Plant Species of Special Concern

and Vascular Plant Flora

of the National Elk Refuge

Prepared for the

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National Elk Refuge

By

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Table of Contents

Figures, Tables, and Appendices

Page

Figure

Table

Appendix

Introduction

The National Elk Refuge was established by Congress in 1912 to protect the winter range of elk in the Jackson Hole Valley. Prior to 1912, the Jackson elk herd had suffered enormous losses from starvation as traditional migration corridors and winter feeding grounds were usurped by human settlement. Establishment of the refuge, coupled with supplemental feeding, has since allowed the elk herd to recover and prosper (Grove 1984).

In addition to protecting elk habitat, the National Elk Refuge also provides habitat for a wide variety of animal and plant species, many of which are state or regionally rare. The conservation of these 'non-game' species has taken on greater importance in recent years as the management emphasis of the National Wildlife Refuge system has shifted from promoting harvestable animals to preserving rare species and managing for biological diversity. This policy shift was recently codified by President Clinton in a 1996 Executive Order defining the mission of the refuge system as being "to preserve a national network of lands and waters for the conservation and management of fish, wildlife, and plant resources of the United States for the benefit of present and future generations" (Rippe 1997).

Unlike animals, plants have received relatively little research attention on the National Elk Refuge in the past. The only systematic inventory of the refuge's flora was conducted in 1979-1980, when Michele Potkin, Meredith Platt, and Tom Melanson collected approximately 200 vascular plants (mostly from upland areas) as part of a wildlife habitat study. The first rare plant study was conducted by Dr. David Cooper of Colorado State University, who in 1994 discovered the first populations of *Scirpus rollandii* and *Utricularia intermedia* (originally determined as *U. ochroleuca*) on the refuge. Fertig (1997 b) briefly surveyed upland areas of the refuge in 1996 for *Lesquerella carinata* var. *carinata*, a proposed US Forest Service Sensitive species. These preliminary surveys, as well as other studies from nearby areas of Grand Teton National Park and Bridger-Teton National Forest indicated that the National Elk Refuge could contain a large number of rare plant species.

To address management questions about plant species, the US Fish and Wildlife Service contracted with The Nature Conservancy's Wyoming Natural Diversity Database (WYNDD) in 1997 to conduct a baseline study of the flora and rare plants of the National Elk Refuge. This report contains the results of that study.

Study Area

The National Elk Refuge encompasses an area of approximately 24,250 acres in the northeastern corner of the Jackson Hole Valley in Teton County, Wyoming (Figure 1). The northern half of the refuge consists of a series of southwest to northeast-trending sedimentary ridges, ranging in elevation from 6400-7197 feet. These slopes support a mosaic of conifer forests, three-tip and big sagebrush grasslands, and cushion plant

communities. The flat valley floor occupies most of the central and eastern portion of the

Figure 1. Study Area.

refuge and contains a mixture of native grasslands and irrigated hay meadows. The southwestern corner contains the extensive floodplain of Flat Creek. Much of this wetland is a shallowly flooded calcareous fen comprised of sedge meadows, moist hummocks, pinkish lime-rich mud flats, and numerous small springs (Figure 2). Flat Creek becomes a complex of ox-bow ponds and sloughs at the south end of the refuge in an area dominated by beaked sedge, bulrush, and cattail marshes. Rising above the southern wetland is Miller's Butte, a saddle-shaped ridge of Paleozoic sandstone and limestone beds covered by sagebrush grasslands, aspen patches, and cushion plant-bunchgrass communities. The refuge is bounded by the Gros Ventre River and Grand Teton National Park on the north, the foothills of the Gros Ventre Range and Bridger-Teton National Forest on the east, US Highway 26/89/187 on the west, and the city of Jackson on the south.

Methods

Surveys of plant species of special concern were conducted by the author in June 1996 and late July and early August 1997. Prior to conducting fieldwork, information on the habitat needs and known distribution of target species was obtained from secondary sources, including WYNDD files and computer databases, collections of the Rocky Mountain Herbarium (RM), pertinent literature, and knowledgeable individuals. USGS topographic maps, geologic maps, refuge maps, and aerial photographs were used to identify areas of potential habitat for ground surveys.

In the field, data were collected on the biology, habitat, population size, and management needs of target species. Locations of rare plant populations were mapped on 7 1/2 minute USGS topographic maps. When populations were sufficiently large, voucher specimens were collected for deposit at the RM. Information gathered in the field was entered into the computerized Element Occurrence database of WYNDD.

A list of all vascular plant species observed on the Refuge was compiled during field surveys in 1997. Voucher specimens were collected for species that could not be reliably identified in the field. These specimens were later identified and deposited at the RM. Additional species were added to the final checklist based on records of the RM and WYNDD.

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Figure 2 (page 9): Aerial view of the southwest corner of the National Elk Refuge showing rare plant habitats on Millers Butte (bottom center) and the Flat Creek Fen (brown wedge at the upper middle and bottom left corner). Photo courtesy of Bridger-Teton National Forest.

Results

Vascular Plant Flora of the National Elk Refuge

Based on 1997 surveys and a review of literature and herbarium records, the vascular plant flora of the National Elk Refuge consists of at least 382 taxa (Table 1). For additional information on the flora of the Jackson Hole area and adjacent Teton and Gros Ventre ranges, consult Reed (1952), Shaw (1976, 1992); Markow (1994), and Hartman (1995).

Plant Species of Special Concern

Surveys in 1997 focused on a "target list" of 19 rare plant species known or suspected to occur on the National Elk Refuge based on previous studies in the Jackson Hole and Grand Teton area (Table 2). Nine of these target species were located in 1997, including five which were not previously documented for the refuge. Three additional rare species not included on the original target list (*Carex parryana* var. *parryana, C. sartwellii,* and *C. scirpoidea* var. *scirpiformis*) were discovered in Flat Creek Fen. In all, 13 Wyoming plant species of special concern are now known to occur on the elk refuge (this total includes *Astragalus terminalis*, which was not relocated in 1997) (Table 3).

Only two of the refuge's thirteen rare plant species are found in upland areas. *Lesquerella carinata* var. *carinata* is known from three main populations on the refuge (divided into 8 subpopulations) found on Millers Butte, the Refuge Peak ridge system, and the mouth of Sheep Creek Canyon. These populations were surveyed in 1996 and found to be locally abundant and number 45,000-52,000 individuals (Fertig 1997 b). Two additional small colonies were discovered near Refuge Peak in 1997, but surveys were limited since the plants were already well past flowering and fruiting. Threats on the refuge appear to be low, although populations may be less abundant near animal trails or in areas used for bedding (Fertig 1997 b). *Astragalus terminalis* is known to co-occur with *L. carinata* on the summit of Blacktail Butte in Grand Teton National Park, but was not found during surveys on the elk refuge in 1996-97. A single, vague record of this species is known from the floor of Jackson Hole, south of Flat Creek (WYNDD records). Potential habitat exists along the gravel terraces of upper Flat Creek and on the foothills of the Gros Ventre Range.

Heterotheca depressa is a rare wetland species that is restricted on the elk refuge to gravel terraces on the south bank of the Gros Ventre River. This taxon is endemic to the Yellowstone Plateau and the Snake River drainage of northwestern Wyoming and adjacent Idaho and Montana (Semple 1996). *H. depressa* appears to be an early successional species adapted to seasonally flooded gravel bars that are above the high water zone throughout the summer. Additional habitat for this species may exist elsewhere along the Gros Ventre River, although mostly outside the boundaries of the elk refuge.

Table 1
Vascular Plants of the National Elk Refuge

The following species checklist is based on field surveys conducted by the author in mid June 1996 and late July to early August 1997 and on unmounted 1979-1980 collections by Michele Potkin, Meredith Platt, and Tom Melanson deposited at the Rocky Mountain Herbarium. Nomenclature follows Dorn (1992) for scientific names and Hitchcock and Cronquist (1973) and Welsh et al. (1993) for common names. Relevant synonyms are included in brackets []. Family acronyms are based on Weber (1982). Exotic (non-native) species are indicated by "!".

Scientific Name	Common Name	Family
	Trees	
Betula occidentalis	Water birch	BET
Picea engelmannii	Engelmann spruce	PIN
Picea pungens	Blue spruce	PIN
Populus angustifolia	Narrowleaf cottonwood	SAL
Populus tremuloides	Quaking aspen	SAL
	Shrubs	
Amelanchier alnifolia var. alnifolia	Western serviceberry	ROS
Artemisia tridentata var. vaseyana	Mountain big sagebrush	AST
Artemisia tripartita var. tripartita	Threetip sagebrush	AST
! *Caragana arborescens*	Pea-tree	FAB
Chrysothamnus nauseosus var. oreophilus	Rubber rabbitbrush	AST
Chrysothamnus viscidiflorus var. lanceolatus	Green rabbitbrush	AST
Chrysothamnus viscidiflorus var. viscidiflorus	Green rabbitbrush	AST
Cornus sericea [*Cornus stolonifera*]	Red-osier dogwood	COR
Elaeagnus commutata	Silverberry	ELE
Gutierrezia sarothrae	Broom snakeweed	AST
Juniperus communis var. depressa	Common juniper	CUP
Kraschenninnikovia lanata [*Ceratoides lanata*]	Winterfat	CHN
Lonicera involucrata	Bearberry honeysuckle	CPR
Mahonia repens	Oregon-grape	BER
Pentaphylloides floribunda [*Potentilla fruticosa*]	Shrubby cinquefoil	ROS

Prunus virginiana var. melanocarpa	Chokecherry	ROS
Purshia tridentata	Bitterbrush	ROS
Ribes aureum var. aureum	Golden currant	GRS
Ribes cereum var. pedicellare	Wax currant	GRS
Ribes oxyacanthoides var. setosum	Missouri gooseberry	GRS
Rosa sayi	Prickly rose	ROS
Rosa woodsii	Woods rose	ROS
Salix bebbiana	Bebb willow	SAL
Salix boothii	Booth willow	SAL
Salix brachycarpa	Small-fruit willow	SAL
Salix candida	Hoary willow	SAL
Salix drummondiana	Drummond willow	SAL
Salix geyeriana	Geyer willow	SAL
Salix lutea	Yellow willow	SAL
[*Salix eriocephala var. watsonii*]		
Salix melanopsis	Dusky willow	SAL
Salix planifolia	Planeleaf willow	SAL
Shepherdia canadensis	Canada buffaloberry	ELE
Symphoricarpos oreophilus var. utahensis	Mountain snowberry	CPR
Tetradymia canescens	Gray horsebrush	AST

