DARWINIANA ISSN 0011-6793

40(1-4): 191-198. 2002

A NEW SPECIES OF *CAREX* SECTION ABDITISPICAE (CYPERACEAE) FROM SOUTH AMERICA AND ADDITIONAL NOTES ON THE SECTION

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ABSTRACT: Wheeler, G. A. 2002. A new species of *Carex* section Abditispicae (Cyperaceae) from South America and additional notes on the section. *Darwiniana* 40(1-4): 191-198.

Carex ruthsatzae of sect. Abditispicae (Cyperaceae) is newly described and illustrated from Bolivia. This species grows in high Andean moors, at elevations above 4000 m s.m., and is characterized by having all of its spikes borne at the base of the plant and leaves less than 1.5 mm wide. In addition, various notes regarding other members of section Abditispicae are presented here, such as range extensions and habitat information, and a key to the species is offered. Moreover, because some members of this section display a trend toward dioecy, this intriguing adaptation is also briefly discussed.

Key words: Cyperaceae, *Carex*, Sect. Abditispicae, Bolivia, Range extensions, Paradioecious.

RESUMEN: Wheeler. G. A. 2002. Una nueva especie de *Carex* sect. Abditispicae (Cyperaceae) de Sud América y notas adicionales sobre la sección. *Darwiniana* 40(1-4): 191-198.

Se describe una nueva especie de Bolivia, *Carex ruthsatzae* perteneciente a la sección Abditispicae (Cyperaceae). Esta especie crece en ciénagas altoandinas, por arriba de los 4000 m s.m. y se caracteriza por sus espigas casi sésiles, escondidas en la base de la planta y por sus hojas angostas, de menos de 1,5 mm de ancho. Se agregan notas sobre distribución geográfica y hábitat de otras especies de esta sección así como también una clave. Además, debido a que algunas de las especies muestran tendencia a la dioecia, esta llamativa adaptación se discute brevemente.

Palabras clave: Cyperaceae, *Carex*, Sección Abditispicae, Bolivia, Distribución geográfica, Paradioecia.

Carex L. (Cyperaceae) is well represented in South America, with an estimated 200 or more species in about 35 sections occurring on the continent (Wheeler, 1996). Notably, all known members of *Carex* section Abditispicae G. A. Wheeler are endemic to South America (Wheeler, 1987, 1988, 1989). Four of them, *C. acaulis* d'Urv., *C. macrosolen* Steud., *C. pisanoi* G. A. Wheeler, and *C. subantarctica* Speg., grow primarily in Patagonia and Tierra del Fuego, and two others, *C. collumanthus* (Steyerm.) G. A. Wheeler and *C. humahuacaensis* G. A. Wheeler, occur near the Tropic of Capricorn and farther north. In this paper, a new species of section Abditispicae is described and illustrated from Bolivia, and, additionally, various other notes on this interesting section are presented and a key to the species is offered.

A NEW SPECIES FROM BOLIVIA

Carex ruthsatzae G. A. Wheeler, sp. nov. TYPE: Bolivia, Dpto. Oruro, Prov. Sajama, Payachatas, 4420 m s.m., moor, 27-I-1999, *Ruthsatz & Budde 10216* (holotype, MIN). Figs. 1, 2A, Bf, C.

Rhizoma repens; culmi minus quam 2.5 cm alti; vaginae basales glabrae, brunneae. Folia 5-11, basales; laminae 0.5–2 cm longae, 0.7-1.4 mm latae, carinatus, marginibus serratus; vaginae glabrae, zone interior pallide brunnea vel hyalinae; ligulae fere 1 cm longae, latiores quam longiores. Inflorescentiae minus quam 1.5 cm longae. Spicae 3–4, erectae, superne staminatae, ceterae pistillatae ca. 2–4-florae, omnis subradicales et subsessilis. Perigynia 3.4–4.6 mm longa, 2–3 mm lata, ovata ad late ovata, glabra, coriacea, venis 11–15 infirmus praeter apud inferior; rostra 0.3–0.6 mm longa, apices integri vel bidentata dentibus debilis. Achenia 1.8–2.2 mm longa, 1.2–1.8 mm lata, late ovata. Stigmata 2. Antherae 3, 2-2.6 mm longae.

