

Taxonomic and nomenclatural notes on South American taxa of *Sarcocornia* (Chenopodiaceae)

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Five South American species of *Sarcocornia* (Chenopodiaceae) are accepted, four of which are new combinations in that genus: *S. ambigua* (Michx.) M.A. Alonso & M.B. Crespo, *S. andina* (Phil.) Freitag, M.A. Alonso & M.B. Crespo, *S. magellanica* (Phil.) M.A. Alonso & M.B. Crespo, and *S. neei* (Lag.) M.A. Alonso & M.B. Crespo. Synonyms and types are cited for the accepted taxa, and three lectotypes, an epitype and a neotype are designated to establish a correct usage of the names. Main diagnostic characters, ecological features and distributions are also reported for each taxon, and a key is provided to facilitate identification.

Key words: Chenopodiaceae, nomenclature, Salicornioideae, *Sarcocornia*, taxonomy

Introduction

Sarcocornia (subfamily Salicornioideae, Chenopodiaceae) includes erect to prostrate dwarf shrubs, sometimes creeping and rooting at the nodes. The flowers are exserted and inserted at the same level, and produce seeds lacking perisperm, with a membranous pericarp and a hairy or papillose testa (Scott 1978). Other morphological characters (e.g., stems succulent, leaves opposite, vestigial and long connate clothing the internode, flowers 3–12 and mostly hidden in cavities of the inflorescence axis, and embryo conduplicate or curved), closely relate *Sarcocornia* to *Salicornia* and *Arthrocnemum*, in both of which the taxa of *Sarcocornia* were originally placed.

Species of *Sarcocornia* grow gregariously on saline soils usually near the coasts throughout

the world (except in eastern Asia), though a few are restricted to arid continental areas where they occur on the shores of salt lakes and marshes, and even in basins between high mountain ranges (cf. Kadereit *et al.* 2006). The genus is richly represented in South Africa, where it has its diversity centre with about 11–15 species (Tölken 1967, O'Callaghan 1992, Kadereit *et al.* 2006), and also in the Americas with about eight or nine species (this paper). Although the generic status of *Sarcocornia* has been questioned by several authors (e.g. Lausi 1982, Meikle 1985, Ball 1993, López González 1997, Giusti 1997, Judd & Ferguson 1999, Freitag 1989, 2000), it has been accepted in many floras of Europe (*see* Greuter *et al.* 1984, Castroviejo *et al.* 1990, Tan 1997), Australia (Wilson 1984), North Africa (Ouyahya 1999), South Africa (O'Callaghan 1992), and North America (Welsh *et al.* 2003).

Recent molecular studies dealing with the Chenopodiaceae (Kadereit *et al.* 2003, Kadereit *et al.* 2006, Schütze *et al.* 2003, Shepherd *et al.* 2004) have shown a close relationship between *Salicornia* and *Sarcocornia*. In particular, after single and combined analyses of the ITS region and the *atpB-rbcL* spacer, Kadereit *et al.* (2006) found three major lineages in a monophyletic *Sarcocornia-Salicornia* lineage: (i) the American-European representatives of *Sarcocornia* (which include the type of the genus), (ii) the South African-Australian taxa of *Sarcocornia*, and (iii) the representatives of *Salicornia*. Both markers showed that *Sarcocornia* (18 sampled taxa) is paraphyletic with respect to *Salicornia* (11 sampled taxa), though the phylogenetic trees contradict each other in the interrelationships of the three lineages, which are still unresolved and receive a weak statistical support. In all cases, *Salicornia* forms a monophyletic group on a long branch, whose position could be but a branch attraction effect. For that reason, and in addition to the somewhat weak morphological arguments, those authors accepted the independence of *Sarcocornia*, first provisionally, but later (Kadereit *et al.* 2007) definitively. In that shrubby genus, the consistently linear arrangement of the three to many, more or less equal-sized flowers (in contrast to the triangular arrangement of the three unequal-sized flowers of *Salicornia*) would have higher taxonomic value and perhaps would be phylogenetically more informative than the perennial vs. annual habit, because the latter occurs side by side in many genera of Chenopodiaceae and also in Salicornioideae (e.g., *Haloplepis*) (Kadereit *et al.* 2006).

Scott (1978) accepted five species of *Sarcocornia* in the Americas: *S. perennis*, *S. fruticosa*, *S. utahensis*, *S. pacifica*, and *S. pulvinata*, into which he included several other American taxa described first in *Salicornia*. Among them, from South America he only recognised *Sarcocornia fruticosa* and *S. pulvinata*. However, their synonymy and the application of names remained confusing. Furthermore, a close inspection shows that more species of that genus are present in the subcontinent. It should be noted that until now no annual species of the related genus *Salicornia* have been reliably recorded from South America. However, all *Sarcocornia* species were first described as *Salicornia*.

In the present contribution Scott's genus is accepted, and the taxonomy and nomenclature of the taxa of *Sarcocornia* growing in South America is updated.

Historical background

Michaux (1803) published *Salicornia ambigua* from the Atlantic coast of North America. This species was regarded by Scott (1978) as a mere synonym of the European *S. perennis*. Some authors (cf. Soriano 1947, Giusti 1984, 1997) applied Michaux's name to a taxon from South America, which Scott (1978) ascribed to *Sarcocornia fruticosa*.

Lagasca (1817: 51) described *Salicornia neei* from South America, honouring Luis Néé who was the botanist of the Malaspina Expedition (1789–1794) around the world (see Muñoz Garmendia 1992). This taxon was accepted by Schultes (1822: 59), though he erroneously attributed its valid publication to Lagasca (1818: 281) in a later contribution to a re-edition of Herrera's *Agricultura General*, which is an accurate copy of the 1817 text. It also should be noted that *S. neei* is not listed among the taxa described or mentioned by other botanists after Néé's collections (see Muñoz Garmendia 1992).

By that time, Kunth (in Von Humboldt *et al.* 1818) described *Salicornia peruviana* from plants collected near Guarmay, at the Peruvian coast, during Von Humboldt's Expedition (1799–1804). This taxon was accepted by Schultes (1822: 57) to differ specifically from *S. neei*. However, Dietrich (1831: 86) regarded the two as conspecific and included *S. neei* in *S. peruviana*. This mistake was surely due to the fact that that author did not have access to Lagasca's original publication, and he accepted explicitly the erroneous publication date of *S. neei* in Schultes (1822: 59).

Meyen (1834) described *Salsola corticosa* from Río Copiapó (northern Chile), which was accepted by Moquin-Tandon (1849), and transferred later to *Salicornia* by Walpers in Ungern-Sternberg (1866). However, morphological features relate it to *S. neei*, a fact which was implicitly recognised by Reiche (1911) when regarding it as a mere variety of *S. peruviana*.

