

## Coordinating work on regional and global diversity of *Carex* (Cyperaceae), the largest angiosperm genus of the temperate zone

### Group leaders

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### Project summary and meeting goals

*Carex* (Cyperaceae) is the largest angiosperm genus of the temperate zone and ecologically important in floodplain forests, dry prairies, alpine meadows, peat lands, swamp forests, sedge meadows, and a wide range of other communities. This meeting will bring together systematists from North America, Europe, East Asia and Australia, floristic specialists from the Western Great Lakes Region, and the EOL's LifeDesk staff to:

- (1) Synthesize and publish online (through LifeDesks) a synonymized checklist of the estimated 2,100 species of *Carex* worldwide (e.g., [vigna.lifedesks.org](http://vigna.lifedesks.org) and [carex.lifedesks.org](http://carex.lifedesks.org)), organized by traditional sections and major clades identified in recent phylogenetic studies;
- (2) Create a set of online portals in LifeDesks to global *Carex* taxonomy, literature, species pages, images, and identification keys, and evaluate alternative technologies for serving biodiversity data to conservation professionals;
- (3) Publish online species pages for the ca. 200 *Carex* species of the Western Great Lakes Region through creation of new content and migration of existing content written for the Chicago region, as well as a representative sample of global *Carex* species;
- (4) Create online keys for the ca. 200 *Carex* species of the Great Lakes region, emphasizing common and ecologically significant taxa relevant to Chicago Wilderness's conservation and education efforts, utilizing the Field Museum's Keys to Nature system ([keystonature.org](http://keystonature.org));
- (5) Create a five-year plan for the creation of LifeDesks species pages for *Carex* worldwide;
- (6) Collaborate in enhancing the functionality of LifeDesks, allowing for more flexible online publication of versioned, citable checklists; and
- (7) Provide sufficient training and buy-in for participants so that they and their students will continue to add and modify content for *Carex* in the on-line checklist, EOL species pages, and Keys to Nature online keys.

The meeting provides an opportunity for collaboration and communication between regional workers and global experts in the systematics and evolution of *Carex*. It also brings together EOL / *LifeDesks* staff with a diverse community of plant systematists and conservationists to enhance the utility of *LifeDesks* for the entire EOL community.

### Applicability to EOL

**Taxonomy of diverse groups.** The sedges (used here in the strict sense to include *Carex* and four

embedded genera of the tribe Cariceae [1]) are the most species-rich genus of the temperate zone (with an estimated 2,100 species [2]), and ecologically important in habitats that range from tundra and dry sand prairies to open wetlands and bottomland forests [3, 4]. Despite the importance and diversity of *Carex*, the last worldwide monograph of the genus was published > 100 years ago [5]. A series of meetings held between 1987 and 2005 [6 – 9] brought together researchers in sedge biodiversity, and recent progress in taxonomy and nomenclature (e.g., [10 – 12]) make the time ideal this meeting.

**Phylogenetics and evolution.** We are including phylogeneticists for all major clades of *Carex* and embedded genera [1, 13 – 17] to create a taxonomy that reflects the Tree of Life. One of the organizers of this BioSynC meeting (Hipp) is a PI on an NSF funded study of *Carex* subgenus *Vignea* (one of the four major clades in *Carex*). Hipp will oversee nomenclatural aspects of the meeting. The postdoc on that grant (Chung) has also applied for an EOL Rubinstein fellowship, which would complement the proposed meeting. Hipp and Chung will oversee creation of clade pages in *LifeDesks* that provide information on the distribution and synapomorphies of major clades.

**Citizen science and digital learning.** One of the immediate outcomes of this meeting will be illustrated online keys to the widespread *Carex* species of the western Great Lakes region. Both the Field Museum and The Morton Arboretum have a long-term commitment to educating teachers and citizen scientists ([www.mortonarb.org/teacher-resources.html](http://www.mortonarb.org/teacher-resources.html); [www.fieldmuseum.org/ecco2008/](http://www.fieldmuseum.org/ecco2008/)), providing digital access to collections and biodiversity data ([emuwb.fieldmuseum.org/botany/Query.php](http://emuwb.fieldmuseum.org/botany/Query.php); [www.vPlants.org](http://www.vPlants.org)), and providing online resources for cataloguing biodiversity (e.g., [fm2.fieldmuseum.org/plantguides/rcg\\_intro.asp](http://fm2.fieldmuseum.org/plantguides/rcg_intro.asp)). One of the organizers of this BioSynC meeting (Alverson) was an architect of the Keys to Nature Project ([keystonature.org](http://keystonature.org)), an author-friendly HTML-based system that we will use to create keys for this project. In addition, both Alverson and Hipp are collaborators in the ongoing development on vPlants ([vplants.org](http://vplants.org)), a virtual herbarium and online field guide.

