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PLANT KNOWLEDGE IN CHILDREN WHO INHABIT DIVERSE SOCIO-ECOLOGICAL ENVIRONMENTS IN NORTHWESTERN PATAGONIA

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In this study, we analyzed plant knowledge in children living in three environments of Northwestern Patagonia. Given the differential socio-ecological circumstances of children's lifestyles that condition their daily activities and perception-action patterns, we hypothesize that their plant knowledge will differ according to their socio-ecological environments. We conducted semi-structured interviews, in which children were asked to mention which plants they knew, what they used them for, how and where they had learned about plants, and whether they gathered or cultivated plants. We interviewed 73 children who were 11 to 12 years old from urban, semi-urban, and rural contexts. Our results showed similarities in the plant knowledge of children inhabiting the same type of socio-cultural environment. Children from rural habitats mentioned a greater diversity of plants, more native species, more plants for medicinal and edible use, and more trees and herbs than children from semi-urban and urban areas. Additionally, children from semi-urban schools cited higher plant richness and more native species, medicinal uses, and life forms than children from urban areas. Most of the plants named by all children were edible species, followed by medicinal, and then ornamental; they also cited more exotic than native plants. Most children referred to species used in their daily lives, suggesting the importance of embodied experience in relation to plant knowledge. The present study showed differential patterns of plant knowledge in children inhabiting distinct environmental contexts, indicating how experience promotes diverse cognitive abilities related to children's connection with plants.

Keywords: *plant knowledge, socio-ecological diversity, experience, children, Patagonia*

Introduction

Plant knowledge constitutes part of traditional ecological knowledge, which involves shared wisdom, beliefs, and experiences handed down from generation to generation (Berkes and Folke 2002; Berkes et al. 2000; Estrada et al. 2007; Nazarea 1987; Walker et al. 2004). This highly dynamic knowledge, influenced by historical, ecological and socio-cultural circumstances, is revealed in children's proficiency in different ways (e.g., Berkes 1993; Berkes and Turner 2006; Berkes et al. 2003). In Northwestern Patagonia, however, traditional plant knowledge has been undergoing persistent transformation processes (Cardoso et al. 2013; Eyssartier et al. 2011a, 2011b, 2013, 2015; Ladio and Lozada 2000, 2001, 2003, 2004, 2008; Lozada et al. 2006). Wild plant gathering and land cultivation has

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been practiced by rural communities of Mapuche ancestry since ancient times in this region (Bandieri 2005; Citarella et al. 1995). People's lives and customs were dramatically affected by the arrival of the Spanish in the seventeenth century, which changed forever their food production and sustenance, health and economic systems, and cosmogony, among other aspects of culture (Bandieri 2005; Citarella et al. 1995; Moyano 2007; Torres and Cisternas 2002). The severe changes that these communities suffered, led to the emigration of local people from rural environments to urban centers (Bandieri 2005; Moyano 2007; Torres and Cisternas 2002). In spite of these significant transformations, numerous local people still gather and use wild plants (Ladio and Lozada 2003, 2004, 2008; Lozada et al. 2006) and also cultivate edible, medicinal, and ornamental plants in gardens and vegetable-gardens (Eyssartier et al. 2011a, 2011b, 2013, 2015). Nevertheless, it is clear that their traditional ecological knowledge is suffering serious erosion (Eyssartier et al. 2011a, 2011b, 2013, 2015; Ladio and Lozada 2008; Lozada et al. 2006). Many investigations conducted in northwestern Patagonian populations have thoroughly studied local plant knowledge and current knowledge erosion in adults (e.g., Cardoso et al. 2013; Eyssartier et al. 2011a, 2011b, 2013, 2015; Ladio and Lozada 2000, 2001, 2003, 2004, 2008; Lozada et al. 2006; Richeri et al. 2013); however, this topic has not been further explored in children inhabiting this region.

Traditional plant knowledge emerges from experience during intimate coupling within socio-ecological contexts, family customs, and daily activities (e.g., Eyssartier et al. 2013; Ladio and Lozada 2008; Zarger and Stepp 2004). In northwestern Patagonia, horticultural and gathering proficiency is learned by actively "doing" from an early age, as children accompany their parents to gather plants, work the land, or simply observe the proceedings (Eyssartier et al. 2011a, 2011b, 2013, 2015; Lozada et al. 2006). Moreover, plant knowledge in children seems to be acquired while experiencing everyday activities more than in formal school settings (Zarger and Stepp 2004). In accordance with the results of several investigations, people do not receive information passively from their environment, but participate in the generation of meaning through their actions and perceptions (Di Paolo and De Jaegher 2012). In line with this perspective, children's activities embedded in certain socio-ecological contexts are expected to condition their plant knowledge and understanding of their environment.

