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Zootherapy and rural livestock farmers in semiarid Patagonia: the transfer of animal aptitudes for health

Lucía Castillo[1] and Ana Ladio[2,*]

ABSTRACT

This work investigates the therapeutic value of animals to rural farmers who live on the central plateau of Chubut, Argentina. Open and in-depth interviews were carried out with 35 rural farmers from Sierra Rosada, Sierra Ventana, El Escorial and Telsen. A total of 16 biological species (12 wild and 4 domestic animals) were involved in treatment (34 registered up to the present) of different ailments, empacho being one of the main therapeutic targets. Of the domestic species, the hen (*Gallus gallus domesticus*) was the most versatile in its usefulness, and the choique (Darwin's Rhea) (*Rhea pennata*) was the most versatile wild animal. Farmers used 15 different parts of the animals, fat being the substance which was obtained from most species. These zootreatments imply the transfer of aptitudes (the acquisition of a certain attribute of a species through ingestion or contact with specific parts of the animal), which transforms the health and lives of the people. Our results shed light on the symbolic and symbiotic relationships woven into rural life, with their implications for the conservation and management of wild fauna.

Keywords: Local Knowledge; Symbolic Relationships; Versatility; Empacho

[1] IPCSH-CONICET. Bv. Almte. Brown 2915, 9120 Puerto Madryn, Chubut, Argentina.

[2] INIBIOMA, CONICET-Universidad Nacional del Comahue. Quintral 1250, 8400 San Carlos de Bariloche, Río Negro, Argentina.

* Corresponding author. E-mail address: L C (luciadanielacastillo@gmail.com), A L (ahladio@gmail.com)

INTRODUCTION

The integral health of rural livestock farmers living in arid and semiarid environments around the world is based strongly on Local Ecological Knowledge (LEK) (Alves et al. 2011; Castillo and Ladio 2017a; Richeri et al. 2013). The animals that form part of these societies play a substantial role in the way of life, where their significance and uses closely reflect the people's conceptions of their environment, and form part of Local Zoological Knowledge (LZK) (Santos Fita et al. 2012).

The use of animals in medicine involves different animal parts and substances for the treatment of diverse human ailments. Although less visible than plants, animals form part of the pharmacopoeia of different regions of the world (Benítez 2011; Ceríaco

2013; Chakravorty et al. 2011; Mahawar and Jaroli 2008, Nikolaus 2001: Pieroni et al. 2002), and particularly Latin America (Alves 2009; Alves and Alves 2011; Alves et al. 2011; Alves et al. 2009; Arenas and Porini 2009; Bourdy et al. 2004; Costa Neto 1999; Enríquez-Vázquez et al. 2006; Jacobo-Salcedo et al. 2010). Several of these authors coincide in proposing that the LZK involved in these medical practices is the result of a biocultural inheritance which is constructed and reconstructed over successive generations (Bezerra et al. 2013; Alves and Rosa 2006).

It has been said that the curative processes carried out using animals in traditional societies is strongly linked to their alterity; that is, the condition of "otherness" assigned to animals from a local perspective. It has been widely shown that animals can carry human characteristics, and can establish bonds of various types, such as protection, alliance or the transfer of powers or services (Descola 2005; Martínez 2013; Medrano et al. 2011; Silla 2004; Viveiros de Castro 1996a,b).

In Brazil, for example, the employment of 16 species in local zootherapy has been described, demonstrating the symbolic value of birds in the area of health (Bezerra et al. 2013). In the Altiplano, the Andean high desert of northwest Argentina and southern Bolivia, the use of 25 species (including invertebrates, amphibians, fish, reptiles, mammals and birds) was documented for magic and ritual use as well as medicinal (Barbarán 2004). In the Qom communities of central Chaco, Martínez (2013) described 199 medicinal uses, corresponding to 72 species (reptiles, mammals and birds), which are considered to have spiritual principles and dialogue with humans. More recently, working with rural livestock farmers in San Juan, Hernández et al. (2015) registered the use of seven animal species (*Rhea pennata* d'Orbigny 1834, *Lama guanicoe* Müller 1776, *Puma concolor* Linnaeus 1771, *Pseudalopex* sp., *Lama vicugna* Molina 1782, *Lepus europaeus* Pallas 1778 and *Conepatus chinga* Molina 1782) that represent a source of ingredients for the preparation of home remedies employed in the treatment of 22 human ailments.

Different studies on livestock farmers in Patagonia have revealed their complex ethno-medical system, whose aetiology and therapies are strongly associated with domestic and wild environments (Molares and Ladio 2014). This system includes a set of knowledge, values, symbols and practices associated with a health-illness concept that recognizes the loss of equilibrium on an individual level, but is also related to the sociocultural and ecological surroundings (Molares and Ladio 2012). The local medicine of the rural livestock farmer living on the central plateau in Chubut has its very own ontology, which superimposes elements and conceptualizations from diverse medical systems: popular medicine, Mapuche medicine, and biomedicine (Castillo and Ladio 2017a). Popular medicine, with a strong presence in rural populations in Argentina (Idoyaga Molina 2008), is part of a syncretic medical system that involves elements and concepts of health, illness and treatment from pre-Hispanic medicine and Mediaeval Europe (Citarella et al. 1995).

Mapuche medicine experiences the process of illness in direct relation to their cosmology, associating it with an imbalance in terms of reciprocity and complementarity (Ibacache) (Burgos et al. 2002). In the therapeutic procedures that form part of local medicine, two large groups can be distinguished: those practiced only by local specialists, largely associated with magic-

religious elements, and those practiced by locals in their homes (Ibacache Burgos et al. 2002). These people perform the medicinal treatment or zootherapy, which is defined as practices employed to re-establish health which involve domestic and/or wild animals, and are associated with the aetiology of the illness (Colatarci and Gomez 2004).

Ethnomedical studies carried out in the region have described a wide spectrum of ailments which are treated in the home with plants, the main ones being digestive, respiratory, related to the cold or to blows or falls suffered during their work with the animals (Molares and Ladio 2009a). Within this group, *empacho* (indigestion) is one of the main therapeutic targets in local medicine, its treatment having been described up to now only with herbal remedies (Molares and Ladio 2009b; Ochoa et al. 2010). This complaint is associated with digestive problems, the result of an inadequate diet, excessive consumption of cold or hot food, or a bad combination of foods, and involves an imbalance, whether organic, social, spatio-environmental or spiritual (Idoyaga Molina 2012; Jiménez de Puparelli 1984). However, little has been studied as to the significance of this ailment in the region, or the search for solutions.

On the Chubut plateau, *empacho* is an ailment interpreted by the people as a consequence of their diet, principally meat, which constitutes a fundamental part of their daily food intake. As in other regions, symptoms mentioned include stomach pains, heaviness, nausea, vomiting, and general discomfort (Idoyaga Molina 2001). Studies carried out in isolated rural zones have shown that local medicine is constructed with redundancy; that is, the corpus of remedies includes a wide variety of items with the same function for treatment of the most common complaints, and fewer items for the less common ones. This means that alternatives are obtainable, depending on their availability, thus giving the system an adaptive quality (Santoro et al. 2018). This has also been interpreted as a solution to the problem of resource overexploitation, since the pressure of use is shared between different species (Nascimento et al. 2015; Richeri et al. 2013). For example, various plants have been described which are used by farmers on the plateau to treat digestive problems in the home: *Artemisia absinthium* L., *Matricaria recutita* L. and *Mentha spicata* L. (Richeri et al. 2013), but no attention has yet been paid to their zootherapies. In this respect, redundancy in treatment of the principal ailments could increase if we consider both plants and animals, and it possibly acts in the system as a mechanism to buffer impacts and diversify alternatives (Albuquerque and Oliveira 2007), among other reasons.

