

# Traditional veterinary solutions for herders living in limited and changing conditions: A case study of “crianceros” of Central Northern Patagonia, Argentina

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## ARTICLE INFO

### Article history:

Received 6 July 2016

Received in revised form

1 June 2017

Accepted 3 June 2017

Available online 12 June 2017

### Keywords:

Traditional veterinary knowledge

Rural Patagonian herders

Rural dynamic herbolaria

Domestic animals

## ABSTRACT

In the arid Patagonia, sheep and goat breeding provides the main source of income for many traditional families of Mapuche-Tehuelche ancestry (locally named as “crianceros”). Using an ethnobotanical qualitative approach, traditional veterinarian knowledge (TVK) was studied in 20 rural establishments on the Central Chubut plateau (Argentina). During the study 17 diseases were registered, which are treated with 28 remedies involving 14 native plants and other resources of mineral origin. Healing practices include symbolic and religious elements, inherited as part of the biocultural memory of the region's original inhabitants and from European Hippocratic medicine. Environmental processes play a substantial role as aetiological agents, given that the environment is considered by inhabitants in an integral way, composed of both natural and supernatural elements. Plant species are versatile in their healing uses, and treatment is performed by both women and men in a similar manner. This TVK forms part of the unique *criancero* identity which is characterized by a constant, multidimensional dialogue with the different elements of nature. This article promotes reflection on the complex processes involved in construction of the dynamic, specialized medical-veterinary system in arid communities, and the importance of local veterinary solutions for herders living in limited and changing conditions.

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## 1. Introduction

Traditional Veterinary Knowledge (TVK), as part of Traditional Ecological Knowledge, has been defined as a body of knowledge, beliefs and practices related to animal care, which involves the use of resources of natural (animal and plant) and/or mineral origin (McCorkle, 1986; Martínez and Luján, 2011), and is complemented with symbolic practices, such as prayer, invocations to God or the saints, songs and different verbal interactions (Heinrich et al., 2009).

The number of articles published on ethnoveterinary practices is on the increase worldwide, both in arid and non-arid regions (Nabukanya et al., 2014; Pieroni et al., 2004; Tolossa et al., 2013). The role played by TVK has been described in relation to the subsistence of different pastoral communities that maintain their practices up to the present day, in a dynamic, ever more globalised

world (Viegi et al., 2003). There have been a profusion of contributions on Asia (Abbasi et al., 2013; Galav et al., 2013; Mishra, 2013), Africa (Nalule et al., 2011; Nabukanya et al., 2014) and Central America (Lans et al., 2007; Jurado-Alvarán et al., 2007). The species richness cited in these studies vary in range; for example, in Asia 89 veterinary plant species are described by Abbasi et al. (2013), while in Africa approximately 40 species have been recorded (Nabukanya et al., 2014).

In Europe studies on the veterinary use of plants have also become more numerous during recent years (Pieroni et al., 2004; Viegi et al., 2003; Söukand and Pieroni, 2016), partly due to recent interest associated with European organic livestock production. In relation to this, a review on European ethnoveterinary practices by Mayer et al. (2014) reported 590 plant species, taking note of their potential. This richness is a promising source for the development of medicines and/or alternative therapies in organic farming, an aspect which has been distinguished by national and multinational organisations. This aspect takes on much more significance if we consider its contribution in other contexts, such as pastoral societies in arid zones where inhabitants have limited

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access to capital goods, as is the case in Patagonia.

In Argentina there are interesting ethnobiological studies on rural communities which have recognised the importance of home-prepared veterinary medicine, and the aetiological and therapeutic interpretations of illnesses suffered by the animals have been analysed. Scarpa (2000) described 61 plant species of veterinary importance to populations inhabiting the Gran Chaco, and Martínez and Luján (2011) included a total of 70 plant species in their work carried out in the Sierras de Córdoba, while Muño (2010), working in La Pampa, described 10 plant species. All these studies indicate that homemade remedies emerge from the diverse cultural syntheses that have come about through situations involving interethnic contact, particularly between indigenous and European knowledge, since the time of the Conquest (16th century), and which were reinforced by European immigrants during the 19th and 20th centuries (Idoyaga Molina, 2012).

In the arid regions of Patagonia current livestock activity is based on the production of domestic animals, including sheep, goat, cattle, horse, and to a lesser extent pig, with marked specialisation in the ovine production of Merino wool (Coronato, 2011). There is a rich historical background to this context, which began with the adoption and breeding of horses as a means of transport and mobility by the first societies of hunter-gatherers that inhabited the region (Bandieri, 2005). Since the 18th century sheep and goats have been seen as a source of clothing, food and barter for local native peoples. Later, at the end of the 19th century, the territory changed its social, political, environmental and geographical configuration when the production model of extensive sheep farming was imposed in the region, thus incorporating the Patagonian territory into the international capitalist market. During this process, the native human populations in the region were decimated and expelled from their lands, and the territory was subdivided mainly into lots controlled by large livestock companies (Delrio, 2010).

The surviving indigenous families that managed to become established in marginal arid areas, together with Creole families who came from the north of the country, and immigrants from across the Andes and overseas, dedicated themselves to sheep and goat breeding as a subsistence activity. Their only access to the market was through commercial intermediaries (Coronato, 2015, 2011). Nevertheless, these societies have based their survival on multiple productive strategies, with the rationality unique to these small-scale producers, invoking a social memory and making use of landscape elements that give meaning and continuity to the past, recreating and maintaining an ancestral lineage (Ramos and Delrio, 2008). Through their livestock the settlers make use of the plant resources, for fodder, veterinary purposes and general healthcare for the animals, and they also collect plants with food and medicinal value for their families (Ladio and Lozada, 2008).

With the passing of time, various vital relationships were developed which promoted the survival of both animals and human populations, giving rise to adaptive behaviours and dynamic construction of TVK. This way of life, oriented more towards reducing risks than increasing productivity, has led to the evolution of a “criancero” identity that continues to be enriched even today (Bandieri, 2005; Coronato, 2011). This distinctiveness has endured despite serious fluctuations in wool prices and drastic environmental and socio-cultural changes in the region (Ladio and Lozada, 2009; Molaes and Ladio, 2014). Consequently, the plant communities of Patagonia have been transformed, and at the same time have acted as agents of transformation of the human communities who interpret and use them, thus generating a dialogue that moves through time and space as a bio-cultural entity, constructing real cultural landscapes (Lema, 2013; Molaes and Ladio, 2014). In this sense, the principal constructors of TVK on the Patagonian plateau

are the *criancero* families, with their subsistence economies. The animal care practices used by *crianceros* are the result of a learning process that spans many generations, and are associated with profound knowledge of the natural surroundings, and arid plants in particular.

Several authors have considered how TVK has originated and evolved in local communities, and its overlap with folk medicine (Pieroni et al., 2004; Scarpa, 2000; Martínez and Lujan, 2011). Following Abbasi et al. (2013), this overlap could be a reflection of how TVK is a diachronic and interconnected result of close observation of the efficacy of certain plants used both in animal and ethnomedical diseases. In general, the superiority of medicinal uses over veterinary applications, and the large number of coincidences in therapeutic targets would seem to show that TVK is a subset of human medicine.

In this sense, studies carried out in pastoral and non-pastoral societies in Patagonia and other regions have shown that the body of knowledge on medicinal plants is very versatile in its treatment of the most prevalent health problems at a local level (Richeri et al., 2013). In other words, the medicinal species most frequently chosen by rural communities are multifunctional (Molaes and Ladio, 2009; Richeri et al., 2013). This logic, which implies exhaustive use of the species, has not been evaluated in the case of veterinary plants in Patagonia. The subject is particularly interesting because it deals with knowledge that has been reshaped and/or adapted to the Patagonian peasant lifestyle in a relatively short period of time (no more than 400 years), contributing to sustainability of the Patagonian pastoral system.

