Current Topics in Plant Biology
Vol. 13, 2012

Original Communication

Analysis of the diversity of the family Poaceae in the region of Aysén, Chilean Patagonia

Víctor L. Finot[1,*], Clodomiro Marticorena[1], Juan A. Barrera[1], Rosemarie Wilckens[1], Susana Fischer[1], Fernán Silva[2] and Gloria Rojas[3]

[1]Facultad de Agronomía, Universidad de Concepción, Casilla 537, Chillán, [2]Servicio Agrícola Ganadero Regional Aysén, [3]Museo Nacional de Historia Natural, Santiago, Chile

ABSTRACT

The diversity of the grass flora (Poaceae) of the Region of Aysén, Chilean Patagonia (43º38'-49º16'S), was studied in order to develop a checklist of the species, to evaluate the completeness of the inventory, and to determine the distribution of the collected specimens and species richness facilitating new expeditions. In Aysén, Poaceae are represented by 36 genera, 122 species and 12 infraspecific taxa, distributed in 3 subfamilies: Bambusoideae, Danthonioideae and Pooideae. Species accumulation curves and the Chao 2 index suggested that it would still be possible to detect between 113 and 32, with an average of 60 new species. These values suggest that the inventory is completed between 52 and 80%. The species richness is directly related to the collection effort; the greatest number of species were found in Coyhaique and General Carrera. It was shown that most of the collections were concentrated in the vicinity of roads and cities, in three areas of the region: Puerto Cisnes-La Tapera, Coyhaique, and near Chile Chico (National Reserve Lago General Carrera, N. R. Jeinimeni). Other collected zones include the protected areas National Reserve Trapananda, National Park Queulat, N. P. Laguna San Rafael, N. P. Isla Magdalena, N. P. Cerro Castillo, and N. R. Lago Las Torres.

*Corresponding author
vifinot@udec.cl

KEYWORDS: Chile, Chilean Patagonia, grass diversity, collection effort, accumulation curves

INTRODUCTION

Poaceae (Gramineae) are the fifth most diverse family of flowering plants and the second most diverse family among the Monocotyledons. The family contains 8,000-10,000 species in 700-800 genera [1-3]. In Chile, the family comprises approximately 523 species and 57 infraspecific taxa, distributed in 122 genera, representing about 10.1% of the Chilean flora [4]. Poaceae is the second most diverse family of angiosperms in Chile, after Asteraceae with about 863 species [5]. Of the 13 subfamilies of Poaceae, eight are present in Chile: Aristidoideae, Arundinoideae, Bambusoideae, Chloridoideae, Danthonioideae, Ehrhartoideae, Panicoideae, and Pooideae. Most of the Chilean grasses (388 spp., 75%) belong to the subfamily Pooideae, followed by a few Panicoideae (59 spp., 10%), and Chloridoideae (43 spp., 7.9%). Species are distributed in 17 tribes and 43 subtribes [4]. Three-hundred and twenty eight species (60.2%) are native, 68 species (12.5%) are endemic and 148 species (27%) are introduced [6].

Previous studies [4] indicated that the knowledge of the Chilean grasses is good enough, with an observed species richness that reaches over 88% of the estimated species richness. However, the collection index calculated for the different political regions showed a poor collection effort in

Aysén, being the third poorest collected region in Chile. During the last century many botanical expeditions to this region have been made. Recent studies of the vascular plants of the rivers Cisnes, Baker, Pascua and Mosco, as well as the vascular flora of the National Reserve Jeinimeni and those associated with peat bogs, have been focused on the identification and description of the species and their conservation status [7-11]. In addition, there are some studies on the propagation and management of potential ornamental Patagonian native species of Aysén and on the medicinal value of the flora [12].

Grasses are an important component of the Patagonian steppe in Aysén, occupying about 230,000 ha between 44°20'S and 49°30'S; the dominant vegetation is called coironal, with *Festuca pallescens* as dominant species [13]. Montaldo [14] describes two plant associations dominated by *F. pallescens* in the Patagonian steppe: the *coironal of F. pallescens* and the association of *Colliguaja integerrima-Festuca pallescens*. Gajardo [15] recognizes 10 communities in the Patagonian steppe of Aysén: low shrub steppe of *Baccharis patagonica-Stipa neaei* (=*Jarava neaei*); *Festuca pallescens-Acaena splendens* coironal; *Festuca pallescens-Mulinum spinosum* coironal; *Adesmia longipes-Azorella incisa* steppe; *Acaena splendens-Bacharis patagonica* community, probably a stage of degradation by human action; *Colliguaja integerrima-Mulinum spinosum* scrub; *Adesmia boronoides-Senecio neaei* community; *Embothrium coccineum-Baccharis obovata* community; and *Nothofagus antarctica-Baccharis patagonica* community. The presence of grass species with high forage value has allowed an important livestock in the steppe [13, 16] but at the same time has led to alteration by human intervention [13, 59].

Lists of the Poaceae species present in different regions of the country have been developed by several authors [4, 6, 8, 17-35].

The aims of this work are to develop a checklist of the species of the family Poaceae recorded for Aysén, to evaluate the collection effort and the completeness of the Poaceae inventory, and to determine the distribution of the collected specimens and species richness in order to facilitate new expeditions.

MATERIALS AND METHODS

Studied area

The Region of Aysén of General Carlos Ibáñez del Campo is one of the fifteen administrative regions in which the country is divided (Region XI, sometimes also spelled Aisén). It stretches north to south from 43º38’ to 49º16'S, and east to west from the border with Argentina (71°06´W) to the Pacific Ocean. The region has an area of 109,024.90 km^2, representing 14.2% of the Chilean territory and being the third largest region in the country; it comprises 4 Provinces: 1. Aysén, 2. Capitán Prat, 3. Coyhaique, and 4. General Carrera (Fig. 1). The borders of the Region of Aysén are: Region of Los Lagos Region on the North and Region of Magallanes and Antártica Chilena on the South. The Region is part of the Chilean Patagonia. Aysén is the least populous of the fifteen Chilean regions (0.85 hab/km^2). The region has a fragmented appearance with numerous channels, fjords and archipelagos. Several watersheds are oriented east to west (rivers Palena, Cisnes, Aysén, Simpson, Ibáñez, Baker).

