you think you could help to conserve birds of prey?

8. Please put a cross against the birds of prey in this list:

Black vulture; Great egret; Barn-owl; Chilean hawk; Austral pigmy owl; Burrowing owl; Artic tern; Red backed hawk; Red gartered coot; Harris's (Bay-winged) hawk; Southern caracara; Chimango caracara; White-tailed kite; Rufous-legged owl; Short-eared owl; Apolomado falcon; Austral kestrel; White-faced ibis; Osprey; Ringed kingfisher; Black-necked swan;

9. Do you believe that birds of prey bring bad luck?

Yes; No; ...

10. Where do you live?

isolated in the countryside; in the country near other houses; in the village/town; ...

11. Do you think there are more mice now than there used to be?

yes, more than 5 years ago; yes, more than 10 years ago; yes, more than 15 years ago; no, there are no more;

12. Are there mice in your house?

always; sometimes; occasionally; never;

13. How do you keep mice out of your house?

putting down poison; setting traps; cleaning round the house; blocking holes in the house; ... keeping cats; Other;

14. Are there mice in or round your sheds?

always; sometimes; occasionally; never;

16. Do you know how many diseases mice transmit to humans

1; 2; 3; >3;

17. Do you believe that life in the country is more dangerous now than it used to be?

Yes; No;

18. If your answer to the last question was "yes", please say why:

Because there are more people who fall sick; because there are more dangerous diseases now; because there are more mice than

before; other;

19. Which job do you think carries the greatest risk of contracting a disease?

farmwork in the fields; forestry work in native forest; forestry work in pine or eucalyptus plantations; artisanal fishing;

20. Have you ever seen or heard a chonchón or chonchona (Rufous-legged owl)?

Yes;No; It doesn't exist;....

21. If it exists, do you think it is an evil bird?

Yes;No;

22. Have you ever seen or heard a tuetué?

Yes; No; It doesn't exist;

23. If it exists, do you think it is an evil bird?

Yes; No;

24. Are there more mice where there are streams, rivers and lakes?

Yes; No;

25. Do you work in tourism?

Yes; No;

26. Activity:

Farmer; housewife; forestry worker; artisanal fishing; teacher; other;

27. Education.

Did not complete primary school; completed primary school; did not complete secondary school; completed secondary school;

APPENDIX 2

Perception survey

AS= Agree strongly, A= Agree, DK= Don't know, D= Disagree, DS= Disagree strongly

1. The barn-owl eats farmyard fowl.

AS....., A....., DK....., D....., DS.....

2. If there is no forest there are still birds of prey.

AS....., A....., DK....., D....., DS.....

3. The Rufous-legged owl is a messenger of death.

AS....., A....., DK....., D....., DS.....

4. The Harris's (Bay-winged) hawk hunts chickens because humans have taken its habitat. AS....., A....., DK....., D....., DS.....

5. The Rufous-legged owl sometimes flies into your house.

AS....., A....., DK....., D....., DS.....

6. I love to listen to nocturnal birds of prey like different kinds of owls.

AS....., A....., DK....., D....., DS.....

7. The tuetué (Rufous-legged owl) is a nocturnal bird of ill omen.

AS....., A....., DK....., D....., DS.....

8. I take care to protect barn-owls.

AS....., A....., DK....., D....., DS.....

9. When I see a barn-owl in a tree I throw stones at it.

AS....., A....., DK....., D....., DS.....

10. If I could I would take care of birds of prey.

AS....., A....., DK....., D....., DS.....

11. You see fewer birds of prey now than in the past.

AS....., A....., DK....., D....., DS.....

12. When I see a Harris's (Bay-winged) hawk I try to kill it.

AS....., A....., DK....., D....., DS.....

Recibido: 07.03.2018
Aceptado: 29.08.2018