In addition to this, various studies have shown that plant knowledge in traditional societies is generally structured according to gender and the division of work, age, and learning opportunities in the local context, amongst other factors (Lozada et al., 2006). For example, it has been suggested that women tend to know more than men about the cultivated resources and/or those destined for domestic use, particularly those associated with health and nutrition (Lozada et al., 2006). Nevertheless, the need for work to be carried out jointly between members of a pastoral family means that the women are also in charge of looking after the herd (Cardoso et al., 2015). As suggested by Madamombe-manduna et al. (2009), analysing and visualising the articulation between the plant knowledge of men and women helps us to understand the roles, significance, different gender perspectives and the dynamics that come into play in the practices associated with pastoral life.

In this work we propose to identify the plant species of veterinary value used in the arid communities of Sierra Rosada, Sierra Ventana and El Escorial (Chubut, Patagonia, Argentina), learn of their uses and understand their function and value in their cultural and social context. Our general hypothesis is that the inhabitants have, throughout their long history, established a profound connection with their plant resources, which is maintained and recreated constantly, resulting in a repertoire of veterinary plants that fits local needs in an arid context. Our principal questions are: What are the main resources used? Are there any differences between men and women in their knowledge of these resources? How important are these plants in veterinary treatments? Is there any similarity to local medical therapy? Where are the main gathering environments? What is the local aetiology and therapy? Is versatility of use of the plants important?

## 2. Methodology

### 2.1. The study area and herder populations

The study was carried out in the northwest of Patagonia, Argentina, in three rural communities of the Patagonian steppe

zone, characterized by a predominance of xerophyte and spiny species (Fig. 1) (Páruelo et al., 2005). The communities involved were Sierra Rosada ( $43^{\circ}04'39,67S/68^{\circ}25'04,65W$ ), El Escorial ( $43^{\circ}05'27,34S/68^{\circ}32'20,10W$ ) and Sierra Ventana ( $43^{\circ}06'34,72S/68^{\circ}10'09,05W$ ), which are located in a sector of basaltic relicts, foothills and narrow ravines (Richeri et al., 2013). The landscape alternates between gently sloped hills and steep sided rocky outcrops (Beeskow et al., 1987). In terms of phytogeography, the vegetation corresponds to the Patagonian biozone (Páruelo et al., 2005), where medium height shrub-grass steppe predominates, characterized by dwarf cushion shrubs, scarce grass cover and low coverage in general (Páruelo et al., 2005). *Berberis microphylla*, *Senecio* spp., *Mulinum spinosum*, *Chuquiraga avellanedae*, *Nardophyllum bryoides*, *Schinus* spp., *Grindelia chilensis*, *Acantholippia seriphioides*, *Nassauvia axilaris*, *N. glomerulosa*, *Acaena* spp., *Sisyrinchium* spp., *Pappostipa* spp., *Poa* spp. and *Erodium cicutarium* are some of the most predominant native species in the region.

The study area climate is arid and cold during a large part of the year (average annual temperature  $11.3^{\circ}\text{C}$  and average annual precipitation 174 mm), exposing inhabitants to severe conditions at certain times of the year (annual average, 98 days of frost). Access to this zone, by unpaved roads, tends to be difficult, and sometimes impossible due to snow or the consequences of heavy rain. Public transport runs from coastal urban centres, circulating with a frequency of once a week on the closest road, and goes as far as the small village El Escorial (Fig. 1), where inhabitants can buy food and general supplies. In addition, this is where they can send messages by means of AM radio, the main method of communication through the “rural message” system. Establishments are relatively distant from each other due to the considerable distances between them and from El Escorial. Basic medical care is also available here, in the form of a rural health post where they have access to a nurse and general medicines. Although some families own their land, the majority find themselves in an irregular and insecure situation of land tenure. This situation can lead to severe difficulties, and also blocks access to possible credit lines.

The inhabitants of these communities are of Mapuche/Tehuelche and/or Creole ancestry, and they live in small-scale rural

farming establishments approximately 2500 ha (one league) in size, demarcated with wire fencing. Small herds of goats and/or sheep constitute their most important social and cultural capital (Coronato, 2015; Richeri et al., 2013). The average size of informants' sheep herds is 370 animals, and goat herds have an average of 154 animals. The use of dietary supplements for the animals is not common, native pastures being the principal source of fodder. The sheep and goats are bred principally for the sale of wool and not of meat, since they prefer to keep the animals and increase the herd. From an economic point of view, the families' subsistence is based on their management of the sheep and goat livestock combined with hunting, family horticulture, the gathering of firewood, the sale of local natural resources and participation in official aid plans (Richeri et al., 2013). The production mode is pastoralism, households earning more than 50% of their income from livestock, using unimproved pastures. Due to the small size of establishments, they are generally not subdivided into sections; the animals are kept in mixed groups, with paddocks for the rams. At present, due to the low market value of wool, the profitability of this activity is very low, and the situation is aggravated by the high mortality of livestock due to predation (Von Thüngen, 2014), volcanic ash (from the Chaitén and Puyehue volcanoes, which erupted in the years 2008 and 2011, respectively) and the drought suffered over the last 10 years, amongst other factors (Iglesias et al., 2015).

## 2.2. Methodology and data analysis

Fieldwork was carried out according to recommendations established at the United Nations Conference on Sustainable Development (Rio+20, 2012), for the regulation of access to genetic resources and the corresponding knowledge, protection of traditional knowledge and recognition of intellectual property rights. Furthermore, the guidelines of the Code of Ethics of the International Society of Ethnobiology (2006) were also followed. Rural establishments were visited repeatedly during four campaigns in the area, in 2013 and 2014. The sampling method consisted of an exhaustive survey, as a census, where the aim was to interview all the smallholding families living in Sierra Rosada (7

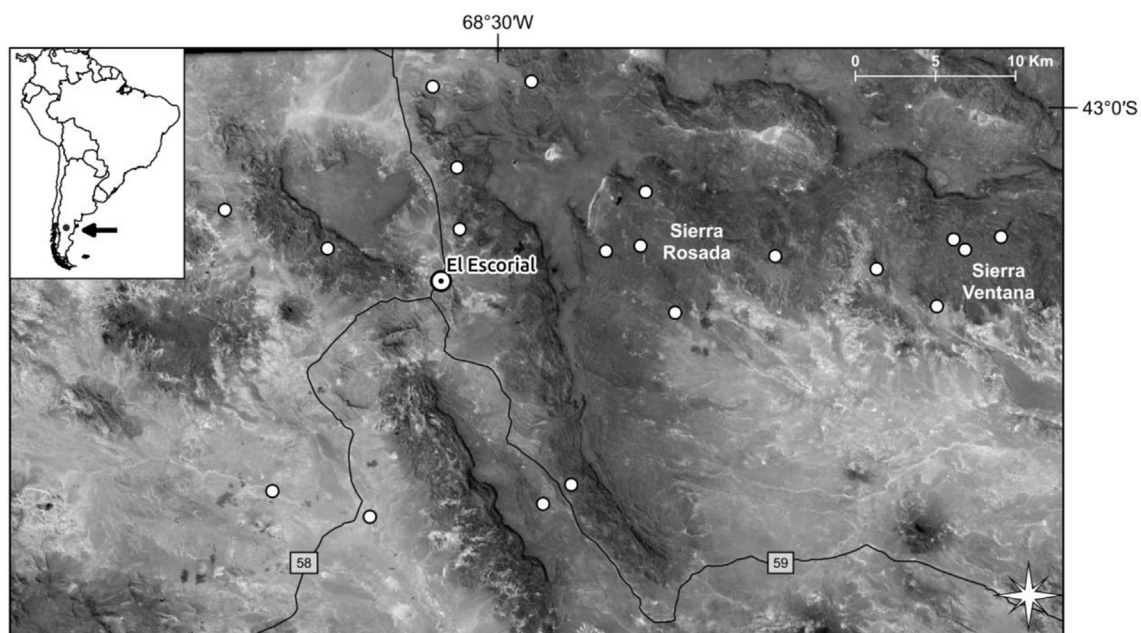


Fig. 1. Study area of the rural communities of Cerro Ventana, Sierra Colorada and El Escorial (Chubut, Patagonia, Argentina).