In the coastal area the climate is oceanic, with abundant rainfall (2,342-3,000 mm/year, strong west winds, low temperatures in the archipelagos and islands and western slopes of the Andes) fostering the formation of woody vegetation. In the eastern slopes of the Andes there is a cold steppe climate with less precipitation (rainfall of approx. 1,200 mm/year) and to a greater distance of the eastern slope of the Andes the climate is continental, with an average rainfall approx. 610 mm/year, either as rain or snowfall, with very low temperature in winter (extreme minimum = -37°C), being warmer and drier in summer. Further south there is the Northern Patagonian Ice Field and a small part of the Southern Ice Fields without vegetation. From east to west it is possible to differentiate the following plant associations (Fig. 2): a. the Patagonian steppe, located in flat areas or smooth hillsides, where low shrubs and grasses dominate; b. the Deciduous Forest of Aysén, consisting mainly of *Nothofagus pumilio* (lenga); c. the High-Montane Deciduous Scrub, which is distributed in the altitudinal limit (1,000 meters) of vegetation in the western summits of the mountains and d. the

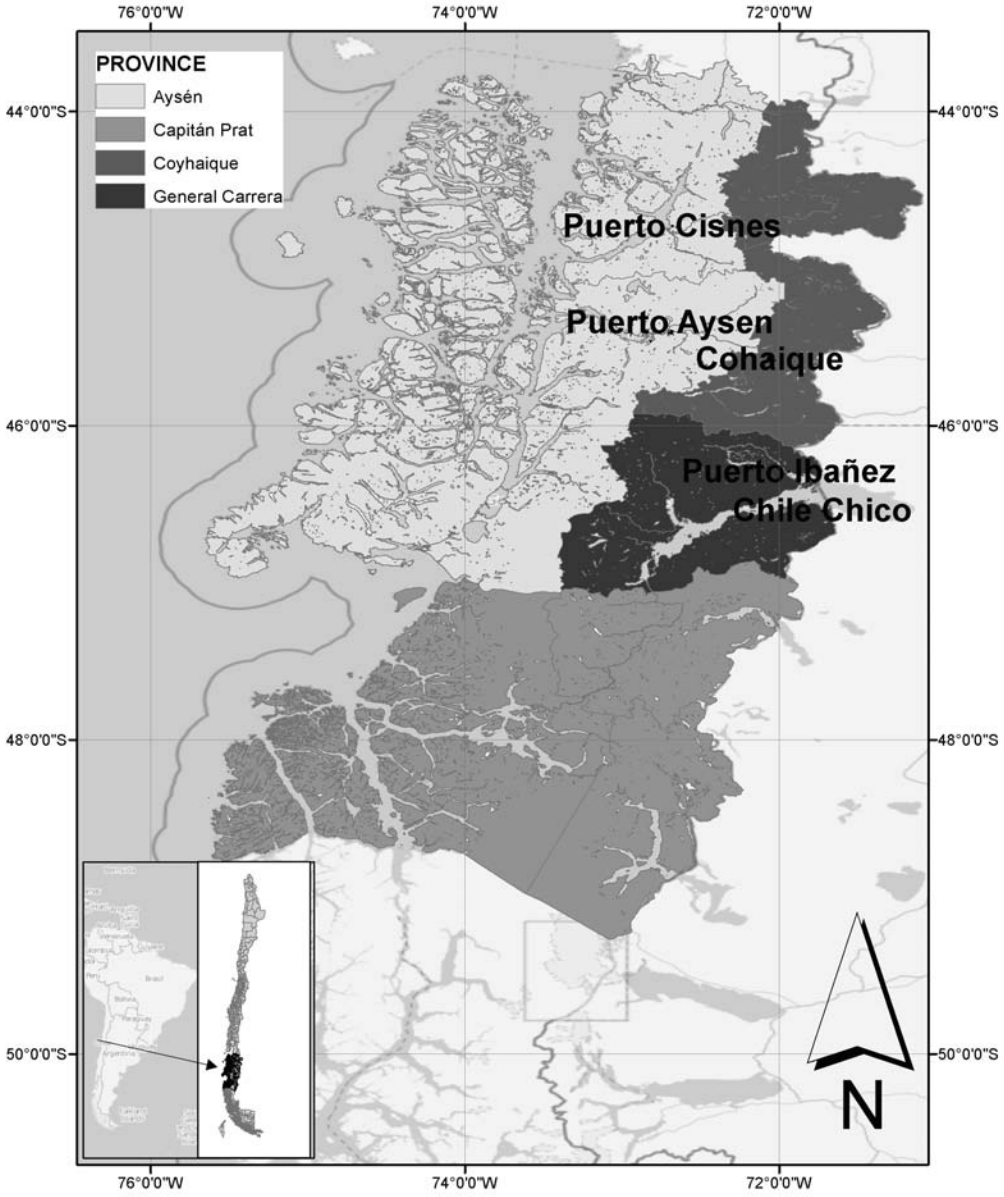

Fig. 1. Map of the region of Aysén, Chile.

Evergreen Forests distributed in the lower slopes and western valleys of the Patagonian Andes, islands and fjords in the boundary between the regions of Los Lagos and Aysén [15].

Methods

To analyze the species diversity a database was prepared based on collections made in an expedition in January 2011, the collections of the herbarium of the University of Concepción (CONC), herbarium of the National Museum of Natural History (SGO), and specimens cited in taxonomic literature for the following genera: *Cortaderia* Stapf [36, 48], *Anthoxanthum* L. [37], *Trisetum* Pers. [38], *Nassella* (Trin.) E. Desv. [39, 42-43], *Festuca* [40], *Bromus* L. [41], *Deyeuxia* Kunth [44], *Agrostis* L. [45], *Nicoraepoa* [46, 48], *Poa* [47-48], *Deschampsia* [49]. Taxonomic treatment follows Soreng *et al*. [50, 51]. Five hundred and eighty five records were incorporated into the database. For each record, the name of the species, subspecific taxon, subfamily, tribe,

