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THE SALINE WETLAND-MEADOW VEGETATION AND FLORA OF THE NORTH PLATTE RIVER VALLEY IN THE NEBRASKA PANHANDLE

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ABSTRACT

The saline wetlands associated with the Platte River have received very little attention from botanists since the 1890s, and several plants widespread in these habitats, such as rayless salt-marsh aster (*Aster brachyactis*), annual goldenweed (*Haplopappus annuus*) and thelypody (*Thelypodium integrifolium*) have been considered rare in the State. A floristic inventory of sixteen tracts of saline lowlands near the North Platte River in Garden, Morrill, and Scotts Bluff counties reveals the presence of 231 species of vascular plants (169 native and 62 introduced), including three Eurasian halophytes (*Althaea officinalis*, *Najas marina*, *Spergularia marina*) not previously reported from Nebraska. Saline habitats along the North Platte River have a larger number of halophytic species than similar habitats in eastern Nebraska, though data from eastern salt marshes are insufficient for quantitative comparisons of species richness.

† † †

Saline wetlands in Nebraska have received little attention until recently. Though several publications have brought the rarity and uniqueness of this habitat to light (Ducey, 1985; Farrar and Gersib, 1991; Gersib and Steinauer, 1991), they focused entirely on saline wetlands of the Salt Creek drainage in Lancaster and Saunders counties in eastern Nebraska. Two extensive areas of saline-alkali wetlands occur in western Nebraska, namely the alkaline lakes of the western Sandhills and the saline wetlands and meadows of the North Platte River floodplain in the Nebraska Panhandle (Fig. 1) (Kaul and Rolfsmeier, 1993).

No comprehensive survey of the vegetation and flora of any of the saline wetlands in Nebraska has ever been published. The eastern salt marshes have received the most attention, but most of the vegetational studies which exist mention only a few of the more prevalent species (e.g. Gersib and Steinauer, 1991; Shirk, 1924; Ungar et al., 1969). The most complete published listing of plants was given by Ducey (1987), who reported forty-four species from Lancaster County salt marshes, one-fourth of which were identified only to genus. The only comprehensive vegetational survey of a saline area in the State is an unpublished report by Rolfsmeier (1991) to the Lower Platte South Natural Resources District, in which 168 species were identified in two small degraded tracts in the Rock Creek drainage east of Ceresco in Saunders County. Of the remaining saline regions, the Sandhills lakes have received the most attention, primarily since they have long been recognized as important production and migration habitats for waterfowl. McAtee (1920) gave community descriptions and listings of wetland species found at numerous Sandhills lakes, including several alkaline ones. McCarraher (1977) provided data on physical characteristics of many more lakes, but recorded only submersed vascular plant species.

The saline wetlands of the North Platte bottoms, on the other hand, have been almost completely ignored by botanists and there are only two brief published descriptions of the vegetation there. Rydberg mentioned a few species found in these habitats in the report of his expedition for the U. S. Department of Agriculture in 1891 (Kiener, 1951). In Pound and Clements' classic *Phytogeography of Nebraska* (1898), the salt marshes of Scotts Bluff and Deuel (which then included Garden) counties were contrasted with eastern saline wetlands. These western communities were neglected in later publications on the State's vegetation, including Weaver's *Native Vegetation of Nebraska* (1965) and the first edition of the vegetation map of Nebraska (Kaul, 1975), but not the second (Kaul and Rolfsmeier, 1993).

In 1992 a study was undertaken to locate and survey areas of saline wetland-meadow vegetation in the

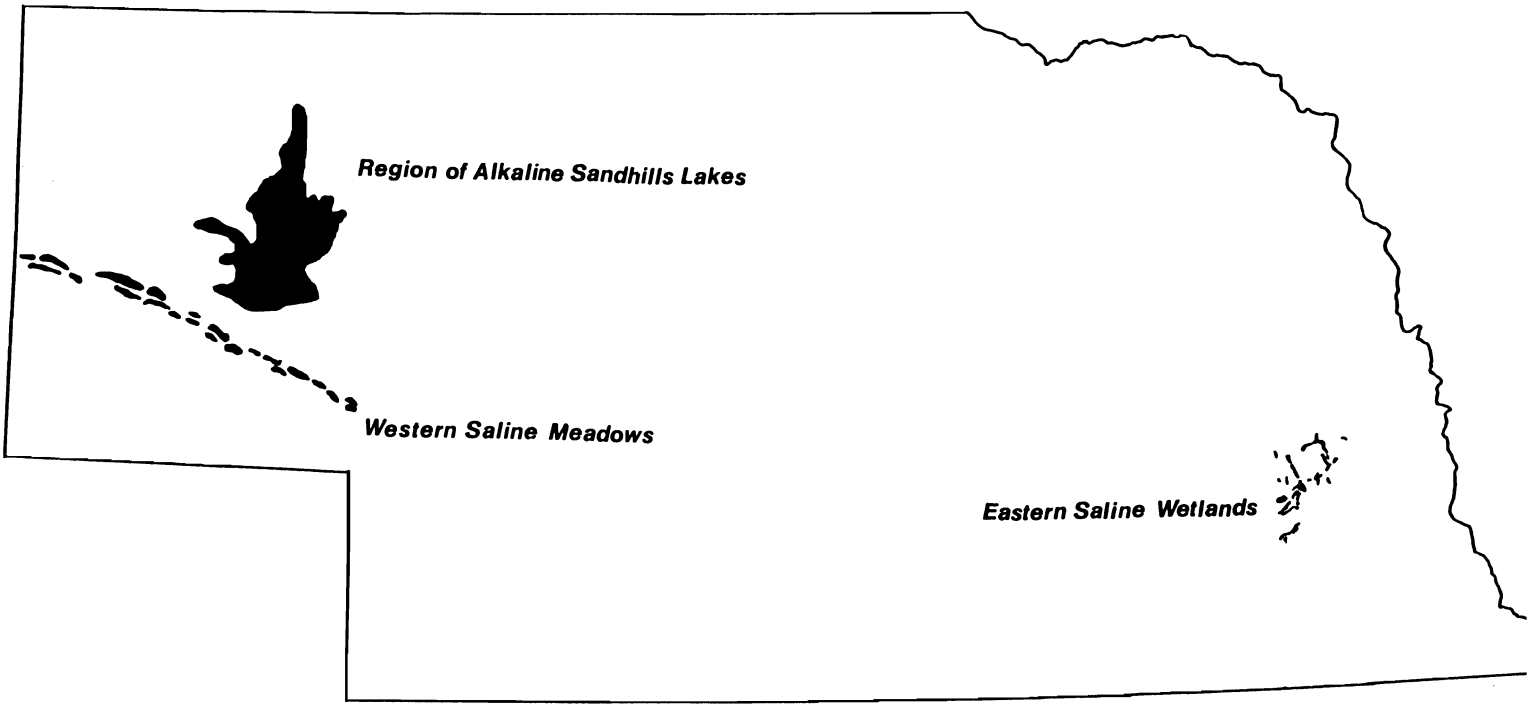

Figure 1. Major saline wetland communities in Nebraska.

