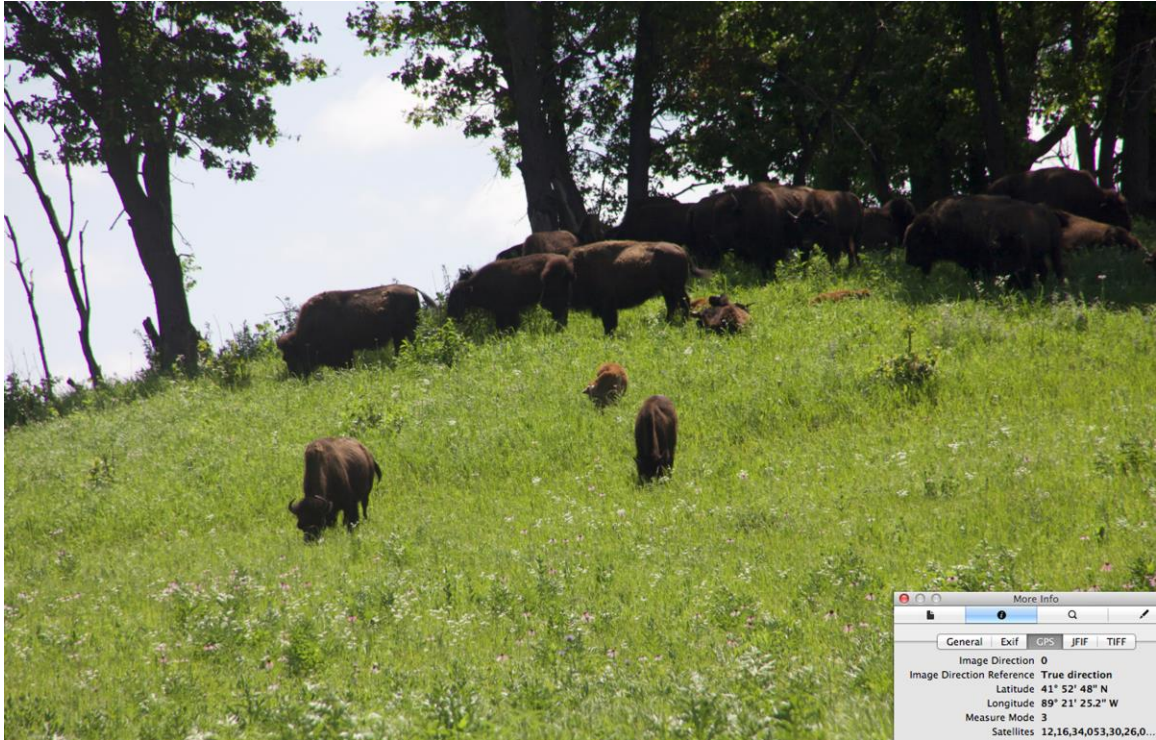


Additions to the Flora of Nachusa Grasslands: **Carex**

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Species richness is one of the goals of the Nachusa Grasslands restoration plan. Usually 0–7 *Carex* species are used in the restoration seed mixes, some from remnant prairies on site, and other mixes from nearby counties. Of the 750 recorded plants at NG, 65 are *Carex* species. *Carex* are valuable for bison, birds, and other small mammals. For the early settlers, the tight sod of sedges and grasses were cut and stacked to build their homes and the leaves used as tinder to start fires. The bison feeding on grasses and *Carex* were imaged with a gps locator camera by James M. Curtis to locate *Carex* later for identification.

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The Nature Conservancy's Nachusa Grasslands spans 4,000 acres of isolated karst topography of both Lee and Ogle Counties, Illinois. During 2016 & 2017 *Carex* species were collected and examined microscopically, then submitted as labeled specimens to the herbarium in Nachusa Grasslands headquarters. A total of 47 voucher specimens, data from field reports, and new collection increased the known flora at Nachusa Grasslands to 65 *Carex* species. A potential for 89 *Carex* species is based on species known to occur in the surrounding Lee and Ogle Counties. Seven new native *Carex* species were collected: *C. austrina*, *C. conoidea*, *C. echinodes*, *C. frankii*, *C. lunelliana*, *C. mesochorea* and *C. radiata*. Two former varieties raised to species status were *C. muhlenbergii* var. *austrina* and *C. gravida* var. *C. lunelliana*.