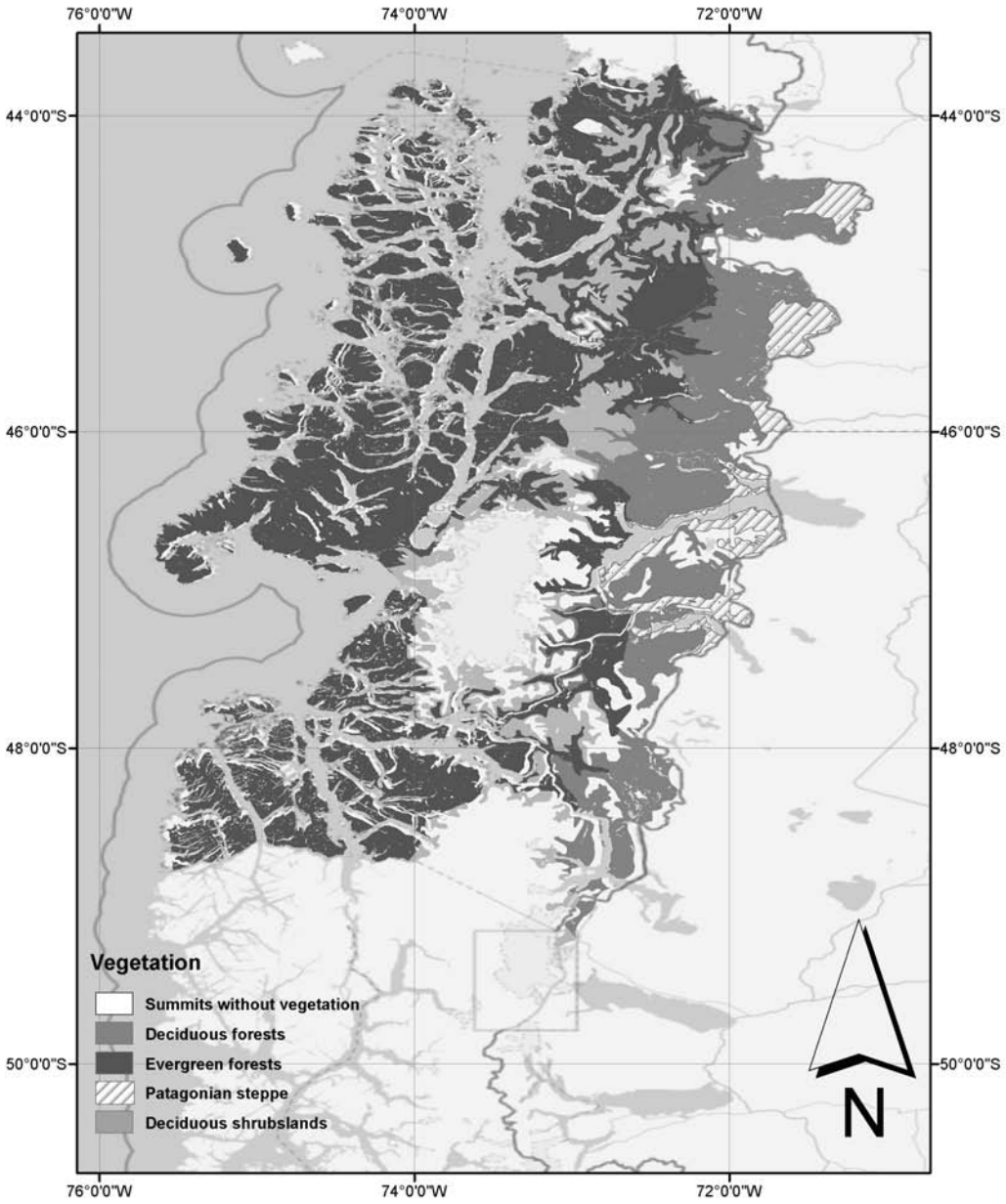

Fig. 2. Map of main vegetation types in the region of Aysén, Chile.

subtribe, geographical origin (as native, endemic, introduced), life form (as annual, biennial or perennial), collector's name, collector's number, latitude, longitude, altitude, locality and date of collection, herbarium and herbarium number were registered. From the database, a checklist of the species was prepared (Appendix 1), completed with those species mentioned in the literature for which there are no collections in the consulted herbaria.

To evaluate the completeness of the inventory represented by the examined specimens, a species accumulation curve was constructed using EstimateS 8.2.0 [52], developed by R. K. Colwell from the Department of Ecology and Evolutionary Biology, University of Connecticut, USA. To analyze the species richness, the Region was divided into 299 grids of 0.25 x 0.25 degrees of latitude x longitude, using the program ArcView 3.2 [53]. As a measure of the collection effort,

the number of species collected per decade in the 16 decades between 1857 and 2011 were considered. The estimated species richness was calculated using the nonparametric Chao 2 index [54-55]. In order to compare the collection effort among the provinces, the collection index was calculated [56]: CI = number of species/number of collections. The collection index takes values ranging from 1 to near zero; value 1 indicates a poor collection effort while values near to 0 indicate that the region is over-collected. In order to show the pattern of spatial distribution of the collection concentration, the number of collected specimens was mapped using direct Kriging interpolation methods using Arcgis 10 [57-58].

RESULTS

In Aysén, Poaceae are represented by 36 genera, 122 species and 12 infraspecific taxa, distributed in 3 subfamilies: Bambusoideae, Danthonioideae and Pooideae (Table 1, Appendix 1). These species belong to 7 tribes, five of them from subfamily Pooideae. Subfamily Bambusoideae comprises only one tribe (Bambuseae) and one genus (*Chusquea*) with 4 species and 1 variety. Subfamily Danthonioideae includes the Tribe Danthonieae with 2 genera, *Cortaderia* (3 species) and *Rytidosperma* (2 species, 1 variety). Subfamily Pooideae is the most diverse with 92.6% of the species (113 species), and 91.6% of the genera (33 genera). It comprises the tribes Meliceae (1 genus, 1 species), Stipeae (5 genera, 9 species), Poeae (24 genera, 81 species), Bromeae (1 genus, 9 species) and Triticeae (2 genera, 12 species). The more diverse genera are *Agrostis* (17 spp.), *Poa* (12 spp.), *Bromus* (9 spp.), *Festuca* (9 spp.), *Hordeum* (8 spp.), *Deschampsia* (6 spp.), *Pappostipa* (5 spp.), and *Trisetum* (5 spp.) (Table 3).

Ninety-seven species (79.5%) are native, including 5 species endemic to Chile. The taxonomic distribution of the species according to the geographical origin is shown in Table 2. The endemic species found were *Agrostis umbellata* (Pooideae, Agrostidinae), *Anthoxanthum altissimum* (Pooideae, Phalaridinae), *Chusquea montana* f. *nigricans*, *Ch. quila* and *Ch. uliginosa* (Bambusoideae, Chusqueinae). On the other hand, 25 species and two varieties are introduced taxa (exotic species), mostly from Eurasia (Fig. 3). All endemic and most of the native grasses (75.4%) are perennials. Some are biennials (*Bromus mango*), and only one native annual species was found (*Vulpia antucensis*).

The accumulation curve together with the curve of Chao 2 estimator is shown in Fig. 4. The species accumulation curve shows the number of species collected in function of the sampling effort (time).

Table 1. Number of tribes, genera, sepecies and infraspecific taxa of each subfamily of Poaceae collected in the region of Aysén, Chile.

Subfamilies	Tribes	Genera	Species	Infraspecific taxa	Total taxa	Taxa (%)
Bambusoideae	1	1	4	1	5	3.82
Danthonioideae	1	2	5	1	6	4.58
Pooideae	5	33	113	10	123	91.70
Total	**7**	**36**	**122**	**12**	**134**	**100.00**

Table 2. Number of native, endemic and adventive species in Aysén, Chile.

Subfamilies	Native	Endemic	Adventive	Total
Bambusoideae	2	3	0	5
Pooideae	92	1	28	123
Danthonioideae	6	0	0	6
Total	**100**	**4**	**28**	**134**

Table 3. Number of genera, species and infraspecific taxa of Poaceae in Aysén, Chile.

Genus	N° spp	N° infraspecific taxa	Total
Agrostis	17	1	18
Poa	12	2	14
Bromus	9	2	11
Hordeum	8	3	11
Festuca	9	0	9
Deschampsia	6	0	6
Pappostipa	5	0	5
Trisetum	5	1	5
Anthoxanthum	4	0	4
Deyeuxia	4	0	4
Elymus	4	0	4
Alopecurus	3	1	4
Rytidosperma	2	1	3
Aira	2	0	2
Cynosurus	2	0	2
Jarava	2	0	2
Phleum	2	0	2
Polypogon	2	0	2
Vulpia	2	0	2
Amelichloa, *Apera*, *Arrhenatherum*, *Avenella*, *Dactilis*, *Glyceria*, *Holcus*, *Koeleria*, *Lolium*, *Nassella*, *Nicoraepoa*, *Ortachne*, *Puccinellia*, *Schenodorus*, *Vahlodea*	1	0	1

Species observed curve (Sobs) is below the curve estimated species. The Chao 2 index suggested that it would still be possible to detect between 113 and 32 species in the study area, with an average of 60 new species. These values suggest that the inventory is completed between 52 and 80%.

