University of Wyoming Red Buttes Environmental Biology Laboratory - 2020 Botany Survey

Bonnie Heidel[1] and Dorothy Tuthill[2]

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[1] Wyoming Natural Diversity Database, University of Wyoming
[2] Biodiversity Institute, University of Wyoming

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Cover: Red Buttes Environmental Biology Laboratory, and darkthroat shootingstar (*Primula pauciflora* var. *pauciflora*; syn. *Dodecatheon pulchellum* ssp. *pulchellum*), flowering abundantly in the Red Buttes study area

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INTRODUCTION

The Red Buttes Environmental Biology Laboratory is a research facility of the University of Wyoming with an illustrious history of fish and wildlife research (Rahel and Bergman 2019). The on-site supply of freshwater supports fisheries research in controlled environments, its isolated setting supports captive breeding programs, and its open environment accommodates pens for other wildlife research.

Rahel and Bergman (2019) report that the Red Buttes property was owned by the Union Pacific Railroad for use of the spring waters in steam engines. In the early 1900's, it was purchased by Wyoming Game and Fish as a fish hatchery. In 1957, it was acquired by the University of Wyoming for research. Construction of the lab and maintenance sheds occurred in 1982-83.

Separate from these developments, the Red Buttes Observatory was built by the Department of Astronomy in 1994 on a high point of the Red Buttes property, a building that is isolated from and accessed separately from the lab. Upgrades to the observatory telescope started in 2014 enabling both remote and in-person usage for research and classes (Kasper et al. 2016).

The Red Buttes facilities, including laboratory and observatory, serve important purposes for the University. This report focuses on the land surrounding the facilities, University of Wyoming property that is referred to in this report as the Red Buttes study area (Figure 1).

Adjoining the Red Buttes Laboratory facilities is a popular recreation area, Leazenby Lake (a reservoir). Over half of the lake is on State Trust Land, but the rest is part of the University property. The Lake is immediately north of the lab facilities. The public access point is at the south end of the Lake on University property. Botanists have made plant collections over the years at Leazenby Lake, mostly on State Trust land, that indicated the presence of interesting taxa and provided a springboard for documenting the flora of the Red Buttes study area.

METHODS

Visits to the Red Buttes study area were made during the growing season to document the flora and briefly describe the vegetation. Observations made during the first visit in early May indicated a level of flowering activity and diversity that prompted repeated visits. A total of ten primary visits were made (sometimes followed by a separate collecting trip the same week): 8, 16 and 29 May; 3 and 29 June; 4, 19 and 26 July; 9 and 25 August and 3 September to identify plants in one or more settings. Plants were named or identified following Dorn (2001), and nomenclature was updated for consistency with the Wyoming Checklist (Nelson 2018). Common names generally follow the PLANTS database (USDA 2020). Wyoming plant species of concern or species of potential concern (Heidel 2018) were documented by collections, as were other species of biogeographic interest or simply needing identification. Determinations were made using regional and national floras and online resources of the Rocky Mountain Herbarium (RM). Vouchers were submitted to RM.

In May, we printed an aerial view of the Red Buttes grounds (Esri et al. 2020), with the property boundary line and wetlands mapping superimposed to help identify environmental differences across the gentle terrain (Figure 1). We also ran a query of the RM online specimen database (2020) to get

collection label information for species collected at Leazenby Lake and deposited at RM (2020). There was a total of 50 specimens representing 41 unique species. Only three were noted as located in or extending into the adjoining Section 21 of the Red Buttes study area.

STUDY AREA

Location: 8 miles south of Laramie, on the east side of Wyoming Hwy 287. The legal description is T14N R73W Sec 21 E ½, E ½ of NW ¼; 22 W ½ of NW ¼ (Figure 1).

Elevation: There is modest topographic relief of little more than 50 ft (7321-7372 ft; 2231-2247 m) from stream channels and open water, to gentle upland rises.

Area: The boundaries encompass an almost triangular area of ca 300 acres (121 ha) with a northern boundary that is 1 mile across and over 1 mile long from north-to-south, but it tapers to the south. This area includes all facilities and fenced off areas, including those around the fish tanks behind the laboratory. Outer boundary fences demarcate much of the property except that there is not a boundary fence that crosses Leazenby Lake or runs along parts of the northern boundary (separating State Trust land from University property), and there are places where the fenceline does not reach the full extent at south and southeast boundaries which are set back from a subdivision road. We did not survey the band of University land outside of the fenceline.

Hydrology: Harney Creek and tributaries flow north-south through the property and are impounded to form Leazenby Lake (a reservoir) at the north end of the property. Some maps also refer to the lake as Hundred Springs Reservoir, and there are still flowing springs above the lake and elsewhere in the study area. At the south end of the property are many wells marked by cylindrical metal tanks. In the south-central part of the property is a spring-fed pond impoundment on Harney Creek constructed to supply water for the fish ponds at the laboratory. To the east of this impoundment is a small natural spring-fed pool that drains into the impoundment.

These riparian and palustrine features on the Red Buttes grounds signify extensive wet habitat as mapped by the National Wetland Inventory (USFWS 2016). They total over 40 acres, i.e., over 10% of the property, and are most extensive east of the laboratory (south of the observatory) along Harney Creek, between Leazenby Lake and the smaller impoundment. This extensive riparian habitat has numerous well-developed perennial springs, with visible groundwater discharge at the surface. Large parts of the grounds are covered by vegetation that is transitional between wetland and upland habitat. If they qualify as wetland, then it appears as though over half of the property is wetland.

Soils: The Red Buttes area is mapped as having four main soil units (Figure 2; Reckner 1998). There are no known on-site soil studies, though high concentration of calcium carbonates were demonstrated at one site, and highly localized peat formation at another incidental to 2020 botany surveys (unpubl.).

All wetland habitat and adjacent transition zones of Harney Creek, its tributaries, and Leazenby Lake borders are mapped as Cantle Loam, 0-3% slopes (133), which is a very deep, somewhat poorly drained soil on flood plains and stream terraces. It formed in alluvium.

Meadow soils directly above wetland habitat are mapped as Alogia Loam, 0-3% slopes (108), a very deep, moderately well drained soil in seep areas and drainageways, and on alluvial fans and terraces adjacent to flood plains. This soil formed in alluvium derived dominantly from reddish sandstone and shale (Reckner 1998). They cover most of the grounds between Harney Creek and Highway 287.