The profound socio-cultural and ecological changes experienced by Patagonian communities have markedly affected younger generations' learning contexts. In addition to the erosion of traditional plant knowledge that is presently occurring, urban development tends to limit contact with nature, thus decreasing ecologically sustainable practices (Cooper 2008; Kellert 2002; Miller 2005; Pergams and Zaradic 2006). It has been proposed that experiences in nature are relevant for plant knowledge in children (Bixler et al. 2002; Campos et al. 2012, 2013; Miller 2005). Knowing and learning about natural contexts fosters the appreciation of all living beings, as well as protective environmental values and behaviors (Chen-Hsuan Cheng and Monroe 2012; Cooper 2008; Lozada and Margutti 2011). In line with this, the importance of exploring the environment through first-hand contact with nature has been emphasized by researchers (Arango et al. 2002; Feinsinger et al. 1997).

In the present work, we compare plant knowledge of children from six schools situated in three different environments of northwestern Patagonia: a forest-steppe rural context located in Nahuel Huapi National Park, an urban center (Bariloche City), and a semi-urban area located in the outskirts of Bariloche City. Given the differential socio-ecological circumstances of children's lifestyles that condition their daily activities and perception-action patterns, we hypothesize that children's plant knowledge will differ according to their socio-ecological environments.

Methods

Study Site

We interviewed 73 children (37 girls and 36 boys) aged from 11 to 12 years who attend six public schools located in northwestern Patagonia: 25 children from two urban schools (No. 71 and 273), 24 children from two semi-urban schools (Pilar and Frutillar), and 24 children from two rural schools (Cuyin and Traful). The children belong to families of mixed ancestry; most of the rural families and many of the semi-urban families are descendants from ancient Mapuche people, while most of the families of the urban zones are of mestizo origin.

The two urban schools (No. 71 and 273) are situated in the center of Bariloche (100,000 inhabitants). The two semi-urban schools are located on the outskirts of Bariloche (interface between the city and the Nahuel Huapi National Park), one of which, Pilar, lies near the forest (more rural) and the other one, Frutillar, at the edge of the city (more urban). The two rural schools are located in distinct ecological environments in the Nahuel Huapi National Park, Traful in the forest and Cuyin in the steppe-forest transition zone.

The urban and semi-urban schools were randomly chosen, while, in the rural zones, the schools selected were the only schools available in that context for this study. Each grade was chosen at random when there was more than one class. The investigation was conducted according to the Helsinki Declaration (2013). Parents were informed as to how their children would participate in the study. Interviews were carried out after parents and school authorities had provided their written consent. Children were individually interviewed in each school during normal teaching hours. Each child answered a questionnaire about their previous knowledge and experience with plants. These interviews, conducted by two researchers, were tape-recorded and lasted 15 to 20 minutes. The participants' data were kept under confidential conditions. Children were asked to mention which plants they knew, what they used them for (plant use), how and where they had learned about plants, whether they gathered or cultivated plants in vegetable gardens, and if they liked plants or not.

Data Analysis

Data were analyzed quantitatively and qualitatively. Species richness of plant knowledge was calculated considering the total number of plants mentioned by

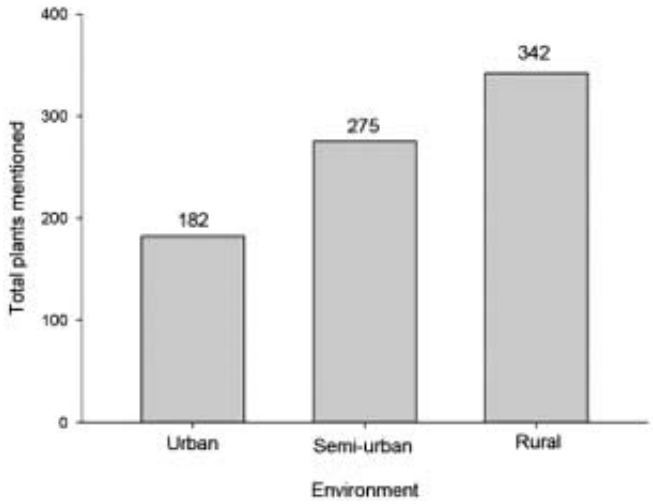

Figure 1. Total plants cited by the children from rural, semi-urban, and urban environments.

children. Plant use-categories were established in accordance with interviews as edible, ornamental, and medicinal.