Even when the collection effort reaches similar values in different parts of Aysén (Table 4), most of the collected specimens come from the Provinces Coyhaique (34%) and General Carrera (31%), while in the Provinces Capitán Prat and Aysén only 86 (17%) and 94 (19%) specimens were collected, respectively. The species richness is directly related to the collection effort; the greatest number of species was found in the Provinces Coyhaique (61%) and General Carrera (51%).

DISCUSSION

In Chile there are about 523 species in 122 genera of Poaceae [4]; in Aysén 122 species of 36 genera were registered, representing approximately 23% of the species and 30% of the genera of Chilean grasses. Most of the identified grass species in Aysén are native, although there are only few endemic species. The introduced grasses represent only 25% of the total flora identified. Although

the number of introduced species is not very high, this is no guarantee of a pristine ecosystem condition because, as have been indicated [13, 59], there is a strong human intervention in this region of the country. It would be necessary to consider the coverage of the species to provide a more accurate estimation, than its mere presence, of the degree of participation of the introduced species in plant communities of Aysén [60].

Compared to other Chilean regions, we found that Aysén showed less grass diversity. For example, Finot *et al*. [35] found that the Bio-Bio Region comprises 44% of the grass flora of Chile, almost twice the present in Aysén. Similarly, in the neighboring Region of Magallanes we recorded 167 species, i.e. 23% more than in Aysén (unpublished data). The taxonomic diversity at the subfamily level is also lower. While in the Bio-Bio Region (36-38°S) 8 subfamilies were found, in the region of Los Lagos (40-43°S) located immediately north of Aysén, we found only 5 subfamilies (unpublished data), and in the most extreme Southern Chile (Aysén and Magallanes) only 3 subfamilies were found: Bambusoideae, Danthonioideae and Pooideae. In Chile there are the following subfamilies: Aristidoideae, Arundinoideae, Bambusoideae, Chloridoideae, Danthonioideae, Ehrhartoideae, Panicoideae, and Pooideae. Subfamily Aristidoideae is distributed in Chile from Arica and Parinacota Region (18°S) to the region of Araucania (37°S). Chloridoideae and Arundinoideae extend from Arica and Parinacota (18º37'S) to Los Rios (42°46'S). Ehrhartoideae is found only cultivated in central Chile and Panicoideae range from Arica and Parinacota to the region of Los Lagos (41ºS). Thus, the absence of the other subfamilies in Aysén seems to be explained by the distribution determined by the environmental conditions of southern Chile and the climatic requirements of the species.

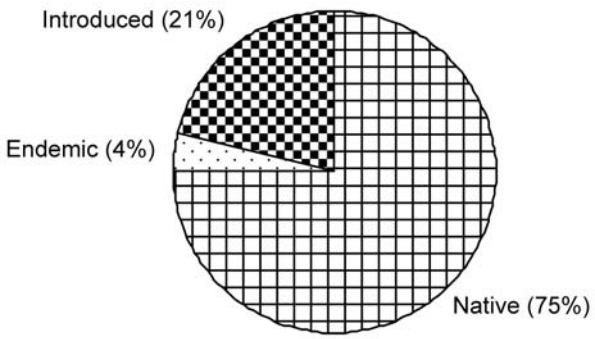

Fig. 3. Number of native, endemic and introduced species of Poaceae in the region of Aysén, Chile.

Even when the relatively low species richness and taxonomic diversity compared to other regions can be attributed to extreme weather conditions in

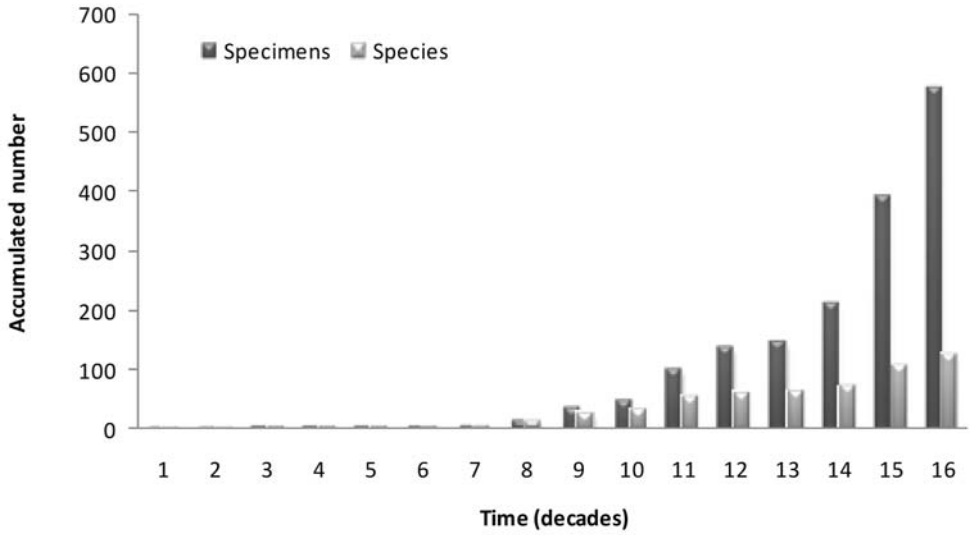

Fig. 4. Accumulated number of specimens and species collected in Aysén in the 16 decades between 1857 and 2011.

Table 4. Number of species and collection index in the four administrative provinces of Aysén.

Province	N° specimens	N° species	% species	CI	Area	N°spp/ 100 km^2
Aysén	94	42	34.43	0.45	52,916	0.08
Capitán Prat	86	43	35.25	0.50	37,242	0.12
Coyhaique	171	75	61.48	0.44	6,454	1.16
General Carrera	155	62	50.82	0.40	12,406	0.50

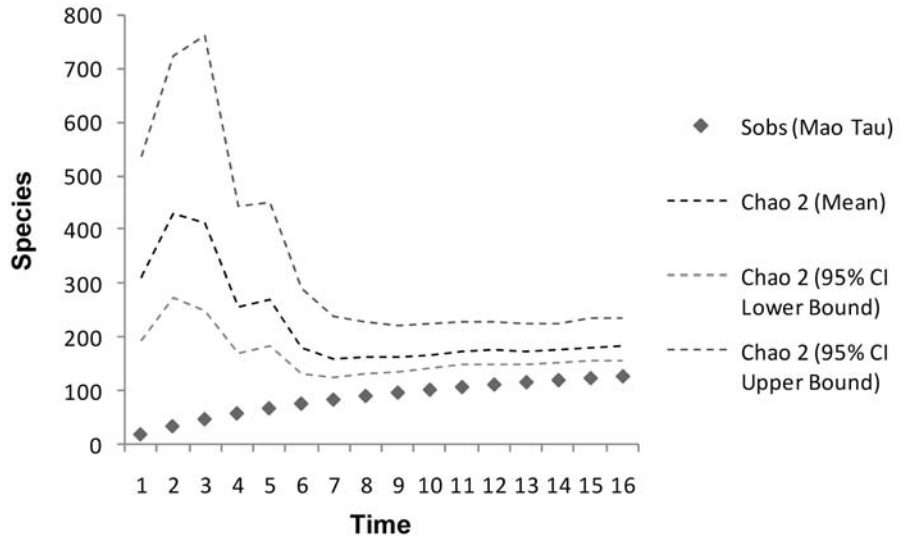

Fig. 5. Species accumulation curve of observed species (Sobs) and curves of estimated number of species calculated using the Chao 2 index for the sixteen decades (1857-2011).