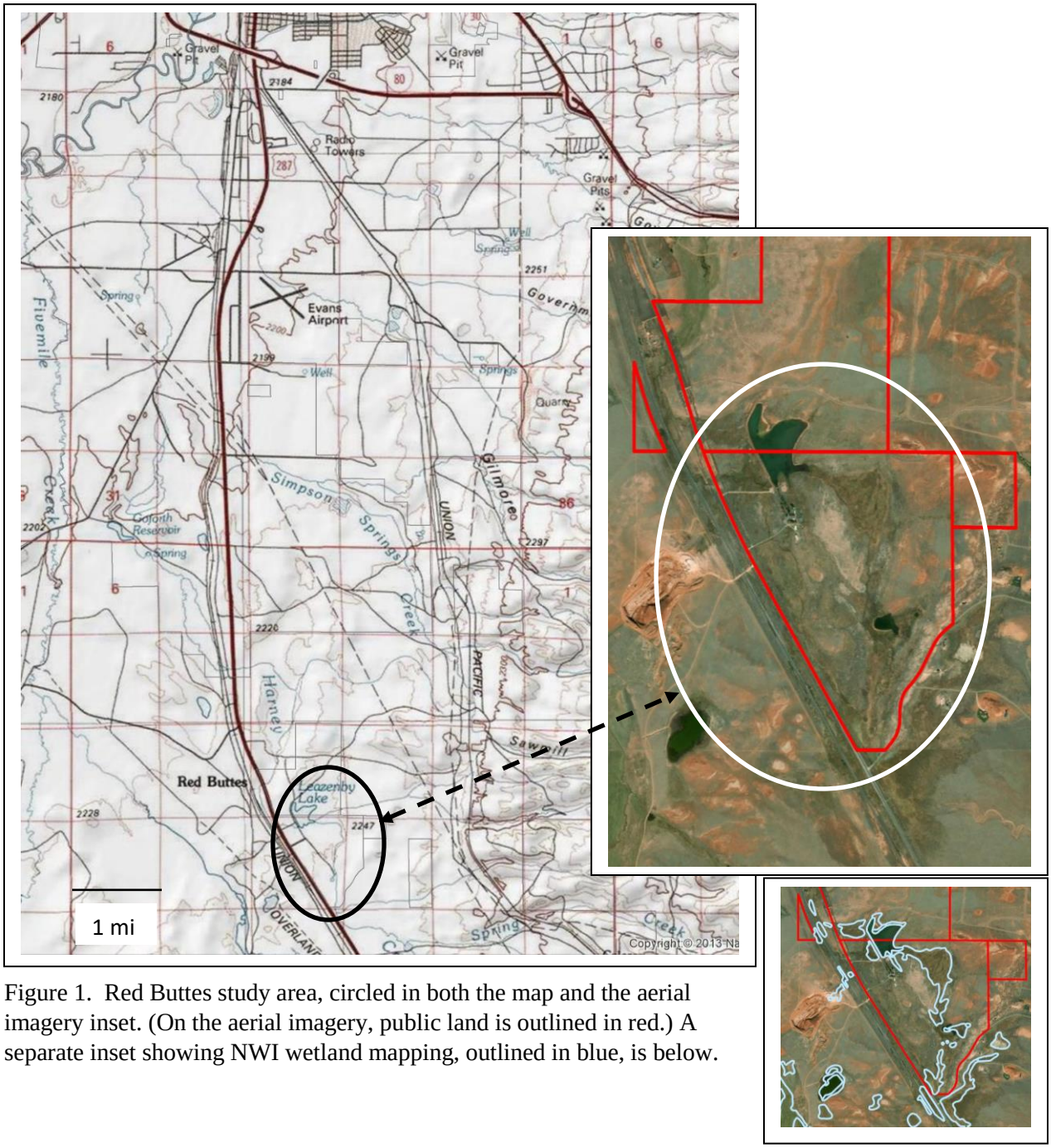

Figure 1. Red Buttes study area, circled in both the map and the aerial imagery inset. (On the aerial imagery, public land is outlined in red.) A separate inset showing NWI wetland mapping, outlined in blue, is below.

Most upland soils are mapped as the Rohonda-Tieside complex, 3-10% slopes (222) as found on benches, terraces and hillslopes. The Rohonda soil is moderately deep and well drained, forming in alluvium and residuum. It encompasses much of the northeastern corner, a small knoll in the southwestern portion of the tract, and large areas of uplands directly east and southeast of the lab. Tieside soil is shallow and well-drained. It formed in weathered materials derived dominantly from interbedded sandstone, shale and limestone. It is situated between the highway and drainageways (Reckner 1998).

In addition, at eastern margins of the grounds, is the Tieside-Pilotpeak-Rock outcrop complex, 3-10% slopes (234) that combines Tieside sandy loam soils with fine cobbly sandy loam of Pilotpeak soils, and intermixed rock outcrop. The Observatory and contiguous northeasternmost corner of the grounds is made up entirely of rock outcrop, including reddish siltstone and narrow bands of limestone. These components are so intricately intermixed across the county that it was not possible to map them separately (Reckner 1998).

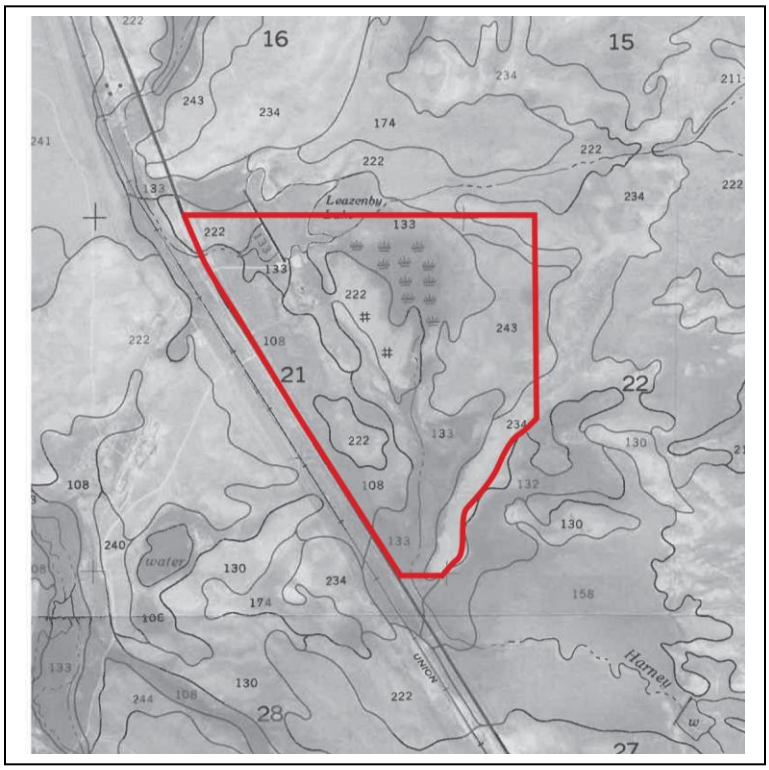

Figure 2. Soils of the Red Buttes Environmental Biology study area (Reckner 1998). The 3-digit mapping unit codes are cross-referenced in the text