rural establishments), Sierra Ventana (5 rural establishments) and El Escorial (11 rural establishments). Apart from Sierra Rosada, where interviews could not be carried out in 3 establishments, all others were visited (20 in total, 87% of the establishments in the region). It should be noted that the dispersed rural population in this zone is estimated at 40 inhabitants distributed among 23 domestic units at the time of study, while data from the latest census revealed an average density of 0.08 inhab/km<sup>2</sup> Central Chubut plateau region, in contrast with 1.84 inhab/km<sup>2</sup> for the province as a whole (INDEC, 2010). Open (Albuquerque et al., 2010) with 20 informants, who were “household heads” (representatives of the domestic unit), whose ages varied between 45 and 77 years (75% men, average age  $64.3 \pm 11$  years, and 25% women, average age  $67.2 \pm 9$  years).

Information was gathered on local names, gathering environments, illnesses treated and methods of administration of the different plant species used for veterinary purposes. Audio recordings were made of the interviews as well as field notes. Herbarium material was used as a reference and samples of plant species collected in the company of interviewees were deposited in the botanical collection of the *Centro Nacional Patagónico*. Species were identified with the help of CENPAT expert botanists. The information was processed and systemised both for this study and for the development of future educational material for the community. The species used in the community were identified and classified as native or exotic relative to the province of Chubut, according to phytogeographical origin, following Zuloaga and Morrone (1999a,b).

The information compiled from the interviews was analysed and first interpreted qualitatively, considering its emic and/or etic dimension. In addition, some data were analysed qualitatively, reinterpreting the information from the field work, and then analysed statistically. For example, the total composition and richness of species and botanical families were estimated, understood as the sum of species and/or families cited in the total number of interviewees (Ladio and Lozada, 2008). Species versatility was obtained by means of the total number of different uses given for each species cited by informants (Ladio and Lozada, 2008). The use consensus index (UC) of each species was also calculated, using the formula: number of informants who cite each species/total number of informants ( $N = 20$ )  $\times 100$  (Ladio and Lozada, 2008). Non-parametric statistics were employed to analyse gender differences for TVK, using the Mann-Whitney test ( $p < 0.01$ ). Finally, the Spearman correlation was applied ( $p < 0.05$ ), to evaluate whether use consensus (UC) is associated with species versatility.

### 3. Results and discussion

#### 3.1. Animal care throughout the year, and faith

Traditional veterinary knowledge in the region is interwoven in the smallholder's work, and is therefore intimately linked to the annual cycle and availability of natural fodder. Families constantly monitor the herd's health throughout the year. Principally, the practices related to care of sheep imply keeping the males separate from the females; they are brought together in the winter, thus ensuring that young will arrive in the season of highest fodder abundance (i.e. spring, when the bushes sprout new shoots, the grass is green due to winter humidity and the highly valued annual forage plants appear), thus favouring survival of the new-borns. The annual livestock cycle is marked by other significant events, such as vaccination and wiggling (removal of wool from around the eyes) in winter, and castration, shearing and marking in spring. For these activities the sheep or goats must be herded, for which the use of horses and dogs is essential, and neighbours tend to help

each other with this task. These activities engender a profound bond between the herders and their breeding animals, whether horses, sheep or goats, since their survival depends on each other. It is even common to observe small orphaned or abandoned sheep or goats being bottle fed in the homes in spring.

##### 3.1.1. Faith in the use of veterinary plants

The herders trust, or “have faith” (emic denomination), in the efficacy of their own treatments, even in comparison with some of the biomedical remedies they have access to. For example, one 77-year-old informant (SV4M) pointed out that the use of plants (ash of the leaves of *Salix* sp. for “ceguera” (Pink eye), further details below) “... cures quickly ... and there's colirio too, that you can buy, it cures it as well, but not so fast, eh? ... only if the infection has just started, but if it's already taken hold the colirio takes more time ...”.

This “faith” in plants has been inherited through oral transmission from ancestors, and seems to be based on traditional cosmovisions of the original peoples of the region, such Mapuches and Tehueches: a relational conception where environmental elements are animated and have powers (Foerster, 1995; Molares and Ladio, 2014). In other words, this concept seems to be strongly sustained not only by the therapeutic efficacy of the plants perceived by the shepherds, but also by the confidence they should have in their powers: “... if you don't have faith in the plants, they won't cure you, eh?..”. SR1M (aged 74) “... to be cured by the plants you have to have faith in the plants, here the medicines are the bushes ...” E1F (aged 62). Nevertheless, the nature of this faith appears to have acquired a hybrid character at this time; it could come from the traditional Mapuche-Tehuelche cosmovision but in some cases it shows elements belonging to Creole medicine, with strong Christian symbolism, incorporating prayers to the Christian God into the healing practice. According to E7F (aged 71), “The praying is new ... it used to be different ... it was like this: this plant is going to heal me, and that's that, that plant will cure you”.

It is worthy of note that in the study area the influence of veterinary biomedicine is very limited, mainly due to the long distances to urban centres or other semi-rural localities in the region, the limited financial resources of locals, and their geographic isolation, which makes frequent visits difficult for the technicians who work in the zone.

#### 3.2. Plant resources in veterinary medicine

##### 3.2.1. Composition and richness of ethnoveterinary species

A total of 14 plant species were registered, belonging to 10 botanical families of ethnoveterinary importance (Table 1). Richness is low in comparison with other publications (Martínez and Luján, 2011; Scarpa, 2000), possibly because of scarcer environmental availability of plants in these semi-arid Patagonian environments that present lower species richness (Richeri et al., 2013). It is interesting to highlight that 50% of these species have been described for human medicinal use in the region (Richeri et al., 2013), as is the case of *Schinus* sp., *Mulinum spinosum*, *Grindella chilensis*, *Senecio filaginoides*, *Atriplex lampa*, *Larrea nitida* and *Larrea divaricata*. Nevertheless, only two of these species coincide in therapeutic terms: *Larrea nitida* (Jarilla), used as an anti-inflammatory remedy, and *Grindella chilensis* (Botón de Oro) used for dermatological purposes. This agreement is to be expected, since both traditional and veterinary medicine correspond to the same system, where the criteria of health and illness are shared.

##### 3.2.2. Botanical families

The botanical family of greatest veterinary importance registered in this work is Asteraceae (11 uses, Table 1), and this is also the most frequently used family for veterinary purposes in Córdoba

**Table 1**  
Plants used for veterinary purposes in rural communities of the Chubut plateau (Patagonia), according to the illnesses affecting domestic animals, type of preparation and local treatments. The botanical species are presented in decreasing order of percentage use consensus as in Fig. 2. \*native origin.

