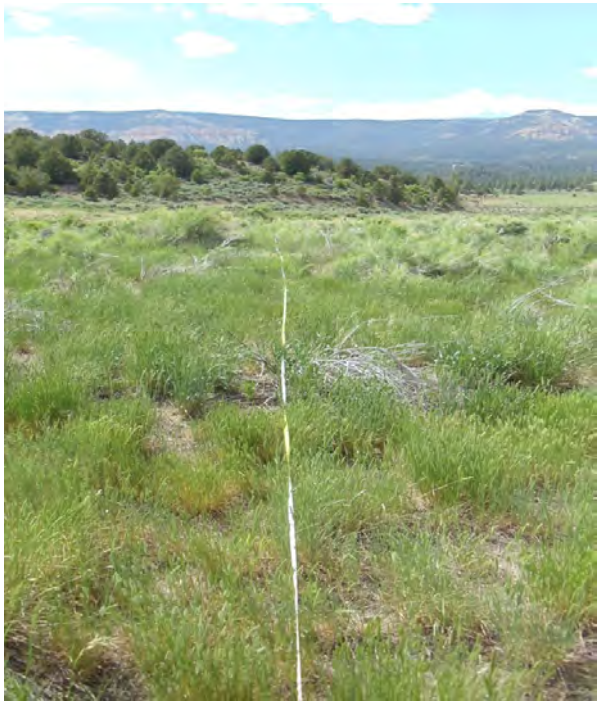
South Hollow
and Adjacent Dixie National Forest Lands:
Ecological Communities
Escalante, Utah
2010 Surveys



June 24-26, 2010

Dennis Bramble –Professor Emeritus, Biology, University of Utah
Don Feener – Professor, Biology, University of Utah
Walter Fertig – Moenave Botanical Consulting
Dave and Emma Gardner – Utah Native Plant Society
Sarah Gerould – Entomologist
Howard Hutchison - Paleontologist
Harold Ikerd – Agricultural Research Services Bee Laboratory
Mei Kwan – Grand Canyon Trust Volunteer
Mary O'Brien– Ecologist, Grand Canyon Trust
Douglas Reagan - Herpetologist
Craig Sorensen - Ornithologist
Mindy Wheeler – Botanist, Grand Canyon Trust

September 21-22, 2010

Semester in the West (21 students); Whitman College; Walla Walla WA

Compiled by Mindy Wheeler and Mary O' Brien

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South Hollow and Adjacent Dixie NF Lands:

Ecological Communities

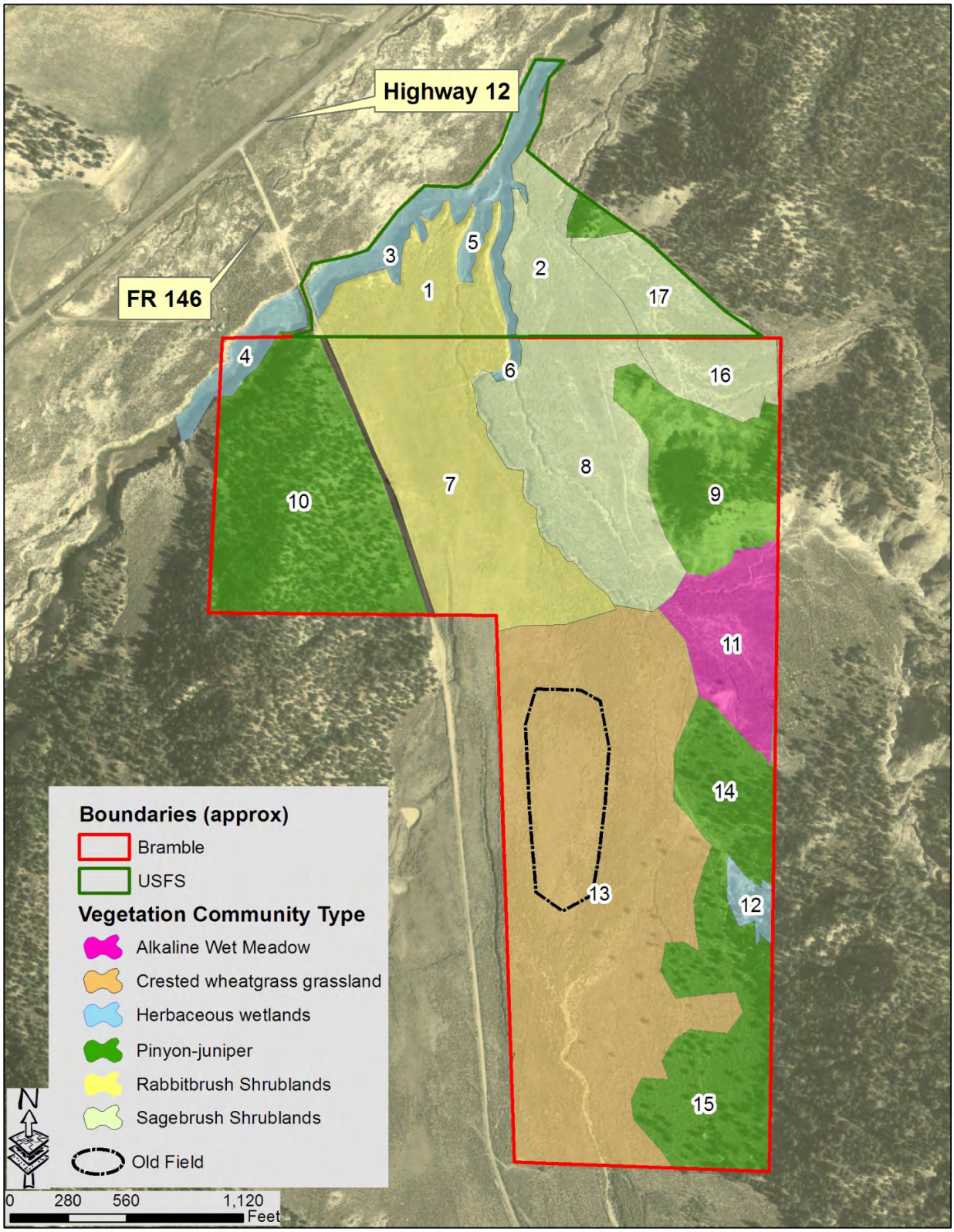
INTRODUCTION

The private property hereafter called "South Hollow" lies approximately 13 miles southwest of Escalante, a small town in the south central part of Utah. The area is known nationally and internationally for its dramatic landscapes as a result of the colorful exposed geology. The 1.9 million-acre Grand Staircase Escalante National Monument lies near South Hollow to the south. South Hollow is approximately 145 acres, surrounded by Dixie National Forest. In 1992, the Brambles (Dennis and Jean) along with Howard Hutchison, bought the property because all have a fascination and love for this area of the state and its history. Dennis Bramble retired in 2009 after serving as Professor of Biology at University of Utah for 32 years

Since 1992, the landowners, in concert with numerous other interested scientists, have researched, observed and documented many aspects of the natural history and complex ecological relationships of the property and surrounding areas. The research, observations and data consist of documented changes occurring on the property as a result of modified land use management. Beginning in 1992, the owners decided to graze cattle only in the Fall (as opposed to Spring, Summer and Fall as had occurred previously). For the past 18 years. Dennis Bramble has tracked major changes that resulted from this decision. Twice during the past 18 years, the property was not grazed in Fall due to drought, once due to visits planned during what would have been the grazing period, and once due to the failure of a previously arranged grazing lease to materialize.

The property has been segmented into distinct areas by the owners generally based on differences in geology, soils, and vegetation types. The vegetation types are broadly pinyon/juniper woodlands on the side slopes and sagebrush and/or rabbitbrush shrublands in the gently sloping lowlands, interspersed with ephemeral and perennial drainages between the woodlands and shrublands. A closer view of South Hollow reveals interesting characteristics of the vegetation communities that make it atypical in terms of species composition and function for the region. The vegetation communities have been mapped (Fig. 1), and the interesting characteristics within them have been explained in an historical and ecological context (see South Hollow Target Areas text following Fig. 1). Within South Hollow, thousands of monitoring photos, taken from multiple photo points, have been acquired over the past 17 years, two Hobo weather stations have been installed to log climatic data [air temperature and humidity, precipitation, soil temperature, soil moisture, wind speed at various sampling intervals (2-10 minutes)]; approximately 300 western harvester ant (*Pogonomyrmex occidentalis*) colonies have been GPS'd and observed; water table depths have been monitored (indirectly); comprehensive plant lists have been assembled; and mammals, paleontological specimens, pollinators, macroinvertebrates and herpetological populations have been observed and partially surveyed.

Figure 1. South Hollow Vegetation Types and Target Areas. (See text below for explanations of numbered target areas).



South Hollow Target Areas

1. **West Meadows/USFS (rabbitbrush shrublands)**. A recovering former wet meadow – deep soils, somewhat alkaline, but more so at the north end. The area has many vole-killed or -damaged rabbitbrush.