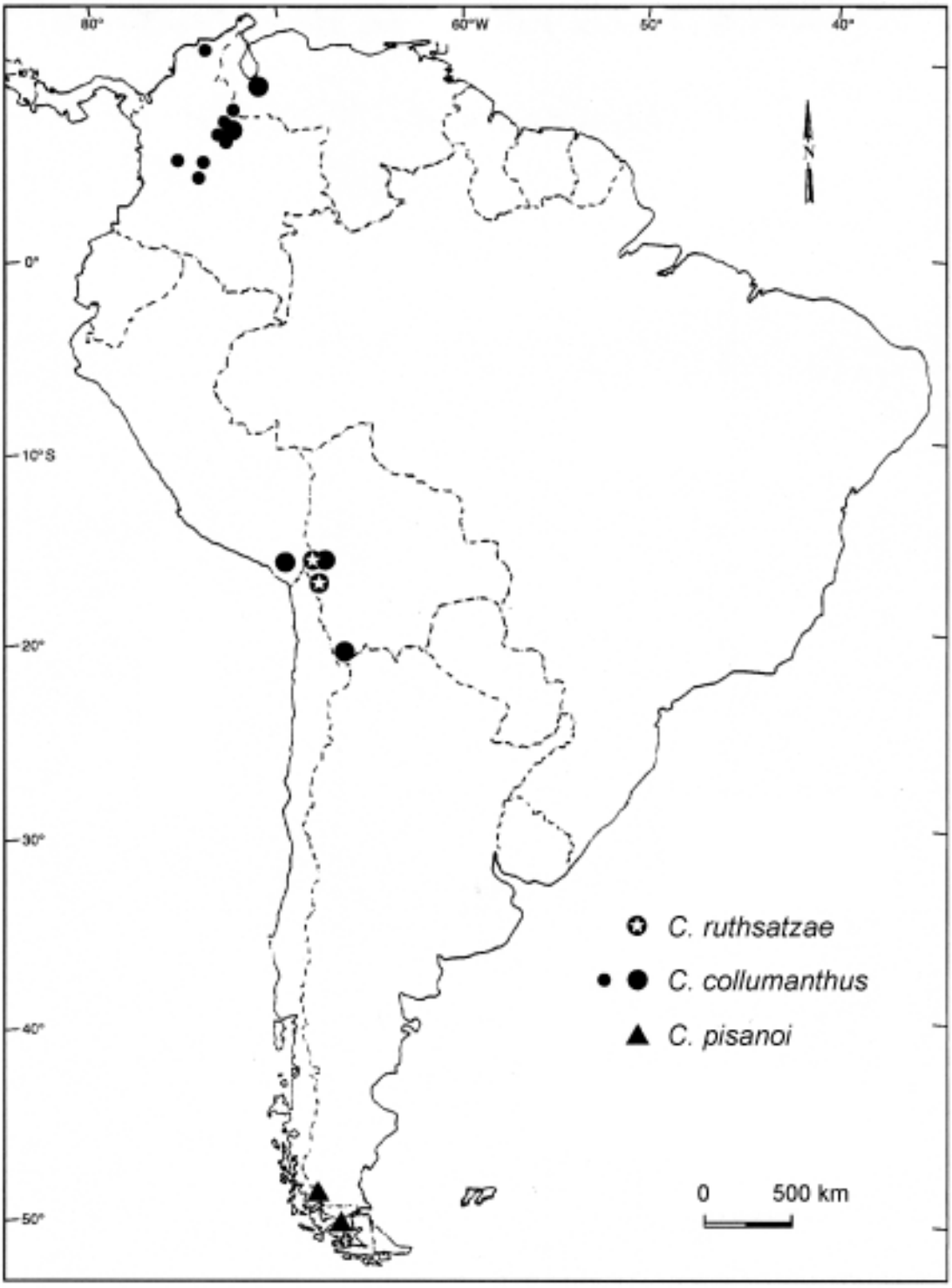

Fig. 1.- Map of South America showing the distributions of *Carex ruthsatzae*, *C. collumanthus*, and *C. pisanoi*. Small dots represent specimens of *C. collumanthus* mapped by Cleef (1982) but not seen by me.