Non-parametric tests were used to analyze non-normally distributed data (H[illegible]1999). Kruskal-Wallis H and Mann Whitney U tests were used to analyze differences in median richness of knowledge of species among students from the three environments. The Mann-Whitney U test (with Bonferroni corrections) was used to explore richness in relation to type of environment, categories of use, biogeographic origin, and life forms of plants mentioned by children in the different contexts. The Kruskal-Wallis H test was used to analyze total richness of plants known by children from different schools to compare main categories of use, biogeographic origin, and life forms of plants in the different contexts. Data were analyzed with SPSS 10.0 for Windows.

Results

Children from six schools located in diverse environments of northwestern Patagonia made 800 total reports of plants, representing a suite of 124 species. Among the most frequently mentioned species were rosehip (*Rosa rubiginosa*), mint (*Mentha* sp.), strawberry (*Fragaria vesca*), cypress (*Astrocedrus chilensis*), pine (*Pinus* sp.), michai (*Berberis darwinii*), and apple tree (*Malus domestica*) (Table 1).

The total plants reported differed between children from the six schools (Figure 1; Table 2). When comparing number of reported plants in relation to type of environment (urban, semi-urban, and rural), children from rural areas mentioned a significantly higher number of plants (356 spp.) than those from semi-urban (266 spp.) and urban zones (181 spp.) (Table 2). Moreover, in semi-urban zones, children recorded more plants than in urban ones.

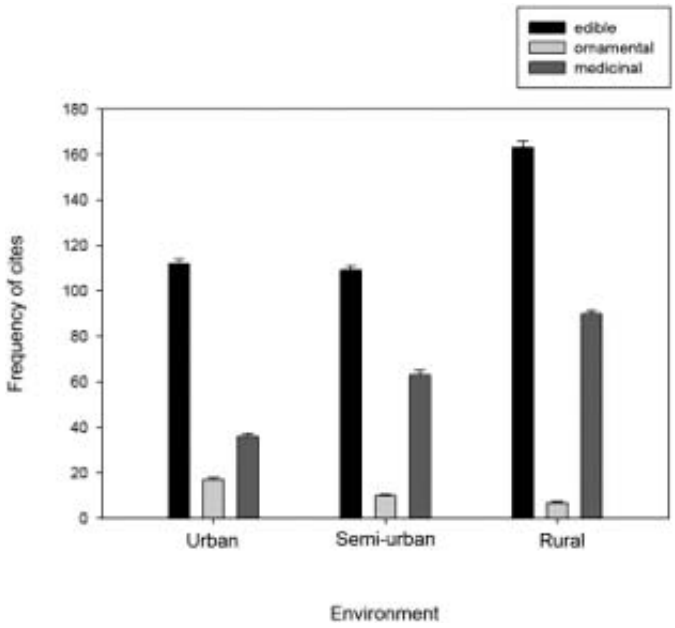

Figure 2. Categories of use cited by the children from rural, semi-urban, and urban environments.

When comparing the most frequently mentioned categories of use (i.e., edible, ornamental, and medicinal), we found significant differences in median richness between categories (Figure 2). Children reported a higher number of edible species (n = 384) than ones for medicinal purposes (n = 189) and ornamental use (n = 34) (Table 2).

Plant use differed in relation to type of ecological context; we observed significant differences in median richness for medicinal species but not with respect to edible and ornamental ones. Children from urban zones mentioned significantly fewer medicinal plants than children from semi-urban and rural zones, and also fewer edible species than children from rural areas. Children from rural zones mentioned more edible and medicinal plants than children from semi-urban zones (Table 2).

In all schools, exotic plants (503) were mentioned in a higher proportion than native species (297) (Figure 3). Children from semi-urban zones referred to more native plants than children from urban zones. Children from rural contexts mentioned more exotic plants than those from urban and semi-urban settings and also more native plants than children from urban contexts (Table 2).

When analyzing life forms, children of all schools mentioned trees (235 of reported plants) and herbs (229 of reported plants) in a similar proportion, whereas shrubs were mentioned in a lower proportion (132 cites) ($H = 21.338$, $p < 0.001$) (Figure 4).

Children from urban zones referred to significantly fewer trees and herbs than children from a rural environment. Moreover, children from semi-urban zones mentioned significantly more trees, shrubs, and herbs than children from urban zones, but fewer herbs than children from rural zones (Table 2). When

Table 1. Plant species cited by the children inhabiting rural, semi-urban, and urban environments.