Versatility of the medicinal use of resources is another characteristic that could be linked to the self-sufficiency of rural populations, particularly in the case of communities that live in conditions of limited resources, such as arid and semiarid zones (Sõukand et al. 2017). In Patagonia in particular, the importance of their pharmacopoeias has been demonstrated, where the more multifunctional species, such as the native *Acantholippia seriphioides* (A.Gray) Moldenke and *Valeriana carnosa* Sm., and/or exotic species like *Plantago lanceolata* L. are the species with the highest consensus among locals for treatment of the most prevalent ailments, such as those involving the digestive, respiratory and circulatory systems (Richeri et al. 2013).

The general aim of this work is to investigate the medicinal role played by animals in the lives of the rural livestock

farmers who live in central northern Patagonia. We ask: What animal richness is included in zootherapy? How, and which parts of the animals are involved? What ailments are treated with animal remedies? What role do animals play in the treatment of *empacho*? What conceptualizations underlie local therapies involving animals? How are these zootherapy remedies obtained? What substances are administered? Which animals used in cures are the most versatile? How redundant is zootherapy and what is its relation to herbal medicine?

MATERIAL AND METHODS

Study area

The study area is located in the farming populations of Sierra Rosada, Sierra Ventana, El Escorial and Sierras de Telsen, situated in the central northern region of Chubut, Patagonia, Argentina (Figure 1). The population is divided into small groups or settlements that are quite spread out, but connected by a network of gravel roads. The settlements are interspersed between large economic units in the hands of major landowners. At the time of this study, the area had a population of approximately 6780 inhabitants (the lowest population density of the province), evidencing considerable processes of rural depopulation (Plan Estratégico Chubut, 2017).

Environmental characterization of the study area

The climate is dry and cold during most of the year (average annual temperature of 11.3 ºC, and average annual precipitation of 174 mm), exposing inhabitants to severe conditions at certain times of the year (on average 98 days of frost per year). Strong western winds are one of the typical climatic characteristics of the region (León et al. 1998). In the study zone, vegetation corresponds to the Patagonian phytogeographic province (Cabrera 1976), where medium-height shrub-grass steppe plants predominate, characterized by dwarf cushion shrubs; grass is scarce and total plant coverage is low (León et al. 1998). The most conspicuous plants are: *Lycium ameghinoi* Speg., L. *chilense* Bertero, *Prosopis denudans* Benth., *Prosopis*

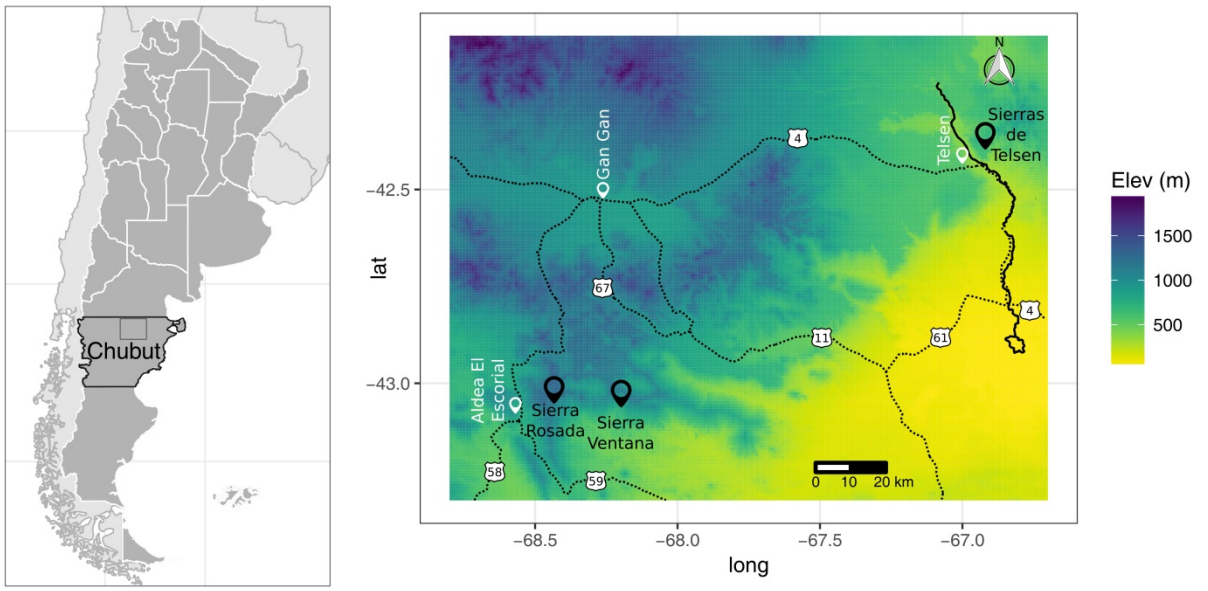

Figure 1. Study area

alpataco Phil., *Berberis microphylla* G. Forst., *Schinus johnstonii* F.A.Barkey, *Ephedra ochreata* Miers, *Atriplex lampa* (Moq.) Guillies, *Colliguaja integerrima* Gill and Hook., *Mulinum spinosum* Pers., *Senecio filaginoides* DC., *Chuquiraga avellanedae* Less, *Acantholippia seriphioides*, *Adesmia volckmanii* Phil., *Nassauvia axillaris* (Lag. ex Lindl.) D. Don, *Grindelia chiloensis* (Cornel.) Cabrera, *Stillingia patagonica* (Speg.) Pax et Hoffm., *Nassasuvia glomerulosa* (Lag. ex Lindl.) D. Don, N. ulicina (Hook. f.) Macloskie, *Chuquiraga aurea* Skottsb., *C. avellanedae* Less., *Acaena pinnatifida* Ruiz and Pav., *Acaena splendens* Hook. and Arn., *Hoffmannseggia trifoliata* Cav., *Nardophyllum bryoides* (Lam.).Cabrera, *Pappostipa speciosa* (Trin. and Rupr.) Romasch, *Pappostipa humilis* (Cav.) Romasch, *Poa lanuginosa* Poir. and *Jarava neaei* (Nees ex Steud.) Peñailillo, among others (León et al. 1998). The fauna is typical of Patagonian steppe: guanaco (*Lama guanicoe*), ñandú petiso or choique (*Rhea pennata*) and two species of edentates (*Chaetophractus villosus* Desmarest 1804 or peludo and *Zaedyus pichiy* Desmarest 1804 or piche), two species of canines (*Lycalopex culpaeus* Molina 1782 or zorro colorado and *Lycalopex griseus* Gray 1837 or zorro gris or chico), mustelids (*Conepatus chinga* or zorrino, *Galictis cuja* Molina 1782 or hurón menor and *Lyncodon patagonicus* de Blainville 1842 or huroncito), felines (*Puma concolor* and *Oncifelis colocolo* Molina 1782 or gato del pajonal). Among the rodents are the vizcacha de la sierra or pilquín (*Lagidium viscacia* Molina 1782) and the false nutria or coipo (*Myocastor coypus* Molina 1934). There are numerous small mammals: marsupials (*Lestodelphys halli* Tate 1934 and *Thylamys pallidior* Thomas 1902), caviomorph rodents (*Ctenomys* sp. and *Microcavia* sp.) and cricetids (*Eligmodontia morgani* Allen 1901, *Reithrodon auritus* G. Fischer 1814 and *Phyllotis xamthopygus* Waterhoise 1837).