Forbs

Achillea millefolium	Yarrow	AST
Agoseris glauca var. glauca	Short-beaked agoseris	AST
Agoseris glauca var. laciniata	Short-beaked agoseris	AST
Allium cernuum	Nodding onion	
LIL		
Allium schoenoprasum	Chives	LIL
! *Alyssum alyssoides*	Pale alyssum	BRA
! *Alyssum desertorum*	Desert alyssum	BRA
Amaranthus albus	White pigweed	AMA
Anemone multifida var. multifida	Cliff anemone	RAN
Anemone patens var. multifida	Pasqueflower	RAN
Angelica arguta	Sharptooth angelica	API
Angelica pinnata	Pinnate-leaved angelica	API
Antennaria dimorpha	Low pussytoes	AST
Antennaria microphylla	Small-leaf pussytoes	AST
Antennaria pulcherrima	Showy pussytoes	AST
Antennaria rosea	Rosy pussytoes	AST
Antennaria umbrinella	Umber pussytoes	AST
Arabis drummondii	Drummond's rockcress	BRA
Arabis glabra	Towermustard	BRA
Arabis holboellii	Holboell's rockcress	BRA
Arenaria congesta	Ballhead sandwort	CRY

Arenaria nuttallii [*Minuartia nuttallii*]	Nuttall's sandwort	CRY
Arnica sororia	Twin arnica	AST
Artemisia biennis var. biennis	Biennial wormwood	AST
Artemisia frigida	Fringed sagebrush	AST
Artemisia ludoviciana var. ludoviciana	Louisiana sagebrush	AST
Aster ascendens	Long-leaved aster	AST
Aster borealis [*Aster junciformis*]	Boreal aster	AST
Aster bracteolatus [*Aster eatonii*]	Eaton's aster	AST
Aster foliaceus	Leafybract aster	AST
Aster occidentalis	Western mountain aster	AST
Aster perelegans	Elegant aster	AST
Astragalus agrestis	Field milkvetch	FAB
Astragalus argophyllus var. argophyllus	Silver-leaved milkvetch	FAB
Astragalus canadensis var. brevidens	Canada milkvetch	FAB
Astragalus diversifolius var. campestris [*Astragalus convallarius*]	Lesser rushy milkvetch	FAB
Astragalus eucosmus	Elegant milkvetch	FAB
Astragalus miser var. decumbens	Sagebrush weedy milkvetch	FAB
Astragalus miser var. tenuifolius	Weedy milkvetch	FAB
Astragalus purshii	Woolly milkvetch	FAB
Astragalus terminalis	Railhead milkvetch	FAB
! *Atriplex rosea*	Red orache	CHN
Atriplex truncata	Wedgescale orache	CHN
Balsamorhiza sagittata	Arrowleaf balsamroot	AST
Besseya wyomingensis	Wyoming kittentails	SCR
Bidens cernua	Nodding beggarticks	AST
Callitriche palustris	Spring water starwort	CLL
Calochortus nuttallii	Sego-lily	LIL
! *Camelina microcarpa*	Littlepod falseflax	BRA
Campanula rotundifolia	Harebell	CAM
! *Capsella bursa-pastoris*	Shepherd's purse	BRA
! *Cardaria chalepensis*	Chalapa hoarycress	BRA
! *Carduus acanthoides*	Plumeless thistle	AST
! *Carduus nutans*	Musk thistle	AST
Castilleja angustifolia var. angustifolia	Narrowleaf paintbrush	SCR
Castilleja angustifolia var. dubia	Desert paintbrush	SCR
Castilleja flava	Yellow paintbrush	SCR
Castilleja miniata	Scarlet paintbrush	SCR
Cerastium beeringianum var. capillare	Alpine chickweed	CRY

Chaenactis douglasii var. montana	Hoary dusty-maiden	AST
Chenopodium berlandieri var. zschackei	Pitseed goosefoot	CHN
Chenopodium capitatum var. parvicapitatum [*Chenopodium overi*]	Smallhead goosefoot	CHN
Chenopodium pratericola	Mountain goosefoot	CHN
! *Cirsium arvense*	Canada thistle	AST
Cirsium scariosum	Elk thistle	AST
Cirsium subniveum	Snowy thistle	AST
! *Cirsium vulgare*	Bull thistle	AST
Clematis hirsutissima	Leatherflower	RAN
Clematis occidentalis var. grosseserrata	Rock virgin's-bower	RAN
Collomia linearis	Narrowleaf collomia	PLM
Comandra umbellata var. pallida	Bastard toad-flax	SAN
! *Convolvulus arvensis*	Field bindweed	CNV
Cordylanthus ramosus	Bushy birdbeak	SCR
Corydalis aurea	Golden-smoke	FUM
Crepis acuminata	Tapertip hawksbeard	AST
Crepis modocensis	Siskiyou hawksbeard	AST
Crepis runcinata var. glauca	Meadow hawksbeard	AST
Crepis runcinata var. hispidulosa	Broad-leaved meadow hawksbeard	AST
Delphinium bicolor	Little larkspur	RAN
Descurainia incana var. macrosperma	Mountain tansymustard	BRA
! *Descurainia sophia*	Flixweed	BRA
Dodecatheon pulchellum	Dark-throat shooting-star	PRI
Epilobium angustifolium	Fireweed	ONA
Epilobium brachycarpum	Panicled willow-herb	ONA
Epilobium ciliatum var. ciliatum	American willow-herb	ONA
Epilobium hornemannii	Hornemann's willow-herb	ONA
Epilobium palustre var. gracile	Swamp willow-herb	ONA
Erigeron compositus var. discoideus	Cut-leaved fleabane	AST
Erigeron corymbosus	Foothill daisy	AST
Erigeron glabellus var. glabellus	Smooth daisy	AST
Erigeron lonchophyllus	Spear-leaf fleabane	AST
Erigeron pumilus	Shaggy fleabane	AST
Eriogonum brevicaule var. laxifolium	Shortstem buckwheat	PLG
Eriogonum caespitosum	Mat buckwheat	PLG
Eriogonum ovalifolium var. purpureum	Cushion buckwheat	PLG
Eriogonum umbellatum var. majus	Sulfur buckwheat	PLG
Erysimum asperum var. arkansanum [*Erysimum capitatum*]	Western wallflower	BRA
Erysimum cheiranthoides	Treacle wallflower	BRA
Fragaria virginiana	Virginia strawberry	ROS

Fritillaria atropurpurea	Checker lily	LIL
Galium boreale	Northern bedstraw	RUB
Galium trifidum	Small bedstraw	RUB
Gentiana affinis var. affinis	Prairie gentian	GEN
Gentiana aquatica	Water gentian	GEN
Geranium viscosissimum var. nervosum	Sticky geranium	GER
Geranium viscosissimum var. viscosissimum	Sticky geranium	GER
Geum macrophyllum var. perincisum	Large-leaved avens	ROS
Geum triflorum	Prairie-smoke	ROS
Glaux maritima	Sea-milkwort	PRI
Glycyrrhiza lepidota	Licorice-root	FAB
Gnaphalium palustre	Lowland cudweed	AST
Grindelia squarrosa	Curly-cup gumweed	AST
Habenaria hyperborea [*Platanthera hyperborea*]	Northern green bog-orchid	ORC
Hackelia floribunda	Many-flowered stickseed	BOR
Haplopappus acaulis	Stemless goldenweed	AST
Haplopappus uniflorus [*Pyrrocoma uniflora*]	One-flowered goldenweed	AST
Hedysarum boreale	Northern sweet-vetch	FAB
Helianthella uniflora	Rocky Mountain helianthella	AST
Heracleum sphondylium var. lanatum	Cow parsnip	API
Heterotheca depressa [*Heterotheca villosa var. depressa*]	Teton golden-aster	AST
Heuchera parvifolia	Littleleaf alumroot	SAX
Hippuris vulgaris	Common mare's-tail	HPU
Hypericum formosum var. scouleri	Western St. Johns's-wort	HYP
Ipomopsis aggregata	Scarlet gilia	PLM
Ipomopsis spicata var. orchidacea	Mountain spicate-gilia	PLM
! *Lactuca serriola*	Prickly lettuce	AST
Lappula redowskii var. redowskii	Western stickseed	BOR
! *Lappula squarrosa var. squarrosa*	European stickseed	BOR
Lemna minor	Lesser duckweed	LMN
Lepidium densiflorum	Common peppergrass	BRA
! *Lepidium perfoliatum*	Clasping peppergrass	BRA
Leptodactylon pungens	Common prickly-phlox	PLM
Lesquerella carinata var. carinata	Keeled bladderpod	BRA
Linanthus septentrionalis	Northern linanthus	PLM
Linum lewisii	Blue flax	LIN
Lithospermum ruderale	Western gromwell	BOR
Lomatium foeniculaceum	Fennel-leaved biscuitroot	API
Lomatium triternatum var. platycarpum	Nineleaf biscuitroot	API
Lupinus argenteus var. argenteus	Silvery lupine	FAB
Lupinus argenteus var. rubricaulis	Silvery lupine	FAB

Lupinus sericeus	Silky lupine	FAB
Machaeranthera canescens var. canescens	Hoary aster	AST
Maianthemum stellatum	Starry false Solomon's-seal	LIL
! *Malcolmia africana*	Malcolmia	BRA
Matricaria matricarioides	Pineapple-weed	AST
! *Medicago lupulina*	Black medic	FAB
! *Medicago sativa var. sativa*	Alfalfa	FAB
! *Melilotus albus*	White sweet-clover	FAB
! *Melilotus officinalis*	Yellow sweet-clover	FAB
Mentha arvensis var. canadensis	Field mint	LAM
Mertensia ciliata	Ciliate bluebells	BOR
Mertensia oblongifolia	Leafy bluebells	
BOR		
Mimulus guttatus	Yellow monkeyflower	SCR
Monolepis nuttalliana	Povertyweed	CHN
! *Myosotis scorpioides*	Common forget-me-not	BOR
Myriophyllum sibiricum	Common water-milfoil	HAL
Oenothera cespitosa var. cespitosa	Tufted evening-primrose	ONA
Oenothera pallida var. trichocalyx	Pale evening-primrose	
ONA		
Opuntia polyacantha var. polyacantha	Plains prickly-pear	CAC
Orthocarpus luteus	Yellow owl-clover	SCR
Oxytropis deflexa var. sericea	Nodding locoweed	FAB
Parnassia palustris var. montanensis	Northern grass-of-Parnassus	SAX
Pedicularis crenulata	Meadow lousewort	SCR
Pedicularis groenlandica	Elephant's-head	SCR
Penstemon humilis	Lowly beardtongue	SCR
Penstemon procerus var. procerus	Small-flower beardtongue	SCR
Penstemon radicosus	Matroot beardtongue	SCR
Penstemon subglaber	Subglabrous beardtongue	SCR
Petrophyton caespitosum	Rocky Mountain rockmat	ROS
Phacelia franklinii	Franklin's phacelia	HYD
Phlox hoodii	Hood's phlox	PLM
Phlox kelseyi var. kelseyi	Kelsey's phlox	PLM
Phlox longifolia	Long-leaf phlox	PLM
Phlox multiflora	Many-flowered phlox	PLM