Local plant name	*Plant species*	Origin	Life form	Common uses	Children's context	Frequency of cites
mosqueta	*Rosa rubiginosa*	exotic	s	m	r, su, ur	49
menta	*Mentha* sp.	exotic	h	m	r, su, ur	47
frutilla	*Fragaria vesca*	exotic	h	e	r, su, ur	45
manzano	*Malus domestica*	exotic	t	e	r, su, ur	37
cipres	*Austrocedrus chilensis*	native	t	lan	r, su	30
pino	*Pinus* sp.	exotic	t	lan	r, su, ur	29
michai	*Berberis darwinii*	native	s	e	r, su, ur	23
alamo	*Populus nigra*	exotic	t	lan	r, su, ur	19
cereza	*Prunus avium*	exotic	t	e	r, su, ur	18
ñire	*Nothofagus antarctica*	native	t	lan	r, su	18
manzanilla	*Matricaria recutita*	exotic	h	m	r, su, ur	17
ciruela	*Prunus domestica*	exotic	t	e	r, su, ur	17
arrayan	*Luma apiculata*	native	s	lan	r, su, ur	17
radal	*Lomatia hirsuta*	native	t	lan	r, su	17
guinda	*Prunus cerasus*	exotic	t	e	r, su, ur	16
paico	*Chenopodium ambrosioides*	native	h	m	r, su, ur	16
laura	*Schinus patagonicus*	native	s	lan	r, su	16
coihue	*Nothofagus dombeyi*	native	t	lan	r, su	16
ajenjo	*Artemisia absinthium*	exotic	h	m	r, su	15
hongo pino	*Boletus granulatus*	native	f	e	r, su, ur	15
frambuesa	*Rubus idaeus*	exotic	s	e	r, su, ur	14
hongo cipres	*Morchella* sp.	native	f	e	r	14
sauco	*Sambucus nigra*	native	t	e, m	r, su, ur	13
maiten	*Maytenus boaria*	native	t	lan	r, su, ur	12
achicoria	*Chicorium intybus*	exotic	h	e	r, su	11
maqui	*Aristotelia chilensis*	native	s	e	r, su	11
salvia	*Salvia officinalis*	exotic	h	m	r, su	10
siete venas/ llanten	*Plantago lanceolata*	exotic	h	m	r, su, ur	10
lenga	*Nothofagus pumilio*	native	t	lan	r, su, ur	10
margarita	*Chrysanthemun* sp.	exotic	h	o	r, su, ur	9
rosa	*Rosa* sp.	exotic	s	o	r, su, ur	9
pañil	*Buddleja globosa*	native	s	m	r, su	9
chacay	*Discaria trinervis*	native	t	lan	r, su	7
zanahoria	*Daucus carota*	exotic	h	e	r, su, ur	6
oregano	*Origanum vulgare*	exotic	h	e, m	r, su,ur	6
diente de leon	*Taraxacum officinale*	exotic	h	m, e	r, su, ur	6
retamo	*Diostea juncea*	native	s	o	su	6
lechuga	*Lactuca sativa*	exotic	h	e	su, ur	5
aloe	*Aloe* sp.	exotic	h	m	ur	5
grosella	*Ribes rubrum*	exotic	s	e	r, su	5
nalca	*Gunnera tinctoria*	native	h	e	r	5
palo piche	*Fabiana imbricata*	native	s	m	r, su	5
paramela	*Adesmia boronioides*	native	s	m	r, su	5
perejil	*Petroselinum sativum*	exotic	h	e	su, ur	4
laurel	*Laurus nobilis*	exotic	s	o	r, su, ur	4
durazno	*Prunus persica*	exotic	t	e	r, su, ur	4
pera	*Pyrus communis*	exotic	t	e	r, ur	4

Table 1. Continued.