Moquin-Tandon (1840: 115) also synonymised *Salicornia neei* with *S. peruviana*, and described a new taxon from Rio de Janeiro (Brazil) named *S. gaudichaudiana*. This latter species has morphological features connecting it with *Sarcocornia ambigua*. In addition, he described the new genus *Arthrocnemum* and included (Moquin-Tandon 1840: 112) *Salicornia ambigua* as *A. ambiguum*, though with a question mark. Later, in his account for De Candolle's *Prodromus* (Moquin-Tandon 1849), he retained *S. neei* in the synonymy of *S. peruviana*, and accepted *Salicornia corticosa* as first described by Meyen.

The account by Ungern-Sternberg (1866) provided a new and rather confusing scenario. On the one hand, he interpreted *Salsola corticosa* (incl. *S. gaudichaudiana*) to include plants belonging to *S. ambigua* (*pro parte*) and *S. neei*. On the other hand, he explicitly synonymised *S. ambigua* (*s. stricto*) and *S. peruviana* with *Salicornia fruticosa*, a Mediterranean taxon, which was thus considered to occur also in the Americas. A similar treatment was later presented by Spegazzini (1902) and Ulbrich (1934).

The botanical research by Lorentz and Niederlein (1881) in the Río Negro Expedition in 1879 yielded three new taxa from nearby areas of Patagonia (Argentina): *Salicornia bergii*, *S. doeringii* and *S. corticosa* var. *nachtigalii*, which had only small morphological differences. Therefore, Soriano (1947) suggested treating all of them as synonyms of *S. ambigua*, the only taxon of the group he accepted for in Argentina.

The contributions by Philippi (1891, 1895) resulted in the description of three new taxa: (i) *Salicornia andina* (1891) for plants collected in the high plateaus of the Atacama Desert (it has a peculiar subcaespitose habit, with stout stems rooting at the nodes and comparatively short and thick inflorescences); (ii) *Salicornia copiapina* (1895) from near Caldera and Copiapó (northern Chile), which was described to differ from *S. peruviana* and *S. fruticosa* by habit characters; and (iii) *Salicornia magellanica* (1895), a remarkable species from around the Magallanes Strait, which is characterised by the stems being delicate, thin, long-creeping and rooting at the nodes, and by the short and stout inflorescences, hence differing consider-

ably from *S. ambigua* and the rest of the South American taxa. Although Soriano (1947) clearly pointed out these morphological differences, he included it and the other two taxa of Philippi in *S. ambigua*.

In his studies on the Patagonian flora, Spegazzini (1902) accepted *Salicornia corticosa* and *S. fruticosa*, both basically as circumscribed by Ungern-Sternberg (1866), and mostly differing by the green or glaucous colour of the stems. He also described some varieties, weakly differing in habit and inflorescence features. Among them, perhaps the most remarkable is *S. corticosa* var. *procumbens*, which includes prostrate plants with short and stout inflorescences, much resembling *S. magellanica*.

The last taxon to be described was *Salicornia pulvinata* (Fries 1905), growing in the highly continental altiplano of the Andes, above 3500 m altitude, in Argentina, Bolivia (Fries 1905, Navarro 1993, Navarro & Maldonado 2002), Chile (Faúndez & Macaya 1997) and Peru (pers. obs.). It is perhaps the most peculiar species of *Sarcocornia*, since it is a cushion-forming plant with minute leaves and inflorescences (up to 2 mm), bearing only a few flowers. All authors who dealt with the *Sarcocornia* aggregate in South America (e.g. Ulbrich 1934, Soriano 1947, Scott 1978, Giusti 1984, 1997) have accepted it as a distinct species, though in different genera.

Finally, Ulbrich (1934) accepted 31 species in *Salicornia*, which were arranged in two sections. Those currently belonging to *Sarcocornia* were grouped in sect. *Perennes*, which consists of 18 species. Among them, eight were said to grow in South America. He accepted explicitly both *S. fruticosa* (incl. *S. ambigua pro parte*, *S. neei*, *S. peruviana*, and *S. doeringii*) and *S. perennis* (incl. *S. ambigua pro parte*) to be widespread in the Americas, as well as *S. corticosa* (incl. *S. gaudichaudiana*, and *S. nachtigalii*), *S. pulvinata*, *S. bergii*, *S. copiapina*, *S. andina*, and *S. magellanica*, as distinct species, mostly confined to small areas in South America.

Material and methods

The morphological studies are based on ca. 500 herbarium vouchers of all *Salicornia/Sarcocor-*

nia taxa validly described from South America, conserved at the herbaria ABH, ACOR, ARC, BM, CORD, G, JSB, K, KAS, LP, LPB, LZ, MA, MJG, MRL, SI, SGO, USM, and VEN (acronyms according to <http://www.nybg.org/bsci/ih/ih.html>). Some additional material from MUB, P, UABC, US, USF, UT, and VAL, belonging to other North American and European taxa was also studied for comparison. The results were compared with living plants from wild populations, including type localities for most taxa.

Features of gross morphology were studied on both fresh and dried material, as far as necessary, under a binocular stereoscopic microscope. For scanning electron microscopy (SEM) seed samples were coated with gold for 5–10 minutes, and examined in a JEOL-840 microscope.

Diagnoses for each taxon include only brief descriptions of those characters useful for discrimination. Characters common to all studied taxa, or are very variable in the wild populations, are not considered.

We focused all our efforts to include the respective type specimens. When they were not available, specimens from type localities and/or their surroundings were examined and carefully compared with the descriptions given in the protologues.

Taxonomically useful characters

Habit

Four different morphological types (pulvinate, subcaespitose, creeping and non-creeping plants) were found in the American and Mediterranean taxa of *Sarcocornia*, mostly depending on the patterns of stem growth and rooting system, and usually related to particular environmental conditions. Pulvinate plants, in which the very short and herbaceous, non-rooting stems grow densely crowded to form a small and dense cushion-like structure, not higher than 5 cm. It is exclusive to *S. pulvinata*, a plant from the cool salt lagoons of the altiplano. Subcaespitose plants, which produce short, weakly woody, procumbent stems, with a few relatively thick roots only at the basal nodes, and form loose subhemispherical structures up to 10 cm high. They are only

known from *S. andina*, a plant from the likewise cool Puna screes of the Central Andes. Creeping plants with long and procumbent stems, woody only at the base, usually with many thinner roots at the nodes, and spreading to form carpet-like structures. They are known from plants of the coastal salt-marshes, such as *S. magellanica* and the European *S. perennis*, a species sometimes erroneously cited from South America. Non-creeping plants with robust, usually erect or decumbent stems, but never forming carpet-like structures, not rooting at the nodes or occasionally with a few adventitious roots at the base of some branches that are in contact with the substrate. They are found in plants such as *S. neei*, *S. ambigua*, the North American *S. pacifica* and *S. utahensis*, and the European *S. fruticosa*, all of them growing on saline, somewhat drier soils, mostly in the lowlands and in coastal territories. Individuals growing on extreme, unusual environments, such as coastal rocks or subdesert habitats, can produce rhizome-like, non-rooting stems, from which erect branches arise, as in some Sonoran populations of *S. utahensis* (P. W. Ball, pers. comm.). However, such forms are only found occasionally together with the typical ones. This type is also common in the Mediterranean-SW Asian *Arthrocnemum macrostachyum*, which ecologically comes close to *S. fruticosa*.

