UNIVERSIDAD DE CHILE -FACULTAD DE CIENCIAS - ESCUELA DE PREGRADO

"**Cambio en el conocimiento de plantas nativas medicinales en territorios rurales sometidos a expansión de plantaciones forestales**"

Seminario de Título

entregado a la Universidad de Chile en cumplimiento parcial de los requisitos para optar al Título de Biólogo Ambiental

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Marzo 2019

Santiago - Chile

ESCUELA DE PREGRADO – FACULTAD DE CIENCIAS – UNIVERSIDAD DE CHILE

INFORME DE APROBACIÓN SEMINARIO DE TITULO

Se informa a la Escuela de Pregrado de la Facultad de Ciencias, de la Universidad de Chile que el Seminario de Título, presentado por el Sr. Fabián Eduardo González Lagos

Se informa a la Escuela de Pregrado de la Facultad de Ciencias, de la Universidad de Chile que el Seminario de Título, presentado por la Sr. Fabián Eduardo González Lagos "Cambio en el conocimiento de plantas nativas medicinales en territorios rurales sometidos a expansión de plantaciones forestales"

Ha sido aprobado por la Comisión de Evaluación, en cumplimiento parcial de los requisitos para optar al Título de Biólogo con mención Medio Ambiente.

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Santiago, Marzo 2019

BIOGRAFÍA

Nací un 22 de Mayo de 1990, en la ciudad de Talca, Región del Maule. Fue por esos lugares donde primeramente descubrí mi cariño por la naturaleza, gracias a las constantes salidas al aire libre con mis padres Fabián González e Isabel Lagos. Tuve la suerte de conocer desde pequeño Vilches, Pelluhue y Pellines, entre tantos otros lugares. Cursé la Educación Media en el Liceo Abate Molina de Talca, fundado por el célebre naturalista chileno del siglo XVIII, el Abate Juan Ignacio Molina. Luego ingresé a la carrera de Medicina en la Universidad Autónoma de Chile, pero me retiré a los 2 años y medio, por no soportar la vida intrahospitalaria. Posteriormente llegué a Biología Ambiental en la Universidad de Chile, motivado por el curso de Zoología. Sin embargo, pronto me di cuenta que eran las plantas mi gran pasión y pude concretar mi anhelo de tener un vivero de especies nativas junto a otros compañeros de carrera. Conocí a mis maestros Mauricio Folchi y Javier Simonetti en el año 2016, los cuales me invitaron a participar en una investigación acerca de plantas medicinales nativas, en el marco de los efectos de la expansión forestal en Chile, desde un enfoque social aplicado a las ciencias biológicas. Tan solo cambió un poco el paciente de estudio.

AGRADECIMIENTOS

Agradezco primeramente a todos los integrantes del proyecto Anillo SOC 1404, “Dinámicas naturales, espaciales y socio-culturales: perspectivas sobre los conflictos socio-ambientales en territorios forestales de Chile, 1975-2014”, ya que fue gracias a este grupo que mi investigación se pudo realizar. Entre ellos, agradezco a Enrique Aliste, Patricio Pliscoff, Noelia Carrasco, Bárbara Hernández, Daniela Cea, Ítalo Moletto, Pablo Aguilera, Valentina Aliste y muchos más, por su inspiración y opiniones acerca de la temática. A Santiago Parra, mi compañero investigador de plantas comestibles, por su paciencia, responsabilidad, rigurosidad y compañerismo.

Al Proyecto Fondecyt 1140657, el cual permitió costear los viajes a terreno y por lo tanto esta investigación.

A mi maestro Javier Simonetti, por su paciencia, empatía, cariño, inspiración y sabia labor docente, cosas que me guiaron en todo momento durante el transcurso de la presente investigación.

A mi cotutor Mauricio Folchi, por su rigurosa y multidisciplinaria visión de los conflictos ambientales en Chile, ya que inspiraron y guiaron mi labor.

A los integrantes del Laboratorio de Conservación Biológica, Ronny, Silvio, Diego, Ariel, Ana, Carolina, Rocío, Marión, entre otros, por su apoyo constante, compañerismo y profesionalismo.

A la familia Parra, por su hospitalidad y amabilidad, en especial a Freddy Parra, por habernos facilitado el auto para las visitas a terreno y por sus gratas conversaciones.

A mi familia, a mi padre, Fabián, mi madre, Isabel, mis hermanos, Felipe, Natalia, Lucas y también a Terry "alegría", por todo su cariño entregado, lo cual me permite ser una mejor persona cada día.

A las familias González Osses y Lagos Fuentes, en especial a mi Tía Licha, Rosa, mi tío Mario, Tito, mi tata Manuel y muchos otros, por su cariño y apoyo en todo momento.

A mis amigos de Universidad y compañeros del Vivero Educativo la Lombri, entre ellos Daniela, Luciano, Antülemu, Claudio, Gustavo y Felipe Morales, entre otros, por su amistad y critica sincera cuando se requería.

A mis amigos de Talca, entre ellos Nicolás, Charly, Greco y Javier, por su apoyo incondicional y amistad sincera.

A integrantes del Club de Árbol de Talca, Don Marcos, Don Fernando, Don Gonzalo, Don Romero, entre tantos otros, por inspirarme a seguir protegiendo las plantas nativas.

A mi compañeros de JUPEN, organización ambiental de Talca, César, Camila, Miguel, Bastián, Angie y Francisca, entre muchos otros, por su inspiración de trabajar en temáticas ambientales.

A Pía, por darme fuerza y ayudarme a entender a la Madre.

A Marcela, por incentivar a lanzarme por completo al mar.

A Belén, por mostrarme el valor de uno mismo.

A cada una de las personas que amablemente contestaron nuestras encuestas y se dieron el tiempo de conversar conmigo, por su sabiduría olvidada y entendimiento del medio en el cual vivían, por inspirarme a seguir cuidando y amando esta Tierra. En especial a la señora que votaba "derecho", a la señora que nos hizo el huevito bañado en aceite y al caballero que me comento acerca del "cielo partido" y la "laguna de sangre", entre muchas otras. Personas con historias interesantísimas para ser escuchadas por aquel que quiera oírlas.

A funcionarios de la Municipalidad de Paredones, a las dueñas de los hostales en que nos quedamos en Paredones y Arauco, por su cariño entregado, amenas conversaciones y ricas comidas.

A todas las personas que directa o indirectamente ayudaron a esta investigación y a cada uno de los lectores.

A los que llegarán, a los que están y a los que se fueron.

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RESUMEN

El reemplazo de la vegetación nativa podría provocar la extinción de la experiencia y una consecuente erosión cultural respecto del conocimiento sobre plantas medicinales nativas. Analizamos si este fenómeno ocurre en los habitantes de dos comunas chilenas sometidas a diferentes grados de expansión forestal. A través de encuestas de listado libre, evaluamos las especies medicinales conocidas, usadas y colectadas. Controlando por variables control socioculturales analizamos si el conocimiento decrecía con el reemplazo de vegetación mediante Modelos Lineares Generalizados. No se detecta relación entre la tasa de reemplazo y conocimiento de plantas nativas medicinales, pero si una relación positiva con la edad, la experiencia local y la vegetación nativa disponible en los años 70. A pesar del reemplazo, la gente aún recolecta algunas plantas en fragmentos de vegetación nativa así como en sitios antropizados, promoviendo su experiencia. Existiría una "deuda de extinción cultural", dando tiempo para generar actividades de difusión y conservación biológica para evitar la extinción de la experiencia y erosión cultural.

ABSTRACT

Replacement of native vegetation could promote the extinction of experience and cultural erosion regarding native medicinal plants. To prove this, 426 free list surveys were carried out in two Chilean municipalities exposed different to forestry plantations expansion, assessing for known, used and harvested plants and sociocultural covariates. Signs of cultural erosion were found. Although no relationship was detected between replacement rate and knowledge, there is a positive relationship of knowledge of medicinal plants with age, local experience, and the amount of native vegetation available during the 70's. People still harvest medicinal plants from native vegetation remnants and anthropized sites, enhancing their experience. We advance the existence of a "cultural extinction debt", giving time to generate activities of diffusion and biological conservation to avoid the extinction of experience and cultural erosion.

Keywords: Extinction of experience, Ethnobotany, Forestry plantations, Medicinal plants, Plants knowledge

INTRODUCTION

Loss and degradation of forests might decrease the availability of medicinal plants to local people (Anyinam 1995), reducing their opportunity to use them, triggering an erosion on their knowledge (Grenier 1998). Harvesting and use of wild medicinal plants is a key source for the knowledge of medicinal plants (Lozada et al. 2006). Therefore, land use changes might foster an "extinction of experience", a "cycle of (environmental) impoverishment that is initiated by the homogenization and reduction of local flora and fauna, followed by (human) disaffection and apathy" (Miller 2005:431). In addition to changes in the availability of medicinal plants, sociocultural factors such as age (older people might have more chances to have experienced medicinal plants), gender (gender-related activities in the countryside might expose a gender more frequently to medicinal plants), years of formal education (formal education reduces the reliance on wild medicinal plants, hence knowledge about them), occupation (some jobs activities could increase the opportunity to experience medicinal plants), place of birth and time of residence (options to have experienced the demise on native vegetation and observed the replacement by forestry plantations) might also impinge upon the knowledge of wild medicinal plants (Quinlan and Quinlan 2007; Pfeiffer and Butz 2005; Voeks and Leony 2004).

In Chile, forestry plantations based on exotic species cover over 3 million hectares (INFOR 2018). By mid-XX century, plantations were used to control soil erosion caused by agricultural and cattle activities in the XIX century (Toro and Gessel 1999).

Later, since the 70s, the high expansion of forestry plantations (mainly by *Pinus radiata* and *Eucalyptus* spp.) have replaced native forest in the south central zone (28% of the total loss of native forest between 1973 and 2011) (Miranda et al. 2017). Nowadays, the remnants of native vegetation, that include native forest and degraded forest or shrubland are located in areas with high slope or places of difficult access (Aguayo et al. 2009). Replaced native vegetation held a suite of medicinal plants historically used by local people (e.g. Espinoza 1897; Vogel et al. 2005); therefore, they might be suffering an extinction of experience due to a decreasing in the opportunity to interact with native medicinal plants, adding cultural erosion to the ongoing biological erosion raised by landscape-level transformations (Simonetti-Grez and Simonetti 2018).

Monterey pine (*P. radiata*) monocultures are unevenly distributed in central Chile. Therefore it might be expected that, everything else being equal, in areas with a greater replacement of native vegetation by pine plantations, local people will exhibit a lesser knowledge of native medicinal plants compared to inhabitants of areas with less landscape transformations. In this research, we test this hypothesis comparing local knowledge of native medicinal plants, in two municipalities of the Coastal Range of central Chile, Paredones and Arauco, which exhibit different amount of native vegetation replacement by the expansion of forestry plantations. We aim to evaluate the relationship between the replacement of native vegetation and the harvest, use and knowledge of native medicinal plants.

MATERIALS AND METHODS

Study Area

The municipalities of Arauco and Paredones (Figure 1) are both located in the area of the forestry plantations expansion. In socioeconomic terms, 20.3% of the 38.270 inhabitants of Arauco live in poverty, similar to the 30% of poverty among the 6.700 inhabitants of Paredones (BCN 2018). While, Arauco exhibits a moderate diversity of economic activities, Paredones is regarded a "strongly rural, with an economy dependent on agriculture" (Berdegué et al. 2010).

Regarding forestry expansion, they differ in their dynamics. While both municipalities have suffered a reduction of native vegetation coverage since the nineteen century, Arauco maintained its native forest by 1944 (Otero 2006). In relation to native vegetation (shrubland and native forest), both municipalities show a decreasing between the 70s and 2015, with Arauco presenting values of 48.4% to 30.2% of its surface between periods and Paredones from 49.1% to 36.8%. On the contrary, they exhibit an increasing in forestry plantations, from 21.3% to 43.6% in Arauco and 3.0% to 48.9%, in Paredones. In relation to native vegetation replacement, forestry plantations replace the 45.8% of the 70s native vegetation in Arauco and 51.3% in Paredones (Moletto, unpubl.).

To properly test our hypothesis, we sampled different types of landscape change, taking into account the following scenarios: a) low past native vegetation and low increasing of plantations, b) medium past native vegetation and a medium increasing of plantations and c) high past native vegetation and high increasing of plantations. Vegetation change was assessed within a circular buffer of 2 km radius around all rural village at each municipality in two different periods: 1975 (Paredones) and 1979 (Arauco), prior to the boost of plantations, and, 2015 up to present day. Nine rural villages (three of each type of landscape change) were selected, with more than 30 households per municipality.