Local plant name	*Plant species*	Origin	Life form	Common uses	Children's context	Frequency of cites
cilantro	*Coriandrum sativum*	exotic	h	e	su, ur	3
tomate	*Lycopersicum esculentum*	exotic	h	e	r, ur	3
girasol	*Helianthus annuus*	exotic	h	e, o	r	3
tulipan	*Tulipa* sp.	exotic	h	o	su, ur	3
murra / mora	*Rubus ulmifolius*	exotic	s	e	ur	3
boldo	*Peamus boldus*	exotic	s	m	ur	3
romero	*Rosmarinus officinalis*	exotic	s	m	r, ur	3
eucalitpo	*Eucalyptus* sp.	exotic	t	lan	r, ur	3
sauce	*Salix alba*	exotic	t	lan	r, ur	3
llao llao	*Cyttaria harioti*	native	f	lan	r, su	3
alfilerillo	*Erodium cicutarium*	native	h	m	r	3
chupasangre	*Maihuenia patagonica*	native	h	m	r	3
berro	*Nasturtium officinale*	exotic	h	e	r	2
cebolla	*Allium cepa*	exotic	h	e	ur	2
cebollin	*Allium* sp.	exotic	h	e	su, ur	2
choclo	*Zea mais*	exotic	h	e	r	2
repollo	*Brassica oleraceae* var. *capitata*	exotic	h	e	ur	2
yerba buena	*Mentha rotundifolia*	exotic	h	e,m	r, ur	2
pensamiento	*Viola tricolor*	exotic	h	o	su, ur	2
nuez	*Juglans regia*	exotic	t	e	r, ur	2
palta	*Persea americana*	exotic	t	e	ur	2
chupaya	*Eryngium paniculatum*	native	h	lan	su	2
ñanculahuen	*Valeriana carnosa*	native	h	m	su	2
natre	*Solanum crispum*	native	t	lan	r, su	2
helecho	undet	undet	h	o	r, ur	2
anana	*Ananas comosus*	exotic	h	e	ur	1
arveja	*Pisum sativum*	exotic	h	e	r	1
brocoli	*Brassica oleracea* var. *italica*	exotic	h	e	ur	1
hinojo	*Foeniculum vulgare*	exotic	h	e	r	1
lechuga amarga	*Lactuca* sp.	exotic	h	e	su	1
papa	*Solanum tuberosum*	exotic	h	e	r	1
rabanito	*Raphanus sativus*	exotic	h	e	r	1
repollo de bruselas	*Brassica oleraceae* var. *gemmifera*	exotic	h	e	ur	1
misodendrum	*Misodendrum punctulatum*	exotic	h	lan	r	1
melisa	*Melissa officinalis*	exotic	h	m	r	1
peperina	*Mentha* sp.	exotic	h	m	r	1
cardo	*Onopordon acanthium*	exotic	h	m, lan	ur	1
conejito	*Antirrhinum majus*	exotic	h	o	ur	1
lazo de amor	*Chlorophytum comosum*	exotic	h	o	ur	1
malvon	*Althaea rosea*	exotic	h	o	ur	1
nomeolvides	*Myosotis sylvatica*	exotic	h	o	ur	1

Table 1. Continued.

Local plant name	*Plant species*	Origin	Life form	Common uses	Children's context	Frequency of cites
peonia	*Paeonia lactiflora*	exotic	h	o	ur	1
petunia	*Petunia hybrida*	exotic	h	o	r	1
violeta	*Vila odorata*	exotic	h	o	su	1
eter	*Artemisia abrotanum*	exotic	s	m	su	1
lavanda	*Lavandula* sp.	exotic	s	m	su	1
ruda	*Ruta graveolens*	exotic	s	m	r	1
tomillo	*Thymus vulgaris*	exotic	s	m	r	1
zarzaparrilla	*Ribes magellanicum*	exotic	s	m	su	1
lila	*Syringa vulgaris*	exotic	s	o	su	1
retama	*Cytisus scoparius*	exotic	s	o	su	1
castaño	*Castanea sativa*	exotic	t	e	ur	1
damasco	*Prunus armeniaca*	exotic	t	e	r	1
mandarina	*Citrus* sp.	exotic	t	e	ur	1
abedul	*Betula pendula*	exotic	t	lan	r	1
alamo blanco	*Populus alba*	exotic	t	lan	r	1
alamo plateado	*Populus* sp.	exotic	t	lan	r	1
bellota (roble)	*Quercus* sp.	exotic	t	lan	ur	1
mimbre	*Salix viminalis*	exotic	t	lan	su	1
pino oregon	*Pseudotsuga menziesii*	exotic	t	lan	su	1
sauce electrico	*Salix x erythroflexuosa*	exotic	t	lan	su	1
tilo	*Tilia* sp.	exotic	t	m	r	1
culle	*Oxalis* sp.	native	h	e	r	1
papita del bosque	?	native	h	e	r	1
colicor de vara	*Solidago chilensis*	native	h	lan	su	1
junco	*Juncus sp.*	native	h	lan	r	1
altamisa	*Tanacetum parthenium*	native	h	m	r	1
arrastrado	*Chenopodium ambrosioides*	native	h	m	r	1
lengua de vaca	*Rumex crispus*	native	h	m	r	1
malvarubia	*Marrubium vulgare*	native	h	m	su	1
ortiga	*Urtica* sp.	native	h	m	r	1
amancay	*Alstroemeria patagonica*	native	h	o	ur	1
topatopa	*Calceolaria* sp.	native	h	o	r	1
trebol	*Oxalis* sp.	native	h	o	r	1
carqueja	*Baccharis sagittalis*	native	s	m	su	1
campanita	*Campanula* sp.	undet	h	o	r	1
manzanita de peru	undet	undet	undet	e	r	1

