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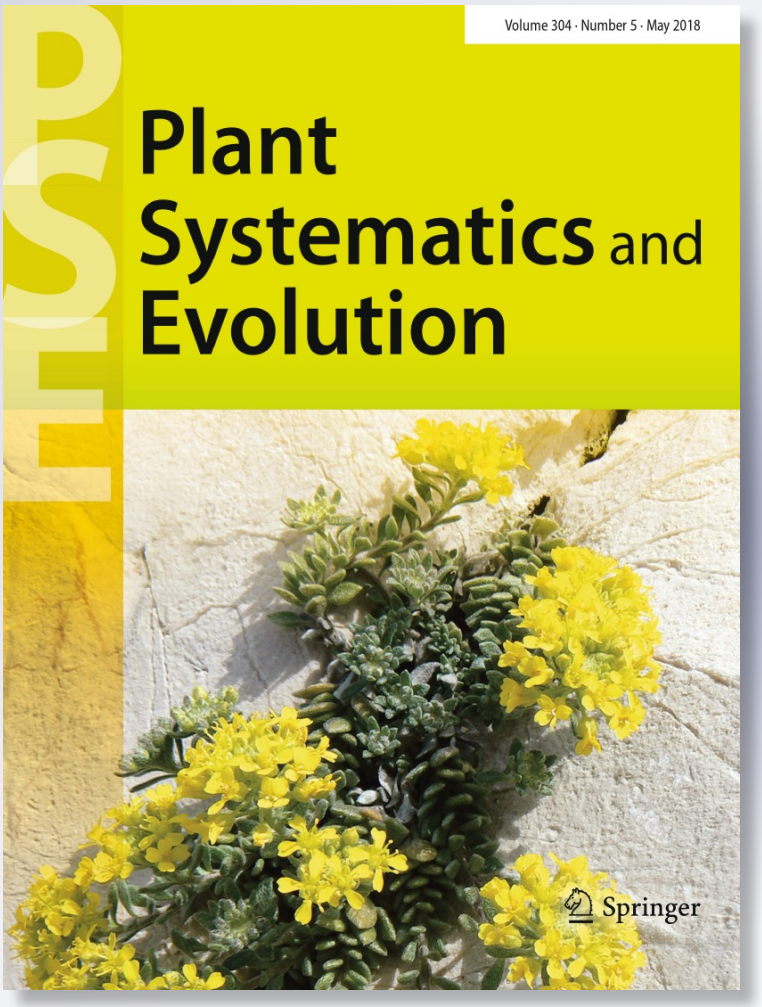

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ORIGINAL ARTICLE

A multivariate morphometric delimitation of species boundaries in the South American genus *Nicoraepoa* (Poaceae: Pooideae: Poeae)

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Abstract

A multivariate morphometric study of the genus *Nicoraepoa* was carried out to examine patterns of morphological variation among the species and to identify additional characters to allow a clearer delimitation among species. *Nicoraepoa* is a taxonomically complex genus comprising seven species endemic to South America. Although most of the species are well delimited, two of them, *N. andina* and *N. chonotica,* are morphologically similar and very difficult to separate. The morphological variation among species, with overlapping morphological characters, pseudovivipary and possible hybridization make species boundaries unclear. In the present paper, sixty-seven characters were scored for a total of 216 specimens and analyzed using ordination, cluster and discriminant analyses. Based on multivariate results, we recognized species groups and morphological diagnostic characters that allow clearer species delimitation. As a result, *N. chonotica* has been transferred to *N. andina* as a subspecies that inhabit southern Patagonia. Other taxa could be recognized and delimited by diagnostic characters: *N. erinacea*, *N. pugionifolia*, *N. stepparia*, *N. subenervis* subsp. *spegazziniana* and *N. subenervis* subsp. *subenervis*. Moreover, we discuss the possibility that a new species from Bolivia, based on only one specimen, closely related to *N. subenervis* should be ascribed in *Nicoraepoa*.

Keywords Argentina · Bolivia · Chile · Multivariate analysis · Southern Patagonia · Species delimitation

Introduction

Nicoraepoa Soreng & L.J.Gillespie (Poaceae, Pooideae, Poeae) is a South American genus of seven species and two subspecies, thought to be restricted to the Patagonia of Chile and Argentina (Soreng and Gillespie 2007; Soreng and Giussani 2012). Its species were mostly originally described in the large genus *Poa* L.

Nicora (1978) revised the taxonomy of all the species in Flora Patagonica, accepting them all in *Poa* subg. *Andinae* Nicora, except *P. subenervis* (for authors of the species and subspecies names see Table 1), which she placed in subg. *Poa.* Soreng and Gillespie (2007) when erecting *Nicoraepoa*, followed Nicora's species taxonomy with only few exceptions: *Poa borchersii* and its synonyms were included in *N. chonotica* (being *Poa chonotica* an older name with a Chilean type that Nicora had not accounted for); the two varieties of *P. subenervis* were raised to subspecies. *Poa stepparia*, which was included by Nicora (1978) in *Poa* subg. *Andinae*, was later transferred to *Nicoraepoa* by Giussani et al. (2011) after the reassessment of its morphology. Currently, *Nicoraepoa* includes *N. andina*, *N. chonotica*, *N. erinacea*, *N. pugionifolia*, *N. robusta*, and *N. stepparia* (all gynodioecious and formerly included in *Poa* subg. *Andinae*) (Nicora 1977, 1978), and *N. subenervis* and its two subspecies (which have perfect flowers). Names, synonyms, geographic distribution and habitat of these taxa are summarized in Table 1 and Figs. 1 and 2.

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Table 1 Names, synonyms, geographic distribution and habitat description of the known taxa of genus *Nicoraepoa*

Species	Name in *Poa*	Other Synonyms	Geographic distribution	Habitat
N. andina (Trin.) Soreng & L.J. Gillespie	*P. andina* Trin.	*Deschampsia latifolia* Phil., *P. acrochaeta* Hack., *P. aristata* Phil., *P. straminea* Steud.	Central-north Andean Patagonian; Chile (Biobío to Los Ríos) and Argentina (Neuquén to Chubut)	Marshes and riversides, 1000–2000 m. a. s. l.
N. chonotica (Phil.) Soreng & L.J. Gillespie	*P. chonotica* Phil.	*P. berningeri* Pilg., *P. borchersii* Phil., *P. chubutensis* Speg., *P. latifolia* Phil., *P. flabellata* var. *mucronulata* Hack. ex Dusén, *P. robusta* Phil.	Southern Chile and southwestern Argentina	Marshes, riversides, wet rocky areas, coastal to 1850 m. a. s. l.
N. erinacea (Speg.) Soreng & L.J. Gillespie	*P. erinacea* Speg.		Narrow endemic to central-western low valley Patagonian, Argentina (Chubut)	Arid zones, saline springs, 800 m. a. s. l.
N. pugionifolia (Speg.) Soreng & L.J. Gillespie	*P. pugionifolia* Speg.	*P. acutissima* Pilg.	Southern Chile (region of Magallanes and Antártica Chilena) and Argentina (provinces of Santa Cruz and Tierra del Fuego, Antártida e Islas del Atlántico Sur)	Seasonally inundated meadow (mallines), swampy, saline soils, coastal to 1200 m. a. s. l.
N. robusta (Steud.) Soreng & L.J. Gillespie	*P. robusta* Steud.	*Festuca arenaria* Lam., *P. arenicola* St.-Yves	Southern Chile and Argentina (Tierra del Fuego, Malvinas Islands)	Low elevation marshes and coastal meadows to 40 m. a. s. l.
N. stepparia (Nicora) Soreng	*P. stepparia* Nicora		Narrow endemic to northwestern low valley and Andean Patagonia, Argentina (Mendoza, Neuquén, Río Negro)	Seasonally inundated subsaline meadows (mallines) and saltpeter soils 980 to 2100 m. a. s. l.
N. subenervis (Hack.) Soreng & L.J. Gillespie subsp. *subenervis*	*P. subenervis* Hack.		Endemic to southwestern Andean Patagonia, Argentina, and Chile (Region of Magallanes)	Seasonally inundated meadows (mallines), springy, subsaline soils, 700 to 1200 m. a. s. l.
N. subenervis subsp. *spegazziniana* (Nicora) Soreng & L.J.Gillespie	*P. subenervis* var. *spegazziniana* Nicora		Endemic to northwestern Andean Patagonia, Argentina (), and Chile ()	Seasonally inundated meadows (mallines), springy, subsaline, subalkaline, and subgypseous soils, 2600 to 3300 m. a. s. l.

Fig. 1 *Nicoraepoa andina*. **a–b** *Nicoraepoa andina* subsp. *andina*. Pistillate plants from Copahue, Dept. Ñorquín, Prov. Neuquén, Argentina (*Giussani 185*). **c–d** *Nicoraepoa andina* susbp. *chonotica*. Perfect plants from Puerto Frías, Dept. Bariloche, Prov. Río Negro, Argentina (*Giussani 188b*). (Photographs by Liliana M. Giussani)

The phylogenetic independence of *Nicoraepoa* from *Poa* was demonstrated by several DNA studies. The first study including some of these seven species (Gillespie and Soreng 2005) used restriction site data of plastid DNA (*trn*T-*trn*F, *trn*F-*trn*V, *trn*V-*rbc*L, *rbc*L-ORF106, *trn*H-*trn*K) and showed that the inclusion of *Poa* subg. *Andinae* within *Poa* made *Poa* non-monophyletic. Based on these DNA results and morphological differences with *Poa,* Soreng and Gillespie (2007) proposed that species of subg. *Andinae* and *Poa subenervis* should be separated from *Poa* and treated as the new genus, *Nicoraepoa*. Later, studies based on sequences of ITS nuclear ribosomal (nr) DNA and plastid *trn*T-*trn*L-*trn*-F (Gillespie et al. 2008) showed *Nicoraepoa* to be isolated from *Poa* and evidently allied to the Arctic and sub-Arctic monotypic genus *Arctagrostis* Griseb. and to the small Australian genus *Hookerochloa* E.B.Aleexev. Gillespie et al. (2009) and Soreng et al. (2015a) included broader taxon sampling (and in the latter paper more plastid regions, and ETS nrDNA sequences) of genera close to *Nicoraepoa*, and across subtribe Poinae s.l. (Soreng et al. 2015b). Gillespie et al. (2010) additionally demonstrated that *N. pugionifolia* has a reticulate history with *Poa* sect. *Parodiochloa* (C.E.Hubb.) Soreng. This species probably gained its nrDNA ITS genotype from hybridization with *P. flabellata* (Lam.) Raspail (the only species of *P.* sect. *Parodiochloa* that occurs in South America), while retaining a plastid type and morphology allying it to *Nicoraepoa*.