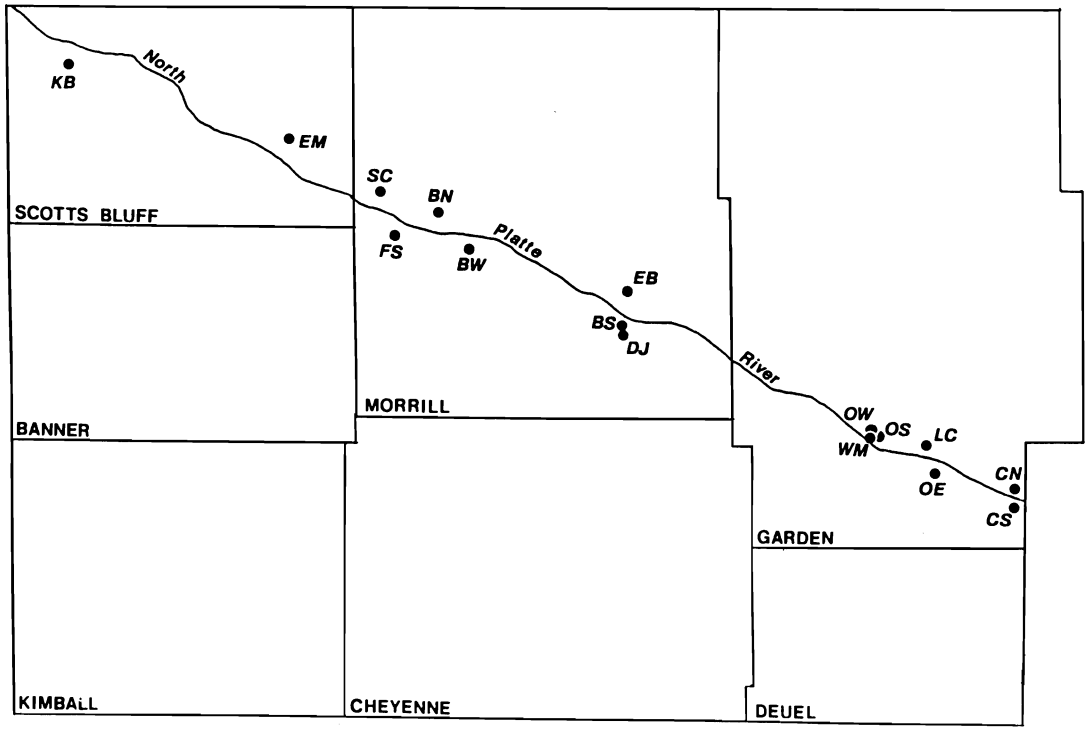

Figure 2. Locations of survey sites. **BN** = Bridgeport NW, **BW** = Bridgeport W, **BS** = Broadwater SE, **CN** = Clear Creek N, **CS** = Clear Creek S, **DJ** = Dead Juniper Meadow, **EB** = East Broadwater, **EM** = East Minatare, **FS** = Facus Springs, **KB** = Kiowa Basin Preserve, **LC** = Lost Creek Meadows, **OE** = Oshkosh E, **OS** = Oshkosh SW, **OW** = Oshkosh W, **SC** = Siegfried Corner, **WM** = Wilkinson Meadow.

North Platte River floodplain in Garden, Morrill and Scotts Bluff counties in the Nebraska panhandle. The primary goals of the survey were to describe the vegetational communities and to provide an initial inventory of species in this region, to ascertain the status of saltmarsh species considered rare in Nebraska, and to locate and evaluate areas of relatively undisturbed, high-quality saline wetland. A comparison of species composition between the North Platte bottom meadows and other saline wetlands in the State is also made.

METHODS

Areas of saline soils in the study area (the floodplain of the North Platte River in the Nebraska panhandle) were identified from U.S.D.A. soil surveys of Scotts Bluff (Yost et al., 1968), Morrill (Helzer et al., 1985), and Garden counties (in progress). An initial reconnaissance of all areas identified as having saline soils (survey area) that were accessible from roadsides was made in June to identify areas of well-preserved wetlands and meadows, and to compile an initial list of species to facilitate later survey work. Relatively well-maintained, accessible sites (Fig. 2) were then surveyed between late June and early October of 1992 where landowner permission was granted.

The first objective of the site surveys was to record all species of vascular plants in each saline wetland-meadow and to estimate the relative abundance of each. A form compiled from the initial survey was used as a checklist for each site. The second goal was to delineate and map populations of all *element* species (plants determined as potentially rare in the State cf. Clausen et al., 1989) within the survey area on U.S.G.S. 7.5 minute topographic quadrangles, with field notes on a separate form and a voucher specimen or photograph of each. Lastly, each site was outlined on the 7.5' quadrangles, and a written description of the vegetation and an evaluation of the quality of and threats to each site were recorded on another form, with each site given a letter ranking of "A" (pristine) to "D" (not distinguishable as native habitat) based on criteria established by the Nature Conservancy. In all, sixteen sites were inventoried during the summer, including two in Scotts Bluff County and seven apiece in Morrill and Garden counties. About half the sites were resurveyed in the fall. Vouchers were taken of many other plants in the survey area such as county records and infrequently-collected species.

DESCRIPTION OF WESTERN SALINE WETLAND-MEADOWS

Halomorphic soils, including saline and alkali soils, are formed in poorly-drained areas with parent material from which soluble salts are formed (Buckman and Brady, 1969). Saline soil associations comprise seven percent of the total land area of Morrill County and nine percent of Scotts Bluff County. The majority of these soils are located in the floodplain of the North Platte River, where conditions are favorable for the formation of such soils. The predominant soils of the survey area are saline-alkali soils of the Minatare-Janise complex. Minatare soils, which are normally intermingled with Janise soils in the western half of the valley, are very strongly alkaline silt loam with silty clay subsoil formed in fine-textured alluvium high in sodium and soluble salts. Janise soils are usually in lower positions on the landscape and are strongly-alkaline silt loams formed in slightly coarser calcareous alluvium often washed in from areas of weathered siltstone (Helzer et al., 1985). In the east half of the study area, Janise soils frequently lack inclusions of Minatare soils.

In much of the valley the water table is very shallow, varying seasonally from one to three feet in areas of Minatare-Janise soils. This allows soluble salts to be carried upward from the parent material by capillary action and to accumulate in the upper horizons of the soil surface. Since runoff is slow to almost nonexistent, accumulated salts are scarcely leached out of these soils. Shallow depressions pond rainwater, forming brackish basins in wet periods. Some areas remain as semi-permanent wetland, but most are only seasonally wet. As the surface water evaporates, dissolved salts crystallize, forming whitish crusts on the soil surface. These crusts have relatively high pH (often near 9), and high ratios of adsorbed sodium (Wilson, pers. comm.), hence they are frequently devoid of vegetation, or are occupied by very few, uniquely adapted plant species. Because of the adverse osmotic conditions of these soils to most crops, most of these areas have remained untilled. When plowed and then irrigated, enough salts may be leached out of the soil to permit cultivation of some saline-tolerant crops such as sugar beets, but most saline meadows in the North Platte floodplain have been left in native vegetation for hay harvesting and pasture.

Areas of saline soils may be relatively large, with units of Minatare-Janise soils in Morrill County as large as 640 acres (Helzer et al., 1985). The vegetation supported by these soils is fairly homogenous and relatively species-poor. Dominant species of saline meadows include halophytes—plants that grow almost exclusively in saline conditions. In the western saline meadows, the halophytic grass alkali sacaton (*Sporobolus airoides*) is one of the most conspicuous components of the vegetation and is commonly the most prevalent species. Although no measurements of species composition were made, Helzer et al. (1985) estimated coverage of 35 and 45 percent alkali sacaton

in grasslands on Janise and Minatare-Janise soils respectively. The most common associated species are saline-tolerant grasses and sedges such as slender wheatgrass (*Agropyron caninum*), western wheatgrass (*Agropyron smithii*), clustered field sedge (*Carex praegracilis*), foxtail barley (*Hordeum jubatum*), alkali muhly (*Muhlenbergia asperifolia*) and plains bluegrass (*Poa arida*).

Species composition is usually fairly consistent within the meadow, except in the more mesic depressions. In the semi-permanent wetland, emergent species are scarce and submerged plants such as sago pondweed (*Potamogeton pectinatus*) and horned pondweed (*Zannichellia palustris*) are common with green algae of the genus *Chara*. Wigeon grass (*Ruppia maritima*), commonly in brackish ponds, was not found during the survey. In the depressions associated with salt crusts, inland saltgrass (*Distichlis spicata*) is often dominant, forming a ring around the margin with other scattered halophytes such as sea blite (*Suaeda calceoliformis*) and occasionally alkali plantain (*Plantago eriopoda*). The central part of many salt crusts is dominated by depauperate plants of arrowgrass (*Triglochin maritimum*). A few saline-tolerant wetland species such as three-square bulrush (*Scirpus pungens*) and Baltic rush (*Juncus balticus*) are often common in low areas surrounding ponds and salt crusts. Other native halophytes observed during the survey include rayless saltmarsh aster (*Aster brachyactis*), spearscale (*Atriplex subspicata*), eastern cleomella (*Cleomella angustifolia*), sea milkwort (*Glaux maritima*), poverty weed (*Iva axillaris*), alkali grass (*Puccinellia nuttalliana*), prairie bulrush (*Scirpus maritimus*), Nevada bulrush (*Scirpus nevadensis*), and alkali cordgrass (*Spartina gracilis*).

