



Report

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Knowledge and perceptions of the southern river otter (*Lontra provocax*), an elusive endangered species in Tierra del Fuego (Argentina)

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Summary

The elusive southern river otter (*Lontra provocax*; *huillín* in Spanish) is critically endangered in the Argentine portion of Tierra del Fuego, and low social awareness may be one of the major threats to its conservation. Our survey of local residents' knowledge and valuation of the *huillín* showed that only 14% recognized photographs of the species, almost half did not know that it is endangered and most erroneously thought it was an introduced species. Greater knowledge about the *huillín* was related to higher respondent education levels. Younger and more knowledgeable residents valued the species more for ecological and relational reasons; its instrumental value was considered least important. More communication should be targeted at older people and groups not directly interacting with nature via informal education methods, including combining positive messages about the *huillín* and other native species with ongoing outreach efforts warning about biological invasions. Understanding perceptions and valuations of biodiversity can make conservation efforts more effective and inclusive.

Introduction

A major challenge for conservation is fostering people–nature relationships, considering that most humans now reside in cities (UN-Habitat 2019) and some species or ecosystems are little known (e.g., Rozzi et al. 2012). This challenge is intensified when seeking to implement participatory strategies (e.g., Convention on Biological Diversity 2022) to staunch biodiversity loss, cultural erosion and the ‘extinction of experience’ with nature (Miller 2005). While the effects of global change on biodiversity and nature's contributions to people (NCP) are well documented (e.g., IPBES 2019), a more complete understanding of the complex social dimensions in this area is necessary to integrate nature's multiple values into decision-making for more just and sustainable futures (Pascual et al. 2023). Sociocultural valuations can help to engage stakeholders and society by improving understanding regarding their perceptions of species and NCP and their attitudes towards management options (Scholte et al. 2015).

Despite being promoted as a unique ‘wilderness area’ (Rozzi et al. 2012), Patagonia and Tierra del Fuego (TDF) are subject to direct and indirect anthropogenic impacts, including invasive introduced species (Valenzuela et al. 2014) and highly urbanized populations (INDEC 2022). Multiple social imaginaries have converged for centuries in Patagonia, but these social dimensions have been largely absent from the predominant discourse on how Patagonia's nature is studied and managed (e.g., Archibald et al. 2020, Anderson et al. 2023). Consequently, TDF is more appropriately considered both a ‘social’ and ‘natural’ laboratory for investigating global change (Valenzuela et al. 2014, Mrotek et al. 2019).

We examined perceptions of the southern river otter (*Lontra provocax*; *huillín* in Spanish), an elusive endangered species endemic to Patagonia (38–55°S; Sepúlveda et al. 2021). In Argentina, this species is only found in certain freshwater ecosystems in northern Patagonia, including watersheds within and around Nahuel Huapi and Los Alerces National Parks (Valenzuela et al. 2019, Fasola et al. 2021). In southern Argentina, the species is represented by a critically endangered coastal marine population in TDF (Valenzuela et al. 2019). While otters often evoke empathy for conservation (Stevens et al. 2011), people's awareness of them is crucial for any protection effort (Verissimo et al. 2014), and understanding the *huillín*'s social dimensions is key to implementing an Argentine–Chilean conservation plan (Sepúlveda et al. 2018).



Experts have identified a lack of social awareness as a principal threat to this otter (Valenzuela 2019), and there is currently little information available regarding how this species is perceived in southern Patagonia (Pozzi & Ladio 2023). Our research exceeds previous studies by investigating knowledge and valuations of southern river otters. Using a sociocultural valuation framework (Scholte et al. 2015), we hypothesized that perceptions of residents from Ushuaia (the capital city of TDF) would be related to their knowledge of the otter and the threats it faces, sociodemographic characteristics (including connection with nature) and attitudes towards conservation. We predicted that respondents with a greater formal education and a closer connection with nature would be more knowledgeable regarding this species, and, along with greater appreciation for conservation, these variables would produce an increased valuation of the species.

Methods

Study site

The study was conducted in Ushuaia (population ~80 000; INDEC 2022), the capital city of the Argentine province of TDF and home to approximately half the province's population. TDF has very high levels of urbanization (~98% of the population) and immigration/emigration (>50% of the population being born elsewhere in Argentina or abroad; INDEC 2022) due to exponential growth since the implementation of tax and labour benefits for industries in 1972 (van Aert 2013).