Plants belonging to the latter group usually show a wide morphological variation, which has led to the description of many taxa, such as *Salicornia bergii*, *S. doeringii* and *S. corticosa* var. *nachtigalii*. In fact, these weak differences in habit lack taxonomic value, as are other small variations in colour from green to glaucous. Here, they all are included in the variation range of *Sarcocornia neei*.

Leaves

In all South American species, the leaves show narrow hyaline margins at their free apical parts (Table 1). Otherwise, they are connate to ensheath completely the internodes, giving a succulent aspect to the stems. The smallest leaves (up to 2 mm long) are found in *S. pulvinata*, in which they are carinate and acute to subacute

at the apex. The other taxa have larger leaves, which are never carinate, and have an obtuse or somewhat subacute (*S. ambigua*) apex.

Inflorescence size

The spike-like inflorescences of *Sarcocornia* bear relatively informative characters. The longest and narrowest inflorescences are found in *S. ambigua* (5–15 × 0.2–0.4 cm), being rather fragile and longer than the rest of the stem, whilst the shortest ones are found in *S. pulvinata* (up to 2 × 2 mm), being subglobose and compact. In the rest of the taxa they are variable in size, though two main patterns can be distinguished. First, *S. neei* produces medium-sized inflorescences (up to 40–60 × 3–4 mm), rather variable in length, though much shorter than the stem. Secondly, *S. magellanica* and *S. andina* produce always shorter and wider inflorescences (up to 11 × 1.5–5 mm).

Seed features

The utility of seed and fruit characters for phylogenetic studies of Salicornioideae has recently been emphasized by Shepherd *et al.* (2005). In *Sarcocornia*, perhaps the most reliable character for taxa identification is the testa indument (cf. Alonso *et al.* 2005, 2006). In the American taxa (Table 1), it consists of trichomes of different types (Fig. 1). Most taxa show hairs, which are either patent or appressed, mostly simple and hooked or curved at the apex, and ranging from 25 to 120 µm. *Sarcocornia neei* and *S. magellanica* have erect hairs dispersed all over the seed surface (Fig. 1a), with many of them being bifid in the latter species (Fig. 1b). Conversely, they are appressed and mostly arranged on the edges in *S. ambigua* (Fig. 1c) and *S. andina* (Fig. 1d). *Sarcocornia pulvinata* has almost glabrous seeds with very short and thick papilla-like trichomes (up to twice longer than wide) only near the micropylar area (Fig. 1e). Trichomes are mostly hooked in *S. neei*, whilst they are straight or slightly curved at the apex in the other of taxa. The colour of the seeds is bright brown in all the American species.

Table 1. Main morphological features of the studied South American taxa of *Sarcocornia*.

	<i>S. ambigua</i>	<i>S. andina</i>	<i>S. magellanica</i>	<i>S. neei</i>	<i>S. pulvinata</i>
Habit	erect	subcaespitose, cushion-like up to 10	creeping, in large carpets up to 15	erect	pulvinate, in dense tufts up to 5
Size (high, cm)	up to 50	up to 10	up to 15	up to 80(–150)	up to 5
Stems	erect or decumbent, rooting only at the basal nodes	procumbent, rooting at the nodes	prostrate, rooting at the nodes	erect to subprostrate, not rooting (or occasionally at the basal nodes)	erect, not rooting
Leaf apex	rounded to subacute	rounded	rounded	rounded	acute to subacute, and carinate
Inflorescence (length × width, mm)	50–150 × 1–3(–4)	5–11 × 1.5–3(–4)	ca. 10 × (3–)4–5	10–40(–60) × 3–4	1.5–2 × ca. 2
Seed size (length × width, mm)	ca. 1.4 × 0.9	ca. 1.4 × 1.1	ca. 1.3 × 0.9	ca. 1.2 × 1.0	ca. 1.2 × 1.1
Seed indument	appressed straight hairs, mostly on the edges	appressed straight hairs, mostly on the edges	sparse patent hairs (many of them bifid), all over	patent hooked or curved hairs, all over	patent, short, thick papillae only near the micropyle
Seed trichomes length (µm)	50–95	45–120	50–90	25–190	ca. 40

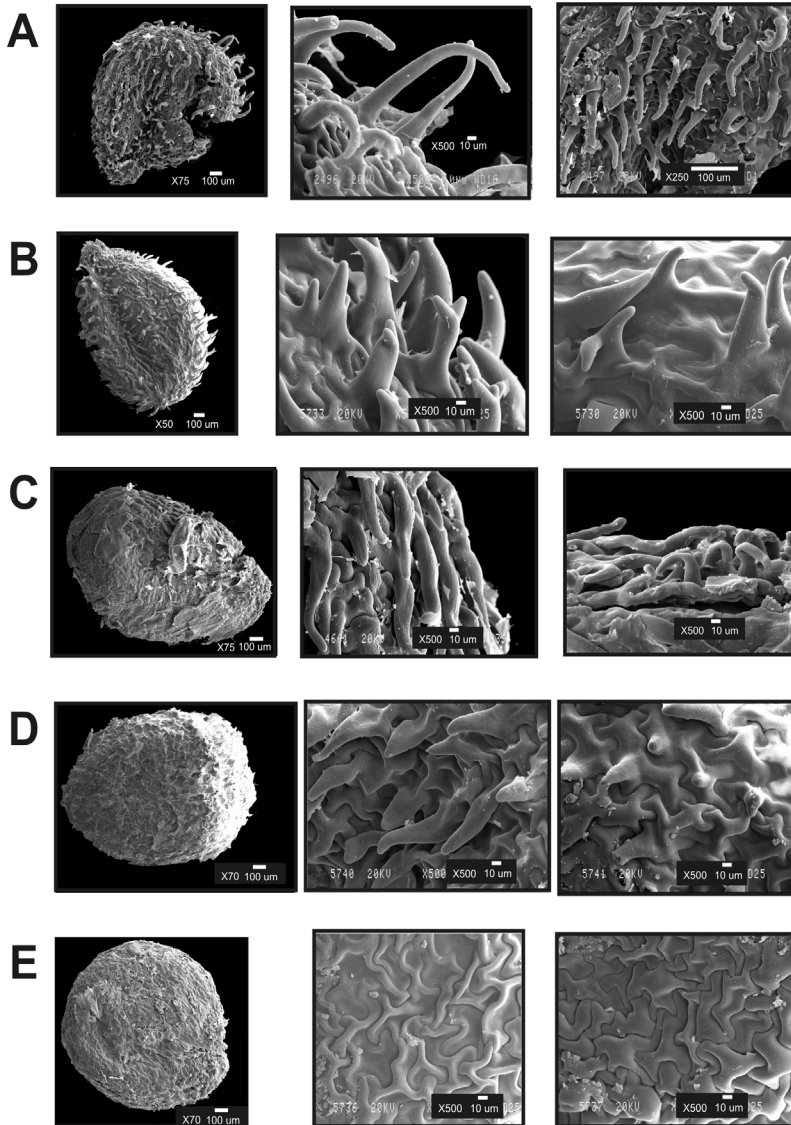


Fig. 1. SEM photographs of seeds of *Sarcocornia*. General habit (left) and details of testa indument on the upper edge (centre) and on the central part (right). — **A:** *S. neei* (ABH 40748). — **B:** *S. magellanica* (SGO 127819). — **C:** *S. ambigua* (USF 167816). — **D:** *S. andina* (SGO 135188). — **E:** *S. pulvinata* (SGO 75185).