Nicoraepoa andina and *N. chonotica* are closely related species from central-southern Chile and Argentina that are frequently difficult to separate; *N. andina* grows mainly in highlands in south of Biobío Region, Chile and in the Neuquén Province, Argentina, whereas *N. chonotica* grows mainly south of Los Ríos Region, Chile and Río Negro Province, Argentina. However, these species overlap in part of their distribution and morphology. Discrimination between *N. andina* and *N. chonotica* is further complicated

Fig. 2 *Nicoraepoa pugionifolia, N. robusta,* and *N. subenervis*. **a**–**b** *Nicoraepoa pugionifolia*. **a** From Estancia Cóndor, Güer Aike sección Frayle, Prov. Santa Cruz, Argentina (*Giussani 140*). **b** From Sierra de los Baguales, Región de Magallanes y Antártica Chilena, Chile (*R.J. Soreng* and *N.L. Soreng 7336*). **c** *Nicoraepoa robusta* from Cabo San Isidro, Straights of Magellan, Península de Brunswick, Prov. Magallanes, Chile (*Soreng* and *Soreng 7358* pseudoviviparous & *7359* normal-flowered). **d** *Nicoraepoa subenervis* subsp. *spegazziniana* from ca 5 km above Embalse del Yeso, Valle del Río Yeso, Región Metropolitana, Chile (*R.J. Soreng* and *N.L. Soreng 7155*). **e** *Nicoraepoa subenervis* subsp. *subenervis* from Rio Ghio, Ruta 41, Prov. Santa Cruz, Argentina (*Peterson* et al. *17255*). (**a** photograph by Liliana M. Giussani. **b**–**e** photographs by Robert J. Soreng)

by pseudoviviparous flowering, wherein few if any normally shaped spikelets are produced, and key diagnostic spikelet traits are then mostly lacking for the species. Plants reproducing by pseudoviviparous offshoots are common in southern areas in the distribution of *N. chonotica* and *N. robusta*. According to Nicora (1978), the presence of a subapical awn or mucro and the glumes larger than the adjacent lemmas characterize *N. andina* whereas *N. chonotica* (as *Poa borchersii*) has muticous lemmas and the glumes are typically shorter than the adjacent lemmas. Due to the wide variability in these characters and the presence of intermediate specimens, Nicora (1978) suggested that they might represent one single highly variable species. Although the presence or absence of the awn seems to be the most reliable character to distinguish *N. andina* from *N. chonotica*, some specimens identified as *N. chonotica* have spikelets with and without awns in the same inflorescence. Conversely, some one-flowered specimens with glumes longer than the floret and contracted panicles characteristic of *N. andina* have lemmas without awns. Moreover, some specimens bear two types of spikelets in the same inflorescence.

Thus far, *Nicoraepoa* was only known from Patagonia of Chile and Argentina (Nicora 1978; Zuloaga et al. 2008; Finot et al. 2011; Giussani et al. 2011; Soreng and Giussani 2012). However, a single specimen collected in northern Bolivia was discovered in the LPB herbarium in 2007 by RJS, which appeared to belong to *Nicoraepoa*, but it was not clear to which species it might belong or be related to. Thus, we concluded that a thorough morphological numerical study would be useful to address the various species problems.

This paper aims to examine patterns of morphological variation in *Nicoraepoa*, to search for characters that allow a clearer delimitation between *N. andina* and *N. chonotica*, to place the odd Bolivian specimen, and to characterize the pseudoviviparous plants, to analyze the morphological similarity among taxa and to better circumscribe species of *Nicoraepoa* using multivariate analysis, distribution patterns and study of the types.

Materials and methods

Specimens

Herbarium specimens were studied and borrowed from BAA, CONC, LPB, SGO, SI and US (herbarium acronyms follow Thiers continuously updated). High-resolution

images of the types of all species were also examined. For the morphometric study, 216 specimens were selected and considered as operational taxonomic units (OTUs) (Online resource 1). Type specimens were measured from the images, but measurements were not included in the data matrix for morphometric analysis. Specimens were a priori assigned to species according to the taxonomic literature (Nicora 1978; Soreng and Giussani 2012). The number of specimens available varied widely among species: *N. erinacea* (2 specimens), *N. stepparia* (2), *N. pugionifolia* (9), *N. subenervis* subsp. *spegazziniana* (12), *N. subenervis* subsp. *subenervis* (10), *N. robusta* (26), *N. chonotica* (67) and *N. andina* (87). Additionally, a putative new species of *Nicoraepoa* represented by only one specimen collected in Bolivia (*Valenzuela 1061*) was studied; specimens that bear only pseudoviviparous spikelets were excluded from the analyses, but pseudoviviparous plants were included in the analyses when bearing normal spikelets. The specimens included in this study were selected to cover as much as possible the geographic range of distribution and the morphological variability of each species.

Characters scored

Sixty-seven characters (40 quantitative (QN) and 27 qualitative (QL)) (Table 2) were scored for each specimen, from digital photographs taken with a Zeiss STEMI SV8 stereomicroscope equipped with an Axiovision digital camera. Measures from digital images were acquired with the software Zeiss Zen 2011. Measurements correspond to the mean value among 3–4 measurements per character, according to the material availability. Published descriptions and keys (Nicora 1978; Soreng and Peterson 2008; Soreng and Giussani 2012) were consulted to include characters that had previously been considered of taxonomic value. A basic data matrix (BDM) was constructed for 216 specimens (OTUS) and 67 characters.

Handmade leaf sections were cut from the middle zone of a leaf from a sterile innovation. Leaves were rehydrated with detergent solution (SDS) in a water bath for 1 h at 90 °C. Sections were stained with methylene blue and mounted in glycerin jelly. Observations were made with a Zeiss Axiostar microscope, and measurements were made from digital images as previously described. For anatomical terminology, we followed Metcalfe (1960) and Ellis (1976).

Statistical analyses

Qualitative (QL) two-state characters (absence/presence) were coded as 0 = absent, 1 = present; qualitative multistate characters were coded as 1, 2, 3, for different states (Table 2). Normality of the quantitative (QN) variables was determined applying the test of Shapiro and Wilk's (Mahibbur and Govindarajulu 1997). Quantitative data that do not fit normal distribution were $\log_{10}$-transformed, and those $\log_{10}$-transformed variables that do not fit normal distribution were deleted from the analyses. Data were standardized subtracting from each observation the mean of the column and dividing by the standard deviation. Different methods of analysis were selected to examine the taxonomic structure of *Nicoraepoa*: cluster analysis (CA), principal coordinate analysis (PCoA) and discriminant analysis (DA). Principal coordinate analysis was chosen to include both QL and QN variables (Gower 1966); PCoA is a good method to represent distances among major groups; a drawback of this method is that it fails to represent distances among members of a group; these are represented more accurately by cluster analysis (Sassone et al. 2013). Cluster analysis was performed using UPGMA algorithm, a robust analysis which tends to join clusters with small variances (Everitt et al. 2011). PcoA and CA were performed using Gower's dissimilarity, which is a measure of choice when the data matrix contains both continuous and binary data (Gower 1971; Gower and Legendre 1986; Everitt et al. 2011). Minimum spanning trees (MST) were superimposed on the distribution of the OTUs in two-dimensional ordinations. MSTs are important to check if the close position of two objects is an artifact or not (Marhold 2011). The analyses were made in two steps: (1) A matrix including all species (initial dataset with 216 OTUs) was analyzed by PcoA and UPGMA; (2) A reduced matrix including 154 specimens was analyzed by nonparametric classificatory discriminant analysis (DA) using 34 variables, k-nearest neighbor method and Gower distance, to discriminate between *N. andina* and *N. chonotica*. Multivariate analyses were carried out using the software Infostat v. 2016p (Di Rienzo et al. 2016). The basic data matrix (BDM) was prepared in Microsoft® Excel® 2011 for Mac v. 14.7.0 and is available on request.

Results

Morphometric analysis of the initial dataset

After testing normality of $\log_{10}$-transformed characters, a total of 20 characters were excluded from the analyses. Then, principal coordinate analysis (PCoA) and cluster analysis (UPGMA) were performed on a data matrix including 216 OTUs and 47 characters (27 QL and 20 QN variables) with normal distribution (Table 2). Gower's distance coefficient was employed, and a minimum spanning tree was superimposed on the distribution of the OTUs on the two principal coordinates. Both PCoA (Fig. 3) and cluster analysis (Online resource 2) yielded similar groupings. Groups correspond to the species as previously classified, except those determined as *N. andina* and *N. chonotica*. Only one specimen (*Aravena* et al. *1108*) from Puerto Natales, Magallanes, Chile (r3v) was placed in

Table 2 Acronyms, description and character states of the characters included in the multivariate analyses of *Nicoraepoa*

Acronym	Description and character states
I. Qualitative characters	
1. SECTOUTL	Outline of the leaf blade section: 1 = V-shaped; 2 = U-shaped; 3 = expanded
2. ADAXRIBS	Adaxial ribs: 0 = absent; 1 = present
3. RIBSH	Shape of the first-order adaxial ribs: 0 = flat; 1 = rounded
4. MEDBUNDL	Median vascular bundle: 1 = free, without sclerenchyma girders; 2 = with abaxial girders only; 3 = with adaxial and abaxial girders
5. FORDBUNDL	First-order vascular bundles: 1 = free, without sclerenchyma girders; 2 = with abaxial girders only; 3 = with adaxial and abaxial girders
6. SORDBUDL	Second-order vascular bundles: 1 = free, without sclerenchyma girders; 2 = with abaxial girders only; 3 = with adaxial and abaxial girders
7. SCLECONT	Sclerenchyma arranged as a continuous abaxial hypodermal band: 0 = absent; 1 = present
8. ABAXSC	Prickles on the abaxial epidermis: 0 = absent; 1 = present
9. ADAXSC	Prikles on the adaxial epidermis: 0 = absent; 1 = present
10. KEEL	Keel shape: 1 = rounded, not projecting abaxially; 2 = acute, projecting abaxially
11. PEDIND	Pedicel indument: 1 = glabrous; 2 = scabrous; 3 = pilose
12. GSPKR	Relative length of the longest glume to spikelet: 1 = shorter; 2 = longer
13. LEMNERV	Intermediate nerves of the lemma: 1 = faint; 2 = marked
14. CAHAIR	Callus hairs: 0 = absent; 1 = present
15. KEELINF	Lower half of the keel: 1 = glabrous; 2 = scabrous; 3 = ciliate
16. KEELSUP	Upper half of the keel: 1 = smooth; 2 = scabrous
17. LEMSCAB	Lemma scabrousness on sides: 0 = absent; 1 = present
18. AWN	Awn: 0 = absent; 1 = present
19. RACHPUB	Rachilla pubescence: 0 = absent; 1 = present
20. RACHSCA	Rachilla scabrousness: 0 = absent; 1 = present
21. PAKEEL	Palea keel: 1 = scabrous; 2 = ciliate
22. VIVIP	Pseudovivipary: 0 = absent; 1 = present
23. ANTHFERT	Anther fertility: 1 = all fertile; 2 = fertile and sterile
24. PANIBRSCA	Panicle branch scabrousness: 0 = absent; 1 = present
25. LIGIND	Ligule indument: 1 = glabrous; 2 = sparsely pubescent; 3 = densely pubescent
26. LEAFT	Leaf texture: 1 = soft; 2 = moderately rigid; 3 = indurate
27. LIGSH	Ligule shape: 1 = oval; 2 = truncate
II. Quantitative characters	
28. NUMFL***	Number of florets per spikelet (n°)
29. SPKL ***	Spikelet length (mm)
30. PEDMIN ***	Length of the shortest pedicels (mm)
31. PEDMAX ***	Length of the longest pedicels (mm)
32. G1L**	First glume length (mm)
33. G1 W**	First glume width (mm). Measured between the median nerve and the margin
34. G1LWR**	First glume length/width ratio
35. G2L**	Second glume length (mm)
36. G2 W**	Second glume width (mm)
37. G2LWR*	Second glume length/width ratio
38. G1G2LR***	Glumes length ratio
39. G1G2WR***	Glumes width ratio
40. G2SPKLR**	Second (longest) glume/spikelet length ratio
41. LEML**	First lemma length (mm)
42. LEMW**	First lemma width (mm)
43. LEMLWR**	Lemma length/width ratio
44. G1LEMLR**	First glume/lemma length ratio
45. G2LEMLR***	Second glume/lemma length ratio