Vegetation: The vegetation settings and their distributions align with the soil mapping units of Reckner (1998) as shown in Figure 2. Grassland and meadow vegetation prevail across the landscape. Over the course of visits, the range of environmental settings and associated dominant species were noted as context for understanding the flora. Dominant species were listed among associated species on the herbarium labels prepared for those plants collected in the study area. Vegetation was not sampled or cross-referenced to the literature so the identifications of abundant species with high cover at Red Buttes (Table 1) is precursor to a more detailed description. The soil units and the settings within them are generally sequenced from wettest to driest members in the table (next page).

There is no one species that dominates in the area. Any vegetation classification and mapping would be difficult in light of species dominance intergradations that can be gradual or abrupt, by the presence of fine-scale feature inclusions that differ from their surroundings, and by distinct microtopography patterns that add to habitat diversity.

Table 1. Settings, species dominants and associated soil series of the Red Buttes study area

Setting	Dominant or co-dominant species	Soils mapping unit
Leazenby Lake and the spring-fed pool	*Stuckenia filiformis* var. *alpina*	Cantle Loam - 133
Smaller spring-fed impoundment	*Chara* spp.	
Harney Creek, flowing segments	*Stuckenia filiformis* var. *alpina* and/or *Juncus nodosus*	
Temporary inundation	*Carex nebrascensis*	
Temporary inundation with marl	*Carex simulata*	
Shallow water table	*Carex praegracilis* and/or *Juncus balticus*	
Shallow water table with salt accumulation	*Elymus lanceolatus* and/or *Distichilis stricta*	
Non-native inclusions	*Alopecurus arundinaceus*	
Wet meadow on western border	*Muhlenbergia richardsonis*	Alogia Loam - 108
Non-native inclusions	*Bromus inermis*	
Non-native inclusions	*Cirsium arvense*	
Transition between wet meadow and upland	*Sporobolus airoides* and/or *Poa secunda*	
Plains on eastern border	*Hesperostipa comata*	Rohonda-Tieside complex - 222
Transition between wet meadow and upland	*Sporobolus airoides* and/or *Poa secunda*	
Barren, patterned transition between wet meadow and upland	*Deschampsia caespitosa* and/or *Carex scirpoides var. scirpiformis*	
Plains with shallow soils overlying bedrock	*Hesperostipa comata*	Tieside-Pilotpeak-Rock outcrop complex - 243
Outcrop area in northeastern corner (includes observatory)	*Elymus spicatus* and cushion plants	

RESULTS

A total of 227 unique taxa, representing 156 genera in 50 families, have been found in the Red Buttes Environmental Biology Laboratory study area (includes on hybrid). A complete list is shown in Table 2.

Of the total taxa, only 6.2% (36) are non-native. With some exceptions, the non-native taxa are not present in large numbers or extent. Two of the exceptions are noxious weeds, Canada thistle (*Cirsium arvense*) and musk thistle (*Carduus nutans*). The western side of the property, along the highway, has the greatest numbers and extent of both thistles, particularly *C. arvense.* Six species are only present as plantings, including native trees planted at the Leazenby Lake public access area. Both native and non-native woody trees and shrubs were planted around the lab.

A high proportion (approx. 64%) of the Red Buttes native species are wetland plants (cross-referenced to Washkoviak et al 2017). Some species are wetland obligates, including ones that only grow submerged in water; most are facultative indicators of wetland habitat. Wetland species are indicated on the plant list (Table 2).

Among the native plants are seven Wyoming plant species of concern or potential concern (Table 3; Heidel 2018). They are discussed in the next section.

Table 2. Vascular plants of the Red Buttes Environmental Biology Laboratory study area

Scientific Name	Common Name	Family	Synonyms	Statewide Origin	Wetland indicator	State Rank (S Rank)	Global Rank (G Rank)	RM coll. @ Leazenby Lk	2020 coll. no.
Atriplex gardneri var. *utahensis*	shadscale	Amaranthaceae		Native	x	S3	G5TNR		
Atriplex hortensis	garden orache	Amaranthaceae		Nonnative		SNA	GNR		
Chenopodium berlandieri var. *zschackei*	pittseed goosefoot	Amaranthaceae		Native		S5	G5T5		
Chenopodium glaucum var. *salinum*	saline oakleaf goosefoot	Amaranthaceae	*Chenopodium salinum*	Nonnative		SNA	G5TNR	x	
Kochia scoparia var. *scoparia*	burningbush	Amaranthaceae	*Bassia scoparia* ssp. *scoparia, B. s.* var. *scoparia, B. sieversiana, Kochia scoparia* ssp. *scoparia*	Nonnative		SNA	GNRTNR		
Krascheninnikovia lanata	winterfat	Amaranthaceae		Native		S5	G5		
Salsola tragus	prickly Russian thistle	Amaranthaceae	*Salsola kali* ssp. *tragus*	Nonnative		SNA	GNR		
Suaeda occidentalis	Slender Seepweed	Amaranthaceae		Native		S2	G5		
Allium cernuum	nodding onion	Amaryllidaceae		Native	x	S4	G5		
Allium geyeri var. *geyeri*	Geyer's onion	Amaryllidaceae		Native	x	S3	G4G5T4		
Allium textile	textile onion	Amaryllidaceae		Native	x	S5	G5		
Rhus trilobata var. *trilobata*	skunkbush sumac	Anacardiaceae	*Rhus aromatica* var. *trilobata*	Native		S5	G5T5		
Cicuta maculata	spotted water hemlock	Apiaceae		Native	x	S3S4	G5		
Musineon divaricatum	leafy wildparsley	Apiaceae		Native		S4S5	G5		
Zizia aptera	meadow zizia	Apiaceae		Native	x	S3	G5		
Asclepias speciosa	showy milkweed	Apocynaceae		Native	x	S4	G5		
Leucocrinum montanum	common starlily	Asparagaceae		Native		S4	G5		