Socio-cultural characterization of the study area

The Mapuche/Tehuelche and Creole families who inhabit the region live on small-scale farms of approximately 2500 hectares. From an economic point of view, the families subsist due to their management of goats and sheep, combined with hunting, family horticulture, firewood gathering and the sale of resources from their surroundings. The production method is extensive farming with a fixed livestock load. The current profitability of this activity is very low, for several reasons, such as the high mortality of animals due to predators (Travaini et al. 2000) and the effects of prolonged drought, heavy snowfalls and volcanic ash. The main factors affecting their lifestyle are desertification processes, social inequality, and the failure of development models and public policies, among others (Iglesias et al. 2015). Added to this is low productive efficiency in terms of the lamb marking percentage (less than 50%), on which depends, basically, the profitability of their production. Nevertheless, extra-economic factors, such as a deep-rooted connection to the land, and strong ovine culture, lead the small producer to continue depending on livestock for a living. The farms are isolated due to the great distances between them and the nearest village (El Escorial, which has a school) and towns (Telsen, Gan-Gan etc.). Access to this zone is by gravel roads, which is often difficult and sometimes impossible due to snow or the effects of heavy rainfall. Public transport from the

coastal urban centers passes by on the closest roads once a week (see Figure 1). Studies in the region have shown that their ethnomedical system is based on plant resources, 500 species having been registered up to the present time which are used in the treatment of diverse physical and emotional ailments, in the home (Cardoso et al. 2015; Castillo and Ladio 2017a; Molares and Ladio 2014, Richeri et al. 2013).

Fieldwork

Fieldwork was carried out according to the agreement established at the United Nations Conference on Sustainable Development (Rio+20 2012), regulating access to genetic resources and corresponding knowledge, the protection of traditional knowledge and recognition of intellectual property rights. In addition, the Society of Ethnobiology Code of Ethics (International Society of Ethnobiology 2006) guidelines were followed.

Repeated visits were made to rural establishments during eight campaigns in the study zone between the years 2012 and 2016. The sampling method consisted of an exhaustive survey or census, our objective being to visit all the farming families living in rural establishments in each area: Sierra Rosada (7 rural establishments), Sierra Ventana (5 rural establishments), El Escorial (11 rural establishments) and Sierras de Telsen (7 rural establishments), which correspond to a total working area of 1 million hectares.

Open and semi structured interviews were performed with 35 participants in total, on the subjects of using animals in human medicine, acquisition methods, the ailments treated, and their conceptions and significance. Activities and walks were shared with inhabitants, and participant observation was carried out, in order to evaluate in depth the aspects mentioned previously, to the point of information saturation (Lozada et al. 2006). Participants' ages varied between 45 and 77 years (75% men of average age 64.3 ± 10.5 years and 25% women of average age 67.2 ± 8.9 years). The conversations were recorded in audio form, with previous consent, and in field notebooks.

Data analysis

The fieldwork and data analysis were simultaneous and have prioritized a) minimization of the distance between the authors and participants, b) construction of a complex and holistic picture of our phenomenon of interest, based on an inductive process of dialogue and, d) triangulation between different participants, in order to interpret the information and determinate its accuracy.

The interviews were based on questions about local names, uses, parts of the animal used, means of acquisition and methods of administering zootherapy remedies. The information was recorded in audio format and in field notebooks, and was interpreted qualitatively, taking into account the emic/etic dimension. Total composition and richness of species and families was estimated considering the sum of the number of species and families cited (Ladio and Lozada 2008). Emic categories related to the registered ailments were used as categories coinciding between different participants, and the zootherapeutic substances registered. These categories were analyzed in light of the complex network of interactions with the natural and supernatural worlds described by the Mapuche people (Grebe 1984).

The versatility of use of each species was

calculated as the sum of the different medicinal uses for each species cited, by the total number of interviewees (Ladio and Lozada 2008). Redundancy was calculated as the number of resources that can have the same function, and can be used as alternative options (Albuquerque and Oliveira 2007; Ladio 2011).

Photographic material was employed to facilitate recognition of the animal species during the conversations (Medrano 2012). In addition, walks in the field were undertaken with inhabitants for identification of birds in flight and signs of mammals cited in the conversations. For identification of the animal species, local bird and mammal guides (Bonino and Pelliza Sbriller 1991; Chebez et al. 2014; Narosky and Babarskas 2001), and a catalogue provided by the IUCN (http://www.iucn.org/) were referred to. Specialists in arthropods and birds were also consulted: Dr. Fernando Martínez (IPEEC-CONICET) and Dr. Alejandro Gatto (CESIMAR-CONICET). The quantitative data were analysed with descriptive statistics, principally parametric ($p<0.05$).

RESULTS AND DISCUSSION

Animal medicine and its richness

Local zootherapy was composed of 16 species (12 native and 4 exotic species), the majority of which were vertebrates (94%). The animal species registered belong to three taxonomic categories and 12 zoological families (Table 1, Figure 2). The group with the largest number of medicinal species was mammals (12 species), followed by birds (three), and one insect. This result was in line with the catalogue of 584 species of animals of medicinal use in Latin America, which reveals that mammals are the group with most medicinal animals, and insects the group containing the lowest number of reported medicinal uses (Alves and Alves 2011). The family with the highest number of medicinal species was Canidae (Pseudalopex culpaeus Molina 1782, red fox; Pseudalopex griseus Gray 1837, grey fox; Canis lupus familiaris Linnaeus 1758, dog) (Table 1), which coincides with other studies that show the wide use of this family in Latin America, Africa and Asia, and describe their use for treating 28 ailments, such as asthma, arthritis, and backache (Alves et al. 2010). Following in order of importance were the families Bovidae and Phasianidae, which include animals kept for farming purposes such as goats, sheep and hens (Capra aegagrus hircus Linnaeus 1758, Ovis orientalis aries Linnaeus 1758, and Gallus gallus domesticus Linnaeus 1758), constituting an interesting complementary source of home remedies, where wild and domestic resources were combined. Similarly, it has been documented that knowledge and practices related to foreign plants has enriched the corpus of native medicinal, firewood, horticultural, and ornamental plants (Cardoso et al. 2013; Eyssartier et al. 2011; Ladio and Molares 2013). Therefore, this complement represented by domestic animals, as in previous cases, shows processes of transformation and adaptation of LZK, contributing resilience and flexibility to the socio-environmental system the livestock farmer forms part of.

In Table 1, 34 treatments are described that employed exotic (44%) and native animals (56%) (Multinomial test, $p>0.05$) (see Figure 2). Except for the wild European hare (*Lepus europaeus*), the exotic species cited were domestic animals. This group of animals accompanied farm life in fundamental aspects of local subsistence: the production of wool and meat in the case

Table 1. List of species that form part of the animal pharmacopoeia of rural livestock farmers of northern-central Patagonia (Chubut, Argentina). *Wild animals; **Domestic animals.