Because of the inhospitable conditions for growth of plants not adapted to the extreme conditions of the salt marsh, many Eurasian species that are serious weeds in the Panhandle, such as smooth brome (*Bromus inermis*) and Canada thistle (*Cirsium arvense*), do poorly in saline soils, though they are frequently in road ditches and in uplands along the margins of the meadows. Relatively few saline-tolerant exotic species have been introduced into Nebraska, and fewer still have become weedy. One that could become a serious problem in this habitat is tall wheatgrass (*Agropyron elongatum*), which has been recommended for revegetation of saline range sites. As it matures, tall wheatgrass is avoided by cattle and can become a locally serious weed in overgrazed saline pastures. Strawberry clover (*Trifolium fragiferum*) is nearly ubiquitous in heavily-grazed saline pastures, being one of a few legume species that thrives in saline conditions. Small inclusions of other Eurasian clovers such as black medick (*Medicago lupulina*), alfalfa (*Medicago sativa*) and the sweet clovers (*Melilotus* spp.) are frequently seen as well.

Eurasian halophytes have become established at many places in the North Platte floodplain, and during the survey eight species were found, including Russian and halberd-leaved atriplex (*Atriplex heterosperma* and *A. prostrata*), clasping-leaf pepperwort (*Lepidium perfoliatum*), and Eurasian alkali grass (*Puccinellia distans*), which are widespread throughout the survey area. Marsh mallow (*Althaea officinalis*), alkali naiad (*Najas marina*), salt-marsh sand spurry (*Spergularia marina*), and redscale (*Atriplex rosea*) were each found at only one site; the first three of these have not been previously reported as occurring in Nebraska, while the fourth (redscale) represents the first Nebraska collection in fifty years.

Though homogenous for the most part, the vegetation of saline meadows frequently grades into surrounding plant communities. Along the margins of saline meadows the alkali sacaton grassland often merges imperceptibly into tall-grass prairie typical of non-saline soils of the Platte Valley. Tall grasses such as big bluestem (*Andropogon gerardii*), Indian grass (*Sorghastrum nutans*), and switchgrass (*Panicum virgatum*) predominate in this community, with a few shorter grasses such as blue grama (*Bouteloua gracilis*) and little bluestem (*Andropogon scoparius*) common in places. Switchgrass and blue grama are somewhat tolerant of salinity and are often found in areas with typical saline meadow species, the former often growing in a stunted condition in this habitat.

In many places, inclusions of Valent soil formed in eolian sands are interspersed with the Minatare-Janise soils in the floodplain, forming a mosaic of sandsage prairie dunes with saline meadows and wetlands occupying the level interdunal areas. The upland species were not included in the survey, except for infrequent instances where an upland species was established in the meadow. A large population of thickspike dalea (*Dalea cylindriceps*), which is rare throughout its range, was found at the East Broadwater site, and represents the only *element* species found in this habitat type at any of the survey sites.

Inclusions of freshwater wetland are not uncommon in saline meadows, particularly in areas of higher drainage, such as subirrigated sloughs and creeks, artificial drainageways such as irrigation canals and roadside ditches, and freshwater overflow ponds around watering troughs. *Juncus articulatus*, a boreal rush not previously reported in Nebraska, was found in a freshwater slough at Broadwater Southeast. Partial listings of the species found in this habitat were included in the survey where convenient.

ANNOTATED LIST OF SPECIES

Two-hundred thirty-one species were recorded from the sixteen survey sites including 169 native and 62 introduced species. All species are recorded in the following list, arranged alphabetically by family. Common names are provided following the Latin name, and nomenclature follows the *Flora of the Great Plains* (Great Plains Flora Association, 1986) unless more recent works indicate a misapplication of an epithet therein, in which case the synonym from the *Flora* is given in brackets. The treatment of *Atriplex* follows Bassett et al. (1983). Each common name is followed by letters representing whether each species is native or introduced, an estimate of abundance, habitats in which it is found, and the counties in which it was recorded. Symbols used in the list follow:

Provenance

N - native species
I - introduced species

Abundance

c - common, recorded in 11-16 sites
f - frequent, recorded in 7-10 sites
u - uncommon, recorded in 3-6 sites
r - rare, recorded in 1 or 2 sites
\+ - some sites surveyed before species could be positively identified, hence more common than indicated here

Habitat

a - aquatic, submersed in permanent or semi-permanent brackish ponds
d - disturbed ground
m - meadow, relatively dry, level grassland
s - salt crusts, seasonally wet brackish areas
w - wet ground, found in ground saturated through much of the year, including sloughs and marshes, often freshwater sites

County

G - Garden
M - Morrill
S - Scotts Bluff

An asterisk (*) preceding the species' name indicates an *element* species, discussed in more detail in the following section. A double asterisk (**) indicates a species not previously reported for Nebraska.

Alismataceae

Alisma triviale Pursh (water plantain). N; r; w; G.
Sagittaria latifolia Willd. (arrowhead). N; r; w; G.

Amaranthaceae

Amaranthus retroflexus L. (rough pigweed). N; r; d; S,M.

Apiaceae

Berula erecta (Huds.) Cov. (water parsnip). N; r; w; G.
Cicuta maculata L. (water hemlock). N; r; w; G.
Conium maculatum L. (poison hemlock). I; r; w; M.

Apocynaceae

Apocynum cannabinum L. (hemp dogbane). N; f; m; M,G.

Asclepiadaceae

Asclepias incarnata L. (swamp milkweed). N; u; w; M,G.
A. speciosa Torr. (showy milkweed). N; f; m; M,G.
A. verticillata L. (whorled milkweed). N; u; m; G.

Asteraceae

Ambrosia artemisiifolia L. (common ragweed). N; r; d; G.
A. psilostachya DC. (western ragweed). N; c; m; S,M,G.
A. trifida L. (giant ragweed). N; r; d; S,M.
Antennaria microphylla Rydb. (pink pussy-toes). N; r; m; G.
A. parvifolia Nutt. (pussy-toes). N; r; m; G.
Artemisia biennis Willd. (biennial wormwood). N?; r; m; S,M.
A. frigida Willd. (sagebrush). N; r; m; S.
**Aster brachyactis* Blake (rayless salt-marsh aster). N; u; w,m; S,M,G.
A. commutatus (T. & G.) Gray (white prairie aster). N; u+; m; S,M,G.
A. hesperius Gray (western lined aster). N; r; w; M,G.
A. pansus (Blake) Cronq. (clustered prairie aster). N; u+; m; S,M,G.
Bidens cernua L. (nodding beggar-ticks). N; u; w; S,G.
B. comosa (Gray) Wieg. (leafy beggar-ticks). N; r; w; G.
Carduus nutans L. (musk thistle). I; c; d; S,M,G.
Chrysopsis villosa (Pursh) Nutt. (golden aster). N; r; m; G.
Cirsium arvense (L.) Scop. (Canada thistle). I; c; w,m; S,M,G.
C. flodmanii (Rydb.) Arthur (Flodman thistle). N; f; m; M,G.
C. undulatum (Nutt.) Spreng. (wavy-leaved thistle). N; r; m; M.
C. vulgare (Savi) Ten. (bull thistle). I; f; d; S,M,G.
Conyza canadensis (L.) Cronq. (horseweed). N; c; d; S,M,G.
Crepis runcinata (James) T. & G. (hawk's-beard). N; f; m; M,G.
Erigeron bellidiastrum Nutt. (western fleabane). N; r; m; G.
E. strigosus Muhl. ex Willd. (daisy fleabane). N; r; m; G.
Euthamia gymnospermoides Greene (viscid euthamia). N; u; w; M,G.
E. occidentalis Nutt. (western euthamia). N; r; w; G.
Grindelia squarrosa (Pursh) Dun. (gumweed). N; u; d; S,M,G.
Gutierrezia sarothrae (Pursh) Britt. & Rusby (broom snakeweed). N; r; m; M.
**Haplopappus annuus* (Rydb.) Cory (annual goldenweed). N; u; d; S,M,G.
Helianthus annuus L. (common sunflower). N; u; d; S,M,G.
H. maximilianii Schrad. (Maximilian's sunflower). N; u; m; M,G.
Iva axillaris Pursh (poverty weed). N; u; m; M,G.
I. xanthifolia Nutt. (marsh elder). N; u; d; S,M,G.
Lactuca ludoviciana (Nutt.) Ridd. (western wild lettuce). N; u; m; M,G.
L. oblongifolia Nutt. (blue lettuce). N; r; m; G.
L. serriola L. (prickly lettuce). I; f; d; S,M,G.
Liatris lancifolia (Greene) Kittell (meadow blazing-star). N; u; m; M,G.
Onopordum acanthium L. (Scotch thistle). I; r; d; M.
Ratibida columnifera (Nutt.) Woot. & Standl. (prairie coneflower). N; f; m; M,G.
Rudbeckia hirta L. (black-eyed Susan). N; u; m; M,G.
***Scorzonera laciniata* L. (false salsify). I; r; m; G.
Solidago canadensis L. (Canada goldenrod). N; c; m; M,G.
S. missouriensis Nutt. (Missouri goldenrod). N; u; m; S,M,G.
S. rigida L. (stiff goldenrod). N; r; m; M,G.
Sonchus asper (L.) Hill (prickly sow thistle). I; r; d; M.
S. arvensis L. ssp. *uliginosus* (Bieb.) Nyman (field sow thistle). I; r; w; G.
Taraxacum officinale Weber (dandelion). I; c; d,m; S,M,G.
Thelesperma megapotamicum (Spreng.) O. Ktze. (slender greenthread). N; r; m; M.
Tragopogon dubius Scop. (western salsify). I; u; m; M,G.
Vernonia fasciculata Michx. (western ironweed). N; r; m; G.
Xanthium strumarium L. (cocklebur). N; r; d; S.