Introduction

The Nature Conservancy's Nachusa Grasslands, NG, in north central Illinois spans 4,000 acres on karst topography in Lee and Ogle Counties. The NG headquarters on Lowden Road near Franklin Grove has an onsite herbarium with a plant inventory list. Field data reported additional species, and provided another list (Hartman, 2016). Permits to collect *Carex* were granted from The Nature Conservancy, Illinois Nature Preserve Commission, and a special permit to collect rare, endangered or threatened *Carex* from IDNR in case of their discovery. Illinois karst map, right, with permission from Illinois State Geologic Survey, 2017.



Research to find new *Carex* began with online herbaria searches for *Carex* known in both Lee and Ogle counties from Illinois Natural History Survey Herbarium ILLS and Illinois State Museum Herbarium ISM. Also, county distribution maps were checked in *Illustrated Flora of Illinois: Carex* describing 193 species (Mohlenbrock, 2011). Nearby Illinois Audubon Amboy Marsh was field searched in 2015 and 33 *Carex* species were collected within its 302 acres.

The collections at NG began in June through July as *Carex* species differ and mature at different times with a few woodland species persisting into autumn. Special consideration was given to collect species well away from the grazing bison herd that moved daily between uplands and lower ponded areas that have *C. atherodes*, a favored bison food, that grows as an emergent aquatic in ponds and streams.

METHODS

Carex were collected and kept fresh until scanned and micro-imaged, then dried in a plant press and sent to herbaria. Some with roots were potted and grown into maturity. Almost half were in subgroup *Carex* subgroup *Vignea* with flat or flattish perigynia and without separate male spikes. The *Vignea* include Fox Sedges with ridge-margined perigynia and Ovals Sedges with wing-margined perigynia. The remaining were *Carex* subgroup *Carex* that have a separate male spike and inflated or compressed perigynia.

Field images of *Carex* were photographed by James M. Curtis using a geo-referencing camera that labeled the photos with their GPS for relocating later in the season when seed heads had matured sufficiently for identification. Some species were imaged in field using a macro-lens in the field and all were collected fresh to photograph later with a digital camera on an OMANA microscope.

RESULTS

Descriptions of the new native *CAREX* species for NG 2017

1. *Carex austrina*, southern bracted sedge, was formerly *C. muhlenbergii* var. *austrina*, and *C. muhlenbergii* var. *inermis* is now *C. plana* as described in *Flora of Illinois: Carex*. Mohlenbrock, 2011). Many herbaria use *Flora of North America* (2002) as a standard and use the previous names. UPL C=4

C. muehlenbergii var. *meuhlenbergii*, sand bracted sedge, has thick nerves on both sides of the flattish perigynia while *C. austrina* has nerves only on one side and *C. plana*, nerveless sedge, is faintly or not nerved on both sides. *C. austrina*'s perigynia are 3.5–4.5 mm long, *C. muehlenbergii*'s are slightly smaller at 3–3.5. *C. plana*'s perigynia are smallest at 2.7–3.1 mm long. In the Chicago region prairies, *C. plana* is either absent or included with *C. muehlenbergii* var. *enermis* as described with perigynia 3–4.2 mm long (*Flora of the Chicago Region*, Wilhelm & Rericha, 2017) In width, *C. austrina*'s perigynia are wider at 2.2–3.0 mm wide, while *C. muehlenbergii*'s are 2–2.6 mm wide, and both are orb-ovoid. *C. plana*'s lance-ovoid perigynia are 1.8–2.2 mm wide. Intergradations occur among the species.