Plantago eriopoda	Alkali plantain	PTG
! *Plantago major*	Common plantain	PTG
Polemonium occidentale	Western Jacob's-ladder	PLM
Polygonum achoreum	Erect knotweed	PLG
Polygonum amphibium var. stipulaceum	Water smartweed	PLG
Polygonum aviculare	Common knotweed	PLG
Polygonum douglasii var. douglasii	Douglas' knotweed	PLG
Polygonum viviparum	Alpine bistort	PLG
Potamogeton filiformis	Slender-leaved pondweed	POT
Potamogeton pectinatus	Fennel-leaved pondweed	POT
Potentilla anserina	Silverweed	ROS
Potentilla arguta	Glandular cinquefoil	ROS
Potentilla gracilis var. nuttallii	Slender cinquefoil	ROS
Potentilla gracilis var. pulcherrima	Soft cinquefoil	ROS
! *Potentilla norvegica*	Norwegian cinquefoil	ROS
Potentilla ovina var. ovina	Sheep cinquefoil	ROS
Potentilla pensylvanica	Prairie cinquefoil	ROS
Primula incana	Mealy primrose	PRI
Prunella vulgaris var. lanceolata	Self-heal	LAM
Ranunculus aquatilis var. diffusus	White water buttercup	RAN
Ranunculus cymbalaria	Shore buttercup	RAN
Ranunculus glaberrimus var. ellipticus	Sagebrush buttercup	RAN
Ranunculus inamoenus var. inamoenus	Unlovely buttercup	RAN
Ranunculus macounii	Macoun's buttercup	RAN
Ranunculus natans var. intertextus	Floating water buttercup	RAN
Ranunculus sceleratus var. multifidus	Blister buttercup	RAN
Rorippa curvipes var. integra	Wasatch yellowcress	BRA
! *Rorippa nasturtium-aquaticum*	Water-cress	BRA
Rumex aquaticus var. fenestratus	Western dock	PLG
Rumex maritimus var. fueginus	Golden dock	PLG
Rumex salicifolius var. triangulivalvis	Willow dock	PLG
! *Salsola australis*	Russian thistle	CHN
Schoenocrambe linifolia	Flax-leaved plainsmustard	BRA
Scutellaria galericulata	Marsh skullcap	LAM
Sedum lanceolatum	Lance-leaved stonecrop	CRS
Senecio canus	Woolly groundsel	AST
Senecio cymbalarioides	Alpine meadow groundsel	AST
Senecio debilis	Weak groundsel	AST
Senecio hydrophilus	Water groundsel	AST
Senecio integerrimus var. exaltatus	Western groundsel	AST
Senecio pauperculus	Balsam groundsel	AST
Senecio serra	Butterweed groundsel	AST
Senecio streptanthifolius var. rubricaulis	Cleft-leaved groundsel	AST
! *Silene latifolia*	White campion	CRY
! *Sisymbrium altissimum*	Tumblemustard	BRA

Sisyrinchium idahoense var. occidentale	Western blue-eyed grass	IRI
Sium suave	Hemlock waterparsnip	API
Solidago canadensis var. salebrosa	Canada goldenrod	AST
Solidago missouriensis var. missouriensis	Missouri goldenrod	AST
Solidago nana	Low goldenrod	AST
! *Sonchus uliginosus*	Marsh sow-thistle	AST
Spiranthes romanzoffiana	Hooded lady's tresses	ORC
Stellaria crassifolia	Thickleaved starwort	CRY
Stellaria longipes	Longstalk starwort	CRY
Swertia perennis	Swertia	GEN
Swertia radiata	Green gentian	GEN
[*Frasera speciosa*]		
! *Taraxacum laevigatum*	Red-seeded dandelion	AST
! *Taraxacum officinale*	Common dandelion	AST
Thalictrum alpinum	Alpine meadowrue	RAN
Thalictrum venulosum	Veiny meadowrue	RAN
Thelypodium paniculatum	Panicled thelypody	BRA
! *Thlaspi arvense*	Field pennycress	BRA
Townsendia nuttallii	Nuttall's Easter-daisy	AST
! *Tragopogon dubius*	Yellow salsify	AST
! *Trifolium hybridum*	Alsike clover	FAB
! *Trifolium pratense*	Red clover	FAB
! *Trifolium repens*	White clover	FAB
Urtica dioica	Stinging nettle	URT
Utricularia intermedia	Flat-leaf bladderwort	LNT
Utricularia macrorhiza	Greater bladderwort	LNT
[*Utricularia vulgaris*]		
Valeriana edulis	Tobacco-root	VAL
Valeriana occidentalis	Western valerian	VAL
! *Verbascum thapsus*	Common mullein	SCR
Verbena bracteata	Bracted vervain	VRB
Veronica americana	American brooklime	SCR
! *Veronica anagallis-aquatica*	Water speedwell	SCR
Vicia americana var. minor	American vetch	FAB
! *Vicia cracca*	Bird vetch	FAB.
Viola adunca	Early blue violet	VIO
Viola palustris	Marsh violet	VIO
Viola praemorsa var. altior	Upland yellow violet	VIO
Zannichellia palustris	Horned pondweed	ZAN
Zigadenus paniculatus	Panicled death-camas	LIL
Zizia aptera	Heart-leaved Alexanders	API

Graminoids

! *Agropyron cristatum*	Crested wheatgrass	POA

! *Agrostis stolonifera*	Redtop	POA
Alopecurus aequalis	Shortawn foxtail	POA
! *Alopecurus pratensis*	Meadow foxtail	POA
Bromus carinatus	California brome	POA
Bromus ciliatus	Fringed brome	POA
! *Bromus inermis var. inermis*	Smooth brome	POA
! *Bromus tectorum*	Cheatgrass	POA
Calamagrostis canadensis	Bluejoint wheatgrass	POA
Calamagrostis stricta	Slimstem reedgrass	POA
Carex aquatilis	Water sedge	CYP
Carex aurea	Golden sedge	CYP
Carex buxbaumii	Buxbaum's sedge	CYP
Carex capillaris	Hair sedge	CYP
Carex filifolia	Thread-leaved sedge	CYP
Carex interior	Inland sedge	CYP
Carex lanuginosa	Woolly sedge	CYP
Carex microptera var. microptera	Small-wing sedge	CYP
Carex nebrascensis	Nebraska sedge	CYP
Carex parryana var. parryana	Parry sedge	CYP
Carex praegracilis	Clustered field sedge	CYP
Carex rossii	Ross sedge	CYP
Carex rostrata	Beaked sedge	CYP
[*Carex utriculata*]		
Carex sartwellii	Sartwell's sedge	CYP
Carex scirpoidea var. scirpiformis	Canadian single-spike sedge	CYP
Carex simulata	Analogue sedge	CYP
Carex stenophylla	Narrow-leaved sedge	CYP
Carex viridula	Green sedge	CYP
Catabrosa aquatica	Brookgrass	POA
! *Dactylis glomerata*	Orchard grass	POA
Deschampsia cespitosa	Tufted hairgrass	POA
Eleocharis acicularis	Slender spikerush	CYP
Eleocharis palustris	Common spikerush	CYP
Elymus albicans var. griffithsii	Griffith's wheatgrass	POA
[*Agropyron albicans var. griffithsii*]		
Elymus cinereus	Great Basin wildrye	POA
Elymus elymoides	Bottlebrush squirreltail	POA
[*Sitanion hystrix*]		
! *Elymus hispidus var. hispidus*	Intermediate wheatgrass	POA
[*Agropyron intermedium*]		
! *Elymus junceus*	Russian wildrye	POA
Elymus lanceolatus var. lanceolatus	Thickspike wheatgrass	POA
[*Agropyron dasystachyum var. dasystachyum*]		
Elymus lanceolatus var. riparius	Riparian thickspike wheatgrass	POA
[*Agropyron dasystachyum var. riparium*]		

! *Elymus repens* [*Agropyron repens; Elytrigia repens*]	Common quackgrass	POA
Elymus spicatus	Bluebunch wheatgrass	POA
[*Agropyron spicatum; Pseudoroegneria s.*]		
Elymus trachycaulus var. trachycaulus [*Agropyron caninum*]	Slender wheatgrass	POA
Eriophorum polystachion	Many-spiked cottongrass	CYP
Eriophorum viridicarinatum	Green-keeled cottongrass	CYP
Festuca idahoensis	Idaho fescue	POA
Glyceria grandis	American mannagrass	POA
Glyceria striata	Fowl mannagrass	POA
Hierochloe odorata	Common sweetgrass	POA
Hordeum brachyantherum	Meadow barley	POA
Hordeum jubatum	Foxtail barley	POA
Juncus balticus var. montanus	Baltic rush	JUN
Juncus ensifolius var. montanus	Mountain rush	JUN
Juncus longistylis	Long-styled rush	JUN
Juncus nodosus	Tuberous rush	JUN
Juncus tenuis var. dudleyi	Slender rush	JUN
Koeleria macrantha	Junegrass	POA
Leucopoa kingii	Spikefescue	POA
Muhlenbergia filiformis	Pullup muhly	POA
Muhlenbergia glomerata	Marsh muhly	POA
Muhlenbergia richardsonis	Mat muhly	POA
Oryzopsis hymenoides	Indian ricegrass	POA
Phalaris arundinacea	Reed canarygrass	POA
Phleum alpinum	Alpine timothy	POA
! *Phleum pratense*	Timothy	POA
! *Poa annua*	Annual bluegrass	POA
! *Poa bulbosa*	Bulbous bluegrass	POA
Poa nevadensis	Nevada bluegrass	POA
Poa palustris	Fowl bluegrass	POA
! *Poa pratensis*	Kentucky bluegrass	POA
Poa secunda var. elongata	Canby bluegrass	POA
Poa secunda var. secunda	Sandberg bluegrass	POA
Scirpus acutus	Hardstem bulrush	CYP
Scirpus pumilus [*Scirpus rollandii, Trichophorum rollandii*]	Pygmy bulrush	CYP
Scirpus validus	Soft-stem bulrush	CYP
Stipa comata var. intermedia	Needle-and-thread	POA
Stipa nelsonii var. nelsonii	Nelson's needlegrass	POA
Stipa viridula	Green needlegrass	POA

Triglochin maritimum	Seaside arrowgrass	JCG
Triglochin palustre	Marsh arrowgrass	JCG
Typha latifolia	Common cattail	TYP

Ferns and Fern Allies

Equisetum hyemale var. affine	Common scouring-rush	EQU
Equisetum laevigatum	Smooth scouring-rush	EQU
Equisetum variegatum	Northern scouring-rush	EQU
Selaginella densa	Compact spike-moss	SEL

The remaining 10 plants of special concern are all restricted to the Flat Creek Fen complex on the east bank of Flat Creek. These species are all found on specialized microsites that are often widely scattered throughout the wetland. Several species, including *Carex parryana* var. *parryana*, *C. scirpoidea* var. *scirpiformis*, *Eriophorum viridicarinatum*, and *Scirpus rollandii* are found primarily on flooded marl beds or otherwise moist, lime-rich banks of small streams and ditches. These species are highly localized and easily overlooked, but are probably more widespread in the Flat Creek wetland. *Muhlenbergia glomerata* and *Salix candida* are largely restricted to drier, loose-textured, hummocky areas that are scattered throughout the fen. These hummocks appear to be associated with ant mounds, a phenomenon that has also been observed in the Pine Creek Fen in Montana (Peter Lesica, personal communication). *Utricularia intermedia* is the only truly aquatic rare plant known on the refuge, although it is also commonly found on shallowly flooded marl beds. *Carex sartwellii* and *C. buxbaumii* both appear to be highly restricted to sites intermediate in moisture between drier uplands and flooded marshes. *Aster borealis* is the only rare wetland plant on the refuge that occurs in a variety of habitats, ranging from flooded marshes and marl beds to drier hummocks.