Survey design

The survey assessed respondents' sociocultural valuations of the southern river otter. To enhance the survey's relevance and legitimacy for decision-making, we incorporated findings from the bi-national meeting for the conservation of the species (Valenzuela 2019), combining a conceptual framework (Scholte et al. 2015) and practical considerations (Valenzuela 2019), to develop a 14-question survey (Appendices S1 & S2). The questionnaire had five analytical axes: connection with nature; attitude towards conservation; knowledge about the species and its context, including 'favourite' species and habitats; valuation of benefits perceived from the otter; and respondent sociodemographics.

Connection with nature was measured through frequency of visits to protected areas (daily, weekly, monthly, yearly or never) and professional/workplace relationships with nature (education and tourism sectors). Attitude towards conservation was assessed by level of support for conservation strategies and the assessed importance of conservation in their voting preferences (Likert scale: 0 = 'none' to 4 = 'a lot'). To evaluate perceptions of biodiversity, participants freely listed their favourite three animals and chose from a list their two favourite habitats in TDF. Knowledge regarding southern river otters was tested via questions related to recognition of the species (photographs), origins of the species (native), the species' habitat (coastal marine in TDF, rivers/lakes in northern Patagonia), the species' conservation status (TDF's population is critically endangered; the species is endangered overall) and recognition of the threats facing the species identified by experts in the bi-national Argentine-Chilean meeting (top three: salmon farming; lack of social awareness/knowledge; and unregulated tourism; Valenzuela 2019). Sociocultural valuations of the *huillín* were based on its perceived ecological, instrumental, intrinsic and relational benefits (Likert

scale: 0 = 'none' to 4 = 'a lot'). Additionally, gender, age and level of education were recorded.

Sampling

A total of 395 questionnaires were completed by Ushuaia residents between January and March 2023, surpassing the representative sample size of 383 for this city's population ($n = 82\ 615$, 95% confidence interval (CI) = $95\% \pm 5\%$). Sites were chosen to sample heterogeneous social strata, including the city's principal commercial areas and various public flea markets. Every third passerby was asked to participate after explaining the project's informed consent policy (Appendix S3). Only individuals of legal age (≥ 18 years) were considered, and basic demographic data (observed age group and gender) were recorded for those who did not participate (Table S1). Surveys were conducted by two-person teams who underwent training to ensure uniformity in the application of the questions.

Data analysis

Survey responses were digitized and anonymized. Descriptive statistics were used for comparison, including demographic information, visits to protected areas and influence of conservation on voting. Binomial categorical variables (except for gender) were converted into numerical values for statistical analyses, and Likert-scale responses were scored from 'no importance' (0) to 'a lot of importance' (4). Visits to natural areas were standardized over a 1-year period (0, 1, 12, 54, 365 days), and occupations were categorized as either 'unrelated' (0) or 'related' (1).

Total knowledge was aggregated from 0 to 5 based on five questions that each contributed up to 1 point. For each question, answering correctly for the TDF *huillín* population got a full point (1); answering in a way that applied to the species in general but not to TDF was considered partially correct (0.5). For example, identifying the photograph as '*huillín*' scored 1, but identifying it as 'otter' scored 0.5. Those who answered incorrectly or did not know received 0 points. This same logic was used to score knowledge about the species' habitat and conservation status. For threats, respondents were awarded points based on the level of coincidence between their answers and the top three expert-identified threats, whereby 3 out of 3 = 1, 2 out of 3 = 0.66, 1 out of 3 = 0.33 and 0 out of 3 = 0. To assess the four valuation questions, a Likert scale was also utilized (0–4). The 'total valuation' score was the aggregate of these scores (maximum = 16).

Relationships between survey variables were analysed using generalized linear models (GLMs) in R version 4.2.3 (R Development Core Team 2023). Two GLMs were constructed: one with knowledge (sum of questions about the *huillín*) as the response variable, influenced by connection with nature (visit frequency to natural areas, nature-related professions) and demographic variables (age, gender, education level); and another with valuation (total and specific ecological, instrumental, intrinsic, relational values) as the response, influenced by knowledge, attitude towards conservation (voting preferences), connection with nature and sociodemographic variables. The GLMs used the Poisson distribution, with model selection based on null-hypothesis significance testing (Tredennick et al. 2021). Significant differences between mean ecological, instrumental, intrinsic and relational values were determined using analysis of variance (ANOVA) in R.

Results

Respondent sociodemographics were similar to those who refused to participate and to national census data for TDF (Tables S1 & S2). Some 78% of respondents did not have professional activities that brought them into regular contact with nature nor provided them with information about it, while 97% stated that they visited natural areas at least once a year; nearly half (49%) visited daily or weekly (Table S2).

