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A Floristic Analysis and Comparison of Plant Communities in Harlan County, Nebraska

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Historically, the Republican River Valley in Harlan County, Nebraska, has been extensively explored, but the county flora has continually been under-represented and has been found to lack records for plants that are considered common. During the 2009 growing season, a taxonomic study and comparison of 3 different sites in Harlan County was made. Site #1 was pastureland and Sites #2 and #3 were both riparian, located on the north side of the Republican River. Collections were pressed, dried, identified, and deposited in the University of Nebraska at Kearney Herbarium (NEBK). Forty-eight new county records were verified, including cutleaf-cucumber (*Cyclanthera dissecta*), a Tier 2 species listed by the Nebraska Natural Legacy Program. The species composition of three sites were compared using both Jaccard's (IS_j) and Sorensen's (IS_s) indices of similarity which are based on the species in common to two given sites and species that are exclusive to each site. According to Sorensen Index values, the two riparian sites (Sites #2 and #3) had the greatest percent similarity ($IS_s = 56.6\%$), followed by Sites #1 and #3 ($IS_s = 51.9\%$) and Sites #1 and #2 ($IS_s = 47.2\%$). Using Jaccard's index of similarity, separation among the sites was not as apparent. The floristic quality indices (FQI) for Sites #1, #2, and #3 (25.08, 12.07, and 22.96 respectively) were somewhat low when compared to FQI values from previous studies in the Loup River Valley of Nebraska. This study helps to document the current plant diversity of the area and updates the known flora of Harlan County, which now totals 395 species.

Key words: Harlan County flora, mixed-grass prairie, Republican River, floristic analysis

Introduction

South-central Nebraska played a major role in the early botanical history of Nebraska. The Spanish traversed this region, the traditional home of the Pawnee Tribe, as early as 1540-1542 when Coronado reached central Kansas. In 1820, the Long Expedition, with botanist Edwin James, made notable records from south-central Nebraska following the big bend of the Platte River. The Wyeth Expedition of 1834 with Thomas Nuttall also passed just to the north of the Republican River Valley and contributed many additional records to the region's flora. The J.C. Fremont expedition was next and moved through parts of the Republican Valley in 1843. Although numerous important plant collections were made, the total number of reported species was far below the number of plants that presently constitute the region's known flora. Therefore, the objective of this study was to provide additions to the flora of Harlan County, Nebraska, from surveys of three different plant communities. These included (1) upland, grazed prairie; (2) lowland riparian forest; and (3) lowland, riparian forest/riverbank communities. Initially, this project was designed to survey only natural, undisturbed sites. However, the best available upland prairie site selected for our study was subjected to seasonal grazing, and much of the riparian community had signs of exposure to limited human activity.

Harlan County, Nebraska (Figure 1), is located in south central Nebraska and has a total area of 143,547

Ha (554 mi²). Of this total, 5587 Ha are occupied by Harlan County Reservoir, resulting in a land area of 137,960 Ha (~532 mi²) for Harlan County (Mitchell et al. 1974). With the exception of the northeastern corner, which is

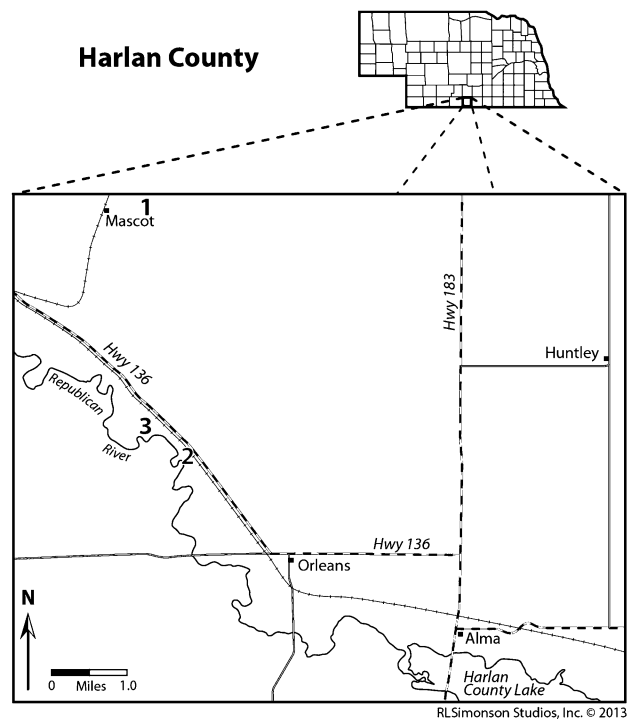


Figure 1. The study area in Harlan County, Nebraska, showing the approximate locations of Sites 1, 2, and 3.