Maianthemum stellatum	starry false lily of the valley	Asparagaceae		Native	x	S5	G5		
Yucca glauca	soapweed yucca	Asparagaceae		Native		S4	G5		
Achillea millefolium	western yarrow	Asteraceae		Native	x	S5	G5	x	
Agoseris glauca var. *glauca*	pale agoseris	Asteraceae		Native	x	S4	G5T5		
Antennaria microphylla	littleleaf pussytoes	Asteraceae		Native	x	S5	G5		
Artemisia campestris var. *scouleriana*	field sagewort	Asteraceae		Native	x	S4	G5T4T5		
Artemisia frigida	prairie sagewort	Asteraceae		Native		S5	G5		
Bidens cernua	nodding beggartick	Asteraceae		Native	x	S3	G5		
Carduus nutans	nodding plumeless thistle	Asteraceae		Nonnative		SNA	GNR	x	
Chrysothamnus viscidiflorus var. *viscidiflorus*	yellow rabbitbrush	Asteraceae	*Chrysothamnus viscidiflorus* ssp. *viscidiflorus*	Native		S5	G5T5		
Cirsium arvense	Canada thistle	Asteraceae		Nonnative		SNA	G5	x	
Cirsium canescens	prairie thistle	Asteraceae		Native		S3	G4G5		
Cirsium scariosum var. *coloradense*	Colorado thistle	Asteraceae	*Cirsium tioganum* var. *coloradense*	Native	x	S4	G5TNR		
Crepis runcinata var. *glauca*	bluish gray fiddleleaf hawksbeard	Asteraceae	*Crepis runcinata* ssp. *glauca*	Native	x	S2S3	G5T4T5		
Ericameria nauseosa var. *nauseosa*	rubber rabbitbrush	Asteraceae		Native		S5	G5T5		
Erigeron lonchophyllus	shortray fleabane	Asteraceae		Native	x	S5	G5		
Erigeron nematophyllus	needleleaf fleabane	Asteraceae		Native		S3	G3		
Gnaphalium exilifolium	slender cudweed	Asteraceae		Native	x	S2	G3G4Q		
Gutierrezia sarothrae	broom snakeweed	Asteraceae		Native		S5	G5		

Helianthus nuttallii ssp. *nuttallii*	Nuttall's sunflower	Asteraceae		Native	x	S3S4	G5T5	x	
Lactuca serriola	prickly lettuce	Asteraceae		Nonnative		SNA	GNR		
Liatris ligulistylis	Rocky Mountain blazing star	Asteraceae		Native	x	S2	G5?	x	
Liatris punctata var. *punctata*	dotted blazing star	Asteraceae		Native		S4	G5T5		
Lygodesmia juncea	rush skeletonplant	Asteraceae		Native		S4S5	G5		
Packera cana	woolly groundsel	Asteraceae		Native		S5	G5		
Packera debilis	weak groundsel	Asteraceae		Native	x	S2	G4	x	
Pyrrocoma lanceolata var. *lanceolata*	lanceleaf goldenweed	Asteraceae		Native	x	S2S3	G4?TNR	x	
Senecio hydrophilus	water ragwort	Asteraceae		Native	x	S3	G5		
Solidago lepida var. *salebrosa*	rough Canada goldenrod	Asteraceae	*Solidago canadensis* var. *salebrosa*	Native	x	S4	G5T5		
Solidago missouriensis	Missouri goldenrod	Asteraceae		Native	x	S5	G5	x	
Sonchus arvensis ssp. *uliginosus*	moist sowthistle	Asteraceae	*Sonchus uliginosus*	Nonnative		SNA	GNRTNR		
Stenotus acaulis	stemless mock goldenweed	Asteraceae		Native		S5	G5		
Symphyotrichum ascendens	western aster	Asteraceae		Native		S5	G5	x	
Symphyotrichum falcatum var. falcatum	white prairie aster	Asteraceae		Native	x	S3	G5T4T5	x	
Symphyotrichum frondosum	short-rayed alkali aster	Asteraceae		Native	x	S2	G4		5034
Symphyotrichum lanceolatum var. hesperium	white panicle aster	Asteraceae	*Symphyotrichum lanceolatum* ssp. *hesperium*	Native	x	S3	G5T5		
Symphyotrichum welshii	Welsh's aster	Asteraceae		Native	x	SNR	G2		
Taraxacum officinale	common dandelion	Asteraceae		Nonnative		SNA	G5		

Tetradymia canescens	spineless horsebrush	Asteraceae		Native		S5	G5		
Tetraneuris acaulis	stemless four-nerve daisy	Asteraceae		Native		S5	G5		
Townsendia hookeri	Hooker's Townsend daisy	Asteraceae		Native		S4	G5		
Tragopogon dubius	yellow salsify	Asteraceae		Nonnative		SNA	GNR		
Xanthisma grindelioides var. *grindelioides*	rayless tansyaster	Asteraceae	*Machaeranthera grindelioides* var. *grindelioides*	Native		S5	G5T5		
Cryptantha celosioides	buttecandle	Boraginaceae		Native		S5	G5		
Cynoglossum officinale	gypsyflower	Boraginaceae		Nonnative		SNA	GNR		
Lappula occidentalis var. *occidentalis*	flatspine stickseed	Boraginaceae	*Lappula redowskii* var. *redowskii*	Native		S5	G5T5	x	
Lithospermum incisum	narrowleaf stoneseed	Boraginaceae		Native		S5	G5		
Mertensia lanceolata	prairie bluebells	Boraginaceae		Native		S3	G5		
Boechera retrofracta	second rockcress	Brassicaceae	*Arabis holboellii* var. *secunda*, *Boechera holboellii* var. *secunda*	Native		S5	G5		
Braya humilis ssp. *humilis*	low northern braya	Brassicaceae	*Neotorularia humilis*	Native	x	S1	G5T5		5003, 5017
Descurainia sophia	herb sophia	Brassicaceae		Nonnative		SNA	GNR	x	
Erysimum repandum	spreading wallflower	Brassicaceae		Nonnative		SNA	GNR		
Lepidium densiflorum	common pepperweed	Brassicaceae		Native		S5	G5	x	
Lepidium draba	whitetop	Brassicaceae	*Cardaria draba*	Nonnative		SNA	GNR		
Lepidium latifolium	broadleaved pepperweed	Brassicaceae		Nonnative		SNA	GNR		
Lepidium montanum var. *wyomingense*	mountain pepperweed	Brassicaceae		Native	x	S2	G5?T2T3		4981
Nasturtium officinale	watercress	Brassicaceae	*Rorippa nasturtium-aquaticum*	Nonnative		SNA	GNR		