The scale of each perigynium is diagnostic as *C. muehlenbergii*'s are 2–2.5 mm wide, ovate, acute, and its awn is less than 1.7 mm. *C. austrina*'s are 2.5–3.0 mm+ wide, lance-ovate, and has awns greater than 1.7 mm long. *C. plana*'s scales are narrower as 1.2–1.3 mm wide, lance-ovate, and short-awned. The lower bract of *C. austrina*'s seed head is broadly dialated at the base while *C. muehlenbergii*'s is not.

The *Illustrated Flora of Illinois: Carex* (Mohlenbrock 1999) first edition has an illustration of *C. muhlenbergii* (p 56) that was *C. muehlenbergii* var. *enermis*, and is now corrected to *C. plana* in the 2011 2nd edition (pages 339-243). The spelling was changed with an added e as the original name *muhlenbergii* had two dots or diacritical marks that are not allowed in epithets and became “ue” instead.

C. meuhlenbergii was one of the first sedge seed purchased for restoration mixes and sown in 51 acres of never plowed pasture in Big Woods Unit in 2003. UPL C=4

2. *C. lunelliana*, Lunell’s sedge, was *C. gravida* var. *lunelliana* in FNA (2002) but given species rank in *Flora of Illinois: Carex* (Mohlenbrock, 2011). Leaf width and number are diagnostic and *C. gravida* and *C. lunelliana* have leaves 4-8 mm wide and only 3-5 leaves per culm. Similar sedges with narrower and more numerous leaves are *C. muehlenbergii*, *C. austrina*, and *C. plana* with leaves 2-4 mm wide and 5-10 leaves per culm. The orb-ovoid, small-beaked perigynia are similar to *C. austrina*’s.

The scales differ as *C. gravida*’s awned scales exceed the perigynia. *C. lunelliana*’s scales are acuminate to cuspidate at the tips and shorter to almost equal the length of the perigynia. *C. gravida*’s perigynia are ellipsoid and faintly nerved on both sides while *C. lunelliana*’s are ovoid to orbicular and faintly nerved on one side. Both have perigynia 3.5-5 mm long but *C. gravida* has narrower perigynia 2.0-2.5 mm in width while *C. lunelliana*’s are much wider 3-5 mm. *C. gravida* has concave and fragile sheath summits while *C. lunelliana*’s are truncate and thick, like *C. austrina* and *C. meuhlenbergii*’s, but those have papillose leaves and sheaths when seen under magnification. FACU C=3

3. *C. mesochorea*, midland sedge, has ovate to rhombic perigynia, 3-4 mm long, flat wide margins, and nerveless. The leaves are 2–4 mm wide and the culms have 5–7 leaves that are papillose and similar in that character to *C. muhlenbergii* and *C. austrina* but those have longer seed heads to 5 cm long while *C. mesochorea*’s are capitate, 1.5-2 cm, similar to *C. cephalophora*. The leaf ligule is low, wider than long, not V-shaped, and the sheath summit is concave. *C. cephalophora* has longer than wide ligules and perigynia nerved on one face. Midland’s sedge’s distribution in Illinois is in south central Illinois counties; this collection is the northernmost.

4. *C. radiata*, straight-styled wood sedge, is similar to the common woodland sedge *C. rosea*, curly-styled wood sedge. The red stigmas distinguish these two starry seed head sedges. *C. radiata*’s are thin and stringy, longer than their sac beak, while *C. rosea*’s are shorter, thicker, and coiled. *C. radiata* usually grows in wetter soil than *C. rosea* that usually grows in upland woods (Curtis 2006). FAC C=5

5. *C. echinodes*, bristly oval sedge, is a new taxon related to *C. normalis*, spreading oval sedge, and *C. tenera*, narrow-leaved oval sedge. The oval sedges are in *Carex* subgroup Vigna: Ovales that have flat winged perigynia and stamens in the basal scales of its small spikes. Its associates include wetland plants including *Thelypteris palustris*, marsh fern. OBL C=10

6. *C. conoidea*, prairie gray sedge, has a separate male spike. *C. conoidea*'s perigynia are beakless and grooved with impressed veins while many other *Carex* have beaks and raised veins. In wet dolomite prairies these associate with *C. buxbaumii*, dark-scaled sedge, and *C. tetanica*, common stiff sedge. FACW C=8