2. **East Meadow /USFS (sagebrush shrublands)**. Former wet meadow on alkaline soils. This was probably the wettest portion of the original South Hollow meadow complex. Stands of native grasses, sedges and rushes and assorted forbs have become established in recent years. The northern edge of this area is highly eroded with deep gullies and sinkholes, but has now become largely stabilized as native grasses and sedges have increased.

3. **East Riparian (herbaceous wetlands).** A primary wetland zone. This portion of the riparian zone is grazed only in the Fall. The exit of water from the culvert at the west end was a 2-3 ft. pour-off in 1993, but now the creek bed has been raised until it is even (or slightly above) the bottom of the culvert. The elevation of the creek bed is due to sediment capture by the dense stands of rush, grass, and sedge during monsoon floods. The east riparian zone has now become an acceptable nesting ground for Brewer's blackbird (*Euphagus cyanocephalus*) and northern harriers (*Circus cyaneus*; in years with high vole populations). This same stretch of riparian vegetation also provides secure habitat for vole populations in drought years. Recent observations suggest that amphibians (probably a northern leopard frog, *Rana pipiens*, and possibly a true toad – i.e. *Bufo* sp.), formerly absent, may now be residing in this wetland.

4. **West Riparian (herbaceous wetlands; Dixie NF).** The creek bottom west of the FS Road (FR 146) and culvert. This area is heavily grazed each summer.

5. **Thistle Basin (herbaceous wetlands)**. This area is closer to the water table than any non-riparian area on the property. This relatively lush depression is a former erosion channel that subsequently became detached from its water source and stabilized. The vegetation currently in the bottom of the basin may be the closest to what originally covered much of the West Meadow before livestock grazing began in the 1880s. The area is still grazed, but only in the Fall. Thistle Basin has become increasingly wet as the nearby streambed has aggraded and the water table has been elevated. In recent years an active water seep has developed at its lower end.

6. **Willow Spring Run/Bramble/USFS (herbaceous wetlands).** This is a deep, steep-sided incision cut into the ground when a stock pond dam failed, probably in the 1950's. It has become increasingly stabilized as coyote willow has progressively covered the bottom and ascended the walls of the ravine. At the bottom is Willow Spring, now the most productive spring in terms of total water output within the South Hollow watershed. This spring has strengthened as the water table has risen. Its origin has migrated up the ravine more than 100 feet horizontally during the restoration period. Dense riparian vegetation near the mouth of this ravine has trapped considerable quantities of sediment swept out of the South Hollow watershed during summer rainstorms. The resulting vertical elevation of the riparian bottom is now between 4 and 5 feet, and has produced a corresponding rise in the local water table.

7. **West Meadow/Bramble (rabbitbrush shrublands)** A former wet meadow complex that had been drained by deeply incised channels to the north with consequent lowering of the water table. This process was likely complete by the 1920s. The meadow was subsequently overrun by big sagebrush that was later burned off in a 1988 prescribed fire. Following the fire, the area was heavily invaded by rubber rabbitbrush. More recently, voles have selectively killed many of these shrubs and various grasses and sedges have begun to expand into the opened areas. The area contains two exclosures, both of which have been without grazing since 2006 and the southern one has been largely without cow grazing since 2001.

8. **East Meadow/Bramble (sagebrush shrublands)**. This area parallels the West Meadow to the east of the main erosion channel. It is similar to the West Meadows, but was probably wetter historically. It has shallower soils and is more alkaline. Rabbitbrush invasion was less intense here, although voles have also killed shrubs in this area. Native grasses, sedges and forbs have been increasing.

9. **Howard's Hill (pinyon-juniper woodlands)**. This is the most prominent elevation on the private property in South Hollow. The hill is an erosion remnant of Kaiparowits Formation (late Cretaceous) consisting chiefly of fine, horizontally bedded alkaline clays and silts. These sediments contain fragmentary dinosaur and turtle bone as well as poorly preserved fossil wood. The top of the hill has a scattered pavement of white calcareous rock representing weathered Claron Formation (Eocene). Some of the pinyon and juniper on this hill appear to be quite old and scarred by historic wildfires. Traces of an original pioneer corral or fence are still discernible near the summit of the hill and axe-cut trees are common. Stone-covered lithosols have accumulated on the lower slopes of the hill and trap enough water to support numerous forbs. The local plant communities associated with lithosols appear to be among the most diverse in South Hollow. The gentle outwash slopes ringing the base of the hill now support some of the densest native grass stands in the area. When restoration began, these same slopes were dominated by a healthy black sagebrush community with little understory. As native grasses have expanded into this area, large numbers of black sagebrush have weakened and died. The reason for this is unclear. Big sagebrush, which is much less uncommon in this area, has not been similarly affected.

10. **Indian Hill (pinyon-juniper woodlands)**. A relatively large and complex area with a range of soils, slopes, aspects and vegetation cover. Good forb diversity on lithosols on lower slopes, especially when open and north- or east-facing. The area has had no official grazing since 1993 (but periodic trespassing cows). The north- and east-facing slopes have experienced a substantial increase in native vegetation since 1992, especially of forbs. The pebble and cobble lithosols on the slopes are particularly rich in forbs. There has also been a significant increase in bitterbrush. Historic aerial photos show that this hill has seen an explosive expansion of pinyon and juniper, such that it is beginning to form a closed canopy in many locations. The hill is locally named for the lithic scatter found in many places, suggesting it was frequently used by Native Americans as a hunting camp during pre-settlement times. (Given its geographic location, South Hollow has probably been occupied by at least three different indigenous cultures in the past: Anasazi, Fremont, and Piute).

11. **Developing Meadow (alkaline wet meadow).** There is a considerable range of local topography and vegetation types in this area, although all of it is constrained to some degree by the distinctly alkaline nature of the soil. The 1988 prescribed fire did not impact this part of the property. Large numbers of dead or dying black sage occur here. The central portion of the area receives flood-water, snowmelt, and periodic spring seepage, all from the area around and above Hobbit Spring to the east. This part of the property is becoming noticeably wetter and has been accumulating dense stands of mostly native grasses. In 1992, this area had little grass and was dominated by greasewood and black sagebrush. A few colonies of a meadow-loving ant have recently appeared. The general trajectory suggests that this area may gradually be moving toward a new meadow complex.

12. **Springs (herbaceous wetlands)**. The two springs (Hobbit and Alvey) are connected and should be studied as a unit. However, due to its setting (slope, aspect) as well as size, Hobbit Spring (Dixie NF) has the greater plant diversity. Its water is also less contaminated by alkaline salts. Hobbit has also experienced less anthropogenic disturbance over the past 100 years. Comparison of the plant associations at the two springs should therefore be interesting. This spring and its associated pool is the largest of its kind in the South Hollow watershed and possibly the Upper Valley. The water flows from a sandstone ledge in the Kaiparowits Formation and floods a clay platform or bench. The spring is north-facing on a steep slope and thus is cool. Douglas fir and very large water birch surround the spring. The water is permanent,

and remains abundant even in severe droughts. The Great Basin spadefoot toad (*Spea intermontana*), the only currently documented amphibian in South Hollow, resides here. Likewise, the only tree squirrels so far observed in South Hollow are closely associated with this spring. Downslope seepage is in the process of creating a local bog with a series of connected pools. A larger, older wet meadow occurs to the east of Hobbit Spring in South Hollow and is fed by it. The area in and around this unusual water source is still relatively unexplored.

Alvey Spring sits on a west-facing bench and is therefore located in a much warmer, drier setting than Hobbit Spring. It has a small permanent pool and a very long, narrow strip of dense wetland vegetation leading down slope to the west. The spring feeds an associated seep on a bench below it; the seep and its associated water-dependent shrubs and forbs have expanded in recent years.

13. **Old Field and South Lowlands (crested wheatgrass grasslands)**. The Old Field, created by a series of historic floods and debris flows, sits between the arms of two low ridges to the East and West. These deposits were transported by water carried in South Hollow Wash, an ephemeral stream that passes through the middle of this area. Most of the deposits are cobbles and sand, but pieces of wood are included in the newer deposits. A 2008 flood dumped massive amounts of woody debris as well as tons of silt and sand on this part of the property. The fairly abrupt termination of the debris (esp. rocks) is largely due to the braking action of woody shrubs (sagebrush and rabbitbrush). That some of the older (100+ years old) debris flows traveled downhill much further suggests that either they were of much higher energy or (more likely) it reflects the relative scarcity of woody vegetation on the reference area at that time. The edges of South Hollow Wash are currently lined by dense stands of rubber rabbitbrush which replaced equally dense stands of big sagebrush following a prescribed fire in 1988. Flanking South Hollow Wash, both east and west, are flat to gently sloping areas dominated by big sage with an understory consisting chiefly of crested wheatgrass. This exotic grass was apparently planted in the 1950's after the area was chained to remove sagebrush. The soil on this part of the property is chiefly sandy silts and loams.