Below the table: Life forms: t (tree), s (shrub), h (herb), f (fungi). Common uses: e (edible), m (medicinal), o (ornamental), lan (landscape). Children's context: r (rural), su (semi-urban), ur (urban). Undet: Undetermined.

comparing schools in rural zones, children from the forest environment (Traful) mentioned more native species and trees ($U = 31.5$, $p = 0.017$; $U = 33$, $p = 0.024$, respectively) than children from the rural transition zone (Cuyin), who mentioned more shrubs and exotic species ($U = 27$, $p = 0.008$; $U = 27$, $p = 0.008$, respectively).

Table 2. Comparison of plant diversity richness, median number of cites, range (R), and interquartile ranges (IQR) between the three environments.

	Rural context				Semi-urban context				Urban context				Contexts' comparison Kruskal Wallis H (p)	Paired comparison - Mann Whitney U (p)		
Plant Context	**Richness**	**Median**	**R**	**IQR**	**Richness**	**Median**	**R**	**IQR**	**Richness**	**Median**	**R**	**IQR**		**Rural vs semi-urban**	**Rural vs urban**	**Semi-urban vs urban**
Exotic	48	6	9	2-11	39	6	11	2-13	50	8.5	14	1-15	0.16			
Native	32	1	4	0-4	25	4.5	11	0-11	8	6	11	1-12	< **0.001**	0.07	**0.001**	**0.001**
Trees	25	1	3	0-3	19	3.5	9	1-10	18	5	6	2-8	0.14			
Shrubs	15	1	3	0-3	19	2	6	0-6	9	1.5	5	0-5	**0.03***	0.23	0.16	**0.01**
Herbs	39	1	4	0-4	24	3	5	1-6	31	4.5	6	2-8	**0.01**	**0.004**	0.15	0.15
Edible	33	5	8	1-9	21	4	8	1-9	30	7	12	3-15	**0.03***	**0.01**	0.66	**0.04**
Medicinal	26	1	5	0-5	19	2	7	0-7	13	3	6	2-8	**0.007**	0.08	**0.002**	0.15
Ornamental	9	0	3	0-3	9	0	2	0-2	12	0	2	0-2	0.65			
Landscape	20	2	20	0-20	18	1	12	0-12	8	0	8	0-8	**0.002**	0.3	**0.001**	**0.02**
N plants cited	356				266				181				< **0.001**	**0.001**	**0.001**	**0.029**
Total richness	83				64				59				**0.005**	**0.01**	**0.002**	0.5

Below the table:
* denotes Bonferroni corrected p values (significant differences).
Bold values denote significant values.

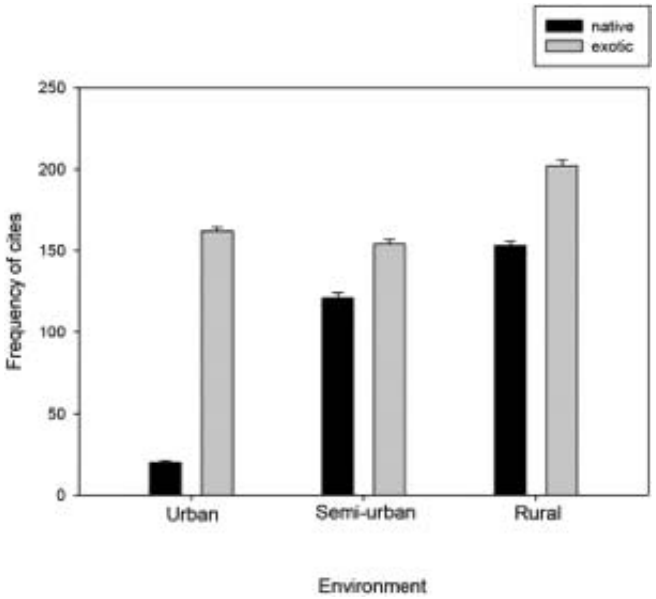

Figure 3. Biogeographic origin of plants mentioned by the children from rural, semi-urban, and urban environments.