Taxonomic treatment

As a result of our research on the perennial taxa of *Salicornia* (*sensu lato*) growing in South America (cf. Alonso *et al.* 2005, 2006), and after evaluation of characters relevant for the taxonomy of that group, several changes are necessary to accommodate them to *Sarcocornia*. The accepted taxa are presented below in alphabetical order, with synonymy and type specimen citations. For each species, the relevant diagnostic characters are given (*see also* Table 1).

Key to the South American species of *Sarcocornia*

1. Plants pulvinate, up to 5 cm high and 25 cm in diameter. Leaves carinate. Inflorescence globose, ca. 1.5–2 × 2 mm. Seeds with short, thick papilla-like hairs only near micropylar area *S. pulvinata*
1. Plants erect to prostrate, never pulvinate. Leaves not carinate. Inflorescence longer than wide, ca. 5–150 × 1.5–5 mm. Seeds with long, erect or appressed hairs at least on edges 2.
2. Inflorescence ca. 5–11 mm long. Stems prostrate or long procumbent, up to 15 cm high, rooting at nodes 3.
2. Inflorescence ca. 10–150 mm long. Stems mostly erect,

- up to 80(–150) cm high, not rooting at nodes (occasionally with some weak roots at basal nodes) 4.
3. Stems woody, with thick roots. Inflorescence ca. 1.5 × 3(–4) mm wide. Seeds with appressed hairs, mostly on edges *S. andina*
3. Stems delicate, with thin and fragile roots. Inflorescence ca. (3–)4 × 5 mm wide. Seeds covered all over with sparse patent hairs, many of them bifid .. *S. magellanica*
4. Inflorescence ca. 50–150 × 1–3(–4) mm; terminal spike solitary, rarely with a few lateral ones. Seeds with appressed straight hairs, mostly on edges *S. ambigua*
4. Inflorescence ca. 10–40(–60) × 3–4 mm; terminal spike commonly accompanied with many shorter lateral ones. Seeds covered all over with long, patent hooked or curved hairs *S. neei*

Sarcocornia ambigua* (Michx.) M.A. Alonso & M.B. Crespo, *comb. nova

Salicornia ambigua Michx., Fl. Bor.-Amer. 1: 2. 1803. — *Arthrocnemum ambiguum* (Michx.) Moq., Chenop. Enum.: 112. 1840. — Ind. loc.: “In Carolinae scirpetis maritimis [USA]”. — LECTOTYPE (designated here): USA. “Hab. in *Scirpetis maritimis* a Carolinâ ad Floridam” (P00270205!, Herbar de l’Amérique septentrionale d’André Michaux). — EPITYPE (designated here): Plants of Florida/Monroe Co.: on salt flat on north end of Big Pine Key. Forming large colonies 15.IX.1982 D.S. & H.B. Correll 54061 (with James B. Watson; USF 167816!, as *Salicornia virginica*).

Salicornia gaudichaudiana Moq., Chenop. Enum.: 115. 1840. — LECTOTYPE (designated here): Brazil. “Brésil (Rio-Janeiro) *M. Gaudichaud 1833 / 394* (G 00087097!). — Synonymised by Soriano (1947).

Erect to decumbent, non-creeping dwarf shrub. Stems long, up to 50 cm high, woody only at base, sometimes at basal nodes with thin roots. Leaf apex rounded to subacute. Inflorescence many-flowered, very long and usually narrow (up to 150 × 4 mm), commonly with a single terminal spike at apex of branchlets (rarely accompanied with a few lateral ones). Seeds ca. 1.4 × 0.9 mm; testa covered with simple hairs up to 50–95 μm long; hairs straight or slightly curved at apex, appressed, and mostly arranged on seed edges.

DISTRIBUTION: Salt-marshes of the Atlantic coast of the Americas, Cuba and neighbouring islands; in South America from Venezuela (and probably also Colombia) to Uruguay (Fig. 2).

Michaux (1803) published *Salicornia ambigua* from plants growing ‘in Carolina’. The type material is deposited at P, and includes sev-



Fig. 2. Studied material of *Sarcocornia ambigua* and *S. andina* in South America.

eral fragments collected ‘in *Scirpetis maritimis* a Carolinâ ad Floridam’ and which fit the original description but lack fruiting branches. Among them, one is selected here as the lectotype. It is clearly a perennial plant, with stems woody at the base, erect or decumbent and with a few weak roots at some nodes. However, as the lectotype is incomplete and lacks inflorescences, an epitype from Florida is here selected to support it and to fix the traditional usage of that name. Sometimes, the name *Salicornia virginica* L. has been misapplied to the present taxon. However, as Ball (2003) pointed out, *S. virginica* is an annual plant, and therefore it is not convenient for any taxon of *Sarcocornia*. The lectotype of *S. virginica* was selected by J. L. Reveal (BM 51639). It includes three annual individuals, which do not match *S. ambigua* at all, and which resemble in some extent *S. bigelowii* by their long acute leaves, showing apparently bicorned nodes.

Although Ulbrich (1934), Scott (1978) and Davy *et al.* (2006) regarded *S. ambigua* as a mere synonym of the European *S. perennis*, several morphological characters differentiate the taxa. Michaux’s (1803) binomial is to be applied to erect or decumbent perennial plants, woody only

at the base, with slender stems and very long and narrow inflorescences, and smaller seeds with short appressed hairs mostly on the edges. They clearly differ from the Mediterranean *S. perennis*, which has shorter inflorescences and bigger seeds (ca. 2.4×1.9 mm) with longer hooked hairs all over. Consequently, *S. perennis* has to be excluded from the South American floras. Preliminary analyses of molecular sequences of nuclear ribosomal DNA (Alonso *et al.* 2006) support this conclusion.