Perceptions of biodiversity, ecosystems and conservation

Eighty-three different 'favourite' animals were freely listed, namely birds (>50% of responses), terrestrial mammals (25%), marine mammals (14%), fish (3%), invertebrates (2%) and reptiles and insects (1% each). Overall, 58% of responses were species native to TDF, 25% were introduced to TDF and 17% were general groups (e.g., birds, fish). The top three were foxes (both native and introduced species in TDF), the North American beaver (*Castor canadensis*; introduced) and penguins (several native species; Fig. S1). The *huillín* occupied the 21st position in this list (1% of responses), and the general 'otter' category was chosen twice.

Most respondents preferred 'lakes/ponds' or 'forests', each with c. 25% of responses. Coastal marine environments – the *huillín*'s principal habitat in TDF – were only selected by 15% of respondents. Regarding the importance of nature conservation when voting for a political leader, 70% said that this topic mattered 'quite a bit' or 'a lot'; only 11.5% gave the topic 'no importance' or did not respond.

Knowledge

In total, 47% of respondents identified the presented photograph as '*huillín*' (14%) or 'otter' (33%; Fig. 1), while the majority (53%) did not know what it was or incorrectly identified it by responding 'sea lion', 'beaver', 'mink', 'seal', 'ferret', 'capybara', 'weasel' or 'coati'. Of those who did not visually recognize the otter, 76% also were not familiar with it after a verbal explanation. Among those able to name it, the majority reported that 'science' institutions were their main information sources (30%), while 'education' establishments were the second most selected information sources (29%). Other information sources included the 'press' (12%) and 'social media' (9%). Only 3% reported being informed about the *huillín* by 'laws'. Those who chose the 'other' option (15%) reported 'acquaintances', 'the Argentine National Parks Administration' or 'direct sightings' as their sources of this information.

Only a quarter of residents knew that the *huillín* is native to TDF, while just 35% answered correctly that 'marine coasts' were its principal habitat, and 40% were partially correct, saying 'lakes/ponds'. Overall, 75% of residents had some knowledge of this species' habitat preferences. However, only 6.8% reported that it was critically endangered in TDF, and just 15.4% assessed it as being 'endangered' at national and international levels.

The highest knowledge score (4.16) was achieved by only 0.5% of respondents; these missed out on obtaining a perfect score due to difficulties assessing the species' threats and conservation status. Overall, 60% stated at least one of the experts' top three threats, and 39% stated two of them. Only 9% provided no responses that agreed with the experts, and 1% coincided with all three main expert-assessed threats (Fig. 1e). Only 'Education level' was significantly related to knowledge about the *huillín* ($p < 0.001$); people with more formal education had more knowledge of the