The total richness of 124 species mentioned by children from all schools (67.8% exotic and 32.2% native species) showed significant differences between zones. Children from rural zones cited a higher number of species (83 spp.) than children from semi-urban and urban zones (64 and 59 spp., respectively).

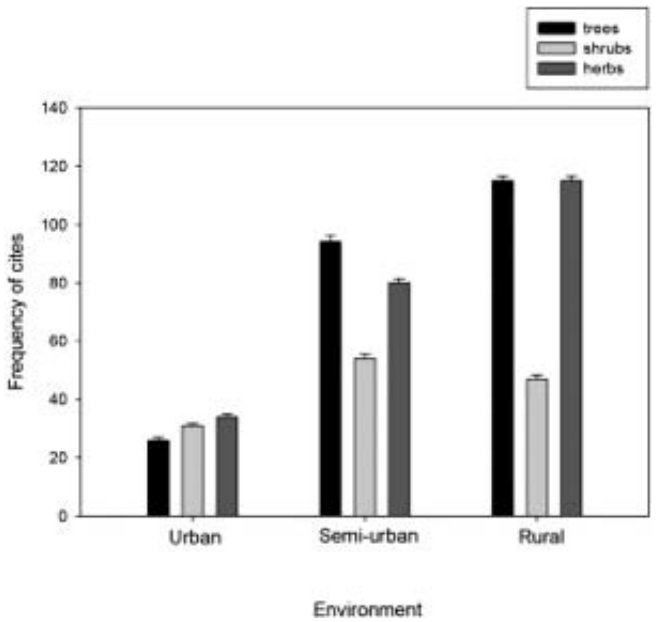

Figure 4. Life forms cited by the children from rural, semi-urban, and urban environments.

Moreover, when comparing the total richness of native species reported by the children, we also observed significant differences between types of environment. Children dwelling in natural parks mentioned a higher number of native plants (32 spp.) than children from urban zones (8 spp.); marginal differences were observed between children from rural and semi-urban zones (32 spp. for rural and 25 spp. for semi-urban). Noticeably, children from all contexts mentioned a similar number of exotic plants (Table 2).

When comparing plant richness in relation to categories of use, we found differences between environments. Medicinal plant richness differed between children inhabiting rural and urban zones. Children from rural zones mentioned a greater number of medicinal species (26 spp.) than those from urban areas (13 spp.), with no differences being observed between the other paired comparisons (Table 2). We did not find significant differences in total richness of edible and ornamental species between environments. Finally, children from urban zones mentioned a lower richness of landscape plants (8 spp.), than children from rural (20 spp.) and semi-urban (18 spp.) zones (Table 2).

When comparing diversity of life forms, we found similar richness for trees and shrubs between zones and for herbs, we observed the lowest richness in semi-urban areas (Table 2).

Discussion

Children's experience in different socio-ecological environments appears to condition their plant knowledge. Proficiency with local plant knowledge is similar in children who inhabit comparable contexts and follows a gradient from rural to urban areas. Children from rural habitats cited a higher number of total plants and diversity, mentioning more native species, plants for medicinal and edible uses, and more trees and herbs than children from both semi-urban and urban areas. Interestingly, most of the children from all three environments cited a higher number and diversity of edible plants than of plants in the other use categories. These findings indicate that the majority of the children referred to plants encountered in their daily lives in close association with activities carried out in their immediate environments, as also observed in other studies (e.g., Reyes-García et al. 2010).

Children inhabiting rural contexts in a national park in Patagonia are surrounded by a high diversity of plants (Ezcurra and Brion 2005). Many of their families are involved in cattle-raising, usually practice horticulture, and also collect wild species; children frequently accompany their parents and in this way learn about local plants (e.g., Lozada et al. 2006). Therefore, children from these communities regularly interact with their ecological contexts, thus gaining hands-on knowledge about plants. Most of the rural families and many of the semi-urban ones are descendants from ancient Mapuche people who have preserved ancestral traditions, such as the medicinal use of wild plants, sharing this wisdom with their kin through active experience, showing that plants are