We are also in conversation with Jeff Holmes of the EOL Learning and Education about evaluating alternative methods of packaging and serving EOL data for our regional users (e.g., [education.eol.org/ideas/tools/fieldguide](http://education.eol.org/ideas/tools/fieldguide)). Jeff will be part of our planning with regional users and part of the synthesis meeting as timing and budget permits.

**Conservation biology.** The Chicago region is a hotspot for *Carex* diversity, housing approximately 7% of the world's *Carex* diversity within a 24-county area. Sedges are important indicators of habitat properties and quality. The species pages and keys we create will be of immediate use to land managers in the Great Lakes Region, who regularly utilize the herbaria of The Morton Arboretum, the Field Museum, and vPlants in identifying sedges. By including regional experts in both the flora and management of regional habitats, we will ensure that the tools we create are of maximal benefit to conservationists, restorationists, and land managers in the region.

### Identified participant list

\* denotes a confirmed participant; <sup>L</sup> denotes a local participant, not requiring lodging; <sup>J</sup> denotes a junior participant; <sup>S</sup> denotes a student participant

#### **Regional taxonomists (session 1 participants)**

- \*<sup>L</sup> Jane Balaban, Volunteer Master Steward, Forest Preserve District of Cook Co., Illinois
- \*<sup>L</sup> John Balaban, Volunteer Master Steward, Forest Preserve District of Cook Co., Illinois
- \*<sup>L</sup> Kenneth Dritz, Area Botanist (previously at Argonne National Labs)

\*<sup>L</sup> Gayle Tonkovich, Collections Digitization Specialist, FM, ECCo

\*<sup>L</sup> Dr. Gerould Wilhelm, Principal of Environmental Services, CDF

<sup>L,S</sup> Undergraduate research intern, The Morton Arboretum

***Taxonomists with regional and global expertise in Carex (session 1 and 2 participants)***

\*<sup>J,L</sup> Dr. Kyong-Sook Chung, Postdoctoral Researcher, Morton Arboretum; as Dr. Chung's NSF-funded postdoc ends in February, we have budgeted travel to BioSynC from Korea.

\*<sup>J,L</sup> Dr. Marcial Escudero, Fullbright Visiting Scholar, Morton Arboretum

\* Theodore Cochrane, Curator, Wisconsin State Herbarium (WIS)

\* Dr. Bruce Ford, Professor and Curator of the U. of Manitoba Herbarium (WIN)

\*<sup>L</sup> Dr. Andrew Hipp, Plant Systematist and Herbarium Curator, Morton Arboretum (MOR)

\*<sup>S</sup> Timothy Jones, Graduate student, Louisiana State University

\* Dr. Robert Naczi, Curator of North American Botany, New York Botanical Garden (NY)

\* Dr. Anton Reznicek, Curator of Vascular Plants, U. of Michigan Herbarium (MICH)

\* Dr. Paul Rothrock, Professor, Taylor University

\* Dr. Marcia Waterway, Associate Professor and Curator, McGill University Herbarium; Dr. Waterway will be on sabbatical in Australia, so we are budgeting for travel from Sydney.

***Carex taxonomists, global expertise (session 2 participants)***

\* Kerry Ford, Biosystematics and Herbarium Staff, Landcare Research, New Zealand

\* Dr. Takuji Hoshino, Professor, Okayama University of Science, Japan.

\* Dr. Modesto Luceno, Professor, Pablo de Olavide University, Seville, Spain

\* Dr. Eric Roalson, Associate Professor, Washington State University, USA

\* Dr. Julian Starr, Assistant Professor, University of Ottawa, Canada

\* Dr. Bruno Wallnöfer, Natural History Museum, Burgring 7, A-1010, Vienna, Austria

Dr. Gerald Wheeler, University of Minnesota Herbarium, Bell Museum of Natural History

Dr. Karen Wilson, Special Botanist, Plant Diversity section, Botanic Gardens Trust

\* Dr. Shu-Ren Zhang, Associate Professor, Institute of Botany, Chinese Academy of Sciences (VISA application expenses estimated at \$350.)

***Key-Writing and Web Implementation (session 1 and 2 participants)***

\* Dr. David Shorthouse, Project Leader, Encyclopedia of Life *LifeDesk* environment.