Physaria arenosa var. *arenosa*	Great Plains bladderpod	Brassicaceae	*Lesquerella arenosa* var. *arenosa*	Native		S4	G5T5		
Physaria montana	mountain bladderpod	Brassicaceae	*Lesquerella montana*	Native		S3	G5		
Sisymbrium altissimum	tall tumblemustard	Brassicaceae		Nonnative		SNA	GNR	x	
Strigosella africana	African mustard	Brassicaceae	*Malcolmia africana*	Nonnative		SNA	GNR		
Thelypodium integrifolium	entireleaved thelypody	Brassicaceae		Native	x	S3	G5		
Campanula rotundifolia	bluebell bellflower	Campanulaceae		Native	x	S5	G5		
Valeriana edulis var. *edulis*	tobacco root	Caprifoliaceae		Native	x	S4	G5T5		
Eremogone hookeri var. *hookeri*	Hooker's sandwort	Caryophyllaceae	*Arenaria hookeri* ssp. *hookeri*	Native		S4S5	G5T5		
Paronychia sessiliflora	creeping nailwort	Caryophyllaceae		Native		S4	G5		
Parnassia palustris var. *montanensis*	mountain grass of Parnassus	Celastraceae		Native	x	S3	G5T3T5	x	
Peritoma serrulata	Rocky Mountain beeplant	Cleomaceae	*Cleome serrulata*	Native	x	S5	G5	x	
Comandra umbellata	pale bastard toadflax	Comandraceae		Native	x	S5	G5		
Sedum lanceolatum var. *lanceolatum*	spearleaf stonecrop	Crassulaceae	*Sedum lanceolatum* ssp. *lanceolatum*	Native		S5	G5T3T5		
Juniperus scopulorum	Rocky Mountain juniper	Cupressaceae		Native	x	S5	G5		
Carex aquatilis var. *aquatilis*	water sedge	Cyperaceae		Native	x	S5	G5T5		
Carex aurea	golden sedge	Cyperaceae		Native	x	S4	G5		
Carex emoryi	Emory's sedge								
Carex filifolia var. *filifolia*	threadleaf sedge	Cyperaceae		Native		S5	G5TNR		

Carex nebrascensis	Nebraska sedge	Cyperaceae		Native	x	S5	G5	x	
Carex pellita	woolly sedge	Cyperaceae	*Carex lanuginosa*	Native	x	S5	G5		
Carex praegracilis	clustered field sedge	Cyperaceae		Native	x	S5	G5		
Carex scirpoidea var. *scirpoidea*	western singlespike sedge	Cyperaceae	*Carex scirpoidea* ssp. *scirpiformis*	Native	x	S1	G5T4Q		4984, 5004
Carex simulata	analogue sedge	Cyperaceae		Native	x	S3	G5		5020
Eleocharis acicularis	needle spikerush	Cyperaceae		Native	x	S3	G5		
Eleocharis palustris	common spikerush	Cyperaceae		Native	x	S5	G5		
Eleocharis quinqueflora	fewflower spikerush	Cyperaceae		Native	x	S3	G5		
Eriophorum angustifolium var. *angustifolium*	tall cottongrass	Cyperaceae	*Eriophorum angustifolium* ssp. *angustifolium*	Native	x	S3	G5T5		
Schoenoplectus acutus var. *occidentalis*	tule	Cyperaceae		Native	x	S3	G5T4T5		
Schoenoplectus pungens var. *polyphyllus*	common threesquare	Cyperaceae		Native	x	S5	G5TNR		
Elaeagnus angustifolia	Russian olive	Elaeagnaceae		Nonnative		SNA	GNR		
Equisetum arvense	field horsetail	Equisetaceae		Native	x	S5	G5		
Equisetum laevigatum	smooth horsetail	Equisetaceae		Native	x	S5	G5		
Euphorbia brachycera	horned spurge	Euphorbiaceae		Native		S4	G5		
Astragalus bodinii	Bodin's milkvetch	Fabaceae		Native	x	S3	G4		
Astragalus missouriensis var. missouriensis	Missouri milkvetch	Fabaceae		Native		S4S5	G5T5		
Astragalus pectinatus	narrowleaf milkvetch	Fabaceae		Native		S4	G5		
Astragalus purshii	woollypod milkvetch	Fabaceae		Native		S5	G5		
Astragalus sericoleucus	silky milkvetch	Fabaceae		Native		S3	G4		

Astragalus shortianus	Short's milkvetch	Fabaceae		Native		S3	G4		
Astragalus spatulatus	tufted milkvetch	Fabaceae		Native		S5	G5		
Glycyrrhiza lepidota	American licorice	Fabaceae		Native	x	S5	G5		
Melilotus officinalis	yellow sweetclover	Fabaceae		Nonnative		SNA	GNR	x	
Oxytropis sericea var. *sericea*	white locoweed	Fabaceae		Native		S5	G5T5		
Gentiana aquatica	moss gentian	Gentianaceae	*Gentiana fremontii*	Native	x	S2S3	G4		4977
Gentianella amarella var. *acuta*	autumn dwarf gentian	Gentianaceae	*Gentianella amarella* ssp. *acuta, G. a.* var. *amarella*	Native	x	S4	G5T5		
Lomatogonium rotatum	marsh felwort	Gentianaceae		Native	x	S2	G5	x	5029
Ribes cereum var. *cereum*	wax currant	Grossulariaceae	*Ribes cereum* var. *pedicellare*	Native		S5	G5T5		
Ribes inerme var. *inerme*	whitestem gooseberry	Grossulariaceae		Native	x	S3	G5T5		
Myriophyllum sibiricum	shortspike watermilfoil	Haloragaceae		Native	x	S3	G5		
Iris missouriensis	Rocky Mountain iris	Iridaceae		Native	x	S4	G5		
Sisyrinchium pallidum	pale blue-eyed grass	Iridaceae		Native	x	S2S3	G3	x	4995
Juncus arcticus var. *balticus*	mountain rush	Juncaceae	*Juncus balticus* var. *montanus, J. b.* var. *vallicola*	Native	x	SNR	G5T5	x	
Juncus longistylis	longstyle rush	Juncaceae		Native	x	S3	G5		
Juncus nodosus	knotted rush	Juncaceae		Native	x	S3	G5	x	
Triglochin maritima	seaside arrowgrass	Juncaginaceae		Native	x	S4	G5	x	
Triglochin palustris	marsh arrowgrass	Juncaginaceae		Native	x	S3	G5		
Hedeoma drummondii	Drummond's false pennyroyal	Lamiaceae		Native		S3S4	G5		
Mentha arvensis	wild mint	Lamiaceae		Native	x	S5	G5	x	

