



Inflorescence structure in the genus *Carex* (Cyperaceae)

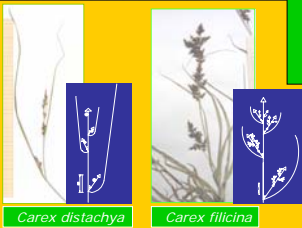
Ana Molina*, Carmen Acedo & Félix Llamas. Dpt. Biodiversity & Environment Management. University of León Spain. *a.molina@unileon.es

Material of some 80 species of *Carex* L. - from the following Herbaria: BCN, FCO, JBAG, K, LEB, LY, MA, SANT, and UPNA - belonging to the four subgenera were studied to know the structure of their inflorescence.

The inflorescence structure is compared in the four subgenera of *Carex* using the typological method (Weberling 1989) and taking the paracladium as inflorescence unit. General trends in the genus are analyzed. Subgenera delimitation follows Kükenthal (1909) and Egorova (1999). Sectional placement follows Ball & al. (2002) for North American species, Egorova (1999) for Eurasian species, and Kükenthal (1909) for the remainder.

1a. Subgenus *Vigneastra* (Tuck.) Kük.

Sheath	variable
Lowest bract	leaflike
Prophyll	yes
Epipodium	short
Pseudospikes	androgynous

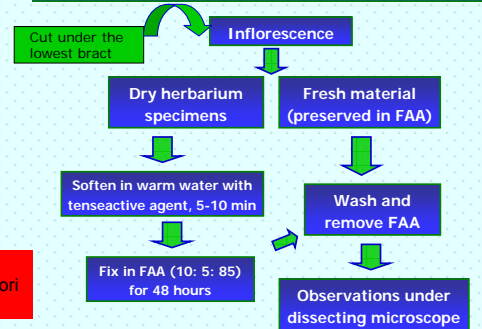


Taxa studied: 6
 Sect. *Schiedeanae* Kük.: *Carex distachya* Desf.
 Sect. *Polystachyae* Tuck.: *Carex baccans* Nees
 Sect. *Indicae* Tuck.: *Carex cruciata* (Wahlenb.), *C. filicina* Nees, *C. vesiculosa* Boott
 Sect. *Scabrellae* Kük.: *Carex rhizomatosa* Steud.

Genus *Kobresia*
Kobresia myosuroides (Vill.) Fiori
Kobresia laxa Nees

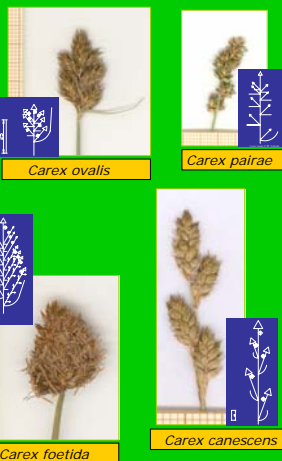
2. Method

34 morphological inflorescence and 9 perigynia characters were studied to assess their taxonomic value (Tabla 1)



1b. Subgenus *Vignea* (P. Bauv. ex Lestib. f.) Peterm.

Sheath	not
Lowest bract	setaceous
Prophyll	not, generally
Epipodium	very short or not
Pseudospikes	variable



Taxa studied: 25
 Sect. *Ammoglochin* Dumort.: *Carex arenaria* L.
 Sect. *Curvulae* Tuck. ex Kük.: *Carex curvula* All.
 Sect. *Divisae* H. Christ ex Kük.: *Carex divisae* Huds.
 Sect. *Foetidae* (Tuck. ex L. H. Bailey) Kük.: *Carex foetida* All.
 Sect. *Gibbae* Kük.: *Carex gibba* Wahlenb.
 Sect. *Glarosae* G. Don: *Carex canescens* L.
 Sect. *Heloglochin* Dumort.: *Carex appressa* R. Br., *C. cusickii* Mack., *C. diandra* Schrank, *C. paniculata* L. subsp. *lustrana* (Schultze ex Willd.) Maire, *C. grisea* Dewey
 Sect. *Macrocephalae* Kük.: *Carex macrocephala* Willd.
 Sect. *Ovalis* Kunth: *Carex ovalis* Gooden.
 Sect. *Phaestoglochin* Dumort.: *Carex ontarioensis* Nelmes, *C. divisa* Stokes, *C. levis* F. W. Schultz, *C. pairae* F. W. Schultz, *C. muricata* L. subsp. *muricata*, *C. spicata* Huds. subsp. *andresii* Molina González, Acedo & Llamas.
 Sect. *Remotae* (Aschers.) C. B. Clarke: *Carex remota* L.
 Sect. *Stellulatae* Kunth: *Carex echinata* Murray.
 Sect. *Vulpinae* (Heuff.) H. Christ: *Carex otrubae* Podp.
incartae sedis: *Carex canariensis* Kük., *C. polyphylla* Kar. & Kir., *C. foliosa* D. Don.