Boraginaceae

Lappula redowskii (Hornem.) Greene (stickseed). N; r; d; G.

Brassicaceae

Arabis hirsuta (L.) Scop. (rock cress). N; u; m; G.
Camelina microcarpa Andrz. ex DC. (small-seeded false flax). I; r; d; G.
Capsella bursa-pastoris (L.) Medic. (shepherd's purse). I; r; d; G.
Chorispora tenella (Pall.) DC. (blue mustard). I; r; d; G.
Descurainia pinnata (Walt.) Britt. (tansy mustard). N; u; d; S,M,G.
D. sophia (L.) Webb (flixweed). I; u; d; S,M,G.
Erysimum asperum (Nutt.) DC. (western wallflower). N; r; m; G.
Lepidium densiflorum Schrad. (peppergrass). N; f; d; S,M,G.
L. perfoliatum L. (clasping peppergrass). I; u; d; S,M,G.
Nasturtium officinale R. Br. (watercress). I; r; w; S.

Rorippa palustris (L.) Bess. var. *fernaldiana* (Butters & Abbe) Stuckey (bog watercress). N; r; w; S,M.
R. sinuata (Nutt.) Hitchc. (spreading yellow cress). N; r; w; M.
Sisymbrium altissimum L. (tumbling mustard). I; u; d; S,M,G.
S. loeselii L. (tall hedge mustard). I; r; d; S.
**Thelypodium integrifolium* (Nutt.) Endl. (thelypody). N; u; m; M,G.
Thlaspi arvense L. (field pennycress). I; r; d; G.

Cactaceae

Opuntia fragilis (Nutt.) Haw. (brittle prickly pear). N; r; m; G.
O. macrorhiza Engelm. (plains prickly pear). N; r; m; S,G.

Campanulaceae

Lobelia siphilitica L. (blue lobelia). N; r; w; M,G.
L. spicata Lam. (palespike lobelia). N; r; m; G.

Capparaceae

Cleome serrulata Pursh (Rocky Mountain bee plant). N; f; d; S,M,G.
Cleomella angustifolia Torr. (eastern cleomella). N; r; s; M.

Caprifoliaceae

Symphoricarpos occidentalis Hook. (western snowberry). N; u; w; M,G.

Caryophyllaceae

***Spergularia marina* (L.) Griseb (salt-marsh sand spurry). I?; r; w; S.

Chenopodiaceae

Atriplex heterosperma Bunge (Russian atriplex). I; u+; m; S,M,G.
***A. prostrata* Boucher ex DC. [*A. hastata*, misapplied] (halberd-leaved atriplex). I?; u; m; S,M,G.
A. rosea L. (redscale). I; r; d; G.
A. subspicata (Nutt.) Rydb. (spearscale). N; u+; m; S,M.
Chenopodium album L. (lamb's-quarters). I; r; d; M.
C. berlandieri Moq. (pitseed goosefoot). N; f; m; M,G.
C. glaucum L. (oak-leaved goosefoot). N; r; s; S,M.
C. pratericola Rydb. (narrow-leaved goosefoot). N; u; m; M,G.
C. rubrum L. (alkali blite). N; u; s; M,G.
Kochia scoparia (L.) Schrad. (kochia). I; c; d; S,M,G.
Salsola collina Pall. (Russian thistle). I; u; d; M,G.
Suaeda calceoliformis (Hook.) Moq. [*S. depressa*, misapplied]. N; c; s; S,M,G.

Commelinaceae

Tradescantia occidentalis (Britt.) Smyth (western spiderwort). N; r; m; G.

Convolvulaceae

Convolvulus arvensis L. (field bindweed). I; r; d; G.

Cyperaceae

Carex aurea Nutt. N; r; w; G.
C. crawei Dew. N; r; w; G.
C. emoryi Dew. N; r; w; G.
C. hystericina Muhl. ex Willd. (bottlebrush sedge). N; r; w; G.
C. nebrascensis Dew. (Nebraska sedge). N; u; w; S,G.
C. pellita Muhl. [*C. lanuginosa*, misapplied] (woolly sedge). N; r; w; M,G.
C. praegracilis W. Boott. (clustered field sedge). N; c; m; S,M,G.
Eleocharis erythropoda Steud. (spikesedge). N; f; w; S,M,G.
Fimbristylis puberula (Michx.) Vahl. N; u; m,w; M,G.
Scirpus acutus Muhl. (hardstem bulrush). N; r; w; M,G.
S. maritimus L. (prairie bulrush). N; r; m; M.
**S. nevadensis* S. Wats. (Nevada bulrush). N; u; s; S,M.
S. pungens Vahl (three-square bulrush). N; c; m; S,M,G.
S. validus Vahl (soft-stem bulrush). N; u; w; S,G.

Elaeagnaceae

Elaeagnus angustifolia L. (Russian olive). I; r; w; S,M.

Equisetaceae

Equisetum laevigatum A. Br. (smooth scouring-rush). N; c; m; M,G.

Euphorbiaceae

Euphorbia marginata Pursh (snow-on-the-mountain). N; r; d; G.
E. spathulata Lam. N; r; m; G.

Fabaceae

Dalea purpurea Vent. var. *purpurea* (purple prairie clover). N; r; m; G.
Glycyrrhiza lepidota Pursh (wild licorice). N; f; m; S,M,G.
Medicago lupulina L. (black medick). I; c; d,m; M,G.
M. sativa L. (alfalfa). I; f; d,m; S,M,G.
Melilotus alba Medic. (white sweet clover). I; f; d,m; S,M,G.
M. officinalis (L.) Pall. (yellow sweet clover). I; f; m,d; M,G.
Psoralea argophylla Pursh (silvery scurf-pea). N; r; m; G.
Trifolium fragiferum L. (strawberry clover). I; f; m; S,M,G.
T. pratense L. (red clover). I; r; m; G.
Vicia americana Muhl. ex Willd. (American vetch). N; u; m; G.

Gentianaceae

Eustoma grandiflorum (Raf.) Shinners (prairie gentian). N; f; m; M,G.

Iridaceae

Sisyrinchium montanum Greene (blue-eyed grass). N; f; m; M,G.

Juncaceae

***Juncus articulatus* L. N; r; w; M.
J. balticus Willd. (Baltic rush). N; c; m; S,M,G.
J. dudleyi Wieg. (Dudley rush). N; u; w; M,G.
J. nodosus L. (knotted rush). N; r; w; M,G.
J. torreyi Cov. (Torrey rush). N; r; w; M,G.