Figure 2. A dust storm strikes Franklin, Nebraska, 26 March 1935.

nearly level, approximately 90% of the county occurs in the Republican River drainage, which runs west to east, just north of the Kansas-Nebraska state line. The pre-settlement vegetation was mostly mixed-grass prairie accented by scattered patches of riparian forest along the river and several spring-fed tributaries. Most of the remaining prairie is either grazed by cattle or has been converted to irrigated farmland. The river valley provides riparian communities, sand bars, riverbank sites, and occasional wetlands, which enhance the potential flora of the area. In addition to the Republican River Valley, the county's uplands are described as *Dissected Plains* with the amount of natural vegetation estimated at 15% (Kaul et al. 2011).

As a result of the sod-busting era (~1862 into the early 20th century), much of the original mixed-grass prairie bordering the valley has been converted to cropland (Kaul et al. 2011). This has provided increased opportunities for introduced, invasive, and weedy plant species to become established in the area and has added additional, but undesirable, diversity to the region's flora.

Historically, the Harlan County flora of ~347 species, has been under-reported as compared to other counties in the region. For example, Webster County, ~40 km to the east, has a minimum flora of 604 species, and Kearney County to the northeast has a reported 586 species (Kaul and Rolfsmeier 1994; Kaul et al. 2011, Kaul and Simpson 2012). In a ranking of Nebraska's

93 counties based on each county's total flora, Harlan County originally was rated 61st (Kaul and Rolfsmeier 1994).

Over the last several decades, Harlan County has experienced environmental extremes that have affected the flora. The Republican River Basin includes parts of southwest and south central Nebraska, north-eastern Colorado, and northwestern Kansas. It differs from the Platte and other western river basins because its flows rely totally on groundwater (springs) and precipitation, in contrast to the snow pack in the Rocky Mountains that feeds the Platte River headwaters. Historically, fluctuations in climate have been common, with periodic drought followed by years of above-normal precipitation. It is not unusual for daily summer temperatures in the area to exceed 38° C accompanied by periods of little or no measurable precipitation. The region was greatly affected by the Great Drought of the 1930's (Figure 2) being on the northern edge of the Dust Bowl. The drought was punctuated by Black Sunday (14 April 1935) when winds and powder-dry soil created one of the largest dust storms ever reported, suffocating people and livestock. Later that same season (30 May 1935), torrential rains in the upper part of the Republican River Basin resulted in a record flood that swept down the valley and took ~113 lives. Consequently, the vegetation has undergone several shifts in species composition in fewer than 100 years.

The present day flora reflects an increase in plant species mainly as a result of invasive species and introductions that take advantage of disturbances caused by cultivation and grazing. Irrigation has mitigated the effects of periodic drought, allowing some species to persist that otherwise would not have survived. The Republican River Valley does provide habitat and the opportunity for less adaptable plant species to inhabit an area that is known for climatic extremes and wide fluctuations in temperature and precipitation.

Material and Methods

Plants were collected at three contrasting sites in Harlan County (Figure 1; Table 1) throughout the 2009 growing season as late as 9 October to insure the inclusion of early and late season species. Plants were collected to help determine the overall diversity of the county, as well as to identify any rare or previously unrecorded species for the county. All collections were pressed and dried using a standard plant press and were deposited in the University of Nebraska at Kearney Herbarium (NEBK). Nomenclature follows the *Flora of Nebraska 2nd ed.* (Kaul et al. 2011). In addition to the *Flora of Nebraska*, field guides by Farrar (2011), Johnson and Larson (1999), and Owensby (1980) were used to assist in plant identification. A species checklist of vascular plants collected at the three sites was made and new county records were designated (Appendix 1).

Jaccard’s Index of Similarity (ISj) was used to assess differences/similarities among the three sites.

$$ISj = \frac{c}{(a + b + c)} \times 100$$

where “c” is the number of common species, “a” is the number of species unique to site #1, and “b” is the number of species unique to site #2. For comparison, it was useful to apply another similarity test, Sorensen’s Index of Similarity (ISs),

$$ISs = \frac{2c}{a + b} \times 100,$$

where c = the number of species common to the two sites, a = the total number of species at a given site and b = the total number of species at the other site in the comparison. Coefficient of Conservatism (C) values as determined for Nebraska by Rolfsmeier and Steinauer (2003) were assigned to all native species in the study. A mean C value (Cm), and a Floristic Quality Index (FQI) were calculated for each of the three sites. The FQI serves as a point of comparison to other floristic studies and was determined using the equation

$$FQI = Cm \times \sqrt{n} ,$$

where n = the total number of native species recorded at a study site (Mushet et al. 2002).