still part of their everyday lives (Lozada et al. 2006). This important cultural factor might have influenced children's knowledge about plants in the region. In line with this, in our study, we found that children inhabiting these natural areas mentioned more herb species, medicinal, and landscape plants than children from the other zones. It is interesting to note a difference found between children of the two sub-areas of the Nahuel Huapi National Park; children from Traful mentioned more native species and trees, whereas those from Cuyin cited more shrubs and exotic plants. This finding agrees with the type of environment they inhabit, since Traful is located in a forest area while Cuyin lies in a steppe-forest transition zone. These results also mirror those of a previous study that evaluated plant knowledge in adults from the Cuyin population, which showed that locals know about a greater number of exotic plants than native species (Lozada et al. 2006). Moreover, in the earlier investigation, local people mentioned the importance of "doing" during childhood, when they were asked how they had learned about plants. They described situations where they were involved in concrete practices, such as gathering wild plants with their families and cultivating the land, as also observed in other investigations (Eyssartier et al. 2011a, 2011b, 2013, 2015; Ladio and Lozada 2003, 2004).

The fact that children living in rural areas mentioned a greater number of plants, life forms, and uses than children from the other contexts, might suggest plant knowledge erosion in families close to the city, as found in another study conducted with adults inhabiting this Patagonian region (e.g., Ladio and Lozada 2001). These differential patterns might also illustrate fewer opportunities to enact with plants, as an urban lifestyle generally implies less contact with ecological environments. Moreover, the difference found in plant knowledge between children from urban and semi-urban zones is worthy of note. Although these areas are physically very close to each other (e.g., approximately 1 km), the children's plant knowledge is markedly different. Children of semi-urban schools live on the outskirts of Bariloche, where many of the families are descendants of ancient Mapuche dwellers who migrated to these areas and who still use and collect wild plants and practice horticulture (e.g., Ladio and Lozada 2001). In spite of the erosion processes that this knowledge is suffering within the Mapuche people (e.g., Estomba et al. 2006; Ladio and Lozada 2003), children belonging to these families demonstrated greater plant knowledge than children from the urban schools. Plant knowledge in children, therefore, reflects cognitive processes acquired in their everyday experience; i.e., it tends to be influenced not only by formal education (similar in all schools) but also by their environmental setting, family customs, traditions, and values, which offer the opportunity to interact with plants in different ways.

In agreement with our findings, other investigations in rural zones of Argentina showed that children cited a higher number of exotic plants than native ones and that they learned about plants while accompanying their parents to the countryside or while working in vegetable-gardens (Campos et al. 2012, 2013; Nates et al. 2010). It has been proposed that contact with natural environments fosters psychological and physical well-being (Kaplan 1973; Ulrich 1984) and enhances cognitive functioning (Kuo 2001; Tennessen and Cimprich 1995). Moreover, the results of our work agree with other studies proposing that

active experience in nature helps develop plant knowledge, as well as caring attitudes and empathic concern with living beings (Campos et al. 2012, 2013; Chen-Hsuan Cheng and Monroe 2012; Collado et al. 2013; Drissner et al. 2013; Mayer and McPherson Frantz 2004; Rozzi 2011). This also favors children's awareness of their own actions in relation to the environment, enabling them to make thoughtful decisions, taking diversity and other ecological viewpoints into account (Arango et al. 2002; Collado et al. 2013).

Conclusion

The present study describes plant knowledge of children who dwell in diverse environments of northwestern Patagonia and shows the existence of significant differences in the children's plant knowledge. This likely results from their daily activities in different socio-ecological contexts, suggesting how experience promotes diverse cognitive abilities related to children's connection with plants. Their multiple ways of living in their particular socio-cultural environments is reflected in their distinctive plant knowledge, indicating that everyday experience is essential. That is, children's experience is highly influenced by their families' customs and cultural traditions. In particular, Mapuche heritage has a long-standing knowledge associated with plant use. The erosion processes that have affected Mapuche traditional ecological knowledge also appear to impact what children learn about plants. In spite of this erosion, children living in rural areas mentioned a high proportion of native species and medicinal uses, as did children from semi-urban zones, indicating that cultural practices help maintain Mapuche traditional plant knowledge. It is interesting to note a general pattern of plant knowledge (considering all three environments) related to the fact that children cited more edible species than other categories. This could also be associated with their daily lives, suggesting how perception-action patterns condition knowledge, as proposed by the embodied cognition theory (Varela 1999, 2000). The current work highlights that it would be desirable for educational institutions to take children's daily experience of plants into consideration, thus fostering cultural diversity and greater empowerment of children's traditional plant knowledge.

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