Juncaginaceae

Triglochin maritimum L. (arrowgrass). N; c; s; S,M,G.

Lamiaceae

Hedeoma hispidum Pursh (rough pennyroyal). N; r; m; G.
Lycopus americanus Muhl. ex Bart. (American bugleweed). N; u; w; M,G.
L. asper Greene (rough bugleweed). N; u; w; S,M,G.
Mentha arvensis L. (field mint). N; u; w; S,M,G.
Monarda pectinata Nutt. (lemon beebalm). N; r; m; G.
Nepeta cataria L. (catnip). I; u; d; S,G.
Scutellaria lateriflora L. (blue skullcap). N; r; w; M,G.
Teucrium canadense L. (American germander). N; u; w; M,G.

Liliaceae

Asparagus officinalis L. (asparagus). I; r; w; M.
Smilacina stellata (L.) Desf. N; u; m; M,G.

Linaceae

Linum rigidum Pursh var. *compactum* (A. Nels.) Rogers (stiffstem flax). N; u; m; M,G.

Lythraceae

Lythrum alatum Pursh (winged loosestrife). N; r; w; M,G.

Malvaceae

Althaea officinalis L. (salt-marsh hollyhock). I; r; d; M.

Mimosaceae

Desmanthus illinoensis (Michx.) MacM. (Illinois bundleflower). N; r; w; M.

Najadaceae

Najas guadalupensis (Spreng.) Magnus (naiad). N; r; a; M.
***N. marina* L. (alkali naiad). I; r; a; M.

Oleaceae

Fraxinus pennsylvanica Marsh. (green ash). N; r; w; M.

Onagraceae

Epilobium ciliatum Raf. (willow herb). N; r; w; G.
Gaura parviflora Dougl. (velvety gaura). N; f; d; S,M,G.
Oenothera villosa Thunb. (common evening-primrose). N; r; w; S,M.

Orchidaceae

Spiranthes magnicamporum Sheviak (plains lady's tresses). N; r; m; M.

Plantaginaceae

Plantago eriopoda Torr. (alkali plantain). N; f; m,s; M,G.
P. major L. (common plantain). I; u; m; S,M,G.

Poaceae

×*Agrohordeum macounii* (Vasey) Lepage (Macoun wildrye). N; u; m; M,G.
Agropyron caninum (L.) Beauv. (slender wheatgrass). N; c; m; S,M,G.
A. cristatum (L.) Gaertn. (crested wheatgrass). I; u; m; M,G.
A. elongatum (Host) Beauv. (tall wheatgrass). I; f; m; S,M,G.
A. smithii Rydb. (western wheatgrass). N; c; m; S,M,G.
Agrostis stolonifera L. (redtop). I; f; w,m; S,M,G.
Alopecurus aequalis Sobol. (meadow foxtail). N; r; w; G.
A. arundinaceus Poir. I; u; w; M,G.
Andropogon gerardii Vitman (big bluestem). N; u; m; M,G.
A. scoparius Michx. (little bluestem). N; u; m; S,M,G.
Bouteloua gracilis (H. B. K.) Lag. ex Griffiths. N; f; m; M,G.
Bromus inermis Leyss. (smooth brome). I; f; m; M,G.
B. japonicus Thunb. ex Murr. (Japanese brome). I; c; d; S,M,G.
B. tectorum L. (downy brome). I; f; d; S,M,G.

Dichanthelium acuminatum (Sw.) Gould & Clark var. *acuminatum*. N; r; m; G.
Distichlis spicata (L.) Greene (inland saltgrass). N; c; s; S,M,G.
Echinochloa muricata (Beauv.) Fern. (barnyard grass). N; u; w,d; S,M,G.
Elymus canadensis L. (Canada wildrye). N; r; m; M,G.
Eragrostis cilianensis (All.) E. Mosher (stinkgrass). I; r; d; M.
Festuca arundinacea Schreb. (tall fescue). I; r; m; M,G.
F. octoflora Walt. (sixweeks fescue). N; r; d; G.
Hordeum jubatum L. (foxtail barley). N; c; m; S,M,G.
H. pusillum Nutt. (little barley). N; r; d; S,M.
Leptochloa fascicularis (Lam.) Gray (sprangletop). N; r; w; S,M.
Muhlenbergia asperifolia (Nees & Mey.) Parodi (alkali muhly). N; f; m; S,M,G.
Panicum virgatum L. (switchgrass). N; f; m; S,M,G.
Phalaris arundinacea L. (reed canary grass). N; u; w; S,G.
Phleum pratense L. (timothy). I; u; m; M,G.
Phragmites australis (Cav.) Trin. ex Steud. (common reed). N; r; w; G.
Poa arida Vasey (plains bluegrass). N; c; m; S,M,G.
P. compressa L. (Canada bluegrass). I; r; m; M,G.
P. pratensis L. (Kentucky bluegrass). I?; f; m; M,G.
Polypogon monspeliensis (L.) Desf. (rabbit's-foot grass). I; u; w; S,G.
Puccinellia distans (L.) Parl. (Eurasian alkali grass). I; u; w,m; S,M,G.
P. nuttalliana (Schult.) A. Hitchc. (alkali grass). N; u; w,s; S,M.
Schedonnardus paniculatus (Nutt.) Trel. (tumblegrass). N; u; d; G.
Setaria glauca (L.) Beauv. (yellow foxtail). I; r; d; S,G.
S. viridis (L.) Beauv. (green foxtail). I; r; d; M,G.
Sitanion hystrix (Nutt.) J. G. Sm. (squirreltail). N; r; m; G.
Sorghastrum nutans (L.) Nash (Indian grass). N; u; m; M,G.
Spartina gracilis Trin. (alkali cordgrass). N; u; m,s; M,G.
S. pectinata Link (prairie cordgrass). N; f; w; M,G.
Sphenopholis obtusata (Michx.) Scribn. (prairie wedgegrass). N; f; w,m; M,G.
Sporobolus airoides (Torr.) Torr. (alkali sacaton). N; c; m,s; S,M,G.
S. asper (Michx.) Kunth (tall dropseed). N; u; m; S,M,G.

Polygonaceae

Polygonum lapathifolium L. (nodding willow weed). N; r; w; S.
P. persicaria L. (lady's-thumb). I; u; w; S,M,G.
P. ramosissimum Michx. (tall knotweed). N; c; s,m; S,M,G.
Rumex crispus L. (curly dock). I; u; w,m; S,M,G.
R. stenophyllus Ledeb. (dock). I; u; m; S,M,G.

Portulacaceae

Portulaca oleracea L. (purslane). I; r; d; S.

Potamogetonaceae

Potamogeton pectinatus L. (sago pondweed). N; r; a; S,M.

Primulaceae

**Dodecatheon pulchellum* (Raf.) Merrill (shooting star). N; u; m; M,G.
**Glaux maritima* L. (sea milkwort). N; r; m; M.

Ranunculaceae

Ranunculus cymbalaria Pursh (seaside crow's-foot). N; f; w,m; S,M,G.
R. sceleratus L. (cursed crow's-foot). N; r; w; G.

Rosaceae

**Potentilla anserina* L. (silverweed). N; r; m; M.
P. pensylvanica L. (cinquefoil). N; u; m; M,G.
Rosa arkansana Porter (Arkansas rose). N; r; m; G.
R. woodsii Lindl. (western wild rose). N; r; m; G.

Scrophulariaceae

Agalinis tenuifolia (Vahl) Raf. (slender gerardia). N; r; w; M.
Veronica anagallis-aquatica L. (water speedwell). I; u; w; S,G.

Solanaceae

Physalis longifolia Nutt. (common ground cherry). N; r; m; G.
Solanum interius Rydb. (plains nightshade). N; r; m; G.
S. rostratum Dun. (buffalo bur). N; u; d; S,M.
S. sarrachoides Sendtner (viscid nightshade). I; u; d; S,M.

Typhaceae

Typha angustifolia L. (narrow-leaved cat-tail). N?; u; w; M,G.
T. latifolia L. (broad-leaved cat-tail). N; u; w; M,G.

Verbenaceae

Lippia lanceolata (Michx.) Greene (fog-fruit). N; r; w; M.
Verbena hastata L. (blue vervain). N; u; w; M,G.
V. stricta Vent. (hoary vervain). N; u; m; M,G.