Table 1. The locations of the three study sites, Harlan County, Nebraska.

| | | |
|--------|------------------------|---------------------------------------|
| Site 1 | Upland/Lowland Prairie | The W ½ SEC 36, T3N, R20W |
| Site 2 | Riparian | The NW ¼ of the SW ¼ SEC 6, T2N, R19W |
| Site 3 | Riparian | The SW ¼ SEC 36, T3N, R20W |

Table 2. Index of Similarity Values Comparing the Three Study Sites.

| | Jaccard’s (ISj) | Sorensen’s (ISs) |
|---------------|-----------------|------------------|
| Sites 1 and 3 | 40.0% | 51.9% |
| Sites 2 and 3 | 39.9% | 56.6% |
| Sites 1 and 2 | 31.3% | 47.2% |

Results and Discussion

Although the 3 sites were not exceptionally diverse and each had been subjected to a degree of disturbance, a total of 48 new records for Harlan County were made, increasing the total flora to ~ 395 species of vascular plants (Appendix). Most are common throughout central Nebraska, but were not previously reported for Harlan County. One Tier 2 species listed by the Nebraska Natural Legacy Project, cut-leaf cucumber (*Cyclanthera dissecta*), was recorded at Site #2, a riparian area on the north side of the Republican River. Cut-leaf cucumber is known only from Harlan, Furnas, and Red Willow Counties in Nebraska but is likely more widely distributed in the Republican River Valley.

Dominant woody species in the riparian sites (#2 and #3) include plains cottonwood (*Populus deltoides*), green ash (*Fraxinus pennsylvanica*), box elder (*Acer negundo*) and northern catalpa (*Catalpa speciosa*). The understory consists of a mixture of herbaceous species, such as motherwort (*Leonurus cardiaca*) and poke weed (*Phytolacca americana*), along with shrubs and vines that are not subjected to continual inundation. River bank and sandbar habitats differ floristically, and support a number of opportunistic species, such as umbrella sedge (*Cyperus odoratus*), water speedwell (*Veronica anagallis aquatica*), reed canary grass (*Phalaris arundinacea*), numerous sedges (*Carex* spp.) and rushes (*Juncus* spp.) that quickly colonize newly exposed substrate.

When we applied Jaccard’s Index of Similarity (ISj), our results were somewhat surprising (Table 2). The most similar sites were #1 and #3 (ISj = 40.0%) but this was essentially equal to the ISj value of the two riparian sites (#2 and #3) which = 39.9%. Sites #1 and #2 were the most dissimilar (ISj = 31.3%). Sorensen’s Index of Similarity was also used because it gives greater weight than Jaccard’s to the species that recur in the two test areas than to those that are unique to either area (Mueller-Dombois and Ellenberg 1974). Based on ISs values, Sites

#2 and #3 were the most similar (ISs = 56.6%), followed by Sites #1 and #3 (ISs = 51.9%), and Sites #1 and #2 (ISs = 47.2%) (Table 2).

Comparing the two methods, the results also indicate that there is not a great degree of separation or variability within the similarity values that were calculated. One explanation might be that the upland, grazed prairie (Site #1) does include a canyon and drainage area that seasonally contains standing water. A representative number of plant species that colonize this area are the same as those that occupy riverbank and sandbar communities (Sites #2 and #3).

A coefficient of conservatism value (C) as originally developed by Swink and Wilhelm (1979, 1994) was assigned to each native species in this study. We used values for Nebraska vascular plants as designated by Rolfsmeier and Steinauer (2003). These values rank native species in a given region on a scale of 0 to 10 and higher numbers give greater importance to native, endemic species that are limited to a narrow range of environmental characteristics. Low C values are assigned to plants that are highly reproductive and are adapted to a variety of habitats. By calculating an average or mean C for an area, this value can be used to assess the quality of vegetation present, or it may be incorporated into a Floristic Quality Index (FQI) for comparison to other sites in the region. Individually, the sites have relatively low Cm and FQI values. For Sites 1, 2, and 3, respectively, Cm values were 2.56, 1.82, and 2.23 and FQI values were 25.08, 12.07, and 22.96. As expected, Site #1, consisting of mixed-prairie and a seasonal wetland is the most diverse.

These values are low in comparison to recent studies that were completed in other river valleys of central Nebraska. In a plant survey of a Loup River meadow, Veloso and Rothenberger (2008) reported a mean C of 4.14 and a FQI of 64.4. Rothenberger et al. (2010) reported a mean C of 3.73 and an FQI of 50.7 resulting from a similar study of a South Loup River meadow. Although these findings are indicative of the higher species richness and floristic quality of the Loup River Valley, this study contributes significantly to the known flora of Harlan County.

Conclusion

The botanical diversity of Harlan County is mainly a result of the combination of upland mixed-grass prairie and the riparian/riverbank communities associated with the Republican River Valley that dominate the county's flora. Other plant communities of significance are the wooded uplands that extend west-east along the south side of the river, scattered wetlands, and the vegetation that borders small tributaries of the river. The Republican River Valley separates mixed-grass prairie

species with both northern and southern affinities. Several species reported on limestone outcrops in Franklin and Webster Counties, such as Fendler's aster (*Aster fendleri*), Fremont's leather-flower (*Clematis fremontii*), and Fremont's evening-primrose (*Oenothera macrocarpa* ssp. *fremontii*), reach the northern edge of their range here. Therefore, additional study of prairies south of the river is recommended and the above species should be targeted. While the flora of Harlan County remains under-studied, 48 newly discovered species were collected confirming the botanical importance and significance of Harlan County.

