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 exerted 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, Lópe 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-Australasian 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., Haloepilis) (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 ambiguа 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 Neé 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 Neé’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 ambiguа*. In addition, he described the new genus *Arthrocnemum* and included (Moquin-Tandon 1840: 112) *Salicornia ambiguа* as *A. ambiguум*, 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. ambiguа (pro parte)* and *S. neei*. On the other hand, he explicitly synonymised *S. ambiguа (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 Rio 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. ambiguа*, 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 considerably from *S. ambiguа* 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. ambiguа*.

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 at 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. ambiguа pro parte*, *S. neei*, *S. peruviana*, and *S. doeringii*) and *S. perennis* (incl. *S. ambiguа 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/Sarco-
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. |
|-----------------------------------------------|---------------------|---------------------|---------------------|---------------------|---------------------|
| S. ambigua | S. pulvinata | S. neei | S. magellanica | S. andina |
| Habit | erect | ered | subcaespitose, cushion-like | creeping, in large carpets |
| Size (high, cm) | up to 50 | up to 10 | up to 10 | up to 15 |
| Stems | rooted only at the basal nodes | rooting at the nodes | rooting at the nodes | rooting at the nodes |
| Leaf apex | acute to subacute, and carinate | erect, not rooting | patent, short, thick papillary only near the micropyle | appressed, straight |
| Inflorescence (length × width, mm) | 1.5–2 × ca. 2 | 1.2–2 × 11 | 1.2 × 1 | 1.3 × 0.9 |
| Seed size (length × width, mm) | ca. 1.4–0.9 | ca. 1.4 × 1 | ca. 1.4–1.5 | ca. 1.4–1.5 |
| Seed indument | patent, hooked or curved hairs, mostly appressed straight | hairs, mostly appressed straight | hairs, mostly appressed straight | cars. of many of them bifid |
| Seed trichomes length (µm) | ca. 40 | ca. 40–60 | ca. 40 | ca. 40 |
| Seed trichomes length (µm) | 50–90 | 50–95 | 45–120 | 50–95 |
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*

2. Inflorescence ca. 5–11 mm long. Stems prostrate or long procumbent, up to 15 cm high, rooting at nodes ........ 3.

3. Inflorescence ca. 10–150 mm long. Stems mostly erect,

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**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. ambiguia* (USF 167816). — **D**: *S. andina* (SGO 135188). — **E**: *S. pulvinata* (SGO 75185).
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


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 several 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 bicorne 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. $2.4 \times 1.9$ 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 ambiguia* 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 ambiguia* 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. ambiguia*. 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 Protodromus Herbarium (G-DC 018242), and includes two different gatherings: one (G 00138526) corresponding to Gaudichaud no. 394 (probably belonging to the same gathering, 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.


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


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 µm 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 alisique 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 11.1888. Guanaqueros 3800 m desertum Atacama”. Vouchers at SGO include three fragments (SGO 48141) and one fragment (SGO 038740) respectively, all of them labelled “Salicornia andina” Ph. Guanaqueros Januario 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 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.


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


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). Similari-
ties with other American taxa with creeping or rooting stems, such as *S. ambiguа* 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 regiones [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.


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


*Salicornia copiipina* 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!; isolecotype SGO 48138!).

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


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 $60 \times 4 \text{ mm}$), with a terminal spike commonly accompanied with many shorter lateral ones at apex of branchlets. Seeds ca. $1.2 \times 1.0 \text{ mm}$; testa covered all over with simple hairs up to 25–190 $\mu \text{m}$ 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 Magellanes 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 ($1.5 \times 1 \text{ mm}$) 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. doingii* 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:**


**- 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 F. Philippi (SGO 48138, isoelectotype; SGO 48139, lectotype); Puerto Huasco, [between Copiapó and Caldera], IX.1885 C. Villagrán & G. Tapia s.n. (LP); Chiloé, Oficina de Agricultura, 2.XI.1914 F. Greissl P 696-04 (KAS); Prov. Santiago, El Tabo, Comuna El Tabo, 33°50′S–70°54′W, San Roque, termas de Agua Negra, 2.XI.1986 C. Spegazzini & A. Mesa s.n. (LP); Patagonia, Lago Cañete, 136900; Coastal bluffs at Los Molles, cliffs, shrubby moorlands just North of the village, 10 m, 13.XI.1976 C. Villagrán & G. Tapia s.n. (LP); Region IV: Litoral de Chiloé, 1.X.1900 C. Villagrán & G. Tapia s.n. (LP); Patagonia, Chubut, Rawson, 6.XII.1980 S. Castroviejo & G. López s.n. (MA713226); Córdoba, Unión, Canals, Entre las lagunas La Salada y el 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. Ceraza s.n. (ABH 40748; neotype).
**Sarcocornia pulvinata** (R.E. Fr.) A.J. Scott


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: Cono Malgrande, 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, 24.1.1994 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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