Zannichelliaceae

Zannichellia palustris L. (horned pondweed). N; r; a; S,M.

ELEMENT SPECIES IN THE SURVEY AREA

In all, 47 occurrences of eight *element* species (plants possibly rare in Nebraska) were recorded as follows:

Aster brachyactis, rayless saltmarsh aster, (5 occurrences) was previously reported from Keith and Cherry counties (Great Plains Flora Association, 1977; Sutherland and Rolfsmeier, 1989). This fall-flowering annual is common on sandbars, banks and terraces of the North Platte River throughout the study area and can be nearly weedy in places, such as at the bridge north of Gering. It is less common in saline meadows, being recorded from just five sites. In this habitat it is most frequent in places where the ground remains moist into the fall, and it does not seem particularly tolerant of grazing. It is common enough that it is not likely threatened in Nebraska.

Dodecatheon pulchellum, shooting star, (5 occ.) is found in low, mesic, often saline ground on margins of moist depressions in undisturbed meadows. It seems absolutely intolerant of grazing and is recorded from five sites, all but one hay meadows, where it is locally abundant. Shooting star is widespread throughout the study area, though no sites in Scotts Bluff County were recorded (both survey sites were grazed). A conspicuous plant in flower, it is quite common here and in places in the western Sandhills, several locals say. It does not seem threatened by current agricultural practices.

Glaux maritima, sea milkwort, (1 occ.) was collected only once previously in Nebraska in an alkaline swale along the Niobrara River in Sioux County. It is locally common at one site (BS) where it is restricted to a narrow strip of Janise soil in a small grazed meadow. It is found only atop small tussocks of uncompacted soil in a narrow wet swale, where it occurs with silverweed, *Potentilla anserina*. The swale extends into a heavily-grazed adjacent pasture, where sea milkwort is not found, though it grows up to the boundary fence. This site is moderately grazed now, but it seems possible that heavy or prolonged grazing may eliminate this population. This species is worthy of consideration for protection in Nebraska, our populations representing outliers of a more northerly range.

Haplopappus annuus, annual goldenweed, (19 occ.) is found in disturbed places, usually associated with saline soil. It may be abundant or occur as a few scattered individuals, but is most common as dense isolated colonies. Most common along roadsides, it does not seem to tolerate grazing or haying, though the largest population seen was in a horse pasture west of Lewellen. Found throughout the study area as far east as the mouth of Blue Creek in Garden County, it is also

widespread in alkaline sites in the western Sandhills and does not seem threatened.

Plantago elongata, slender plantain, (1 occ.) was not seen at any of the survey sites, but was in a small playa on the margin of a grazed saline meadow just inside the Scotts Bluff County line west of Bayard, representing the first collection of this species from the study area. There are historical collections from saline habitats near Lincoln, and it is likely more widespread along the North Platte, but is exceedingly inconspicuous. Further survey work is necessary to determine its status in Nebraska.

Potentilla anserina, silverweed, (2 occ.) was once widespread in the Platte and Missouri River valleys but is presently known in the State from only a few sites within the study area. Spreading by stolons, it may be common locally and was observed at one location in each of the three counties in the study area (no voucher was taken from Scotts Bluff County). Herb Karcher of Bridgeport, a student of the local flora, indicates there are several populations in Morrill County and further survey work is needed to determine its status.

Scirpus nevadensis, Nevada bulrush, (3 occ.) is disjunct from its main range in western North America and is locally abundant in salt-encrusted depressions KB, FS and SC. These collections represent the first recorded from the study area. It was collected three times previously in alkali sites in the western Sandhills of Box Butte and Sheridan Counties, and this year's work has doubled the number of known localities in Nebraska. Appropriate habitat is common in western Morrill and Scotts Bluff counties, but populations occur sporadically, though the plants are always common where it is found. Since it can be easily confused with three-square bulrush, it has likely been overlooked by previous collectors. Nevada bulrush was also found at Crescent Lakes Refuge in Garden County, and further survey work may reveal it to be widespread in the Panhandle. It does not seem to be threatened.

Thelypodium integrifolium, thelypody, (11 occ.) is a conspicuous plant found in moderately saline sites through the study area east of Oshkosh as well as in the western Sandhills. It can be locally common in unsaturated meadows and does not tolerate heavy grazing. Thelypody is most abundant in hay meadows and undisturbed roadside right-of-ways, as on the north side of Nebraska 92 between Bayard and McGrew. It does not seem immediately threatened by current management practices.

Three noteworthy non-*element* species were found during the course of the study. Greasewood (*Sarcobatus vermiculatus*) was locally common in dry ground in the western end of the survey area and two populations south of Morrill were mapped. Greasewood may be common in places (it has been reported from the badlands of northwest Nebraska and was also seen on the Lyman Plain) but has been infrequently collected in Nebraska in recent years. Eastern cleomella (*Cleomella angustifolia*) was locally common at Facus Springs and was seen in an overgrazed pasture south of Bayard. It has been collected from fewer than ten sites in the State and should probably be considered for *element* status. One plant new to Nebraska, *Juncus articulatus*, was found in a freshwater slough at Broadwater Southeast and represents a presumably native disjunct population of a boreal species. The next closest population is at Spearfish, South Dakota, and is represented by a specimen in the Chadron State College herbarium. *Juncus articulatus* should also be considered for inclusion on the *element* list.

One halophytic *element* species sought during the survey was not located. Seaside heliotrope (*Heliotropium curassavicum*) is a halophyte known from the western Sandhills and saline places along Pumpkin Creek, a tributary of the North Platte River, but has never been recorded from the study area.

Of the eight *element* species found, it appears that three are widespread enough to be excluded from consideration for protection, namely rayless saltmarsh aster, annual goldenweed, and thelypody. Three others (shooting star, silverweed, Nevada bulrush) are more common than previously thought, but probably warrant further field work to ascertain their status in the State. The status of slender plantain is still unclear, and one species, sea milkwort, may warrant protection.

DESCRIPTIONS AND EVALUATIONS OF SURVEY SITES

Bridgeport NW (BN)

Location: Morrill Co., ca 2 mi. NW of junction of U. S. 26 and 385 on 385 (N of Bridgeport), 3 mi. W, 1 mi. N, 1 mi. W, and 1 mi. S on county roads. **Size:** 80 acres (not including surrounding lands). **Usage**: grazing. **Landscape Condition**: Unfragmented, but much of the surrounding area is heavily grazed. Closer to the river the landscape is undisturbed, but is primarily sandy uplands. **Description**: The survey site had been heavily grazed and had withstood a freeze at the time of the survey, hence the vegetation could not be evaluated thoroughly. Some permanent seepage sloughs are found in the N part of the area which had been grazed to the ground. Limited grazing would restore much of the original vegetation, and because of its size and wetland resources would be of value if a large tract could be procured. Many of the wetlands in the S part are ephemeral. **Ranking**: C.

Broadwater SE (BS)

Location: Morrill Co., ca 1.5 mi. SSW of junction of U.S. 26 and Nebr. 92 (E of Broadwater) on 92, ca 1 mi. SE to the end of paved road, N side of road. **Size:** 100 acres. **Usage**: Grazing. **Landscape condition**: Degraded, though relatively unfragmented, the pastures to the W are heavily grazed. **Description**: Saline soils comprise only a small strip of the site, yet contain sea milkwort and silverweed. This area has a very high water table and freshwater sloughs abound. Russian olive and cottonwood are common and provide cover for wildlife. In fact until two years ago the area was preserved undisturbed as a hunting preserve. A cabin is present on the site, and some development is

taking place along the river, but much of the original vegetation could quickly recover if proper management were restored. **Ranking**: C.

Bridgeport West (BW)

Location: Morrill Co., S side of U.S. 26 ca 2 mi. W of junction with Nebraska 92 in Bridgeport. **Size**: 190 acres. **Usage**: Grazed. **Landscape condition**: Degraded and partly fragmented, surrounded mostly by tilled, grazed, or developed uplands. **Description**: A large, wet saline pasture on the S side of U. S. 26 supplied by an irrigation ditch. Very wet at the time of the survey, it appears to have potential to support waterfowl on the E side, though it is heavily grazed, being dominated by foxtail barley. The W tracts are ungrazed and in slightly better condition, but are also very small. **Ranking:** W - B, E - C.