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[Appendix 1 follows.]

Appendix 1. A Species Checklist for Harlan County Study Sites. (R = new county record; * = nonnative species)

| Scientific Name | Common Name | Site | | | New county record | C-value |
|---|---------------------|------|---|---|-------------------|---------|
| | | 1 | 2 | 3 | | |
| <i>Abutilon theophrasti</i> Medikus | velvet-leaf | X | | X | | * |
| <i>Acer negundo</i> L. | box-elder | X | X | X | | 3 |
| <i>Agrostis stolonifera</i> L. | redtop | | | X | | * |
| <i>Achillea millefolium</i> L. | common yarrow | X | | | | 2 |
| <i>Amaranthus retroflexus</i> L. | redroot pigweed | X | | X | | 0 |
| <i>Ambrosia artemisiifolia</i> L. | common ragweed | X | | X | R | 0 |
| <i>Ambrosia psilostachya</i> DC. | western ragweed | X | | X | | 1 |
| <i>Ambrosia trifida</i> L. | giant ragweed | X | X | X | | 0 |
| <i>Ammannia robusta</i> Heer & Regel | toothcup | | | X | | 4 |
| <i>Amorpha fruticosa</i> L. | false indigo | | X | X | R | 5 |
| <i>Antennaria neglecta</i> Greene | pussytoes | X | | | R | 3 |
| <i>Apocynum cannabinum</i> L. | Indian hemp dogbane | | | X | | 2 |
| <i>Arctium minus</i> (Hill) Bernh. | common burdock | | X | X | | * |
| <i>Argemone polyanthemus</i> (Fedde) G.Ownbey | prickly poppy | X | | | | 1 |
| <i>Aristida purpurea</i> Nutt. | purple three-awn | X | | | | 5 |
| <i>Asclepias incarnata</i> L. | swamp milkweed | | X | X | R | 4 |
| <i>Asclepias purmila</i> (A. Gray) Vail | plains milkweed | X | | | R | 4 |
| <i>Asclepias syriaca</i> L. | common milkweed | | | X | | 1 |
| <i>Astragalus crassicaarpus</i> Nutt. | ground-plum | X | | | R | 7 |
| <i>Astragalus mollissimus</i> Torr. | wooly locoweed | X | | | | 3 |
| <i>Aster ericoides</i> L. ssp. <i>ericoides</i> | heath aster | X | | X | | 3 |
| <i>Aster oblongifolius</i> Nutt. | aromatic aster | X | | | | 5 |
| <i>Aster lanceolatus</i> Willd. subsp. <i>lanceolatus</i> | willowleaf aster | | X | X | R | 2 |
| <i>Bidens cernua</i> L. | bur-marigold | | X | X | | 3 |
| <i>Bidens comosa</i> (A.Gray) Wiegand | beggar-ticks | | | X | | 2 |
| <i>Bidens frondosa</i> L. | devil's pitchfork | | | X | R | 1 |
| <i>Bolboschoenus fluviatilis</i> (Torr.) Soják | river bulrush | | | X | R | 3 |
| <i>Bouteloua curtipendula</i> (Michx.) Torr. | side-oats grama | X | | X | | 5 |
| <i>Bouteloua gracilis</i> (Kunth) Lag. ex Griffiths | blue grama | X | | X | | 4 |
| <i>Brickellia eupatorioides</i> (L.) Shinners var. <i>corymbulosa</i> (Torr. & A.Gray) Shinners | false boneset | | | X | R | 4 |
| <i>Bromus inermis</i> Leyss. subsp. <i>inermis</i> | smooth brome | X | | X | | * |
| <i>Bromus japonicus</i> Thunb. ex Murr. | Japanese brome | X | | X | | * |
| <i>Bromus tectorum</i> L. | downy brome | X | | | | * |
| <i>Buchloe dactyloides</i> (Nutt.) Engelm. | buffalo grass | X | | | | 2 |
| <i>Callirhoe involucrata</i> (Torr. & A.Gray) A.Gray | purple poppy mallow | | | X | | 2 |
| <i>Calystegia sepium</i> (L.) R.Br. var. <i>angulata</i> (Brummitt) N.H. Holmgren | hedge bindweed | X | | | | 1 |
| <i>Cannabis sativa</i> L. | hemp | X | X | X | | * |
| <i>Capsella bursa-pastoris</i> (L.) Medik. | shepherd's purse | X | X | X | | * |
| <i>Carduus nutans</i> L. | musk thistle | X | | X | | * |
| <i>Carex blanda</i> C. Dewey | common wood sedge | X | | X | R | 2 |
| <i>Carex brevior</i> (C. Dewey) Mack. ex Lunell | fescue sedge | X | | X | | 4 |
| <i>Carex gravida</i> L.H. Bailey | heavy-fruit sedge | X | | | | 4 |
| <i>Carex laeviconica</i> C. Dewey | smooth-cone sedge | | | X | | 4 |