southern Chile, it is clear that the collection effort is still insufficient. Both species accumulation curve and the Chao 2 index indicate that it is still possible to detect about 60 species hitherto unrecorded and therefore the collections in this area of the country must be increased. As shown in Fig. 5, the number of collections in the first 8 decades (1857-1937) is very low; in this period it was possible to record only about 10% of the species currently recognized in this region of the country. Moreover, Fig. 6. shows that most of the collections made in Aysén were concentrated in the vicinity of roads, in three or four areas of the region: Puerto Cisnes-La Tapera, Coyhaique, and near Chile Chico (National Reserve Lago General Carrera, N. R. Jeinimeni). Other collected zones include the protected areas National Reserve Trapananda, National Park Queulat, N. P. Laguna San Rafael, N. P. Isla Magdalena, N. P. Cerro Castillo, and N. R. Lago Las Torres. Based on the data showed, it becomes clear that the observed number of species is still far from the estimated number for this region in which there are many remote areas of difficult access, as well as many areas devoid of vegetation. Most of the collections are made in the eastern slopes of the Andes which also concentrate the majority of towns in the region.

The collection of specimens of Poaceae in Aysén begins at the end of the nineteenth century; as far as we know, the first collected specimen corresponds to *Hordeum chilense*, from a collection made by F. Fonk at Laguna San Rafael (46°36'S) in 1857. In 1872, E. Simpson gathers two specimens in Río Aysén: the first corresponds to *Bromus lithobius* and the second is the type of *Agrostis clausa* Phil.

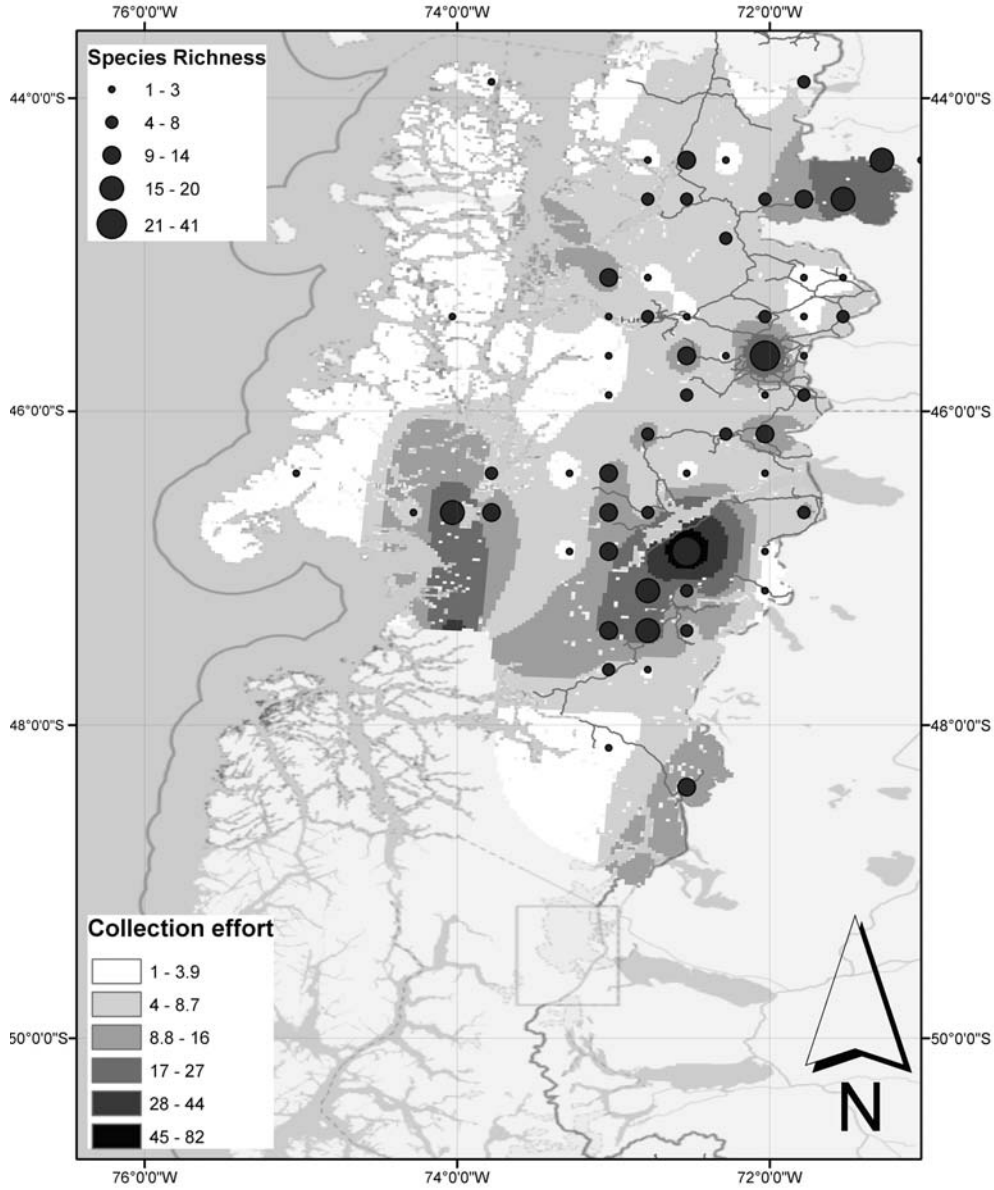

Fig. 6. Collection effort and species richness in Aysén, Chile, between 1857 and 2011.

(= *A. philippiana* Rúgolo & De Paula ex Correa). In 1878, A. Guajardo collected one specimen of *Hierochloe redolens* (= *Anthoxanthum redolens*) at Guaitecas Islands (43°53'S). The number of specimens and, as a result, the number of species collected in the first 10 decades (1857-1956), is quite low (Fig. 5). In this period the number of collected specimens per decade varies from 0 to 24, representing a total of 34 species (approximately 25% of all taxa currently recognized in the region). Since 1957 the collection effort was increased significantly; the new collections allowed to register some 100 species not previously recorded, although the largest collection effort has been made in the past two decades. Between 1997 and 2006, 181 specimens have been collected, representing 35 new species and in the period 2007-2012, 183 specimens have been collected, representing 18 species not previously recorded. The division of the region in 299 grids shows that only 66 of them were collected, leaving a wide margin for possible further expeditions to the region.