Clear Creek N (CN)

Location: Garden Co., ca 3 mi. E of junction of U. S. 26 and Nebr. 92 on 92, 1 mi. S and 1 mi. E on gravel road. **Size: 22** acres. **Usage**: Haying. **Landscape Condition**: Fragmented by crop fields and other degraded hay meadows. **Description**: A relatively small patch of saline meadow extending eastward into Keith County, heavily infested with exotics such as tall wheatgrass and Canada thistle. No wetlands nor conspicuous salt crusts present, but site is close to the river. Representative of much of the land on the N side of Clear Creek Wildlife Management Area. **Ranking**: CD.

Clear Creek S (CS)

Location: Garden Co., ca 2.5 mi. SE of Lewellen on U. S. 26, 3 mi. E on gravel road. **Size:** 180 acres. **Usage**: Haying. **Landscape Condition**: Relatively unfragmented, but mostly grazed uplands and some tilled ground. **Description**: A narrow strip of saline wetland and meadow in good condition in close proximity to the Platte. Two cat-tail marshes are found in the central part, separated by nearly level upland prairie. Many small seasonally-flooded depressions are present in the E portion. **Ranking**: B.

Dead Juniper Meadow (DJ)

Location: Morrill Co., ca 1.5 mi. SSW of junction of U. S. 26 and Nebr. 92 on 92, 1 mi. SE to end of paved road, S side of road. **Size**: 65 acres. **Usage**: Wildlife habitat. **Landscape condition**: relatively well-preserved pasture to the N and E, but borders disturbed uplands on the S. **Description**: A small saline meadow with tall-grass prairie elements on the E side and many salt crusts in the SW part. Shooting star is locally common. Well-preserved except for inclusions of juniper and other trees planted by the NRD for wildlife habitat "improvement." Most of the plantings have not survived. **Ranking:** B.

East Broadwater (EB)

Location: Morrill Co., ca 1 mi. E of Broadwater on paved road, between road and U. S. 26. **Size**: 170 acres. **Usage**: Haying and late-season pasture. **Landscape condition**: partly fragmented, bordered by grazed uplands and degraded saline meadows. **Description**: A mosaic of sandy uplands and interdunal saline meadows with scattered seasonally-wet depressions. One larger wetland in the northeast portion has been destroyed. The uplands are relatively degraded, but the meadows have been well-preserved. **Ranking**: AB.

East Minatare (EM)

Location: Scotts Bluff Co., 1 mi. E of Minatare, N side of U. S. 26. **Size**: 95 acres. **Usage**: Grazing. **Landscape Condition**: Mostly unfragmented, some tilled areas present but mostly heavily grazed and ditched pasture surrounds the site. **Description**: A relatively small, level meadow on the N side of U.S. 26, which was not grazed until late Sept. in 1992. No wetlands to speak of except land bordering a large irrigation ditch on the N side. Salt crusts are present and conspicuous. **Ranking:** BC.

Facus Springs (FS)

Location: Morrill Co. 3 mi. SE of junction of U. S. 26 and Nebr. 92 S of Bayard, E side of county road, either side of highway. **Size**: 565 acres. **Usage**: Grazing. **Landscape condition**: Degraded and mostly unfragmented, generally grazed but a few areas tilled and hayed. **Description**: Part of one of the largest complexes of wetlands in the survey area. The area S of U. S. 26 is moderately grazed and in very good condition, the area N of the highway is degraded, but was not grazed during the survey. The bulk of the area is semi-permanent wetland intermingled with saline meadow and tall-grass prairie. Upland prairie is present on the S and E sides. Probably the most representative tract of saline wetlands in the study area. **Ranking:** S 1/2 - A, N 1/2 - C.

Kiowa Basin Preserve (KB)

Location: Scotts Bluff Co., 2.5 mi. S of Morrill, W side of road. **Size**: 220 acres. **Usage**: Grazing, but soon to be managed by Nature Conservancy. **Landscape condition**: Mostly uplands, tilled on S side and heavily grazed elsewhere. **Description**: A large complex of large wetlands and seasonally flooded and saturated ground. Nevada bulrush is common in the W half. Very saline and with a large amount of native flora remaining. Few exotics are present, and the flora should improve with new management regimen. **Ranking**: AB.

Lost Creek Meadows (LC)

Location: Garden Co., ca 3 mi. SE of Oshkosh on U. S. 26, 1/2 mi. S on gravel, and across horse pasture to the S. **Size**: 400 acres. **Usage**: Haying. **Landscape condition**: Very good, surrounded by hay meadows and moderately-grazed pasture. **Description**: A large complex of undisturbed saline meadows and tall-grass prairie, the only wetlands are the freshwater sloughs associated with Lost Creek, though the area is close to the Platte River. Contains large populations of shooting star. **Ranking**: AB.

Oshkosh E (OE)

Location: Garden Co., 3 mi. S of Oshkosh on Nebr. 27, 5 mi. E on unimproved road. **Size**: 350 acres **Usage**: Haying. **Landscape condition**: unfragmented, but surrounded by degraded hay meadows and grazed uplands. **Description**: a large complex of degraded hay meadows heavily infested by exotic species such as tall wheatgrass and Japanese brome in places. Only wetland habitats are stock tank overflow ponds, though the area closely borders the Platte. Few salt crusts and halophytes present. No EO's recorded. **Ranking**: BC.

Oshkosh SW (OS)

Location: Garden Co., 2 mi. W and 1/2 mi. S of Oshkosh on gravel roads, E across country. **Size**: 320 acres. **Usage**: Haying. **Landscape condition**: surrounded by variously degraded hay meadows. **Description**: a large tract of saline meadow with some salt crusts present in the northeast part. Thelypody is common. No semi-permanent wetland in the area, and exotics are locally common in places. **Ranking**: BC.

Oshkosh W (OW)

Location: Garden Co., 2 mi. W of Oshkosh on gravel roads, S side of intersection. **Size**: 240 acres. **Usage**: Haying. **Landscape condition**: Surrounded by variously degraded hay meadows. **Description**: The driest site surveyed, salt crusts are uncommon and many upland prairie species are found throughout. Similar to Oshkosh SW, which it borders. Contains the largest population of thelypody observed in the study area. **Ranking**: BC.

Siegfried Corner (SC)

Location: Morrill Co., 1/2 mi. S of Bayard on U. S. 26, 1.25 mi. E on gravel road, between road and railroad tracks E of crossing. **Size**: 10 acres. **Usage**: Haying. **Landscape condition**: Degraded and partly fragmented. Many of the surrounding tracts are heavily grazed or tilled. **Description**: Part of a complex of highly saline meadows in various degrees of degradation, this small corner is by far the best-preserved of its surroundings. Dominated by alkali sacaton and switchgrass with numerous salt crusts present. No semi-permanent wetlands present, though a few are found to the NW. **Ranking**: B.

Wilkinson Meadow (WM)

Location: Garden Co., 2 mi. W of Oshkosh on gravel road, 1/2 mi. S. **Size**: 105 acres. **Usage**: Grazed in N half, hayed in the S. **Landscape condition**: Surrounded by variously degraded saline hay meadows. **Description**: A degraded, weedy meadow without wetlands, but bordering the river. A few salt crusts are present in the N part, but overall not very interesting, though silverweed is present along the Platte just to the S. **Ranking**: C.

COMPARISON WITH OTHER SALINE WETLANDS

The earliest descriptions of saline wetlands of the North Platte Valley (Pound and Clements, 1898) were very incomplete and somewhat puzzling. They were said to resemble those of eastern Nebraska:

> But the *Salicornia* is absent, and the dry, salty bottom is sparsely occupied by *Dondia depressa* [seablite], while in the upper portion the role of *Atriplex hastata* and *A. argentea* in [eastern saline basins] is taken by *Bahia oppositifolia* and *Chenopodium incanum* in some cases, or by *Monolepis nuttalliana* in others.

From this description it is difficult to ascertain what type of habitat they had observed. *Bahia* (now

Picradeniopsis) *oppositifolia* is found in Nebraska only in badland habitats in Sioux and Dawes counties. *Chenopodium incanum* is infrequent in dry situations in the Panhandle and was not observed in the survey area. *Monolepis nuttalliana*, now a widespread weed, was seen at only a single site in the study area, in disturbed ground at the Scotts Bluff County fairgrounds. Pound and Clements' failure to recognize *Atriplex* is also disturbing, since I found four species, and at least one was present at fifteen of the sixteen sites I surveyed.