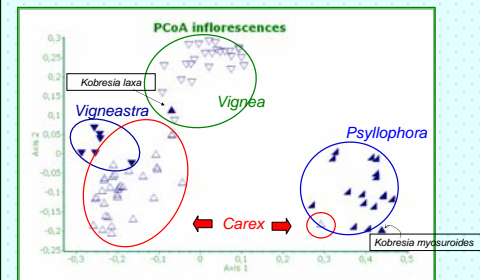
Table 1. Inflorescence characters and character states

1. Male and female flowers on the same axis: 0 yes, 1 not, 2. Perigynium entirely closed: 0 not, 1 yes, 3. Prophyll present: 0 not, 1 yes, 4. Fertile prophyll: 0 yes, 1 not, 5. Rhachilla: 0 yes, 1 not, 6. Stigmata number: 0 three, 1 two, 7. Solitary spike (monostachia): 0 not, 1 yes, 8. Lax spike: 0 not, 1 yes, 9. Perigynium hairy: 0 not, 1 yes, 10. Perigynium nerved: 0 not, 1 yes, 11. Perigynium papillate: 0 not, 1 yes, 12. Perigynium reflexed: 0 not, 1 yes, 13. Net beak in the perigynium: 0 not, 1 yes, 14. Inflorescence dense (internodes ≤ 20 mm): 0 not applied, 1 not, 2 yes, 15. Perigynium hair-covering: 0 without hairy, 1 somewhat pilose, 2 hairy, 16. Perigynium surface: 0 smooth, 1 narrow pluriestriate, 2 thick nerves, 17. Margins of the beak: 0 without beak, 1 smooth, 2 scarcely denticled, 3 escarbin, 18. Beak length: 0 without beak, 1 short (≤ 0.4 mm), 2 long (> 0.4 mm), 19. Lateral spikes with sheath: 0 not applied, 1 not, 2 yes.

20. Basal spikes with sheath: 0 not applied, 1 not, 2 yes, 21. Type of lowest bract: 0 not applied, 1 setaceous, 2 leaf-like, 3 glume-like, 22. Type of rhachilla: 0 without rhachilla, 1 smooth and without apex, 2 ciliate and without apex, 3 smooth and with apex, 23. Type of prophyll: 0 not applied, 1 cladoprophyll, 2 utricle-like, 24. Prophyll in paracladium: 0 never, 1 several paracladia, 2 all paracladia, 25. Sex of the spikes in the basal paracladium: 0 not applied, 1 female, 2 androgynous, 3 gynaeandrous, 4 variable, 26. Sex of the spikes in the middle paracladium: 0 not applied, 1 unisexual, 2 androgynous, 3 gynaeandrous, 4 mixed, 27. Sex of the distal spike: 0 not applied, 1 female, 2 androgynous, 3 gynaeandrous, 4 dioecious, 28. Number of distal unisexual spikes: 0 not applied, 1 usually 0 (or 1), 1 usually 1 (or 2), 2 usually 2 or more, 29. Length of the last internode: 0 not applied, 1 ≤ 1 other internodes, 2 \geq other internodes, 30. Main spike shape: 0 not applied, 1 ovoid, 2 cylindrical, 3 slender, 4 claviform, 31. Middle spikes shape: 0 linear, 1 ovoid, 2 cylindrical, 3 rounded, 32. Basilar or subbasilar spike: 0 not applied, 1 never, 2 sometimes, 3 always, 33. Number of the first order paracladia: 0 not applied, 1 few (5-8), 2 medium (up to 10-12), 3 more than 10-12, 34. Paracladia order: 0 single spike, 1 only first order paracladia, 2 second order paracladia, 3 a few third order basal paracladia, 4 with third order paracladia, 35. Angle of the spike: 0 not applied, 1 $\leq 30^\circ$, 2 $30^\circ-50^\circ$, 3 $\geq 50^\circ$, 36. Length of the first internode, 37. Length of the second internode, 38. Length of the P 11 peduncle, 39. Length of the P 12 peduncle, 40. Length of the main spike (HF), 41. Length of the inflorescence, 42. Length of the lowest bract.

3. Results

We performed a principal coordinate analysis (PCoA) using Gower's coefficient with 82 species (80 of *Carex* and two of *Kobresia*). The scatter plot in the first two axes of the PCoA shows three main groups. Subgenus *Indacarex* is quite closed to subgenus *Carex*. Subgenus *Vignea* has a core of strongly grouped species but other species, as *C. gibba*, *C. remota*, appear more distant. Poliphyletic subgenus *Psyllophora* is uniform from the morphological point of view, so monostachya species are grouped in a well defined cluster from the remaining. The two species of *Kobresia* appear separated.