14. **East Uplands (pinyon-juniper woodlands)**. This area is a geologically active zone in which significant "mass wasting" has been underway for the past decade. Down slope movement of large chunks of hillside is caused by underground lubrication of clay layers by seepage from Hobbit Spring. Numerous dead or dying pinyon and juniper are found here, most killed by disrupted root systems as the soil moves. New wet zones are forming in this area and grasses and forbs previously absent are appearing in association with them. The lower portion of this area, which includes Lone Pine, is another portion of South Hollow that has not experienced any type of "treatment" by former landowners. Some harvester ant colonies just north of Lone Pine appear to have defended their cleared zones against invasion by at least two generations of big sage, suggesting that the ants already occupied the sites before livestock entered the Upper Valley in the 1880s Expanding pinyon-juniper (P-J) woodland is rapidly overrunning this area and thus reducing its biological potential.

15. **South Uplands (pinyon-Juniper woodlands)**. This is the highest portion of the property. The soils are predominantly sandy silts and loams with interspersed cobble stringers (old debris flows and channel deposits). This area was also chained in 1958 and planted to crested wheatgrass. This exotic bunchgrass still dominates the herbaceous vegetation. The area was burned in 1988 to clear sagebrush but the results were mixed, with some portions being thoroughly burned while others were untouched by the fire. The eastern-most portion of this area, close to the eastern fence line, has never been "treated" and contains old big sagebrush that appear to represent the original expansion of this shrub following the onset of grazing in the 1880s. The highest portions of the area also mark the beginning of the transition from pinyon-juniper woodland to the ponderosa pine-Gambel oak zone.

16. **East Side Slopes/Bramble (sagebrush shrublands)**. This area has relatively thin soils and is much more alkaline, drier and heavily eroded than the neighboring East Meadow proper. It has likely lost much of its original soil but is now regaining some of its native vegetation, especially cool season grasses.

17. **East Side Slopes/ USFS** – Essentially the same as the preceding area, but with a steeper average slope and a rockier surface.

LAND USE HISTORY

The history of the property dates back to homesteading times. Records show the property was first homesteaded in 1906, with unregulated grazing beginning in the 1880s (Bramble and Bramble 2006). The area was likely used for farming and ranching, then likely moved to ranching only. Sheep and cattle grazed the property for decades, likely most concentrated in Spring and Summer, although season-long grazing was also likely practiced.

PHYSICAL CHARACTERISTICS

CLIMATE

The area receives an average of 12-14 inches of precipitation in the year, with most of it coming as snow in the winter months, but with as much as 30% of it originating as monsoonal rains during the months of July through September. Average warm season (June-September) temperatures are 64 F while cold season (December-February) temperatures average about 25 F.

GEOLOGY

Most of the soils in the lower portion of the property are derived from the Kaiparowits Formation and consist of alkaline clays, sandy silts or loams. The clays are resistant to rapid water penetration and thus make the area vulnerable to flooding during the monsoonal rainstorms. The Canaan Peak Formation overlays the Kaiparowits, and is a massive pebble and cobble conglomerate cemented together by a white calcareous mix. The formation tends to break apart belowground, releasing large quantities of pebble and cobble, which often fill the washes, channels and gullies. The uppermost geologic unit in the South Hollow area is the Claron Formation, consisting primarily of pink and white silty limestones that were formed at the bottom of a large Eocene lake. The Claron does not contribute importantly to most of the soils on the site except for the calcareous lithosols on the tops of the hills and ridges.

SOIL TYPES

The soil types on the upper slopes of the property formed from the breaking down of rock from limestone through the forces of gravity and weathering, whereas the soils on the bottomlands are chiefly derived from volcanic and/or sedimentary rock carried and deposited via water erosion. In many areas, the vegetation communities closely follow the soil type boundaries. As an example, the crested wheatgrass grassland is found in Jodero Loam soils (P73). This would have been the most suitable and/or productive soil to grow crops and/or range grasses in the past. The Jodero loam is not as moist or alkaline as Alldown Loam (P4), which is found in the northern

portion of the property. As a result, Jodero Loam is where crested wheatgrass seedings are more persistent whereas the Alldown Loam supports a greater diversity of native sedges and grasses. Figure 3 shows the property boundary, soil type boundaries, vegetation community type boundaries, and vegetation transect locations.

More detailed soil descriptions can be found in Appendix A.

BIOLOGICAL CHARACTERISTICS

SOUTH HOLLOW VEGETATION OVERVIEW[1]

Excerpted from 'South Hollow Bio-Blitz – Vascular Plants' by Walter Fertig, Moenave Botanical Consulting

On June 25-26, 2010, the South Hollow Bio-blitz botany team (consisting of Dennis Bramble, Mindy Wheeler, and Walt Fertig) observed 162 vascular plant species, representing 105 genera and 36 families. Coupled with records kept by Dennis Bramble over the years, the total known flora of the South Hollow area stands at 178 species in 111 genera. This is a relatively high number of species, given the small size of the study area (140 acres of private land and less than 30 acres of adjacent US Forest Service lands). The diversity of species can be attributed to the variety of habitats present in the area. The total number of species is undoubtedly higher, and will probably exceed 200 species if additional surveys are conducted in the early spring and late fall.

Only 21 introduced and naturalized plant species have been recorded at South Hollow, representing 12% of the total flora. This percentage is slightly lower than the statewide average of 13.1% in Utah (Fertig 2007). About 1/3 of the introduced species are pasture grasses that are commonly cultivated in southern Utah for livestock forage. Three of these grasses (crested wheatgrass, smooth brome, and Kentucky bluegrass) are dominant species over much of the meadow and pasture lands of the study area. None of the introduced species at South Hollow are officially designated as noxious weeds by the state of Utah (SUDAF 2008).

Of the 157 native plant species found at South Hollow, 150 are common and widespread across Utah and the western United States. Only seven species are local or regional endemics known just from Utah or the Colorado Plateau ecoregion. Most of the Colorado Plateau endemics are relatively common and not considered species of conservation concern. These include variable spring-parsley (*Cymopterus purpureus* var. *purpureus*), Utah trefoil (*Lotus utahensis*), dusty penstemon (*Penstemon comarrhenus*), roundleaf buffaloberry (*Shepherdia rotundifolia*), narrow-leaved yucca (*Yucca angustissima*), and Plummer's siltbush (*Zuckia brandegeei* var. *plummeri*).

The rarest species on South Hollow is the Henrieville woodyaster (*Xylorhiza confertifolia* or *Machaeranthera confertifolia*). This perennial, white-rayed member of the sunflower family is known only from Kane, Garfield, and Wayne counties (see photo). The type locality is from "The Blues", an exposure of Cretaceous Kaiparowits Formation just 2.5 miles southwest of South Hollow. Henrieville woodyaster is known from less than two dozen populations and is tracked on the "Watch List" of species of conservation concern by the Utah Conservation Data Center (Utah Division of Wildlife Resources 1998) and Utah Native Plant Society (Fertig 2009). At South Hollow, this species is locally common (several hundred individuals) on whitish-gray barren clay soils at the base of Howard's Hill and in blowouts elsewhere on the east side of the property.

[1] Fertig, Walter. 2010. *South Hollow Bio-Blitz – Vascular Plants.* Unpublished Report

Among other notable discoveries during the June 2010 bio-blitz were six plant species not previously documented from the neighboring Grand Staircase-Escalante National Monument. These include western sedge (*Carex occidentalis*), tall wheatgrass (*Elymus elongatus*), Nelson's needlegrass (*Stipa nelsonii*), and fragile pricklypear (*Opuntia fragilis*). Two tentative reports of slender spikerush (*Eleocharis acicularis*) and hollyleaf clover (*Trifolium gymnocarpon*) are also included here: both need confirmation when mature fruiting or flowering specimens are available. All of these species should be sought in the Upper Valley or Henrieville Creek areas of Grand Staircase.

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Figure 2. Henrieville woodyaster (*Xylorhiza confertifolia*) along the west base of Howard's Hill, South Hollow. Photo by W. Fertig

At an ecoregional scale, the study area has 10.5% of the 1,694 plant species known from the Utah portion of the Colorado Plateau (Shultz et al. 2006). Within Garfield County, South Hollow has 12.4% of the 1440 plant taxa reported for the county by Welsh et al. (2008). Relative to Grand Staircase-Escalante National Monument, South Hollow shares approximately 18% of the monument's 983 taxa (Fertig 2005). While these percentages may seem small, it must be borne in mind that the South Hollow inventory comes from a relatively small area (~150 acres) with a minimal range of elevation (~300 feet) and a limited set of soil types compared to these much larger regional areas. No data are presently available to compare plant diversity in South Hollow with comparable samples elsewhere in south-central Utah.