Although not found in 1997, potential habitat may still exist on the refuge for several species on the original target list (Table 2). *Draba borealis* is a Bridger-Teton National Forest Sensitive species that is known from two colonies on shady limestone cliffs near the mouth of Curtis Canyon and Sheep Creek (Fertig and Marriott 1993). Some areas of similar appearing habitat were surveyed along Flat Creek in 1997, but not all sites on the south bank could be reached due to high water. Potential habitat may also exist for a variety of floating mat and marl wetland sedges and forbs, all of which have been found under similar conditions in the Swamp Lake wetland of Park County, Wyoming (Fertig and Jones 1992).

Table 2
List of Target Rare Plant Species
Suspected to Occur on the National Elk Refuge
(prior to 1997 surveys)

Aster borealis
* *Astragalus terminalis*
Carex buxbaumii
Carex diandra
Carex limosa
Carex livida
Carex microglochin
Draba borealis
Epipactis gigantea
* *Eriophorum viridicarinatum*
Heterotheca depressa
Kobresia simpliciuscula
* *Lesquerella carinata* var. *carinata*
Muhlenbergia glomerata
Primula egaliksensis
Salix candida
* *Scirpus rollandii*
Spiranthes diluvialis
* *Utricularia ochroleuca* [*U. intermedia*]

* Previously known from the Refuge

Table 3

Status of Rare Plant Species Known to Occur on the National Elk Refuge

Species/Common Name	Federal Status	Heritage Rank
Aster borealis * [*A. junciformis*] Boreal aster	None	G5/S1
Astragalus terminalis Railhead milkvetch	None	G3G4/S1
Carex buxbaumii Buxbaum's sedge	None	G5/S2
Carex parryana var. *parryana* Parry sedge	None	G4T4/S1
Carex sartwellii Sartwell's sedge	None	G4/S1
Carex scirpoidea var. *scirpiformis* * Canadian single-spike sedge	None	G5T4Q/S1
Eriophorum viridicarinatum Green-keeled cotton-grass	None	G4/S1
Heterotheca depressa [*H. villosa* var. *depressa*] Teton golden-aster	None	G5T3/S2
Lesquerella carinata var. *carinata* Keeled bladderpod	USFWS: former C2	G3G4T3/S1
Muhlenbergia glomerata * Marsh muhly	USFS R2: Sensitive	G4/S1
Salix candida * Hoary willow	None	G5/S2
Scirpus rollandii [*S. pumilus*] Pygmy bulrush	USFS R2: Sensitive	G3Q/S1
Utricularia intermedia [Flat-leaved bladderwort]	None	G5/S1

Information from Fertig (1997 a) and The Nature Conservancy Heritage network.

* Not previously known from Teton County.

Suitable habitat appears to be lacking for two rare orchid species on the original target list. *Epipactis gigantea*, a USFS Region 4 Sensitive species, is known from a calcareous warm springs area on the north bank of the Gros Ventre River (south of Kelly), just north of the National Elk Refuge boundary in Grand Teton National Park (Marriott 1991). Potential thermal spring habitat was investigated north of the National Fish Hatchery in 1997, but no plants were located. The spring itself has been modified to provide water for the hatchery, and appears to be too cool and shrubby to support this species.

An intensive effort was made to locate populations of *Spiranthes diluvialis* on the refuge, in light of recent discoveries of this federally listed Threatened plant species along the Snake River in eastern Idaho (Moseley 1997 a). This species is found primarily in mid-seral riparian habitats on alluvial substrates along gravel bars, old oxbows, wet meadows, and flood plains (Arft and Ranker 1998). Recent findings in southwestern Montana also indicate that *S. diluvialis* may occur on basic soils with little organic matter (Heidel 1997). Habitats like this occur sporadically throughout the Flat Creek Fen. Surveys in 1997, however, revealed only the presence of the closely related *S. romanzoffiana*, a montane species that is widely distributed across western and northern Wyoming. *S. romanzoffiana* can be distinguished from *S. diluvialis* by its fused, hood-like sepals, more deeply constricted lip petals, and shorter, more densely flowered inflorescences (Fertig et al. 1994; Moseley 1997 a). All of the *Spiranthes* plants observed and collected in the Flat Creek Fen (Fertig #s 17785, 17819, 17838, 17852, 17869, 17891, and 17932, all deposited at RM) clearly exhibited the condensed inflorescence and hooded sepal characteristics of *S. romanzoffiana*.

Moseley (1997 b) briefly surveyed the Snake River corridor in Wyoming from Palisades Dam to South Park (Jackson Hole) in early October 1997 and reported potential *Spiranthes diluvialis* habitat. Moseley recommended that these areas receive survey attention in 1998. Additional surveys of the Flat Creek Fen do not appear to be warranted, however, based on the results of the present study.

Species Summaries

Information on the biology and conservation status of the 13 plant species of special concern known from the National Elk Refuge is presented in the following species summaries. Element Occurrence Records (formatted database reports) and location maps for these species are included in Appendix A.

Aster borealis Prov.
Boreal aster
Asteraceae or Compositae (Sunflower Family)

Synonyms: *Aster junciformis* (Rush aster).

Heritage Rank: G5/S1.

Federal Status: None.

Description: Boreal aster is a slender perennial herb with creeping rhizomes (Figure 3). The stems are 15-80 cm tall, less than 2 mm thick, and hairy above (with the hairs arranged in lines), but glabrous at the base. Leaves are linear (mostly 6 or more times longer than wide), 2-5 (8) mm wide, clasping at the base, and mostly entire. Basal leaves are not present and the lower stem leaves are often reduced and early deciduous. The inflorescence may be short and broad to elongate (reduced to a single head in some plants) and consists of small heads of white or blue-rayed flowers. The involucre is 5-7 mm high, glabrous, and consists of overlapping pointed bracts with purple tips and margins (Cronquist 1955; Dorn 1992).

Similar Species: *Aster bracteolatus* has lavender, pink, or white ray flowers in an elongate, leafy inflorescence which is nearly 1/3 to 1/2 the length of the plant. *A. ascendens* has wider stems and leaves, obtuse and whitish-based involucre bracts, and occurs in drier, upland habitats. *A. occidentalis* has wider stems and leaves and larger blue to purple rayed flowers (Dorn 1992).

Geographic Distribution: Occurs from Alaska to Quebec south to New Jersey, Minnesota, South Dakota, Colorado, and Idaho (Cronquist 1955). In Wyoming, it is known from scattered locations in the Laramie, Absaroka, Wind River, and Uinta mountains, the Yellowstone Plateau, Jackson Hole, and Wind River Basin in Albany, Fremont, Park, Sublette, Teton, and Uinta counties and Yellowstone National Park (WYNDD records).

Occurrences Within the Study Area: Boreal aster is known from 9 main subpopulations scattered throughout the Flat Creek Fen from the confluence of Flat Creek and the Gros Ventre Aqueduct to the south end of Millers Butte.

Habitat: This species occurs primarily in cold bogs and damp, mossy forest openings (Cronquist 1955; Porsild and Cody 1980). Most populations in Wyoming are associated with cold water springs or calcareous wetlands. In the National Elk Refuge, boreal aster is found primarily in hummocky, wet calcareous meadows and flooded marl beds along streams, ditches, and ponds dominated by *Carex*

simulata-Triglochin maritimum-Juncus balticus vegetation. Occasionally, populations can also be found on flooded, muddy-bottomed marshes of *Carex rostrata* [*C. utriculata*], *C. simulata,* and *C. aquatilis*.

Flowering/Fruiting Period: July-September.

Population Size and Condition: Populations on the National Elk Refuge are widespread, but rarely contribute more than trace amounts of cover. No census was attempted in 1997 due to difficulties in distinguishing this species from *A. bracteolatus*.

Existing and Potential Threats: Draining and ditching of wetland areas on the refuge may have eliminated some habitat of this species in the past. *A. borealis* does not appear to be significantly grazed by elk or other animals during the summer flowering season.

Notes: The population on the refuge is the first to be recorded for Teton County. Boreal aster is currently known from seven other extant occurrences in Wyoming. At least three populations of this species are protected in Yellowstone National Park, and the Swamp Lake and Kendall Warm Springs Special Botanical Areas.

Figure 3. *Aster borealis*. Illustration from Cronquist (1955).

Astragalus terminalis Wats.
Railhead milkvetch
Fabaceae or Leguminosae (Pea Family)

Heritage Rank: G3G4/S1.

Federal Status: None.

Description: Railhead milkvetch is a perennial herb from a woody, forked caudex with several erect, leafy stems 5-30 cm high (Figure 4). Foliage is ashy gray pubescent with short, appressed, dolabriform hairs (hairs are attached at the middle and have 2 free ends, like a short "T"). Leaves are 5-17 cm long and divided into 11-21 oblong-elliptic, blunt-tipped leaflets. Stipules are lance-shaped, 3-5 mm long, and not fused on the side of the stem opposite the petiole. The inflorescence is a compact raceme of 10-30 nodding, pea-like flowers borne on a peduncle 6-20 cm long. The banner and wing petals are 11-16 mm long, whitish to cream-colored, and often suffused with pale lilac, while the blunt-tipped keel is creamy white with a purple-spot at the tip and 8.5-10.5 mm long. The calyx is 4-7 mm long, asymmetrical, and has short triangular teeth. Fruits are erect, narrowly oblong pods up to 1.7 mm long and have 2 locules. The pods are green and fleshy when young, but become leathery-woody at maturity (Barneby 1989; Culver and Marriott 1989).

Similar Species: *Astragalus miser* has a sharp-pointed keel, stipules fused on the side of the stem opposite the petiole, greenish leaves, and fruits with a single locule. *A. canadensis* has stipules fused on the side of the stem opposite the petiole (Dorn 1992).

Geographic Distribution: Regional endemic of central Idaho, southwestern Montana, and northwestern Wyoming. All known Wyoming occurrences are from Jackson Hole and the surrounding foothills of the Gros Ventre Range.