Table 2 (continued)

Acronym	Description and character states
46. CAHAIRL ***	Length of the callus hairs (mm)
47. CAHAIRLEMR***	Callus/lemma length ratio
48. AWNL**	Awn length (mm)
49. RACHL**	Length of the rachilla (mm)
50. PALEAL**	Length of the palea (mm)
51. PALEALEMLR*	Palea/lemma length ratio
52. PLANTH***	Plant height (cm). Measured from the base of the culms to the apex of the panicle
53. PANICL ***	Panicle length (cm)
54. PANICW**	Panicle width (cm)
55. PANICLWR**	Panicle length/width radio
56. PANICBRL**	Length of the longest branch of the panicle (cm)
57. SPIKNUM***	Number of spikelets in the longest branch (n°)
58. LIGUL***	Ligule length in the upper leaf (mm)
59. LIGBL**	Ligule length in the basal leaves (mm)
60. ULEAFL***	Length of the upper leaf blade (cm)
61. USHEATHL***	Length of the upper leaf sheath (cm)
62. BLEAFL***	Leaf length in sterile shoots (cm)
63. BLEAFW***	Leaf width in sterile shoots (mm)
64. MEDVTH***	Thickness of the leaf in the median vein (mm)
65. LEAFTHICK***	Thickness of one half of the leaf blade in the median portion (mm). Measured on the median portion from the leaf margin to the median bundle in front of a first-order vascular bundle
66. HALFLAML*	Length of the half blade (mm). The leaf blade of *Nicoraepoa* is asymmetric in transverse section; one half of the leaf blade is wider than the other half. The length was measured on the widest half
67. FURROWD***	Depth of the adaxial furrows (mm). Measured from the apex of a first-order rib to the top of the bulliform cells situated on the bottom of the furrow. This character was missing in *N. erinacea* which lack ribs and furrows

*Characters with normal distribution; **characters with normal distribution after $\log_{10}$ transformation; ***characters without normal distribution even after $\log_{10}$ transformation

an intermediate position between *N. andina* + *chonotica* and *N. robusta.* As expected, *N. robusta* and *N. pugionifolia* were placed closely although both species form discrete clusters. *Nicoraepoa andina* and *N. chonotica* overlap widely along the second axis (Fig. 3) and third axis (not shown). UPGMA phenogram performed with Gower's distance shows three main clusters: (1) *N. andina* + *N. chonotica*, (2) *N. pugionifolia* + *N. erinacea* + *N. robusta* + *N. stepparia* and (3) *Nicoraepoa* sp. + *N. subenervis. Nicoraepoa robusta* and *N. pugionifolia* form discrete subgroups in the same cluster, with *N. erinacea* close to *N. pugionifolia* and *N. stepparia* close to *N. robusta*. *Nicoraepoa andina* and *N. chonotica* tend to form independent clusters, but *N. andina* included 18 OTUs identified as *N. chonotica* whereas *N. chonotica* included 23 OTUs identified as *N. andina* (Online resource 2).

UPGMA performed using only binary (presence/absence) characters (phenogram not shown) showed that differences between *N. andina* and *N. chonotica* are mainly supported by the presence or absence of the awn; however, 37 specimens were missplaced.

Discriminant analysis of two taxa: *Nicoraepoa andina* (long-glumed group) and *N. chonotica* (short-glumed group)

In order to find out if the separation of *N. andina* and *N. chonotica* is feasible, and to identify the characters that best differentiate these taxa, a discriminant analysis was carried out. Specimens were assigned to a priori groups based on the length of the upper glume relative to the length of the adjacent lemmas (G2LEMLR): group 1, glumes longer than adjacent lemmas and group 2, glumes shorter than adjacent lemmas. This character was chosen because *N. andina* was characterized as having glumes longer than the adjacent lemmas and the presence of a subapical awn or mucro and *N. chonotica* as having glumes shorter than adjacent lemmas and lemmas without awn or mucro (Nicora 1978). Thus, this character represents the "*andina*" group (long-glumed group) including all specimens with glumes 1–1.5 times larger than the adjacent lemmas and the "*chonotica*" group (short-glumed group) including the specimens with glumes shorter (< 1) than the adjacent lemmas. The

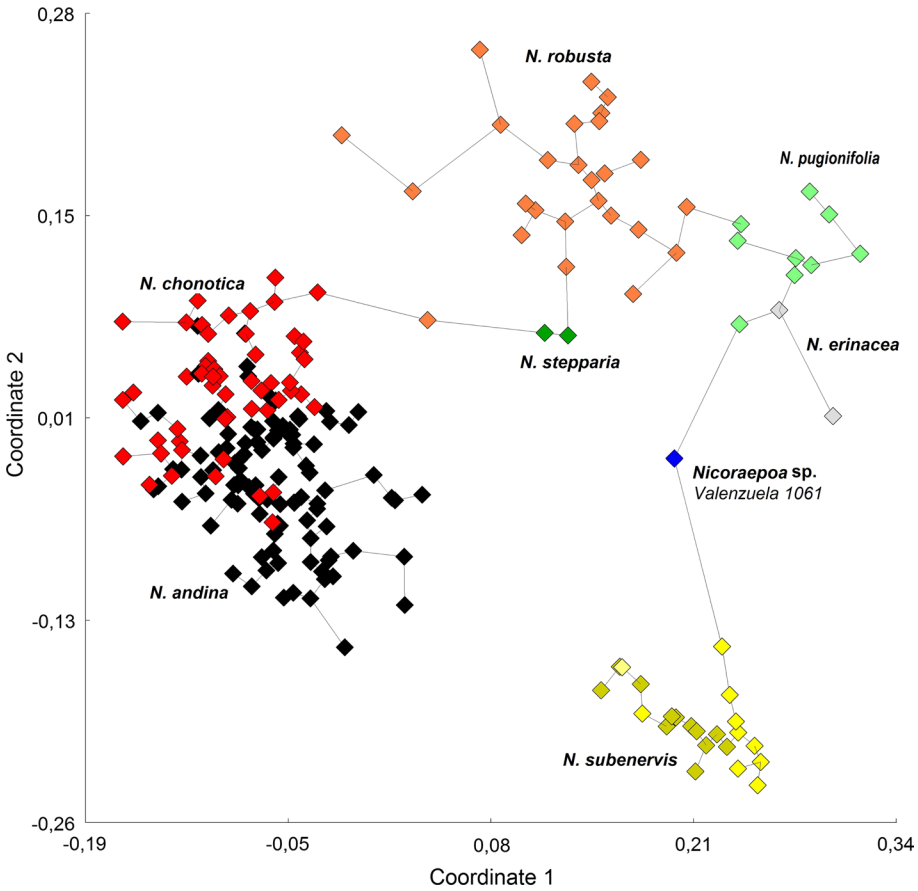

Fig. 3 Principal coordinate analysis of the initial dataset, based on 47 characters and 216 OTUs plotted on the first two principal coordinates. A minimum spanning tree was superimposed to the distribution of OTUs. Black diamonds = *Nicoraepoa andina*; dark blue diamonds = *Nicoraepoa* sp. (*Valenzuela 1061*); dark yellow diamonds = *N. subenervis* subsp. spegazziniana; light yellow diamonds = *N. subenervis* subsp. *subenervis*; light green diamonds = *N. pugionifolia*; gray diamonds = *N. erinacea*; orange diamonds = *N. robusta*; red diamonds = *N. chonotica*; dark green diamonds = *N. stepparia*

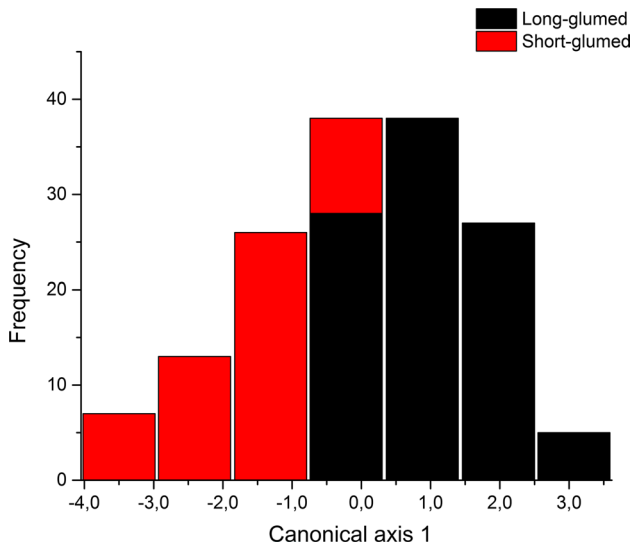

Fig. 4 Discriminant analysis of the *Nicoraepoa andina/chonotica* complex based on 34 morphological characters and two a priori groups based on the length of the glumes relative to adjacent lemmas

presence/absence of the awn was not useful to construct groups because of the intraspecific variability of this character. Although the presence or absence of the awn has been considered one of the most reliable characters to distinguish *N. andina* from *N. chonotica*, some specimens identified as *N. chonotica* have spikelets with and without awns in the same panicle. The histogram of the classificatory discriminant analysis (Fig. 4) shows partial separation of both groups. Characters of the spikelet were the most correlated with the canonical axis: Length of the palea (PALEAL), length of the spikelet (SPKL), length of the palea relative to the length of the lemma (PALEALEMLR) and width of the first glume (G1W). The cross-classification table showed 10.39% of the specimens were incorrectly classified (Table 3).

Discussion

Based on the results of the morphological multivariate analyses performed and based on the geographic distribution patterns, support was found for recognizing *Nicoraepoa subenervis*, *N. erinacea*, *N. pugionifolia*, *N. stepparia* and *N. robusta* as different species. Recognition of *N. andina* and *N. chonotica* as distinct species is only possible based on several quantitative characters that showed statistically significant differences. Specimens in the *N. andina/chonotica* complex have all vascular bundles with abaxial and adaxial