Plants very low-growing, culms single or few together from slender, creeping rhizomes; fertile culms less than 2.5 cm tall, rigid, with brown basal sheaths. Leaves 5-11, basal, mostly exceeding the culms; blades 0.5–2 cm long, 0.7-1.4 mm wide, keeled, stiff, terminating in a 3-angled, smooth or scaberulent, blunt tip, the margins retrorsely scabrous at the base and with irregularly-spaced short, straight teeth elsewhere; leaf sheaths glabrous, 7–11-veined dorsally, pale brown to brown; inner band of sheaths pale brown or hyaline, glabrous; ligules up to 1 mm long, convex, wider than long. Vegetative shoots 2.5-3.5 cm tall; leaves 3-7, with keeled blades up to 2 cm long and usually less than 1 mm wide; pseudoculms 1-1.5 cm tall. Inflorescences less than 1.5 cm long, with all spikes buried among leaves at base of plant. Spikes 3-4, the terminal one staminate, the lateral ones pistillate. Terminal spikes 6-7 mm long, 1.8-2.2 mm wide, ca. 6–8-flowered; staminate scales 4.5-5.8 mm long, 1.4-2 mm wide, ovate to ovate-lanceolate, acute, reddish brown, with hyaline margins and greenish or stramineous center, 1-veined, the lowest one often short-awned. Lateral spikes 4.5-6.5 mm long, 3–5 mm wide, ascending, ca. 2–4-flowered, on smooth peduncles less than 4 mm long; pistillate scales shorter than perigynia, 3–4.5 mm long, 1.5–3 mm wide, ovate to broadly ovate, obtuse or mucronate, glabrous, stramineous or pale reddish brown (at least distally), with hyaline margins and greenish or stramineous center, 3-veined. Perigynia 3.4–4.6 mm long, 2–3 mm wide, ovate to broadly ovate, glabrous, coriaceous, yellowish brown but often reddish brown distally, weakly 11–15-veined (most conspicuous near the base), plano-convex in cross section, margins smooth, rounded or slightly tapered at base and stipitate (stipe 0.2–0.8 mm long), more or less abruptly tapered into a short beak; beaks 0.3–0.6 mm long, reddish brown, margins smooth, the apex entire or bidentulate, the teeth (when present) weak, scarious and hyaline-tipped and up to 0.2 mm long. Achenes 1.8–2.2 mm long, 1.2–1.8 mm wide, biconvex with ovate or oblong sides, subsessile, brown. Stigmas 2. Anthers 2-2.6 mm long.

Paratype: BOLIVIA. **La Paz**. *Prov. Los Andes*: Laguna Khara Khota, 4450 m s.m., moor, 9-IX-2001, *Ruthsatz 10525* (MIN).

I take pleasure in naming this species after its discoverer, Dr. Barbara Ruthsatz, well known European plant ecologist who has contributed substantially to our knowledge of high andean vegas and moors, particularly those extending from central Chile and adjacent Argentina northward to southern Peru.

Plants of *Carex ruthsatzae* with mature perigynia (Fig. 2A) and ripe achenes are thus far known only from the type locality; however, plants with immature perigynia are also known from an adjacent department (see Fig. 1). Moreover, Ruthsatz (pers. comm.) notes that she has often observed vegetative plants of this diminutive species in high andean bofedales. In these wetlands, which are predominantly formed by cushion-forming Juncaceae, *C. ruthsatzae* often grows in between cushion-forming vascular plants, such as *Oxychloë andina* Phil. and *Distichia muscoides* Nees & Meyen (Ruthsatz, pers. comm.). Because the perigynia of this species, when mature, are very easily detached from the spikes, most collected specimens are largely, if not entirely divested of fruit (Fig. 2C).

Like *Carex collumanthus* (Fig. 2Bc) and *C. humahuacaensis* (Figs. 2Be, D), the new species is characterized by having all of its spikes, including the terminal staminate spike, buried among leaves at the base of the plant; in contrast, the four remaining members of section Abditispicae have a peduncled terminal spike that, at least to some degree, is elevated above the lateral spikes, which themselves are largely hidden among leaves at the plant base. *Carex ruthsatzae* is separated from *C. collumanthus* and *C. humahuacaensis* by characters given in the key further below. Unlike most *Carex* species, which have antrorsely scabrous leaf margins, the leaves of *C. ruthsatzae* (and most other Abditispicae species) possess leaf margins that are retrorsely scabrous at the base and have irregularly-spaced short, straight teeth elsewhere.