Occurrences Within the Study Area: Railhead milkvetch is known from a single population along the Long Hollow Road last observed in 1980 by Meredith Platt. Specimens from this population are among the unmounted accessions of the RM, and had been mislabeled as *Oxytropis lagopus*. Potential habitat for this species was investigated during surveys for *Lesquerella carinata* in 1996-97, but no additional populations were observed on the Refuge. Potential habitat may exist along the crest of Refuge Peak Ridge and in the foothills of the Gros Ventre Range on whitish clay soils with abundant surface gravels.

Habitat: Occurs in gravelly outwash terraces, stony or grassy hillsides, and cushion plant-bunchgrass communities on summit flats of brownish-sandy clay soil with abundant surface gravel.

Flowering/Fruiting Period: June-August.

Population Size and Condition: Population size is not known on the Refuge. Specific population data are lacking for other known occurrences in the Jackson Hole area, although Shaw (1976) reports it to be "common" along the dry terraces above the Snake River in Grand Teton National Park.

Existing and Potential Threats: Prescribed burning has been identified as a potential threat to this species on adjacent Bridger-Teton National Forest lands (Culver and Marriott 1989). Competition from exotics may also be a threat. This species does not appear to be readily grazed on sites outside of the Refuge, probably due to the presence of anti-herbivory compounds in its foliage.

Notes: Railhead milkvetch is currently known from 5 extant occurrences and 2 historical records in Wyoming (WYNDD records). Several of these occurrences are within the same general area, and may need to be combined in the future. At least three populations are protected in Grand Teton National Park.

Figure 4. *Astragalus terminalis*. Illustration from Barneby (1989).

Carex buxbaumii Wahl.
Buxbaum's sedge
Cyperaceae (Sedge Family)

Heritage Rank: G5/S2.

Federal Status: None.

Description: Buxbaum's sedge is a loosely tufted perennial from a long, scaly rhizome (Figure 5). Stems are 20-80 cm high with reddish-purple scaly bases and are leafy only below the middle. The leaves are flat, 1.5-4 mm wide and glaucous. The inflorescence consists of 2-5 erect, non-clustered spikes, with the terminal spike gynaecandrous (upper flowers pistillate, lower staminate) and the lateral spikes pistillate and sessile. Flowering scales are lance-shaped, long-acuminate, reddish-brown with a light green midrib and are longer and narrower than the perigynia. The perigynia are 3-4 mm long, elliptic, glaucous-green, and densely papillate on the surface. Achenes are trigonous and pistillate flowers have 3 styles (Hitchcock et al. 1969; Hermann 1970; Moss 1983; Dorn 1992).

Similar Species: *Carex aquatilis* has 2 stigmas per flower, 2-sided achenes, and long-stalked lateral spikes. Other *Carex* species with 3 styles and trigonous achenes have all black or blunt-tipped flowering bracts, clustered head-like spikes, or tufted stems (Dorn 1992).

Geographic Distribution: Northern Canada and Alaska south to scattered locations in California, Utah, Colorado, North Dakota, and the northeastern United States. In Wyoming, it is known from the Absaroka, Beartooth, and Uinta mountains, Yellowstone Plateau, Jackson Hole, and Clarks Fork Valley (Park, Teton, and Uinta counties and Yellowstone National Park).

Occurrences Within the Study Area: Buxbaum's sedge is known from 5 small to medium-sized colonies in the Flat Creek Fen. Two small populations are found along the east bank of Flat Creek between the sleigh bridge and the southwest corner of Millers Butte. The other three colonies are located in the vicinity of Nowlin Creek and Nowlin Pond # 4.

Habitat: Occurs in peat bogs, marshes, and moist meadows along lakeshores and streams (Marriott 1991). On the elk refuge, this species is sparsely distributed in moist (but not flooded) *Juncus balticus* or *Carex simulata/J. balticus/Elymus albicans* communities on organic-clay hummocks or marl flats. The largest population is

found on wet marl beds with short, semi-sparse vegetative cover of *Carex viridula, Juncus nodosus,* and *Triglochin palustre.*

Flowering/Fruiting Period: June-August.

Population Size and Condition: The largest colony of Buxbaum's sedge was found along the north side of Nowlin Creek and numbered 1500-2000 stems. All of the other colonies surveyed in 1997 were much smaller, averaging 15-100 stems.

Existing and Potential Threats: No evidence of herbivory by elk or other large grazers was observed during the summer growing and flowering season in 1997. Human impacts appear to be low at present, although past ditching of the Flat Creek wetland complex may have eliminated some habitat.

Notes: Recent surveys in western Wyoming have resulted in the discovery or relocation of 18 populations of this species (Marriott 1991; Fertig and Jones 1992; J. Whipple, personal communication). In light of these discoveries, the conservation status of *C. buxbaumii* may need to be reassessed in the near future.

Figure 5. *Carex buxbaumii*. Illustration by Jeanne Janish from Hitchcock et al. (1969).

Carex parryana Dewey
var. *parryana*
Parry sedge
Cyperaceae (Sedge Family)

Heritage Rank: G4T4/S1.

Federal Status: None.

Description: Parry sedge is a loosely tufted perennial with short, creeping rhizomes (Figure 6). Stems are 20-40 cm tall, erect, and exceed the basal leaves. Leaves are flat, 2-4 mm wide, and in clusters of 5-12 near the base of the stem. The inflorescence consists of 3-6 elongate spikes that are not obviously clustered, at least at the base. The terminal spike consists of either all staminate flowers or both pistillate and staminate flowers (with the staminate located at the base). Lateral spikes consist only of pistillate flowers, and at least one spike is typically as large as the terminal spike. The lowest spike is subtended by a short, nearly sheathless bract. Perigynia are 2.5 mm long, brown, rounded at the tip and minutely toothed along the margins. The beak of the perigynium is 0.1-0.6 mm long and either entire or 2-toothed. Pistillate scales are dark reddish brown with a green midrib and white membranous margins and are typically equal to the perigynia in size. Achenes are 3-sided and short-stalked at the base. Pistillate flowers have 3 stigmas (Murray 1969; Hermann 1970; Cronquist et al. 1977; Dorn 1992; Jones and Fertig 1996).

Similar Species: *Carex parryana* var. *unica* has lateral spikes shorter than the terminal spike and often confluent into an elongate, single-headed inflorescence. *C. scirpoidea* var. *scirpiformis* has flowering bracts with broadly white-hyaline margins and non-green midribs and pubescent perigynia. Other sedge species with 3 stigmas differ in having glabrous perigynia, dark pistillate scales, or spikes aggregated into a single head (Murray 1969; Dorn 1992; Jones and Fertig 1996).

Geographic Distribution: Occurs from central Manitoba to southern Alaska, south to Utah and northern Colorado (Murray 1969). In Wyoming, this species is known from the Black Hills, Sweetwater River Valley, Green and Great Divide basins, Gros Ventre Range, and Jackson Hole in Carbon, Crook, Sweetwater, and Teton counties.

Occurrences Within the Study Area: This taxon is known from a single, small population along an oxbow of Flat Creek at the south end of Millers Butte.

Habitat: Parry sedge is found in wet meadows, swales, and moist low ground in prairies

and high plains (Cronquist et al. 1977). The Elk Refuge population is found in a community of *Muhlenbergia glomerata, Elymus trachycaulus,* and *Hordeum brachyantherum* on low hummocks of dried marl deposits at the edge of a wet meadow and cattail marsh.

Flowering/Fruiting Period: June-early August.

Population Size and Condition: No census was made in 1997, but the refuge population appears to be small and localized.

Existing and Potential Threats: No threats were observed to the refuge population and no evidence of grazing by elk or other ungulates was detected (at least during the summer reproductive season).

Notes: Parry sedge is currently known from 7 extant and 1 historical populations in Wyoming, all of which appear to be limited to small and specialized microhabitats (WYNDD records). Hermann (1970) reports this species to be "rare to infrequent and very local" throughout its range.

Figure 6. *Carex parryana var. parryana*. Illustration from Cronquist et al. (1977).

Carex sartwellii
Sartwell's sedge
Cyperaceae (Sedge Family)

Heritage Rank: G4/S1.

Federal Status: None.

Description: Sartwell's sedge is a perennial with culms arising singly or together from an elongate brown or blackish creeping rhizome (Figure 7). Leaves are flat, 2-5 mm wide, and scattered along the culm (not restricted to a basal cluster). Leaf sheaths are elongate and green streaked on the ventral surface rather than white hyaline. Inflorescence dense, ovoid to cylindric, 2-5 cm long, and composed of 15-20 or more sessile, androgynous spikes (with the staminate flowers arranged above the pistillate ones). Lowermost spikes subtended by long, leafy bracts. Flowering scales scarious or hyaline-margined, straw-colored or light brown except for the pale midrib, and nearly as long as or equaling the perigynia. The ovate to elliptic perigynia are 2.3-4 mm long, narrowly wing-margined, ventrally nerved, and taper to a short, bi-toothed beak. The achenes are lens-shaped and pistillate flowers have 2 stigmas (Hitchcock et al. 1969).

Similar Species: *Carex praegracilis* has dark brown to black lower leaf sheaths, leaves arranged mostly in a basal cluster and perigynia without thin margins or ventral nerves. *C. simulata* has dark, wingless and nerveless perigynia under 2.7 mm long. *C. diandra* and *C. cusickii* have copper-margined or spotted ventral leaf sheaths and clustered stems rather than stems borne along creeping rhizomes (Hitchcock et al. 1969; Dorn 1992).

Geographic Distribution: Northern Alberta to western New York, south to the northern Great Plains and in the Rocky Mountains to Colorado (Hitchcock et al. 1969). In Wyoming, known from scattered locations in Jackson Hole, the Medicine Bow Range, Yellowstone Plateau, and Wind River Basin in Albany, Fremont, and Teton counties and Yellowstone National Park (WYNDD records).

Occurrences Within the Study Area: Sartwell's sedge is known from three small to medium-sized colonies on the elk refuge. The most abundant colonies are located on the east bank of Flat Creek downstream of the sleigh bridge and west of Millers Butte. A smaller colony is found in the wetland east of Nowlin Pond # 1 at the northeastern end of Millers Butte.

Habitat: Reported from swales, wet meadows, marshy lake shores, and other moist, low-lying places (Hitchcock et al. 1969). On the refuge, this species can be locally

dominant or co-dominant with *Juncus balticus* and *Deschampsia cespitosa* on mossy, moist organic black soils. These stands tend to be restricted to a narrow band located between wetter *Carex aquatilis/C. rostrata* [*C. utriculata*] communities and drier *Juncus balticus* vegetation. Populations can also be found on moist ditchbanks with dense cover of *Carex simulata, Triglochin maritimum,* and *Juncus balticus*.

Flowering/Fruiting Period: June-August.

Population Size and Condition: The largest populations on the refuge are located near the east bank of Flat Creek and contain several thousand culms. At favorable sites this species is locally dominant and imparts a lime-green color to the landscape from its broad stem leaves. Additional habitat may be present at the south end of the refuge in the less marshy areas on the banks of Flat Creek.