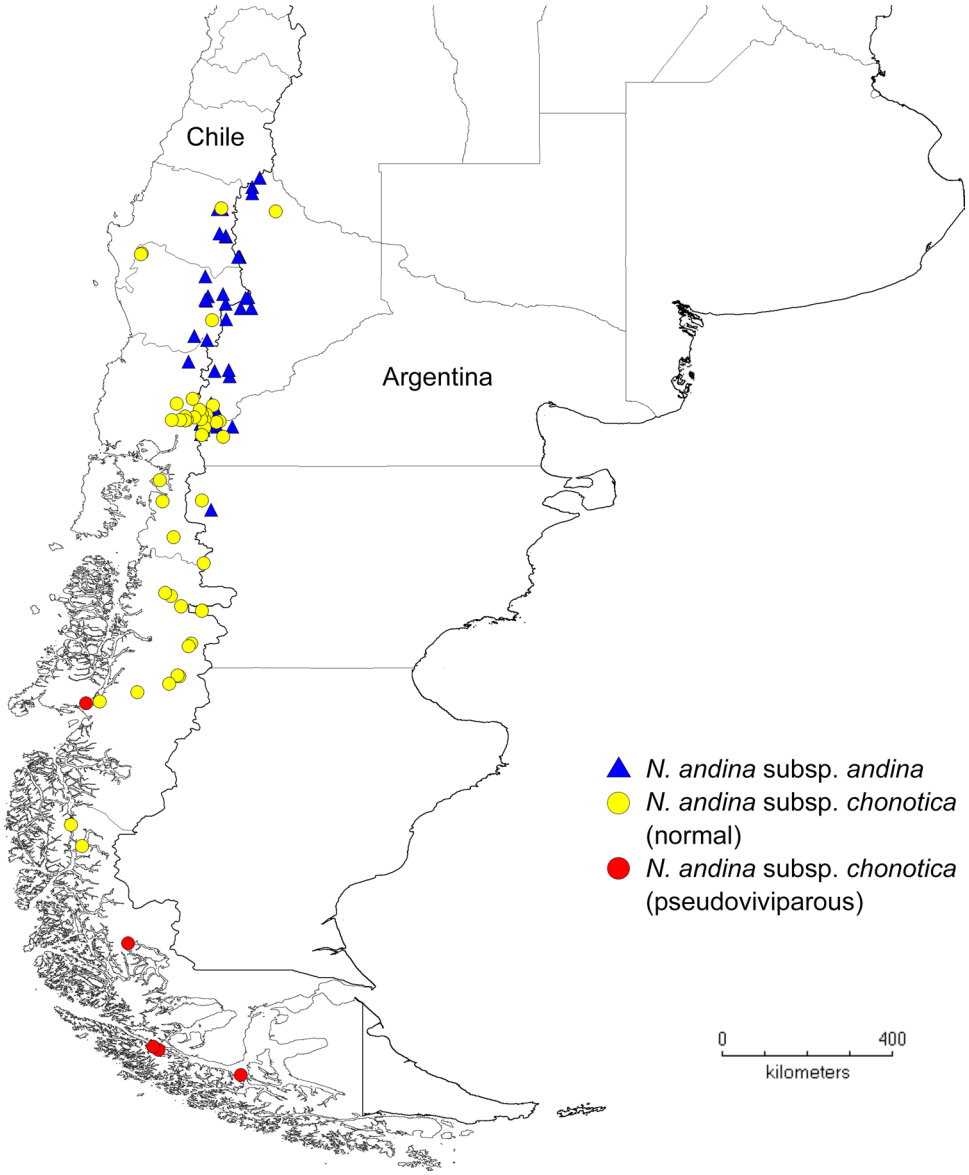

Fig. 5 Map showing the distribution of *Nicoraepoa andina* subsp. *andina* and *N. andina* subsp. *chonotica* in South America. Blue triangles = *N. andina* subsp. *andina*; red circles = pseudoviviparous *N. andina* subsp. *chonotica*; yellow circles = normal-flowered *N. andina* subsp. *chonotica*

Table 3 Classification table from the classificatory discriminant analysis using six uncorrelated significant variables

A priori	Size (*n*)	A posteriori		Error (%)
		Long-awned	Short-awned	
Long-awned	99	90	9	9.09
Short-awned	55	48	7	12.73
Total	154	138	16	10.39

Percentage of cases correctly classified: 89.61%

sclerenchymatic girders, lemma with distinct intermediate nerves, callus hairs present and lemmas with the keel scabrous on the lower half.

The results support Nicora's (1978) hypothesis that *N. andina* and *N. chonotica* could be better treated as one species; nevertheless, significant differences support their recognition as two different taxa that should be reasonable treated with infraspecific rank. As previously discussed by Nicora (1978), the presence/absence of the awn is inconsistent to distinguish *N. andina* from *N. chonotica*. When discussing this character, Nicora (1978) recognized the existence of specimens whose identification is problematic. In contrast, our results support the length of the glume relative to the adjacent lemmas as a good character to separate these taxa. Nevertheless, the lack of morphological discontinuities impedes the recognition of two separate species. Instead, the morphological continuum separating the taxa divides along elevational and geographic ranges, suggesting these taxa are better treated as two subspecies (see below: *N. chonotica* is transferred to a subspecies of *N. andina*).

Discrete (QL) characters are not useful to differentiate both subspecies; however, some QN characters significantly differ between them, such as panicle length, panicle width, length of the first glume relative to lemma length, length of the second glume relative to lemma length, length of the awn, plant height, length of the longest panicle branch, number of spikelets in the longest branch of the panicle, length of the upper sheath, lemma length, lemma width, upper leaf length, upper sheath length and half blade width (see key to species and descriptions).

All multivariate analyses support a close morphological relationship between *N. pugionifolia* and *N. erinacea* as Nicora (1978) previously pointed out. *Nicoraepoa erinacea* is endemic to Argentina (Chubut, 43°34′S, 70°27′W); the studied specimens of *N. erinacea* were collected at median elevation (830 m). *Nicoraepoa pugionifolia* grows in Chile (Region of Magallanes and Antártica Chilena) and in Argentina (Provinces of Santa Cruz and Tierra del Fuego), from the sea level to 1200 m (Figs. 2a, 6). Morphological differences between *N. erinacea* and *N. pugionifolia* are the presence of short callus hairs (present in *N. erinacea*, absent in *N. pugionifolia*), leaf section outline (U-shaped in *N. erinacea*, V-shaped in *N. pugionifolia*), adaxial ribs in cross section of leaves (absent in *N. erinacea*, present in *N. pugionifolia*), spikelets length (longer in *N. pugionifolia*), second glume length (longer in *N. pugionifolia*), lemma length (longer in *N. pugionifolia*), palea length (longer in *N. pugionifolia*), panicle width (wider in *N. pugionifolia*), panicle branch length (longer in *N. pugionifolia*), basal leaf length (longer in *N. pugionifolia*) and half-lamina length (longer in *N. pugionifolia*).

Although Nicora (1978) indicated a close relationship between *N. stepparia* and *N. pugionifolia*, our results showed that *N. stepparia* is morphologically closer to *N.*

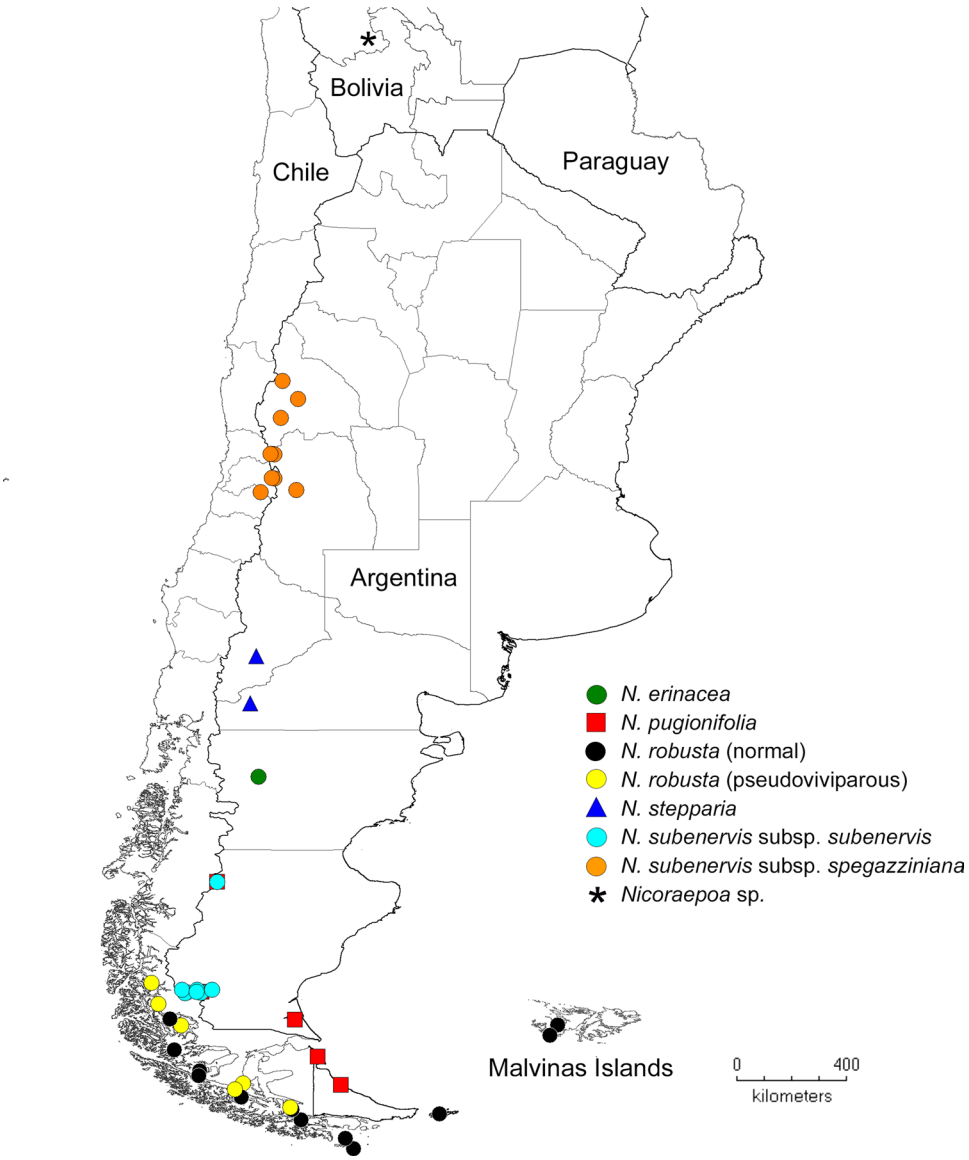

Fig. 6 Map showing the distribution of *Nicoraepoa erinacea*, *N. pugionifolia*, *N. robusta*, *N. stepparia*, *N. subenervis* and *Nicoraepoa* sp. in South America. Black circles = normal-flowered *N. robusta*; blue triangles = *N. stepparia*; green circles = *N. erinacea*; light blue circles = *N. subenervis* subsp. *subenervis*; orange circles = *N. subenervis* subsp. *spegazziniana*; red squares = *N. pugionifolia*; yellow circles = pseudoviviparous *N. robusta*

robusta than to *N. pugionifolia*. *Nicoraepoa robusta* grows in Chile (Region of Magallanes and Antártica Chilena) and Argentina (Tierra del Fuego), from 50°26′ to 55°58´S and 60°29′ to 74°01′W from the sea level to 139 m (Figs. 2c, 6). *Nicoraepoa stepparia* is endemic to Argentina (Mendoza, Neuquén, Río Negro, 39°32′–41°07′S, 70°31–70°43′W) at 980–1200 m altitude (Fig. 6). Several anatomical and morphological characters clearly distinguish these two species. Gillespie et al. (2008, 2010) found that phylogenetic analyses based on ITS resolved *N. pugionifolia* within a clade *Poa* sect. *Parodiochloa* and sect. *Tzvelevia* instead with the rest of the genus *Nicoraepoa* but TLF-based phylogenies resolved *N. pugionifolia* with *Nicoraepoa*. As Gillespie et al. (2008, 2010) pointed out, these results are indicative of hybridization and reticulate evolution between *Poa* and other related genera (unpublished nuclear and plastid DNA data place *N. stepparia* in *Nicoraepoa*; L.J.Gillespie pers. comm.). On the other hand, phylogenetic results of Gillespie et al. (2008) resolved *N. robusta* as sister to *N. chonotica*.