Appendix 1. A Species Checklist for Harlan County Study Sites. (R = new county record; * = nonnative species) (continued)

| Scientific Name | Common Name | Site | | | New county record | C-value |
|---|-----------------------|------|---|---|-------------------|---------|
| | | 1 | 2 | 3 | | |
| <i>Carex praegracilis</i> W. Boott | clustered field sedge | X | | | | 4 |
| <i>Catalpa speciosa</i> (L.) Bureau | northern catalpa | | X | X | | * |
| <i>Celtis occidentalis</i> L. | hackberry | X | | | R | 4 |
| <i>Cenchrus longispinus</i> (Hack.) Fernald | sandbur | X | X | X | R | 0 |
| <i>Chenopodium berlandieri</i> Moq. | pitseed goosefoot | X | X | X | | 0 |
| <i>Chenopodium simplex</i> (Torr.) Raf. | maple-leaf goosefoot | X | X | X | | 1 |
| <i>Chloris verticillata</i> Nutt. | windmill grass | X | X | X | | 0 |
| <i>Cirsium altissimum</i> (L.) Spreng. | tall thistle | X | X | X | | 1 |
| <i>Cirsium undulatum</i> (Nutt.) Spreng. | wavy-leaf thistle | X | X | X | | 4 |
| <i>Cirsium vulgare</i> (Savi) Tenore | bull thistle | X | | X | | * |
| <i>Conium maculatum</i> L. | poison-hemlock | | X | | | * |
| <i>Convolvulus arvensis</i> L. | field bindweed | X | X | X | | * |
| <i>Coryza canadensis</i> (L.) Cronquist | horseweed | X | X | X | | 0 |
| <i>Cornus drummondii</i> C.A. Mey. | rough-leaved dogwood | X | X | X | | 3 |
| <i>Croton texensis</i> (Klotzsch) Müll. Arg. | Texas croton | X | | X | | 1 |
| <i>Cyclanthera dissecta</i> (Torr. & A. Gray) Arn. | cutleaf-cucumber | | X | | R | 0 |
| <i>Cyclachaena xanthiifolia</i> Fresen. | big marsh-elder | | X | X | | 0 |
| <i>Cyperus odoratus</i> L. | rusty flatsedge | | | X | | 3 |
| <i>Cyperus squarrosus</i> L. | square flatsedge | | | X | | 2 |
| <i>Delphinium virescens</i> Nutt. | prairie larkspur | | | X | R | 6 |
| <i>Descurainia pinnata</i> (Walter) Britton | tansy mustard | X | | X | R | 0 |
| <i>Descurainia sophia</i> (L.) Webb ex Prantl | tansy mustard | X | | X | | * |
| <i>Desmanthus illinoensis</i> (Michx.) MacMillan ex B.L. Robinson | Illinois bundleflower | | | X | | 5 |
| <i>Desmodium canadense</i> (L.) DC. | Canada tickclover | | | X | | 5 |
| <i>Digitaria cognata</i> (Schult.) Pilg. | fall witchgrass | | | X | R | 4 |
| <i>Digitaria sanguinalis</i> (L.) Scop. | hairy crabgrass | | | X | | * |
| <i>Dyssodia papposa</i> (Vent.) A.S. Hitchc. | fetid-marigold | X | | X | R | 0 |
| <i>Echinochloa crus-galli</i> (L.) P. Beauv. | barnyard grass | | | X | R | * |
| <i>Echinocystis lobata</i> (Michx.) Torr. & A. Gray | wild-cucumber | | | X | | 3 |
| <i>Eclipta prostrata</i> (L.) L. | yerba de tajo | | | X | | 2 |
| <i>Elaeagnus angustifolia</i> L. | Russian olive | | | X | | * |
| <i>Eleocharis palustris</i> (L.) Roem. & Schultes | spike-rush | X | | X | | 4 |
| <i>Eleusine indica</i> (L.) Gaertn. | goosegrass | X | X | X | | * |
| <i>Ellisia nyctelea</i> (L.) L. | waterpod | X | | | | 0 |
| <i>Elymus canadensis</i> L. | Canada wild-rye | | | X | | 5 |
| <i>Elymus repens</i> (L.) Gould | quackgrass | X | | | R | * |
| <i>Elymus smithii</i> (Rydb.) Gould | western wheatgrass | X | | | R | 3 |
| <i>Elymus virginicus</i> L. | Virginia wild-rye | X | X | X | | 4 |
| <i>Eragrostis cilianensis</i> (All.) Vignolo ex Janch. | stinkgrass | X | | X | | * |
| <i>Eragrostis pectinacea</i> (Michx.) Nees | Carolina lovegrass | X | | X | | 0 |
| <i>Erigeron strigosus</i> Muhi. ex Willd. | prairie fleabane | X | | X | R | 2 |
| <i>Euphorbia davidii</i> Subils | toothed spurge | | | X | | 0 |
| <i>Euphorbia glyptosperma</i> Engelm. | ridge-seed spurge | | | X | | 0 |