7. *C. frankii*, bristly cattail sedge has a separate male spike. The dark seed heads have abruptly-beaked obovoid perigynia and the spikes are often concealed by leaves. Found along Kittentail Knobs lower trail. The seed heads were collected for future plantings in 2017 (Hartman, 2017). OBL C=4

DISCUSSION

NG has 26 *Carex* species that grow in permanent or temporary wetlands that includes marshes, wet prairies, sedge meadows, potholes and along streams and ponds. The remaining grow in mesic and upland prairies, savannas and woodlands.

The www.illinois.wildflowers.info lists 26 *Carex* species and their associates of five prairie habitats in Illinois: Black Soil Prairie, Dolomite Prairie, Gravel Prairie, Hill Prairie and Sand Prairie. The most common *C. brevior* grows in four of the prairie habitats, *C. bicknellii*, *C. granularis*, and *C. gravida* grow in two and *C. richardsonii* is listed in Gravel and Hill Prairie. As yet, these have not been found in NG.: *C. aurea*, *C. bushii*, *C. longii* and *C. tonsa*. Name changes include *C. brachyglossa* as *C. annectens* var. *xanthophylla*, *C. foena* as *C. siccata*. and *C. stenophylla* var. *enervis* as *C. duriuscula*.

Table 1. Carex in Prairie Habitat Types

Black Soil Prairie	Dolomite Prairie	Gravel Prairie	Hill Prairie	Sand Prairie
<i>C. bicknellii</i> *	<i>C. annectens</i> *	<i>C. pallescens</i> ,	<i>C. pallescens</i> ,	<i>C. aurea</i>
<i>C. brachyglossa</i> *	<i>C. bicknellii</i> *	<i>C. richardsonii</i> *	<i>C. richardsonii</i> *	<i>C. brevior</i> *
<i>C. brevior</i> *	<i>C. brevior</i> *	<i>C. stenophylla</i>	<i>C. stenophylla</i>	<i>C. bushii</i>
<i>C. bushii</i>	<i>C. crawei</i> *	var. <i>enervus</i>	var. <i>enervus</i>	<i>C. foena</i> *
<i>C. festucacea</i> *	<i>C. eburnea</i>			<i>C. longii</i>
<i>C. granularis</i> *	<i>C. frankii</i> *			<i>C. tonsa</i>
<i>C. gravida</i> *	<i>C. granularis</i> *			
<i>C. hirsutella</i>	<i>C. gravida</i> *			
<i>C. meadii</i>	<i>C. pedunculata</i>			
<i>C. molesta</i> *	<i>C. scoparia</i> *			
	<i>C. sterilis</i>			
	<i>C. stricta</i> *			
	<i>C. suberecta</i> *			
	<i>C. tetanica</i> *			
	<i>C. viridula</i>			

Note: Species found in NG are marked with an asterisk [*].

Table 2. Comparison of Carex of Nachusa Grasslands to County Records

Herbaria lists from Lee and Ogle Counties. L = Lee O = Ogle
 ILLS=Illinois Natural History Survey, ISM=Illinois State Museum Herbarium
 *Species collected + recorded field data at Nachusa Grasslands = 65 Carex.