Family	Scientific Name	Local Name	Illness	Part used/ Preparation	Treatment	Animal	Gathering Environment
Asteraceae	<i>Senecio filaginoides</i> DC.*	Charcao	Mal seco (Grass sickness) Moquillo (Distemper)	Branches and leaves/ Burning and Smoking Branches and leaves/ Smoking Branches and leaves/ Infusion	The animal is smoked, so that it inhales the smoke. It is given as a drink	Horse	Campo
Asteraceae	<i>Grindella chilensis</i> (Cornel.) Cabrera *	Botón de oro	Wounds Bumps Post-castration swelling Pasma (swelling due to temperature) Burns Sprains	Leaves/Infusion Leaves/Poultice Branches and Leaves/ Decoction Leaves/Decoction Leaves/Poultice	Bathed with the infusion The crushed leaves are placed on the affected area and bandaged. The affected area is bathed with the lukewarm preparation Bathing with the infusion, with salt and soap Bathing The crushed leaves are placed on the affected area and bandaged.	all	Campo
Zigofilaceae/ Asteraceae	<i>Larrea</i> sp.* and <i>Grindella chilensis</i> (Cornel.) Cabrera *	Jarilla and Botón de Oro	Wounds	Branches and leaves/ Poultice	The crushed leaves are placed on the affected area and bandaged.	all	Campo
Apiaceae	<i>Mulinum spinosum</i> (Cav.) Pers.*	Neneo	Mal seco (Grass sickness) Parasites Moquillo (Distemper)	Branches and leaves/ Burning and Smoking Root/Decoction Root/Infusion	The animal is smoked, so that it inhales the smoke. 1 lt. of the decoction is given in spring It is given as a drink and used to bathe the body	Horse Horse and sheep Horse	Campo
Zigofilaceae	<i>Larrea nítida</i> Cav.* and/or <i>Larrea divaricata</i> Cav.*	Jarilla	Wounds Pasma Mal seco (Grass sickness)	Branches and leaves/ Infusion Branches and leaves/ Poultice Branches and Leaves/ Decoction Branches and leaves/ Infusion	Bathing with the infusion The crushed leaves are placed on the affected area and bandaged. Bathing Bathing with the infusion, with salt and soap It is given as a drink	all Sheep Horse	Campo
Fabaceae	<i>Prosopis denudans</i> Benth.*	Algarrobbillo	Ceguera (Pink eye)	Spine/Puncture	The ear(s) are pierced with the spine(s)	Sheep	Campo
Salicaceae	<i>Salix</i> sp.	Sauce	Ceguera (Pink eye)	Branches/Burning and Smoking	Applied with a paper rolled into a tube, and the smoke is blown into the eyes.	Sheep	Marshes, watering holes and/or springs
Fabaceae	<i>Senna aphylla</i> (Cav.) H.S. Irwin & Barneby *	Pichana	Moquillo (Distemper)	Branches and leaves/ Smoking	The animal is smoked, so that it inhales the smoke.	Horse	Marshes, watering holes and/or springs
Fabaceae	<i>Prosopis alpataco</i> Phil. f. alpataco *	Algarrobo	Ceguera (Pink eye)	Spine/Puncture	The ear(s) are pierced with the spine(s)	Sheep	Campo
Cactaceae	<i>Maihueiopsis darwinii</i> (Hensl.) F. Ritter*	Tuna	Mal seco (Grass sickness)	Entire plant/Burning and Smoking	The animal is smoked, so that it inhales the smoke.	Horse	Campo
Euphorbiaceae	<i>Stillingia patagónica</i> (Speg.) Pax & K. Hoffm. *	Yuyo cresco	Sarna (Mange)	Branches/Decoction	The area is bathed	Sheep	Campo
Chenopodiaceae	<i>Atriplex lampa</i> (Moq.) D. Dietr.*	Zampa	Sarna (Mange)	Branches and leaves/ Burned to obtain ash	The area is bathed with the ash	Sheep	Campo
Berberidaceae	<i>Berberis microphylla</i> G. Forst. *	Calafate	Ceguera (Pink eye)	Spine/Puncture	The ear(s) are pierced with the spine(s)	Sheep	Campo

(Argentina) (Martínez and Luján, 2011) and Europe (Mayer et al., 2017; Sökand and Pieroni, 2016). In relation to the botanical families used in traditional medicine, Asteraceae also presents the highest percentage of taxons with human medicinal use in this study region in particular (Richeri et al., 2013), and also in other parts of Patagonia (Molares and Ladio, 2009). This has been

associated with their environmental availability, since they are the botanical family with the greatest species richness in the region (Richeri et al., 2013). Martínez and Luján (2011) have suggested that the global pattern of knowledge and selection of medicinal plants, where the Asteraceae family is one of the most intensely used for human medicinal purposes in the world (Moerman et al., 1999),

may also extend to the field of veterinary medicine. Both aspects, therefore, biogeographical and cultural, could explain their regional relevance.

Amongst the botanical families registered in this work, the Zygophyllaceae family also stands out, and the genus *Larrea* in particular, due to its great cultural importance and versatility in terms of veterinary use to the farmers of La Pampa (Argentina) (Muiño, 2010), and in traditional medicine in Patagonia due to its analgesic/anti-inflammatory properties (Richeri et al., 2013).

### 3.2.3. Biogeographic origin

It is interesting to note that the majority of plants used for veterinary purposes are native to the region (97%) while only one species is exotic (3%) (Table 1), a phenomenon which has also been described in rural communities of other regions in Argentina (Martínez and Luján, 2011; Muiño, 2010). This result indicates the importance of native flora and the fine adjustment of practices to local possibilities through dialectic interactions over time. In addition, the lower level of hybridisation of knowledge with that of exotic plants, compared to the medicinal herbolaria, is notable; in general for this zone native and exotic plants are used in similar proportions in local medicinal therapies, but in this case the pattern is different (Richeri et al., 2013). This could be mainly due to the fact that the context of animal treatment takes place directly in the countryside, “in situ”, and so the medicinal plants at hand are the ones mainly used. In contrast, medicinal plants are generally used in the home, where they have been either dried and stored, or brought in fresh from the garden, and are mainly exotic in origin (Lozada et al., 2006; Richeri et al., 2013).

### 3.2.4. Species consensus amongst inhabitants (UC%)

It was found that the species with highest use consensus were *Senecio filaginoides*, *Grindelia chiloensis*, *Larrea nitida*, *Larrea divaricata* and *Mulinum spinosum* (Fig. 2, Table 1). The species with the lowest use consensus were *Prosopis denudans*, *Maihueiopsis darwinii*, *Prosopis alpataco*, *Senna aphylla*, *Salix* sp., *Atriplex lampa*, *Berberis microphylla*, *Schinus* sp. and *Stillingia patagonica*. This shows that some species have greater importance than others, possibly due to the higher prevalence of certain illnesses, and therefore more frequent use of particular plants (Fig. 2). It is notable that the species with higher veterinary use consensus were also used to treat human ailments, whereas those with lower use consensus were used only in veterinary medicine. *Atriplex lampa* and *Berberis microphylla* (Fig. 2) are exceptions, which were registered as medicinal plants by Richeri et al. (2013) and edible plants by Ladio and Lozada (2009). As found by other authors (Scarpa, 2000; Martínez and Luján, 2011; Pieroni et al., 2004), this result indicates that species of which ethnoveterinary knowledge is more widespread and used amongst the region's inhabitants were utilized both for curing animal and human illnesses, although not necessarily in the same way.