Scutellaria galericulata	marsh skullcap	Lamiaceae		Native	x	S3	G5		
Utricularia minor	lesser bladderwort	Lentibulariaceae		Native	x	S3	G5		5013a
Linum australe var. *australe*	southern flax	Linaceae		Native		S2	G5T3T5		
Linum lewisii var. *lewisii*	prairie flax	Linaceae		Native		S5	G5T5		
Mentzelia sinuata	leechleaf blazingstar	Loasaceae		Native		S2	G3		5022
Sphaeralcea coccinea	scarlet globemallow	Malvaceae		Native		S5	G5		
Zigadenus elegans	mountain deathcamas	Melanthiaceae		Native	x	S4S5	G5		
Syringa vulgaris	common lilac	Oleaceae		Nonnative		SNA	GNR		
Epilobium brachycarpum	tall annual willowherb	Onagraceae		Native	x	S5	G5		
Epilobium palustre var. *palustre*	swamp willowherb	Onagraceae		Native	x	S2	G5TNR		5013b
Oenothera albicaulis	white evening primrose	Onagraceae		Native		S3	G5		
Oenothera cespitosa var. *cespitosa*	tufted evening primrose	Onagraceae	*Oenothera caespitosa* ssp. *caespitosa*	Native		S5	G5T5		
Oenothera suffrutescens	scarlet beeblossom	Onagraceae	*Gaura coccinea*	Native		S4S5	G5		
Platanthera aquilonis	northern green orchid	Orchidaceae		Native	x	S4	G5		4997
Castilleja sessiliflora	downy paintedcup	Orobanchaceae		Native		S3	G5		
Orthocarpus luteus	yellow owl's-clover	Orobanchaceae		Native	x	S5	G5		
Pedicularis crenulata	meadow lousewort	Orobanchaceae		Native	x	S3	G4	x	
Picea pungens	blue spruce	Pinaceae		Native	x	S3	G5		
Pinus ponderosa	ponderosa pine	Pinaceae		Native	x	S4	G5		
Penstemon eriantherus var. *eriantherus*	fuzzytongue penstemon	Plantaginaceae		Native		S4S5	G4G5T4		

Penstemon laricifolius var. *exilifolius*	white larchleaf beardtongue	Plantaginaceae	*Penstemon laricifolius* ssp. *exilifolius*	Native		S3	G4T3Q		
Plantago eriopoda	redwool plantain	Plantaginaceae		Native	x	S3	G5		
Plantago major	common plantain	Plantaginaceae		Nonnative		SNA	G5		
Achnatherum hymenoides	Indian ricegrass	Poaceae		Native		S5	G5		
Agropyron cristatum var. *cristatum*	crested wheatgrass	Poaceae		Nonnative		SNA	G5TNR		
Agrostis stolonifera	creeping bentgrass	Poaceae		Nonnative		SNA	G5		
Alopecurus arundinaceus	creeping meadow foxtail	Poaceae		Nonnative		SNA	GNR		
Bouteloua gracilis	blue grama	Poaceae		Native		S5	G5		
Bromus inermis	smooth brome	Poaceae		Nonnative		SNA	G5		
Bromus tectorum	cheatgrass	Poaceae		Nonnative		SNA	GNR		
Calamagrostis stricta	slimstem reedgrass	Poaceae		Native	x	S3	G5		
Catabrosa aquatica	water whorlgrass	Poaceae		Native	x	S3	G5		
Dactylis glomerata	orchardgrass	Poaceae		Nonnative		SNA	GNR		
Deschampsia cespitosa var. cespitosa	tufted hairgrass	Poaceae	*Deschampsia cespitosa* ssp. *cespitosa*	Native	x	S5	G5T5	x	
Distichlis spicata	saltgrass	Poaceae	*Distichlis stricta*	Native	x	S5	GNR		
Elymus elongatus var. *ponticus*	tall wheatgrass	Poaceae	*Elytrigia pontica*	Nonnative		SNA	GNRTNR		
Elymus glaucus var. *glaucus*	Jepson's blue wildrye	Poaceae	*Elymus glaucus* ssp. *glaucus*	Native	x	S4	G5T5		
Elymus hispidus var. *hispidus*	intermediate wheatgrass	Poaceae		Nonnative		SNA	GNRTNR		
Elymus lanceolatus var. *lanceolatus*	thickspike wheatgrass	Poaceae		Native	x	S5	G5TNR		
Elymus xmacounii	A hybrid	Poaceae		Native		SNA	GNA		5035
Elymus smithii	western wheatgrass	Poaceae	*Pascopyrum smithii*	Native	x	S5	G5		

Elymus spicatus	bluebunch wheatgrass	Poaceae	*Pseudoroegneria spicata*	Native		S5	G5		
Elymus trachycaulus var. *trachycaulus*	slender wheatgrass	Poaceae		Native	x	S5	G5TNR		
Glyceria grandis	American mannagrass	Poaceae		Native	x	S3	G5		
Hesperostipa comata var. *comata*	needle and thread	Poaceae	*Hesperostipa comata* ssp. *comata*	Native		S5	G5T5		
Hordeum jubatum ssp. *jubatum*	foxtail barley	Poaceae		Native	x	SNR	G5T5	x	
Koeleria macrantha	prairie Junegrass	Poaceae		Native		S5	G5		
Muhlenbergia filiculmis	slimstem muhly	Poaceae		Native		S2	G4		
Muhlenbergia richardsonis	mat muhly	Poaceae		Native	x	S3S4	G5	x	
Phleum pratense	timothy	Poaceae		Nonnative		SNA	GNR		
Poa pratensis	Kentucky bluegrass	Poaceae		Nonnative		SNA	G5		
Poa secunda ssp. *secunda*	Sandberg bluegrass	Poaceae	*Poa gracillima, P. secunda* var. *elongata, P. s.* var. *incurva, P. s.* var. *secunda*	Native	x	S5	G5T5		
Puccinellia nuttalliana	Nuttall's alkaligrass	Poaceae		Native	x	S4	G5		
Schizachyrium scoparium var. *scoparium*	little bluestem	Poaceae	*Andropogon scoparius, Schizachyrium scoparium* ssp. *scoparium*	Native		S4	G5T5		5021
Spartina gracilis	alkali cordgrass	Poaceae		Native	x	S4	G5		
Sporobolus airoides	alkali sacaton	Poaceae		Native	x	S4	G5	x	
Ipomopsis spicata var. *spicata*	spiked ipomopsis	Polemoniaceae	*Ipomopsis spicata* ssp. *spicata*	Native		S4	G5T4T5		
Phlox hoodii	spiny phlox	Polemoniaceae		Native		S5	G5		
Phlox kelseyi	Kelsey's phlox	Polemoniaceae		Native	x	S2	G4		4978