Appendix 1. A Species Checklist for Harlan County Study Sites. (R = new county record; * = nonnative species) (continued)

| Scientific Name | Common Name | Site | | | New county record | C-value |
|---|-------------------------|------|---|---|-------------------|---------|
| | | 1 | 2 | 3 | | |
| <i>Euphorbia marginata</i> Pursh | snow-on-the-mountain | X | X | | | 0 |
| <i>Fraxinus pennsylvanica</i> Marshall | green ash | X | X | X | | 2 |
| <i>Gaura coccinea</i> Nutt. ex Pursh | scarlet gaura | X | | | | 4 |
| <i>Gaura parviflora</i> Dougl. ex Lehm. | velvety gaura | X | X | X | | 1 |
| <i>Gleditsia triacanthos</i> L. | honey-locust | | X | X | | 1 |
| <i>Hackelia virginiana</i> (L.) I.M. Johnst. | stickseed | | | X | | 2 |
| <i>Hedeoma hispida</i> Pursh | rough false pennyroyal | X | | | | 2 |
| <i>Helianthus annuus</i> L. | common sunflower | | | X | R | 0 |
| <i>Helianthus maximiliani</i> Schrad. | Maximilian sunflower | | | X | R | 4 |
| <i>Hesperis matronalis</i> L. | dame's-rocket | X | | | | * |
| <i>Hordeum jubatum</i> L. | foxtail barley | X | X | X | | 1 |
| <i>Hordeum pusillum</i> Nutt. | little barley | X | | | | 1 |
| <i>Juniperus virginiana</i> L. | red cedar | X | X | X | R | 1 |
| <i>Kochia scoparia</i> (L.) Schrad. | kochia | X | X | X | | * |
| <i>Lactuca scariola</i> L. | prickly lettuce | X | X | X | | * |
| <i>Lactuca canadensis</i> L. | wild lettuce | X | X | X | R | 2 |
| <i>Lappula redowskii</i> (Hornem.) Greene var. <i>cupulata</i> (A. Gray) M.E. Jones | cupseed | X | | | | 2 |
| <i>Leonurus cardiaca</i> L. | motherwort | | X | X | | * |
| <i>Lepidium densiflorum</i> Schrad. | pepper-grass | X | X | X | | 0 |
| <i>Leptochloa fusca</i> (L.) Kunth subsp. <i>fascicularis</i> (Lam.) N. Snow | sprangle-top | | | X | | 1 |
| <i>Liatrix punctata</i> Hook. | gayfeather | X | | | | 5 |
| <i>Lindernia dubia</i> (L.) Pennell | false pimpernel | | | X | | 5 |
| <i>Linum sulcatum</i> Riddell | grooved flax | X | | | R | 6 |
| <i>Lippia lanceolata</i> Michx. | fogfruit | | | X | | 3 |
| <i>Lithospermum incisum</i> Lehm. | fringed pucoon | X | | | | 5 |
| <i>Lygodesmia juncea</i> (Pursh) D. Don ex Hook. | skeleton weed | X | | | | 4 |
| <i>Malva neglecta</i> Wallr. | common mallow | | | X | R | * |
| <i>Medicago lupulina</i> L. | black medic | | X | X | | * |
| <i>Medicago sativa</i> L. subsp. <i>sativa</i> | alfalfa | | X | X | R | * |
| <i>Mentha canadensis</i> L. | field mint | | X | X | | 4 |
| <i>Meililotus albus</i> Medikus. | white sweet clover | | | X | | * |
| <i>Meililotus officinalis</i> (L.) Pallas | yellow sweet clover | X | | | | * |
| <i>Mentzelia decapetala</i> (Pursh ex Sims) Urban | ten-petal stickleaf | X | | | R | 5 |
| <i>Mimosa quadrivalvis</i> L. var. <i>nuttallii</i> (DC. ex Standl.) Beard ex Barneby | sensitive brier | X | | | | 6 |
| <i>Mirabilis nyctaginea</i> (Michx.) MacMill. | common four-o'clock | X | X | X | | 1 |
| <i>Morus alba</i> L. | white mulberry | X | X | X | | * |
| <i>Muhlenbergia mexicana</i> (L.) Trin. | wirestem muhly | X | | X | | 4 |
| <i>Muhlenbergia racemosa</i> (Michx.) Britton, Sterns, & Poggenb. | marsh muhly | X | | X | | 4 |
| <i>Nasturtium officinale</i> W.T. Aiton | water cress | X | | | R | * |
| <i>Nepeta cataria</i> L. | catnip | | X | X | | * |
| <i>Oenothera biennis</i> L. | common evening primrose | X | X | X | R | 1 |
| <i>Opuntia humifusa</i> (Raf.) Raf. | bigroot prickly-pear | X | | | | 5 |
| <i>Oxalis dillenii</i> Jacq. | gray oxalis | X | | X | | 0 |