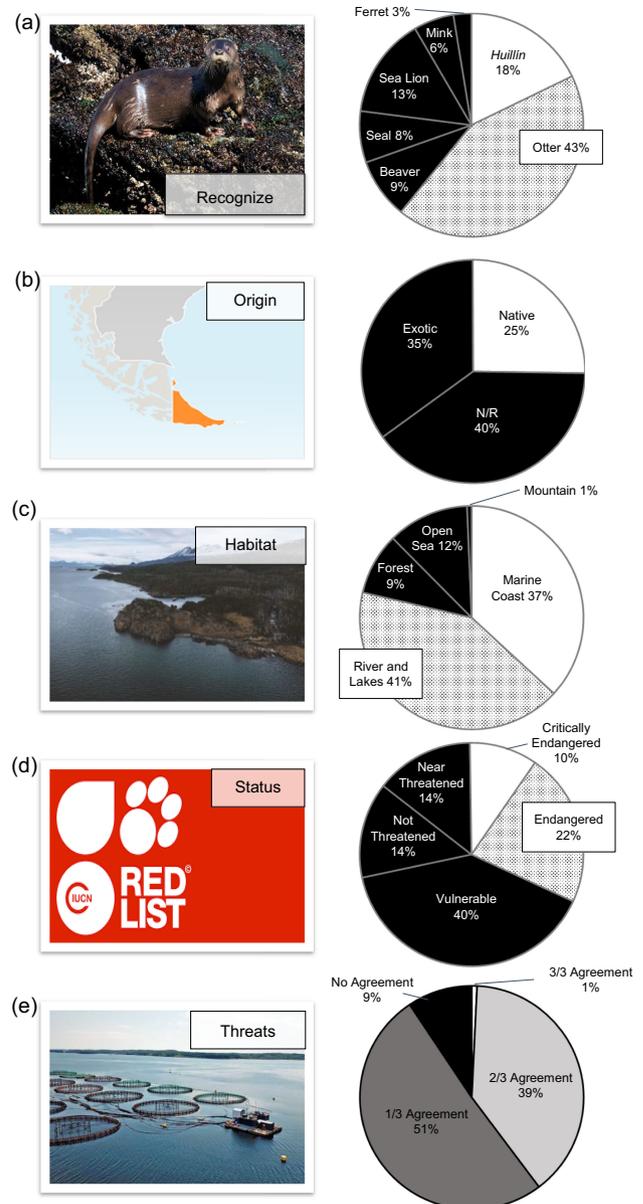


Figure 1. Ushuaia residents' knowledge of the southern river otter (*Lontra provocax*), as assessed by their ability to correctly recognize or describe (a) a photograph of the species, (b) its origin as native or introduced, (c) its habitat, (d) its conservation status and (e) the three principal threats facing the species as compared to expert opinion. Pie charts show the proportions that were 'fully correct' (solid white-filled segments) for the *huillín* in Tierra del Fuego, 'partially correct' (by being correct for the species overall and considering its broader range in northern Patagonia; hashed white-filled segments) or entirely 'incorrect' (black-filled segments). N/R = no response.

species and its conservation status than those with less formal education (Table 1).

Valuations

The *huillín*'s intrinsic importance was the most highly valued (mean = 3.56 ± 0.03 ; 67% classifying it as having 'a lot' of importance), and its instrumental benefit was the least highly valued (mean = 1.26 ± 0.07 ; 31% classifying it as being of 'very little' importance). Ecological and relational value categories were in the middle and statistically identical; they were rated highly as having 'a lot' or 'quite a bit' of importance, respectively (Fig. 2).

Table 1. Results from generalized linear models (GLMs) of Ushuaia residents' knowledge of the *huillín* (*Lontra provocax*), including recognition of and information about the species and its habitat, origins, conservation status and threats. The p-values presented are given as a function of the following explanatory variables: connection with nature (measured by natural area visitation frequency and job type), education level (primary, secondary and higher education), age and gender (male, female). Bold text indicates the model selected based on the significant parameters, with value of the coefficient ± the standard error given in parentheses.

Knowledge model	Intercept	Education	Gender	Age	Connection
~ Education	<2e^{-16σ} (0.94 ± 0.12)	1.2e^{-06σ} (0.14 ± 0.04)	–	–	–
~ Education + Gender	<2e ^{-16σ}	0.13e ^{-06σ}	0.13	–	–
~ Education + Age + Gender	<2e ^{-16σ}	1.2e ^{-06σ}	0.179	0.34	–
~ Education + Age + Gender + Connection	<2e ^{-16σ}	2.26e ^{-06σ}	0.25	0.35	0.381

^aParameters with significant differences in their influence on the dependent variable.

Table 2. Results from generalized linear models (GLMs) on the specific and total valuations of the *huillín* (*Lontra provocax*) by Ushuaia residents. The total valuation was for the sum of the four specific values assessed (ecological, intrinsic, instrumental and relational). Rows shows the best model selected based on the significant parameters and the p-values of each parameter. The parentheses indicate the value of the coefficient ± the standard error.

Model	Intercept	Knowledge	Age	Connection
Relational valuation ~ Knowledge + Age	1.08e ^{-07σ} (0.68 ± 0.12)	3.84e ^{-05σ} (0.07 ± 0.01)	0.06 ^a (–0.004 ± 0.002)	–
Ecological valuation ~ Knowledge + Age	3.33e ^{-13σ} (0.89 ± 0.12)	0.008 ^a (0.04 ± 0.01)	0.02 ^a (–0.005 ± 0.002)	–
Intrinsic valuation ~ Intercept	<2e ^{-16σ} (1.25 ± 0.02)	–	–	–
Instrumental valuation ~ Knowledge + Connection	0.23 (–0.13 ± 0.11)	0.03 ^a (0.05 ± 0.02)	–	0.02 ^a (–0.001 ± 0.0006)
Total valuation: ~ Knowledge + Age	2e^{-16σ} (2.12 ± 0.03)	1.15e^{-06σ} (0.04 ± 0.008)	0.059 (–0.001 ± 0.001)	–

^aParameters with significant differences in their influence on the dependent variable.