Overall, the system appears to be functioning well as a cool season desert grassland where natives are still present, but not as predominant as they were in pre-settlement times. The current management of grazing only in the fall allows grasses (both natives and exotics) to produce seed heads to increase cover. This cover serves to increase vole activity where the vegetation cover is sufficient enough for both food and escape cover. The increased activity of voles can serve to modify the vegetation structure. This phenomenon has been documented in Bramble and Bramble (2008) as the voles girdled and eventually killed the aggressive rabbitbrush in the area to allow for an increase in grass cover. Moreover, with the area's past grazing history, it is possible that South Hollow and surrounding areas are supporting more woody vegetation than in previous centuries as grazing tends to favor woody vegetation as grass populations are decreased.

One of the most notable and important trends on the South Hollow Restoration Area has been a dramatic increase in total grass cover as well as a substantial increase in the diversity of the grasses occupying the site. There are now 31 species confidently identified, and others may eventually be observed (Table 1). Of the species now known to be present, eight are introduced (26%), but of these only three (crested wheatgrass, smooth brome, cheatgrass) contribute importantly to grass biomass. Crested wheatgrass continues to be the dominant graminoid on the higher and drier southern half of South Hollow, but has been largely replaced by native grasses on the lower, wetter northern part of the site. Significantly, both crested wheatgrass and cheatgrass have been declining in abundance during the restoration period while nearly all native grasses have been increasing. Almost one third of the grasses were absent at the start of the restoration project (1993) and several have experienced rapid expansion soon after they first appeared. It is important to note that none of these grasses were planted and all are scarce or absent from the neighboring FS allotment. It is probable that these native grasses had been lost from the area by the 1940s (if not before) and hence, their reappearance cannot be solely attributed to recruitment from a relict seed bank. Because the seeds of these plants are too heavy for wind dispersal, it is presumed that vertebrate-mediated transport has been the primary mechanism of reintroduction.

Several studies have demonstrated that one of the most diagnostic indicators of excessive livestock impact on western rangelands is the absence or at least rarity of cool season bunch grasses. In this context, it is noteworthy that among the additions to the South Hollow grass community during the restoration period are four native cool season bunchgrasses absent at the beginning of the project and still scarce or absent from the surrounding FS allotment. Moreover, three of these grasses [bluebunch wheatgrass (*Pseudoroegneria spicata*), slender wheatgrass (*Elymus trachycaulus*), and Nelson's needlegrass (*Achnatherum nelsonii*)] are important forage species for domestic livestock and therefore are among those most likely to have been extirpated by historic grazing in the South Hollow area. Additionally, other cool season bunchgrasses, e.g., needle–and-thread (*Hesperostipa comata*) and Indian ricegrass (*Stipa hymenoides*), which were reduced but not eliminated by historic grazing pressure, have also experienced significant increases in abundance and distribution. Among the warm season grasses (C4), local populations of alkali sacaton (*Sporobolus airoides*) and blue grama (*Bouteloua gracilis*) have substantially expanded within South Hollow but no similar corresponding change in these species' populations has taken place on the adjacent FS lands. Important native rhizomatous grasse, *e.g.,* thickspike wheatgrass (*Elymus lanceolatus*) and western wheatgrass (*Pascopyrum smithii*), have also

increased dramatically and are among those species most aggressively challenging crested wheatgrass in many places.

Table 1. List of grass species currently recognized on the South Hollow Reference Area

Species	Common Name	Origin	Cool Season Bunchgrass	Appeared During Restoration	Current Trend
Agropyron cristatum	Crested wheatgrass	Introd.	Yes		**Declining**
Bouteloua gracilis	Blue grama	Native			**Increasing**
Bromus inermis	Smooth brome	Introd.			**Increasing**
Bromus tectorum	Cheatgrass	Introd.			Declining
Elymus elongatus	Tall wheatgrass	Introd.		Yes	Static
Elymus elymoides	Squirreltail	Native			Increasing
Elymus hispidus	Intermediate wheatgrass	Introd.		Yes	Increasing
Elymus junceus	Russian wildrye	Introd.		Yes	Rare
Elymus lanceolatus	Thickspike wheatgrass	Native			**Increasing**
Elymus salinus	Salina wildrye	Native	Yes		**Increasing**
Elymus smithii	Western wheatgrass	Native			**Increasing**
Elymus spicatus	Bluebunch wheatgrass	Native	Yes	Yes	**Increasing**
Elymus trachycaulus	Slender wheatgrass	Native	Yes	Yes	**Increasing**
Glyceria striata	Fowl mannagrass	Native		Yes	Rare
Hilaria jamesii	Galleta	Native		Yes	**Increasing**
Hordeum jubatum	Foxtail barley	Native	Yes		Increasing
Munroa squarrosa	False buffalograss	Native			Static
Muhlenbergia asperifolia	Scratchgrass muhly	Native			Increasing
Muhlenbergia richardsonis	Mat muhly	Native			Rare
Poa fendleriana	Muttongrass	Native			**Increasing**
Poa pratensis	Kentucky bluegrass	Introd.			Increasing?
Poa secunda	Sandberg bluegrass	Native	Yes		**Increasing**
Puccinellia distans	Weeping alkali grass	Introd.			Static
Puccinellia nuttalliana	Nuttall's alkali grass	Native			Increasing
Spartina gracilis	Alkali cordgrass	Native		Yes	Increasing
Sporobolus airoides	Alkali sacaton	Native			**Increasing**
Sporobolus cryptandrus	Sand dropseed	Native			Increasing
Stipa comata	Needle-and-thread	Native	Yes		**Increasing**
Stipa hymenoides	Indian ricegrass	Native	Yes		**Increasing**
Stipa lettermanii	Letterman's needlegrass	Native	Yes	Yes	Increasing
Stipa nelsonii	Nelson's needlegrass	Native	Yes	Yes	**Increasing**

Note:Species in **bold** are important cool season bunchgrasses that were absent from the site in 1993 when the restoration project commenced. While most native species have experienced increases in abundance and coverage during the restoration period (1993-present), two key introduced species (crested wheatgrass, *Agropyron cristatum*; cheatgrass, *Bromus tectorum*) have witnessed notable declines, both having been displaced by expanding populations of native grasses and sedges. The list of increasing grasses includes many (**bold type**) that are known to be important forage species for livestock and wildlife on western rangelands.

VEGETATION TRANSECTS – METHODS

On June 25 and 26, 2010, vegetation transects were read within four vegetation community types, and on September 21, 2010, seven vegetation community types were read on South Hollow and on Forest Service land. The vegetation community types were delineated by differences in plant community composition and structure observed during the June 24-26, 2010 Bio-blitz. Additionally, the intimate landowner knowledge of historic land use assisted the vegetation community mapping, as land use and management have profound effects on community structure and composition.

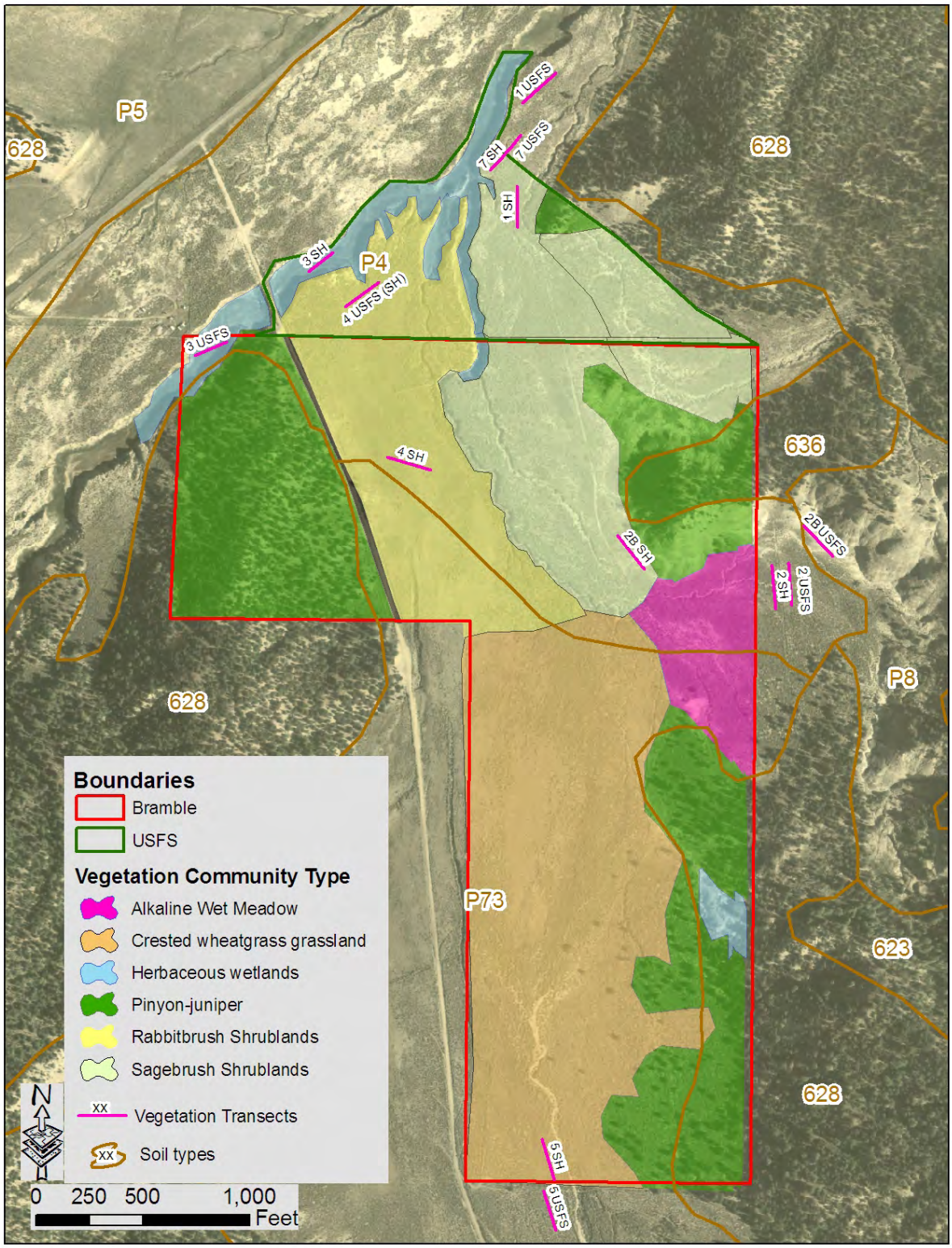
The vegetation community types are typical for this vicinity of Utah, although the condition and trend of some of the community types found on South Hollow appear to be different than the surrounding lands. A total of fourteen transects were established in and around the property to capture differences in vegetation structure and composition. The methods used to establish and read these transects are discussed below. The following discussion is of each vegetation community type, its significant characteristics, and any pertinent comparisons to the adjacent Dixie National Forest Service property. Refer to Figure 1 for vegetation community boundaries.