### 3.2.5. Gender and knowledge of veterinary plants

The number of plants used for veterinary purposes mentioned by men ( $2.6 \pm 3.54$ ) is similar to the number given by women,  $2.8 \pm 4.20$  (Test de Mann Whitney:  $U = 35$ ,  $p = 0.86$ ). This reflects that knowledge and practices related to the care and healing of animals is shared between men and women in the communities visited. The goats are often cared for by the women, who also do the domestic tasks, as mentioned by E5F (aged 74), “... I did a bit of everything ... I liked going out into the campo, I liked being at home, pasturing the animals, bottle feeding the orphaned goats, coming home from the campo and cooking ... cold meats, a piece of meat, and we ate outside, in the Creole style, the gaucho style. I like going around the campo, looking after the animals, my whole life was about looking

after the animals ...” In the region, the role of women in the family's medical care has been substantially demonstrated, particularly in the domestic context (Richeri et al., 2013). Our findings reveal that their role extends to caring for the animals, and to other areas, such as the countryside. In addition, our results seem to show that gender relations were complementary and equitable in terms of this type of knowledge, involving extensive exploration of the environment.

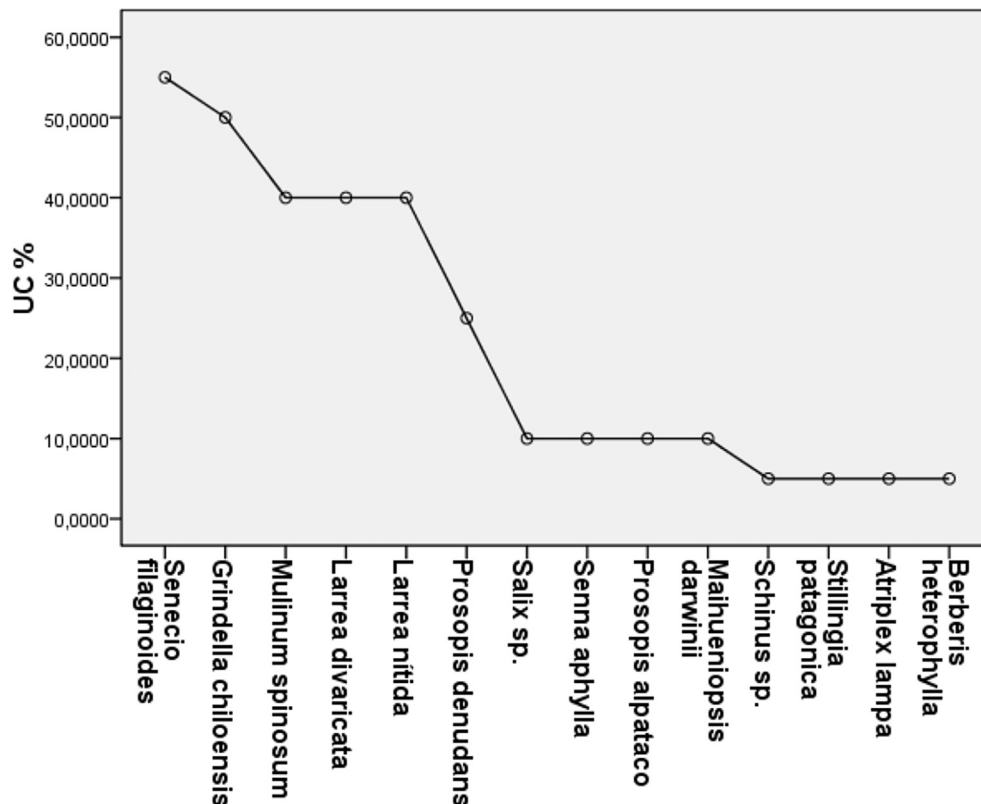
### 3.3. Gathering environments

Veterinary plants used in the region come mainly from two gathering environments which have different characteristics, distinguished mainly by differential humidity. The “campo” (the camp, the steppe) is the main gathering environment (12 species, 96%), while only a few plants are collected from marshlands, springs, watering holes and riversides (the humid areas) (2 species, 14%) (Table 1). The humid areas, such as the marshlands, are generally found close to dwellings (approx. 200 m), while the countryside implies a much larger and more variable area to travel through. The countryside plants used by herders tend to be identified in patches that may or may not be found far from the establishment, depending on the species in question. For example, plants that grow in high areas of the countryside, such as *Paramela*, are generally found in patches situated far from dwellings (approx. 500 m).

Shrub-grass steppe vegetation predominates in this area, and amongst the most conspicuous native species are *Berberis microphylla*, *Senecio* spp., *Mulinum spinosum*, *Chuquiraga avellanadae*, *Nardophyllum bryoides*, *Schinus* spp., *Grindelia chiloensis*, *Acantholippia seriphioides*, *Nassauvia axilaris*, *N. glomerulosa*, *Acaena* spp., *Sisyrinchium* spp., and the fodder grasses *Pappostipa* spp., *Poa* spp. and *Erodium cicutarium*, which are scarce during very dry periods. The soil is poor in organic material; sand is abundant, as are the erosion pavements observed when eolic erosion removes the fine material, leaving Patagonian rocks and stones exposed. Coverage is low, less than 50%. Few exotic species grow on the Patagonian steppe, examples being *Rosa rubiginosa* (Sweet briar, a European shrub), and *Bromus tectorum* (an annual graminea of Eurasian origin). The steppe is where locals spend most of their time, carrying out the work required by their way of life (“campereando” is the local term to describe this). About this, informant E4M (aged 73) says the following: “I like the campo ... you're lucky if you find me at home ... I go out in the morning even if I don't have to ... you'll find me in the hills.” The campo also represents a place of learning, which seems to figure increasingly less in the lives of the young, as mentioned by E1F (aged 62): “The medicines one used to make, I'll never forget them, I always have them in my memory, the young today don't know anything about that because they're not brought up in the campo.” SR2M (aged 65): “The children of the country folk go to the town and in the end they don't understand anything”.

In addition, during the interviews there were many different views expressed on the importance of the rains in the dynamics of this environment: “If we get good years, the campo comes back to life” SR2M (aged 65) “if there is moisture the campo recovers” E1F (aged 62). In this conversation it also transpires that the “campo” is an entity which has a life of its own, which can become ill and have the power to recover with the rains.

The campo, the environment which most represents the herders, is the meeting place where solutions to everyday problems are worked out, not only animal ailments, but also how to heat the home, acquire construction materials, things for the home, food for the livestock, medicine, etc. Therefore, the camp is a multipurpose place-entity. It is the place of grazing, of transit and collection of other useful plants (Molares and Ladio, 2014), and learning about



**Fig. 2.** Range-Frequency curve of use consensus (UC %) of the different veterinary plants utilized in the rural communities of Cerro Ventana, Sierra Colorada and el Escorial (Chubut, Argentina).

local uses and practices. This reveals the strong dependence of inhabitants on wild areas, and the profound connection between humans and the campo, which is seen as an extension of their homes, and is where they spend most of their time.

In particular, this is also the environment which exhibits the greatest environmental and social fragility, due mainly to soil erosion processes and desertification (Coronato, 2011; Paruelo et al., 2005), which have intensified in the region in recent years, directly impacting the abundance and distribution of native plants (Ares et al., 1990; Beeskow et al., 1987). Unfortunately, this is also where most mining projects are currently being developed in the country, representing, in the opinion of inhabitants and specialists (Iglesias et al., 2015), a serious threat to the wild plant resource and to traditional knowledge.