Because plants of *Carex ruthsatzae* are low-growing and easily overlooked, as well as often being observed only vegetatively or entirely divested of fruit, this species is probably more widespread than present collections suggest. Based on Ruthsatz's observations, this species should be searched for in high andean wetlands, particularly bofedales, in Argentina and Chile, as well as for additional sites in Bolivia.

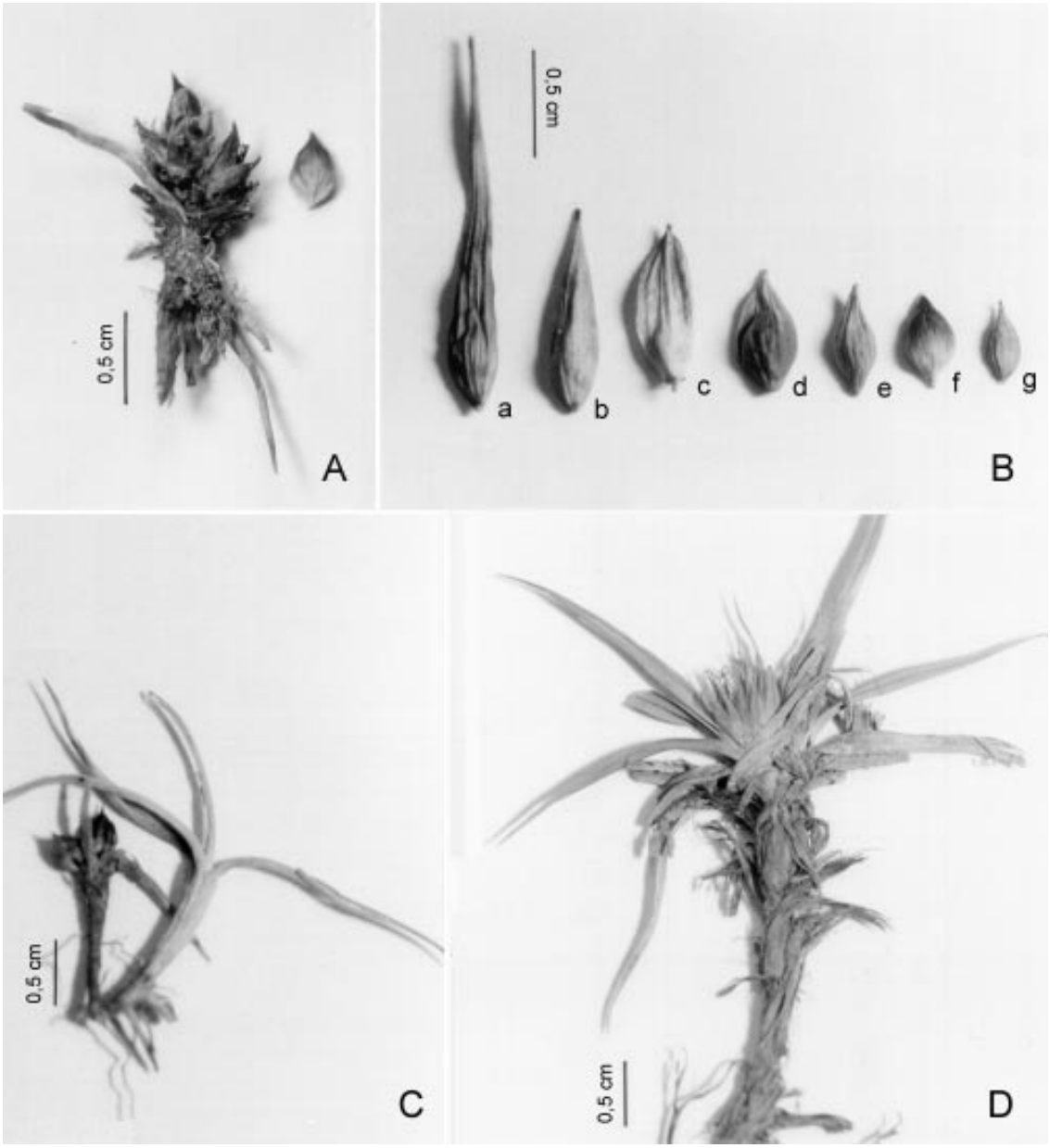

Fig. 2.- A: *Carex ruthsatzae*, habit and detached perigynium. B. Perigynia of *Carex*, abaxial view. a: *C. macrosolen.* b: *C. pisanoi.* c: *C. collumanthus.* d: *C. subantarctica.* e: *C. humahuacaensis.* f: *C. ruthsatzae.* g: *C. acaulis.* C: *Carex ruthsatzae*, largely fruited-out fertile shoot and attached sterile shoot. D: *Carex humahuacaensis*, habit. A, Bf, C, from *Ruthsatz & Budde 10216;* Ba, from *Moore 2220;* Bb, from *Elvebakk 96:039;* Bc, from *Ruthsatz & Budde 10304;* Bd, from *Soriano 4505*; Be, D, *from Ruthsatz 340/1;* Bg, from *Elvebakk 95:469.*