Species	Common name	Herbaria & County
<i>C. aggregata</i> *	Smooth Clustered Sedge	ILL S, L O, ISM L
<i>C. albicans</i>	Blunt-scaled Oak Sedge	ILL S O
<i>C. albursina</i> *	White Bear Sedge	ILL S, ISM L
<i>C. alopecoidea</i>	Golden Fox Sedge	ISM L O
<i>C. annectens xanthocarpa</i> *	Small Yellow Fox Sedge	ILL S L, ISM O
<i>C. aquatilis substricta</i> *	Long-bract Tussock Sedge	ISM O
<i>C. atherodes</i> *	Hairy-leaved Lake Sedge	ISM L
<i>C. austrina</i> *	Southern Sedge	neither
<i>C. bebbii</i> *	Bebb's Oval Sedge	ISM L
<i>C. bicknellii</i> *	Copper-shoulder Oval Sedge	ILL S L, ISM O
<i>C. blanda</i> *	Charming Wood Sedge	ILL S, ISM L O
<i>C. brevior</i> *	Plains Oval Sedge	ILL S L O, ISM O
<i>C. buxbaumii</i> *	Dark-scaled Sedge	ILL S L, ISM O
<i>C. cephaloidea</i> *	Rough Clustered Sedge	ILL S O, ISM O
<i>C. cephalophora</i> *	Short-headed Bracted Sedge	ILL S O, ISM L O
<i>C. comosa</i> *	Bristly Sedge	ILL S, ISM L
<i>C. conjuncta</i> *	Green-headed Fox Sedge	ILL S O
<i>C. conoidea</i> *	Prairie Gray Sedge	ILL S, ISM L, O
<i>C. crawei</i>	Early Fen Sedge	ISM L
<i>C. crinita</i> *	Fringed Sedge	neither
<i>C. cristatella</i> *	Crested Oval Sedge	ILL S, ISM L O
<i>C. davisii</i> *	Awed Graceful Sedge	ISM L
<i>C. debilis</i>	Northern Weak Sedge	ILL S L
<i>C. eburnea</i>	Ivory Sedge	ILL S, ISM O
<i>C. echinodes</i>	Bristly Oval Sedge	neither
<i>C. emoryi</i> *	Riverbank Sedge	ILL S O, ISM L
<i>C. festucacea</i> *	Fescue Sedge	ILL S L, ISM O
<i>C. frankii</i> *	Bristly Cattail Sedge	ISM L
<i>C. gracillima</i> *	Graceful Sedge	ILL S O
<i>C. gracilescens</i>	Slender Wood Sedge	ISM O
<i>C. granularis</i> *	Grain Sedge	ISM L O

<i>C. gravida</i> *	Heavy Sedge	ILLS, ISM L O
<i>C. grayi</i>	Gray's Sedge	ISM L
<i>C. grisea</i> *	Wood Gray Sedge	ILLS, ISM L O
<i>C. haydenii</i> *	Long-scaled Tussock Sedge	ILLS, ISM L
<i>C. hirtifolia</i> *	Hairy Wood Sedge	ILLS O
<i>C. hitchcockiana</i>	Hairy Gray Sedge	ILLS O
<i>C. hystericina</i> *	Porcupine Sedge	ILLS, ISM L, ISM O
<i>C. interior</i> *	Prairie Star Sedge	ISM L
<i>C. jamesii</i> *	James's Sedge	ILLS O
<i>C. lacustris</i> *	Lake Sedge-Rip-gut	ILLS L, ISM O
<i>C. laeviconica</i> *	Long-tooth Lake Sedge	ILLS O
<i>C. laevivaginata</i> *	Smooth Sheathed Fox Sedge	Neither
<i>C. lasiocarpa</i>	Narrow Woolly Sedge	ISM L
<i>C. leavenworthii</i>	Dwarf Bracted Sedge	ISM L, O
<i>C. longii</i>	Long's Sedge	ISM L
<i>C. lunelliana</i> *	Lunell's Sedge	Neither
<i>C. lupuliformis</i> *	Knobbed Hop Sedge	Neither
<i>C. lupulina</i> *	Hop Sedge	Neither
<i>C. lunelliana</i>	Lunell's Sedge	Neither
<i>C. lurida</i> *	Bottlebrush Sedge	Neither
<i>C. meadii</i>	Mead's Sedge	ILLS, ISM L
<i>C. mesochorea</i> *	Midland Bracted Sedge	Neither
<i>C. molesta</i> *	Troublesome Oval Sedge	ILLS L O, ISM L
<i>C. muehlenbergii</i> *	Sand Bracted Sedge	ILLS L O, ISM neither
<i>C. muskingumensis</i> *	Swamp Oval Sedge	Neither
<i>C. normalis</i> *	Spreading Oval Sedge	ILLS O, ISM L O
<i>C. oligocarpa</i> *	Few-fruited Gray Sedge	ILLS O, ISM O
<i>C. pedunculata</i>	Long-stalk hummock Sedge	ILLS O
<i>C. pellita</i> *	Woolly Sedge	ILLS, ISM L O
<i>C. pennsylvanica</i> *	Penn Sedge	ILLS, ISM L O
<i>C. praegracilis</i> *	Expressway Sedge	ISM L, ILLS O
<i>C. prairea</i> *	Fen Panicked Sedge	Neither
<i>C. projecta</i>	Loose-headed Sedge	ILLS L
<i>C. radiata</i> *	Straight style Star Sedge	Neither
<i>C. richardsonii</i> *	Prairie Hummock Sedge	ISM O
<i>C. rosea</i> *	Curly-styled Wood Sedge	ISM L O, ILLS O
<i>C. rostrata</i>	Northern Beaked Sedge	ISM L