Existing and Potential Threats: Populations in the Elk Refuge may be sensitive to fluctuations in moisture levels and grazing.

Notes: This species is currently known from 5 extant and 1 vague historical records in Wyoming.

Figure 7. *Carex sartwellii*. Illustration from Hitchcock et al. (1969).

Carex scirpoidea Michx.
var. *scirpiformis* (Mack.) O'Neill & Duman
Canadian single-spike sedge
Cyperaceae (Sedge Family)

Synonym: *Carex scirpiformis*; included in *C. scirpoidea* var. *scirpoidea* by some authors.

Heritage Rank: G5T4Q/S1.

Federal Status: None.

Description: Canadian single-spike sedge is a tufted perennial with stems 2-4.5 dm high (Figure 8). The stems originate from vegetative shoots of the current year and have scaly bases that are not hidden by dried, tattered leaves remaining from the previous year. Each stem has 2-6 somewhat channeled leaves that are 2-3 mm wide. Spikes are solitary, erect, and unisexual. Pistillate spikes are linear, 2-4 cm long, 4-5 mm wide, and have 30-80 flowers. Perigynia are oblong-ovoid, obscurely 3-sided, greenish to yellowish brown, abruptly contracted to a 2-toothed beak, and stiffly short-pubescent. The pubescent pistillate and staminate flowering scales are purplish-black with a lighter center stripe and broad, white-hyaline margins (nearly 1/2 the width of the scale). Achenes are sharply trigonous, brownish-yellow, and short-stalked (Hermann 1970; Fertig and Jones 1992; Dorn 1992).

Similar Species: *Carex scirpoidea* var. *scirpoidea* has flowering bracts with more narrowly hyaline margins (white membranous edge is only ¼ or less the width of the bract). *C. parryana* var. *parryana* has glabrous perigynia with minutely-toothed margins and flowering bracts with green midribs (Dorn 1992).

Geographic Distribution: Occurs from Manitoba to Alberta and south to North Dakota, northern Wyoming, and Utah (Hermann 1970). In Wyoming, it is known only from the Swamp Lake wetland (Park County) and Jackson Hole (Teton County).

Occurrences Within the Study Area: Three small populations were found on the east bank of Flat Creek west of Millers Butte and along an unnamed tributary near the north end of the Flat Creek Fen in 1997.

Habitat: Occurs in open, sunny sites, often at the edge of wet meadows, on calcareous substrates (Hermann 1970). At Swamp Lake, it has been observed on semi-moist hummocks in marly *Triglochin-Eleocharis* communities and on floating mats of

Carex simulata/Calamagrostis inexpansa (Fertig and Jones 1992). Populations on the elk refuge are mostly on exposures of dry to moist marl-clay near seep springs and dried stream channels. Associated vegetation on the refuge consists of *Agrostis stolonifera, Carex aquatilis, Deschampsia cespitosa,* and *Juncus balticus*.

Flowering/Fruiting Period: June-August.

Population Size and Condition: Populations on the refuge may be locally numerous, but are restricted to small areas of suitable microhabitat.

Existing and Potential Threats: No threats were observed in 1997, although populations may be vulnerable to habitat loss from flooding, ditch construction for irrigation, and grazing.

Notes: This taxon is currently known from only one other location in the state. Variety *scirpiformis* is closely related to var. *scirpoidea* and has been combined with it by some authors (Hitchcock et al. 1969).

Figure 8. *Carex scirpoidea* var. *scirpiformis*. Illustration from Hermann (1970).

Eriophorum viridicarinatum
Green-keeled cottongrass
Cyperaceae (Sedge Family)

Heritage Rank: G4/S1.

Federal Status: None.

Description: Green-keeled cottongrass is a rhizomatous perennial with 3-angled stems 2-9 dm tall (Figure 9). Leaves are 2-6 mm wide, flat (except at the very tip), and borne along the stem and in a basal cluster. The inflorescence consists of 3 or more drooping spikelets arranged in an umbel-like cyme and subtended by 2-3 leafy green bracts. Each flower of the spikelet has a drab greenish to blackish scale with a prominent pale midrib running its full length and expanding at the distal tip. Perianth bristles are cottony, white, and greatly exceed the scales and fruit in length, giving the fruiting heads a cotton-ball appearance. Fruits are blackish, 2-3 mm long achenes (Hitchcock et al. 1969; Moss 1983).

Similar Species: *Eriophorum polystachion* has tawny brown scales (occasionally blackish) with a slender midrib that does not reach the tip of the scale. Other cottongrass species differ in having a single spikelet or leafy bract per stem or in having triangular and deeply channeled leaf blades (Dorn 1992).

Geographic Distribution: Occurs from Newfoundland to Alaska and south to New York, Michigan, Colorado, and northern Idaho (Hitchcock et al. 1969). In Wyoming, it is known from the Clarks Fork Valley, Teton Range, Jackson Hole, and Yellowstone Plateau in Park and Teton counties.

Occurrences Within the Study Area: Green-keeled cottongrass is presently known from only two small locations along Nowlin and Sheep Creeks in the Flat Creek Fen.

Habitat: Boggy woods and wet meadows (Moss 1983). On the elk refuge, this species is found in wet marshes and creek bottoms on deep, water-soaked, loamy hummocks dominated by *Carex simulata/Agrostis stolonifera/Triglochin maritimum* vegetation.

Flowering/Fruiting Period: June-early August.

Population Size and Condition: No population estimates were attempted in 1997 due to

difficulties in reliably distinguishing this species from its more abundant congener, *E. polystachion* (both species were in late fruit and usually had already lost their diagnostic flowering scales). Additional habitat probably exists for *E. viridicarinatum* throughout the wetter parts of the Flat Creek Fen, and this species may be more abundant than our current knowledge suggests.

Existing and Potential Threats: Impacts from grazing are not known, although few plants appeared to be grazed in the summer of 1997. Historically, this species may have lost some habitat on the refuge from past ditching of the wetland area.

Notes: This species is known from only three other occurrences in the state of Wyoming.

Figure 9. *Eriophorum viridicarinatum*. Illustration by Jeanne Janish from Hitchcock et al. (1969).

Heterotheca depressa
Teton golden-aster
Asteraceae or Compositae (Sunflower Family)

Synonyms: *Heterotheca villosa* var. *depressa*.

Heritage Rank: G5T3/S2.

Federal Status: None.

Description: Teton golden-aster is a multi-branched, often somewhat prostrate, perennial herb with leafy stems 7-20 cm long from a woody rootstalk (Figure 10). Leaves are 7-14 mm long, narrowly elliptic to spoon-shaped, and densely grayish-pubescent (giving the surface a smooth appearance). Leaf blades may have small glands. Heads are borne singly on narrow leafless of short-leafy stalks often over 1 cm long. The flower stalks and involucres are densely pubescent with appressed, smooth-looking hairs. Flower heads are 7-10 mm long and have 3 overlapping sets of linear, sharp-tipped bracts. Ray flowers are yellow. The flattened fruits are topped by slender pappus bristles (Mills and Fertig 1996; Semple 1996).

Similar Species: *Heterotheca villosa* has sessile flower heads and somewhat spreading, ragged-appearing pubescence on the stems and leaves. *H. horrida* has coarser, more obviously glandular pubescence and broadly scale-like outer pappus segments (Dorn 1992).

Geographic Distribution: Regional endemic of the Yellowstone Plateau and Snake River/Gros Ventre River drainages of northwestern Wyoming and immediately adjacent areas of Montana and Idaho (Semple 1996).

Occurrences Within the Study Area: A single small population was discovered along the south bank of the Gros Ventre River in 1997, in the vicinity of a vague historical collection made by Louis Williams in 1933.

Habitat: Teton golden-aster occurs primarily on sparsely-vegetated gravel bars and thermally-influenced sites. On the elk refuge, it is limited to seasonally flooded sandy-cobbley river terraces above the summer flood zone. These sites are dominated by heavily grazed stands of *Elaeagnus commutata* and *Populus angustifolia* with a sparse, weedy understory of scattered *Agrostis stolonifera* and *Phleum pratense*.

Flowering/Fruiting Period: Mid July-early September.

Population Size and Condition: The elk refuge population consists of approximately 500-1000 plants in an area of less than 4 acres.

Existing and Potential Threats: Teton golden-aster is an early successional species that is capable of colonizing semi-disturbed sites, but which may be vulnerable to competition from exotic plants or habitat loss due to vegetative succession. The shrubby vegetation along the Gros Ventre River is heavily browsed, but the golden-aster population does not appear to be excessively grazed. Populations elsewhere in the Snake River drainage may be threatened by gravel quarrying.

Notes: Despite its limited geographic range, populations of Teton golden-aster may be locally abundant, especially in thermally influenced areas of Yellowstone National Park (Jennifer Whipple, personal communication).

Figure 10. *Heterotheca depressa*. Illustration by W. Fertig from Mills and Fertig (1996).

Lesquerella carinata
var. *carinata*
Keeled bladderpod
Brassicaceae or Cruciferae (Mustard Family)

Heritage Rank: G3G4T3/S1

Federal Status: USFWS: former C2.

Description: Keeled bladderpod is a densely pubescent perennial herb with decumbent stems to 15 cm long (Figure 11). The stem and basal leaves are silvery-pubescent, spoon-shaped, and 1.5-3 cm long. The 4-petaled flowers are yellow, 7.5-10 mm long, and arranged in a compact inflorescence. The pubescent fruits are oval, 5-9 mm long, flattened, and strongly keeled along the margins and partition, making them appear diamond-shaped in cross-section (Rollins and Shaw 1973; Rollins 1993; Fertig 1997 b).

Similar Species: *Lesquerella paysonii* has flattened fruits with rounded (non-keeled) margins and flat faces. *L. fremontii* has recurved fruit stalks and smaller flowers and styles. Other *Lesquerella* species in Wyoming differ in having inflated fruits. *Physaria* species can be distinguished by their two-parted, balloon-like fruits, more rounded leaf blades, and typically more robust size (Dorn 1992; Fertig et al. 1994).

Geographic Distribution: Regional endemic of east-central Idaho and northwestern Wyoming. In Wyoming, it is only known from the Jackson Hole Valley and adjacent foothills of the Teton and Gros Ventre ranges in Teton County (Fertig 1997 b).

Occurrences Within the Study Area: Keeled bladderpod is known from 3 main occurrences (with a total of 8 subpopulations) on the summit of Millers Butte, the foothills of the Gros Ventre Range near the mouth of Sheep Creek Canyon, and along the Refuge Peak ridge system near Long Hollow (Fertig 1997 b).

Habitat: Occurs primarily on sparsely vegetated outcrops of fine, pale whitish clay-sandy soil with a surface layer of grayish calcareous gravel on slopes and ridgecrests. These sites are usually dominated by scattered cushion plants and bunchgrasses and lack shrubs (Fertig 1997 b).