RANGE EXTENSIONS AND OTHER NOTES ON CAREX SECTION ABDITISPICAE

With the addition of *Carex ruthsatzae*, section Abditispicae currently consists of seven South American species. Although originally thought to be restricted to the southern half of the continent (Wheeler, 1987), members of this section occur throughout the Andean region of South America. In Patagonia and Tierra del Fuego, these species grow from near sea level to over 800 m s.m., with the ranges of two of them, *C. macrosolen* and *C. subantarctica*, extending well east of the Andes.

North of 30°S lat., however, all of the species grow at high elevations, from about 3000 to 4700 m s.m., with most of them confined to high andean vegas and moors.

Members of section Abditispicae seem to have evolved by adaptive radiation, with each species being morphologically modified (Fig. 2B) and adapted to a particular habitat. All of them are low-growing and rhizomatous and, as the name of the section implies, the plants have the proximal portion of the inflorescence buried among leaves at the plant base; thus, the lateral spikes are often only partially visible if not hidden entirely. The members of this section are bistigmatic and, further, are monoecious except for *C. subantarctica* and probably *C. macrosolen*, which appear to be paradioecious.

Recent collections of *Carex pisanoi* and *C. collumanthus* have extended the known ranges of these species, as well as providing new habitat information for each, thus they are discussed separately below. Because there seems to be a trend toward dioecy in some members of section Abditispicae, such as in *C. subantarctica*, this interesting adaptation is also discussed. Lastly, a key to the species of section Abditispicae is given at the end of this report.

Carex pisanoi G. A. Wheeler, Syst. Bot. 12: 579. 1987. Fig. 1, 2Bb, 4C

This species was previously known only by the holotype collection, which was made at Cordonier near Punta Arenas, Chile, on the Península de Brunswick (*Pisano 4214*, holotype, HIP). Other than noted as growing in "mossy vega", little else was known about the plant. Recently, however, *C. pisanoi* has been collected from two sites in Torres del Paine National Park in southern Chile, these some 250 km north-northwest of the holotype locality. At one site, the plant was collected from an open, north-facing, calcareous slope, which is moist to wet early in the season but apparently dry later on (*Elvebakk 96:039*, MIN); at the other site, the plant was collected from near the middle part of the inundation zone of a lake, (*Elvebakk 96:752*, MIN). The plants are seldom over 5 cm tall and typically have the lateral pistillate spikes partially buried among leaves at the base of the plant. Although this species closely resembles *C. macrosolen*, the former is distinguished by having smaller perigynia and achenes, a shorter perigynium beak, and pistillate scales with hyaline margins very narrow or lacking. For comparisons between the two species see Figs. 2Ba, 3A, B. *Carex pisanoi* is endemic to Chile, as far as known, where it seemingly is a rarity.

Carex collumanthus (Steyerm.) G. A. Wheeler, Syst. Bot. 14: 39. 1989. Figs. 1, 2Bc, 4B

This species was originally described from Venezuela and placed in the monotypic genus *Vesicarex* (Steyermark, 1951). Subsequently, Wheeler (1989) transferred the plant to *Carex* and placed it in section Abditispicae. Although previously known from Venezuela and Colombia (Cleef, 1982; Mora-Osejo, 1982), it has also recently been collected in Bolivia (*Ruthsatz 10200*, MIN, *10304*, MIN) and southern Peru (*Ruthsatz 10132*, MIN). Similar to northern reports, the Bolivian and Peruvian plants grow at high elevations, from 4400 to 4700 m s.m., where they frequent moist to wet sites in high andean moors. The plants are diminutive in stature and generally grow in more or less dense mats and, according to Ruthsatz (pers. comm.), it "is one of the most steadily occurring plants in the andean mires". Thus far, however, it is unknown from Argentina and Chile. It differs from other members of section Abditispicae by having perigynia that are quite large in proportion to the overall size of the plant, and which are yellowish green when immature but yellow to yellowish brown at maturity (Wheeler, 1989). Moreover, it is the only member of the section with rhomboidal achenes. As such, fruiting plants of this species should not be confused with those of other members of the section.