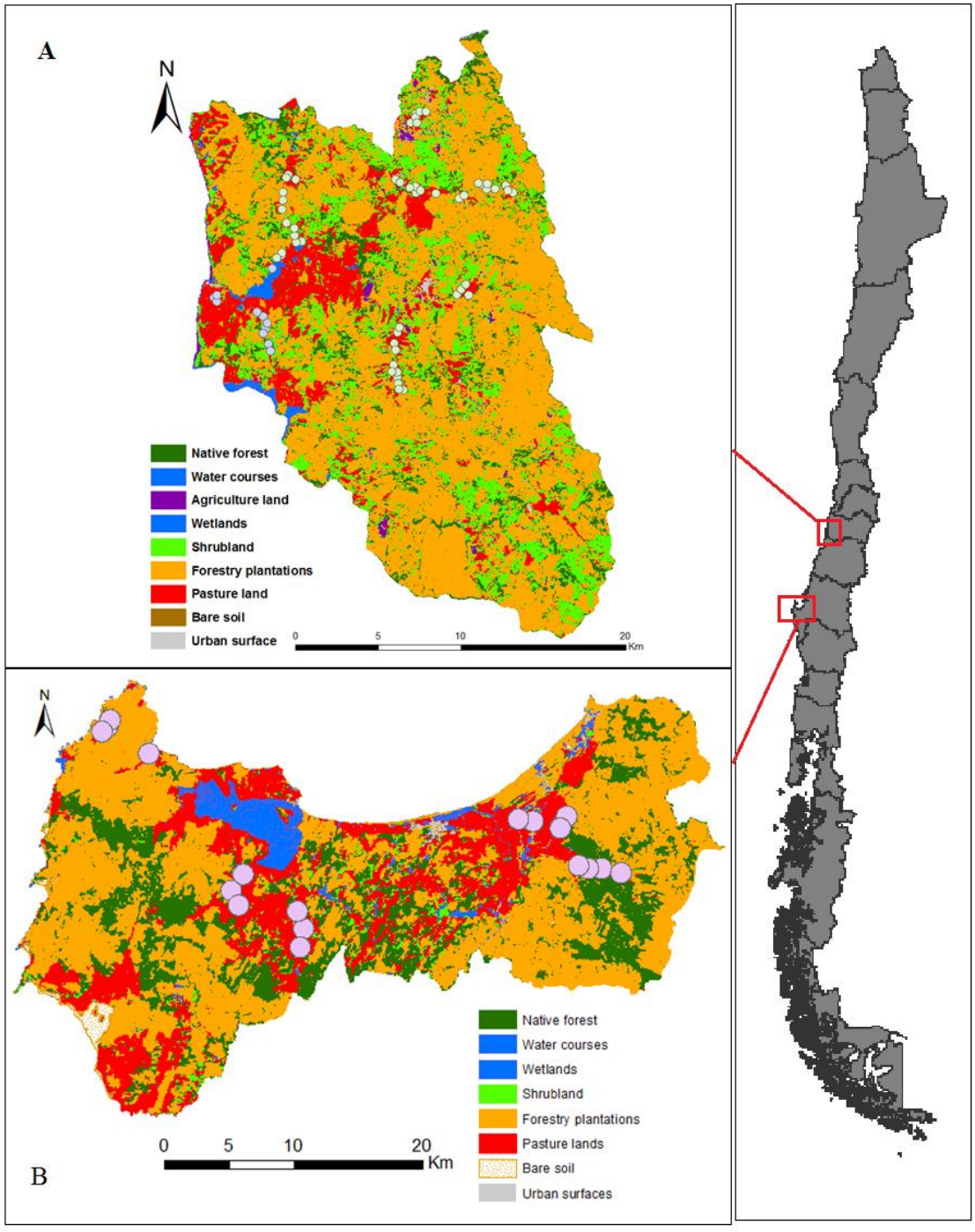

Figure 1 Land coverage (2015) in Arauco and Paredones with their circle buffers (explained later) in the villages selected for the study. A: Paredones, B: Arauco.

Knowledge of medicinal plants

The number of native medicinal plants free-listed by local inhabitants of Arauco and Paredones was used as an index of the knowledge. To assess the potential maximum number of native medicinal species that could have known and compare it to the total of native species mentioned, we first estimated the number of native medicinal plants recorded in Arauco and Paredones from several databases (Muñoz et al. 1981; Bannister et al. 2011; Instituto de Botánica Darwinion).

In order to assess the knowledge of medicinal plants, individual Free Listing surveys (Puri 2011) were carried out interviewing a total of 426 people (194 in Paredones and 232 in Arauco). The questionnaire used in the survey is presented in the Appendix 1. At each village, only persons over 18 years old were interviewed, one per household, with a maximum of 30 and a minimum of 10 interviews per village, depending on the availability and disposition of the inhabitants. Each respondent was requested to list wild plants with medicinal purposes. Also, they were requested to indicate which ones had been used during the last 12 months, and of those, which ones were harvested. Also, it was inquired regarding the distance from their homes to the site of harvesting. The identity of plants named were confirmed by direct observation, data delivered by respondent or bibliography. Plants were classified in native and exotics species according to their biogeographical origin.

Sociocultural covariates that might impinge upon knowledge of wild medicinal plants such as age, years of formal education, occupation place of birth and time of residence,

were asked. On these grounds, we typified the Local Rural Experience as a): low, for people who had been born in regions different than Arauco or Paredones and had arrived there 5 or less years ago, b): medium, for people who had been born in rural areas of Arauco and Paredones but who then migrated to an urban environment and later returned. It also considered people who were born in a rural area different than Arauco and Paredones and had arrived more than 5 years ago and c): high, for those who were born and had always lived in the surveyed villages. Similarly, we considered a) jobs linked to wild environments, including activities related to agriculture, forestry, fishing, hunting and gathering and, b) jobs unrelated to wild environments, such as domestic work, commerce, construction, among others.

The importance of each plant species was assessed through the Smith Salience Index S: $(\Sigma((ni - ri + 1) / ni))/N$, where *ri* is the position of *i* species in the listing offered by each respondent, and *ni* is the number of items on it. *N* is the total number of interviews. (Puri 2011). This index considers the frequency of appearance and the ranking of each species and takes values from 0 to 1, where 1 represents species named first in all lists and 0 represents species infrequently named or altogether absent in some lists (Smith 1993). Therefore, a value of Salience near 1 of a species named, reflects a higher importance of that one within the cultural domain of medicinal plants in the surveyed group. Native and exotic species were evaluated but the analysis focused in the natives at municipality scale.

In order to assess the effect of the replacement of native vegetation by forestry plantations upon the opportunity to experience medicinal native plants, we assessed the distance at which native plants were harvested. All quanti and qualitative information regarding harvest distances (walking time, a site mentioned or others) were standardized to traveled meters. We considered the average human walking speed of 5 kmh-1 (Abdel-Malek and Arora 2013) and the average speed of car travel of 50 km h-1 (due to the gravel roads in the places visited). Data were analyzed at municipality level, and the harvesting area of the most salient native species (< 90% of accumulated Salience, Appendix 2 Figure 1 and 2) was estimated. Then, we used the median harvest distance as the radius of a circular buffer around interviewed households (a circle buffer could contain more than one house, see total circle buffers in Figure 1 and an example in Appendix 2 Figure 3). Coverage of native vegetation (native forest and shrubland lumped) and forestry plantations were quantified within this circle. Coverage of different soil uses, including native forest, forestry plantations and others by the 70s (1979 in Arauco and 1975 in Paredones) and 2015 (both municipalities) was provided by A. Moletto (unpublished), in order to estimate landscape changes over the last 40 years. Native vegetation replacement was obtained with the ArcMap software program tool "Intersection". Considering that forestry plantations were not the only cause of native vegetation loss, two types of replacement were considered a): Replacement due to forestry plantations and b): Total replacement, including loss due to forestry plantations, urban surface, agriculture and pasture lands.

The relationship between the number of native medicinal known, used and harvested species by person and the amount of native vegetation replacement was assessed through three different Generalized Linear Models (GLIM), including environmental variables such as total and forestry replacement, past native vegetation (to evaluate the effect of that past offer of medicinal species in the present knowledge) and sociocultural covariates (age, education, gender, job type and local rural experience). The explanation of each variable used in the GLIM is shown in Table 1 and the frequency distribution of each numerical variable is shown in Appendix 2. We used a negative binomial model with a logistic link function, considering that the response variables were counts of species mentioned and had a positive skew distribution (see Figure 2). To avoid multicollinearity, the criterion of exclusion in variables with VIF over 5 was used (Craney and Surles 2002). The data of the two municipalities were considered in one model. Kendall Tau rank test was used for correlations and Wilcoxon rank sum test for difference between variables.

Table 1 Characterization of variables used in the GLIM

Variable	Variable type	Unit/ Levels
Explanatory		
Total replacement of 70s native vegetation	Continuous	Percentage of the buffer surface
Replacement of 70s native vegetation due to forestry plantations	Continuous	Percentage of the buffer surface
70s native vegetation	Continuous	Percentage of the buffer surface
Covariates		
Age	Discrete	Years
Education	Discrete	Years
Local rural experience	Categorical ordinal	Low, medium and high
Gender	Categorical	Male, female
Type of occupation	Categorical	Not related to wild environments, related to wild environments

RESULTS

Land cover analysis

Cover changes were assessed within the areas were harvesting of medicinal plants take place, determining its area based on the distance at which people carry out such harvesting. The median harvest distance of most salient native species was 800 meters in Arauco, resulting in 18 circle buffers (24 most salient native species accounted for 90% of accumulated Salience, Appendix 2 Figure 1) and 250 meters in Paredones with 55 circle buffers (19 most salient native species selected, Appendix 2 Figure 2). Regarding the dynamics of land coverage change within buffers, there was a decrease in native vegetation and an increase in forestry plantations in both municipalities (Table 2). Native vegetation ranged from 39.2% to 22.1% in Arauco, decreasing a 17.1%, and 40.7% to 35.9%, decreasing a 4.8% in Paredones. Forestry plantations fluctuated from 6.6% to 24.3% in Arauco, increasing a 17.7% and 1.2% to 28.3% with an increase of 27.1% in Paredones. A 33.9% of the 70s native vegetation was replaced by forestry plantations in Arauco and a 30.1% in Paredones (Table 2).

Table 2 Mean of coverage (percentage) of native vegetation, forestry plantations and replacement of past native vegetation of each circle buffer by municipality. The differences between periods of native vegetation and forestry plantations are shown, with (-) meaning a decrease and (+) an increase between periods.

Coverage Variable	Arauco	Paredones
Native vegetation of the 70s (%)	39.2	40.7
Native vegetation 2015 (%)	22.1	35.9
Difference of native vegetation between periods (%)	-17	-4.8
Forestry plantations in the 70s (%)	6.6	1.2
Forestry plantations in 2015 (%)	24.3	28.3
Difference of forestry plantations between periods (%)	+17.7	+ 27.1
Total replacement of the 70s native vegetation (%)	63.5	57.9
Forestry plantations replacement of 70s native vegetation (%)	33.9	30.1
Relative percentage of replacement due to forestry plantations (%)	53.4	52.0

Note: The relative percentage of forestry plantations was calculated dividing the forestry plantation replacement by the total replacement.

Free-listed surveys

A total of 426 people were interviewed, 60% of which were women, no indigenous person was interviewed. On average, respondents were 54.3 ± 15 years old, ranging from 18 up to 92 years. Mean number of years of schooling was 7.4 ± 4 years, ranging from illiterate people (28 cases) up to one person holding graduate studies. Regarding occupation, six people did not answer. Conversely, those who did, 37% hold jobs related to wild environments, other 63% did not have jobs with such an opportunity. Most people (70%) exhibited a high degree of local rural experience, 21% medium and 9% low experience (for more details of the variables, see figures 6-10 and table 1 in Appendix 2).

Overall, six common names could not be recognized (each one named only one time, see Appendix 2 Table 2) and a total of 155 species of wild medicinal plants were identified, of which 74 (48%) were native. If there was no way to differentiate between species with the same genus, they were lumped at the generic level (see species marked with a "*" in Appendix2 Table 2). Listed plants included, one fern (*Adiantum* sp), two conifers (*Cupressus macrocarpa* and *Pinus* sp.), seven monocots (Poaceae and Amaryllidaceae) and 145 dicots. It is worth mentioning that native species "coile" (*Lardizabala biternata*) do not have a record of national medicinal use in the scientific literature.

At the municipality level, total known species accounted to 33% (60 out of 182) of the potential native flora of medicinal value in Arauco and 28% (44 out of 157) in Paredones. Of these, 37 species were named by only one person in Arauco (61.7%) and 31 in Paredones (70.5%). In total, 35 native species were selected like the most salient in both municipalities (8 were shared). Among theses, there were 14 shrubs, 11 trees, 9 herbs and 1 parasite. In relation to the medicinal use of these species, stand out the stomachic and febrifuge use, with 11 species (34.4%), the antirheumatic, vulnerary and emmenagogue with 9 species (25.7%) and the astringent, diuretic and tonic properties with 7 species (20%).

In both municipalities, people knew more native medicinal plants than they actually use and harvest (Figure 2). In fact, 87.6% of respondents knew, at least, one native species, 73%, at least, used one and 66.1% , at least, harvested one. The mean number of native known plants by respondent was 3.3 ± 2.6 (range from 0 to 14), with one former

forestry employee that listed 14 species in Arauco. The mean number of used plants per person was 2.1 ± 2.2 (range from 0 to 10) and 1.8 ± 2 (range from 0 to 10) to the harvested plants. The number of known plants differed significantly with number of the used ($P < 0.01$, $n = 426$) and harvested species ($P < 0.01$, $n = 426$). Also, the number of native and exotic plants were positively correlated (tau = 0.08, $P = 0.01$, $n = 426$ for known; tau = 0.19, $P < 0.01$, $n = 426$ for used and tau = 0.24, $P < 0.01$, $n = 426$ for harvested plants).