Biodiversity is being destroyed by humans at an impressive rate [61] in an irreversible way (National Research Council 1992). The human modification of ecosystems favors the entry of invasive species that could displace or eliminate native species completely through competitive exclusion [68]. As has been shown, most of the species might disappear even before having been studied [69]. For this reason, it is important to document the biodiversity, to know more about its distribution and how to use it in a sustainable manner and protect it [62]. As Ortega & Bruning [59] pointed out, the history of the nineteenth and twentieth centuries in the Region of Aysén, as far as intervention of man over nature is concerned, demonstrates a constant predation and destruction of ecosystems that arrives to delirious levels. More than 1,400,000 ha of land are in an advanced state of erosion [59]. Consequently, many projects have been initiated in the last decade to study the biodiversity of the Region of Aysén [11, 63-67].

Taxonomy plays an essential role in species conservation [69-72]. In the last decades, herbaria have made a huge effort to digitize collections, and to build and update databases that become indispensable tools to document biodiversity [35, 73]. The first stage is to generate accurate lists of species to distinguish between endemic, non-endemic native and introduced species, in order not to artificially overestimate values of native diversity and to establish the degree of human intervention in the region under study [74, 75].

ACKNOWLEDGEMENTS

We would like to thank Alejandro Solís, Wilson González and Verónica Fuentealba for their technical assistance and Valeria Velasco for comments on the manuscript. Projects DIUC 210.212.014.1.0 and DIUC 210.122.012-ISP from Dirección de Investigación, Universidad de Concepción.

APPENDIX 1

Checklist of the species of Poaceae registered in the Region of Aysén, Chile. * = introduced; bold = endemic.

SUBFAMILY BAMBUSOIDEAE LUERSS

TRIBE BAMBUSEAE Dumort.

SUBTRIBE CHUSQUEINEAE Soderstr. & R. P. Ellis

1. CHUSQUEA Kunth: *C. culeou* E. Desv., *C. montana* Phil. f. *montana*, ***C. montana*** Phil. f. ***nigricans*** (Phil.) Matthei, ***C. quila*** Kunth, ***C. uliginosa*** Phil.

SUBFAMILY POOIDEAE BENTH.

TRIBE MELICEAE LINK EX ENDL.

2. GLYCERIA R. BR.: *G. multiflora* Steud.

TRIBE STIPEAE DUMORT.

3. AMELICHLOA Arriaga & Barkworth: *A. brevipes* (E. Desv.) Arriaga & Barkworth
4. JARAVA Ruiz & Pav.: *J. neaei* (Nees ex Steud.) Peñailillo, *J. psilantha* (Speg.) Peñailillo
5. NASSELLA (Trin.) E. Desv.: *N. gigantea* (Steud.) Muñoz-Schick
6. ORTACHNE Nees ex Steud.: *O. rariflora* (Hook. f.) Hughes
7. PAPPOSTIPA (Speg.) Romasch., P.M. Peterson & Soreng: *P. chrysophylla* (E. Desv.) Romasch. *P. humilis* (Cav.) Romasch., *P. ibarii* (Phil.) Romasch., *P. nana* (Speg.) Romasch., *P. speciosa* (Trin. & Rupr.) Romasch.

TRIBE POEAE R. BR.

SUBTRIBE AGROSTIDINAE FR.

8. AGROSTIS L.: *A. brachyathera* Steud., **A. capillaris* L., **A. castellana* Boiss. & Reut., **A. gigantea* Roth, *A. glabra* var. *melanthes* (Phil.) Rúgolo et De Paula, *A. inconspicua* Kunze ex E. Desv., *A. leptotricha* E. Desv., *A. magellanica* Lam., *A. mertensii* Trin., *A. meyeni* Trin., *A. philippiana* Rúgolo & De Paula, *A. scabra* Willd., *A. serranoi* Phil., **A. stolonifera* L. var *stolonifera*, **A. stolonifera* var. *palustris* (Huds.) Farw., *A. uliginosa* Phil., ***A. umbellata*** Colla, *A. vidalii* Phil.
9. DEYEUXIA CLARION EX P. BEAUV.: *D. erythrostachya* E. Desv. var. *erythrostachya*, *D. poaeoides* (Steud.) Rúgolo, *D. rigida* Kunth, *D. suka* (Speg.) Parodi

10. POLYPOGON Desf.: *P. australis* Brongn., *P. elongatus* Kunth

SUBTRIBE AIRINAE FR.

11. AIRA L.: **A. caryophyllea* L., **A. praecox* L.
12. AVENELLA (Bluff & Fingerh.) Drejer**:** *A. flexuosa* (L.) Drejer
13. DESCHAMPSIA P. Beauv.: *D. airiformis* (Steud.) Benth. & Hook., *D. cespitosa* (L.) P. Beauv. var *cespitosa*, *D. elongata* (Hook.) Munro, *D. kingii* (Hook. F.) E. Desv., *D. laxa* Phil., *D. parvula* (Hook. f.) E. Desv.
14. VAHLODEA FR.: *V. atropurpurea* (Wahlenb.) Fr. ex Hartm.

SUBTRIBE ALOPECURINAE DUMORT.

15. ALOPECURUS L.: *A. geniculatus* var. *patagonicus* Parodi, *A. magellanicus* Lam. var. *magellanicus*, *A. magellanicus* var *bracteatus* (Phil.) Mariano, **A. pratensis* L.

SUBTRIBE AVENINAE J. PRESL

16. ARRHENATHERUM P. BEAUV.**:** **Arrhenatherum elatius* subsp. *bulbosum* (Willd.) Schübl. & G. Martens
17. KOELERIA PERS.: *K. fueguina* C.E. Calderón ex Nicora
18. TRISETUM PERS.: *T. caudulatum* Trin., *T. cernuum* Trin., *T. preslei* (Kunth) E. Desv., *T. pyramidatum* Louis-Marie ex Finot, *T. spicatum* (L.) K. Richt. subsp. *spicatum*, *T. spicatum* subsp. *cumingii* (Nees ex Steud.) Finot

SUBTRIBE COLEANTHINAE RCHB.

19. PUCCINELLIA PARL.: *P. glaucescens* (Phil.) Parodi

SUBTRIBE CYNOSURINAE FR.

20. CYNOSURUS L.: **C. cristatus* L., **C. echinatus* L.

SUBTRIBE DACTYLIDINAE STAPF

21. DACTYLIS L.: **D. glomerata* L.

SUBTRIBE HOLCINAE DUMORT.

22. HOLCUS L.: **H. lanatus* L.

SUBTRIBE LOLIINAE DUMORT.