Role: collaboration with *LifeDesk*

\*<sup>L</sup> Dr. William Alverson, Research Fellow at UW-Madison (WIS), Adjunct Curator at The Field Museum (FM). Role: coordinating key-writing and regional species-page work

\*<sup>L</sup> Ryan Peters, Web and Database Developer, FM, ECCo. Role: technical support, keys

\*<sup>L</sup> Jon Markel, GS and Digital Media Coordinator, FM, ECCo. Role: technical support, keys

\* Jennie Kluse, Keys to Nature Project Specialist, FM, ECCo. Role: technical support, keys

\*<sup>L</sup> Dr. Patrick Leacock, Adjunct Curator and *vPlants* Fungal Resources Specialist, FM, Botany. Role: technical support to taxonomists for Keys to Nature and *LifeDesks*

<sup>L,S</sup> Undergraduate research intern, The Field Museum. Role: technical support, all aspects

**Statement of novelty**

Previous international Cyperaceae meetings [6 – 9] have focused on communicating new research and identifying avenues for future research, and they have been highly productive. However, there has never been an international work meeting dedicated to addressing questions in Cyperaceae systematics, and the last worldwide monograph for *Carex* was published in 1909 [5]. Given work that has been done on the phylogeny of the group in recent years, the timing of this meeting is ideal.

Beyond this, the meeting offers a unique opportunity for regional floristic specialists (with extensive knowledge of *Carex* ecology and local variation) to interact with international taxonomists (with more typically clade-based knowledge). It is our expectation that the regional keys and species pages produced during the meeting will reflect the combined experience of these groups. The meeting will also enrich the entire biodiversity community by providing feedback to the *LifeDesks* team on implementing checklists and utilizing *LifeDesks* as an endpoint for online keys. While online keys will be deployed in Keys to Nature, we will also be investigating alternative key strategies with participant Timothy Jones, who has implemented a synoptic key to North American sedges ([www.herbarium.lsu.edu/keys/carex/carex.html](http://www.herbarium.lsu.edu/keys/carex/carex.html)). All resources utilized, including Keys to Nature and LifeDesks, are free or open-source.

## **Tentative agenda**

### ***Pre-meeting***

Preparation by Morton Arboretum and Field Museum staff will begin in March and April, and planning sessions with participants will be undertaken beginning in May and June, with the following goals: (1) agree on a draft list of regional taxa; (2) assemble the text for a draft regional key and publish it to the web so that it is available when the meeting begins; (3) assign responsibilities for the global checklist and associated species pages; (4) identify and assign responsibility for *Carex* images and literature that can be uploaded to our LifeDesks site prior to the meeting; and (5) train participants in the mechanics of LifeDesks and Keys to Nature systems. Meetings will be conducted by conference call and Media Wiki (set up by Hipp on institutional servers), with nomenclatural work conducted directly in LifeDesks following orientation. *We have discussed this intended use of LifeDesks with David Shorthouse, who is a participant in this proposal, and he anticipates no problem with using LifeDesks for a collaboration of this magnitude.* Morton Arboretum staff — herbarium assistant, research assistant — and herbarium volunteers under the supervision of Hipp will assist in uploading literature references, photographs, and text to our LifeDesks and Keys to Nature sites. Species pages for ca. 140 Western Great Lakes taxa, which are already in preparation, will either be uploaded to LifeDesks or cut-and-pasted in (by Morton Arboretum staff) prior to the meeting to allow revision and completion during the meeting. Two conference calls will be planned for the taxonomy group and two for the key-writing group, and training in the LifeDesk and Keys to Nature systems will be performed prior to the meeting.

### **Session 1 (regional *Carex*) Mon. – Weds.; Session 2 (global *Carex*) Weds. – Fri.**

*Sunday*      Session 1 participants arrive.

*Monday*      AM: Introduction; four workgroups review online keys drafted prior to session; begin entry of additional images for keys.  
PM: Continue revision of keys and aligning images with keys; progress reports by workgroups and discussion at end of day.

*Tuesday*      AM: Workgroups finish revision of illustrated keys and identify gaps to be filled by Keys to Nature staff at The Field Museum after the workshop; workgroups start revisions on previously drafted species pages for regional taxa.  
PM: Work groups continue revisions of regional species pages in LifeDesks; progress reports and discussion at end of day.  
 Session 2 participants arrive.

*Wednesday*      AM: Workgroups finish revision of regional species pages, and identify gaps to be

filled by Field Museum and Morton Arboretum staff after the workshop; final presentations for progress on keys and species pages to all attendees.

PM: Session 2 attendees give mini-lectures on higher-level phylogenetic work and taxonomic groups, and highlight nomenclatural and taxonomic problem areas; then, divide up tasks for cleaning up nomenclature and taxonomy. Some session 1 participants depart at end of day.

*Thursday* AM: Session 2 participants work on taxonomy of subdivided checklist.