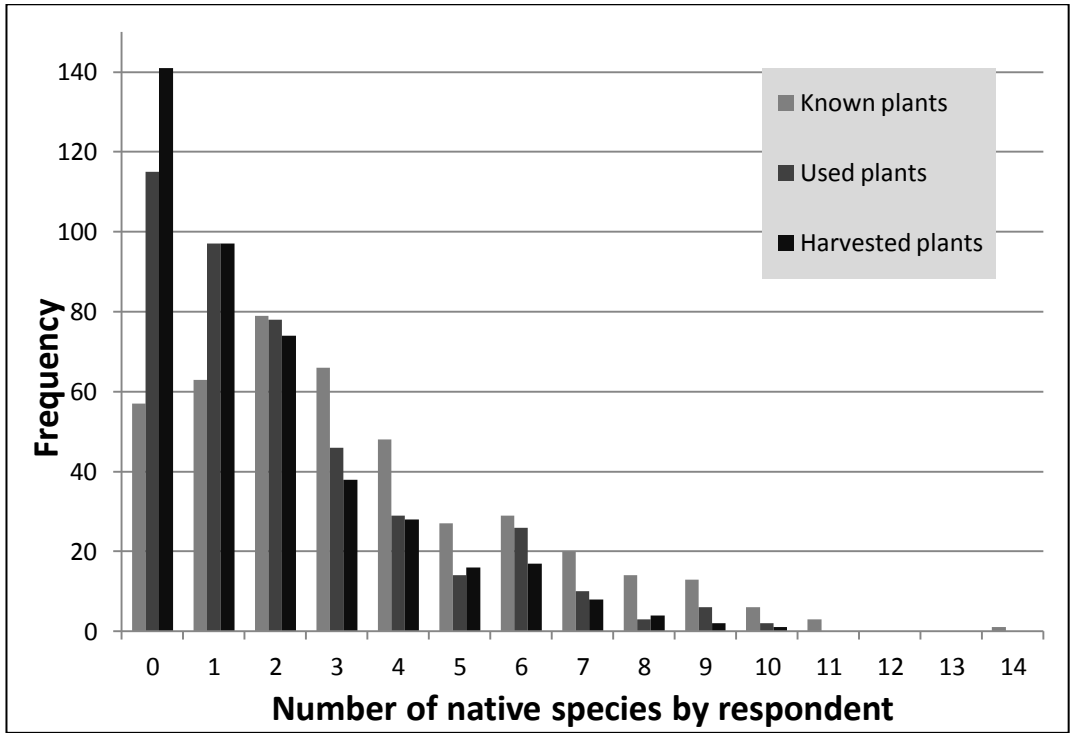

Figure 2 Frequency of the number of native known, used and harvested plants by respondent in both municipalities. Light grey: known plants, dark grey: used plants and black: harvested plants.

Within the 15 most salient species, Arauco's respondents included 7 native species (Figure 3), with salvia (*Lepechinia chamaedryoides*) as the most salient native species at fourth place, named by 39% of respondents. In Paredones only 5 natives species were

mentioned within the first 15 species named (Figure 4), with boldo (*Peumus boldus*) being the most salient native species, which also appeared in the first place, named by more than 50% of respondents. Boldo, maqui (*Aristotelia chilensis*), matico (*Buddleja globosa*) and natre (*Solanum* sp.) are most mentioned in both municipalities, while salvia, zarzaparrilla (*Ribes* sp.), palo negro (*Podanthus ovatifolius*) and radal (*Lomatia hirsuta*) only in Arauco and hierba de la plata (*Equisetum bogotense*) only in Paredones. It should be noticed that the exotic species eucaliptus (*Eucalyptus* sp.) in the 5th place of Salience in Paredones, considering that it is common member of forestry plantations.

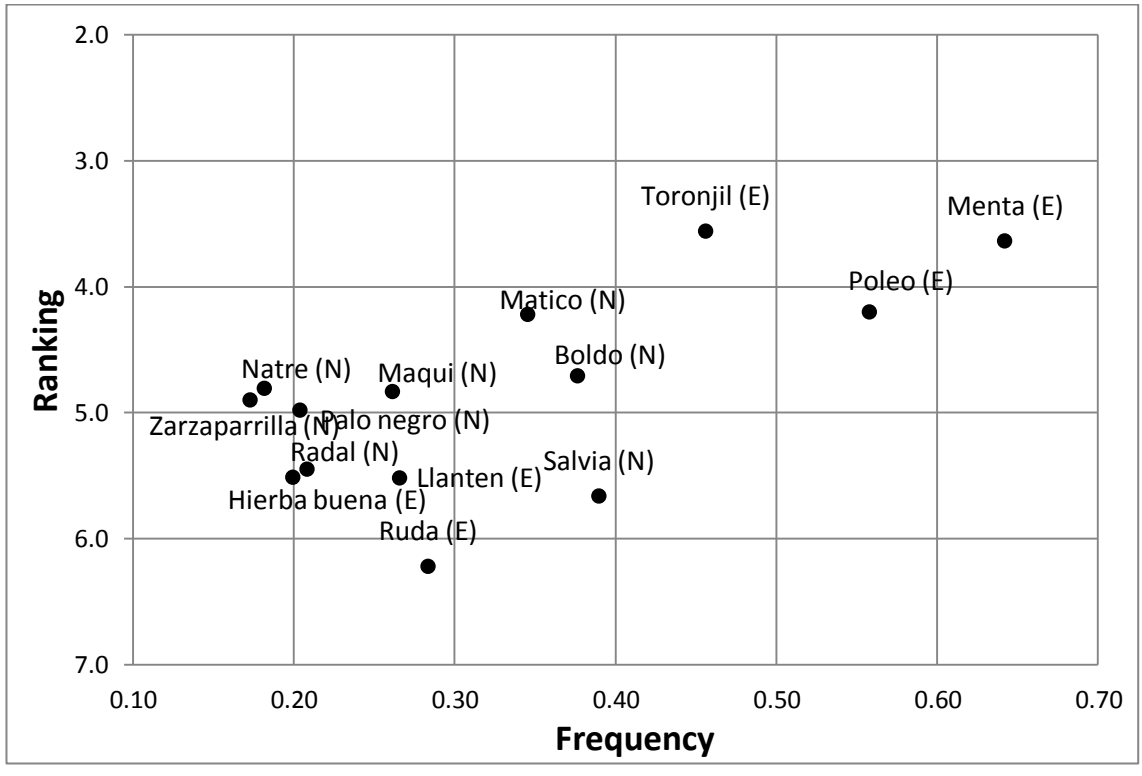

Figure 3 Fifteen most salient species in Arauco. The frequency of mentions and ranking within the respondents of municipality are plotted using common names. N = Native species; E = Exotic species.

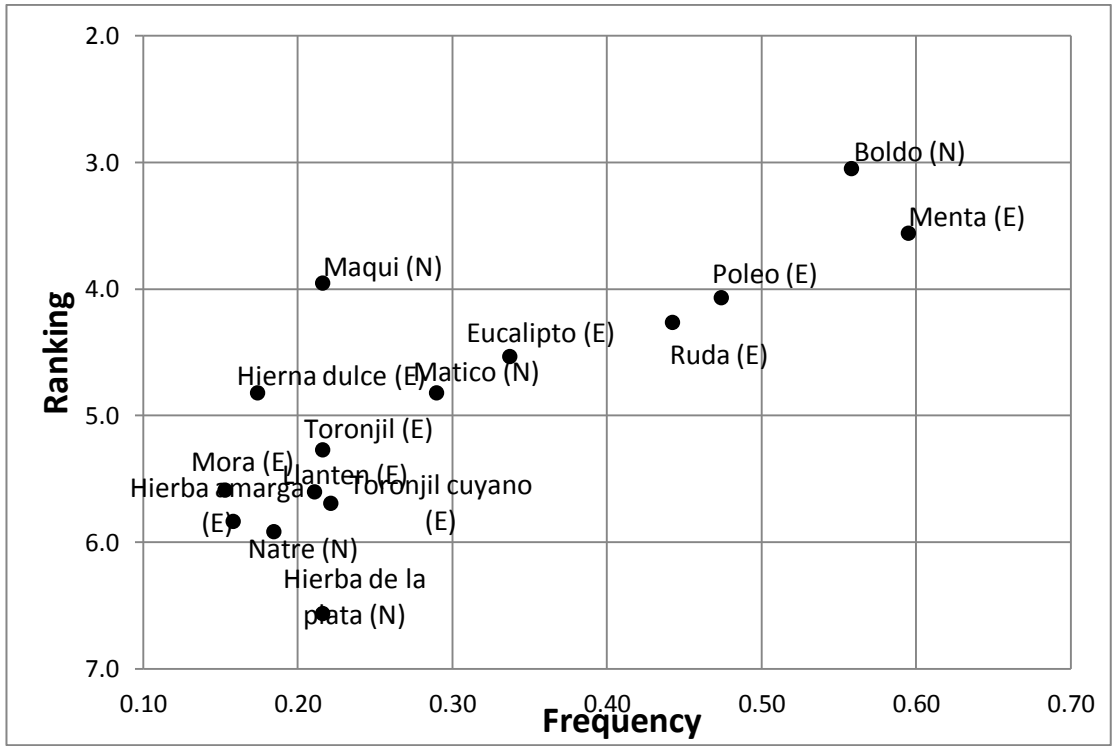

Figure 4 Fifteen most salient species in Paredones. The frequency of mentions and ranking within the respondents of municipality are plotted using common names. N = Native species; E = Exotic species.

Harvest of native plants

People obtained medicinal native plants in different ways, be it by buying, receiving as gifts, or harvesting them (this last option corresponded to the 66.1% of total respondents). Regarding harvesting distance, the median distance of all natives species was 750 meters in Arauco and 250 meters in Paredones. The maximum harvest distance was 175 km for pangue (*Gunnera tinctoria*) in Arauco and 100 km in Paredones for sanguinaria (*Polygonum* sp.). In relation to harvest distances of most salient native species at each municipality (Figure 5 and 6), Arauco respondents harvested species on a wide range of distances, concentrating nine species at the farthest ones. Conversely, Paredones respondents harvested the majority of species in distances less than 1000

meters, except for bailahuén (*Haplopappus* sp.), which was commonly harvested at distances farther than 2000 meters. Harvest distance was negatively correlated to the amount of current native vegetation (tau = -0.17, P < 0.01), and was not correlated to current forestry plantations coverage (tau = -0.07, P = 0.12). Salience of natives species was negatively correlated to harvest distance (tau = -0.17, p-value = < 0.001).

Harvesting sites were varied, including nearby yards, roadsides, nearby water courses, agriculture or pasture fields, wetlands, ravines, coastal ridges, seashores, nearby homegardens and remnants of native vegetation (that could occur between forestry plantations and even forming part of their understory). In relation to the native plants harvested in homegardens, respondents considered them as "wilds", because they knew those plants grew by themselves in the wilderness which were brought into the homegardens. Some people also mentioned frequent travels to specific sites of harvesting, which were commonly group activities that could last many hours due to the remoteness of these sites from their households.