Carex macrosolen Steud., Syn. Pl. Glum. 2: 210. 1855. Figs. 2Ba, 3A, B

This species extends roughly from 51°S lat. southward to Isla Navarino in Antártica Chilena Province, Chile (Wheeler, 1987). It typically is monoecious, with 3 or 4 spikes, the terminal one staminate and the lateral ones pistillate. But near the northwestern-most limit of its range, in Torres del Paine National Park, Chile, plants have recently been collected bearing shoots that are entirely pistillate (*Elvebakk 96:708*, MIN). Of four such pistillate shoots examined, one of them has a solitary spike on a peduncle 28 mm long; each of the three other shoots have a peduncled terminal spike, these on peduncles 25–30 mm long, and 2 or 3 lateral

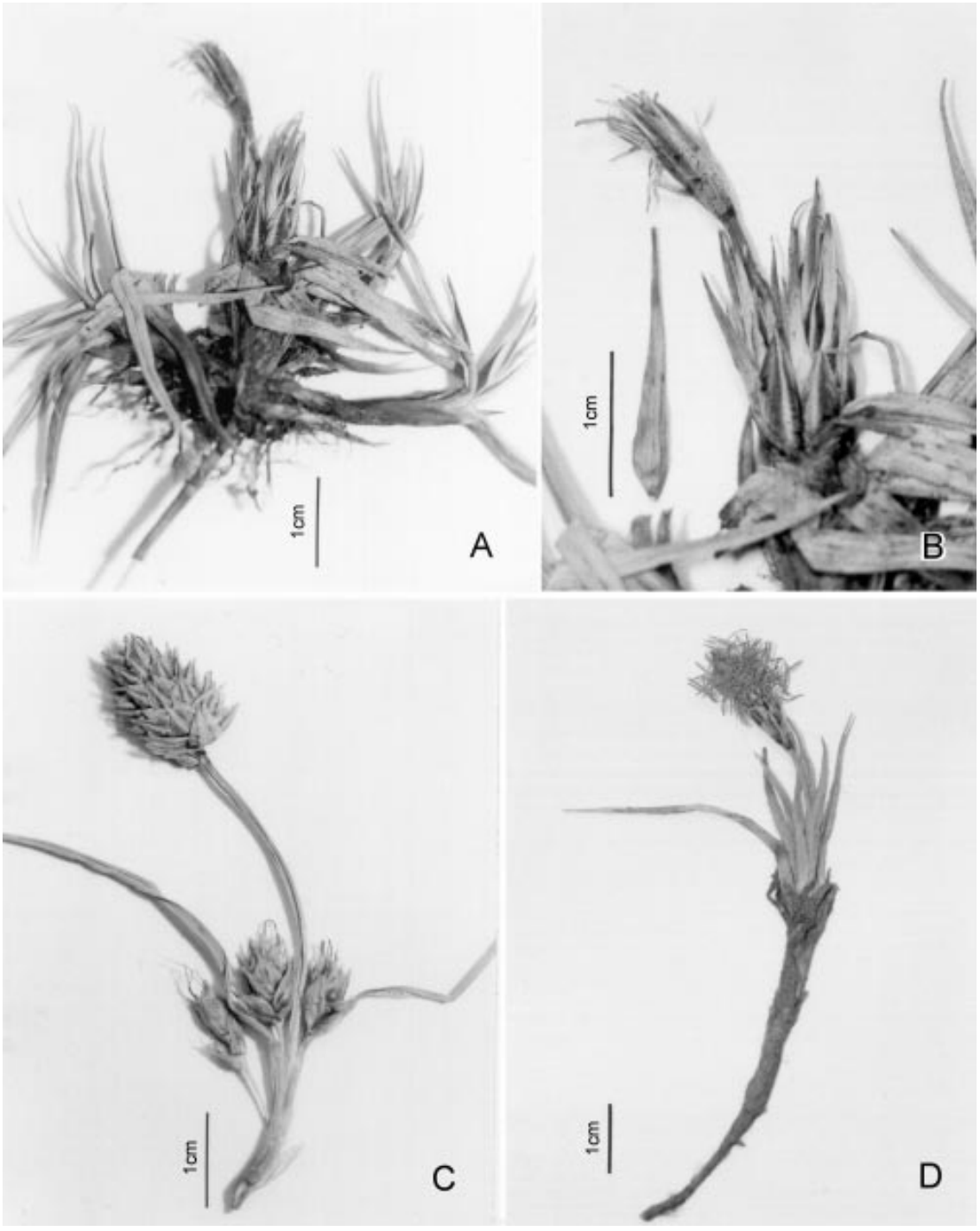

Fig. 3.- *Carex macrosolen*. A: habit. B: inflorescence and detached perigynium. C-D. *Carex subantarctica*. C: pistillate plant. D: staminate plant, A-B, from *Moore 2220*; C, from *Soriano 4505;* D, from *Koslowsky 72*.

spikes all of which are buried among leaves at the plant base. Notably, however, no plant of *C. macrosolen* bearing an entirely staminate shoot has thus far been seen. This species seems to display a trend toward dioecy, but not as markedly as in *C. subantarctica*.

Carex subantarctica Speg., Anales Mus. Nac. Hist. Nat. Buenos Aires 7: 180. 1902. Figs. 2Bd, 3C, D.

This species is endemic to Argentina, as far as known, and extends from southern Patagonia, near Río Gallegos, northward to Río Negro Province, with isolated occurrences also known from San Juan Province further north. It occurs on the dry plateaus east of the Andes, with the plants growing primarily where the water table is close to the surface, such as in swales, around spring seepages, and in other wet depressions (Wheeler, 1989).

Unlike other members of section Abditispicae, this species frequently produces unisexual shoots (e.g., Fig. 3C, shows a pistillate shoot and Fig. 3D, a staminate shoot); but when bisexual shoots are produced they closely resemble the monoecious members of this section. It is also worth noting that other *Carex* species have been reported (e.g., Standley, 1985; Zika et al., 