Locations for point-intercept transects were chosen by locating representative areas within the targeted vegetation types on both the Bramble property and/or the 35 Forest Service acres that have been fenced off and managed the same as South Hollow for many decades, as well as adjacent Dixie NF lands. Areas with similar soil types, slope, and aspect were sought and found to establish permanent 200 foot transects.

A pin was lowered every 2 feet and the vegetation and ground cover hit by the pin were recorded. If the pin touched more than one species, the first vegetation encountered was recorded as 'first hit,' and the second as 'second hit' and so on. Only the first hit is used in the calculation of areal cover, but the number of second hits is also reported to signify the degree of vegetation layering at the site. Additionally, species encountered within a 6' wide belt centered on the transect but not touched by the pointer, were recorded as present. Height of vegetation touched by the pointer was measured at every third point to gain an idea of vegetation vigor.

Vegetation cover is reported as total cover as well as percent relative cover by species and by life form type.

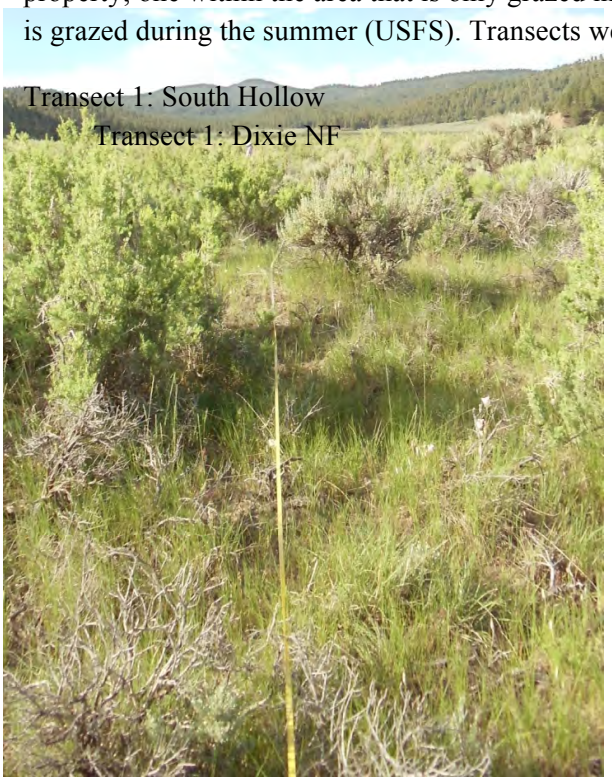
Figure 3. Soil Types, Vegetation Types and Vegetation Transect Locations



SAGEBRUSH SHRUBLANDS

Two 200' point-intercept transects were placed within the sagebrush shrublands on the eastern side of the property; one within the area that is only grazed in the fall (South Hollow), and one within the Dixie NF that is grazed during the summer (USFS). Transects were read in late June and again in late September, 2010.

Transect 1: South Hollow



Transect 1: Dixie NF

In June 2010, **Transect 1(South Hollow**) had a total vegetation cover of 60%, with most of that cool season perennial grasses (~38% relative cover), followed by shrubs at ~29% relative cover. A warm season grass, alkali sacaton (*Sporobolus airoides*), contributed ~14% relative cover. A few perennial forbs were present, but they contributed <1% relative cover, whereas annual and biennial forbs contributed about 6% relative cover. Both cheatgrass (*Bromus tectorum*) and crested wheatgrass contributed about 6% relative cover each.

There was 10% bare ground along the transect, but overall bare ground was 12% when including ground under the vegetation. Litter was the most abundant ground cover at 24% along the transect and 85% when the ground under the vegetation is included.

A total of 12 second hits were recorded indicating a single layer of vegetation predominates.

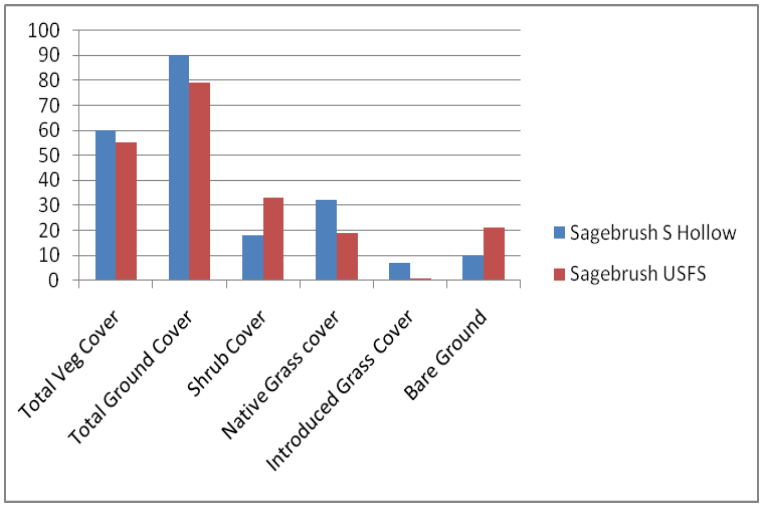
In September 2010, vegetation cover increased to 74%, with 54% of that cover attributed to cool season grasses, and 24% attributed to alkali sacaton. Shrubs accounted for about 20% of the vegetation cover. Ground cover was equally divided between litter and bare soil at 9% each along the transect, but increased to 62% and 29% respectively when the ground cover under the vegetation is included. Nineteen second hits were recorded.

Transect 1 (Dixie NF) is east of Transect 1 (South Hollow), but subject to a different (summer) grazing management regime, In June, this transect had a total vegetation cover of 44%, with the large majority of that cover being afforded by shrubs (~55% relative cover). Cool season native perennial grasses afforded 16% relative cover, a warm season perennial grass (*Sporobolus airoides*) 5% relative cover, and cheatgrass 18% relative cover. Ground cover along the transect was 19% litter (52% when including ground cover under plants), and 33% bare ground (48% when including ground cover under plants).

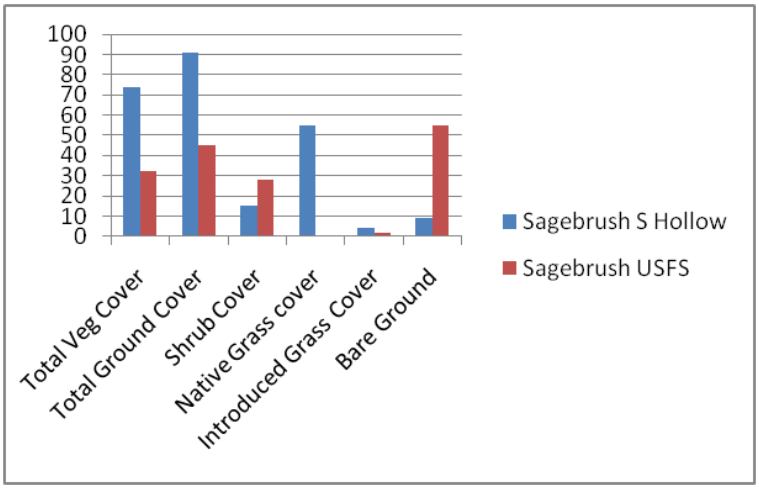
A total of 4 second hits were recorded showing a very low level of multi-layer vegetation.