Several authors (Ungern-Sternberg 1866, Watson 1874, Soriano 1947, Giusti 1984, 1997) used the name *Salicornia ambigua* for plants from South America. However, Scott (1978) named them *Sarcocornia fruticosa*, which is a Mediterranean species. All those South American plants correspond to either *Sarcocornia ambigua* or *S. neei*. Regarding *Salicornia gaudichaudiana* Moq., a plant widely distributed along the entire coast of Brazil to Mar del Plata (Costa & Davy 1992, Souza Filho & Paradella 2002, Davy *et al.* 2006), its vegetative features together with the long, narrow terminal inflorescences, suggest inclusion into *S. ambigua*. Type materials of *S. gaudichaudiana* are on two sheets at G. The first is in the General Herbarium (G 00087097), and includes two fragments collected in Rio de Janeiro by Gaudichaud (no. 394) in 1833. The second is in the Prodrum Herbarium (G-DC 018242), and includes two different gatherings: one (G 00138526) corresponding to Gaudichaud no. 394 (probably belonging to the same gathering as the former, though said to be collected in 1834), and the other (G 00138550) to Lund no. 575, collected in Brazil in 1834 (according to Moquin-Tandon 1849: 145–146). Although all of them belong to *S. gaudichaudiana*, G 00087097 is selected as the lectotype since they fit the protologue better.

SELECTED SPECIMENS EXAMINED: — **Brazil.** Espírito Santo: Vila Velha, Praia da Costa, 22.II.1962 *E. Santos 1608* (LP); Rio de Janeiro: Rio-Janeiro, 1833 *Gaudichaud 394* (G 00087097); *Ibidem*, 1834 [sic], *Gaudichaud 394* (G 00138526, as a part of G-DC 018242); Guanabara, Distr. Guaratiba, en manguesa da Baía de Sepetiba, pr. Desembocadura do rio Piraquê, 29.XI.1964 *L.G.F. Pabst 8293* (K); Cabo Frio, Km 21.5 da Estrada São Pedro de Aldeida, 7.VIII.1978 *F. Palmieri (Embrapa)* (K); Brésil, 1834 *Lund 575* (G 00138550, as a part of G-DC 018242). — **Dominican Republic.** Prov. Montecristi: Valle de Cibao, en la playa

arenosa entre la ciudad de Montecristi y Loma El Morro, zona salada al interior de la playa 19°42'N, 71°40'W, 0–50 m, 30.III.1987 *T. Zanoni, W. Bowers & P. Bowers s.n.* (JBSD 38828); Provincia de Montecristi: Isla de Cabra, al Norte de la ciudad de Montecristi; bosque seco con abundante *Coccoloba* spp., *Conocarpus erectus*, *Pictetia sulcata* y *Lantana* spp., 19°53'33''N, 71°39'05''W, 10 m, 18.IV.2002 *A. Veloz, B. Peguero & I. de los Angeles s.n.* (JBSD 66120); Prov. La Altagracia: Las Calderas, Parque Nacional del Este, Sector Las Palmillas, 18°14'N 68°45'W, 25.X.1983 *J. Salazar, R. García & B. Peguero s.n.* (JSB 062297). — **Venezuela.** Edo. Zulia: Distr. Páez, Península de la Guajira, región de Castilletes, cerca de la laguna de Cocinetas, 15.III.1983, *D. Rodríguez 16* (VEN); Edo. Falcón: Distr. Buchivacoa, Playa Miramar, 6 km North of Capatárida, shore of Golfo de Venezuela, 0–2 m, 17.VI.1980 *G. David & A. González s.n.* 'Plants of Venezuela' no. 18184 (VEN 141165); Distr. Falcón, Península Paraguaná, Adicora, II.1982 *F. Delascio & V. Medina s.n.* (VEN 178946); Dependencias Federales: Archipiélago de Los Roques, El Gran Roque, VI.1958 *Aris-teguieta 3140* (VEN 44838).

Sarcocornia andina* (Phil.) Freitag, M.A. Alonso & M.B. Crespo, *comb. nova

Salicornia andina Phil., Anales Mus. Nac. Santiago de Chile, secc. 2, Bot.: 75. 1891. — *S. peruviana* var. *andina* (Phil.) Reiche, Fl. Chile [Reiche] 6: 172. 1911. — Ind. loc.: "De Guanaquero [sic] et aliisque loci deserti" [Prov. Salta, Argentina, and Atacama Desert, Chile; cf. Muñoz & Prina 1987]. — LECTOTYPE (designated by Soriano 1947: 163): Argentina. *Salicornia andina* Ph., Guanaqueros. Enero. 1885 *F. Ph.* (SGO 48141!).

Subcaespitose dwarf shrub. Stems long, procumbent, forming wide but loose cushion-like structures up to 10 cm high, at nodes with thick roots. Leaf apex rounded. Inflorescence few-flowered, short and stout (up to 11×4 mm), commonly with a single terminal spike at apex of branchlets. Seeds ca. 1.4×1.1 mm; testa covered with simple hairs up to 45–120 μ m long; hairs straight or slightly curved, appressed, and mostly arranged on seed edges.

DISTRIBUTION: Endemic to Argentina, Bolivia, Chile and Peru (Fig. 2); on saline soils in the dry, continental high plateaus of the Atacama Desert and northern territories, between 2300 and 4200 m a.s.l.

The protologue of *Salicornia andina* (Philippi 1891) indicates "De Guanaquero aliisque locis deserti". Three syntypes were found with labels handwritten by Philippi himself: one at K and two at SGO. The voucher at K bears a single

fragment labelled: “*Salicornia andina* Ph. Chili, Com. R. A. Philippi II.1888. Guanaqueros 3800 m desertum Atacama”. Vouchers at SGO include three fragments (SGO 048141) and one fragment (SGO 038740) respectively, all of them labelled “*Salicornia andina* Ph. Guanaqueros Enero 1885” or “*Salicornia andina* Ph. Guanaqueros I.1885”. The former one was selected as the lectotype. In our opinion, and according to Reiche (1911) and Ulbrich (1934), this plant is quite distinct from its American relatives mainly by its subcaespitose habit, its stout stems rooting at the nodes and its short, wide inflorescences. Relationships to other taxa growing in similar cool to cold habitats are not close. *Sarcocornia utahensis* differs by its high, erect, non-rooting stems, and seeds with short, erect papillae only on one edge. *Sarcocornia pulvinata* differs by its minute, herbaceous and non rooting stems, which form dense small cushions, and seeds with short, erect papilla-like hairs only near the micropylar area. Recent molecular research (Alonso *et al.* 2006, Kadereit *et al.* 2006) also supports segregation of *S. andina* as a distinct species.

A peculiar form from Huacarpay, Cusco (Peru) was provisionally named *Salicornia cuscoensis* by Gutte and Müller (1985). It was considered to be annual and related to *S. europaea*. However, the syntypes (USM 74969, KAS) prove to be perennial woody plants, with slender creeping stems, and also slender inflorescences. A drawing resembling those forms was reported by Zamalloa-Díaz (1974) as *Salicornia* sp. In habit, the plants approach somewhat to *Sarcocornia magellanica*, though the rather stout roots and the seeds are similar to those of *S. andina*. They grow in the same area as typical plants of the latter, and they are here provisionally interpreted as a phenotype of *S. andina*. Further studies including examination of more material and living plants are needed for a definitive conclusion.