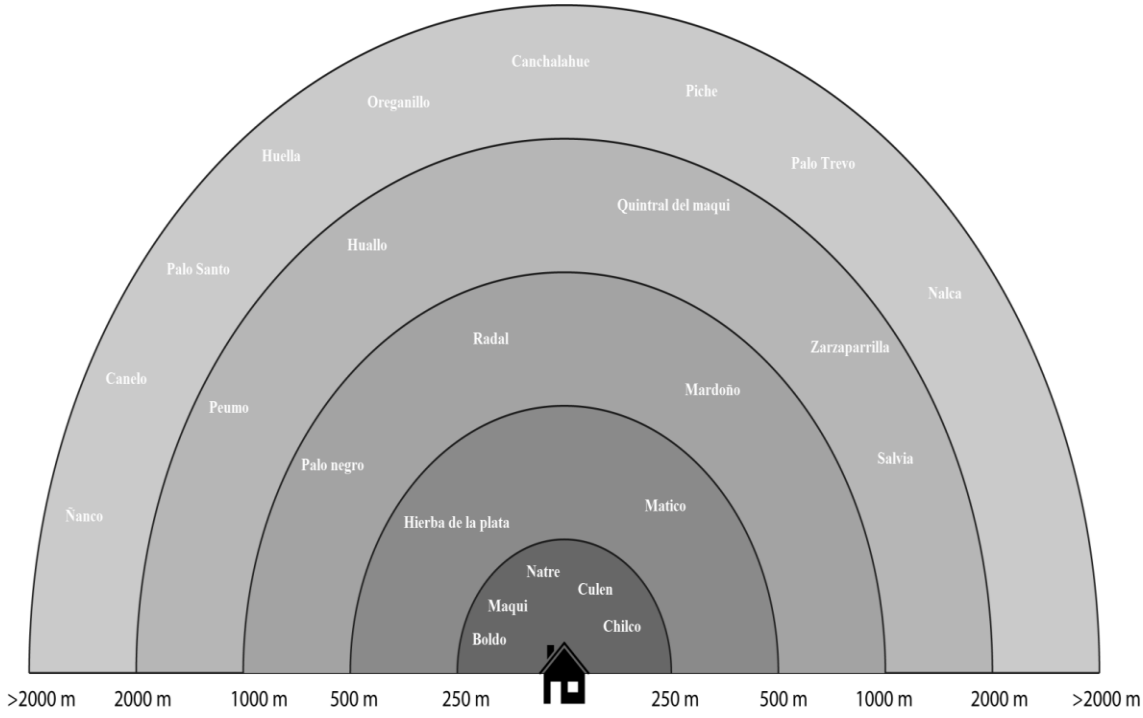

Figure 5 Scheme of the 24 most salient native species according to the median of their harvest distance in Arauco

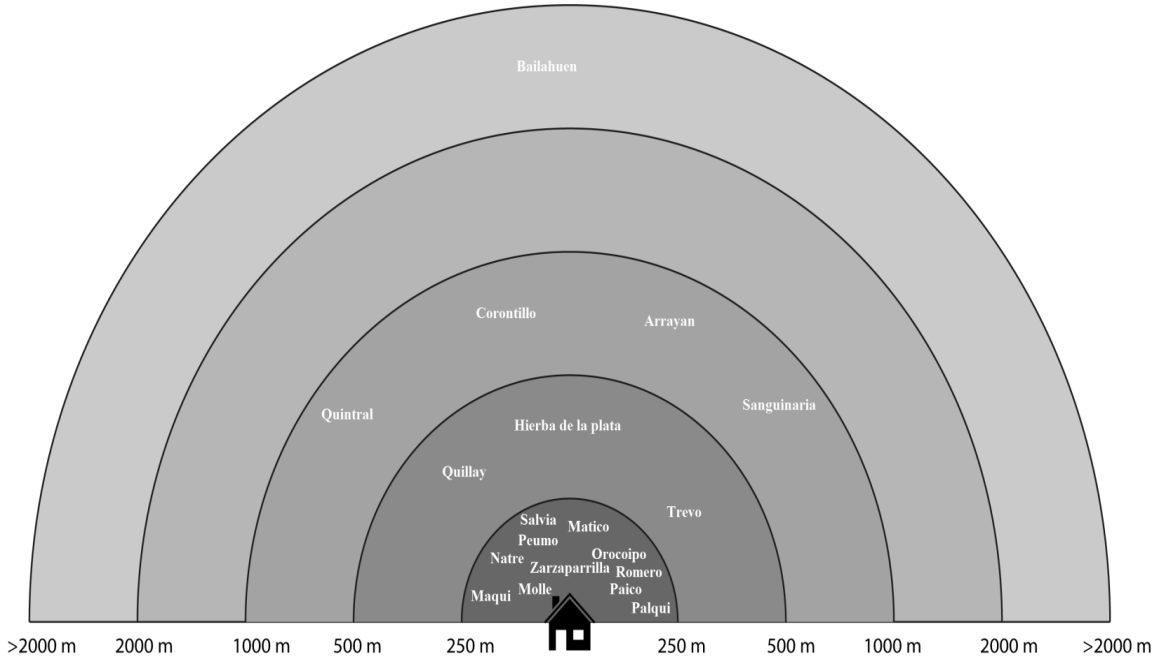

Figure 6 Scheme of the 19 most salient native species according to the median of their harvest distance in Paredones

Relation of known, used and harvested native medicinal plants with environmental and sociocultural variables

Only interactions related to the experience with native vegetation were considered. Consequently, only the effect between age and 70s native vegetation and local rural experience and 70s native vegetation were analyzed. No one of these interactions were signifcative (P = 0.34 for Age-70s native vegetation interaction and for local rural experience-70s native vegetation interaction, P = 0.76 for medium and P = 0.59 for high local rural experience, for the model of known species). Therefore only additive of each variable were considered for the Generalized Linear Model. The number of known plants showed a different trend in relation to the number of used and harvested species. Known plants were not significantly related to the rate of replacement, but were positively related to the amount of past native vegetation available in the 70`s (Table 3). Also, the number of known plants related positively with local rural experience (medium and high in relation to low) and age, but not with jobs related to wild environments, years of education or gender. Age presented a higher coefficient than past native vegetation and the coefficient of medium local experience was higher than high local experience.

On the other hand, the number of used and harvested plants related positively with forestry replacement and past native vegetation . Also, were positively related with age and marginally with jobs related to wild environments. Neither of them was significantly related with gender, local experience, years of education or total

replacement. Age, presented a higher coefficient than past native vegetation and forestry replacement (Table 3).

Table 3 Results of GLIM for known, used and harvested native medicinal plants with environmental and sociocultural covariates

Explanatory Variable	Known species β coefficient (Standard error)	Used species β coefficient (Standard error)	Harvested species β coefficient (Standard error)
Intercept	-0.356 (0.385)	-1.187(0.487)	-0.908(0.536)
Environmental explanatory variables			
Total replacement	0.003 (0.003)	0.001(0.004)	0.001(0.005)
Forestry plantations replacement	0.004 (0.003)	0.009(0.003)*	0.009(0.004)*
Native vegetation of the 70's decade	0.006 (0.003)*	0.008(0.003)*	0.009(0.004)*
Control sociocultural covariates			
Age	0.011 (0.003)***	0.017(0.004)***	0.011(0.005)*
Gender (Male)	0.002 (0.094)	-0.117(0.12)	0.010(0.132)
Jobs related to wild environments	-0.091 (0.095)	0.216(0.122)·	0.227(0.133)·
Years of education	-0.001 (0.013)	0.017(0.016)	0.002(0.018)
Medium local rural experience	0.487(0.181)***	0.140(0.222)	0.190(0.245)
High local rural experience	0.386 (0.172)*	0.177(0.209)	0.140(0.230)

Note: The dependent variable was the number of known, used and harvested plants by each respondent. n = 420 (six respondents didn´t say their occupation). Significance codes: · < 0.1; * < 0.05; ** < 0.01; *** < 0.001.

DISCUSSION

Replacement of native vegetation by forestry plantations could diminish the opportunity of interaction between people and native medicinal plants; therefore, such replacement could erode the knowledge of local people, fostering the extinction of experience with nature. In central Chile, where native vegetation has been replaced by other types of vegetation and land uses, there are signs of cultural erosion. In fact, the high percentage of native species named by only one person (70.5% of species in Arauco and 62% in Paredones) suggests that those species could be in risk of local cultural extinction in the population. Further, the intergenerational difference (older people knew more plants), could be a sign of cultural erosion. Similarly, around one third of the potential native medicinal flora recorded to occur at each municipality was known, which points out the great possibility of medicinal resources that are not known or that have been forgotten by local people. Hence, people in studied locations could be in a process of erosion of knowledge due to the replacement and degradation of native vegetations as knowledge was associated to the amount of past native vegetation experienced, reinforced by its relationship to age and local experience.

The relationship of knowledge of medicinal plants with age and residence time is a common fact (e.g. Pfeiffer and Butz 2005; Voeks and Leony 2004). In particular, older people and those with more local experience were subjected to environments who held more past native vegetation. While we did not find a relationship with gender, others studies have detected more knowledge of medicinal plants among women (Voeks 2006;

Voeks and Leony 2004). Our results suggest that women activities would not allow them to have more experience (and, subsequently knowledge) with native medicinal plants than men, as proposed Lozada et al. (2006) in Patagonian communities. Education on the other hand seems not to be an important factor that influences knowledge; however, Srithi et al. (2009) found the contrary trend, relating formal education with acculturation of a ethnic group in Thailand. Underlying factors to account for this difference ought to be further studied.

Additionally, the lack of relationship between the rate of replacement and erosion of medicinal plant knowledge could be seen as a cultural version of the extinction debt, which in biological terms expresses a delayed effect between habitat loss and local biological extinction of a species (Kuussaari et al. 2009). Here, the decrease of native medicinal species by replacement of the native vegetation would diminish their abundance and possibility for people could experience them. However, it would take a time in the extinction of knowledge of medicinal species on local people's culture, because it remains in the memory of older people that had the chance to experience more quantity of native vegetation. That is, disappear at different rate, faster for native vegetation but slower for memory of associated to these plants. Furthermore, older people could transfer the knowledge of these species to younger ones, as suggests Lozada et al. (2006), attenuating the cultural erosion of that knowledge.

Interestingly, a parallel study on edible native plants in the same villages, related positively the knowledge of these plants to age, high local experience, native forest (shrubland wasn't considered) and jobs related to wild environments (Parra 2018). According Parra (2018), job activities related to wild environments were associated preferably to men, relating the knowledge of edible plants to gender activities. However, this gender role on plants knowledge was not found on medicinal ones, standing out the different effects of gender activities between edible and medicinal plants.

The use of medicinal plants can change over a short time, without affecting to plants' knowledge instantaneously, but in the long run (Reyes-García et al. 2015) and may co-vary due to many factors (de Albuquerque 2006), like the substitution of native plants for commercial alternatives. Moreover, six people mentioned to have learned about the medicinal uses of three native plants (boldo, maqui and quintral del maqui or *Tristerix corymbosus*) on television suggesting the potential of this mass communication media for the diffusion of knowledge related to native medicinal plants. Also, one respondent mentioned to use only medicine from health care facilities, suggesting the existence of others factors that affect in the use of medicinal plants.

In another aspect, spite the replacement of native vegetation, people harvest native medicinal plants from many other sites besides native vegetation remnants, like several anthropized sites. This phenomenon is also mentioned by Stepp (2004), who stands the importance of anthropized sites for medicinal plants procurement. In relation to forestry

plantations, one person harvest boldo in pines understory. Also, many medicinal native species are known to grow in pine plantations understory (Ramírez et al. 1984). This suggests forestry plantations with a developed understory might allow some opportunity of experience with some native medicinal species, delaying the extinction of experience.

Additionally, some people maintain harvest sites at far distance from their households. In those activities, families or other social group could spend long part of the day, an activity that could enhance the experience and knowledge of native plants, especially in younger people (Lozada et al. 2006). To harvest at long distances, emphasize the importance of some species in their cultural domain (e.g. bailahuén, palo trevo or *Dasyphyllum diacanthoides*, peumo or *Cryptocarya alba*, huella or *Corynabutilon* sp.). This trend is also seen in a study in Patagonia that showed only native medicinal plants were harvested more than 1000 meters from their dwellings (Estomba et al. 2006). Those plants, might not grow in anthropized sites and be restricted only to far remnants of native vegetation, running the risk of getting lost in local knowledge with the replacement of that vegetation (Quinlan and Quinlan 2007).

Also, many people cultivated natives medicinal plants that obtained carrying wild individuals to their houses, phenomenon also seen in Frei et al. (2000). Those species were the same that appeared within the most salient species (e.g. boldo, matico, maqui, natre) in both municipalities. This fact could also be delaying the extinction of experience due to replacement of native vegetation. In addition, people needed small amounts of plants for medicinal purposes, in this way, people mainly extracted leaves,

cogollitos (young buds), *raspaduras* (bark scrapes) and sometimes roots. The plants that grow near people's houses (e.g. yards, homegardens, roadsides, wet places, pasture fields), despite of being in low density or small size, could supply those amounts of plant parts and help to maintain the harvest, use and knowledge of native medicinal plants. Those facts imply the importance of the proximity of medicinal plants to people for their Salience and medicinal importance. In fact, visibility and accessibility of plants promotes the learning of people about them (Voeks 2007).

Actions to avoid further cultural erosion should promote the opportunity of experience with native plants by restoring native vegetation as feasible, protection of native vegetation remnants and the incentive of cultivating medicinal native plants by local nurseries or homegardens, specially in species with low Salience values or harvested from far distances. Indeed, the promotion of homegardens for cultivation of medicinal plants in scenarios with cultural erosion have been proposed as a suitable approach to reduce the erosion of knowledge (Agelet et al. 2000). Another course of action is to launch activities regarding native medicinal plants, particularly among younger people, due to the fact that medicinal knowledge is passed down from older to younger people (Srithi et al. 2009) and the risk that it could be lost if nothing is done (Tugume et al. 2016). These activities must incorporate cognitive and affective aspects to generate real changes of attitude in relation to the conservation of native medicinal species (Pooley and O'Connor 2000). This would promote the valuation of medicinal plants and, therefore, the connection between the society and its native biodiversity, taking people an active part in its management (Grez-Simonetti and Simonetti 2018).

CONCLUSIONS

In short, a cultural extinction debt might be occurring in central Chile regarding the knowledge and reliance on native medicinal plants due to the replacement of native vegetation. The cultural erosion takes place at a slower pace than environmental degradation. This delayed extinction offers time to avoid the extinction of experience and erosion of knowledge of native medicinal plants by promoting cultural diffusion and biological conservation actions.