In September 2010, the total vegetation cover was reduced to 32%, with 93% of the cover consisting of shrubs. Perennial grasses afforded 3% relative cover. Ground cover along the transect was 6% litter, and 55% bare ground, and increased to 28% and 63% when the ground under the vegetation is included.

June 2010



September 2010



RABBITBRUSH SHRUBLANDS

The rabbitbrush (*Chrysothamnus nauseousus*) shrublands on South Hollow were cleared of sagebrush prior to 1991. The soil is similar to the sagebrush shrublands to the east, but appears to be a bit more moist and saline. Two transects were placed in this area. Presently, both areas are grazed fall only However, one transect was placed on 35 acres of Dixie NF on the northern end (Transect 4B) to monitor any changes to the area should the management change. These transects were also read in June and September 2010.

Transect 4 (South Hollow) – This transect is located in the midst of the rabbitbrush shrublands. In June, overall vegetation cover is 61%, with 51% of that vegetation cover attributed to crested wheatgrass. Shrubs accounted for 21% of the vegetation cover. Native cool season perennial grasses contributed 5%, and native perennial forbs 6%. The ground cover was chiefly litter (27%) along the transect, increasing to 86% when ground cover under the vegetation is included. Bare ground was 9% along the transect and was 11% when ground cover under vegetation is included. Second vegetation hits totaled 14 indicating a predominance of single layer vegetation. Shrubs averaged a height of 57 inches and crested wheatgrass 12 inches.

In September, total vegetation cover was 71%, with 28% of the cover crested wheatgrass and 21% native cool season grasses. Shrubs account for 37% of the cover, and perennial forbs were 13% of the vegetation cover. Ground cover was 5% litter and 18% bare soil along the transect (42% and 54% respectively when ground cover under the vegetation is included). Shrubs averaged a height of 3 feet and grasses 19 inches.

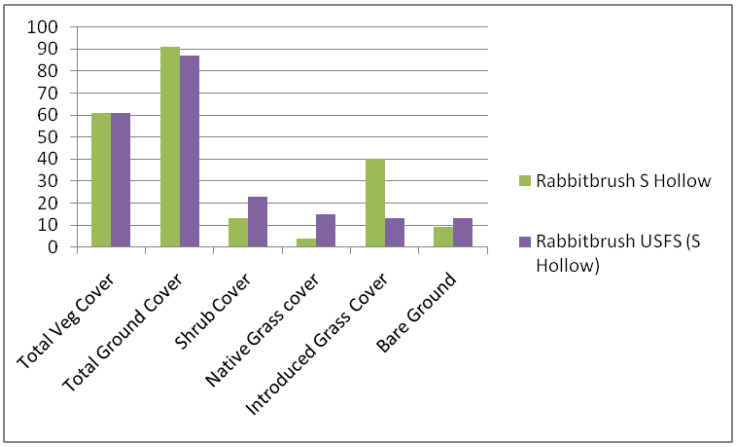
Transect 4 [Dixie NF (S Hollow)] – Transect 4 is located on the northern edge of the rabbitbrush shrubland where the soil is a bit more moist. In June, vegetation cover was 61%, but crested wheatgrass accounted for only 20% of that vegetation cover and cool season native perennial grasses for 21%. Shrubs accounted for 38% of the vegetation cover and native perennial forbs 13%. Ground cover was 21% litter along the transect, increasing to 79% when the ground below the vegetation is included. Bare ground was 13% along the transect (21% when ground cover below the vegetation is included). Shrubs averaged a height of 42 inches along this transect and crested wheatgrass averaged 18.

In September, total vegetation cover was 85%, with crested wheatgrass attributing 40% of the vegetation cover, and native cool season perennial grasses contributing 29% cover. Shrubs accounted for 15% of the vegetation cover, and perennial forbs yielded 12%. Ground cover was 1% litter along the transect, increasing to 46% when the ground below the vegetation is included. Bare ground was 12% along the transect (51% when the ground below the vegetation is included).

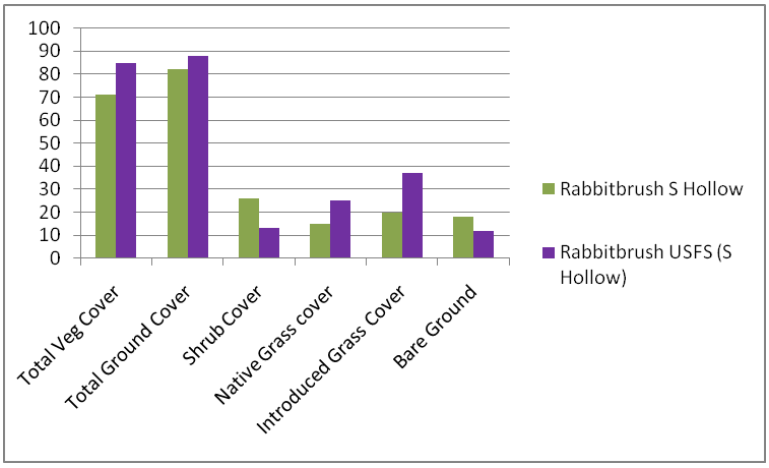
Transect 4 - S Hollow

Transect 4- USFS (S Hollow-

June 2010



September 2010



Pinyon-Juniper Woodland

The pinyon-juniper (PJ) woodlands essentially surround the lowlands of South Hollow. The lower slopes also harbor some ponderosa pines. The northwestern-most pinyon-juniper woodland has not been formally grazed for 17 years, although trespass cattle have been seen here. While the increase in the density of pinyon and juniper in this area continues, there has been a noticeable increase in understory species in this area, particularly forbs.

Herbaceous Wetlands

The herbaceous wetlands on the east side of the road at the northern end of the property have changed dramatically over the last 17 years. In 1993, the water from the culvert poured 3 feet to the ground and now the water level is even with (or even slightly above) the bottom of the culvert. The dense stands of rush, bulrush and sedges have been able to capture sediment in the area to slowly raise the water table. One transect was placed within the 35 acres of the Dixie NF that have only been grazed in the fall for 17 years (Transect 3) and one transect (3B) in the Dixie NF herbaceous wetland west of the FR 146 (summer grazing).

Transect 3 – Dixie NF (S Hollow) herbaceous wetlands; Fall grazing only

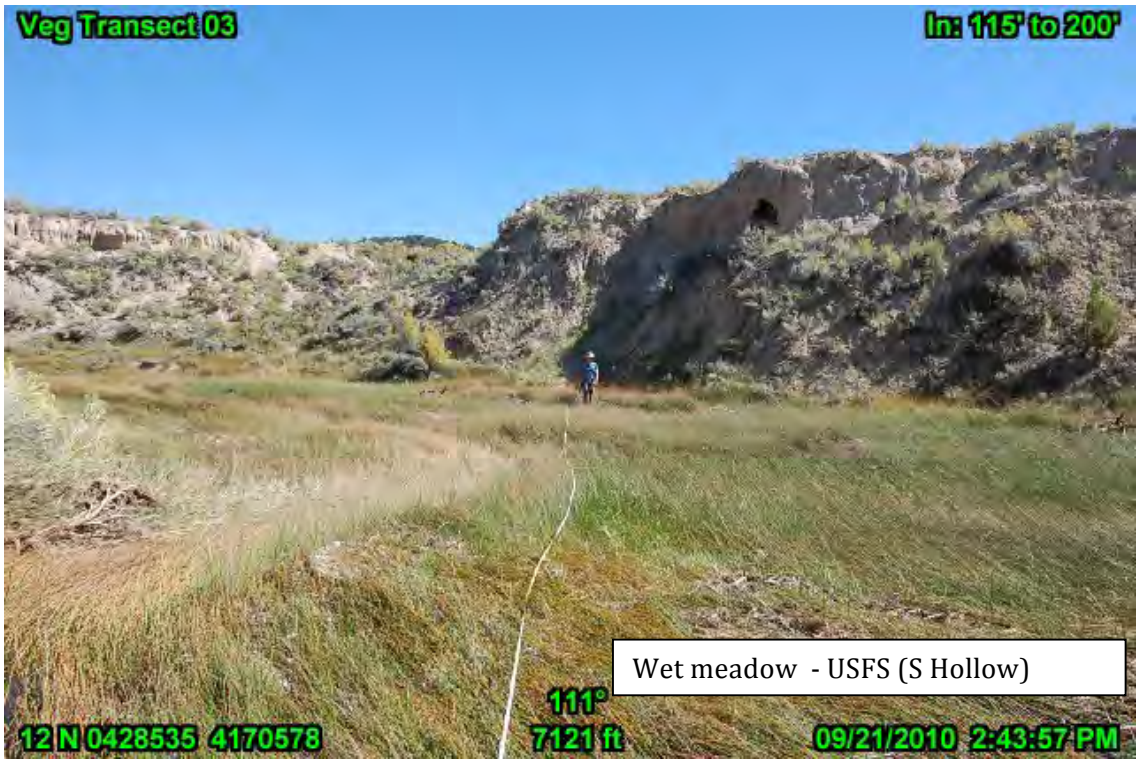
Transect 3 is located on the 35 acres owned by the USFS, but managed by South Hollow landowners for decades. The area has been grazed only in the fall for the past 17 years. In June, the total vegetation cover in this area was 75%. The majority of the vegetation is sedges and rushes (*Carex praegracilis, Juncus balticus*, and *Scirpus pungens*) and accounts for 88% of the vegetation cover. The average height of Baltic rush was 22 inches, and *Carex praegracilis* was 12 inches. The ground cover was 25% litter along the transect and 100% litter under the plants; there was no bare ground. Second hits were encountered 24% of the time, signifying a moderate amount of vegetation layering.