PM: Workgroups work on taxonomy of subdivided checklist; results imported at the end of the day.

*Friday* AM: Session 2 workgroups reevaluate status of checklist and continue cleanup.

PM: Complete cleanup of checklist; wrap-up.

*Saturday* Participants in second session depart.

*Post-meeting* Following the meeting, the checklist and keys will undergo another round of review by participants and Morton Arboretum and Field Museum staff; the finalized checklist and keys then will be announced in a brief publication on the meeting to be submitted to *Systematic Botany* or *Taxon*, both international journals of plant systematics.

### **Tentative meeting logistics**

We propose that the meeting be hosted in a five-day (Monday through Friday) session at BioSynC in late August or September 2011 (these are the months that work best for the majority of participants). The meeting would be structured as two overlapping three-day sessions. The first session would focus on key-writing and species pages for the Great Lakes region. It would run from Monday a.m. through lunchtime on Wednesday. The second session would focus on taxonomy and nomenclature and would run from Wednesday morning through end of the day on Friday. We have allowed for the participants to overlap on Wednesday morning and lunch, allowing the key-writing group and the taxonomic group to interact. (Participants in session 1 also could attend the taxonomic lectures on Wednesday afternoon, at their discretion.) Moreover, international participants in the taxonomic session will have the option to arrive Monday rather than Tuesday, allowing for additional transition time. To ensure a smooth transition, Andrew Hipp will be fully available to work with members of the taxonomic group arriving Tuesday, while Bil Alverson continues to facilitate the key-writing work that day.

### **Meeting outcomes and products**

- Online publication (through *LifeDesks*) of a vetted, worldwide checklist of *Carex* with explicit section and clade membership;
- Web-based photo galleries linked to these vetted scientific names;
- Keys to the all *Carex* species of the Western Great Lakes Region, aimed at nonprofessionals, and linked to vetted, online species pages and images;
- Increased intercontinental collaboration on the taxonomy of this widespread and diverse genus;
- A roadmap to completing species pages for *Carex* of the world.

## Itemized meeting budget

**Location and dates.** BioSynC, Chicago; Late August or September, 2011.

**Table of travel and all expenses, itemized by participant**

Person	Days	Hotel	Food	Lodging	Flight	Driving	Ground transport, Visa
<b>Regional taxonomists</b>							
Jane Balaban	3	n	150	-	-	-	60
John Balaban	3	n	150	-	-	-	60
Ken Dritz	3	n	150	-	-	-	60
Jerry Wilhelm	3	n	150	-	-	-	60
Elizabeth Zimmerman	4	y	200	680	-	154	-
Undergrad, FM	5	n	-	-	-	-	-
Undergrad, MOR	5	n	-	-	-	-	-
<b>Regional and global taxonomists (* denotes sharing a room)</b>							
Marcial Escudero	5	n	-	-	-	-	-
Kyong-Sook Chung *	6	y	300	510	1,800	-	200
Ted Cochrane *	6	y	300	510	-	154	-
Tim Jones *	6	y	300	510	250	-	200
Bruce Ford *	6	y	300	510	600	-	200
Rob Naczi *	6	y	300	510	250	-	200
Tony Reznicek *	6	y	300	510	250	-	200
Paul Rothrock *	6	y	300	510	-	154	-
Marcia Waterway *	6	y	300	510	2,500	-	200
<b>Global taxonomists (square brackets indicate participant not yet confirmed)</b>							
Kerry Ford	5	y	250	850	1,700	-	250
Takuji Hoshino	5	y	250	850	1,850	-	200
Modesto Luceno	5	y	250	850	1,000	-	200
Eric Roalson	4	y	200	680	500	-	200
Julian Starr	4	y	200	680	500	-	200
Shu-Ren Zhang	5	y	250	850	2,000	-	550
Bruno Wallnöfer	5	y	250	850	1,000	-	200
[Gerald Wheeler]	6	y	300	1,020	200	-	200
[Karen Wilson]	5	y	250	850	1,950	-	200
<b>Key-writing and web-implementation</b>							
Bil Alverson	6	y	300	510	-	154	-
Andrew Hipp	5	n	-	-	-	-	-
Patrick Leacock	5	n	250	-	-	-	-
Gayle Tonkovich	5	n	250	-	-	-	100
Jennie Kluse	4	y	200	680	300	-	200
John Markel	3	n	150	-	-	-	-
Ryan Peters	3	n	150	-	-	-	-
David Shorthouse	6	y	300	510	300	-	1,700
<b>Total: \$44,146</b>		21	<b>7,000</b>	<b>13,940</b>	<b>16,950</b>	<b>616</b>	<b>5,640</b>

**Itemized meeting budget [continued from previous page]**

**Lodging.** Total costs, \$13,940 for a total of 100 nights, covering 21 people. Eight North American participants who will be sharing hotel rooms to economize.