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APPENDICES

APPENDIX 1
Survey questionnaire (original in Spanish)

Good day: we are asking some questions about wild plants for an investigation of the University of Chile. Do you have time to answer them? What's your: age, gender, occupation or job, time of residence in the locality, place of birth and, years of formal education.

A) What wild plants, that is, those who grow alone, do you know that can be used of medicinal purposes?

B) From the ones you named, which ones were used the last year by you or your family?

C) From the plants you used last year, how do you use them?

D) How did you obtain the plants that you have used during the last year?

E) If you harvested them, where did you harvest them? What is the distance from this place to your house?

F) If you did not harvest them, how do you obtain the plants you used?

APPENDIX 2

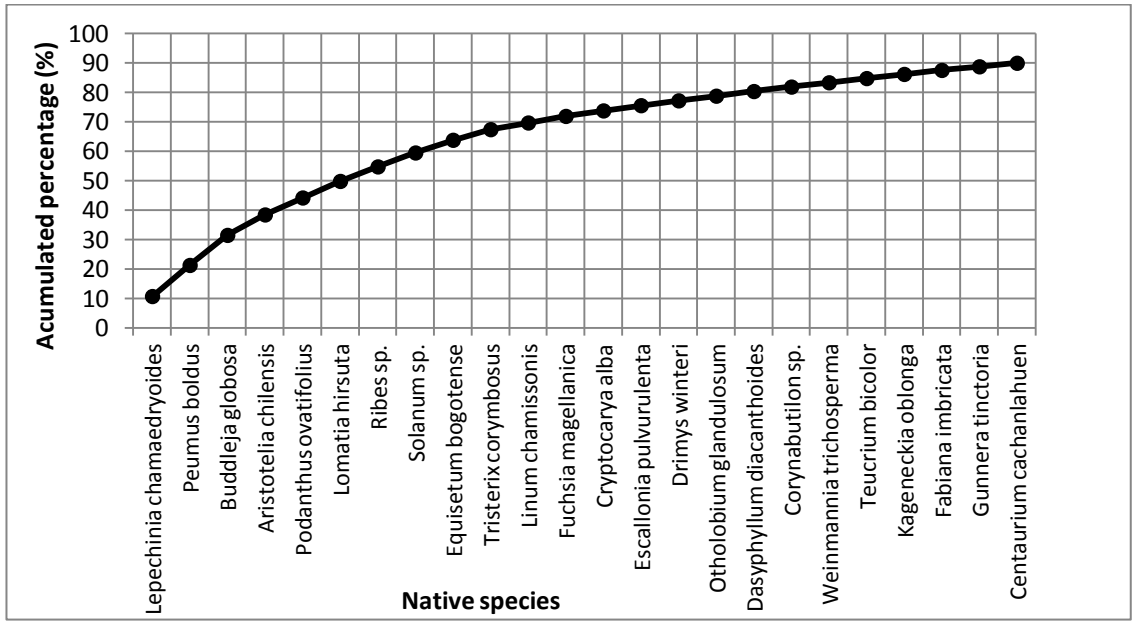

Figure 1 Selected species in Arauco. Twenty-four species accounts for 90% of accumulated relative Salience

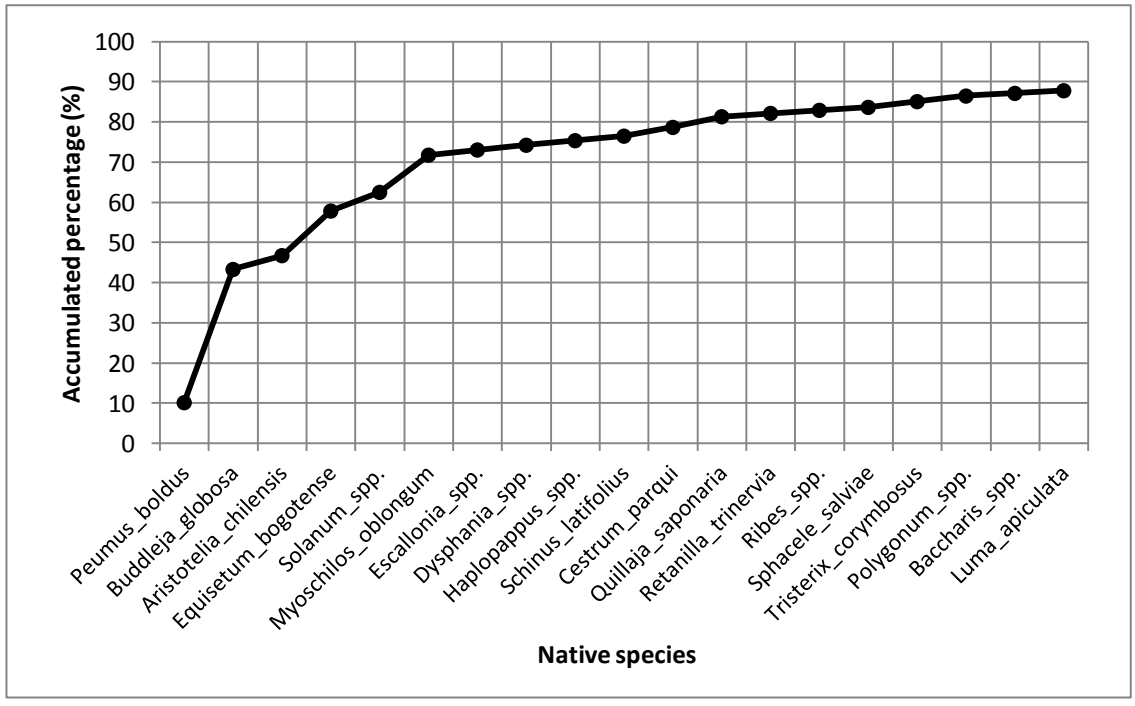

Figure 2 Selected species in Paredones. Nineteen species accounted for 90% accumulated relative Salience

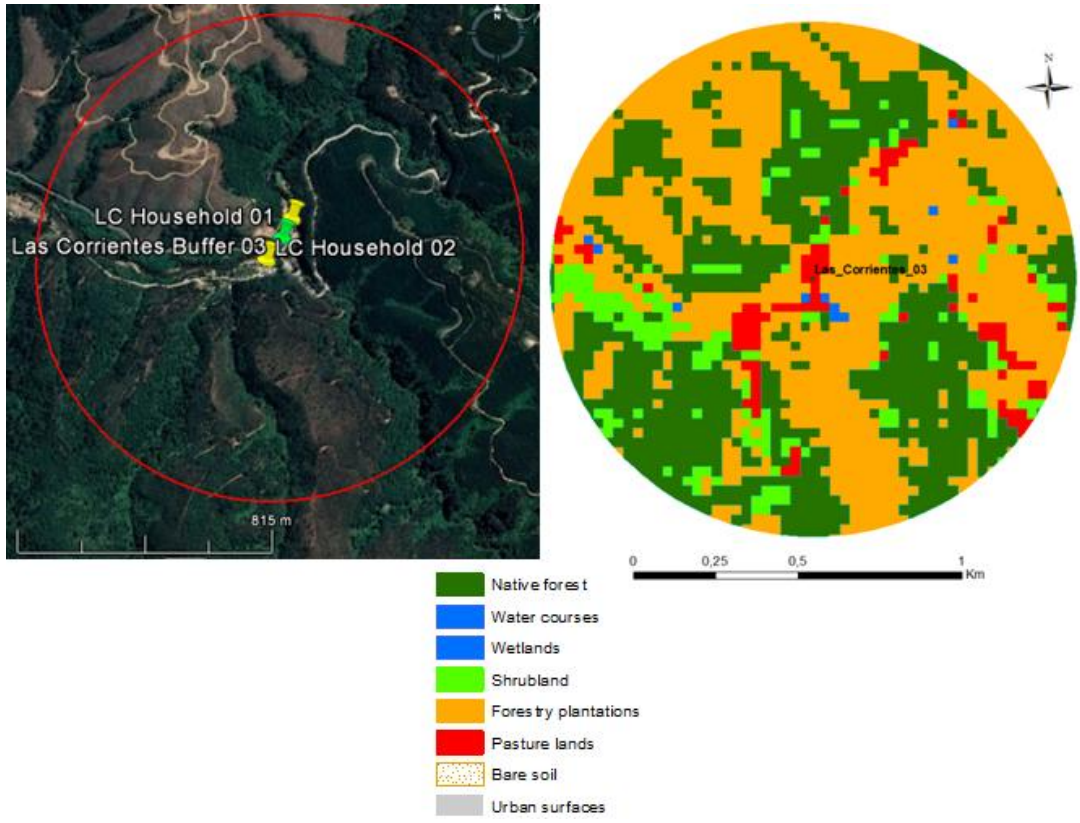

Figure 3 Example of a buffer (with 800 meters of radio) with two households inside of its area: Las Corrientes 03, Arauco. LC = Las Corrientes.

Figure 4 Example of a landscape in Arauco with pasturelands, forestry plantations, native vegetation remnants and households

Figure 5 Example of a landscape in Paredones, with eroded hills, native shrubland, forestry plantations, agriculture and pasturelands and households