23. FESTUCA L.: *F. argentina* (Speg.) Parodi, *F. gracillima* Hook. f., *F. magellanica* Lam., *F. monticola* Phil., *F. pallescens* (St.-Yves) Parodi, *F. purpurascens* Banks & Soland. ex Hook., *F. pyrogea* Speg., *F. rubra* L., *F. thermarum* Phil.
24. LOLIUM L.: **L. perenne* L.
25. SHENODORUS P. BEAUV.: *S. arundinaceus* (Schreb.) Dumort.
26. VULPIA C.C. Gmel.: *V. antucensis* Trin., **V. bromoides* (L.) Gray

SUBTRIBE PHALARIDINAE FR.

27. ANTHOXANTHUM L.: ***A. altissimum*** (Steud.) Veldkamp, *A. juncifolium* (Hack.) Veldkamp, **A. odoratum* L., *A. redolens* (Vahl) P. Royen

SUBTRIBE PHLEINAE BENTH.

28. PHLEUM L.**:** **P. alpinum* L., **P. pratense* L.

SUBTRIBE POINAE DUMORT.

29. APERA ADANS.: **A. interrupta* (L.) P. Beauv.
30. NICORAEPOA SORENG & L. J.: GILLESPIE: *N. chonotica* (Phil.) Soreng & L. J. Gillespie
31. POA BARNHART: *P. alopecurus* (Gaudich. ex Mirb.) Kunth subsp. *alopecurus*, *P. alopecurus* ssp *fuegiana* (Hook. f.) D.M. Moore & Dogg., **P. annua* L., *P. denudata* Steud., *P. glauca* Vahl subsp. *glauca*, *P. ligularis* Nees ex Steud. var. *ligularis*, *P. ligularis* var. *resinulosa* (Nees ex Steud.) Fernández Pepi & Giussani, **P. nemoralis* L., *P. obvallata* Steud., **P. pratensis* L. subsp. *pratensis*, *P. scaberula* Hook. f., *P. secunda* J. Presl subsp. *secunda*, *P. spiciformis* var. *spiciformis*, *P. stenantha* Trin.

TRIBE TRITICEAE DUMORT.

SUBTRIBE HORDEINAE DUMORT.

32. ELYMUS L.: *E. angulatus* J. Presl, *E. magellanicus* (E.desv.) A. Löve, *E. patagonicus* Speg., *E. scabriglumis* (Hack.) A. Löve.
33. HORDEUM L.: *H. chilense* Roem. & Schult., *H. comosum* J. Presl var. *comosum*, *Hordeum comosum* J. Presl var. *bifidum* Parodi & Nicora, *H. lechleri* (Steud.) Schenck, **H. marinum* Huds. subsp.

gussoneanum (Parl.) Thell., **H. marinum* Huds. subsp. *marinum*, **H. murinum* L. subsp. *murinum*, Presl, *H. patagonicum* subsp. *magellanicum* (Parodi ex Nicora) Bothmer, Giles & N. Jacobsen, *H. pubiflorum* Hook.f. subsp. *pubiflorum*, *H. pubiflorum* subsp. *halophilum* (Griseb.) Baden & Bothmer, *H. tetraploideum* Covas

TRIBE BROMEAE DUMORT.

34. BROMUS L.: *B. catharticus* Vahl var. *catharticus*, *B. catharticus* var. *elata* (E. Desv.) Planchuelo, *B. coloratus* Steud., **B. hordeaceus* L., *B. lithobius* Trin., *B. mango* E. Desv., **B. rigidus* Roth, *B. secalinus* L., *B. setifolius* J. Presl, *B. setifolius* var. *brevifolius* Nees, *B. tunicatus* Phil.

SUBFAMILY DANTHONIOIDEAE
P. H. LINDER & N. P. BAKER

TRIBE DANTHONIEAE ZOTOV.

35. CORTADERIA STAPF: *C. araucana* Stapf, *C. egmontiana* (Roem. Et Schult.) M. Lyle ex Connor, *C. selloana* (Schult. & Schult.) Asch. & Graebn.
36. RYTIDOSPERMA STEUD.: *R. pictum* (Nees & Meyen) Nicora var. *bimucronatum* Nicora, *R. pictum* (Nees & Meyen) Nicora var. *pictum*, *R. virescens* (E. Desv.) Nicora

REFERENCES

1. Clayton W. D. and Renvoize, S. A. 1986, Genera graminum. Grasses of the world. Kew Bulletin Additional Series XIII, London.
2. Tzvelev, N. N. 1989, Bot. Rev., 55, 141.
3. Watson, L. and Dallwitz, M. J. 1992, The grass genera of the world. CAB International, Cambridge.
4. Finot, V. L., Barrera, J. A., Marticorena, C., and Rojas, G. 2011, Systematic diversity of the family Poaceae (Gramineae) in Chile, Grillo, O. and Venora, G. (Eds.), InTech, Rijeka, 71.
5. Moreira-Muñoz, A. and Muñoz-Schick, M. 2007, Div. Distrib., 13, 818.
6. Zuloaga, F. O., Morrone, O. and Belgrano, M. 2008, Catálogo de las plantas vasculares del Cono Sur. Missouri Bot. Gard. Press, St. Louis.
7. Skottsberg, C. 1960, Proceedings Royal Soc. London, Ser. B. Biol. Sci., 152, 447.
8. Rodríguez, R., Marticorena, A. and Teneb, E. 2008, Gayana Bot., 65, 39.
9. Saldivia, P. and Rojas, G. 2008, Gayana Bot., 65, 198.
10. Teneb, E., Gómez, P. and González, M. 2008, Gayana Bot., 65, 229.
11. Wilckens, R., Fischer, S., Finot, V. L., Silva, F., Berti, M., Solís, A. and González, W. 2011, AAIC, 23rd Meeting, Fargo.
12. Silva, F., Ullrich, T., Hartmann, P., Medina, H., Moraga, L. and Saini, G. 2004, Bol. Lat. Carib. Pl. Med. Arom., 3, 36.
13. Pisano, E. 1985, Ambiente y Desarrollo, 1, 45.
14. Montaldo, P. 1976, Medio Ambiente, 2, 12.
15. Gajardo, R. 1994, La vegetación natural de Chile. Clasificación y distribución geográfica. Ed. Univ., Santiago de Chile.
16. Hepp, C. 1996, Praderas de la zona austral: Undécima región (Aysén). Ruiz, I. (Ed.). Inst. Inv. Agropec., Santiago de Chile.
17. Reiche, C. 1903, La isla de la Mocha. Anales Mus. Nac. Chile, 1.
18. Muñoz, C. 1941, Indice bibliográfico de las gramíneas chilenas. Min. Agric., Santiago de Chile.
19. Kunkel, G. 1968, Willdenowia, 4, 329.
20. Marticorena, C. and Quezada, M. 1985, Gayana Bot., 42, 1.
21. Marticorena, C. 1990, Gayana Bot., 47, 85.
22. Arroyo, M. T. K., Marticorena, C., Miranda, P., Matthei, O., Landero, A. and Squeo, F. 1989, Gayana Bot., 46, 121.
23. Arroyo, M. T. K., Marticorena, C. and Muñoz, M. 1990, Gayana Bot., 47, 119.
24. Arroyo, M. T. K., von Bohlen, C., Cavieres, L. and Marticorena, C. 1992, Gayana Bot., 49, 47.
25. Arroyo, M. T. K., Castor, C., Marticorena, C., Muñoz, M., Cavieres, L., Matthei, O., Squeo, F., Grosjean, M. and Rodríguez, R. 1998, Gayana Bot., 55, 93.
26. Matthei, O., Marticorena, C. and Stuessy, T. 1993, Gayana Bot., 50, 69.
27. Teillier, S., Hoffmann, A., Saavedra, F. and Pauchard, L. 1994, Gayana Bot., 51, 13.
28. Rundel, P. W., Dillon, M. O. and Palma, B. 1996, Gayana Bot., 53, 295.