Pseudovivipary was observed in austral specimens of both subspecies of *Nicorapoa andina*, and in *N. robusta*. Pseudoviviparous spikelets occur frequently in *N. andina* subsp. *chonotica*. Pseudovivipary results from genetic or environmental triggers that disrupt timing of signals inducing flower development within initiated inflorescences wherein spikelets switch back to development of leaves, which may become a fixed or facultative mode of reproduction. It is a fairly common reproductive phenomenon in grasses. It occurs in heterogeneous terrestrial environments characterized by short growing periods such as arctic and alpine, and Mediterranean habitats (Cabi et al. 2016). It enables plants to complete their life cycle within a short growing season (Elmqvist and Cox 1996; Moore and Dogett 1976; Pierce et al. 2003; Giussani et al. 2016). Pseudovivipary is common

Fig. 7 *Nicoraepoa* sp. **a** Herbarium sheet from LPB (*Valenzuela 1061*). **b** Portion of the inflorescence. **c** Spikelet. **d** Ligule. **e** Floret. **f** Apex of the lemma showing the apical mucro. **h** Callus and rachilla. **i** Cross section of the leaf blade. *Scale bar* **a** 5 cm; **b** 3 mm; **c**, **d** 2 mm; **e–h** 1 mm; **i** 0.3 mm

in a few *Poa* species (*P. alopecurus* (Gaudich. ex Mirb.) Kunth, *P. obvallata* Steud.) from the same geographic region and in *Nicoraepoa* (Moore and Dogett 1976), suggesting it is a useful reproductive strategy in wetter and colder zones of the southern Patagonian region.

Nicoraepoa comprises until now seven species endemic to Chile and Argentina. In order to investigate if the specimen *Valenzuela 1061* collected in La Paz, Bolivia, at 4200 m.a.s.l. in the border of Lago Challapata, represents a putative new species of *Nicoraepoa*, this specimen was included in multivariate analyses except DA (Marhold 2011). This specimen resolved close to *N. subenervis* or within a cluster including *N. pugionifolia* and *N. erinacea* suggesting it can be considered a member of this genus. This specimen shows a leaf anatomy that resembles the diagnosis of *Nicoraepoa*, especially close to the *N. andina/chonotica* complex (Fig. 7i). This paper was intended to portray patterns of morphological variation to assist us delineating the taxa. It was not possible to achieve these objectives with only one specimen that was not sharply divergent from all the others. Moreover, as Dayrat (2005) contended "*no species name should be created based on fewer than a number of specimens.... and never with a single specimen.*" For these reasons, this putative new species of *Nicoraepoa* is not formally described here. We recommend that population sampling and molecular study be conducted to resolve the status of this specimen within the genus *Nicoraepoa*.

Taxonomic treatment and additional specimens of *Nicoraepoa* taxa

Key to species and subspecies of *Nicoraepoa*

1a. Callus glabrous (rarely with a few hairs to 1 mm long in some spikelets) 2
1b. Callus hairy (with a crown of hairs around the base of the lemma) 4
2a. Lemmas unawned, 4.8–5.2 mm long; keel scabrous on the upper half ..... ***Nicoraepoa* sp**. (*Valenzuela 1061)*
2b. Lemmas awned, 11–12 mm long; keel glabrous on the upper half 3
3a. Plants 8–23 cm tall; panicle 2.8–5.4 cm long; longest branches of the panicle with 1–3 spikelets; leaf blades 3–7.5 cm long; half-lamina in cross section 1–1.8 mm wide; median vascular bundles without sclerenchyma girders; pseudovivipary absent ..... ***N. pugionifolia***
3b. Plants 11–93 cm tall; panicle 4.4–25.5 cm long; longest branches of the panicle with 3–29 spikelets; leaf blades 6–27 cm long; half-lamina in cross section 1.45–3.5 mm wide; median vascular bundles with abaxial and adaxial sclerenchyma girders; pseudovivipary common ..... ***N. robusta***
4a. Plants all perfect; anthers fertile, 2–3 mm long; lemmas awned, awn 0.04–0.7 mm long, keel smooth (*N. subenervis*) 5
4b. Plants perfect or pistillate; anthers fertile and 3–4 mm long, or sterile staminodes and 1–3 mm long; lemmas awned or unawned; keels glabrous or ciliate on the lower half, scabrous on the upper half, rarely totally glabrous 6
5a. Plants 17–58.3 cm tall; panicle somewhat lax, 4–16.5 cm long, 0.6–4.1 cm wide; lower branches of the panicle 2–5.5 cm long, bearing 3–12 spikelets; lower glume 3.3–4.7 mm long; callus hairs 0.6–1.4 mm ..... ***N. subenervis* subsp. *spegazziniana***
5b. Plants 13–36.5 cm tall; panicle contracted, 2.4–8.7 cm long, 0.6–1.2 cm wide; lower branches of the panicle 1.3–3.2 cm long, with 2–6 spikelets; lower glumes 4.0–5.6 mm long; callus hairs 0.45–1 mm ..... ***N. subenervis* subsp. *subenervis***
6a. Lemmas unawned; median vascular bundles free or with adaxial girders only (abaxial girders absent) 7
6b. Lemmas awned or unawned; leaf blades with median vascular bundles with adaxial and abaxial girders (*N. andina*) 8
7a. Plants 7.6–10.5 cm tall; panicle 3.23–3.40 cm long; leaf blades 2.5 cm long; lower glume 4.99–5.52 mm long ..... ***N. erinacea***
7b. Plants 63–70 cm tall; panicle 8.5–12 cm long; leaf blades 6–7 cm long; lower glumes 4.4–5 mm long … ***N. stepparia***
8a. Glumes shorter than adjacent lemmas; awn usually absent, if present less than 1 mm long; plants (14–) 44–127(–148) cm tall; pseudovivipary common ..... ***N. andina*** subsp. ***chonotica***
8b. Glumes longer than adjacent lemmas; awn up to 2.9 mm, rarely absent; plants (13–)19–84 (–121) cm tall; pseudovivipary rare ..... ***N. andina* subsp. *andina***

Nicoraepoa andina (Trin.) Soreng & L.J.Gillespie **subsp. *andina***, Ann. Missouri Bot. Gard. 94(4): 843, f. 4A–G. 2007. ≡ *Poa andina* Trin., Linnaea 10(3): 306. 1836.—TYPE: Chile austr. in alp. frigidi. mont. ingiv. Antuco, *E. Poeppig s.n.* (holotype: LE-TRIN 2578.01a [n.v.]; isotypes: BAA fragm. ex LE-TRIN-2578a!, BAA-2449!, BAA-2450!) (Figs. 1a–b, 5).

= *Deschampsia latifolia* Phil., Linnaea 29(1): 91. 1858, **nom. illeg. hom**.—TYPE: Chile, in Andibus dep. Linares invenit orn. *Germain* (holotype: SGO-PHIL 197 [n.v.], isotypes: BAA 885 ex SGO- PHIL 197!, US 556494 ex SGO-PHIL 197!, W [n.v.]).

= *Poa straminea* Steud., Berberid. Amer. Austr. 52. 1857, **nom. nud**.

= *Poa achrochaeta* Hack., Repert. Spec. Nov. Regni Veg. 10(243–247): 172. 1911.—TYPE: Chile, Vulkan Peteroa (no date), K.F. Reiche comm. (holotype: W-39455 (ex SGO-PHIL-448); isotypes: SGO-PHIL-448, US-1723707 (fragm. ex SGO-PHIL-448 & photo), US-88711 (fragm. ex W)) (collector unknown: "*448*" in Philippi script on ticket).
= *Poa aristata* Phil., Anales Univ. Chile 43: 574. 1873.—TYPE: Chile, Volcán de Osorno, 1872, *C. Juliet* (holotype: SGO-PHIL-439 (now W-39450); isotypes: US-89700 (fragm.ex SGO-phil-439 & photo)).

Description: Perennials with rhizomes; plants 46.7 ± 20.8 (13.0–121.0) cm; leaves moderately rigid or indurate; basal leaves 16.5 ± 7.5 (3.2–44.0) cm long, 0.3 ± 0.2 (0.1–1.0) mm wide; ligules oval or truncate, glabrous or sparsely pubescent; ligules of basal leaves 1.3 ± 0.9 (0.2–4.1) mm long; ligules of upper leaf 2.1 ± 0.8 (0.6–5.3) mm. Panicles 11.1 ± 4.9 (0.9–31.7) cm long, 2.4 ± 1.1 (0.1–7.5) cm wide; longest branches of the panicle 4.3 ± 1.9 (2.1–10.4) cm long, bearing 9.6 ± 4.6 (3.7–25.5) spikelets. Spikelets 6.6 ± 1.1 (4.6–9.5) mm; longest pedicels 4.1 ± 2.5 (1.7–20.0) mm long; pedicels glabrous or scabrous; first glumes 5.2 ± 0.9 (3.4–7.0) mm long, 0.7 ± 0.1 (0.4–1.0) mm wide; second glumes 5.7 ± 0.9 (4.1–8.4) mm long, 0.8 ± 0.1 (0.5–1.1) mm wide; rachilla 1.0 ± 0.3 (0.5–2.7) mm; lemmas 5.3 ± 0.6 (4.2–6.7) mm long, 0.9 ± 0.1 (0.7–1.2) mm wide; lemmas glabrous or scabrous on sides; keel glabrous or ciliate on the lower half, scabrous on the upper half; callus hairs 1.5 ± 0.4 (0.6–2.7) mm long; paleas 4.5 ± 0.6 (2.9–5.9) mm; keels scabrous or ciliate; awn 0.9 ± 0.7 (0.0–2.9) mm long.

Leaf anatomy: Cross section V-shaped or expanded; keel rounded not projecting abaxially or acute projecting abaxially; leaf blade asymmetric; longest half-lamina 2.6 ± 0.7 (1.7–5.4) mm wide; leaf thickness in cross section 0.3 ± 0.1 (0.2–0.3) mm; adaxial ribs present; furrows 0.1 ± 0.03 (0.1–0.2) mm depth; first-order adaxial ribs rounded; median vascular bundles with adaxial and abaxial sclerenchyma girders; first-order vascular bundles with adaxial and abaxial sclerenchyma girders; second-order vascular bundles with adaxial and abaxial sclerenchyma girders; sclerenchyma arranged as a continuous hypodermal layer absent or present; prickles on the abaxial epidermis absent or present; prickles on the adaxial epidermis absent or present.

Distribution area and habitats: *Nicoraepoa andina* subsp. *andina* is found from 36°17′S to 42°52′S, in Chile (Regions of Biobío, Araucanía, Los Ríos and Los Lagos Region) and Argentina (Provinces of Neuquén, Río Negro, and Chubut), from 310 to 2200 m a. s. l. (Fig. 6), in "mallines" (e.g., *Boelcke* and *Correa 6037; Boelcke 1834*), *Nothofagus pumilio* (lenga) forests (e.g., *Soriano 4171*), alpine wet meadows with *Gunnera* (e.g., *Boelcke 6481*), rocky riparian meadows, disturbed ground in open *Nothofagus pumilio* forests (e.g., *Soreng* and *Soreng 7119*), alpine steppe, around drying ponds (e.g., *Soreng* and *Soreng 7212*), open meadows surrounded by *N. antarctica*, *Escallonia* and *Ribes*, meadows with *Carex*, *Eleocharis* and *Agrostis* (e.g., *Peterson* et al. *17495*).

Note: *Nicoraepoa andina* subsp. *andina* usually has 2–3-flowered spikelets; however, 1-flowered spikelets are also found.