The marshlands, watering holes, swamps and springs are zones situated in depressions with high water content. They are plains associated with rivers or valley bottoms, where there is a lot of farming interest. They differ from the areas around them in the type of soil, which is highly organic, and the amount of palatable grazing for the livestock (Paruelo et al., 2005). Plant coverage at these sites is often 100%, and is therefore also essential for wild and domestic fauna. Some of the main edible species are *Juncus balticus*, *Hordeum* sp., *Distichlis* sp. and *Carex* sp. Most of the species currently present in the marshes are exotic (generally European) or cosmopolitan (Paruelo et al., 2005). Added to this, these humid zones, or wherever there are rivers or springs, tend also to have gallery forests of *Salix* sp. Molares and Ladio (2014) registered the importance of these environments as a source of medicinal species. Informants reported collecting two veterinary species here, one native (*Senna aphylla*) and one naturalised, of the genus *Salix* sp.

### 3.4. Aetiology and the veterinary model

The animal diseases cited by herders are described in Table 2. It includes a brief description of the 17 illnesses affecting animals of the region cited by informants, with their corresponding local names. Six ailments affect horses (envenenamiento, grass sickness, *peciato*, distemper, parasites, *mal de orín*); five affect sheep (mange, *ceguera*, post-castration swelling, *peciato*, envenenamiento); two affect dogs (envenenamiento, moquillo) while the remainder may affect horses, sheep, goats and dogs (sprains, *pasmo*, poisoning, burns, *agusamiento*, etc).

Natural and supernatural causes can be differentiated according to the inhabitants' perspective of the aetiology of these diseases. Unlike the supernatural explanations, the natural causes are those which could be accepted as valid by modern biomedicine (Idoyaga Molina, 2012). An example of these is the "temperature imbalance", where logic associated with humoral medicine can be perceived, a tendency which is strong in traditional Creole medicine in Argentina (Idoyaga Molina, 2012; Martínez and Luján, 2011; Scarpa, 2000) and in the rest of the world (Alawa et al., 2002; Bartha et al., 2015), and determines the principal therapies. Nevertheless, in agreement with McCorkle (1986), our results show that the emic distinction between natural and supernatural in terms of animal health is diffuse, and they have a mutually reinforcing and inseparable affinity.

It is important to point out here that the environment is experienced by locals in its natural and supernatural entirety. In this work it was found that the campo is where, from an emic vision, "the plants are raised" while at the same time the settlers "raise" their animals (Lema, 2013). In other words, the campo is the source of health, since it signifies a source of food, shelter and medicine for



**Table 2**

Veterinary illnesses affecting domestic animals, and healing practices that include plants and non-plant elements. \* affects only sheep.

Local illnesses	Treatments using non-plant elements
<b>a) Illnesses affecting sheep and goats</b>	
<i>Ceguera</i> (=Blindness) (Pink eye). The eyes go white and the animal can't see. Known in biomedicine to be caused by an infectious keratoconjunctivitis	- A rusty wire is driven into the ear(s) - A cut is made in the eye so that it bleeds
<i>Hinchazón post-castración</i> .	- Bathing with kerosene
<i>Post castration swelling</i> of castrated animals	- Bathing with used oil
<i>Sarna</i> *(Mange). Affections of the skin. According to biomedicine it is an ectoparasitosis caused by different genera of mites ( <i>Psoroptes</i> sp., <i>Sarcoptes</i> sp.).	- Bathing with Yuyo Crespo ( <i>Stillingia patagónica</i> ).
<b>b) Illnesses affecting sheep and horses</b>	
<i>Peciato</i> . Hardening of the mouth (skin lesions) which cause starvation and death. According to biomedicine it is caused by a virus of the Poxviridae family.	- Bathing with kerosene - Bathing with used oil
<i>Poisoning</i> . Consumption of Garbancillo ( <i>Astragalus pehuenches</i> )	- Locals know of no cure
<b>c) Illnesses affecting horses</b>	
<i>Mal seco</i> (Grass Sickness). The animal cannot defecate and finally dies. Known to biomedicine as a multisystemic neuropathy.	- They are given a dose of water with detergent to drink
<i>Moquillo</i> (Distemper). The animal has a constantly runny nose. Known in biomedicine to be caused by a bacteria ( <i>Streptococcus equis</i> )	- Jute from sandals is burned around the animal so that it will inhale the smoke. - A bag containing salt and kerosene is tied to the bit
<i>Parasites</i> . The animal loses weight and dies because of the parasites. Caused by different organisms, the most common of which is the "Bicho del Cuajo" ( <i>Gasterophilus</i> spp.)	- A preventative dose is given of an infusion of Neneo ( <i>Mulinum spinosum</i> )
<i>Mal de orín</i> . The animal cannot urinate.	- Steam inhalation
<b>d) Illnesses affecting dogs</b>	
<i>Poisoning</i> . Consumption of poison left for predators such as the puma or fox.	- An incision is made so that bleeding occurs
<i>Moquillo</i> (Distemper). The animal has a constantly runny nose. Known in biomedicine to be caused by a bacteria (genus <i>Morbillivirus</i> of the Paramyxovirus family)	- Drops of detergent are put in the eyes - They are given meat with ground sulphur - They are given meat with garlic - They are given meat with salt and kerosene
<b>e) Illnesses affecting all animals (sheep, goats,, dogs, horses)</b>	
<i>Agusanamiento</i> . External wounds with worms. Known in biomedicine as a Myiasis caused by insect larvae.	- Bathing with kerosene - Bathing with used oil
<i>Bumps</i> . Pains in the body which impede normal mobility	- Treated with a poultice or plant infusion ( <i>Grindella chilensis</i> and <i>Larrea</i> sp.)
<i>Wounds</i> . Cuts in the skin	- The wound is covered with ash from the fire and salt. - The wound is bathed with used oil
<i>Pasmo</i> . Swelling induced by heat or cold. There is no equivalent in biomedicine.	- Bathing with kerosene - Bathing with used oil
<i>Burns</i> . Injury to the skin caused by excess heat or friction	- An incision is made so that bleeding occurs - Bathing with kerosene
<i>Sprains</i> . Injury to the limbs due to bumps	- Treated with a poultice or plant infusion ( <i>Grindella chilensis</i> and <i>Larrea</i> sp.) - Treated with a poultice or plant infusion ( <i>Grindella chilensis</i> and <i>Larrea</i> sp.)

the breeding animals, although certain elements of the environment also appear to be agents of possible illnesses (Molares and Ladio, 2014). For example, a signal for some of the interviewees are the dust whirlwinds which can be seen in the campo, considered a supernatural agent that may cause something bad to happen. The local recommendation is: "it's better not to get too close" or "cross your fingers when you see it" to prevent this. Which could indicate that certain aspects of the cosmovision of native peoples are still kept alive. The meaning of dust whirlwinds, called "Meulen" in the Mapuche language, has been re-signified and transmitted across generations, as locals consider this territory as the stage where they face the forces of good and evil (Molares and Ladio, 2014).