SELECTED SPECIMENS EXAMINED: — **Argentina.** Prov. Salta, Guanaqueros, I.1885 *F. Philippi s.n.* (SGO 38740; lectotype); idem (SGO 48141); Ibidem, desertum Atacama, 3800 m, II.1888, comm. R. A. Philippi *s.n.* (K). — **Bolivia.** Dpto. Oruro, Prov. Avaroa, planicie salina a 10 km de Challapata, 4.X.1985 *García, Beck & Michel 600* (LPB). — **Chile.** Región II, Antofagasta: El Loa Province, near Ayquina, 22°16'S; 68°W (K); El Loa, Salar de Atacama, Sector Chaxa,

23°11'S–88°00'W, 2475 m, 29.IX.1993 *S. Teillier & J. Torres-Mura s.n.* (SGO 139265); Provincia El Loa, Peine, Salar de Atacama, 23°23'S–68°21'W, 2300 m, 11.VII.1994 *S. Teillier & A. Walkowiak s.n.* (SGO 139274); Prov. Antofagasta, Salar de Atacama, rivera curso de agua salobre, 3–4 km frente al pueblito de Peine, 8.XII.1974 *D. Torres s.n.* (SGO 135188); Salar de Atacama, Peine, 1.XII.1949 *González & Böhme s.n.* (SGO 69426); Atacama, 1.I.1854 *F. Philippi s.n.* (SGO 48140); Vilaco, 7.XII.1969 *H.C. Martin 539* (LP). — **Peru.** Yuracchuasi, Laguna de Parinacochas, al sur de Ayacucho, 3200 m [undated, no collector name] (USM).

Sarcocornia magellanica (Phil.) M.A. Alonso & M.B. Crespo, *comb. nova*

Salicornia magellanica Phil., Anales Univ. Chile, sec. 1, 91: 430. 1895. — Ind. loc.: “Ad fretum Magellanicum habitat. Aestate 1878–79 lecta est”. — LECTOTYPE (designated by Soriano 1947: 163): Chile. *Salicornia magellanica* Ph., *Salicornia peruviana*, Magallanes aestate 1878/79 (SGO 481261).

? *Salicornia corticosa* var. *procumbens* Speng., Anales Mus. Nac. Buenos Aires 7: 154. 1902, *syn. nov.* — TYPE: not extant at LP; synonymization based on the description.

Prostrate, creeping dwarf shrub. Stem very weakly woody, delicate, forming large carpets up to 15 cm high, profusely rooting at nodes with thin and fragile roots. Leaf apex rounded. Inflorescence few-flowered, short and stout (up to 10 × 5 mm), commonly with a single terminal spike at apex of branchlets. Seeds ca. 1.3 × 0.9 mm; testa loosely covered all over with hairs up to 50–90 μm long; hairs patent, straight or slightly curved at apex, many of them bifid.

DISTRIBUTION: Endemic to southern Argentina and southern Chile; in salt-marshes near the Magallanes Strait in southern Patagonia and Tierra del Fuego (Fig. 3).

Philippi (1895) described *Salicornia magellanica* from plants collected near the Magallanes Strait, which differed from *Salicornia peruviana* and *S. herbacea* by herbaceous, prostrate stems rooting at the nodes, and with thin roots and short inflorescences. The type material is conserved at SGO (num. 48126) and matches the protologue exactly. The species resembles the European *S. perennis*, but they differ in seed characters. *Sarcocornia magellanica* bears erect hairs (many of them bifid) on smaller seeds (ca. 1.4 × 1 mm), whilst *S. perennis* has appressed, simple hairs on bigger seeds (ca. 2.4 × 1.9 mm). Similar-



Fig. 3. Studied material of *Sarcocornia magellanica*, *S. neei* and *S. pulvinata* in South America.

ties with other American taxa with creeping or rooting stems, such as *S. ambigua* or *S. andina*, are weak. The former shows much longer inflorescences and seeds with erect, simple hairs. The latter presents a different rooting pattern with thicker roots, and usually woody procumbent stems, seeds covered with loosely arranged appressed hairs, among other characters. Its particular features warrant recognition of Philippi's taxon at the species rank, as already accepted by Ulbrich (1934) and supported by recent molecular analyses (Alonso *et al.* 2006). Similarly, Reiche (1911) also accepted the independence of *S. magellanica*, which he incorrectly included in var. *doeringii* with a question mark, though stating it grows "En las rejiones [sic] del Estrecho de Magallanes". According to Spegazzini's (1902) description, probably his *Salicornia corticosa* var. *procumbens* also corresponds to *S. magellanica*. Unfortunately, we were not able to check the type material, currently not extant at LP.

SELECTED SPECIMENS EXAMINED: — **Argentina.** Santa Cruz, Estancia Chymen, Río Gallegos, 5.V.1968 *S. Anliot s.n.* (SGO 78423). — **Chile.** Region XII: Tierra del Fuego, entre San Sebastián y Cerro Sombrero, salt flats, 28.I.1969 *R. N. Goodall 2039* (LP); Magallanes district, Porvenir, along

shore ca. halfway between taron a punt wharf, 31.III.1985 *B. Wallace s.n.* (SGO 127819); Isla Grande de Tierra del Fuego, 1.I.1955 *D. Claro de la Maza s.n.* (SGO 134213); Magallanes, aestate 1878/79, *F. Philippi s.n.* (SGO 48126; lectotype).

Sarcocornia neei* (Lag.) M.A. Alonso & M.B. Crespo, *comb. nova

Salicornia neei Lag., Mem. Pl. Barrill.: 51. 1817. — Ind. loc.: "Se cría en la América meridional, en donde la encontró D. Luis Néé." — NEOTYPE (designated here): Argentina. Cinco saltos, Río Negro, Lago Pellegrini, 260 m alt., 27.5.1998 *M.A. Alonso, L. Conticello & M.B. Cerazo s.n.* (ABH 40748!).

Salicornia peruviana Kunth in Humb., Bonpl. & Kunth, Nov. Gen. Sp. 2: 193. 1818, *syn. nov.* — TYPE: Peru. "Crescit in Peruviae maritimis, pr. Huarmay" (P; not seen; synonymisation based on the description).

Salsola corticosa Meyen, Reise Erde 1: 378. 1834, *syn. nov.* — *Salicornia corticosa* (Meyen) Walp. ex Ung.-Sternb., Vers. Syst. Salic.: 60. 1866. — *Salicornia peruviana* var. *corticosa* (Meyen) Reiche, Fl. Chile [Reiche] 6: 172. 1911. — *Salicornia corticosa* var. *typica* Speg., Anales Mus. Nac. Buenos Aires 7: 154. 1902. — TYPE: Chile. "Rep. Chile, ab deserto Copiapó". Not extant at CAS nor K; synonymisation based on the description.