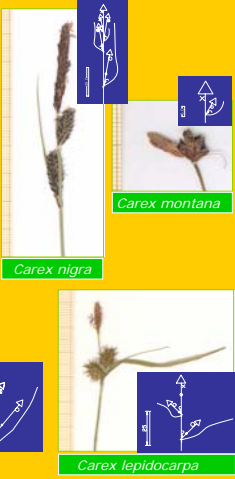


5. General trends

- ✓ *Psyllophora*: simplification
- ✓ *Vigneastra*: ??
- ✓ *Vignea*: diversification
- ✓ *Carex*: specialization

1c. Subgenus *Carex*

Sheath	yes, generally
Lowest bract	leaflike
Prophyll	yes
Epipodium	variable
Pseudospikes	unisexual

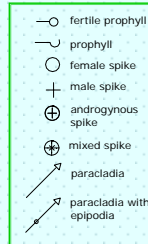


Taxa studied: 33
 Sect. *Acrocystis* Dumort.: *Carex montana* L., *C. pilulifera* L., *C. tomentosa* L.
 Sect. *Auloacystis* Dumort.: *Carex sempervivans* Vill., *C. frigida* All.
 Sect. *Bicoloris* (Fr.) Rouy: *Carex bicolor* All.
 Sect. *Carex*: *Carex hirta* L.
 Sect. *Ceratocystis* Dumort.: *Carex demissa* Hornem., *C. flava* L., *C. lepidocarpa* Tausch.
 Sect. *Chlorostachyae* Tuck. ex Meinh.: *Carex capillaris* L.
 Sect. *Depauperatae* Meinh.: *Carex brevicollis* DC., *C. depauperata* Curtis ex Stokes.
 Sect. *Digitatae* (Fr.) H. Christ: *Carex ornithopoda* Willd.
 Sect. *Hallerianae* (Asch. & Graebn.) Rouy: *Carex halleriana* Asso.
 Sect. *Hymenochlanae* (Drejer) L. H. Bailey: *Carex sylvatica* subsp. *sylvatica* Huds.
 Sect. *Mitratae* Kük.: *Carex caryophyllaea* Labour., *C. depressa* Link subsp. *depressa*
 Sect. *Paludosae* G. Don: *Carex acutiformis* Ehrh.
 Sect. *Paniccae* G. Don: *Carex asturica* Boiss., *C. panicla* L.
 Sect. *Phacocystis* Dumort.: *Carex elata* All. subsp. *reuteriana* (Boiss.) Luceño & Acedo, *C. nigra* (L.) Reichard., *C. trinervis* Degl.
 Sect. *Phyllostachyae* Tuck. ex Kük.: *Carex backii* Boott
 Sect. *Pseudocyperus* Tuck. ex Kük.: *Carex pseudocyperus* L.
 Sect. *Racemosae* G. Don: *Carex arata* L., *C. parviflora* Host.
 Sect. *Spirostachyae* (Drejer) L. H. Bailey: *Carex binervis* Sm., *C. extensa* Gooden., *C. punctata* Gaudin.
 Sect. *Vesicariae* (Heuff.) J. Carey: *Carex rostrata* Stokes, *C. vesicaria* L.

4. Working in inflorescence allows

- ✓ Taxonomic delimitation at subgenus level
- ✓ Discover taxa outside the current sections
- ✓ Make questions about phylogenetic relationships

6. Key of inflorescence



7. Characters variation

- ✓ **Internode length**: *Vignea* < *Vigneastra* < *Carex*
- ✓ **Peduncle length**: *Vignea* < *Vigneastra* < *Carex*
- ✓ **Lowest bract**: *Vignea* setaceous, *Vigneastra* and *Carex* leaf-like
- ✓ **Sheath**: sometimes in *Carex*, and rarely in *Vigneastra*
- ✓ **Prophyll**: *Vigneastra* and *Carex*: yes, *Vignea*: occasionally.
- ✓ **Sex of the spikes**: *Psyllophora*, *Vigneastra* and *Vignea* bisexual; *Carex* and *Vignea* unisexual.
- ✓ **Branching**: *Vignea* and *Vigneastra* yes, *Carex* not.
- ✓ **Stigmata**: *Vignea* 2 (3), *Psyllophora* 2 or 3, *Carex* 3 (2) and *Vigneastra* 3.

Literature:
 Ball P W & al., 2002. *Carex* L. in *Flora of North America, North of Mexico*, vol. 23, ed. Flora of North America Editorial Committee. New York. Oxford: Oxford University Press.
 Egorova T V. 1999. The sedges (*Carex* L.) of Russia and adjacent states (within the limits of the former USSR). ed. A L Takhtajan. St. Petersburg: St. Petersburg State Chemical-Pharmaceutical Academy; St. Louis: Missouri Botanic Garden Press.
 Kükenthal G. 1909. *Cyperaceae-Caricoideae*. Pp. 1-824 in *Das Pflanzenreich*, IV, 20 (Heft 38), ed. A Engler. Leipzig: W. Englemann.
 Weberling F. 1989. *Morphology of flowers and inflorescences*. Cambridge: Cambridge University Press



IV International Conference:
The Comparative Biology of the Monocotyledons
 Copenhagen, Denmark
 11-15 August 2008