Ungar et al. (1969) gave detailed descriptions of species associations correlated with soil salinity within eastern Nebraska saline marshes. No similar study was completed for western saline marshes though some comparisons can be made. Highly saline places such as salt crusts have seablite and saltgrass but lack glasswort, as observed by Pound and Clements (1898). Depauperate arrowgrass often grows in the central portion of salt crusts, and seems to take the place of glasswort, though the two plants represent very different life forms, the former being perennial and the latter an annual. The prevalent species of the meadows differ as well. In Ungar's (1969) most similar communities (Prairie-*Distichlis*, *Hordeum-Iva*), he reported inland saltgrass, foxtail barley, plains bluegrass and western wheatgrass as constituents, all of which were found in meadows of the North Platte floodplain. He also reported prairie bulrush as a frequent constituent, particularly in slightly more saline areas. Prairie bulrush was found only at Facus Springs in this study, where it was locally common. Other plants frequent in meadows of the west, such as slender wheatgrass, are not found in the east; and while alkali muhly and alkali sacaton have been collected in the east, and are not significant components of the saline meadow flora. Native halophytes collected from eastern Nebraska saline marshes but not found in this study include saltmarsh aster (*Aster subulatus*), silverleaf spearscale (*Atriplex argentea*), seaside heliotrope (*Heliotropium curassavicum*), annual marsh elder (*Iva annua*), ditchgrass (*Ruppia maritima*), saltwort (*Salicornia rubra*), and Texas dropseed (*Sporobolus texanus*). With the exception of the marsh elder, all these species are notably disjunct from their main range as are a few species common to the east and west, such as sea blite and alkali sacaton (cf. Great Plains Flora Association, 1977). Curiously, the greatest concentration of two of the aforementioned species in Nebraska, silver spearscale and seaside heliotrope, is in the Panhandle (in the badlands and western Sandhills, respectively) yet neither was found in the study area.

At least nine halophytes found in this study are unknown in the eastern Nebraska saline marshes, namely rayless alkali aster (*Aster brachyactis*), alkali blite (*Chenopodium rubrum*), eastern cleomella (*Cleomella angustifolia*), sea milkwort (*Glaux maritima*), poverty weed (*Iva axillaris*), alkali plantain (*Plantago eriopoda*), alkali grass (*Puccinellia nuttalliana*), Nevada bulrush (*Scirpus nevadensis*), and alkali cordgrass (*Spartina gracilis*). Exotic halophytes, which are widespread in the west, have not been reported from eastern saline wetlands, though Russian atriplex has been collected sparingly. This is probably an artifact of a lack of comprehensive collecting in these wetlands.

Though even less is known about the vegetation of the alkaline lakes and meadows of the western Sandhills, preliminary observations indicate a number of species in common with the western saline meadows. A survey of the herbarium and casual collecting in saline-alkaline habitats at Crescent Lake Wildlife Refuge in Garden County reveal the presence of inland saltgrass, alkali cordgrass, Nevada bulrush, alkali blite, rayless alkali aster, spearscale, thelypody, and Russian atriplex in areas of Wildhorse soils. McAtee (1920) reported very few species in and around alkaline lakes, with just six listed from Big Alkali Lake in Cherry County and two from Phalarope Lake in Garden County. McAtee (1920) and McCarraher (1977) report a few more submersed species, such as dwarf pondweed (*Potamogeton pusillus*), western wigeon grass (*Ruppia occidentalis*), and water milfoil (*Myriophyllum sibiricum*) in addition to those found in the survey, but in general these lakes are species-poor compared to freshwater Sandhills lakes.

Two halophytes of the alkaline lakes and meadows, seaside heliotrope and western wigeon grass, are unknown in the study area, with the latter seemingly restricted to the western Sandhills in Nebraska (Kaul, 1992). Though too little data exist to preclude the absence of given Platte Valley halophytes from the western Sandhills, one species, alkali sacaton, is conspicuously less common in the latter area. During field work for the recently-completed soil survey of Garden County, alkali sacaton was not seen in the Wildhorse soils of the Sandhills (J. Wilson, pers. comm.) though these soils have high pH and could seemingly support it. Alkali sacaton is also absent from saline soils in North and South Dakota (Ungar, 1976). It is suspected the higher ratio of adsorbed sodium in the soils of the North Platte floodplain may be tied to the presence of this grass in the study area, although the relationship between SAR and presence of alkali sacaton has not yet been tested.

ASSESSMENT OF WESTERN SALINE WETLAND-MEADOWS IN NEBRASKA

It has frequently been stated that salt marshes represent the rarest and most endangered vegetation

zone in the State (Kaul, 1975; Farrar and Gersib, 1991) and although certain recently-recognized habitats such as Sandhills fens may be rarer still (Steinauer, 1992), the eastern saline marshes probably do represent an endangered community type. The threats to these areas from urban development, stream channelization, and agricultural disturbance is well documented (Gersib and Steinauer, 1991), and though not as serious, similar threats imperil the western saline marshes as well.

Saline meadows and wetlands cover a much greater area in the Nebraska panhandle than in the eastern part of the State and are by and large not immediately threatened by urban development. Though current agricultural practices are degrading saline habitats, the western meadows have fared much better than their eastern counterparts in that respect. Very few areas of saline soil have been tilled in the North Platte floodplain, and few are likely to in the near future because of the poor productivity of the soils and the current weak state of the sugar beet market. The tradition of cutting native hay along the Platte and an overall better understanding of beneficial range management practices among residents of the Panhandle have preserved most areas to a greater extent than the salt marshes around Lincoln. Nonetheless these agricultural practices also represent the greatest threat to these sites.

Exotic species such as tall wheatgrass and strawberry clover may continue to spread unchecked in regularly grazed areas, and Canada-thistle-control measures such as spraying and intensive grazing adversely affect native species with which they compete. Range improvement and revegetation practices, open possibilities for introduction of still more exotics into ungrazed areas to increase the nutritional content of what is otherwise notoriously nutrient-poor hay. Even "unimproved" areas which are lightly grazed or hayed may suffer from identical year-to-year management regimens. Many areas are not hayed or grazed until late in the growing season, which favors growth of early-flowering constituents of the meadow, including most of the exotics, and adversely affects late-season species, which comprise the bulk of natives in these habitats.

Perhaps a more serious threat to the western saline meadows has been a near lack of recognition of the value of these areas, which have gone virtually unnoticed by biologists, no less by the general public. Hence with the exception of a few privately-owned hunting reserves, no areas have been set aside specifically to preserve the indigenous components of this habitat until very recently. In fact, despite its limited extent, far more acreage of eastern Nebraska saline wetland has been designated for protection than similar habitats along the Platte. The Kiowa Basin Preserve in Scotts Bluff County, which was purchased by the Nature Conservancy during this survey, represents the first site in the study area to be set aside as a nature sanctuary. The only saline meadows on public land in the survey area, at Clear Creek Wildlife Management Area in Keith and Garden counties, are degraded and managed primarily for hay harvesting. It may be too late to preserve western saline meadows in pristine condition, but a few very-well preserved sites such as Facus Springs and Lost Creek meadows deserve consideration. The overwhelmingly negative attitudes toward governmental purchase and management of land among the people of the Panhandle may make it difficult to establish more protected public lands in the study areas, though conservation-easement agreements with regional agencies such as natural resources districts may be an effective means of checking further degradation of well-preserved sites. Once degradation is controlled, the relatively unfragmented condition of the land surrounding most tracts of saline meadow would promote restoration of degraded sites to near-pristine conditions.

Though the data presented in this paper greatly expand our knowledge of the vegetation of the North Platte River bottoms, these results are preliminary, being based on only one season's collections. This study will not be the last word on the western saline meadows. Many more promising sites in the study area remain unexplored and even unobserved, and further work would likely reveal many more botanical rarities and new additions to the Nebraska flora. Though incomplete, it will serve as impetus for further survey work in western and other saline wetlands in addition to other neglected vegetational communities in the State.

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