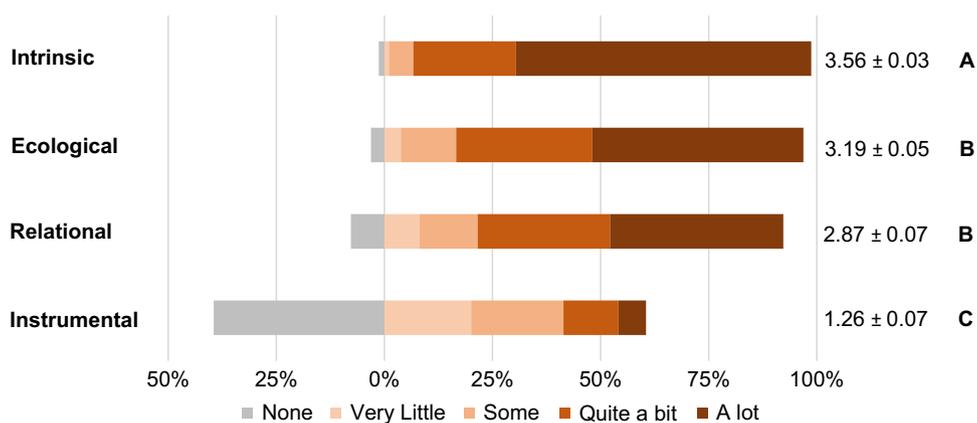


Figure 2. Ushuaia residents' perceptions and valuations of the various benefits associated with the southern river otter (*Lontra provocax*) in Tierra del Fuego. To the right are average ratings ± standard errors and letters representing the group similarities/differences according to analysis of variance (ANOVA) tests.

The intrinsic value model was not related to any explanatory variables (i.e., demographic, knowledge or connection variables; Table 2). 'Knowledge' had a significant and positive influence on the other specific valuations (i.e., people with more knowledge about the *huillín* valued it more highly based on its cultural relevance, ecosystem role and potential economic benefits). 'Age' inversely influenced the ecological and relational value models (i.e., younger individuals tended to assess these specific values more highly), and 'Connection' was inversely related to instrumental valuation.

The aggregate valuation scores showed that 'Knowledge' (which is directly related to the level of education) and 'Age' had significant ($p < 0.0001$) and marginally significant ($p < 0.06$) effects, respectively, on the overall assessment of this species' importance (Table 2). Thus, the main influence on the total valuation of this otter was 'Knowledge', which showed a positive relationship (i.e., those with more knowledge valued the *huillín* more). 'Age' moderately influenced the total valuation in an inverse direction, meaning that younger respondents tended to

have a higher valuation of the species. The remaining variables (i.e., 'Gender' and 'Connection') did not influence the model.

Discussion

Implications for the bi-national management plan

Previously, the Global Otter Conservation Strategy recommended developing a strategic communication campaign for the *huillín* (Sepúlveda et al. 2018), and the bi-national Argentine–Chilean workshop highlighted the need to fill information gaps related to societal perceptions and knowledge for more effective outreach strategies (Valenzuela 2019). However, to date, research on the southern river otter has focused mostly on ecological aspects (but see Pozzi & Ladio 2021, 2023). Now, our study shows that education level was not only a strong predictor of knowledge about this species, but also valuations of it were based on relational, instrumental and ecological justifications of its importance. Going forward, it is important for bi-national management strategies to

include informal mechanisms for receiving information about otters to reach other social groups (e.g., older residents). This would also provide them with opportunities to instil greater empathy towards otters, which has also been shown to enhance support for conservation efforts generally (Hageman 1985, White et al. 1997).

Overall, these findings align with previous studies linking knowledge/valuation to education (Aminrad et al. 2013, Janmaimool & Khajohnmanee 2019). However, we also found that people working in tourism and education or frequently visiting natural areas placed less emphasis on the species' instrumental value. This result, which also aligns with sociocultural valuations observed in Tierra del Fuego National Park (Mrotek et al. 2019), can constitute an entry point to expand residents' comprehension of the multiple values of nature. Considering a full range of benefits can increase both understanding and empathy towards wildlife (Loreau 2014); in this case, it would lead to improved awareness of the economic/touristic benefits of this species and of nature generally. At the same time, these new narratives should reinforce people's existing valuations of the *huillín* based largely on its existence or its ecosystem functions. A final opportunity to enhance such communication is to link existing warnings about biological invasions with positive messages about native species (e.g., Food and Agriculture Organization & Ministerio de Ambiente y Desarrollo Sostenible 2021). In short, expanding this species' social niche requires targeting diverse audiences, including older people and those who are not in formal education.