Nicoraepoa andina (Trin.) Soreng & L.J.Gillespie **subsp. *chonotica*** (Phil.) Finot, Soreng & Giussani, **comb. nov**. ≡ *Poa chonotica* Phil., Linnaea 29(1): 97. 1858. ≡ *Nicoraepoa chonotica* (Phil.) Soreng & L.J.Gillespie, Ann. Missouri Bot. Gard. 94(4): 843. 2007.—TYPE: Chile "in monte Cerro de Chonos ad circa 1290 ped. s.m.," *Fonk s.n.* (holotype: SGO-PHIL-410 [n.v.]; isotypes: US-89684, fragm. ex SGO-PHIL-410 & photo!, US-89683 fragm. ex SGO-PHIL-410 & photo!) (Figs. 1c–d, 5).
= *Poa latifolia* Phil., Linnaea 29(1): 97. 1858, nom. illeg. hom.—TYPE: Chile "in monte Cerro de Chonos ad circa 1290 ped. s.m.," *Fonk s.n.* (isotypes: BAA-2613 fragm. ex SGO!, BAA-2612 fragm. ex SGO!, US-88768 fragm. ex SGO-PHIL-414 & photo!).
= *Poa robusta* Phil., Anales Univ. Chile 43: 574. 1873, **nom. illeg. hom**.—TYPE: Chile "Esta *Poa* fue hallada en el volcán de Calbuco" *Juliet s.n.* (holotype: W [n.v.]; isotypes: US-88733 fragm. ex SGO-PHIL-443 & photo!).
= *Poa borchersii* Phil., Anales Univ. Chile 94: 172. 1896.—TYPE: Chile "prope thermas chillanenses" *Borchers s.n.* (holotype: W-39457 ex SGO-PHIL-431 [n.v.]; isotype: BAA-2478!).
= *Poa chubutensis* Speg., Anales Mus. Nac. Hist. Nat. Buenos Aires 7: 196. 1902.—TYPE: Argentina "hab. in rupestribus collinis prope Teka-choique, Chubut, aest. 1901," *N. Illin s.n.* (holotype: LPS [n.v.]; isotypes: BAA 2516!, BAA 2517!, SI [n.v.], US 916986!, US 1503958!).
= *Poa berningeri* Pilg., Notizbl. Bot. Gart. Berlin-Dahlem 10(97): 761. 1929.—TYPE: Chile, Prov. Llanquihue: volcán Yates, ca. 1200 m a.s l.. "vereinzelt zwischen-*Nothofagus*-an der Waldgrenze," Mar 1925, *Werdermann 1698* (holotype: B; isotypes BAA 2474 fragm. ex B!; US 89693 fragm. ex B!).

Description: Perennial with rhizomes; plants 81.8 ± 28.1 (14.6–148.0) cm; leaves soft to indurate; basal leaves 22.2 ± 10.4 (1.2–55.0) cm long, 0.3 ± 0.1 (0.1–0.5) mm wide; ligules oval or truncate, glabrous or sparsely pubescent; ligules of basal leaves 1.4 ± 0.9 (0.2–5.5) mm long; ligules of upper leaves 2.4 ± 1.0 (0.5–5.1) mm. Panicles 18.7 ± 4.4 (11.2–28.0) cm long, 5.4 ± 2.7 (1.6–13.5) mm wide; longest branches of the panicles 8.8 ± 3.8 (4.0–21.0) cm long, bearing 5.0–61.0 spikelets. Spikelets 7.0 ± 0.9 (5.0–9.2) mm; longest pedicels 4.6 ± 1.6 (2.0–8.4) mm long; pedicels scabrous or pilose; first glumes 5.4 ± 0.7 (3.9–7.1) mm long, 0.7 ± 0.1

(0.5–1.2) mm wide; second glumes 6.0 ± 0.8 (4.3–8.1) mm long, 0.9 ± 0.1 (0.7–1.3) mm wide; rachilla 1.0 ± 0.3 (0.4–2.0) mm; glabrous or pubescent; lemmas 6.0 ± 0.8 (4.5–8.5) mm long, 1.0 ± 0.1 (0.6–1.4) mm wide; lemmas smooth or scabrous on sides; keel glabrous or ciliate on the lower half, scabrous on the upper half; callus hairs 1.4 ± 0.4 (0.5–2.7) mm long; paleas 4.8 ± 0.5 (3.4–6.1) mm, keels scabrous or ciliate; awn 0.2 ± 0.2 (0.0–1.0) mm long.

Leaf anatomy: Cross section V-shaped or expanded; keel rounded not projecting abaxially or acute projecting abaxially; leaf blade asymmetric; longest half-lamina 3.0 ± 0.6 (2.1–5.0) mm long; leaf thickness in cross section 0.3 ± 0.04 (0.2–0.5) mm; adaxial ribs present; furrows 0.1 ± 0.02 (0.1–0.2) mm depth; first-order adaxial ribs rounded; median vascular bundles with abaxial sclerenchyma girders only or with adaxial and abaxial sclerenchyma girders; first-order vascular bundles with adaxial and abaxial sclerenchyma girders; second-order vascular bundles with abaxial sclerenchyma girders only or with adaxial and abaxial sclerenchyma girders; sclerenchyma arranged as a continuous hypodermal layer absent or present; prickles on the abaxial epidermis absent or present; prickles on the adaxial epidermis absent or present.

Distribution area and habitats: *Nicoraepoa andina* subsp. *chonotica* grows from 36°53′S to 54°05′S, in Chile in the Regions of Biobío, Araucanía, Los Ríos, Los Lagos, Aysén and Magallanes and Antártica Chilena and in Argentina in Provinces of Neuquén, Río Negro, Chubut and Santa Cruz (Fig. 6), in marshes with *Nothofagus pumilio*, *N. antarctica*, *N. dombeyi*, *Carex* sp. and *Juncus* sp., littoral vegetation, muddy lake foreshore, peat bogs in *Fitzroya cupressoides* forests ("alerzales"), also in *Sphagnum* meadows surrounded by *Nothofagus betuloides* forests (e.g., *Soreng and Soreng 7255*).

Notes: Type of *P. chubutensis* in BAA 2516 (ex Herb. Spegazzini 68), collected at río Corcovado, Chubut, by N. Illin in 1901 is a fragment with spikelets 6.3–6.6 mm long; lower glumes 4.8 mm long; upper glumes 5.3 mm; lemmas 4.6–5.3 mm, the apex acute, muticous. Type of *P. chubutensis* at US 1503958 has open, lax panicles ca. 17.5 xm long. Type of *P. berningeri* at BAA 2474 has glabrous leaf blades ca. 10 mm wide; 2-flowered spikelets 6.2–7.0 mm long, glumes purple; lower glume 4.5 mm; upper glume 5 mm long, ca. 1 mm wide; lemmas with acute, muticous apex.

Pseudoviviparous material of subsp. *chonotica* is mostly known from the region of geographic overlap with western populations of *N. robusta* between 49 and 52°s, where normal-flowered subsp. *chonotica* is rare, but occurs as far north as 46.6°S. *Nicoraepoa robusta* is commonly pseudoviviparous from throughout the species range, from 50 to 56°S, over the same range that subsp. *chonotica* is pseudoviviparous, and well eastward of that as far as Isla de Los Estados, and pseudoviviparous and normal-flowered plants are commonly found together. These taxa are separable by the more lax open inflorescence and frequent occurrence of at least a few callus hairs in spikelets in *N. andina* subsp. *chonotica* versus contracted inflorescences and no callus hairs in *N. robusta*. A few putative hybrids between *N. robusta* and *N. andina* subsp. *chonotica* were identified in herbarium materials, as too intermediate to separate (e.g., *Pisano 5954*, Fiordo Peel, Río Murtillar, 18 Nov 1985 (CONC), *Pisano 6464*, Canal Grappler, Paso Charteris, Cabo Colorado, 19 Dec 1988 (CONC)). Pseudovivipary was observed in only one specimen of subsp. *andina* (Los Lagos, Cerro O'Connor, *Rúgolo* et al. *12417*). Pseudovivipary is rare in the interface between subsp. *andina* and subsp. *chonotica*.

Nicoraepoa erinacea (Speg.) Soreng & L.J.Gillespie, Ann. Missouri Bot. Gard. 94(4): 844, f. 5A–D. 2007. ≡ *Poa erinacea* Speg., Anales Mus. Nac. Hist. Nat. Buenos Aires 7: 198. 1902.—TYPE: Argentina, Chubut "in aridissimis subsalcis secus Rio Chubut, Dec 1899" *N. Illin s.n.* (holotype: LPS-67 in LP!; isotypes: BAA-2534!, US-88783!, MPU-027785!) (Illustration: Soreng and Giussani 2012, p. 273) (Fig. 6).

Description: Perennial with rhizomes 1–1.5 mm in diameter; plants 9.1 ± 2.0 (7.7–10.5) cm; leaves indurate; basal leaves 2.5 ± 0.02 (2.5–2.55) cm long, 0.3 ± 0.1 (0.2–0.3) mm wide; ligules truncate, glabrous; ligules of basal leaves 1.0 ± 0.4 (0.7–1.3) mm long; ligules of upper leaf 1.3 ± 0.8 (0.7–1.8) mm. Panicles 3.3 ± 0.1 (3.2–3.4) cm long, 0.5 ± 0.2 (0.3–0.6) cm wide; longest branches of the panicle 1.0 ± 0.1 (0.9–1.0) cm long, bearing 1.0 spikelet. Spikelets 6.5 ± 0.6 (6.1–6.9) mm; longest pedicels 5.0 ± 1.8 (3.7–6.3) mm long; pedicels glabrous or scabrous; first glume 5.3 ± 0.4 (5.0–5.5) mm long, 0.8 ± 0.00 mm wide; second glume 5.6 ± 0.8 (5.1–6.1) mm long, 1.0 ± 0.1 (0.9–1.1) mm wide; rachilla 1.2 ± 0.2 (1.1–1.3) mm, glabrous; lemmas 5.9 ± 0.4 (5.6–6.2) mm long, 1.1 ± 0.0 mm wide; lemmas smooth on sides; keel glabrous on the lower and upper halves; callus hairs 0.3 ± 0.0 mm long; paleas 4.6 ± 0.6 (4.1–5.0) mm, keels ciliate; awn absent or reduced to a short mucro 0.1 ± 0.1 (0.0–0.16) mm long.

Leaf anatomy: Cross section U-shaped; keel rounded not projecting abaxially; leaf blade asymmetric; longest half-lamina 0.8 ± 0.1 (0.8–0.9) mm long; leaf thickness in cross section 0.3 ± 0.0 mm; adaxial ribs absent; furrows absent; median vascular bundles free; first-order vascular bundles free; second-order vascular bundles free; sclerenchyma arranged as a continuous hypodermal layer absent; prickles on the abaxial epidermis absent; prickles on the adaxial epidermis present.

Distribution area and habitats: *Nicoraepoa erinacea* is endemic to Argentina, where it has been collected only in the Province of Chubut (Fig. 7). It forms cespitose cushions on alkaline, saline soils. It is closely related to *N. pugionifolia* from which it is distinguished by having shorter spikelets, callus with short hairs (callus glabrous in *N. pugionifolia*), leaves subulate (conduplicate, sometimes flat at the base in *N. pugionifolia*) and adaxial ribs absent on the leaf section (present in *N. pugionifolia*).

Note: Type specimen BAA-2534 bears three plants 10–15 cm tall; leaves glabrous, very narrow, 2-3 cm long, ending in a sharp pointed apex; panicles 1.8–3 cm long; spikelets 6 mm long; glumes shorter than the florets. Collected in flower from December to April (Nicora 1978).