The conception of an integrated physical and social environment whose imbalance leads to animal illnesses is a cosmovision derived from the historic process of social change experienced by inhabitants. The considerable emigration of locals in the past 100 years (Iglesias et al., 2015), the fact that the land was fenced off due to the establishment of "private land" (Coronato, 2015) and the accumulation of land by the "más pudientes" (a local expression referring to landowners who have a lot of buying power), are all

related by some of the locals to a notable decrease in the amount and occurrence of religious ceremonies like the Ngillatun. The Ngillatun is a Mapuche ceremony during which the people request good weather, successful sowing and harvesting, protection from illness, abundance of food, and spiritual strength and vitality for the community (Foerster, 1995). In the past this ceremony was celebrated every year at the winter solstice, bringing families from far around, but this tradition was later abandoned in the region. All of this has generated an imbalance, and according to some informants, has triggered processes that favoured the occurrence of the prolonged droughts seen in the last 20 years (Iglesias et al., 2015), which have had a severe impact on the animals' health. In recent years the ceremony has been taken up again, on the local school's initiative. Informants mentioned that because of this a greater amount of snow had fallen during the previous winter, that of 2014. This vision finds concordance in Mapuche cosmology, which reflects an animist conception of Nature where all animals, plants, rivers, hills and man have a spirit, i.e. possess life and will, and are in constant dialogue and interaction through words, attitudes, chants, dances and actions, which are governed in turn by certain laws, such as reciprocity, balance, cyclical time and



complementarity (Foerster, 1995).

As a consequence, drought is seen as an environmental imbalance, an agent causing certain illnesses in the animals, and of course, the lack of fodder which often leads to animal deaths. On the other hand, water is another environmental agent that causes illness, according to the local vision, and so it is considered that animals which graze on land with access to brackish water are healthy, with a lower risk of becoming infected with parasites. From this we see that the aetiological method reflects a medical system based on a conception of illness associated with an imbalance or rupture of the equilibrium.

The associated healing practices employed to counteract this imbalance are also similar to the European humoral medicine practices present in Creole medicine (Idoyaga Molina and Sarudiansky, 2011). For example, the healing practice of making incisions in order to “bleed” the animal used in domestic dogs in cases of poisoning (Table 2), involving a cut in the ear has its roots in these Hippocratic conceptions. In this case the ear cutting seeks to re-establish the balance of the fluids in the body. Also seen, for the case of temperature imbalance, is the therapy of using hot or cold elements to recover the lost balance, following the principal of hot-cold contrast (Idoyaga Molina, 2012). Some of the remedies used for this temperature condition can be seen in the study area, such as “kerosene” or “used oil” (further details are given below in Table 2), both “hot substances” which according to inhabitants cure different animal ailments. In relation to this, during the interviews “heat” (and “cold”) were cited as agents that provoke the illness “pasma” after castration, which is cured with the external application of plants in the form of poultices, such as Jarilla (*Larrea divaricata* and *Larrea nitida*) and Botón de Oro (*Grindella chilensis*) (Table 1), both considered “hot” plants in this and other regions (Molares and Ladio, 2014). This could represent an alteration in the principle of the hot-cold contrast, where a “hot” ailment is cured with a plant of the same “hot” nature, and represents one more aspect of the metamorphosis suffered by this theory in Argentina, and which is also seen in other zones such as NOA, Cuyo and Mesopotamia (Idoyaga Molina and Sarudiansky, 2011).

### 3.5. Illnesses and veterinary therapy

A total of 28 different curative treatments of domestic animals were recorded (Table 1). However, the therapeutic practices are not limited to the use of plants, but are complemented with the use of other, non-plant or mineral elements (Table 2). The use of veterinary remedies composed of mineral elements, or mixtures of mineral elements and plants, is widespread around the world, such as the use of soft soap, schnapps, vinegar, oil and honey in Europe (González et al., 2016; Bischoff et al., 2016; Sōukand and Pieroni, 2016), the use of salt, sugar, milk, oil, eggs and ghee in Asia (Abbasi et al., 2013), of wood ash, kaolin and potassium, local soap and spent engine oil in Africa (Alawa et al., 2002) and of salt, fat from different wild animals, oil, ash and kerosene in America (Martínez and Luján, 2011; Scarpa, 2000). It has been proposed that these mixtures produce synergic effects, and/or additives which can contribute to healing of the animals (Alawa et al., 2002).

In addition to this, magic-religious healing practices are also carried out, as in other folk veterinary systems of Argentina (Martínez and Luján, 2011; Muiño, 2010; Scarpa, 2000) and Europe (Vogl et al., 2016; Bischoff et al., 2016). Preventative practices were also identified, particularly in the case of illnesses more closely related to supernatural causes which are combatted by means of “humos” (smoke), making offerings to the land, crossing one’s fingers and through prayer; for example, during ceremonies like Nguillatún. The burial of bezoars (mineral concretions which form in the stomachs of animals such as goats) in the corral is another

way of protecting the animals’ health, procuring good weather and abundant fodder. Another practice associated with this integrated vision of animal health is the habit of hanging dead wild predatory animals, such as the red fox (*Pseudalopex culpaeus*) or Geoffroy’s cat (*Leopardus geoffroyi*), on corral fences to dissuade predators from approaching the livestock. Finally, in accordance with Vogl et al. (2016) and Pieroni et al. (2004) in Europe, the informants in this study viewed fodder and feeding as the most important preventive measures for ensuring animal health and welfare.

#### 3.5.1. The role of smoke in veterinary therapy

Worthy of special mention within local therapy is the “purifying” symbolism of smoke in the treatment of a sick animal. Illnesses such as grass sickness which attacks horses and impedes excretion, is often interpreted by some inhabitants as being caused by an agent that acts on the animal, and has to be “removed from the animal’s body”. To this end, “humos” are used, particularly strong ones being used for this purpose, like the “Tuna” (*Maihueniopsis darwinii*) or the “Charcao” (*Senecio filaginoides*). The use of smoke to “get evil spirits out” or “protect” living beings or places is common practice amongst some inhabitants of the region. Distemper, another illness that affects horses, is considered the product of an agent that has to be “removed from the body”. For these occasions “strong” plants are used. Those selected for the purpose of curing animals are *Senna aphylla* (Pichana), *Mulinum spinosum* (Neneo), *Senecio filaginoides* (Charcao) and *Maihueniopsis darwinii* (Tuna) (Table 1). Some locals also cited the use of a jute sole (from a kind of local shoe named “alpargata”) or horse dung, which also produce “strong smoke”. In other words, through the burning of “strong” elements, such as jute, cloths or dung, they seek to obtain smoke which is dense, dark and penetrating to purify and restore health. It should be noted that the root of *Mulinum spinosum* was also cited by informants as a useful plant, since the burning of its root produces smoke that protects the home and the people, keeping evil spirits at bay and preventing illness.

Molares and Ladio (2014), in their work on Mapuche-Tehuelche communities in arid environments in Patagonia, have already described the importance in these traditional medical systems of the plant species associated with problems caused by the supernatural world, within the linguistic label of “alwe lawen” (medicine for the souls of the dead, in Mapuzungun), considered “füre lawen” (strong/unpleasant/repugnant in Mapuzungun). Species like *Rosmarinus officinalis*, *Ruta* spp., *Laurus nobilis* and *Artemisia absinthium*, are described within this group of “strong” plants (Molares and Ladio, 2014, 2009). It is also known that smoke holds important symbolism in the Catholicism system of beliefs, as a semantic equivalent of fire (Idoyaga Molina and Sarudiansky, 2011). Within this system, fire has been used since ancient times to annihilate evil through burning, and, since this is not possible, it is done symbolically through the use of smoke. It is likely that the veterinary practices recorded in this work combine the availability of the plants perceived, classified and named according to deep-rooted traditional knowledge of their sensorial “füre lawen” characteristics, with therapies of European origin, inherited from Hispanic Christian medicine.