Family	CLASS	Scientific name	Common name	Part used	Ailment treated	Preparation/Recipe
Bovidae	Mammalia	*Capra aegagrus hircus* Linnaeus, 1758	Capon**	Meat	*Empacho*	Toasted and ground and prepared as an infusion
				Fat	Muscular/joint pains	Spread on the affected area and massaged
				Fleece/Fur	Colds	Applied on the head as a poultice
Bovidae	Mammalia	*Ovis orientalis aries* Linnaeus, 1758	Goat**	Meat	*Empacho*	Toasted and ground and prepared as an infusion
				Fat	Muscular/joint pains	Spread on the affected area and massaged
				Fleece/Fur	Colds	Spread on the affected area and massaged
Camelidae	Mammalia	*Lama guanicoe* P.L.S. Müller, 1776	Guanaco*	Stone	Heart	Ground and prepared as an infusion
				Meat	*Empacho*	Toasted and ground and prepared as an infusion
Canidae	Mammalia	*Pseudalopex culpaeus* Molina, 1782	Red fox*	Fat	Muscular/joint pains	Spread on the affected area and massaged
				Fat	Chilblains	Spread on the affected area
				Penis	Earache	Applied to the ear
Canidae	Mammalia	*Pseudalopex griseus* Gray, 1837	Grey fox*	Fat	Muscular/joint pains	Spread on the affected area and massaged
Canidae	Mammalia	*Canis lupus familiaris* Linnaeus, 1758	Dog**	Faeces	*Empacho*	Ground and prepared as an infusion
				Fur	Toothache	A necklace made from shorn fur from a dog's neck is hung round the baby's neck
				Fur	Choking	A necklace of twice the length of the dog's neck is hung round the person's neck
Canidae	Mammalia	*Puma concolor* Linnaeus, 1771	Puma*	Testicles	Sexual vigour	Toasted and ground and prepared as an infusion
Chinchillidae	Mammalia	*Lagidium viscacia* Molina, 1782	Southern viscacha*	Meat	*Empacho*	Toasted and ground and prepared as an infusion
				Paws	Riding skills	A paw is hung from the riding tack

Dasypodidae	Mammalia	*Zaedyus pichiy* Desmarest, 1804	Dwarf armadillo*	Shell	*Empacho*	Toasted and ground and prepared as an infusion
				Meat	*Empacho*	Toasted and ground and prepared as an infusion
				Fat	Burns	Spread on the affected area
Felidae	Mammalia	*Leopardus geoffroyi* d'Orbigny & Gervais, 1844	Geoffroy's cat *	Skin	Muscular/joint pains	Applied on the affected area as a poultice
Formicidae	Insecta	*Acromyrmex lobicornis* Emery,1888	Leafcutter ant*	Anthill	Transfer	The person places their hand in the anthill and allows the ants to bite it
Leporidae	Mammalia	*Lepus europaeus* Pallas, 1778	European hare*	Fat	Muscular/joint pains	Spread on the affected area and massaged
Mephitidae	Mammalia	*Conepatus humboldtii* Gray, 1837	Skunk*	Fat	Burns	Spread on the affected area
Phasianidae	Aves	*Gallus gallus domesticus* Linnaeus, 1758	Hen**	Fat	Burns	Spread on the affected area
				Fat	Sore throat	Spread on the affected area and massaged
				Eggs	*Empacho*	Alcohol is added and the mixture is beaten then applied as a poultice on the belly, with a cloth. If it sticks it means you have *empacho*.
				Eggs	Burns	A cream is prepared by heating several egg-whites in a pan, and is spread on the affected area
				Eggs	Fever	The beaten whites are applied to the forehead
Rheidae	Aves	*Rhea pennata* d'Orbigny, 1834	Darwin's rhea*	Crop	*Empacho*	Toasted and ground and prepared as an infusion
				Tendons	Blows/Pains	The tendon is tied to the knee
				Meat	*Empacho*	Toasted and ground and prepared as an infusion
Accipitridae	Aves	*Geranoaetus melanoleucus* Vieillot, 1819	Black-chested buzzard eagle*	Talons	Riding skills	Toasted and ground and prepared as an infusion

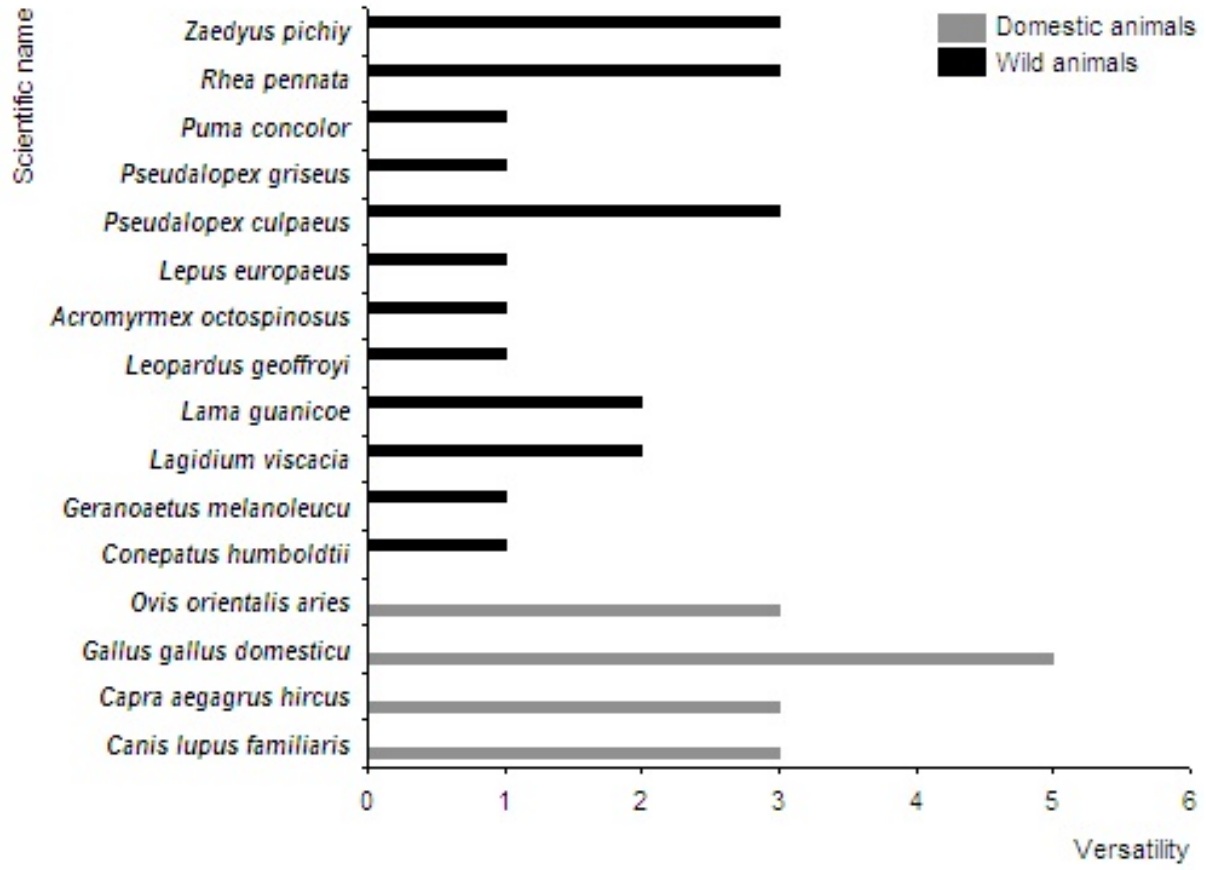

Figure 2. Versatility of the animal species that form part of the pharmacopoeia of rural livestock farmers on the Chubut plateau.

of goats and sheep (*Capra aegagrus hircus*, *Ovis orientalis aries*), food security (*Gallus gallus domesticus*, the hen) and company in activities such as rounding up animals and protecting herds, among others (*Canis lupus familiaris*, the dog) (Verón 2005). Their importance as zootherapeutic elements was due to their high level of accessibility and availability compared to the substances obtained from captured animals. Domestic animals have been highlighted in diverse pharmacopoeias of the world; for example, Vallejo et al. (2017) compiled 63 remedies obtained from the domestic dog (*Canis lupus familiaris*) in Spain. These results emphasize the fact that animal therapies are still relevant in modern ethnomedicine, despite the many transformations undergone in primary health care systems (Elmacı and Cevizci 2015, Filan and Llewellyn-Jones 2006).