Additional specimens examined: ARGENTINA, Prov. Chubut, Quichaura, 5 Apr 1952, *A. Soriano 4393* (BAA); Quichaura, near Tecka, 10 km S of Esquel, *s.d.*, *A.A. Beetle and A. Soriano 446/52* (BAA).

Nicoraepoa pugionifolia (Speg.) Soreng & L.J.Gillespie, Ann. Missouri Bot. Gard. 94(4): 844, f. 4P–S. 2007. ≡ *Poa pugionifolia* Speg., Anales Mus. Nac. Hist. Nat. Buenos Aires 7: 199. 1902.—TYPE: Argentina, "in rupestribus porphyricis Parr-aik secus Río Chico et Boron-aik secus Río Sehuen, Jan. et Febr. 1898" *Ameghino s.n.* (lectotype: LP-SPEG-65! designated by R.J. Soreng & L.J.Gillespie, Ann. Missouri Bot. Gard. 94: 845. 2007; isolectotypes: BAA-2672!) (Figs. 2a–b, 6).
= *Poa acutissima* Pilg., Repert. Spec. Nov. Regni Veg. 12: 306. 1913.—TYPE: Argentina "Süd-Patagonien, *Skottsberg s.n.* (holotype: B [n.v.]; isotypes: BAA-2442!, BAA-2443!).

Description: Perennial rhizomatose plants forming cushions up to 1 m in diameter; rhizomes with serial tillers; plants 14.4 ± 4.3 (8.7–23.0) cm; leaves moderately rigid to indurate; basal leaves 4.6 ± 1.3 (3.0–7.5) cm long, 0.3 ± 0.2 (0.2–0.8) mm wide; leaves with the apex ending abruptly in a very sharp point, and wide and bright sheaths; ligules oval or truncate, glabrous; ligules of basal leaves 1.2 ± 0.5 (0.6–1.8) mm long; ligules of upper leaves 1.3 ± 0.3 (0.7–1.8) mm. Panicles 3.9 ± 0.9 (2.8–5.4) cm long, 0.9 ± 0.3 (0.5–1.4) cm wide; longest branches of the panicle 1.5 ± 0.3 (1.2–2.1) cm long, bearing 1–3 spikelets. Spikelets 9.2 ± 1.3 (7.9–11.3) mm; longest pedicels 4.4 ± 0.9 (3.3–5.8) mm long; pedicels glabrous or scabrous; first glume 6.3 ± 0.7 (5.4–7.5) mm long, 1.0 ± 0.2 (0.8–1.2) mm wide; second glume 7.0 ± 0.7 (6.0–8.4) mm long, 1.2 ± 0.2 (0.9–1.5) mm wide; rachilla 1.6 ± 0.4 (1.0–2.4) mm; glabrous or scabrous; lemmas 7.1 ± 0.3 (6.7–7.6) mm long, 1.2 ± 0.2 (0.8–1.4) mm wide; lemmas smooth on sides; keel glabrous or scabrous on the lower half, smooth on the upper half; callus glabrous (rarely with a sparse crown of hairs on a few florets; e.g., *Peterson* et al. *17128*); paleas 5.8 ± 0.4 (5.2–6.4) mm, keels scabrous or ciliate; awn absent, but sometimes with a very short mucro 0.2–0.3 µm long (e.g., *Dauber 176*, *Vallerini 3975*).

Leaf anatomy: Cross section V-shaped; keel rounded, not projecting abaxially; leaf blade asymmetric; longest half-lamina 1.4 ± 0.3 (1.0–1.8) mm long; leaf thickness in cross section 0.3 ± 0.04 (0.2–0.3) mm; adaxial ribs present; furrows 0.1 ± 0.0 (0.1–0.2) mm depth; first-order adaxial ribs rounded; median vascular bundles free or with abaxial sclerenchyma girders only; first-order vascular bundles free or with adaxial sclerenchyma girders; second-order vascular bundles free; sclerenchyma arranged as a continuous hypodermal layer absent; prickles on the abaxial epidermis absent or present; prickles on the adaxial epidermis absent or present.

Distribution area and habitats: *Nicoraepoa pugionifolia* grows in Argentina (Provinces of Santa Cruz and Tierra del Fuego) and Chile (Magallanes and Antártica Chilena Region), from 47°04′S to 53°51′S, from the sea level to 1200 m of elevation (Fig. 7). It grows in dry lowlands (e.g., *Dauber 176*) and saline inundate meadows (mallines) (e.g., *Vallerini 3975*, *Peterson* et al. *17254*) with *Carex*, *Calamagrostis* and *Azorella*, between 60 and 1200 m.s.m.

Notes: Some Argentinian specimens collected in Tierra del Fuego (e.g., *Vallerini 3975*, *Castellanos 7554*) have very narrow leaves (see also comments made by Nicora 1978). Types BAA 2442 and BAA 2443 of *Poa acutissima* have spikelets 7.7–9.0 mm long, first glumes 5.8 mm long × 0.8 mm wide, second glumes 7.5 mm long x 1.1 mm wide and lemmas 5 mm long, callus and awn absent; plants are 5.0–7.5 cm tall, with basal leaves 2.0–2.5 cm long x 1.0–1.3 mm wide. These measurements are within the range of variation observed for the species. Collected in flower from November to January.

Nicoraepoa robusta (Steud.) Soreng & L.J.Gillespie, Ann. Missouri Bot. Gard. 94(4): 844-845, f. 5E–I. 2007. ≡ *Poa robusta* Steud., Syn. Pl. Glumac. 1: 426. 1854.—TYPE: Chile, Magallanes "in paludosis maritimis Sandy Point Magellan" *Lechler 1191* (holotype: P!; isotypes: BAA 2776 ex P!, US-946984!, US-81586!) (Figs. 2c, 6).
= *Festuca arenaria* Lam., Tabl. Encycl. 1: 191. 1791, **nom. illeg. hom**. ≡ *Poa arenicola* St.-Ives, Candollea 3: 282. 1927.—TYPE: Chile or Argentina "E. Magellania, in arenis maritimis" *Commerson s.n.* (holotype: P!; isotypes: US-2875377a fragm. & photo ex MPU!, US-2875377b fragm. Ex P!).

Description: Perennials with thick rhizomes; frequently with pseudoviviparous spikelets; plants 41.8 ± 22.3 (11.5–93.1) cm; leaves indurate; basal leaves 12.4 ± 5.6 (6.0–27.0) cm

long, 0.3 ± 0.1 (0.2–0.7) mm wide; ligules oval or truncate, glabrous or pubescent; ligules of basal leaves 1.1 ± 0.5 (0.6–2.8) mm long; ligules of upper leaves 1.9 ± 0.9 (0.7–4.8) mm. Panicles spiciform, 11.1 ± 4.9 (4.4–25.5) cm long, 2.5 ± 2.3 (0.9–11.3) cm wide; longest branches of the panicles 4.4 ± 2.7 (1.7–10.6) cm long, bearing 3–16(–29) spikelets. Spikelets 9.2 ± 1.4 (6.7–12.1) mm; longest pedicels 5.2 ± 1.8 (2.0–10.2) mm long; pedicels scabrous or pilose; first glume 7.2 ± 1.3 (5.3–10.2) mm long, 0.9 ± 0.2 (0.5–1.5) mm wide; second glume 7.6 ± 1.3 (5.3–10.3) mm long, 1.0 ± 0.2 (0.6–1.6) mm wide; rachilla 1.4 ± 0.3 (0.9–2.6) mm, glabrous; lemmas 7.4 ± 0.8 (5.9–9.5) mm long, 1.2 ± 0.2 (0.9–1.6) mm wide; lemmas smooth or scabrous on sides; keel glabrous on the lower half, glabrous or scabrous on the upper half; callus hairs absent, rarely present 0.2 ± 0.4 (1.1–1.4) mm long; paleas 6.2 ± 0.7 (4.8–7.9) mm, keels scabrous or ciliate; awn absent or reduced to a short mucro 0.1 ± 0.2 (0.6–0.8) mm long.

Leaf anatomy: Cross section V-shaped or U-shaped; keel rounded, not projecting abaxially; leaf blade asymmetric; longest half-lamina 2.2 ± 0.5 (1.5–3.5) mm wide; leaf thickness in cross section 0.3 ± 0.1 (0.2–0.4) mm; adaxial ribs present; furrows 0.2 ± 0.1 (0.1–0.3) mm depth; first-order adaxial ribs rounded; median vascular bundles with abaxial sclerenchyma girders only or with adaxial and abaxial sclerenchyma girders; first-order vascular bundles with adaxial and abaxial sclerenchyma girders; second-order vascular bundles with adaxial and abaxial sclerenchyma girders; sclerenchyma arranged as a continuous hypodermal layer absent; prickles on the abaxial epidermis absent; prickles on the adaxial epidermis absent or present.

Distribution area and habitats: *Nicoraepoa robusta* is found in Argentina (Malvinas Islands, Tierra del Fuego) and Chile (Region of Magallanes and Antártica Chilena), from 50°26′S to 55°58′S, from the sea level to 140 m of altitude (Fig. 7), on coastal scrubs, at the interface of marshy meadows and the rocks and dunes; coastal herbaceous associations with *Anthoxanthum redolens* (Vahl) P.Royen, *Marsipposperm um grandiflorum* (L.f.) Hook.f., *Elymus magellanicus* (E.Desv.) Á.Löve. Sometimes attacked by *Claviceps* sp. (e.g., *Domínguez 985, 990*).

Notes: Nicora (1978) and Soreng and Giussani (2012) characterize *N. robusta* as having the callus glabrous. In a few specimens (e.g., *Pisano 6464*, *Aravena* et al. *1108*), we found callus with hairs 1.07–2.09 mm long, and these are considered possible intermediates between *N. robusta* and *N. andina* subsp. *chonotica*.

The isotype of *Poa robusta* (BAA 2676) has leaves 8.5–9.0 cm long x ca. 4 mm lat, glabrous, acute; spikelets ca. 7 mm long; first glumes 6 × 1 mm; second glumes 7.2 × 1.5 mm; lemmas 6–7 mm with glabrous calluses. A drawing of the inflorescence of the Paris (P)-type specimen made by L.R. Parodi shows a spiciform panicle ca. 6 cm long, 1 cm lat. These measurements are within the range of variation of the species.

Nicoraepoa stepparia (Nicora) Soreng, Darwiniana 49(1): 91. 2011. ≡ *Poa stepparia* Nicora, Hickenia 1(18): 101. 1977.—TYPE: Argentina, Neuquén, Dpto. Zapala, Zapala, 5 Feb 1920, *L.R. Parodi 1268* (holotype: BAA!) (Illustration: Soreng and Giussani 2012, p. 276) (Fig. 6).