Appendix 1. A Species Checklist for Harlan County Study Sites. (R = new county record; * = nonnative species) (continued)

| Scientific Name | Common Name | Site | | | New county record | C-value |
|---|----------------------------|------|---|---|-------------------|---------|
| | | 1 | 2 | 3 | | |
| <i>Oxytropis lambertii</i> Pursh | purple locoweed | X | | | | 6 |
| <i>Panicum capillare</i> L. | witchgrass | X | X | X | R | 0 |
| <i>Panicum dichotomiflorum</i> Michx. | fall panicum | X | X | X | | 0 |
| <i>Panicum oligosanthes</i> Schult. var. <i>scribnerianum</i> (Nash) Fernald | Scribner panicum | X | | | | 4 |
| <i>Panicum virgatum</i> L. | switchgrass | X | X | X | | 4 |
| <i>Parthenocissus vitacea</i> (Knerr) A. Hitchc. | woodbine | X | X | X | | 4 |
| <i>Pediomelum digitatum</i> (Nutt. ex Torr. & A. Gray) Isely | palm-leaf scurfpea | X | | | R | 6 |
| <i>Phalaris arundinacea</i> L. | reed canarygrass | X | X | X | | 0 |
| <i>Phytolacca heterophylla</i> Nees | clammy ground cherry | X | | | | 4 |
| <i>Physalis longifolia</i> Nutt. | common ground-cherry | X | | | | 0 |
| <i>Phytolacca americana</i> L. | pokeweed | X | X | X | R | 0 |
| <i>Plantago patagonica</i> Jacq. | wooly plantain | X | | | | 1 |
| <i>Poa pratensis</i> L. | Kentucky bluegrass | X | X | X | | * |
| <i>Polygonum aviculare</i> L. subsp. <i>depressum</i> (Meissn.) Arcang. | knotted | X | X | X | | * |
| <i>Polygonum bicorne</i> Raf. | pink smartweed | X | X | X | | 0 |
| <i>Polygonum lapathifolium</i> L. | pale smartweed | X | X | X | | 2 |
| <i>Polygonum pensylvanicum</i> L. | Pennsylvania smartweed | X | X | X | R | 0 |
| <i>Polygonum persicaria</i> L. | lady's thumb | X | X | X | | * |
| <i>Polygonum scandens</i> L. | climbing false buckwheat | X | X | X | | 1 |
| <i>Populus deltoides</i> Bartr. ex Marsh. subsp. <i>monilifera</i> (Aiton) Eckenwalder | Plains cottonwood | X | X | X | | 3 |
| <i>Prunus virginiana</i> L. | choke cherry | X | | | R | 3 |
| <i>Psoralegium tenuiflorum</i> (Pursh) Rydb. | slender-flowered scurf-pea | X | | | | 5 |
| <i>Ranunculus sceleratus</i> L. var. <i>sceleratus</i> | cursed crowfoot | | | X | | * |
| <i>Rhus glabra</i> L. | smooth sumac | | | X | | 2 |
| <i>Ribes missouriense</i> Nutt. | Missouri gooseberry | | | X | R | 4 |
| <i>Ribes odoratum</i> H.L. Wendl. | buffalo currant | | | X | | 4 |
| <i>Rorippa palustris</i> (L.) Bess. var. <i>glabra</i> (O.E. Schulz) Roy L. Taylor & MacBryde | bog yellow cress | X | X | X | | 4 |
| <i>Rosa woodsii</i> Lindl. | western wild rose | X | X | X | R | 4 |
| <i>Rudbeckia hirta</i> L. var. <i>pulcherrima</i> Farw. | black-eyed susan | | | X | R | 4 |
| <i>Rumex altissimus</i> A.W. Wood | pale dock | | | X | | 0 |
| <i>Rumex crispus</i> L. | curly dock | | X | X | | * |
| <i>Salix amygdaloides</i> N.J. Andersson | peach-leaf willow | X | | | | 4 |
| <i>Salix exigua</i> Nutt. subsp. <i>interior</i> (Rowlee) Cronquist | coyote willow | | | X | | 3 |
| <i>Salsola tragus</i> L. | Russian thistle | X | | | | * |
| <i>Salvia reflexa</i> Hornem. | Rocky Mountain sage | X | | | R | 0 |
| <i>Sambucus canadensis</i> L. | elderberry | X | X | X | | 2 |
| <i>Schizachyrium scoparium</i> (Michx.) Nash | little bluestem | X | | | | 4 |
| <i>Setaria faberi</i> R.A.W. Herrm. | Chinese foxtail | X | | | R | * |
| <i>Setaria pumila</i> (Poir.) Roem. & Schult. | yellow foxtail | X | X | X | | * |
| <i>Setaria verticillata</i> (L.) P.Beauv. | bristly foxtail | X | X | X | | * |
| <i>Setaria viridis</i> (L.) P. Beauv. | green foxtail | X | X | X | | * |
| <i>Sicyos angulatus</i> L. | bur-cucumber | | | X | | 1 |
| <i>Sisymbrium loeselii</i> L. | tall hedge mustard | | | X | R | * |