Phlox muscoides	moss phlox	Polemoniaceae	*Phlox hoodii* ssp. *muscoides*	Native		S3S4	G5		
Eriogonum exilifolium	dropleaf buckwheat	Polygonaceae		Native		S2	G3		4996
Eriogonum flavum var. *flavum*	alpine golden buckwheat	Polygonaceae		Native		S5	G5T5		
Eriogonum microthecum var. *effusum*	slender effuse buckwheat	Polygonaceae	*Eriogonum effusum* var. *effusum*	Native		S3	G4G5T4Q		
Persicaria amphibia	water smartweed	Polygonaceae	*Polygonum amphibium, P. a.* var. *emersum, P. a.* var. *stipulaceum*	Native	x	S4	G5		
Persicaria lapathifolia	curlytop smartweed	Polygonaceae	*Polygonum lapathifolium*	Native	x	S4	G5	x	
Polygonum aviculare	prostrate knotweed	Polygonaceae		Nonnative		SNA	GNR		
Rumex fueginus	golden dock	Polygonaceae	*Rumex maritimus* var. *fueginus*	Native	x	S3	G5		
Rumex occidentalis	western dock	Polygonaceae	*Rumex aquaticus* var. *fenestratus*	Native	x	S3	G5		
Rumex triangulivalvis	white willow dock	Polygonaceae	*Rumex salicifolius* var. *mexicanus, R. s.* var. *triangulivalvis*	Native	x	S5	G5	x	
Potamogeton praelongus	whitestem pondweed	Potamogetonaceae		Native	x	S2	G5		5023
Stuckenia filiformis var. *alpina*	fineleaf pondweed	Potamogetonaceae	*Potamogeton filiformis, Stuckenia filiformis* ssp. *alpina*	Native	x	S3	G5T5		4998
Lysimachia maritima	sea milkwort	Primulaceae	*Glaux maritima*	Native	x	S3	G5		
Primula incana	silvery primrose	Primulaceae		Native	x	S2	G5	x	4985
Primula pauciflora var. *pauciflora*	darkthroat shootingstar	Primulaceae	*Dodecatheon pulchellum* ssp. *pulchellum*	Native	x	S4S5	G5T5		
Delphinium geyeri	Geyer's larkspur	Ranunculaceae		Native		S4	G5		

Ranunculus acriformis var. *acriformis*	sharpleaf buttercup	Ranunculaceae		Native	x	S2S3	G5T3T4		
Ranunculus cymbalaria	alkali buttercup	Ranunculaceae		Native	x	S5	G5	x	
Ranunculus macounii	Macoun's buttercup	Ranunculaceae		Native	x	S4	G5		
Thalictrum alpinum	alpine meadow-rue	Ranunculaceae		Native	x	S2	G5		5007
Cotoneaster lucidus	shiny cotoneaster	Rosaceae	*Cotoneaster acutifolia*	Nonnative		SNA	GNR		
Dasiphora fruticosa	shrubby cinquefoil	Rosaceae	*Pentaphylloides floribunda, Potentilla fruticosa*	Native	x	S4S5	G5		
Potentilla anserina ssp. *anserina*	silverweed cinquefoil	Rosaceae		Native	x	S3	G5T5	x	
Potentilla gracilis var. *flabelliformis*	slender cinquefoil	Rosaceae	*Potentilla diversifolia* var. *diversifolia*	Native	x	S1S2	G5T5		
Potentilla ovina var. *ovina*	sheep cinquefoil	Rosaceae		Native		S2	G5?T5?		
Rosa acicularis var. *sayi*	prickly rose	Rosaceae	*Rosa acicularis* ssp. *sayi, R. sayi*	Native	x	S4S5	G5T5		
Populus x acuminata	a hybrid	Salicaceae	*Populus acuminata*	Native	x	SNA	GNA		
Salix bebbiana	Bebb willow	Salicaceae		Native	x	S5	G5		
Salix discolor	pussy willow	Salicaceae		Native	x	S2	G5		
Salix fragilis	crack willow	Salicaceae		Nonnative		SNA	GNRQ		
Lycium barbarum	matrimony vine	Solanaceae		Nonnative		SNA	GNR		
Typha angustifolia	narrowleaf cattail	Typhaceae		Nonnative	x	SNA	G5		
Typha latifolia	broadleaf cattail	Typhaceae		Native	x	S3S4	G5		
Viola nephrophylla	northern bog violet	Violaceae	*Viola sororia* var. *affinis*	Native	x	S3	G5		
Viola nuttallii	Nuttall's violet	Violaceae		Native		S3S4	G5		

Table 3. Wyoming plant species of concern or potential concern

Scientific name	Common name	Wyoming status[3]	Range context	Red Butte notes
Braya humilis	Low northern braya	SOC	Disjunct	Occasional in one of the four soils units
Carex emoryi	Emory's sedge	SOC	Widespread/ edge	Common at edge of pool and springfed impoundment
Eriogonum exilifolium	Slender-leaved buckwheat	SOC	Regional endemic	Locally common on uplands in one of the four soils units
Lomatogonium rotatum	Marsh felwort	SOC	Disjunct	Occasional at the Leazenby Lake inlet
Mentzelia sinuata	Leechleaf blazingstar	SOC	Widespread/ edge	Uncommon on outcrop uplands in one of the four units
Sisyrinchium pallidum	Pale blue-eyed grass	SOPC	Regional endemic	Locally common along Harney Creek between Leazenby Lake and the Red Buttes impoundment
Utricularia minor	Lesser bladderwort	SOPC	Widespread/ edge	Present as submerged plant in some of the springs that have spring-fed series of small pools

[3] Wyoming Natural Diversity Database.

DISCUSSION

The Red Buttes Environmental Biology Laboratory harbors high species diversity for an area its size. A major component of on-site diversity is comprised of wetland plants (64%) that reflects both the array of wetland habitats and diversity within them.