Description: Perennials with rhizomes; plants 66.5 ± 5.0 (63.0–70.0) cm; leaves moderately rigid or indurate, relatively short, conduplicate, with very acute apex, forming a dense clump that does not exceed 10 or 15 cm high; basal leaves 6.5 ± 0.7 (6.0–7.0) cm long, 0.2 ± 0.0 mm wide; ligules truncate, glabrous; ligules of basal leaves 1.0 ± 0.0 mm long; ligules of upper leaves 1.8 ± 0.0 mm. Panicles panicle linear, narrow, 10.3 ± 2.5 (8.5–12.0) cm long, 1.3 ± 0.4 (1.0–1.5) cm wide; longest branches of the panicles 4.9 ± 1.2 (4.0–5.7) cm long, bearing 5 spikelets. Spikelets 6.4 ± 1.3 (5.5–7.3) mm; longest pedicels 6.9 ± 2.1 (5.4–8.3) mm long; pedicels glabrous; first glume 4.7 ± 0.9 (4.4–5.0) mm long, 0.9 ± 0.0 mm wide; second glumes 5.3 ± 0.3 (5.1–5.5) mm long, 1.0 ± 0.0 mm wide; rachilla 1.4 ± 0.0 mm; lemmas 6.4 ± 0.8 (5.9–7.0) mm long, 1.3 ± 0.1 (1.2–1.4) mm wide; lemmas glabrous on sides (but see comments in Nicora 1978, p. 171 and fig. 111); keel glabrous on the lower and on the upper halves; callus hairs 0.4 ± 0.0 mm long; paleas 5.3 ± 0.0 mm; keels scabrous; awn 0.5 ± 0.0 mm long. Caryopsis 2.0–2.5 mm, subtriangular in cross section.

Leaf anatomy: Cross section V-shaped; keel rounded, not projecting abaxially; leaf blade asymmetric in cross section; longest half-lamina 1.6 ± 0.3 (1.4–1.8) mm long; leaf thickness in cross section 0.3 ± 0.1 (0.3–0.4) mm; adaxial ribs present; furrows 0.1 ± 0.0 mm depth; first-order adaxial ribs rounded; median vascular bundles free; first-order vascular bundles with adaxial and abaxial sclerenchyma girders; second-order vascular bundles with adaxial and abaxial sclerenchyma girders; sclerenchyma arranged as a continuous hypodermal layer absent; prickles on the abaxial epidermis absent; prickles on the adaxial epidermis absent.

Distribution area and habitats: Endemic to Argentina (39°32′S – 41°07′S, Mendoza, Neuquén, Río Negro), from 980 to 1200 m (Fig. 7), growing on inundate meadows (mallines) and saltpeter soils.

Notes: Type specimen of *Poa stepparia* (BAA) has two complete plants with inflorescences; leaves glabrous, 5–7 cm long, with a sharp pointed apex; spikelets 7–9.5 mm; first glumes 5 mm long, 1.2 mm wide; second glumes 5.5 mm long, 1.2 mm wide.

According to Nicora (1978) this species is closely allied to *N. pugionifolia*. *Nicoraepoa stepparia* differs from that in having shorter spikelets (5.5–7.3(–8) mm in *N. stepparia*, 7.9–11(–12) mm in *N. pugionifolia*), shorter glumes, shorter lemmas, callus with short hairs (callus glabrous in *N. pugionifolia*), and taller plants (63–70 cm high in *N. stepparia*, 8.7–23 cm in *N. pugionifolia*). Collected in flower from September to January.

Nicoraepoa subenervis (Hack.) Soreng & L.J.Gillespie, Ann. Missouri Bot. Gard. 94(4): 845, f. 5 N–J. 2007. ≡ *Poa subenervis* Hack., Ark. Bot. 7(2): 7, t. 2, f. 2. 1908.—TYPE: Argentina, Santa Cruz "in paludosis inter, Lago Viedma et Laguna Tar, ca. 1000 m, 27 Feb 1905" *P. Dusén 6021* (lectotype: W [n.v.], designated by R.J. Soreng and L.J.Gillespie, Ann. Missouri Bot. Gard. 94: 845. 2007; isolectotypes: US-88723!, K!, BAA ex US!) (Figs. 2d–e, 6).

Description: Plants 28.3 ± 11.4 (11.3–58.3) cm; leaves soft or indurate; basal leaves 5.3 ± 3.2 (2.3–13.0) cm long, 0.3 ± 0.1 (0.1–0.5) mm wide; ligules oval or truncate, sparsely pubescent or densely pubescent; ligules of basal leaves 0.7 ± 0.4 (0.2–1.5) mm long; ligules of upper leaves 1.0 ± 0.6 (0.3–3.2) mm. Panicles 6.9 ± 3.1 (2.4–16.5) cm long, 1.2 ± 0.8 (0.6–4.1) cm wide; longest branches of the panicles 2.8 ± 1.0 (1.3–5.5) cm long, bearing 1–12 spikelets. Spikelets 6.0 ± 0.7 (5.1–7.4) mm; longest pedicels 8.6 ± 5.5 (0.8–20.7) mm long; pedicels scabrous or pilose; first glume 4.4 ± 0.5 (3.3–5.6) mm long, 0.8 ± 0.2 (0.5–1.1) mm wide; second glume 4.9 ± 0.6 (3.8–6.0) mm long, 0.9 ± 0.2 (0.6–1.3) mm wide; rachilla 1.1 ± 0.2 (0.4–1.4) mm, glabrous or scabrous; lemmas 4.7 ± 0.5 (3.7–5.8) mm long, 1.0 ± 0.1 (0.7–1.1) mm wide; lemmas smooth or scabrous on sides; keel glabrous on the lower half, scabrous on the upper half; callus hairs 1.0 ± 0.3 (0.5–1.4) mm long; paleas 3.8 ± 0.3 (3.3–4.4) mm, keels scabrous or ciliate; awn 0.3 ± 0.2 (0.0–0.7) mm long.

Leaf anatomy: Cross section V-shaped or expanded; keel rounded not projecting abaxially; leaf blade asymmetric in cross section; longest half-lamina 1.4 ± 0.4 (0.8–2.2) mm long; leaf thickness in cross section 0.2 ± 0.1 (0.2–0.3) mm; adaxial ribs present; furrows 0.1 ± 0.0 mm depth; first-order adaxial ribs rounded; median vascular bundles with adaxial and abaxial sclerenchyma girders; first-order vascular bundles with abaxial sclerenchyma girders only or with adaxial and abaxial sclerenchyma girders; second-order vascular bundles free; sclerenchyma arranged as a continuous hypodermal layer absent; prickles on the abaxial epidermis absent; prickles on the adaxial epidermis absent or present.

Nicoraepoa subenervis* subsp. *spegazziniana (Nicora) Soreng & L.J.Gillespie, Ann. Missouri Bot. Gard. 94(4): 845.2007. ≡ *Poa spegazziniana* Parodi, Dansk Bot. Ark. 22(1): 67. 1963, **nom. nud**. ≡ *Poa subenervis* Hack. var. *spegazziniana* Nicora, Hickenia 1(18): 103. 1977.—TYPE: Argentina, Mendoza, Dpto. San Rafael, Valle del Atuel, Arroyo Colorado, *T.W. Böcher, J.P.K. Hjerting* and *K. Rahn 1306* (holotype: BAA-2706-1!; isotype: SI-62364!) (Figures 2d, 7).

Nicoraepoa subenervis subsp. *spegazziniana* differs from subsp. *subenervis* having longer and wider panicles (4.0–16.5 cm long, 0.6–4.1 cm wide in subsp. *spegazziniana* vs. 2.4–8.7 cm long, 0.6 – 1.2 cm wide in subsp. subenervis); plants of subsp. *spegazziniana* are taller (17.1–58.3 cm) than those of subsp. *subenervis* (13.3–36.5 cm).

Distribution area and habitats: *Nicoraepoa subenervis* subsp. *spegazziniana* grows in Argentina (San Juan, Mendoza and Santa Cruz) and Chile (Metropolitan Region and Region of Libertador Bernardo O´Higgins) (30°22′S–34°05′S) from 2600 to 3320 m a. s. l. of elevation (Fig. 7), on rocky slopes near water (e.g., *Peterson* et al. *19296*), and marshes (e.g., *Kurtz 9609*).

Note: Types BAA 2706-1 and 2706-2 of *Poa subenervis* var. *spegazziniana* include four and one almost complete plants, respectively. Plants are 30–35 cm tall, with basal leaf blades 6.6 cm long, 6.1–6.5 cm long x 1.7–2.9 mm lat; panicles 8–10 cm long x 1.4–2.2 cm lat; spikelets 7.8 mm long, first glume 5–5.2 mm long × 0.9 m wide, second glume 5.2–5.7 mm × 1 mm wide. These measurements are within the range of variation of the subspecies.

Nicoraepoa subenervis* subsp. *subenervis (Figures 2e, 6).

Distribution area and habitats: *Nicoraepoa subenervis* subsp. *subenervis* grows in southern Chile (Magallanes) and southern Argentina (Santa Cruz) (Fig. 7); the citation of subsp. *subenervis* for Prov. San Juan, Argentina (Soreng and Giussani 2012) is erroneous, based on the specimen *P.M. Peterson* et al. *19296* that belongs to subsp. *spegazziniana*. This subspecies grows in wet meadows with *Carex*, *Calamagrostis* and *Azorella*, mesic vegas and rocky slopes along rivers, up to 1200 m. a. s. l.

Nicoraepoa sp. (*Valenzuela 1061*) (Fig. 7).

Description: Plants perfect, perennials, 20 cm tall, decumbent at the base; leaf sheaths glabrous; basal leaf sheaths 1.0–3.0 cm long; upper leaf sheaths 4.0 cm long; ligule truncate, glabrous on the back, minutely denticulate at the apex; ligule of basal leaves 1.6 mm long; ligule of upper leaves 2.0 mm long; leaf blades glabrous, ending in a sharp pointed apex; basal leaf blades 2.0–3.2 cm long, 1.0–2.0 mm width, glabrous, moderately rigid; upper leaf blade 3.5 cm long. Inflorescence a dense, spiciform panicle, 4.5–4.6 cm long, 0,8–1.0 cm wide; rachis glabrous; longest branches 1.2–1.8 cm. Spikelets 5.7–6.3 mm long, 2–3-flowered,

shortly pedicellate, sometimes somewhat purple; pedicels 0.7-2.8 mm long, glabrous; glumes shorter than the florets; first glume 3.3–3.7 mm long, 0.6 mm wide, 1-nerved; second glume 3.8–4.0 mm long, 0.8–1.0 mm wide, 3-nerved; rachilla internodes 1.0–1.1 mm long, glabrous; first lemma 4.8–5.2 mm long, 0.8–1.0 mm wide, glabrous, the keel smooth, the apex hyaline, a short mucro born 0.1 mm below the apex; callus glabrous; upper lemmas shorter; palea 3.2–4.2 mm long; lodicules 0.7–0.9 mm long; anthers 3, 2.5 mm long, fertile; ovary with plumose stigmata. Fruit not seen.

Leaf anatomy: Leaf in cross section V-shaped in outline; half-lamina 1.7 mm long, 0.25 mm thick at the median bundle and 0.19 mm thick at the middle portion; keel rounded, not notably projected abaxially; adaxial ribs present, more or less rounded at the apex; furrows 0.07 mm deep; epidermal cells more or less rounded in cross section; bulliform cells in groups of four or five at the bottom of the furrows; adaxial epidermis with prickles; abaxial epidermis smooth; median, first-order and second-order vascular bundles with adaxial and abaxial girders of sclerenchyma; third-order vascular bundles free; sclerenchyma mostly limited to the margins.

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Information on Electronic Supplementary Material

Online resource 1. Additional specimens examined of *Nicoraepoa* in the herbaria BAA, CONC, LPB, SGO, SI, and US.
Online resource 2. UPGMA phenogram of the initial dataset based on a basic data matrix including 67 qualitative and quantitative characters and 216 OTUs of *Nicoraepoa.*
Online resource 3. Specimens included in the multivariate analyses of *Nicoraepoa* (names according to the initial identification).

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