Methods of administration

Zootherapeutic preparations varied depending on the ailment to be treated, and involved dried, toasted, and ground materials, infusions, ointments, creams and the use of fresh parts (Table1). The principle methods of administration included rubbing on, massaging, tying on and drinking. Treatment was mainly direct, through specific preparations (e.g., infusions, ointments, poultices) (88%), although 12% of the animals mentioned were carried as a charm (indirect use) (Table 1) (multinomial test, $p<0.05$).

External use, in comparison with internal use of the different parts, prevailed in the case of remedies of animal origin (multinomial test, $p<0.05$). This contrasted with the remedies of plant origin cited for this region, whose principal form of administration is infusion (Molares and Ladio, 2009a, Richeri et al. 2013). In addition, it was found that many remedies of animal origin required no preparation (53%), while those which were taken as an infusion first required drying and/or grinding (35%); to a lesser extent creams were prepared (9%), or plaits made with elements obtained from the animals (3%).

Ailments and treatments

Table 1 describes treatments for 15 different emic ailments, principally digestive, or involving muscles and respiratory passages, which represent the main therapeutic targets in rural areas of the region (Molares and Ladio 2014; Richeri et al. 2013). Empacho was the most frequent complaint for which zootherapy was used (Figure 3, multinomial test $p<0.05$). This finding is the first cite in the bibliography to mention its treatment with animals. Richeri et al (2013) had documented the use of strong, bitter plants such as ajenjo (common wormwood) (*Artemisia absinthium*), paico (wormseed) (*Dysphania ambrosioides* (L.) Mosyakin and Clemants), carqueja (*Baccharis sagittalis* L.) and ñanculawen (*Valeriana carnosa*) to treat *empacho* in the region. However, *empacho* is an ailment related to the consumption of animals, and, in a participant's own words, "…it's the animal itself that cures you" (JG-ST). This is where the importance of using animals in its treatment came from, and this was reinforced with elements of plant or mineral origin. To this end, a piece of meat from the same animal as was eaten (*Capra aegagrus hircus*, *Ovis orientalis aries*, *Lama guanicoe*, *Lagidium viscacia*, *Zaedyus pichiy*, *Rhea pennata*), was left to dry, then toasted, ground, and an infusion was prepared that was combined with the plants cited, to enhance its effect. This practice was carried out with both wild and domestic animals (Table 1) and implies a dialogical relationship with the animal itself, bringing into play the conceptualizations of animals as possessors of certain powers and the capacity to transfer their aptitudes.

The domestic dog (*Canis lupus familiaris*) was of great importance in rural life, collaborating as it did with daily tasks - as pets, herding the animals, protecting the domestic area, and also contributing a remedy for treating *empacho*. Known locally as *flor de camino* ("flower of the road"), the white feces of the dog (dried by the sun) were ground and prepared as an infusion. They are especially rich in phosphate as a result of the dogs' bone-rich diet, and referred to as *Album graecum* in ancient pharmacopoeias (Cuello et al. 1959; Vallejo et al. 2017). In other regions the medicinal use of dog feces is currently known as azúcar del campo ("countryside sugar") (Campos Navarro 2016). In general, the color of dog excrement is associated with an animal's good diet and digestion (Vallejo et al. 2017). In Brazil and Europe (Alves and Rosa 2007; Costa-Neto 1999; Vallejo et al. 2017), the high use versatility of dog feces is noteworthy, for the treatment of diverse ailments such as diarrhea, spider bites, pneumonia, chickenpox, and also for preparing restorative tonics, among other uses.

In this context Medrano (2016), in her work with the Qom people of the Gran Chaco, highlighted connections between people and animals when considering the

activity of eating, and referred to the concept of physiologically-related bodies. For example, the tapinec (*Dasypus* sp.) is considered by the Qom to be a very clean animal in terms of alimentation. This perspective also coincides with the plateau farmers' use of the *cáscara de piche* (shell of *Zaedyus pichiy*, the dwarf armadillo). The shell was burned and ground up, and mixed in an infusion with paico (cutleaf goosefoot) (*Dysphania multifida* (L.) Mosyakin and Clemants). In addition, the internal lining of the crop of Darwin's rhea (*Rhea pennata*), known locally as *pecina*, was left to dry, then toasted or burned among the embers, and ground up. This treatment for *empacho* was cited by locals in combination with flor del camino, with or without paico. In both cases it was based on the good diet of the animal, according to participants.

The ailments that followed in order of importance were muscular/joint pains and burns (Figure 3), for which fat was the therapeutic substance of choice, cited in this and other Argentine communities (see Table 1). For example, Barbarán (2004) cited the use of fat from the puma (*Felis concolor*), suri (Darwin's rhea) (*Pterocnemia pennata*) and snake (*Tachymenis peruviana* Weigmann 1834), among others, to alleviate pain caused by arthritis, bone pains, blows, rheumatism and sprains, in populations inhabiting the Altiplano in northwestern Argentina and southern Bolivia. Idoyaga Molina and Sarudiansky (2011) highlighted the warm condition of iguana fat, in keeping with the logic underlying these zootherapeutic treatments. That is, these substances counteract the warm or cold condition of the illness, so their action is literally, or metaphorically, thermic. In the case of fat, a warm effect is produced due to the friction with which it is applied.