Until now, 16 species of concern or potential concern, (i.e., rare taxa) were known from the Laramie Basin. Of these, four are represented at the Red Buttes study area. This study, which documents the presence of seven rare taxa, has increased the number of Laramie Basin rare species by three, an increase of 19%, and represents an area having a concentration of them.

Two of the seven rare species, *Lomatogonium rotatum* (marsh felwort) and *Sisyrinchium pallidum* (pale blue-eyed grass), are wetland plants that had previously been documented in the vicinity of Leazenby Lake, and the 2020 survey expanded their known local distribution: Two of the rare upland plants, *Eriogonum exilifolium* (slenderleaf buckwheat) and *Mentzelia sinuata* (leeechleaf blazingstar) are known from the Laramie Basin and were documented for the first time locally. The former is a regional endemic only known from two counties in Wyoming and three counties in Colorado. The latter is a Southern Rocky Mountains plant at the northern end of its distribution. One of the rare species, *Utricularia minor* (lesser bladderwort) is a wetland plant that is mainly in mountain settings, and another, *Carex emoryi* (Emory's sedge), is a wetland species otherwise known from an eastern tier of Wyoming counties and Colorado but not in between.

Finally, documentation of one species represents a major range extension; not previously known from the southern half of Wyoming. *Braya humilis* (low northern braya), at its southern limits in the Rocky Mountains where its habitat is described as typically alpine (Harris pers. commun.), otherwise present across Alaska, Canada and territories. In Wyoming, it was previously known from two alpine occurrences in the Wind River Range. It has not been found before in basin settings in the Rocky Mountains.

There are other noteworthy discoveries in the 2020 botanical surveys. Our survey also found common species that had not been collected before in Albany County, such as *Phlox kelseyi* (Kelsey's phlox, abundant in the study area); species rarely collected from basin settings in Wyoming such as *Valeriana edulis* (tobacco root, abundant in the study area); species that are abundant in parts of their rangewide distribution but not in the Laramie Basin, such as *Schizachyrium scoparium* (little bluestem); wetland species that are not usually found in abundance in Wyoming, such as *Primula incana* (mealy primrose); and species that have not been collected in Albany County for many years, such as *Symphyotrichum frondosum* (short-rayed alkali aster) – last collected in the county in 1900 .

The Red Buttes Environment Biology Laboratory study area supports an especially diverse wetland flora with species from northern latitudes and high elevations. The study area flora harbors the highest number of Wyoming plant species of concern in the Laramie Basin. The diversity and uniqueness may point to unusual wetland systems, and any of these elements warrant further study. According to Copeland et al., (2010), low elevation wetlands "generally sustain greater biological diversity," though the authors were primarily considering animal diversity. At the same time, low elevation wetlands are impacted or at risk due to anthropologic changes in land use (Copeland et al., 2010). The University-owned lands of the Red Buttes Biological Laboratory are in notably intact condition. The diverse flora points to a diverse landscape that is well-suited for documentation of the rest of the biota. The Red Buttes study area offers a natural outdoor classroom and laboratory for research and education, not only in botany and ecology but in all other biological sciences.

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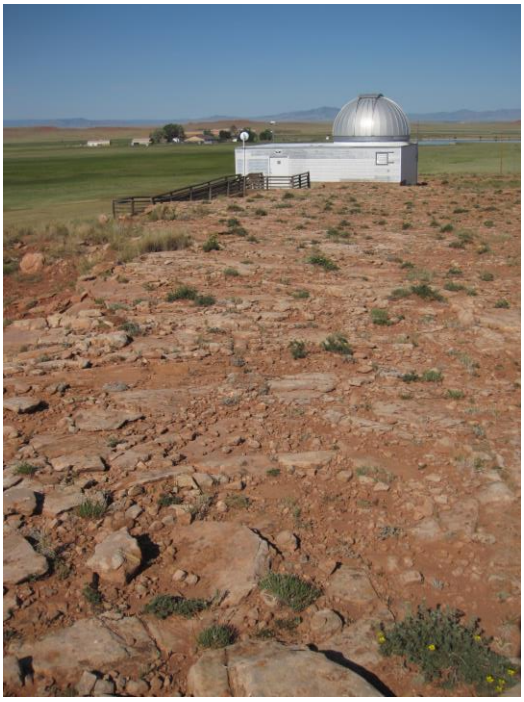
Appendix A. Red Buttes study area photographs



Above and right: The two main facilities on the University property are the Red Buttes Environmental Biology Laboratory, and the Red Buttes Observatory (with the lab in the background). They are separated by about a half mile and with separate access off of US Hwy 287.

Above left: The first visit to the Red Buttes study area was made by the co-authors on 8 May 2020, when Kelsey's phlox (*Phlox kelseyi*) was in flower, a species that had not been collected before in Albany County. Above right: Also in flower was moss gentian (*Gentiana aquatica*). A running checklist was started at this time.

Above and right: Leazenby Lake is also known as Hundred Springs Reservoir. The popular public access to it in was created in recent years on the University property, while most botany studies have been on the State Trust land immediately north of University property. Signs at the access advise fishermen to stay along the water, inferring that the University land is private.

Left: A dugout lies below the observatory, juxtaposition of old and new.

Left and above: Many perennial springs are scattered in wet meadows along Harney Creek, between Lake Leazenby and a spring-fed impoundment that is water source for the laboratory.

Left: Tobacco root (*Valeriana edulis*) is common in wet meadows of the Red Buttes study area, a tall species that is considered more common in mountains than basins. It is favored browse by big game in the Red Buttes area.

Upper right and right: The observatory is built on bedrock, and the rock outcrops extend to the northeastern corner of the study area. They harboring regional endemics such as slenderleaf buckwheat (*Eriogonum exiifolium*) and white larchleaf penstemon (*Penstemon laricifolius* var. *exilifolius*).

Left: Meadow lousewort (*Pedicularis crenulata*) is one of the most common wet meadow plants of the Red Buttes study area and it flowers during peak flowering activity in late June – early July.

Above: Nuttall's sunflower (*Helianthus nuttallii*) is locally abundant in late summer, a common Wyoming plant.

Right: Marsh felwort (*Lomatogonium rotatum*) grows in a small area of peat accumulation, a widespread species that is rare in Wyoming at the edge of its range.

Above: Low northern braya (*Braya humilis*) is a dainty white-flowered plant of the far north; only known from two other places in Wyoming. Upper right: Its patterned habitat is transitional between wetland and upland.

Lower right: Gentle dips and rises are throughout alkali sacaton (*Sporobolus airoides*) grassland, adding to study area microhabitat diversity.