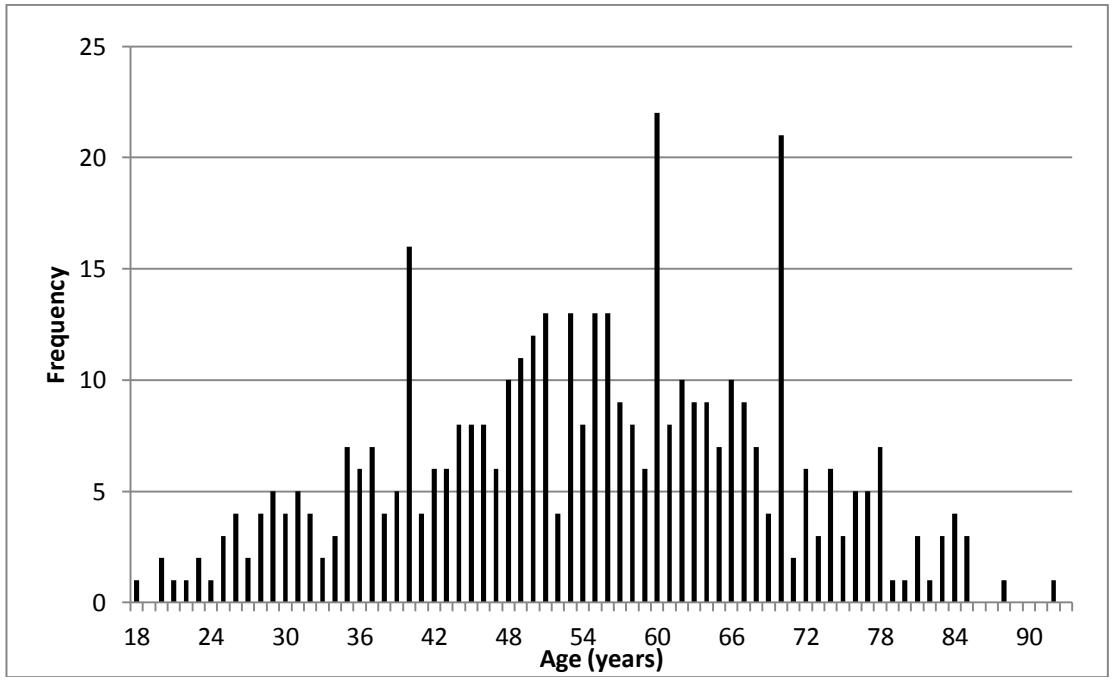

Figure 6 Frequency distribution of age

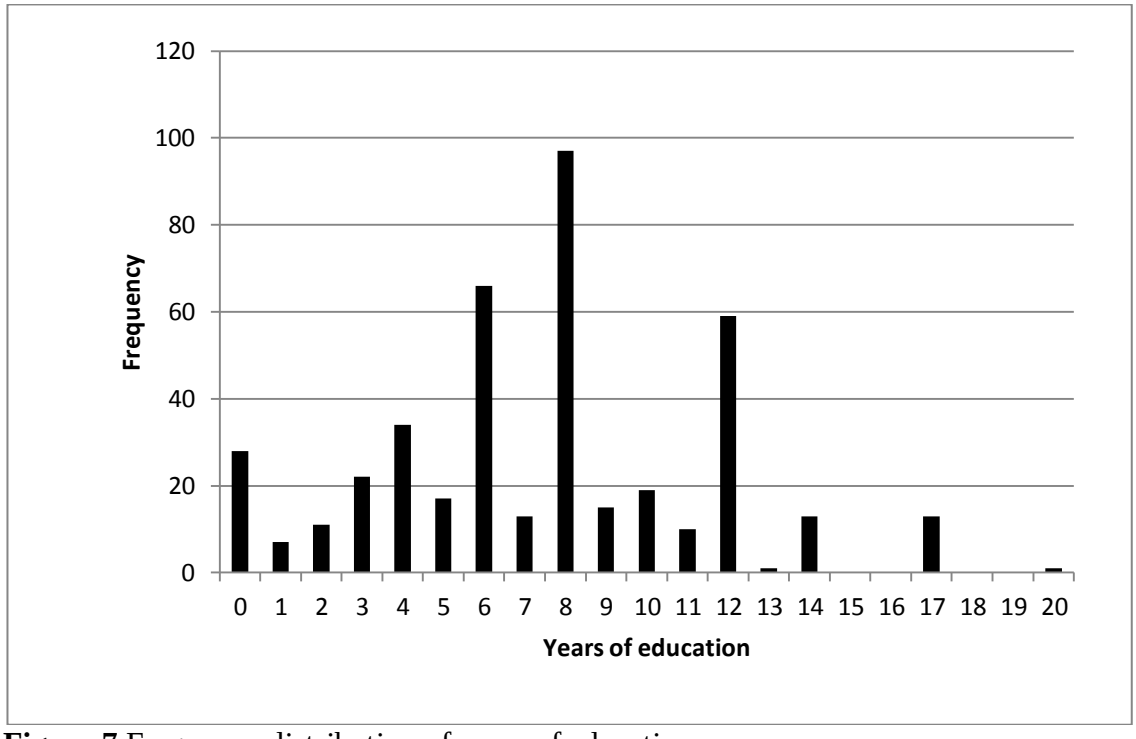

Figure 7 Frequency distribution of years of education

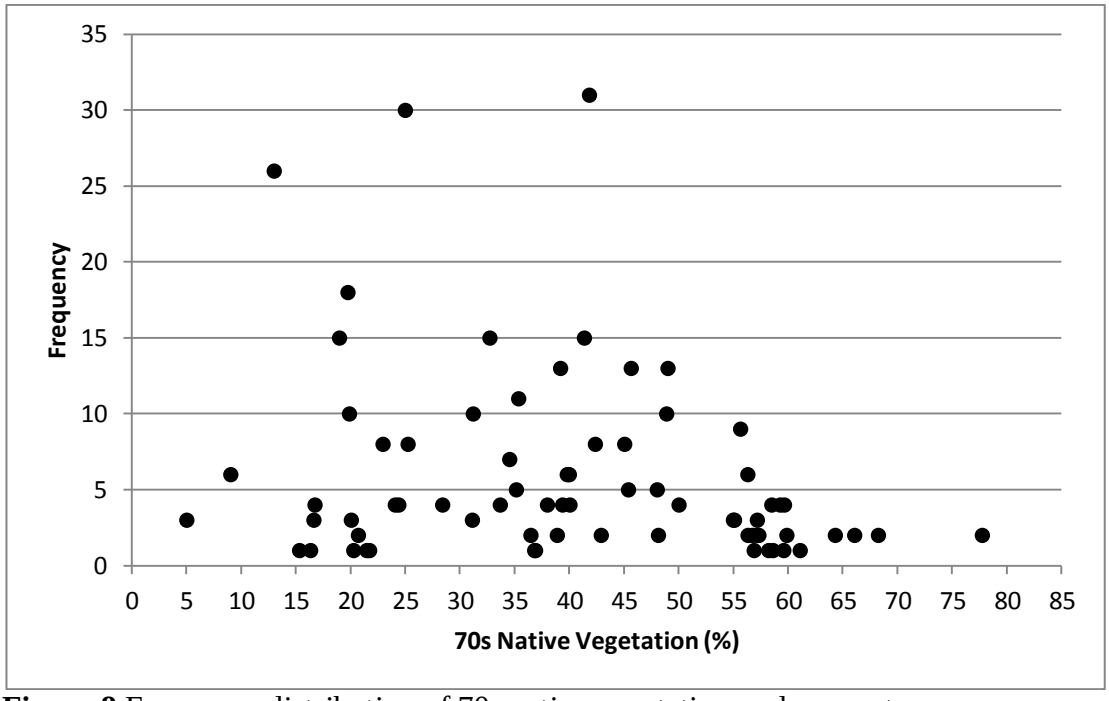

Figure 8 Frequency distribution of 70s native vegetation replacement

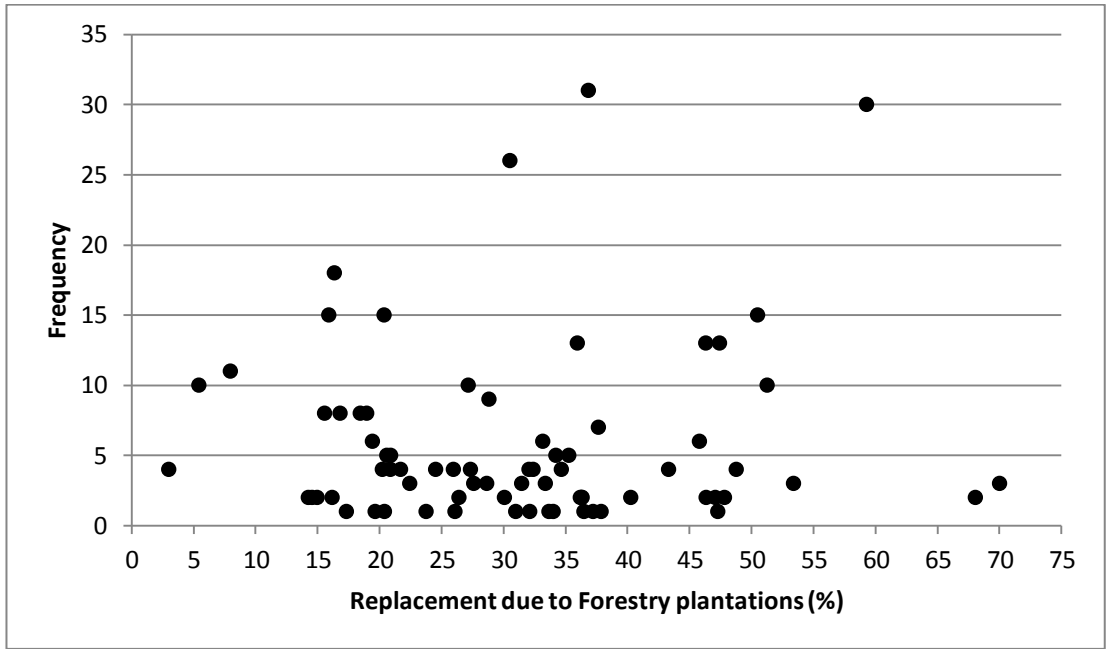

Figure 9 Frequency distribution of forestry plantation replacement

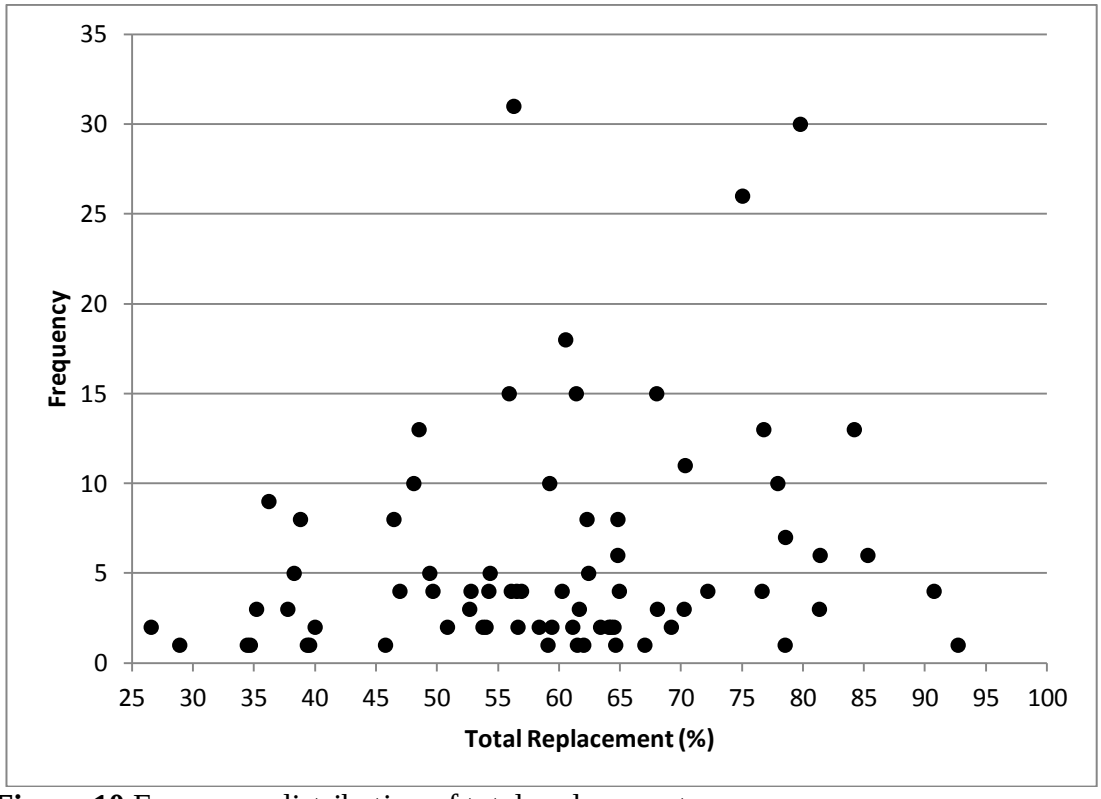

Figure 10 Frequency distribution of total replacement

Table 1 Summary of categorical variables used in the GLIM

Variable	Category levels		
Local rural experience	Low	Medium	High
n	36	90	300
Type of occupation	Related to wild environments	No related to wild environments	-
n	156	264	-
Gender	Male	Female	-
n	172	254	-

Table 2 List of medicinal plants named in the surveys.

Scientific name (Family)	Common name	Origin[a]	Habit	Paredones Salience Index[b]	Arauco Salience Index[b]	Medicinal Use
Acacia caven (Fabaceae)	Espino	N	Tree	0.006	-	Astringent. vulnerary, digestive, stimulant, antidote against alkaloids[1]
Acaena argentea (Rosaceae)	Trun, Trune	N	Herb	-	0.008	Astringent, vulnerary, diuretic, against venereal disease[1]
Adiantum sp. (Pteridaceae)	Helecho, Palo negro	N	Herb	-	0.004	Diuretic, emmenagogue, refrigerant[1]
Aextoxicon punctatum (Aextoxicaceae)	Olivillo	N	Tree	-	0.003	Rheumatism[2]
Allium ampeloprasum (Amaryllidaceae)	Ajo perro, Ajo porrón, Ajo chilote	E	Herb	0.001	-	Anthelmintic, antiasthmatic, anticholesterolemic, antiseptic, antiespasmodic, cholagogue, expectorant, febrifuge, stimulant, stomachic, tonic[3]
Allium vineale (Amaryllidaceae)	Ajo de monte, Ajo, Ajo silvestre, Ajo perro	E	Herb	0.006	0.002	Antiasthmatic, depurative, carminative, diuretic, expectorant, stimulant[3]
Aloe vera (Asphodelaceae)	Aloe vera	E	Succulent	0.012	0.005	Cancer, emmenagogue, emollient, laxative, purgative, stimulant, stomachic, tonic,

						anthelmintic, vulnerary[3]
Aloysia citriodora (Verbenaceae)	Cedrón	E	Shrub	0.030	0.033	Sedative, digestive, antiespasmodic, stomachic, febrifuge, carminative[3]
Apium panul (Apiaceae)	Panul	N	Herb	0.014	-	Astringent, skin diseases, depurative, headaches[1]
Apium sp. (Apiaceae)*	Apio de campo, Apio, Apio silvestre	N	Herb	0.004	0.012	Carminative, refreshing, depurative, rheumatism[1]
Aristotelia chilensis (Elaeocarpaceae)	Maqui, Maque	N	Tree	0.142	0.155	Vulnerary, astringent, anti-inflammatory, antidiarrhetic, febrifuge, throat diseases[1]
Artemisia abrotanum (Asteraceae)	Éter	E	Herb	0.011	0.029	Anthelmintic, antiseptic, cholagogue, emmenagogue, stomachic, tonic[3]
Artemisia annua (Asteraceae)	Hierba dulce, Ajenjo	E	Herb	0.100	-	Antiseptic, carminative, digestive, febrifuge[3]
Artemisia sp. (Asteraceae)*	Ajenjo, Hierba amarga	E	Herb	0.133	0.045	Anthelmintic, antiseptic, antispasmodic, appetizer, carminative, cholagogue, emmenagogue, febrifuge, stimulant, stomachic, tonic[3]
Avena sativa	Avena	E	Herb	-	0.001	Antidiarrhetic,