Flowering/Fruiting Period: Late May-July.

Population Size and Condition: Surveys in 1996 found approximately 45,000-52,000

individuals of keeled bladderpod on the National Elk Refuge and immediately adjacent areas of Bridger-Teton National Forest (Fertig 1997 b).

Existing and Potential Threats: Populations on the elk refuge appear to be less threatened by competition from exotic plants and impacts from recreation than populations on Bridger-Teton National Forest or Grand Teton National Park. Some refuge populations, however, appear to be less numerous near heavily used game trails than in less disturbed sites. Keeled bladderpod is not grazed by elk or other ungulates, but could be impacted by trampling or bedding (Fertig 1997 b).

Notes: This species was formerly a candidate for listing under the Endangered Species Act, but was dropped from consideration following surveys that found it to be locally abundant and largely unthreatened in eastern Idaho. Only five extant populations are known from Wyoming and the species is being considered for Sensitive designation by Bridger-Teton National Forest (Fertig 1997 b).

Figure 11. *Lesquerella carinata* var. *carinata*. Illustration by W. Fertig from Fertig et al. 1994.

Muhlenbergia glomerata
Marsh muhly
Poaceae or Gramineae (Grass Family)

Synonyms: Included in *Muhlenbergia racemosa* by some authors.

Heritage Rank: G4/S1.

Federal Status: USFS Region 2: Sensitive.

Description: Marsh muhly is a rhizomatous perennial with unbranched (or basally branching) leafy stems 20-90 cm tall (Figure 12). The upper leaf blades are flat, 2-5 mm wide, 5-15 cm long, and have slightly keeled sheaths and minute, membranous ligules. Internodes of the stem are minutely pubescent below the nodes. The inflorescence is a terminal, congested panicle 4-7 cm long. The glumes have long, tapering, scabrous awns and exceed the single floret. Hairs at the base of the floret are less than half as long as the lemma. Anthers are 0.7-1.5 mm long (Hallsten et al. 1987; Dorn 1992; Fertig et al. 1994).

Similar Species: *Muhlenbergia racemosa* has glabrous internodes, strongly keeled sheaths, branched stems, smaller anthers (0.4-0.9 mm), and typically occurs in drier habitats. *M. andina* has long hairs at the base of the floret that equal or exceed the lemma. Other *Muhlenbergia* species have open, diffuse inflorescences, lack creeping rhizomes, or are annuals (Dorn 1992; Fertig et al. 1994).

Geographic Distribution: Northern Canada south to West Virginia, Colorado, and Nevada. In Wyoming, this species occurs in scattered locations in the Black Hills, Yellowstone Plateau, Southeastern Plains, Green River Valley, Clarks Fork Valley, and Jackson Hole (Crook, Goshen [?], Park, Sublette, and Teton counties and Yellowstone National Park).

Occurrences Within the Study Area: Marsh muhly occurs sporadically throughout the Flat
Creek Fen, especially along the smaller tributary streams of Flat Creek (including Nowlin and Sheep creeks).

Habitat: This species has been reported from bogs, springs, peaty or calcareous meadows,
floating mats, stream edges, and shores (Fertig et al. 1994). On the elk refuge, marsh muhly is found primarily on low, moist (but not flooded) hummocks of humus-rich, well-aerated soil locally dominated by *Carex simulata/Triglochin*

maritimum or *Juncus balticus/Potentilla fruticosa* communities. Many of these hummocks appear to be formed by ant colonies.

Flowering/Fruiting Period: July-September.

Population Size and Condition: The total population on the refuge was conservatively estimated at several thousand stems. Due to the plant's rhizomatous growth form, more exact counts are difficult to make. Individual populations ranged from sparse to locally abundant, although never dominant.

Existing and Potential Threats: No evidence of herbivory by elk or other grazers was observed during the summer flowering period in 1997. Semi-dry hummock habitats in the Flat Creek Fen may be vulnerable to colonization by exotic clovers such as *Trifolium repens* and *T. pratense*.

Notes: The population from the National Elk Refuge is the first to be documented for Teton County and only the fifth extant population known for the state.

Figure 12. *Muhlenbergia glomerata*. Illustration by Jeanne Janish from Fertig et al. (1994).

Salix candida
Hoary willow
Salicaceae (Willow Family)

Heritage Rank: G5/S2.

Federal Status: None.

Description: Hoary willow is a low shrub 0.2-15 dm high with dense, short white-woolly pubescence on the young twigs (Figure 13). The narrowly elliptic, leathery leaf blades are dark green above and densely white-woolly below and have entire and slightly inrolled margins. The pistillate catkins are 3-5 cm long and sessile or on short, leafy branchlets. Fruiting capsules are woolly-pubescent and subtended by a brown or yellowish (rarely black) wavy-hairy flowering bract. Staminate catkins (borne on separate plants) are 1.5-2.5 cm long and have 2 stamens per flower (Dorn 1992, 1997; Fertig and Markow 1998).

Similar Species: *Salix drummondiana* is a taller shrub with pruinose branchlets (with a bluish-white waxy coating) and straight, silvery hairs on the undersides of the leaves. *S. brachycarpa* has shorter petioles, glaucous leaf undersurfaces, and more densely gray-hairy upper leaf surfaces.

Geographic Distribution: Labrador to Alaska and south to the Great Lakes, South Dakota, Colorado, and Idaho. In Wyoming, this species is known from widely scattered locations in the upper Green River Basin, the Yellowstone Plateau, and Laramie, Medicine Bow, Absaroka, Beartooth, and Wind River ranges.

Occurrences Within the Study Area: Hoary willow is known from 10 subpopulations scattered throughout the Flat Creek wetland from the confluence of Flat Creek and the Gros Ventre Aqueduct to the south side of Millers Butte.

Habitat: In Wyoming, this species has been reported from anchored floating mats at the edge of small fens and from marl-rich hummocks dominated by *Carex simulata*, *Eleocharis*, and *Triglochin* (Fertig and Jones 1992; Walford et al. 1997). In the Flat Creek Fen it is found primarily on ant mounds or slightly elevated hummocks of thick organic-humus soil within moist calcareous meadows of *Carex simulata/Triglochin maritimum* vegetation. These sites may be locally dominated by dwarf shrubs, including *Salix brachycarpa* and *Potentilla fruticosa.*

Flowering/Fruiting Period: June-July.

Population Size and Condition: The refuge population of *S. candida* may consist of as

many as 5000-10,000 individuals. Populations are usually densely clustered, with as many as 31 stems per square meter in favorable microsites. Individual colonies, however, are widely scattered and patchy.

Existing and Potential Threats: Heavily browsing by elk or other ungulates is preventing the elk refuge population from producing flowers or fruit. Browsing intensity is probably greatest in the fall when elk are returning to the Jackson Valley for the winter. The continual loss of first-year stem growth requires individual willow plants to allocate their food reserves for replacement stem growth rather than for production of catkins. Lack of fruit production may have a long-term negative impact on the survival of the refuge population.

Notes: Hybrids between *S. candida* and *S. brachycarpa* occur sporadically in the Flat Creek Fen. Hybrid individuals can be recognized by their lack of conspicuous white tomentum on the leaf undersides. The elk refuge colony is the first to be documented in Teton County and only the eighth extant record for Wyoming.

Figure 13. *Salix candida*. Illustration by W. Fertig from Fertig and Markow (1998).

Scirpus rollandii Fern.
Pygmy bulrush
Cyperaceae (Sedge Family)

Synonyms: *Scirpus pumilus, S. pumilus var. rollandii, Trichophorum pumilum*.

Heritage Rank: G3Q/S1.

Federal Status: USFS Region 2: Sensitive.

Description: Pygmy bulrush is a low-growing tufted perennial with slender rhizomes (Figure 14). Stems are 5-10 cm tall, round in cross-section, green to yellowish, and leafless. Leaf blades are 0.5-1 mm long and located near the base of the stem. The inflorescence consists of a single, round-tipped, oval spikelet composed of 3-5 flowers borne at the tip of the stem. The smooth, 2-sided achenes are dark brown and subtended by 3-6 red bristles and short, white-membranous scales (Beetle 1941; Dorn 1992; Fertig and Jones 1992; Fertig et al. 1994; Mills and Fertig 1996).

Similar Species: Low-growing *Eleocharis* species have a cap-like structure at the top of the achene (actually the enlarged base of the style) and have sharp-tipped inflorescences. Other *Scirpus* species in Wyoming have 2 or more spikelets per stem and leafy inflorescences or stems (Fertig et al. 1994; Mills and Fertig 1996).

Geographic Distribution: Widely scattered from Yukon to northern Quebec, south to British Columbia and Montana, with disjunct populations in northwest Wyoming, central Colorado, and California (Argus and Pryer 1990). In Wyoming, pygmy bulrush is currently known from 3 small, calcareous wetland sites in the Clarks Fork Valley, Gros Ventre River drainage, and Jackson Hole in Park and Teton counties (Mills and Fertig 1996).

Occurrences Within the Study Area: Pygmy bulrush is known from at least 6 small subpopulations scattered along Flat Creek and its tributaries (including Nowlin and Sheep creeks) and along a small pond at the south end of Millers Butte.

Habitat: In Wyoming, pygmy bulrush has been documented from montane fens, marl wetlands along small streams, and flooded marl deposits dominated by *Triglochin* and *Eleocharis* (Fertig and Jones 1992; Mills and Fertig 1996). Populations on the refuge are found mostly on moist, mossy, marl-rich banks of small streams dominated by *Deschampsia cespitosa/Juncus balticus/Elymus albicans* vegetation or on wet calcareous streambanks in dense stands of *Carex simulata, Triglochin maritimum,* and *Agrostis stolonifera.*

Flowering/Fruiting Period: June-July/July-August.

Population Size and Condition: The Elk Refuge population is the largest in Wyoming, consisting of approximately 5,000-10,000 individuals. This estimate is probably low given the difficulty in locating this tiny plant and the large amount of additional potential habitat. Individual populations range from 20-50 plants in areas of less than 1 square meter to several thousand in nearly one acre of suitable habitat.

Existing and Potential Threats: Threats from herbivory appear to be low. Some colonies occur in areas being invaded by exotic plants, especially non-native clovers. The habitat specialization of this species may make it vulnerable to changes in hydrology.

Notes: Traditionally, this species has been treated as a synonym of the closely related Eurasian taxon, *Scirpus pumilus* (Dorn 1992). Only two other occurrences are presently known in Wyoming.

Figure 14. *Scirpus rollandii*. Illustration by W. Fertig from Fertig et al. (1994).

Utricularia intermedia
Flat-leaf bladderwort
Lentibulariaceae (Bladderwort Family)

Heritage Rank: G5/S1.

Federal Status: None.