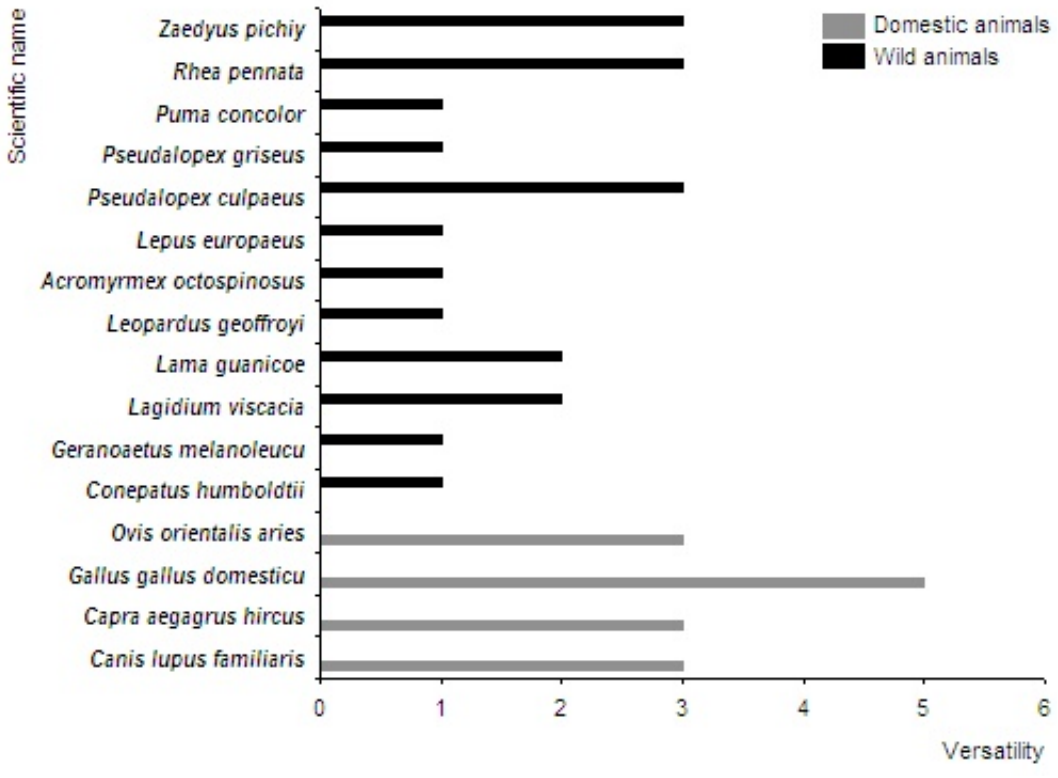

Figure 3. Redundancy of ailments treated with domestic and wild animal remedies.

The transmission of local zootherapy

In the medicine of the Chubut plateau, the role of animals involved interconnection between individuals and the transfer of aptitudes. A large proportion of the zootreatments cited were based on the transfer of morphological similarities or desired characteristics, whether to treat illness or obtain certain admired aptitudes, directly or indirectly. For example, Darwin's rhea (*Rhea pennata*) was thought of as a "medicine factory"; depending on the specific selection of plants used to feed the animal, it can provide a powerful remedy for humans. This conceptualization invokes an "otherness" in line with the idea of a continuum between animals and people, with characteristics that can be transferred between beings of different appearances, but the same nature.

One example that was cited is the use of protective necklaces for babies, made from the neck fur of the dog (*Canis lupus familiaris*), which allowed the child's teeth to develop healthily and without discomfort, and also protected against choking on food. With regard to choking, a practice commonly cited among participants was "taking the measure of the dog"; this involves taking the dog's neck measurement with a cloth or rope, and hanging something of the twice the length around the neck of the person who was choking. In this way, the capacity to "stretch" the neck, as if to the "measurement of the dog" was transferred, and choking to death was avoided. Another animal, the pilquín (southern viscacha) (*Lagidium viscacia*) was admired for its ability to "jump quickly from rock to rock without falling", which explained the local use of one if its paws tied to riding tack, to improve a rider's abilities. The hide of the agile gato montés (Geoffroy's cat) (*Leopardus geoffroyi*) applied to the knee relieved muscular/joint pains. Furthermore, the tendons of the avestruz (Darwin's rhea) (*Rhea pennata*) were used to treat discomfort in the legs, since they transferred the power of their strong legs (Table 1) "… the rhea never gets cramp" (MC-EE).

In the same way, admiration for the strength of the talons of the águila mora (black-chested buzzard eagle) (*Geranoaetus melanoleucus* Vieillot 1819), justified the use of its talons for the transfer of its power, so that the rider doesn't fall off his horse. In contrast to the charms worn (indirect treatment), the talons were ground and made into an infusion (direct treatment). Similarly, the stone of the guanaco (*Lama guanicoe*) ground in an infusion was used for chest discomfort; locally it was said to be "for the heart". The guanaco stone was a calculus or concretion that formed in the animal's stomach, and was cited as a bezoar among the animal medicinal uses of post-Hispanic indigenous societies in continental Patagonia (Prates 2009). It is worthy of note that the use of bezoar stones is widespread on a global level; they are obtained from different animals (e.g., vicuña, deer, antelope) in different regions of the world (Grenón 1922). Another example was the use of ants (*Acromyrmex lobicornis* Emery 1888), whose bites on the hands directly transferred their capacity to move quickly, enhancing the ability to play instruments like the guitar or accordion. The direct or indirect use of animal parts, depending on morphological similarities or desired characteristics with transfer potential, has been evidenced in other communities (Alves et al. 2011, Alves and Rosa 2006; Bezerra et al 2013; Medrano 2016; Souto et al 2011). For example, in Brazil, the use of jacaré (broad-snouted caiman) (*Caiman latirostris*

Daudin 1802) teeth has been cited, to strengthen the dentition of babies or adults (Alves et al. 2011; Moura and Marques 2008).

Human traits in animals and zootherapy

Our results have provided evidence that the local pharmacopoeia included animals conceived to have certain features or characteristics in common with humans, with which connections were made (e.g., physiological), as different kinds of bonds between individuals. This conceptualization of the fauna is in agreement with Mapuche-Tehuelche animistic cosmologies, where personal relations are established with animals. The bonds may be those of a companion, relative, protector, progenitor or helper, to which superhuman powers and abilities are attributed, which can be transferred to humans (Aguas Deumacán and Clavería Pizarro NA 2009; Herrmann et al 2013; Rozzi 2004; Silla 2004, Villagran 1999). This capacity for transfer between humans and animals has been reported in other regions of Argentina, and semiarid regions in north-eastern Brazil (Alves et al. 2009; Alves et al 2008; Bezerra et al. 2013; Medrano 2016; Moura and Marques 2008). This perspective has also been highlighted in other American Indian societies such as the Amazonian and Andean societies, revealing the existence of an interior nature shared between humans and non-humans, which emphasizes continuity, alliance, and reciprocity, among other values (Descola 2001; Medrano 2016; Surrallés 2009; Tola 2012; Viveiros de Castro 1996a,b). In agreement with Medrano (2016), these bonds bestow meaning on the healing practices, zootherapy being deeply rooted in local zoo-sociology; that is, it is a result of how animals are conceptualized by the farmers, and the relationship woven between them in their rural context.

Acquisition practices

The varied animal materials used in zootherapy were obtained principally by means of hunting wild animals (56%), and the remainder came from domestic animals ($p<0.05$). Nevertheless, in the interviews it was understood that this was not the main objective when hunting these animals, but rather the acquisition of food and/or protection for the herds against predators. Securing the different animal parts for medicinal use was a secondary result, representing an example of taking full advantage of the species, following a logic that calls for thorough use of all the parts; for example, the crop of Darwin's rhea (*Rhea pennata*) when the animal is hunted for food, or the fat of the red fox (*Pseudalopex culpaeus*) when this species is hunted to prevent them preying on the livestock.

This pattern coincides with the results of various authors (Bezerra et al. 2013; Moura and Marquez 2008); however, the specific hunting of certain animals in search of specific elements also occured, such as the talons of the black-chested buzzard eagle (*Geranoaetus melanoleucus*), due to the symbolic role of this animal in the complex local medical system.

Medicinal substances of animal origin

A variety of substances were used in zootreatment, involving different animal parts (15 registered in this work), such as: meat, fur, fleece, skin, and paws (Figure 4). Fat was the most appreciated substance, and was obtained from eight different animals:

three domestic (*Gallus gallus domesticus*, *Ovis orientalis aries* and *Capra aegagrus hircus*) and five wild species (*Pseudalopex culpaeus*, *Pseudalopex griseus*, *Lepus europaeus*, *Zaedyus pichiy* and *Conepatus humboldtii* Gray 1837) (Figure 4). Following this was the meat obtained from *Rhea pennata*, *Lama guanicoe*, *Zaedyus pichiy*, *Lagidium viscacia*, *Ovis orientalis aries* and *Capra aegagrus hircus*. This result agrees with records for diverse communities that highlight the zootherapeutic use of animal fat above all other substances (Martinez 2013; Medrano 2016; Moura and Marques 2008).