(Poaceae)	común					antirheumatic, antispasmodic, emollient, nervine, stimulant, diuretic[3]
Baccharis linearis (Asteraceae)	Romero, Romero bruto	N	Shrub	0.027	-	Stimulant, emollient, stomachic, emmenagogue, antispasmodic, antirheumatic, pulmonary and urinary diseases[1]
Bauhinia forficata (Fabaceae)	Pata la vaca, Pate vaca	E	Tree	0.004	0.001	Hypoglycemic, antiseptic, diuretic, depurative, anticholesterolemic, tonic[3]
Berberis sp. (Berberidaceae)*	Michay	N	Shrub	0.009	-	Refreshing, purgative, stomachic[1]
Borago officinalis (Boraginaceae)	Borraja	E	Herb	0.006	0.023	Antirheumatic, depurative, diaphoretic, diuretic, emollient, expectorant, sedative, hypotensive, poultice[3]
Brassica rapa (Brassicaceae)	Yuyo	E	Herb	0.002	-	Cancer, poultice[3]
Buddleja globosa (Scrophulariaceae)	Matico, Pañil	N	Shrub	0.167	0.227	Vulnerary, internal wounds, anti-hemorrhage[1]
Calendula sp. (Asteraceae)*	Calendula	E	Herb	0.001	0.003	Antiseptic, antispasmodic, astringent, cholagogue, sudorific, stimulant,

						vulnerary[3]
Capsella bursa-pastoris (Brassicaceae)	Mal-tuerzo	E	Herb	0.004	-	Astringent, cancer, diuretic, emmenagogue, haemostatic, stimulant, vulnerary[3]
Carpobrotus aequilaterus (Aizoaceae)	Doca	N	Succulent	-	0.003	Purgative[1]
Castanea sp. (Fagaceae)	Castaño	E	Tree	-	0.004	Antidiarrhetic, anti-inflammatory, astringent, expectorant[3]
Centaurea benedicta (Asteraceae)	Cardo santo	E	Herb	<0.001	-	Antiseptic, digestive, anti-inflammatory, febrifuge, hypoglycemic[3]
Centaurium cachanlahuen (Gentianaceae)	Canchalao, Canchalahue	N	Herb	0.012	0.027	Depurative, febrifuge, sudorific, tonic, appetizer, stomachic, antiparasitic, antirheumatic, emmenagogue, jaundice[1]
Cestrum parqui (Solanaceae)	Palqui, Palque, Parqui, Parque	N	Shrub	0.045	0.008	Sudorific, febrifuge, skin eruptions, febrifuge[1]
Cissus striata (Vitaceae)	Voqui-quilo	N	Climber	-	0.001	Refreshing, astringent, skin eruptions, anti-hemorrhage, dysentery[1]
Citrus × *limon* (Rutaceae)	Limon	E	Tree	0.008	0.001	Antiseptic, astringent, carminative,

						stimulant, stomachic, refrigerant, rubefacient[3]
Citrus x sinensis (Rutaceae)	Naranjo	E	Tree	0.010	-	Appetizer, depurative, carminative, tonic[3]
Colletia sp. (Rhamnaceae)*	Cunco, Yagi	N	Shrub	0.005	<0.001	Purgative[1]
Conium maculatum (Apiaceae)	Cicuta, Perejil silvestre	E	Herb	0.003	0.003	Analgesic, antirheumatic, antispasmodic, cancer, emetic, galactofuge, sedative[3]
Convolvulus arvensis (Convolvulaceae)	Correhuela	E	Climber	0.001	-	Cholagogue, diuretic, laxative, purgative[3]
Corynabutilon sp. (Malvaceae)*	Huella, Huella blanca	N	Shrub	-	0.034	Emollient, emmenagogue, partufaciant[1]
Crinodendron patagua (Elaeocarpaceae)	Patagua	N	Tree	-	<0.001	Abortive[4]
Cryptocarya alba (Lauraceae)	Peumo	N	Tree	0.005	0.042	Liver diseases, vaginal hemorrhage, antirheumatic[1]
Cupressus macrocarpa (Cupressaceae)	Ciprés	E	Tree	0.022	0.006	Antirheumatic[3]
Cydonia oblonga (Rosaceae)	Membrillo	E	Tree	0.001	0.002	Anti-inflammatory, astringent, carminative, digestive, diuretic, emollient, expectorant, hypotensive, laxative, refrigerant,

						stimulant, tonic[3]
Cynara cardunculus (Asteraceae)	Penca, Cardo	E	Herb	0.004	0.001	Anticholesterolemic, cholagogue, digestive, diuretic[3]
Dasyphyllum diacanthoides (Asteraceae)	Trevo, Trevo blanco, Palo Trevo	N	Tree	-	0.035	Febrifuge, vulnerary, antirheumatic, purgative, astringent, emollient, contusions[1]
Drimys winteri (Winteraceae)	Canelo, Canelo de campo	N	Tree	0.007	0.037	Skin diseases, antiseptic, antirheumatic, stomachic, toothache, cancer, vulnerary[1]
Dysphania sp. (Amaranthaceae)*	Paico	N	Herb	0.049	0.021	Stomachic, anthelmintic, carminative, digestive, diuretic, headache, emmenagogue[1]
Embothrium coccineum (Proteaceae)	Notro	N	Tree	-	0.005	Toothache, vulnerary[1]
Ephedra chilensis (Ephedraceae)	Pingo-pingo	N	Shrub	<0.001	-	Diuretic, depurative, bladder diseases[1]
Equisetum bogotense (Equisetaceae)	Hierba de la plata, Limpia plata, Cola de caballo	N	Herb	0.104	0.096	Calculus, astringent, hemorrhages, liver diseases, bladder diseases, spleen diseases[1]
Erodium sp. (Geraniaceae)	Alfilerillo	E	Herb	0.004	-	Diuretic, antispasmodic, astringent, vulnerary[1]

Escallonia pulvurulenta (Escalloniaceae)	Mardoño, Corontillo, Palo mardoño, Mardoño colorado	N	Shrub	0.053	0.040	Balsamic, stimulant, digestive, colds, asthma, diuretic, depurative[1]
Escallonia sp. (Escalloniaceae)*	Ñipa, Siete camisas, Corontillo, Lun	N	Shrub	-	0.012	Vulnerary, liver, diseases[1]
Eucalyptus sp. (Myrtaceae)*	Eucalipto, Eucaliptu	E	Tree	0.206	0.057	Antiseptic, antirheumatic, antispasmodic, appetizer, febrifuge, stimulant.[3]
Euphorbia sp. (Euphorbiaceae)	Pichoga	N	Herb	-	0.001	Purgative, colic, diuretic[1]
Fabiana imbricata (Solanaceae)	Piche, Pichi, Romero pichi, Pichi romero	N	Shrub	0.008	0.030	Carminative, appetizer, bladder diseases, stomachic, venereal diseases, diuretic, hemorrhages, pectoral[1]
Ficus carica (Moraceae)	Higuera	E	Tree	-	0.001	Cancer, digestive, emollient, galactogogue, laxative, stomachic, pectoral[3]
Foeniculum vulgare (Apiaceae)	Hinojo	E	Herb	0.009	0.090	Analgesic, anti-inflammatory, antispasmodic, carminative, diuretic, emmenagogue, galactogogue, stimulant, stomachic[3]
Francoa appendiculata	Hierba del pasmo	N	Herb	-	<0.001	Astringent, hemorrhages,

(Francoaceae)						diuretic[1]
Fuchsia magellanica (Onagraceae)	Chilco, Chilca	N	Shrub	0.006	0.050	Febrifuge, emmenagogue, diuretic, refreshing[1]
Gnaphalium viravira (Asteraceae)	Hierba de la diuca, vira-vira	N	Herb	0.003	0.005	Vulnerary, febrifuge, expectorant, sudorific[1]
Gunnera tinctoria (Gunneraceae)	Nalca, Pangue	N	Herb	0.006	0.027	Febrifuge, astringent, antidiarrhetic, throat diseases, anti-hemorrhage, menstrual diseases[1]
Haplopappus sp. (Asteraceae)*	Bailahuén, Jarilla, Jarilla de mar	N	Herb	0.047	0.017	Antidiarrhetic, liver and bladder diseases, emmenagogue, stomachic, antiseptic[1]
Heriochloe uiriculata (Poaceae)	Ratonera	N	Herb	-	0.004	Appetizer, diuretic, refreshing[1]
Hypericum perforatum (Hypericaceae)	San Juan	E	Herb	-	0.001	Anthelmintic, vulnerary[1]
Juncus sp. (Juncaceae)	Junco	N	Herb	0.003	-	Emetic[5]
Kageneckia oblonga (Rosaceae)	Huallo	N	Tree	-	0.032	Febrifuge, tonic, emetic, laxative[6]
Lardizabala biternata (Lardizabalaceae)	Coile	N	Climber	0.004	-	Medicinal use not described
Laurelia sempervirens (Atherospermetaceae)	Laurel, Laurel silvestre	N	Tree	-	0.018	Headaches, venereal diseases, antirheumatic, emmenagogue, liver diseases, skin diseases, urinary

						diseases[1]
Laurus nobilis (Lauraceae)	Laurel, Laurel de comida	E	Tree	0.009	0.006	Antirheumatic, antiseptic, appetizer, astringent, cancer, carminative, digestive, diuretic, emetic, emmenagogue, stimulant, stomachic[3]
Lavandula angustifolia (Lamiaceae)	Lavanda	E	Herb	0.003	-	Antiseptic, appetizer carminative, cholagogue, diuretic, nervine, stimulant, stomachic, tonic[3]
Lepechinia salviae (Lamiaceae)	Salvia, Salvia blanca	N	Herb	0.030	-	Tonic, stomachic, throat diseases, liver, emmenagogue, antiemetic, antirheumatic[1]
Lepechinia chamaedryoides (Lamiaceae)	Salvia	N	Shrub	-	0.239	Antiseptic (tumors)[1]
Libertia sessiliflora (Iridaceae)	Triquel, Triquil, Triquelcillo	N	Herb	0.020	-	Laxative, digestive, purgant[1]
Linum chamissonis (Linaceae)	Ñanco	N	Herb	-	0.051	Digestive, febrifuge, stomachic, appetizer, diuretic, sedative, antirheumatic, refreshing[1]
Lomatia hirsuta (Proteaceae)	Radal	N	Tree	-	0.126	Purgative, antispasmodic, pectoral[1]
Luma apiculata	Arrayan	N	Tree	0.027	0.017	Astringent,

(Myrtaceae)						stimulant, balsamic, vulnerary, antidiarrhetic, vulnerary[1]
Lupinus arboereus (Fabaceae)	Flor del chocho (Chocho)	E	Shrub	-	0.001	Antiseptic[6]
Malva sp. (Malvaceae)*	Malva, Melisa silvestre	E	Herb	0.003	0.001	Anti-inflammatory, astringent, diuretic, emollient, expectorant, laxative[3]
Margyricarpus pinnatus (Rosaceae)	Pimpinela, Perlilla, Cebanilla	N	Herb	0.008	-	Appetizer, diuretic[1]
Marrubium vulgare (Lamiaceae)	Toronjil cuyano, Toronjil, Hierba del burro, Toronjil amargo	E	Herb	0.116	0.019	Antidiarrhetic, carminative, antiseptic, antispasmodic, appetizer, cholagogue, digestive, diuretic, emmenagogue, stimulant, tonic[3]
Matricaria recutita (Asteraceae)	Manzanilla, Manzanilla de Castilla, Manzanilla de olor, Manzanilla dulce	E	Herb	0.080	0.104	Analgesic, anti-inflammatory, antiseptic, antispasmodic, carminative, cholagogue, nervine, stomachic, tonic[3]
Maytenus boaria (Celastraceae)	Maitén	N	Tree	0.010	0.006	Febrifuge, skin eruptions, purgative[1]
Melissa officinalis (Lamiaceae)	Melisa, Toronjil, Toronjil para la pena, Toronjil de olor	E	Herb	0.121	0.281	Antiseptic, antiemetic, antispasmodic, antiviral, digestive, emmenagogue, febrifuge, sedative,

						tonic, carminative[3]
Mentha citrata (Lamiaceae)	Hierba moto, Moto	E	Herb	0.037	-	Analgesic, antiseptic, antispasmodic, carminative, cholagogue, refrigerant, sudorific, stomachic, tonic[3]
Mentha pulegium (Lamiaceae)	Poleo	E	Herb	0.301	0.349	Antiseptic, antispasmodic, carminative, sudorific, emmenagogue, sedative, stimulant[3]
Mentha sp. (Lamiaceae)	Menta alemana	E	Herb	0.005	-	?
Mentha spicata (Lamiaceae)	Hierba buena	E	Herb	-	0.112	Antiemetic, antiseptic, antispasmodic, cancer, carminative, diuretic, poultice, stimulant, stomachic[3]
Mentha suaveolens (Lamiaceae)	Menta	E	Herb	0.411	0.468	Antiseptic, carminative, febrifuge[3]
Mentha x piperita (Lamiaceae)	Menta negra	E	Herb	-	0.016	Abortive, antiseptic, antispasmodic, carminative, cholagogue, refrigerant, stomachic, tonic[3]
Modiola caroliniana (Malvaceae)	Pila-pila	E	Herb	-	0.012	Throat diseases, febrifuge[1]
Muehlenbeckia hastulata (Polygonaceae)	Quilo	N	Climber	0.001	-	Diuretic, purgative, hypotensive, burns,