In September, the total vegetation cover along this transect was 91%, with majority of that cover being afforded by Baltic rush and bulrush at 90% relative cover. Along the transect bare soil was 3% and litter was 6%. The average height of bulrush was 23 inches, and the average height of Baltic rush was 22 inches.

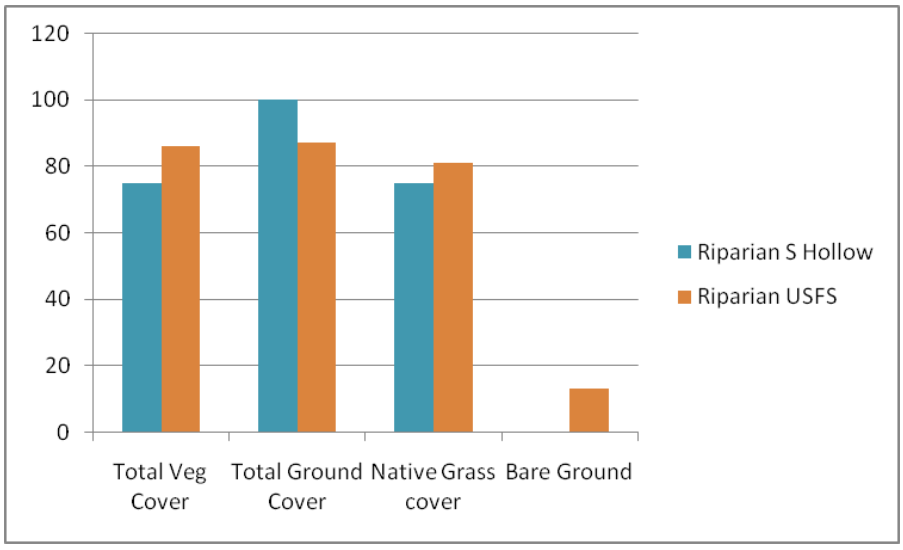
Transect 3 (Dixie NF) – Spring and Summer Grazed Herbaceous Wet Meadow

In June, the total vegetation cover in this area was 86%, most afforded by sedges and rushes (*Carex praegracilis, Eleocharis acicularis, Eleocharis palustris,* and *Juncus balticus*) at 91% relative cover. Perennial forbs accounted for 6% of the vegetation cover and cool and warm season perennial grasses for 3.5%. The ground cover along the transect was 13% bare soil and 1% litter, but bare soil and litter were 39% and 55% when the ground below the vegetation is included.

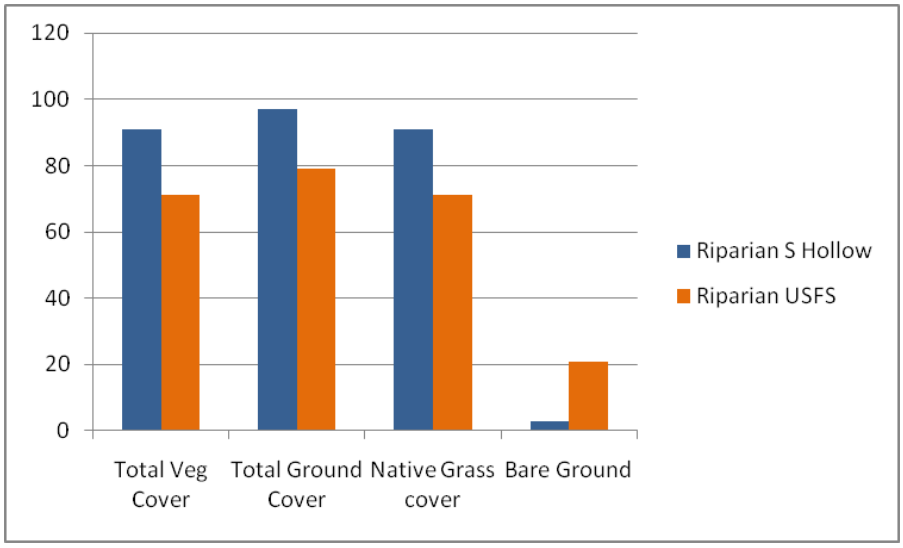
In September, the vegetation cover along this transect was 71%, with 21% bare ground and 8% litter. The majority of the vegetation was Baltic rush at 78% of the vegetation cover followed by bulrush at 20%. The average height of the bulrush was 7 inches and the average height of the Baltic rush was 10 inches.


Veg Transect 03
In: 115' to 200'
Wet meadow - USFS (S Hollow)
111°
12 N 0428535 4170578
7121 ft
09/21/2010 2:43:57 PM

June 2010


120
100
80
60
40
20
0
Total Veg Cover
Total Ground Cover
Native Grass cover
Bare Ground
Riparian S Hollow
Riparian USFS

September 2010

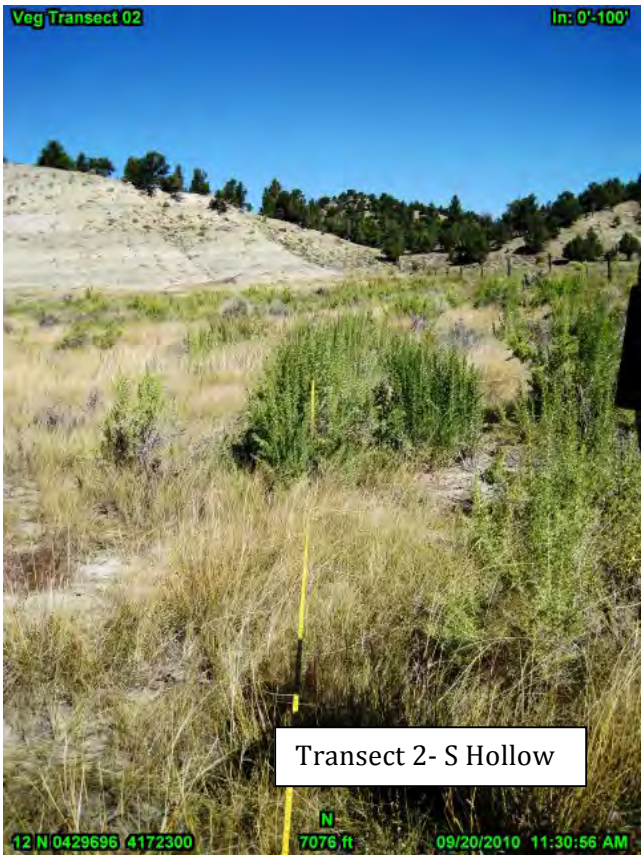


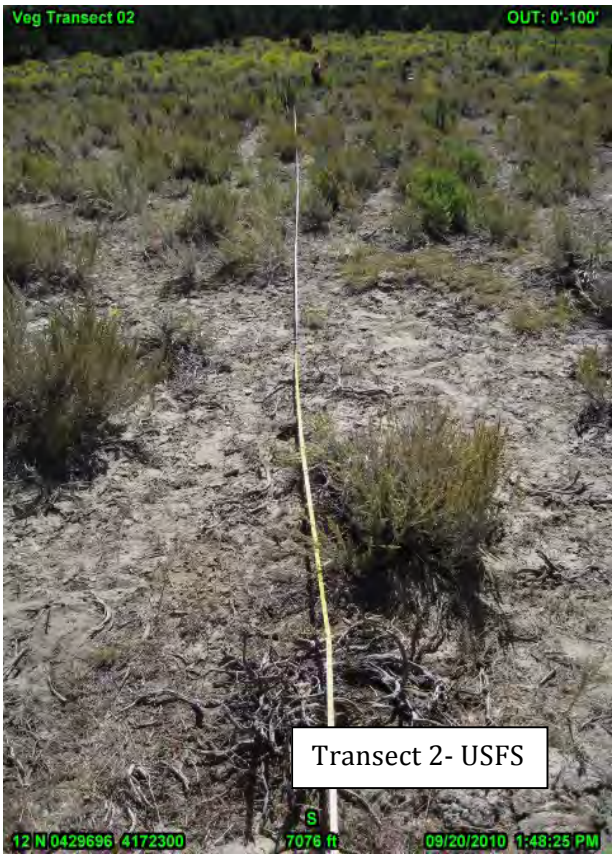
ALKALINE MEADOW

In the central eastern region of the property, there is a meadow area that appears to receive some groundwater, potentially from the Hobbit and Alvey Springs to the south and east. Two transects were placed in this area, one on South Hollow property, and one on the adjacent USFS property.