The rural farmers of the Chubut plateau used animal fat in many ways. It was recorded as treating a variety of ailments, such as: burns, sore throat, muscular pains and chilblains (Figure 4). The value of animal fat depended on the animal it came from. For example, as a participant stated: *"Not all fats are the same, for example, the fox has fat that is good for rheumatism. It has a film like the capon, that is the fat, it goes around the animal's belly; we make a cream and rub it in"*. Ethnozoological studies in Andean communities also emphasize the symbolic value of llama fat (*Lama glama* Linnaeus 1758) as "a seedbed of vital substance", (known locally as wira) (Vilá 2014). This element is representative of a reciprocal relationship with humans (Vilá 2014). The importance of fat has also been highlighted in Qom ethnozoological studies (Martínez 2013). Medrano (2016) suggests that the fat holds the greatest potential of desirable attributes, and the possibility of transmission, amplifying this concept to include use/ingestion/contact with different animal parts.

In contrast to the widespread use of fat, Figure 5 shows that the meat – obtained from different animals – had a specific function: to heal *empacho* (Table 1). Monroy and García Flores (2013) have detailed the same use in an indigenous community of

Figure 4. The crop of Darwin's rhea (*Rhea pennata*), which is toasted, ground, and prepared as an infusion to treat empacho.

Morelos (Mexico), who use meat of the Coyote (*Canis latrans* Say 1823) and Zorrillo (*Mephitis macroura* Lichtenstein 1832). In our interpretation, this implies transmitting powers such as nourishing and healing through the meat, and the concept of a balance, as compensation for excesses/deficiencies in diet and in health.

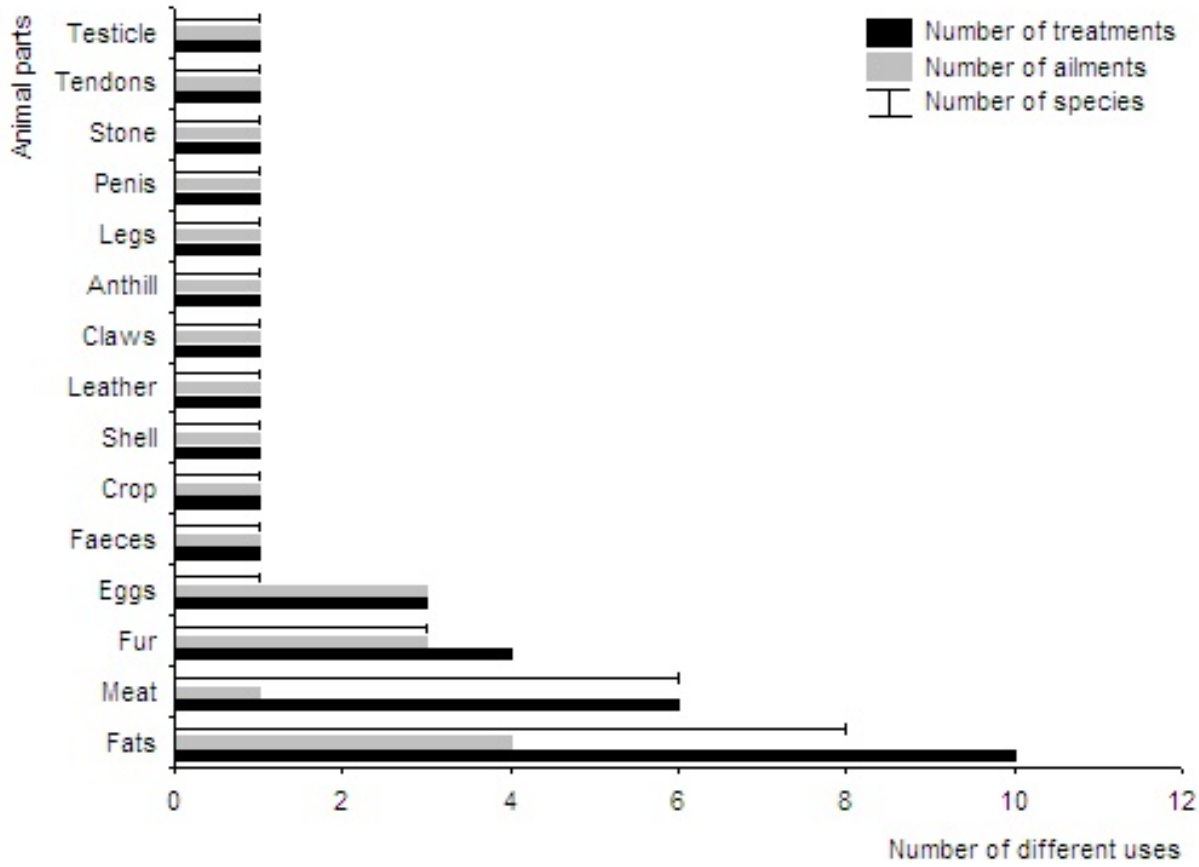

Figure 5. Zootherapeutic elements used in diverse treatments and ailments.

Versatility of use of animal medicines

The hen (*Gallus gallus domesticus*) was the species that offered the highest number of alternative treatments (Figure 2). Its eggs were used in the form of a poultice to cure *empacho*, and to treat burns through preparation of a cream. Its fat was also useful for burns and for a sore throat. It is known that this sociable bird plays an important role in the food security of farming communities of the Patagonian plateau, and in Argentina as a whole, conferring self-sufficiency on rural communities (Castillo and Ladio 2017b; Martínez 2013). Their importance in medicine has been amply cited, with dermatological, gynaecological/obstetric, pneumonological, toxicological and traumatological uses, among others (Alves and Alves 2011, Alves et al. 2011; Martínez 2013).

In order of versatility the hen was followed by *Ovis orientalis aries*, *Capra aegagrus*

hircus, *Rhea pennata* and *Pseudalopex culpaeus*. The use versatility of *Rhea pennata* described here coincides with historical records (Prates 2009).

Redundancy in animal medicine

The local zootherapy corpus was varied, dealing specifically with most of the ailments. Different, however, was the case of *empacho*, the ailment with highest redundancy of animal medicine for its treatment, numbering eight species (multinomial test, $p<0.05$): four domestic (*Canis lupus familiaris*, *Gallus gallus domesticus*, *Ovis orientalis aries* and *Capra aegagrus hircus*) and four wild (*Rhea pennata*, *Lama guanicoe*, *Zaedyus pichiy* and *Lagidium viscacia*). These results may be linked to the drastic socio-environmental change that followed the conquest of the territory, and the incorporation of livestock as the principal economic activity in the 19th century (Coronato 2015; Delrio 2010). Among the diverse processes involved, changes in certain habits, such as diet, had a strong impact on the health of Patagonian populations, like the incorporation of new illnesses such as *empacho*, and the solutions found in domestic and wild animals. This is in line with the findings of Crivos (2003) who worked with rural populations in Salta, where locals perceive the environment as an agent that may cause illness due to the severity of the climate, but can also offer healing solutions through the resources (plant and animal) that inhabit it.