1998) which produce both unisexual and bisexual shoots. The degree of polymorphism in *C. subantarctica* suggests that the differentiation of flower primordia is not genetically fixed; thus, this species is not dioecious but seemingly paradioecious (Wheeler, 1989), in which the gender of flowering shoots is labile. As used here, the term "paradioecious" is defined as monoecious plants in which individuals or individual ramets (clumps of shoots) may be unisexual (Lloyd, 1980).

The paradioecious pathway seems to reflect the adaptative evolutionary history of some species, including some carices (Standley, 1985). As Lloyd (1980) points out, in some plants there apparently was an evolutionary shift along the paradioecy pathway from monomorphic plants with diclinous flowers and multiple flowering spikes to dimorphic plants with unisexual flowers and a single flowering spike. The selective pressures that cause the evolutionary shift from monoecy to paradioecy to dioecy remain largely unknown (Lloyd, 1980). Nevertheless, in section Abditispicae, where paradioecy is manifest in *C. subantarctica* (and seemingly in *C. macrosolen*), a possible scenario of the evolutionary history of such a paradioecious species is offered here.

As intimated earlier, it appears that section Abditispicae is monophyletic and that its members have undergone adaptive radiation from a common ancestor or ancestral group inhabiting orographic sites. If so, then it seems reasonable to suggest that migration, followed by successful ecesis, of an ancestral monoecious member of section Abditispicae from an essentially hydric habitat in the Andes to the harsh conditions present in the dry plateaus of Patagonia occurred. The selective adaptation of a monomorphic plant in an inimical environment, such as created by the rain-shadow effect of the Andes and exemplified by the vast Patagonian steppe, could possibly alter the developmental "switch or trigger" that determines the differentiation of male or female flowers, particularly if the plant eventually experienced changes in the levels of hormones known to control the development of flower primordia (Standley, 1985).