Salicornia corticosa var. *nachtigalii* Niederl. in Lor. & Niederl., Exped. Río Negro, Bot. 2: 194. 1881, *syn. nov.* — LECTOTYPE (designated by Soriano 1947: 163): Argentina. "Bei Fortin Inicialtiva, 23.IV.1879, Leg. Lorentz et Niederlein" (CORD!).

Salicornia doeringii Lor. & Niederl., Exped. Río Negro, Bot. 2: 194. 1881, *syn. nov.* — *S. fruticosa* var. *doeringii* (Lor. & Niederl.) Speg., Anales Mus. Nac. Buenos Aires 7: 154. 1902. — *S. peruviana* var. *doeringii* (Lor. & Niederl.) Speg. ex Reiche, Fl. Chile [Reiche] 6: 173. 1911. — LECTOTYPE (designated by Soriano 1947: 163): Argentina. Rio Nauquenthal, 2 leguas unterhalb der Mündung des Rio Currulebu Fuerte 4^a Division am 23.VI.1879 Leg. *Ndrln.* [sic] (CORD!).

Salicornia bergii Lor. & Niederl., Exped. Río Negro, Bot. 2: 194. 1881, *syn. nov.* — LECTOTYPE (designated by Soriano 1947: 163): Argentina. Bei Insel Choele-Choel, Río Negro, 29.V.1879 Lorentz & Niederlein (CORD!).

Salicornia copiapina Phil., Anales Univ. Chile, sec. 1, 91: 429. 1895, *syn. nov.* — LECTOTYPE (designated here): Chile. Monte Amargo [between Copiapó and Caldera, Atacama, Region III], IX.1885 (SGO 48139!; isolectotype SGO 48138!).

Salicornia fruticosa var. *macrostachya* Speg., Anales Mus. Nac. Buenos Aires 7: 154. 1902, *syn. nov.* — TYPE: not extant at LP; synonymisation based on the description.

Salicornia ambigua sensu Watson, *pro parte*. [Proc. Amer. Acad. Arts 9: 125. 1874].

Erect to decumbent small shrub. Stem robust, strongly woody, up to 80(–150) cm high, not

creeping nor rooting at nodes (occasionally with a few adventitious, weak roots at base of branches in contact with substrate). Leaf apex rounded. Inflorescence many-flowered, medium-sized (up to 60×4 mm), with a terminal spike commonly accompanied with many shorter lateral ones at apex of branchlets. Seeds ca. 1.2×1.0 mm; testa covered all over with simple hairs up to $25\text{--}190$ μm long; hairs patent, most of them strongly hooked or curved at apex.

DISTRIBUTION: Saline soils along the Pacific coast of South America from Peru to Chile, and in the lowlands of Argentina, except the Magallanes Strait area (Fig. 3).

According to the protologue of *Salicornia neei* (Lagasca 1817: 51), the type specimen should correspond to a plant collected “en la América meridional” by Luis Neé, and should be conserved at MA. In his diary of the Malaspina expedition (see Muñoz Garmendia 1992: 168), Neé himself mentioned a site with salt marshes near San Luis, between Mendoza and Buenos Aires (Argentina), where he collected samples of *Salicornia*. This could be regarded as the putative type locality of Lagasca’s taxon. However, no syntype of any *Salicornia* currently exists in the historical collections at MA, and hence a neotype is here designated to preserve the use of that name.

Although Ulbrich (1934) and Scott (1978) regarded it as a synonym of *S. fruticosa*, clear morphological characters separate the taxa. *Sarcocornia fruticosa* produces strongly woody, tall stems, but it differs by its slightly bigger (1.5×1 mm) seeds, which have quite different, short and clavate, rounded papillae. Therefore, *S. fruticosa* is to be excluded from the American floras, since it is not conspecific with *S. neei*, as recently evidenced by molecular analyses (Kadereit *et al.* 2006, Alonso *et al.* 2006). *Sarcocornia neei* is close to *S. pacifica*, both in morphological (including seed features) and molecular respect (cf. Alonso *et al.* 2006). However, further studies are needed to clarify the relationships between the taxa.

Sarcocornia neei exhibits a wide morphological variation in different parts of its distribution, which might be the reason for the description of many taxa. However, the types and living populations of them appear to belong to a single

variable taxon which is to be named *S. neei*. As regards to *Salicornia bergii*, *S. doeringii* and *S. corticosa* var. *nachtigali*, we have examined the type specimens and visited the type localities of those taxa. This led us to agree with Soriano (1947) in treating them as a part of a single taxonomic entity, which corresponds to Lagasca’s *S. neei*, as Reiche (1911) had already suggested implicitly.

SELECTED SPECIMENS EXAMINED: — **Argentina.** Prov. Santiago del Estero, Saladillo, Salinas Amargasta, 29.VIII.1995 *A. Juan s.n.* (ABH 15624); La Paz, Desaguadero, 29.II.1944 *J. Semper s.n.* (ABH 36444); Prov. San Juan, Dpto. Jachal, San Roque, termas de Agua Negra, 2.XI.1986 *E.R. Guaglianone, L.D. Galotti & N.M. Tur s.n.* (K); Prov. Buenos Aires, Carmen de Patagones, Salina de Piedras, II.1898 *C. Spezzazzini s.n.* (ex LPS 21376 in LP); Prov. Buenos Aires, Salitral de Luro, II.1900 *C. Spezzazzini s.n.* (ex LPS 21377 in LP); Prov. Chubut: Cabo dos Bahías, bei Camarones, 12.II.2003 *F.-G. Schröder s.n.* (KAS); Prov. Chubut: Península Valdés, Salina Chica, 9.II.2003 *F.-G. Schröder s.n.* (KAS); Patagonia, Chubut, Rawson, 6.XII.1980 *S. Castroviejo & G. López s.n.* (MA713226); Córdoba, Unión, Canals, Entre las lagunas La Salada y del Medio, 14.XII.1973 *C.B. Villamil & J. Cáceres s.n.* (ACOR: CBV-410); Córdoba, Unión, Laguna La Brava, entre Olmos y San Severo, 15.XII.1973 *C.B. Villamil & E.J. Cáceres s.n.* (ACOR: CBV-434); Cinco saltos, Río Negro, Lago Pellegrini, 260 m, 27.V.1998 *M.A. Alonso, L. Conticello & M.B. Cerazo s.n.* (ABH 40748; neotype). — **Chile.** Region II, Antofagasta: Depto. Taltal, quebrada Cachina, 2271 m, 3.II.1947 *W. Biese s.n.* (SGO 74195); Region III: Atacama, 5 km al N de Copiapó, 28.IX.1970 *A. Mesa & I.D. Serey 5* (SGO 127798); Monte Amargo [between Copiapó and Caldera], IX.1885 *Fr. Philippi* (SGO 48138, isoelectotype; SGO 48139, lectotype); Puerto Huasco, 1.I.1860 *H. Volckmann s.n.* (SGO 48135); Region IV: Litoral de Coquimbo, 1.IX.1898 *K. Reiche s.n.* (SGO 48137); Fray Jorge 450 m, 26.IX.1935 *C. Muñoz B-204* (SGO 58478); Coquimbo, boca Río Elqui, 13.II.1981 *R. West s.n.* (SGO 136900); Coastal bluffs at Los Molles, cliffs, shrubby moorlands just North of the village, 10 m, 13.XI.1976 *W. Weber & B. Johnston 1027* (SGO 95133); Region V: Valparaíso, Prov. San Antonio, El Tabo, Comuna El Tabo, $33^{\circ}50'S\text{--}70^{\circ}54'W$, ca. 2 m, arena entre rocas costeras formando manchones, IV.2004 *R. Greissl P 696-04* (MJG); El Convento, El Yali, cordón litoral moderno, post playa, 1.XII.1988 *J. Araya s.n.* (SGO 128020); Region VI: Pr. Colchagua [sic; Colchagua?], *Isern s.n.* (MA 559165); Colchagua: Bucalemu, 1.I.1878 *Sanfargo s.n.* (SGO 38742). Bucalemu, 5 m, 1.I.1878 *Sanfargo s.n.* (SGO 48136); Region VI, Juan Fernández: Masafuera, 30.XII.1891 *Schoenlein s.n.* (SGO 69781); Masafuera, 1.X.1854 *P. Germain s.n.* (SGO 48134); Masatierra, 2.II.1892 *F. Johow s.n.* (SGO 69785); Region VII: Llico, 25 m, 1.XII.1861 *Philippi s.n.* (SGO 48129, 38745); Laguna Llico, Ribera Sur, 20 m, 3.II.1969 *C. Villagrán & G. Tapia s.n.* (SGO 78982); Region VIII: Arauco, 1.I.1925 *F. Pennell 12931* (SGO 59233); Talcahuano, Los Budes, 26.I.1981 *R.*