#### 3.5.2. Manipulation of the landscape for animal health

Herders also try to procure animal health by manipulating their landscape. In accordance with the findings of McCorkle (1986), health care of domestic animals on the plateau implies work of a wide-ranging nature, which includes all the practices that can have a positive or negative impact, direct or indirect, on the physical condition of the animals they manage. Manipulation of the landscape in this case implies management practices associated with the eradication of weeds toxic to the livestock. Another way of

looking after the animals' health is eliminating a particular plant species, garbancillo (*Astragalus pehuenches*), considered the “horse drug”, since, say the inhabitants, once the animal has tried the plant it can't stop eating it, becoming ill with a kind of “madness” until it dies: “... it's like a drug ... the animal searches for it. It makes the horses go crazy until they die.” (E9M, aged 82). There is no remedy to cure this illness, neither in biomedicine (Martínez et al., 2014) nor in the local traditional medicine, possibly because it has arrived in the area relatively recently. Therefore, the way to keep the animals healthy is to eliminate this plant from their land, which they do by means of burning, before the seeds are produced, or simply by removing the plants from the area. This environmental management practice of protection has been described by Richeri et al. (2013) and is an example of the local solutions used by inhabitants in order to preserve their herds.

### 3.6. Versatility of plant resources and use consensus (UC)

In this research it was found that the body of TVK possessed by the herders of the Chubut plateau is composed of species which are notable for their versatility. The species with the greatest variety of uses are *G. chilensis*, *L. divaricata*, and *L. nitida*, principally for external use, for sprains, burns, bumps and other skin complaints; *M. spinosum* and *S. filaginoides* cure illnesses like distemper and grass sickness (Fig. 3).

It was also found that the species with highest use consensus amongst inhabitants, such as *S. filaginoides*, *G. chilensis*, *M. spinosum*, *L. divaricata* and *L. nitida*, are those with most versatility of use, which can cover the widest spectrum of ailments (Spearman correlation:  $r = 0.080$ ,  $p < 0.05$ ). This result reveals the profound exploration conducted into these plants and the close relationship which has been forged between these species and the smallholders over time, a link that is reinforced by the efficacy of their healing,

and therefore, sustained by social validation. This pattern, associating the higher frequency of use of certain veterinary plants which are more multifunctional, coincides with findings for other use categories, such as medicinal, edible and fuel wood species, both in Patagonian populations (Ladio and Lozada, 2009; Richeri et al., 2013) and in other Latin American (Ceuterick et al., 2011) and European rural communities (Sóukand et al., 2017).

To sum up, our overall results show that Patagonian arid landscapes constitute a place where pastoral societies find valuable plants for a predefined purpose: continuity of their pastoral lifestyle. Herders who live in the regions of Sierra Rosada, Sierra Ventana and El Escorial find in the wild plant resource an important source of specialized remedies useful in treating domestic animals, as an adaptation strategy to combat a hostile environment. The inhabitants have constructed, over the long history of the community, a profound connection with the plant resource, which is maintained, recreated and transmitted constantly, leading to a repertory of veterinary plants of great versatility which satisfy local needs and sustain the smallholders' way of life. Their TVK is enriched with the livestock breeding work carried out by the men and women, and speaks of the important relationship created between these species and the rural smallholder over the long history of the region, as well as its efficacy and social validation.

## 4. Conclusions

The world's pastoral arid and semi-arid socio-ecosystems, like the one in this study, are of great current scientific interest due to their fragility as a consequence of global environmental change. In addition, these societies which are generally invisible, marginalised and vulnerable, have historically been subjected to situations of social inequality, which has led to a lack of structure that exacerbates drought and desertification processes. This is why TVK is

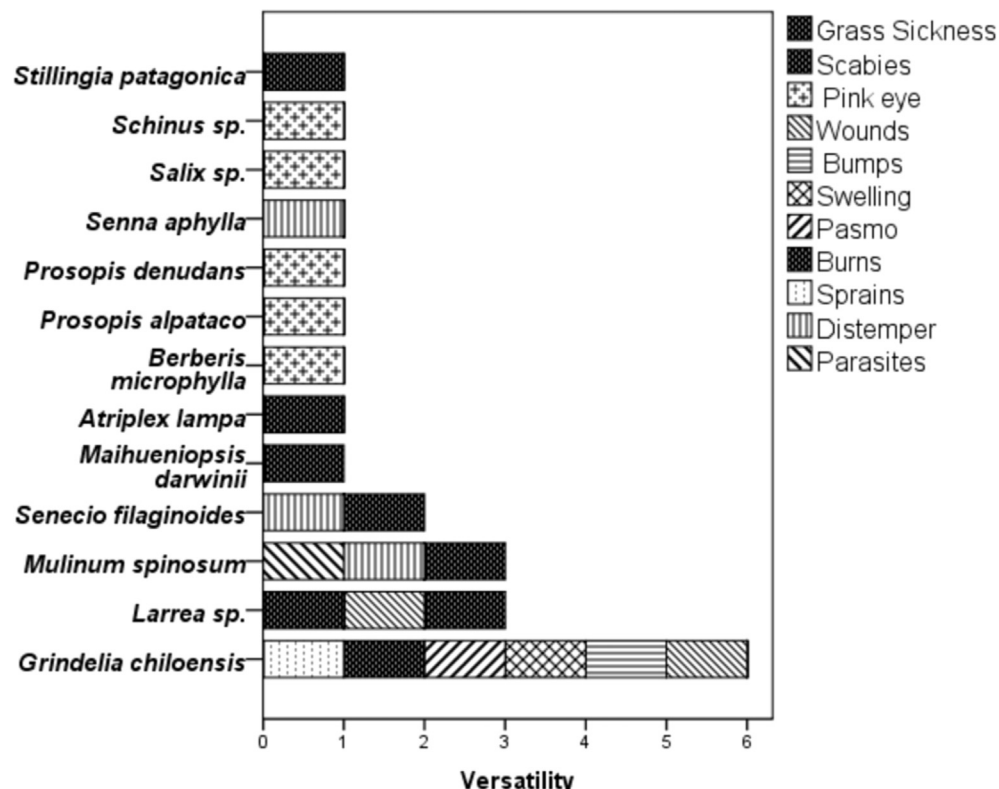


Fig. 3. Ranked Proportions of plant taxa used in traditional veterinary medicine, in relation to their versatility of use.

invaluable as a solution to the lack of economic and technological resources.

In this work it is seen that local ethnoveterinary knowledge is rich in wisdom, practices and conceptions that involve, in a profound way, environmental processes as disruptive factors to animal health, such as the changes brought about by the increase in aridity, and desertification. Through livestock breeding and the processes of transformation that have taken place over time in social practices, a complex, dynamic veterinary-medical system was constructed, forming part of the criancero's unique identity. A system which still continues to participate in a continuous multidimensional dialogue with the different elements of nature.

This case study enables us to reflect on the importance of including TVK in herder community development policies in arid zones the world over, as an alternative way of decreasing their vulnerability due to global change. The establishment of public policies which accompany “development with identity” is essential, i.e., development “from within”. TVK offers autonomy and low-impact, accessible, green solutions, the result of reciprocal relationships between herders and their landscape.

## Acknowledgements

We are profoundly grateful to the inhabitants of the Sierra Rosada, Sierra Ventana and El Escorial communities for their kindness in sharing their knowledge with us, and for their hospitality. We would also like to thank Lic. Juan Pablo Nievas for his important contribution as field assistant, and the anonymous reviewers for their constructive criticism and suggestions. This research was supported by a doctoral dissertation fellowship assigned to the author Lucía Castillo by the Consejo Nacional de Investigaciones Científicas y Técnicas (PIP 2013-0466) and the Secretary of Science and Technology of the province of Chubut Province. We also thank Fondo Nacional de Ciencia y Técnica (FONCYT) of Argentina (grant PICT 2012-1073).

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