						contusions[1]
Myoschilos oblongum (Santalaceae)	Orocoipo, Orocoi	N	Shrub	0.055	0.006	Stomachic, digestive, appetizer, carminative, emmenagogue[1]
Nassella chilensis (Poaceae)	Corrión (Coirón)	N	Herb	-	0.002	Skin eruptions (caused by *Lithraea caustica*)[7]
Nasturtium officinale (Brassicaceae)	Berro	E	Herb	0.005	0.007	Antirheumatic, appetizer, depurative, diuretic, expectorant, toothache, purgative, stimulant, stomachic[3]
Ocimum basilicum (Lamiaceae)	Albahaca	E	Herb	0.007	-	Antiseptic, antirheumatic, antispasmodic, appetizer, digestive, galactogogue, stomachic, tonic, carminative, ophtalmic[3]
Olea europaea (Oleaeceae)	Olivo	E	Tree	0.008	-	Antipruritic, antiseptic, astringent, cholagogue, emollient, febrifuge, laxative, sedative[3]
Opuntia ficus-indica (Cactaceae)	Tuna	E	Succulent	-	0.004	Antispasmodic, diuretic, emollient[3]
Origanum vulgare (Lamiaceae)	Orégano	E	Herb	0.016	0.004	Antirheumatic, antiseptic, antispasmodic, carminative, cholagogue, sudorific,

						expectorant, toothache, stimulant, stomachic, tonic[3]
Psoralea glandulosa (Fabaceae)	Culén	N	Shrub	0.027	0.036	Febrifuge, vulnerary, antidiarrhetic, emetic, stomachic, emollient, diabetes[1]
Oxalis sp. (Oxalidaceae)*	Cuye colorado, Vinagrillo	N	Herb	<0.001	0.008	Antihemorrhagic, stomachic, digestive, febrifuge, emmenagogue, abortive[1]
Paspalum sp. (Poaceae)*	Chépica, Chépica blanca	N	Herb	0.005	0.003	Diuretic, urinary diseases, antihemorrhagic[1]
Pelargonium sp. (Geraniaceae)	Cardenal blanco	E	Herb	0.001	-	Astringent, emollient[3]
Peperomia galioides (Piperaceae)	Congona	E	Succulent	0.015	0.008	Vulnerary[8]
Persea americana (Lauraceae)	Palto	E	Tree	0.015	0.005	Hypotensive, Cancer, astringent, carminative, emmenagogue, antidiarrhetic, emollient, anticholesterolemic, abortive, vulnerary, anthelmintic, astringent[3]
Persea lingue (Lauraceae)	Lingue	N	Tree	-	0.001	Antidiarrhetic, uterus diseases, tumor[1]
Petasites fragrans (Asteraceae)	Tusilago, Tusila	E	Herb	-	0.008	Cough[9]
Peumus boldus	Boldo	N	Tree	0.419	0.236	Headaches,

(Monimiaceae)						carminative, nervine, uterus diseases, antirheumatic, appetizer, digestive, tonic, respiratory diseases, urinary and respiratory diseases[1]
Pinus sp. (Pinaceae)*	Piña, Pino	E	Tree	0.004	0.001	Antiseptic, diuretic, anthelmintic, rubefacient, respiratory diseases, skin diseases, urinary diseases, antirheumatic[3]
Plantago sp. (Plantaginaceae)*	Llantén, Chaitén, Siete venas	E	Herb	0.116	0.150	Skin diseases, vulnerary, astringent, earache, emollient, diuretic, contusions[1]
Podanthus ovatifolius (Asteraceae)	Palo negro	N	Shrub	-	0.129	Urinary diseases, balsamic, emollient[1]
Polygonum sp. (Polygonaceae)*	Sanguinaria, Sangrinaria	N	Herb	0.029	0.006	Emmenagogue, depurative, emmenagogue, febrifuge, antirheumatic, calculus, menstrual pains, refreshing, tonic[1]
Populus alba (Salicaceae)	Álamo blanco	E	Tree	-	0.002	Analgesic, anti-inflammatory, antiseptic, astringent, diuretic, febrifuge, tonic[3]
Primula veris (Primulaceae)	San Pedro	E	Herb	0.002	-	Nervine, contusions, anti-inflammatory, antispasmodic,

						diuretic, sudorific, expectorant, analgesic[3]
Prunella vulgaris (Lamiaceae)	Tapón, Hierba negra, Tapón hierba	E	Herb	-	0.025	Antiseptic, antidiarrhetic, febrifuge, antispasmodic, astringent, carminative, diuretic, hypotensive, stomachic, antihemorrhagic, tonic, anthelmintic, vulnerary[3]
Prunus armeniaca (Rosaceae)	Damasco	E	Tree	-	<0.001	Analgesic, anthelmintic, febrifuge, antiseptic, antispasmodic, emetic, emollient, expectorant, laxative, ophthalmic, pectoral, sedative, tonic, vulnerary[3]
Prunus persica (Rosaceae)	Durazno	E	Tree	0.008	0.012	Anthelmintic, antiasthmatic, astringent, diuretic, emollient, expectorant, febrifuge, laxative, sedative[3]
Punica granatum (Lythraceae)	Granado	E	Tree	0.003	-	Antiseptic, antidiarrhetic, antiviral, astringent, cardiac, emmenagogue, refrigerant, stomachic,

						anthelmintic[3]
Quillaja saponaria (Quillajaceae)	Quillay	N	Tree	0.034	-	Skin diseases, pectoral, sudorific, diuretic, stomachic[1]
Quinchamalium chilense (Schoepfiaceae)	Quinchamalí	N	Herb	0.005	0.003	Diuretic, tonic, depurative, emmenagogue, vulnerary, liver diseases, contusions[1]
Retanilla trinervia (Rhamnaceae)	Trevo	N	Shrub	0.034	-	Burns, contusions[1]
Rhaphithamnus spinosus (Verbenaceae)	Espino blanco	N	Tree	-	0.001	Emetic, digestive[10]
Ribes sp. (Grossulariaceae)*	Zarzaparrilla	N	Shrub	0.032	0.110	Vulnerary, antihemorrhagic, contusions, digestive, gastrointestinal diseases[7]
Robinia pseudoacacia (Fabaceae)	Acacio	E	Tree	-	0.004	Antispasmodic, antiviral, cancer, cholagogue, diuretic, emetic, emollient, febrifuge, laxative, narcotic, purgative, tonic[3]
Rosa eglanteria (Rosaceae)	Rosa mosqueta, Mosqueta	E	Shrub	-	0.005	Purgative, depurative, astringent, anthelmintic, refreshing[1]
Rosa sp. (Rosaceae)	Rosa blanca	E	Shrub	-	0.007	Astringent, cancer, laxative[3]
Rosmarinus officinalis (Lamiaceae)	Romero, Romero de Castilla	E	Shrub	0.076	0.038	Antiseptic, antispasmodic, appetizer, astringent,

						carminative, sudorific, emmenagogue, nervine, stimulant, stomachic, tonic[3]
Rubus ulmifolius (Rosaceae)	Mora, Zarza, Zarzamora	E	Shrub	0.082	0.052	Astringent, antidiarrhetic, tonic[11]
Rumex sp. (Polygonaceae)*	Romaza	E	Herb	-	0.006	Astringent, emmenagogue[1]
Ruta sp. (Rutaceae)	Ruda	E	Herb	0.279	0.140	Venereal diseases, emmenagogue, antispasmodic, sudorific, anthelmintic, stimulant[1]
Salix humboldtiana (Salicaceae)	Sauce amargo	N	Tree	-	0.002	Febrifuge, astringent, tonic, colds, antirheumatic[1]
Salix nigra (Salicaceae)	Sauce negro	E	Tree	0.025	-	Analgesic, anti-inflammatory, antiseptic, astringent, sudorific, diuretic, febrifuge, sedative, tonic[3]
Salix sp. (Salicaceae)*	Sauce	E	Tree	0.001	0.001	Analgesic, antirheumatic, astringent, febrifuge, poultice[3]
Sambucus sp. (Adoxaceae)*	Sauco	E	Tree	0.018	0.003	Anti-inflammatory, laxative, diuretic, sudorific, emetic, emollient, expectorant, galactogogue, ophthalmic, purgative, stimulant[3]

Santolina chamaecyparissus (Asteraceae)	Cola de chancho, Saturnina, Santonina, Hierba nino, Antonina	E	Herb	0.021	-	Antispasmodic, antiseptic, emmenagogue, anthelmintic[3]
Schinus latifolius (Anacardiaceae)	Molle, Muelle	N	Tree	0.046	-	Contusions, antirheumatic, balsamic, nervine, purgative, diuretic, vulnerary, carminative, tonic, depurative[1]
Schinus polygamus (Anacardiaceae)	Huingán	N	Tree	-	0.004	Fractures, contusions, galactogogue, vulnerary, diuretic, balsamic, antirheumatic, purgative[1]
Senecio fistulosus (Asteraceae)	Hualtata	N	Herb	-	0.003	Emollient, diuretic, cardiotonic, antiinflammatory[1]
Senna stipulacea (Fabaceae)	Mayo negro	N	Shrub	-	0.003	Astringent, purgative, laxative[1]
Solanum sp. (Solanaceae)*	Natre	N	Shrub	0.092	0.106	Febrifuge, tonic, analgesic[1]
Solanum nigrum (Solanaceae)	Llagui, Llague	E	Herb	-	0.007	Herpes, skin eruptions (due to *Lithraea caustica*), febrifuge, liver diseases[1]
Sophora cassiodes (Fabaceae)	Pilo-pilo	N	Shrub	0.002	-	Purgative, sudorific, stimulant, skin eruptions, antirheumatic[1]
Stellaria media (Caryophyllaceae)	Hierba de la gallina	E	Herb	-	0.001	Antirheumatic,

						astringent, carminative, depurative, diuretic, emmenagogue, expectorant, galactogogue, laxative, ophthalmic, poultice, refrigerant, vulnerary[3]
Stemodia durantifolia (Scrophulariaceae)	Contrahierba	N	Herb	-	0.001	Vulnerary[12]
Tanacetum balsamita (Asteraceae)	Menta de San Pedro, Menta coca, Menta blanca	E	Herb	0.013	-	Antiseptic, astringent, digestive, laxative[3]
Tanacetum parthenium (Asteraceae)	Artemisa, Artamisa, Tamisa	E	Herb	0.029	-	Contusions, anti-inflammatory, antirheumatic, antispasmodic, laxative, carminative, emmenagogue, stimulant, stomachic, anthelmintic[3]
Taraxacum officinale (Asteraceae)	Diente de león	E	Herb	0.006	0.017	Laxative, cholagogue, depurative, diuretic, stomachic, tonic[3]
Teucrium bicolor (Lamiaceae)	Oreganillo	N	Herb	0.004	0.032	Tumor[13]
Thymus sp. (Lamiaceae)*	Tomillo	E	Herb	0.004	-	Anthelmintic, antiseptic, antispasmodic, carminative, sudorific, antiseptic, expectorant,

						sedative, tonic[3]
Tilia sp. (Malvaceae)	Tilo, Flor pectoral	E	Tree	0.015	0.004	Antispasmodic, sudorific, expectorant, laxative, sedative[3]
Tristerix corymbosus (Loranthaceae)	Quintral, Quintral del maqui, Quintral del álamo, Quintral del maitén	N	Hemi-parasite	0.029	0.081	Antioxidant, astringent, hypotensive, sedative, anticholesterolemic, internal hemorrhages[14]
Ugni molinae (Myrtaceae)	Murta, Murtilla, Mutilla	N	Shrub	-	0.017	Stimulant, astrigent[1]
Ulex europaeus (Fabaceae)	Flor del espino, espino, Aliaga	E	Shrub	-	0.063	Antidiarrhetic, calculus[3]
Urtica urens (Urticaceae)	Ortiga, Orticaria	E	Herb	0.038	0.016	Antiasthmatic, astringent, depurative, diuretic, galactogogue, hypoglycemic, tonic[3]
Verbascum thapsus (Scrophulariaceae)	Paño	E	Herb	-	0.003	Analgesic, antiseptic, astringent, emollient, expectorant, toothache, vulnerary[3]
Verbena officinalis (Verbenaceae)	Verbena	E	Herb	0.005	-	Analgesic, antiseptic, antirheumatic, antispasmodic, tumor, astringent, depurative, diuretic, emmenagogue, galactogogue,

						stimulant, tonic, vulnerary[3]
Veronica sp. (Plantaginaceae)	Verónica, Verónica, Triaca silvestre	E	Herb	-	0.011	Tonic, diuretic, sudorific, emollient, stomachic, pectoral, calculus, vulnerary[11]
Viola sp. (Violaceae)*	Violeta de campo	N	Herb	-	0.008	Appetizer, colds, emollient, antispasmodic, sudorific, digestive[1]
Weinmannia trichosperma (Cunoniaceae)	Palo santo	N	Tree	-	0.032	Astringent, balsamic, antidiarrhetic, vulnerary[1]
?	Choto	?	-	-	-	-
?	Pata Chucho	?	-	-	-	-
?	Huichinco	?	-	-	-	-
?	Hierba de la lora	?	-	-	-	-
?	Tranca la puerta	?	-	-	-	-
?	Hierba blanca	?	-	-	-	-

[a]:N= Native, E= Exotic.
[b]: The species that were not mentioned in the municipality, have no Salience value.
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