<i>C. sartwellii</i> *	Running Marsh Sedge	ILLS L, ISM O
<i>C. scoparia</i> *	Lance-fruited Oval Sedge	ILLS L, ISM O
<i>C. shortiana</i>	Short's Sedge	ISM L
<i>C. siccata</i> *	Running Savanna Sedge	ISM L, ISM neither
<i>C. sparganioides</i> *	Loose-headed Bracted Sedge	ILLS L O, ISM neither
<i>C. sprengei</i> *	Long-beaked Sedge	ISM L, ILLS O
<i>C. sterilis</i>	Fen Star Sedge	ILLS, ISM L
<i>C. stipata</i> *	Awl-fruited Fox Sedge	ISM L O
<i>C. stricta</i> *	Tussock Sedge	ILLS L O, ISM O
<i>C. suberecta</i> *	Wedge-fruited Sedge	ILLS, ISM L
<i>C. swanii</i>	Downy Green Sedge	ILLS, ISM L
<i>C. tenera</i> *	Narrow-leaved Oval Sedge	ISM L
<i>C. tetanica</i> *	Stiff Sedge	ISM L
<i>C. texensis</i> *	Texas Bracted Sedge	ILLS O, ISM neither
<i>C. tonsa</i>	Smooth-fruited Sedge	ILLS L
<i>C. tribuloides</i> *	Bristle-bract Sedge	ISM L, ILLS O
<i>C. trichocarpa</i> *	Hairy-fruited Lake Sedge	neither
<i>C. umbellata</i> *	Umbrella Sedge	ILLS L, ISM L
<i>C. utriculata</i> *	Yellow Lake Sedge	Neither
<i>C. vesicaria</i> *	Tufted Lake Sedge	ILLS L, ISM L O
<i>C. vulpinoidea</i> *	Brown Fox Sedge	ILLS, ISM L O

The Nachusa Grasslands plant inventory listed 60 *Carex* species among 850 species. https://www.nachusagrasslands.org/uploads/5/8/4/6/.../plant_inventory_2_.pdf Another site included 36 *Carex* species that were field picked or purchased and catalogued for restoration projects, increasing the diversity of the seed mixes, but usage is usually 0-7 species per mix. *C. meadii* was introduced from non-site mixes. https://www.nachusagrasslands.org/uploads/5/8/4/6/58466593/pick_dates_scientific_name_order_1_.pdf

CONCLUSION

After reviewing field records, the Nachusa Grasslands herbarium inventory and the new field collections, 65 *Carex* species were compiled in an overall inventory with county species. This search revealed gaps between the herbarium lists based on vouchered specimens and those of field records. Additional species should be collected to provide a more complete inventory nearer the 89 vouchered *Carex* species in Lee and Ogle Counties. Two new species found were former varieties that were raised to species status: *C. austrina* and *C. lunnelliana*. Four new from this research were also new county records: *C. austrina*, *C. echinodes*, *C. mesochorea*, and *C. radiata*. None were on the IDNR threatened or endangered species list.

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