**Food.** Total = \$7,000, assuming \$50/person/day.

**Miscellaneous.** Ground transport has been allowed for fliers and regional commuters. Visa application expenses have been added for Zhang (China).

**Co-sponsorship.** Expenses for undergraduates and Morton Arboretum participants (except Dr. Chung, whose postdoc ends in February, barring additional funding) will be covered by institutional funds and an NSF grant to Hipp on the systematics of *Carex* subgenus *Vignea*. Also, Dr. Chung, one of the postdoctoral participants, has applied for an EOL Rubinstein Fellowship to work on species pages. If funded, her project would be a significant help in starting the synthesis work.

**References**

- [1] Starr, J. and B. Ford, Phylogeny and Evolution in Cariceae (Cyperaceae): Current Knowledge and Future Directions. *The Botanical Review*, 2009. 75(1): 110-137. [2] Reznicek, A.A., Evolution in sedges (Carex, Cyperaceae). *Canadian Journal of Botany*, 1990. 68: 1409-1432. [3] Hipp, A.L., A checklist of carices for prairies, savannas and oak woodlands of southern Wisconsin. *Transactions of the Wisconsin Academy of Sciences Arts and Letters*, 1998. 86: 77-99. [4] Wheeler, G.A. and G.B. Ownbey, Annotated list of Minnesota Carices, with phytogeographical and ecological notes. *Rhodora*, 1984. 86: 151-231. [5] Kükenthal, G., Cyperaceae-Caricoideae, in *Das Pflanzenreich IV*, A. Engler, Editor. 1909, Wilhelm Engelmann: Leipzig. pp. 1-824. [6] Catling, P.M., A.A. Reznicek, and W.J. Crins, Introduction: Papers from a symposium on Carex hosted 16 June 1987 by the Systematics and Phytogeography section of the Canadian Botanical Association. *Canadian Journal of Botany*, 1990. 68(7): 1405-1408. [7] Naczi, R.F.C. and B.A. Ford, eds. *Sedges: Uses, Diversity, and Systematics of the Cyperaceae*. *Monographs in Systematic Botany from the Missouri Botanical Garden*. Vol. 108. 2008, Missouri Botanical Garden Press: St. Louis. [8] Thomas, W.W., et al., Forward to Cyperaceae: A special issue based on papers presented at two symposia on Cyperaceae held during the XVII International Botanical Congress in Vienna, Austria in July of 2005. *Botanical Review*, 2009. 75(1): 1. [9] Columbus, J.T., et al., eds. *Monocots: Comparative Biology and Evolution—Poales*. *Aliso: A Journal of Taxonomic and Evolutionary Biology*. Vol. 23. 2007, Rancho Santa Ana Botanic Garden: Claremont. [10] Egorova, T.V., *The Sedges (Carex L.) of Russia and Adjacent States*. 1999, St. Louis: Missouri Botanical Garden Press. [11] Ball, P.W. and A.A. Reznicek, *Carex* Linnaeus, in *Flora of North America*, Flora of North America Editorial Committee, Editor. 2002, Oxford University Press: New York. pp. 254-572. [12] Govaerts, R., et al., *World Checklist of Cyperaceae*. 2009, The Board of Trustees of the Royal Botanic Gardens, Kew. Published on the Internet; <http://www.kew.org/wcsp/> accessed 10 February 2010. [13] Ford, B.A., et al., Phylogeny of *Carex* subg. *Vignea* (Cyperaceae) based on non-coding nrDNA sequence data. *Systematic Botany*, 2006. 31(1): 70-82. [14] Waterway, M., T. Hoshino, and T. Masaki, Phylogeny, Species Richness, and Ecological Specialization in Cyperaceae Tribe Cariceae. *The Botanical Review*, 2009. 75(1): 138-159. [15] King, M.G. and E.H. Roalson, Exploring Evolutionary Dynamics of nrDNA in *Carex* Subgenus *Vignea* (Cyperaceae). *Systematic Botany*, 2009. 33(3): 514-524. [16] Hipp, A., P. Rothrock, and E. Roalson, The evolution of chromosome arrangements in *Carex* (Cyperaceae). *Botanical Review*, 2009. 75(1): 96-109. [17] Hipp, A.L., et al., Phylogeny and classification of *Carex* section *Ovales* (Cyperaceae). *International Journal of Plant Sciences*, 2006. 167(5): 1029-1048.