Key to the species of Carex section Abditispicae

1. Spikes 1 or more; plant unisexual: all spikes entirely staminate or entirely pistillate 2

1. Spikes 2 or more; plant bisexual: the terminal spike staminate, the lateral spikes pistillate 3

2(1). Perigynia (8.6–)10–24 mm long; beaks 3–5 mm long ..... *C. macrosolen*

2. Perigynia 4–7 mm long; beaks 0.5–1 mm long ..... *C. subantarctica*

3(1). Staminate spikes subsessile, buried with pistillate spikes among leaves at plant base and often inconspicuous; plants growing primarily north of 30°S lat. 4

3. Staminate spikes on peduncles 7–45 mm long, generally elevated above pistillate spikes and conspicuous; plants growing primarily south of 30°S lat. 6

4(3). Achenes rhomboid; perigynia oblong, 4-8 mm long, yellowish green to yellowish brown or yellow; leaves less than 1.5 cm long ..... *C. collumanthus*

4. Achenes not rhomboidal; perigynia ovate to broadly ovate or oblong-elliptic, 3.5–4.6 mm long, brownish or reddish brown; leaves 0.5-4 cm long 5

5(4). Staminate scales reddish brown, ovate to broadly ovate, tips obtuse; leaves 1.4 mm wide or less ..... *C. ruthsatzae*

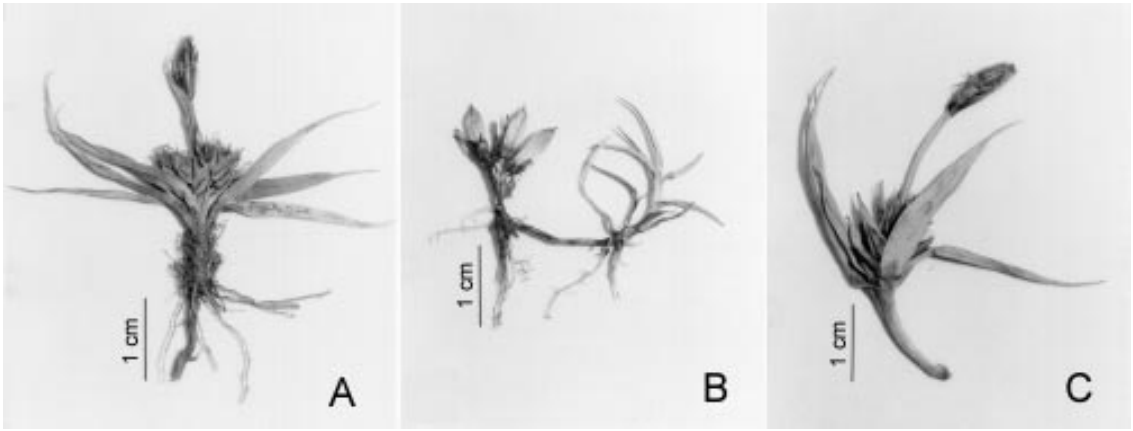

Fig. 4.- A: *Carex acaulis*, habit. B: *Carex collumanthus*, habit. C: *Carex pisanoi*, habit. A, from *Elvebakk 95:469;* B, from *Ruthsatz & Budde 10304;* C, from *Elvebakk 96:039.*

5. Staminate scales stramineous, lanceolate, tips acuminate; leaves 1.2-3.5 mm wide ..... *C. humahuacaensis*

6(3). Perigynia (8.6-)10-24 mm long, beaks 3-5 mm long; achenes 2.8-3.8 mm long, 2-2.6 mm wide ..... *C. macrosolen*

6. Perigynia 3.2-9 mm long, beaks 0.3-2.5 mm long; achenes 1.9-2.5 mm long, 1.3-2.1 mm wide 7

7(6). Perigynia 6–9 mm long, beaks 1–2.5 mm long ..... *C. pisanoi*

7. Perigynia 3.2–5.4 mm long, beaks 0.3–0.8 mm long 8

8(7). Staminate spike 6–10 mm long; perigynia greenish brown or whitish; pistillate scales 2.5–3.7 mm long ..... *C. acaulis*

8. Staminate spike 12.5–28 mm long; perigynia stramineous or golden brown; pistillate scales (3.8–)4.4–5.6 mm long ..... *C. subantarctica*

ACKNOWLEDGMENTS

The writer thanks Barbara Ruthsatz (University of Trier, Germany) for duplicate specimens of *Carex* from South America and also for habitat information on the new species; Arve Elvebakk (University of Tromso, Norway) for duplicate specimens of section Abditispicae from Torres del Paine National Park, Chile, as well as for habitat information on various Patagonian species; also, I want to thank two anonymous reviewers for providing several helpful suggestions and, additionally, to one of them for writing a Spanish translation of the abstract.

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Original recibido el 26 de diciembre de 2001; aceptado el 3 de octubre de 2002.