West s.n. (SGO 136772); Concepción, Río Lengua, 27.I.1981 *R. West s.n.* (SGO 136763); Region X: Pantanos salobres de Coyhuin, *F. Fonck* (SGO 48131); Valdivia, Mehuin, 31.I.1981 *R. West s.n.* (SGO 136735); Quintero, 1.II.1890 *F. Albert s.n.* (SGO 48130). — **Peru.** Lima, Cañete, 10 m, 11.XII.1962 *H. Hugh & C. Illis s.n.* (USM 18608); Lima, Cañete, 24.II.1981 *R. West s.n.* (USM 60634); Piura, Piura, 1.X.1981 *J. Campos s.n.* (USM 53935); Chiclayo, Lambayeque, Puerto Eten, 10 m, 22.III.94 *S. Llantas Quiroz s.n.* (USM 111046); Ica, Pisco, Laguna grande, 16.III.1980 *M.A. Ferreira s.n.* (USM 54852).

Sarcocornia pulvinata (R.E. Fr.) A.J. Scott

Bot. J. Linn. Soc. 75: 369. 1978. — *Salicornia pulvinata* R.E. Fr., Nova Acta Regiae Soc. Sci. Upsal., ser. 4., 1(1): 157. 1905. — Ind. loc.: “Prov. Jujuy: Laguna Colorada, loco salso, ca. 3800 m. s. m. (20 Oct. 1901, Fr. 805); Moreno, locis salis subhumidis, 3500 m. s. m. (18 Oct. 1901; Fr. 805 a)”. — LECTOTYPE (designated by Soriano 1947: 170): Argentina. *Salicornia pulvinata* R. Fries, Exped. succ. in reg. Chaco-Andinas, N° 850, Jujuy: Laguna Colorada in “Puna”, loco salso 3500–4000 m., X.1901 *Rob. E. Fries* (SI 28649!). — ILLUSTRATIONS: Fries 1905: tab. 7, fig. 9–11.

Plant pulvinate, up to 5 cm high and 25 cm in diameter. Stem very short, mostly herbaceous and weakly woody only at base, not rooting, densely crowded to form small tufts. Internodes up to 1(–2) mm long; leaf apex acute to subacute, carinate. Inflorescence few-flowered, very short, up to 1.5–2 × 2 mm, usually subglobose, with a single terminal spike at apex of branchlets. Seeds ca. 1.2 × 1.1 mm; testa partially covered with very short, thick-walled, papilla-like simple hairs up to 40 μm long (twice longer than wide); hairs straight, arranged only near micropylar area.

DISTRIBUTION: Endemic to Altiplano Andino, above 3500 m altitude, in Argentina, Bolivia, Chile and Peru (Fig. 3); on strongly saline soils, commonly at the edges of temporary, endorreic salt lagoons.

SELECTED SPECIMENS EXAMINED: — **Argentina.** Prov. Jujuy: Laguna Colorada in “Puna”, loco salso, 3500–4000 m, X.1901 *R.E. Fries 850* (SI 28649; lectotype); Prov. Salta: Cangrejillos, cojines en el borde de las salinas grandes, 3500 m, 21.II.1945 *A.L. Cabrera 8817* (LP 54825); Diego de Almagro, 21.X.1968, *A.L. Cabrera 10611* (LP 76358). — **Bolivia.** Prov. Quijarro: Uyuni, Salar de Uyuni, 15.XII.2004 *R. López s.n.* (ABH 49246); Prov. Cercado: 5 km de Oruro hacia Caracollo, 3700 m, 4.XII.1987 *St. G. Beck 1357* (LPB, KAS); Prov. Avaroa: Planicie salina a 10 km de Challapata, 4.X.1985 *García, Beck & Michel 598* (LPB, KAS). — **Chile.**

Region I: Pica, Salar de Coposa, 3725 m, 26.I.1993 *S. Teillier s.n.* (SGO 140731); Pica, Salar de Coposa, 3750 m, 24.I.1994 *S. Teillier s.n.* (SGO 140729); Region II: El Loa, Salar de Ascotán, frecuente en el salar, 3800 m, 1.VIII.1997 *S. Teillier s.n.* (SGO 147864); Antofagasta: Salar de Ascotán, 3800 m, 1.II.1997 *S. Teillier s.n.* (SGO 142466); Salar de Ascotán, 3800 m, 30.VI.1995 *S. Teillier s.n.* (SGO 139492); Antofagasta, pr. Paso Jama 23°11'43''S, 67°17'19''W, 4200 m, 28.XI.2001 *C. Aedo s.n.* (MA 686584); Salar de San Martín, 3800 m, 12.I.1950 *W. Biese s.n.* (SGO 75185); Geisers del Tatio, 3800 m, 15.XI.1994 *J. Macaya s.n.* (SGO 137866). — **Peru.** Jesús María, Huancarani Valley, Puno, 12500 ft., 19.V.1937 *D. Stafford s.n.* (Flora of Peru no. 757; K).

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