Appendix 1. A Species Checklist for Harlan County Study Sites. (R = new county record; * = nonnative species) (continued)

| Scientific Name | Common Name | Site | | | New county record | C-value |
|---|-------------------------|------|---|---|-------------------|---------|
| | | 1 | 2 | 3 | | |
| <i>Solanum carolinense</i> L. | Carolina nightshade | X | | X | | 2 |
| <i>Solanum interius</i> Rydb. | plains black nightshade | X | | X | | 0 |
| <i>Solanum rostratum</i> Dunal | buffalo-bur | X | X | X | | 0 |
| <i>Solidago canadensis</i> L. | Canada goldenrod | X | X | X | | 2 |
| <i>Solidago gigantea</i> Aiton | late goldenrod | X | X | X | | 3 |
| <i>Solidago missouriensis</i> Nutt. | Missouri goldenrod | X | | | | 5 |
| <i>Sonchus asper</i> (L.) Hill | prickly sow-thistle | | X | | | * |
| <i>Sorghastrum nutans</i> (L.) Nash | Indian grass | X | X | X | | 5 |
| <i>Spartina pectinata</i> Link | prairie cordgrass | | X | X | | 5 |
| <i>Sporobolus compositus</i> (Poir.) Merr. | rough dropseed | X | | X | | 3 |
| <i>Sporobolus cryptandrus</i> (Torr.) A. Gray | sand dropseed | | | X | R | 2 |
| <i>Stipa viridula</i> Trin. | green needle grass | X | | | | 4 |
| <i>Symphoricarpos orbiculatus</i> Moench | coralberry | X | X | X | | 2 |
| <i>Taraxacum officinale</i> F.H. Wigg. | common dandelion | X | X | X | R | * |
| <i>Teucrium canadense</i> L. var. <i>occidentale</i> (A.Gray) McClint. & Epling | American germander | | | X | | 4 |
| <i>Thelesperma megapotamicum</i> (Spreng.) Kuntze | greenthread | X | | | | 4 |
| <i>Toxicodendron radicans</i> (L.) Kuntze var. <i>rydbergii</i> (J.K. Small ex Rydb.) Erskine | poison ivy | X | X | X | | 2 |
| <i>Tragopogon dubius</i> Scop. | goatsbeard | X | | | R | * |
| <i>Tribulus terrestris</i> L. | puncture-vine | X | X | X | | * |
| <i>Tridens flavus</i> (L.) A.S. Hitchc. | purpletop | | | X | R | 2 |
| <i>Ulmus americana</i> L. | American elm | X | X | X | | 3 |
| <i>Ulmus pumila</i> L. | Siberian elm | X | X | X | | * |
| <i>Urtica dioica</i> L. subsp. <i>gracilis</i> (Aiton) Selander | stinging nettle | X | X | X | | 1 |
| <i>Verbascum thapsus</i> L. | mullein | X | X | X | | * |
| <i>Verbena bipinnatifida</i> Nutt. | fernleaf vervain | X | | | | 4 |
| <i>Verbena bracteata</i> Lag. & J.D. Rodriguez | prostrate vervain | X | | | | 0 |
| <i>Verbena hastata</i> L. | blue vervain | | | X | | 4 |
| <i>Verbena stricta</i> Vent. | hoary vervain | X | | X | | 2 |
| <i>Verbena urticifolia</i> L. | white vervain | | | X | | 3 |
| <i>Vernonia baldwinii</i> Torr. | western ironweed | X | | | R | 3 |
| <i>Veronica anagallis-aquatica</i> L. | water speedwell | | | X | | * |
| <i>Vitis riparia</i> Michx. | river-bank grape | X | X | X | | 3 |
| <i>Vulpia octoflora</i> (Walter) Rydb. | sixweeks-fescue | X | | | | 3 |
| <i>Xanthium strumarium</i> L. var. <i>canadense</i> (P. Mill.) Torr. & A. Gray | cocklebur | X | X | X | | 1 |