29. Marticorena, C., Matthei, O., Rodríguez, R., Arroyo, M. T. K., Muñoz, M., Squeo, F. and Arancio, G. 1998a, Gayana Bot., 55, 23.
30. Marticorena, C., Stuessy, T. and Baeza, C. 1998b, Gayana Bot., 55, 187.
31. Baeza, C., Marticorena, C. and Rodríguez, R. 1999, Gayana Bot., 56, 125.
32. Baeza, C., Marticorena, C., Stuessy, T., Ruiz, E. and Negritto, M. 2007, Gayana Bot., 64, 125.
33. Baeza, C., Steussy, T. and Marticorena, C. 2002, Brittonia 54, 154.
34. Domínguez, E., Elvebakk, E., Marticorena, C. and Pauchard, A. 2006, Gayana Bot., 63, 131.
35. Finot, V. L., Marticorena, C., Barrera, J., Muñoz-Schick, M. and Negritto, M. 2009, Gayana Bot., 66, 134.
36. Acevedo de Vargas, R. 1959, Bol. Mus. Nac. Hist. Nat., 27, 205.
37. De Paula, M. 1975, Darwiniana, 19, 422.
38. Finot, V. L., Peterson, P. M., Zuloaga, F., Soreng, R. J. and Matthei, O. 2005, Ann. Missouri Bot. Gard., 92, 533.
39 Matthei, O. 1965, Gayana Bot., 13, 1.
40. Matthei, O. 1982, Gayana Bot., 37, 1.
41. Matthei, O. 1986, Gayana Bot., 43, 47.
42. Muñoz-Schick, M. 1985, Bol. Mus. Nac. Hist. Nat., 40, 41.
43. Muñoz-Schick, M. 1990, Gayana Bot., 47, 9.
44. Rúgolo de Agrasar, Z. E. 1978, Darwiniana, 21, 417.
45. Rúgolo de Agrasar, Z. E. and Molina, A. M. 1997, Gayana Bot., 54, 91.
46. Soreng, R. J. and Gillespie, L. J. 2007, Ann. Missouri Bot. Gard., 94, 821.
47. Soreng, R. J. and Peterson, P. M. 2008, J. Bot. Res. Inst. Texas, 2, 847.
48. Giussani, L., Soreng, R. J. and Anton, A. 2011, Darwiniana, 49, 90.
49. Chiapella, J. and Zuloaga, F. 2010, Ann. Missouri Bot. Gard., 97, 141.
50. Soreng, R. J. and Davis, J. 2000, Phylogenetic structure in Poaceae subfamily Pooideae as inferred from molecular and morphological characters: misclassification versus reticulation, Jacobs, S. W. L. and Everett, J. (Eds.), CSIRO Publ., Melbourne.
51. Soreng, R. J., Peterson, P. M., Davidse, G., Judziewicz, E., Zuloaga, F., Filgueiras, T. S. and Morrone, O. 2003, Catalogue of New World Grasses (Poaceae): IV. Pooideae. Contr. U.S. Natl. Herb, 48, 1-730.
52. Colwell, R. K. 2009, EstimateS 8.2.0. Statistical estimation of species richness and shared species from samples. Estimates 8.2 User's guide. http://purl.oclc.org/estimates or http://viceroy.eeb.uconn.edu/estimates
53. ESRI. 1996, Software ARCVIEW-GIS 3.2. Environmental System Research Institute, New York.
54. León, J. L., Soberón, J. and Llorente, J. 1998, Div. Distrib., 4, 37.
55. Escalante, T. 2003, Elementos, 52, 53.
56. Squeo, F. A., Cavieres, L., Arancio, G., Novoa, J., Matthei, O., Marticorena, C., Rodríguez, R., Arroyo, M. T. K. and Muñoz, M. 1998, Revista Chil. Hist. Nat., 71, 571.
57. Heisel, T., Andreasen, C. and Ersbøll, A. K. 1996, Weed Res., 36, 325.
58. Hamouz, P., Nováková, K., Soukup, J. and Tyšer, L. 2006, J. Pl. Dis. Prot., 20, 205.
59. Ortega, H. and Brüning, A. 2004. Aisén. Panorama histórico y cultural de la XI Región, Lom Ed. Ltda, Santiago de Chile.
60. Shengjun, J., Genga, Y., Lia, D. and Wanga, G. 2009, Agric., Ecosyst. and Environ., 129, 491.
61. Purvis, A. and Hector, A. 2000, Nature, 405, 212.
62. National Research Council. 1992, Conserving biodiversity: A research agenda for development agencies. Natl. Acad. Press, Washington, D.C.
63. Torres-Mura, J. C., Castro, D. and Howorth, R. 2004, Biol. Res., 37, R5.
64. Rojas, G. and Saldivia, P. 2004, Biol. Res., 37, R5.
65. Tomé, A., Teillier, S. and Howorth, R. 2007, Contribución al conocimiento de la flora vascular de la Reserva Nacional Tamango, Región de Aysén, Chile. Bol. Mus. Nac. Hist. Nat., Chile, 56, 9.
66. Tomé, A. and Teillier**,** S. 2004, Biol. Res., 37, R5.
67. Quilhot, W. and Rubio, C. 2004, Biol. Res., 37, R5.

68. Mooney H. A. and Cleland, E. 2001, Proc. Natl. Acad. Sci., 98, 5446.
69. Dubois, A. 2003, C. R. Biol., 326(Suppl. 1), S29.
70. Agapow, P. M., Bininda-Emonds, O. R. P., Crandall, K. A., Gittleman, J. L., Mace, G. M., Marshall, J. C. and Purvis, A. 2004, Q. Rev. Biol., 79, 161.
71. Mace, G. M. 2004, Phil. Trans. R. Soc. Lond. B, 359, 711.
72. Collar, N. J. 1997, Bull. Br. Ornithol. Club, 117, 122.
73. Klopper, R. R., Gautier, L., Chatelain, C., Smith, G. F. and Spichiger, R. 2007, Taxon, 56, 201.
74. Pysek, P., Richardson, D., Rejmánek, M., Webster, G., Williamson, M. and Kirschner, J. 2004, Taxon, 53, 131.
75. Babar, S., Giriraj, A., Reddy, C. S., Jurasinski, G., Jentsch, A. and Sudhakar, S. 2011, Spatial patterns of phytodiversity - Assesing vegetation using (dis)similarity measures, Grillo, O. and Venora, G. (Eds.), InTech, Rijeka, 147.