Description: Flat-leaf bladderwort is an aquatic or semi-terrestrial perennial herb with green, leafy, bladderless aquatic stolons 10-50 cm long and colorless, leafless, bladder-bearing, rooting stolons (Figure 15). Leaves are 5-30 mm long and divided into threes, with each division further divided into 6-20 flat, blunt-tipped segments with 2-10 short bristles along the margin. Bladders are 1.5-4.5 mm long, ovoid, and restricted to side branches (not intermixed among the vegetative leaf segments). The inflorescence consists of 3-5 bright yellow 2-lipped flowers borne on an emergent stalk 5-20 cm tall with 1-2 bract-like scales. The calyx consists of 2 subequal lobes 3-4 mm long, with the upper lobe acute and the lower lobe blunt. The corolla is 1-1.8 cm long, with the ovate upper lip about 6.5 mm long and the broadly rounded lower lip about 12 mm long and 15 mm wide and bearing a prominent, rounded swelling. The spur of the flower is straight, cylindrical, more than 1/2 the length of the lower corolla lip and borne closely parallel to it (rather than at a right angle). Fruits are globose capsules about 3 mm in diameter (Ceska and Bell 1973; Taylor 1989).

Similar Species: *Utricularia macrorhiza* (syn = *U. vulgaris*) has deeply pinnately-divided leaves with more than 20 rounded segments and numerous bladders intermixed among the vegetative leaf segments (not on separate branches). *U. minor* has slender, flattened, leaf blades divided into three main, bladder-bearing segments and flowers with spurs much less than 1/2 the length of the lower lip. *U. ochroleuca* has shorter spurs borne at a right angle to the lower corolla lip, and sharp-tipped leaf segments with less than 4 long bristles or teeth along the margin (Ceska and Bell 1973; Dorn 1992).

Geographic Distribution: Circumboreal; in North America occurs from Alaska to eastern Canada and south to California, northwestern Wyoming, North Dakota, Illinois, and Pennsylvania (Taylor 1989; WYNDD records). In Wyoming, this species is known only from the Flat Creek Fen on the National Elk Refuge in Teton County.

Occurrences Within the Study Area: Flat-leaf bladderwort is known from 11 subpopulations found throughout the Flat Creek Fen.

Habitat: Occurs in oligotrophic and dystrophic lakes and marshes and on sublittoral mud flats (Ceska and Bell 1973). Populations on the National Elk Refuge are found in aquatic or semi-terrestrial habitats with slow-moving or slack water currents. Most populations are found on shallowly flooded streambanks and marshy meadows in less than 1 1/2 inches of water over marl beds or deep organic muck. Such sites are typically dominated by communities of *Carex aquatilis, C. simulata, Calamagrostis stricta, Triglochin maritimum,* and *Deschampsia cespitosa*. Less commonly, this species may be found at the edge of small ponds, streams, and ditches amid emergent stands of *Carex rostrata, C. aquatilis, Calamagrostis stricta,* and *Glyceria grandis* in water 6-24 inches deep. Populations are conspicuously absent from drier, raised hummock areas within the wetland.

Flowering/Fruiting Period: July-August.

Population Size and Condition: Populations are difficult to census due to the clonal nature of the species. The species appears to be locally abundant throughout the Flat Creek Fen area, where it may form extensive mat-like colonies on flooded meadows. The largest individual colonies were observed to cover areas up to 5 x 20 feet in area. Less than 3% of the total population was in reproductive condition in August 1997.

Existing and Potential Threats: Threats to this species appear to be low under current management. Past ditching of portions of the Flat Creek Fen may have had less impact on flat-leaf bladderwort than other rare plants on the refuge as this species is able to colonize ditch edges if the water current is slow. Carnivorous plants like the flat-leaf bladderwort may be potentially vulnerable to over-collection by plant hobbyists.

Notes: Dr. David Cooper made the first discovery of this species at the Elk Refuge in 1994. Cooper's specimen was originally determined to be *Utricularia ochroleuca* by Dr. William Weber, a closely related species that differs in flower shape and subtle features of the leaf margins. *U. intermedia* is also a species of concern in Montana, North Dakota, Oregon, and Washington (Lesica and Shelly 1991).

Figure 15. *Utricularia intermedia.* Illustration from Taylor (1989).

Other Noteworthy Species

In addition to new distribution records for plant species of concern, the following noteworthy species were documented on the National Elk Refuge in 1997:

Carduus acanthoides: First record for Teton County*. A potentially serious noxious weed (see below).

Crepis runcinata var. *hispidulosa*: First record for Teton County and the state of Wyoming (Fertig 1997 c). This wide-leaved, stiffly-hairy, yellow-rayed composite is known from a single large patch on dried, whitish alkali flats on the east bank of Flat Creek (west of Millers Butte). It may warrant future listing as a species of special concern in Wyoming.

Epilobium palustre var. *gracile*: First record for Teton County. Var. *gracile* is closely related to var. *palustre* (a WYNDD species of special concern), but differs in having more notably pubescent leaves. It was found to be widely distributed throughout the Flat Creek Fen.

Pedicularis crenulata: First record for Teton County. Uncommon in the Nowlin Creek area, but probably more widespread in the Flat Creek Fen complex.

Phlox kelseyi var. *kelseyi*: First record for Teton County. Observed to be widely scattered in drier areas of the Flat Creek Fen, especially where chalky marl deposits are exposed.

Vicia cracca: First record for Teton County. This exotic species is not listed for Wyoming by Dorn (1992), but is now known from at least two locations in the National Elk Refuge and Yellowstone National Park (J. Whipple, personal communication).

Exotic Plant Species

Fifty-two exotic (non-native) vascular plant species have been documented in the National Elk Refuge (Table 1), accounting for 13.6 % of the total flora of the refuge. The majority of these taxa are found at low densities in disturbed upland areas, especially along gravel roadsides and in cultivated hay meadows. A few of these upland exotics, such as musk thistle (*Carduus nutans*), Chalapa hoarycress (*Cardaria chalepensis*), Canada thistle (*Cirsium arvense*), yellow sweetclover (*Melilotus officinalis*), crested wheatgrass (*Agropyron cristatum*), smooth brome (*Bromus inermis*), cheatgrass (*Bromus tectorum*),

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* County records were determined from Dorn (1992), Shaw (1992), Markow (1994), and collections of the Rocky Mountain Herbarium.

timothy (*Phleum pratense*), and Kentucky bluegrass (*Poa pratensis*) have become locally abundant and have the potential to expand into less disturbed areas of the refuge.

Two other upland exotic species may become problems in the near future. A small patch of plumeless thistle (*Carduus acanthoides*) was documented along the Flat Creek Road near the Bridger-Teton National Forest boundary in 1997. This close relative of musk thistle has been expanding across Wyoming in the last 5 years and may become a serious agricultural and rangeland pest if control efforts are not initiated. An even more serious threat may come from spotted knapweed (*Centaurea maculosa*), which has become established on disturbed areas of East Gros Ventre Butte, along the west boundary of the refuge (Jim Ozenberger, personal communication).

Exotic species are also present in the Flat Creek Fen and could be a potential threat to rare plant species. Non-native clovers (*Trifolium hybridum, T. pratense,* and *T. repens*) have become established on some of the semi-moist hummock areas inhabited by *Muhlenbergia glomerata, Salix candida*, and *Scirpus rollandii*, and could become important competitors for space, light, and other resources. Other non-native species, such as marsh sow-thistle (*Sonchus uliginosus*), water-cress (*Rorippa nasturtium-aquaticum*), and meadow foxtail (*Alopecurus pratensis*) have become established in wetter parts of the fen. The potential impacts from these species are poorly known.

Summary and Management Recommendations

The National Elk Refuge provides important habitat for 13 Wyoming plant species of special concern, including two listed as Sensitive by the US Forest Service and one that was formerly a candidate for listing under the Endangered Species Act (Table 3). With the exception of *Lesquerella carinata* var. *carinata* and *Astragalus terminalis*, all of these rare species are restricted to wetland areas. Ten of the wetland species occur in specialized habitats scattered throughout the Flat Creek Fen on the east bank of Flat Creek and its tributaries (most notably Nowlin Creek and Sheep Creek). Several other rare species may still occur on the refuge, particularly a suite of calceophilic wetland sedges and forbs in the Flat Creek Fen and *Draba borealis* on shady limestone cliffs in the upper canyon of Flat Creek. No populations of *Spiranthes diluvialis,* a federally listed Threatened species, were found on the Refuge despite intensive surveys in the Flat Creek wetland.

Many of the rare plant species found on the refuge appear to be secure at the present time. Refuge populations of *Lesquerella carinata* var. *carinata* are among the largest known for this species in Wyoming, and appear to be less threatened from recreational activity and competiton from noxious weeds than other populations in Grand Teton National Park or Bridger-Teton National Forest. The species does not appear to be grazed by elk, although populations may be less abundant on slopes with numerous game trails (Fertig 1997 b). Populations of several wetland species, including *Aster borealis, Carex sartwellii, Muhlenbergia glomerata, Scirpus rollandii,* and *Utricularia intermedia*, also

seem to be secure at the present time. These species do not appear to be grazed by elk or other large ungulates during the summer growing and reproductive season.

One rare plant species that appears to be impacted by elk is *Salix candida*. This low-growing shrub is heavily browsed each year, probably in the fall as elk return to the valley to spend the winter. Yearly browsing removes the annual stem growth of these plants and prevents them from producing reproductive catkins the following year. Although this species remains locally abundant throughout the Flat Creek Fen, its long-term survival may be jeopardized if the population remains incapable of producing fruit and seed. A series of permanent exclosures could be established to determine the impact of elk browsing on the reproductive ability of this species and to encourage fruit production.

Past human actions have had some impact on the Flat Creek Fen, especially in places that have been ditched and drained to improve hay production. Construction of a pipeline to transport water to the National Fish Hatchery may have also impacted the wetland vegetation, although leaks in the pipeline may, in fact, mimic the effects of natural springs. Additional modifications to the wetland should be done with care, as many of the plant species may be sensitive to changes in water availability.

Several exotic plant species have become well-established on the refuge, especially in drier upland areas and on the valley floor. Efforts should be made to contain the spread of aggressive weed species and to prevent the establishment of new exotics, especially *Carduus acanthoides* and *Centaurea maculosa*. Relatively few exotics have invaded the Flat Creek Fen, but some of these (especially exotic clovers) may pose a threat to semi-moist hummock communities and their associated rare species.

Overall, rare plant populations appear to be secure and well-protected on the National Elk Refuge. Assumptions about the present stability of many rare plant populations need to be made with some caution, however, given the lack of trend data for any of these species. Periodic monitoring of the rare species on the refuge would be beneficial in answering trend and management questions. Such monitoring could consist of permanent transects or be more qualitative in nature. Additional surveys (especially at different times of the year, such as late spring and late summer) would also be beneficial in further elucidating the distribution and abundance of these species. At a minimum, annual visits to known locations should be made and the results thoroughly documented.

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Appendix A.

Element Occurrence Records and Population Maps