Connecting elusive and cryptic species with society

Environmental scientists and managers are striving to implement more inclusive conservation that includes how people value biodiversity and NCP (Pascual et al. 2022). Furthermore, awareness of an endangered species' ecological dimensions (e.g., status, drivers of change) is essential for its conservation (Wallace et al. 2002, Tisdell et al. 2006). Yet, when species are elusive or cryptic, it can be difficult to establish such social connections. In this context, the valuation of less perceived species requires strategies that combine education, community participation and cultural integration. Specifically, policies that create experiences in nature can foster emotional and cognitive connections (e.g., sense of stewardship and responsibility towards the environment; Miller 2005, Pizarro et al. 2017).

In the Cape Horn Biosphere Reserve (Chile), efforts have been implemented to position cryptic species as symbols of local/regional biodiversity, bringing little-known bryophytes (i.e., mosses, liverworts) into community-based conservation programmes based on formal and informal environmental education as well as the use of novel metaphors ('miniature forests' of Cape Horn) and diverse artistic expression (Rozzi et al. 2007). Direct engagement with nature requires narrative content (e.g., books, brochures, signs), but also physical spaces (e.g., trails, visitor centres). For example, species with low public visibility can gain prominence when they are tied to broader ecological narratives (e.g., their role as bioindicators or their vulnerability to anthropogenic threats; Soga & Gaston 2016), as well as through providing opportunities to experience the species or its habitat directly (Pizarro et al. 2017).

Encouraging this connection to biodiversity can generate support for protecting not just individual species but whole ecosystems. These social-ecological conservation approaches serve

as replicable models for generally overlooked species, including insects, lichens and amphibians. Endangered and elusive species like the southern river otter can also benefit from such approaches, and they can play an important role by acting as focal points for education and awareness. Highlighting the social and ecological niches of these species not only elevates their visibility but also can inspire collective action for habitat conservation. Indeed, studies have shown that the perceptions of local residents can be key to preventing the extinction of very scarce endangered species, as was evidenced in Vietnam through the establishment of a positive relationship between local ecological knowledge and the identification of priority areas and actions for the conservation of the saola (*Pseudoryx nghetinhensis*), one of Asia's rarest and most critically endangered mammals (Turvey et al. 2015).

This study's findings can form a basis for undertaking analogous social-ecological approaches throughout the southern river otter's range, including areas where it faces more direct pressures (e.g., river channelization, dams, tourism, deforestation; Valenzuela 2019). Strengthening the ties between academia and local policymaking can help disseminate information within the day-to-day agendas of social media, the press and the authorities. Consequently, improving understanding, awareness and communication regarding the *huillín* – and native species generally – represents a step towards fostering greater appreciation of local biodiversity and its management. In turn, understanding these aspects feeds back into the broader need to consider how people–nature relationships can be cultivated in the context of social-ecological change and unperceived biodiversity and ecosystems (Rozzi et al. 2012).

Conclusion

While our project did not co-produce knowledge with other stakeholders, by enhancing social perspectives on nature, it advances us towards overcoming biases regarding conservation decisions that prioritize ecological approaches (e.g., intrinsic values, biophysical measurements) or development agendas (e.g., instrumental values, monetary measurements; Pascual et al. 2022). The southern river otter has a restricted ecological niche (Valenzuela 2019, Valenzuela et al. 2019), and here we show that it currently has a limited 'social niche' in Argentine TDF (e.g., 0.5% of respondents correctly answered four out of the five questions regarding knowledge of this species). Nonetheless, we also detected a baseline to develop the *huillín's* potential as an 'emblematic' species (e.g., 47% of residents did recognize a photograph of the species as either '*huillín*' or 'otter'). In addition, overall, there was a high level of support for conservation, and respondents had a good understanding of the threats that this otter faces. Yet, transforming the *huillín* into a flagship for conservation in TDF requires overcoming the fact that only small proportions of the population knew other basic facts about the species, such as it being a native species, it inhabiting marine coasts and it being critically endangered.

Supplementary material. The supplementary material for this article can be found at <https://doi.org/10.1017/S0376892925000025>.

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Competing interests. The authors declare none.

Ethical standards. All study participants were informed about the objectives, costs and benefits of the research and the mechanisms to ensure their personal anonymity and the confidentiality of their individual responses. For details, see survey and informed consent documents (Appendices S1–S3).

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