Animals and plants of digestive use

It was found that treatments associated with digestive ailments combined elements of animal origin (the crop of Darwin's rhea, *flor de camino*, burned meat) with plants. Our interpretation is that no one element is preferred over another, rather they are both combined in the treatments, whether of animal or plant origin, forming part of a unique, complex, local medical system. The plants cited are *Artemisia absinthium* L., (common wormwood), *Dysphania ambrosioides* (L.) (wormseed), *Clinopodium darwinii* (Benth.) Kuntze (known as Pampa tea), *Mentha* ssp. L. (mint) and *Acantholippia seriphioides* (known as Patagonian thyme), possibly due to their aromatic, refreshing character, which enhances the remedy and its digestive effects. In addition, previous ethnobotanical studies in the region point out that digestive complaints are the most commonly treated with plants (Estomba et al. 2006; Molares and Ladio 2012; Richeri et al. 2013). Also found is the combination of animal fat with *jarilla* (*Larrea divaricata* Cav.) and *botón de oro* (*Grindelia chilensis* Cornel. Cabrera) for treatment of muscular/joint pains.

Considering the revision of Campos Navarro (2016), *empacho* is an ailment of widespread temporal and spatial diffusion, its treatment forming part of the traditional medicine of Latin American populations. Historical and ethnographic information on *empacho* is wide-ranging and exhaustive, since it appears in records as far back as the 16th century. In general, the illness is treated at home, and if necessary, popular specialists are employed, but a visit to a qualified doctor would be exceptional. There are many complex combined treatments, ranging from herbal products (more than 150 different plant species) to ritual elements (Campos Navarro 2016, Campos Navarro and Scarpa, 2013). The use of "countryside sugar" (dog feces) and the crop of the ñandú (*Rhea americana* Linnaeus 1758) (Darwin's Rhea) are also indicated in colonial and Jesuit texts, although registered as being of

secondary importance (Campos Navarro, 2009). Therefore, the similarities we can establish between the bibliography and our study is the cultural continuity of this ailment up to the present time in an isolated area of Northwestern Patagonia. In addition, the domestic zootherapy used to treat *empacho* in this community is notably diverse, records of this richness not being found elsewhere. Future studies should therefore be carried out in order to understand the strong regional roots of this ailment.

This coherence related to digestive complaints is to be expected, as their importance has been emphasized in association with a diet that is very high in meat and flour (Richeri et al. 2013), and because the treatments, whether of animal or plant origin, form part of a unique, complex, local medical system. For example, one of the most powerful medicinal plants (for heartburn) is *ñancolahuen* (*Valeriana* spp.) or "*remedio del ñamku*" (in Mapudungun) (Castillo and Ladio 2017b). The "*ñamku*" (*Geranoaetus polyosoma* Quoy and Gaimard 1824) plays an important role in the Mapuche cosmology: the bird appears in the dreams of an old woman, revealing the benefits of the plants, and the healing of 7 different illnesses (Lorenzo Loncón, Confederación Mapuche Neuquina, personal communication). This integration between humans, plants and animals in mutual transformation coincides with Ingold's meshwork idea, revealing a context that combines a unique assemblage of humans and non-humans with a cultural-environmental trajectory deeply rooted in local cosmology (Ingold 2008; Skewes and Guerra 2016).

CONCLUSIONS

This work concludes that animals play an important role in the local medical system, according self-sufficiency to these rural communities. Our results show the importance of each animal remedy, strongly linked to alterity; that is, the unique way in which animals are considered by livestock farmers. This study shows the methodological need in ethnobiology to contextualize in greater depth the vital networks that make up the processes of health and illness in rural societies. In these contexts, Nature and Culture are not separated as they are in western medical science; here animals are social players that transfer their powers and virtues to humans.

In line with the important role played by medicinal animals in the lives of Patagonian rural livestock farmers, the need for management measures in accordance with sustainability of the species must be emphasized. A large proportion of the animals of medical importance described here figure on the IUCN red list, implying certain conservation concern: Least concern (*Lama guanicoe, Pseudalopex culpaeus, Pseudalopex griseus, Puma concolor, Lagidium viscacia, Leopardus geoffroyi, Rhea pennata*), some of which (*Rhea pennata, Zaedyus pichiy, Puma concolor*) are highlighted because of their population trend, which is decreasing, and one Near Threatened (*Zaedyus pichiy*) (Figure 6). The laws that aim to protect wild species are designed from a western conservationist point of view, unaware of or disregarding local perspectives on animals and their dialectic and spiritual bonds. In this context, then, our results open up the possibility of transdisciplinary work, contributing information and emphasizing the richness and complexity of knowledge that constitutes

local ethnozoology. In agreement with Martínez (2013), our investigation aims to generate an atmosphere of reflection, to help us understand the different symbolic and symbiotic relationships established between local societies and their environments.

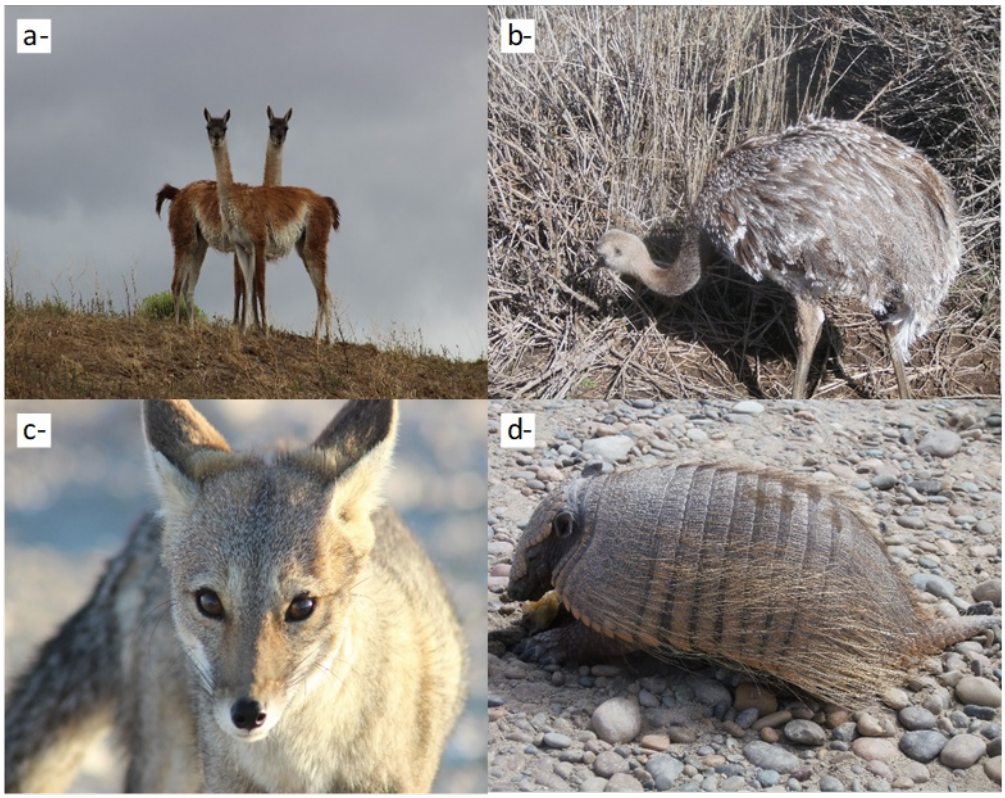

Figure 6. Animals used as local zootherapy, and IUCN Red List categories (World Conservation Union; www.iucnredlist.org/): Least concern (a-*Lama guanicoe* (guanaco), b-*Rhea pennata* (Darwin's rhea) c-*Pseudalopex griseus* (grey fox) and Near Threatened (d-*Zaedyus pichiy* (dwarf armadillo)

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