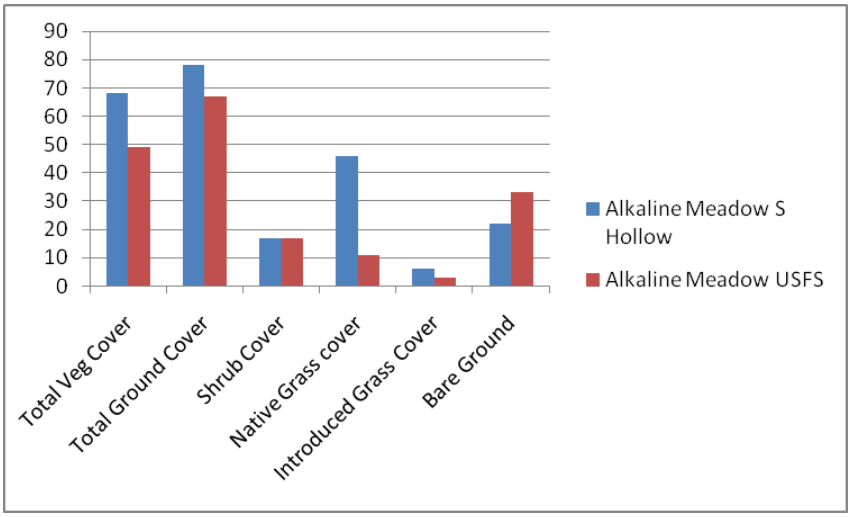
Transect 2 (South Hollow) In September, the total vegetation cover in this alkaline meadow area was 68% with more than half (66%) of that cover native cool and warm season grasses. Cheatgrass was present as 7% of the vegetation cover. Shrubs (chiefly greasewood) afforded 25% of the vegetation cover. Along the transect the ground cover was 3% litter and 22% bare soil (33% litter and 41% bare ground when ground cover under the vegetation is included). Thirteen second hits were recorded showing a very low level of vegetation layering. The average height of grasses was 18 inches.

Transect 2 (Dixie NF) is located just to the east of the South Hollow boundary fence on the Dixie NF. Total vegetation cover was 49%, with a large portion of bare soil (33% along the transect), and 8% litter along the transect. Bare soil and litter were 31% and 25% respectively when ground cover under vegetation is included. Cool and warm season perennial grasses accounted for 30% of the cover, cheatgrass 8% , and shrubs 46%. Shrubs were a mix of greasewood, black sagebrush (*Artemisia nova*) and rabbitbrush (*Chrysothamnus nauseosus*). Average grass height was 7 inches.





September 2010



ROUGH BREAKS/ BADLANDS

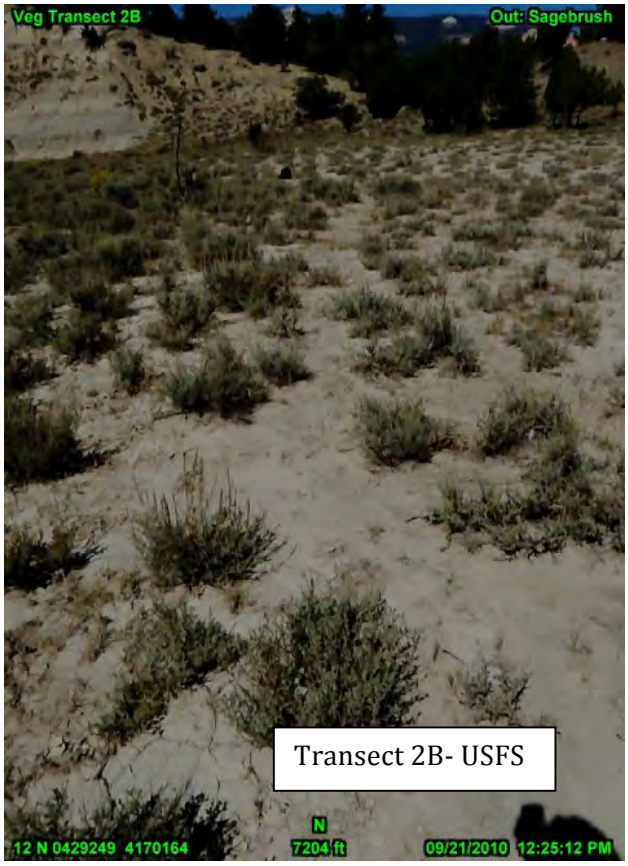
A pair of transects were placed in areas that lie at the base of a knoll comprised chiefly of soft, easily erodible Kaiparowits formation. Common species found in these areas include Salina wildrye (*Elymus salina*), and black sagebrush (*Artemisia nova*), however, the proportions of each of these species differ widely between the two areas. These areas receive a fair amount of sediment from the adjacent hillsides.

Transect 2B- USFS

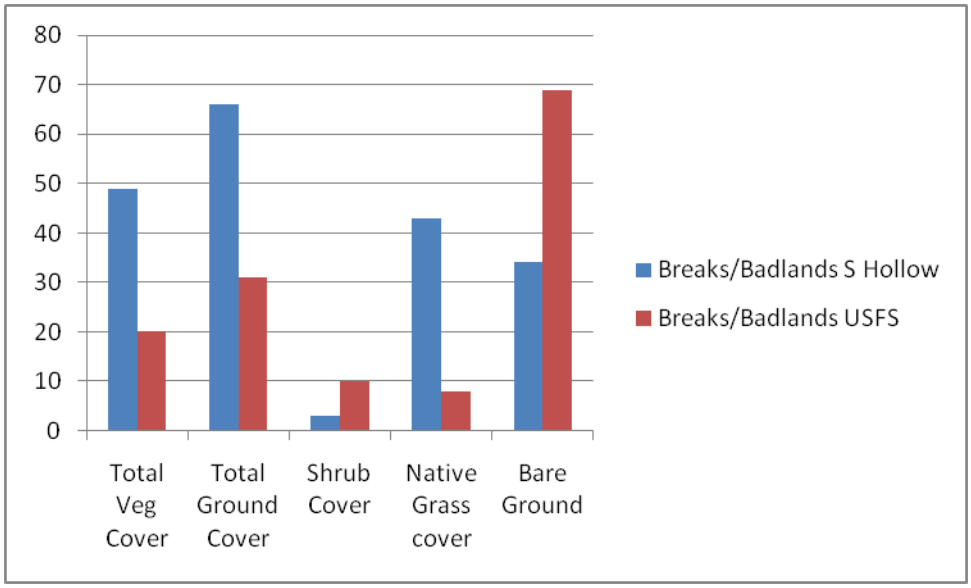
The total vegetation cover for this transect was 20%, with 45% of that cover black sagebrush and 40% Salina wildrye. The ground cover was dominated by bare soil at 69%, followed by litter at 6%. There were only 2 second hits on vegetation signifying a single layer of vegetation.

Transect 2B- S Hollow

Total vegetation cover along this transect was 49%, with 84% of that cover Salina wildrye (and other perennial wheatgrasses). This transect only had 6% vegetation cover by shrubs. The dominant ground cover was bare soil at 34% along the transect, followed by litter at 11%. Moreover, this transect had areas of biological soil crusts.



September 2010



CRESTED WHEATGRASS GRASSLAND

A pair of transects was placed in this area in September. This vegetation community is dominated by crested wheatgrass from a rangeland seeding likely done in the 1950's or 1960's. This area may have earlier been used as a crop production field (likely wheat). A flood in 2008 brought a lot of debris over this field, but was stopped by the woody vegetation present in the field. Flood debris in previous years had been able to travel further north, likely due to the lack of woody vegetation. Other common species in this area include sagebrush (*Artemisia tridentata* var *tridentata*), Indian ricegrass (*Stipa hymenoides*), viscid rabbitbrush (*Chrysothamnus viscidiflorus*), thickspike wheatgrass (*Elymus lanceolatus*), and western stickseed (*Lappula occidentalis*).

In addition to vegetation characteristics, the number of vole vegetation castings within 1 foot of the pointer were counted along each transect in this area to determine the level of vole activity in the two areas. Figure 4 shows a typical vole cache.

Figure 4. Vole seed cache

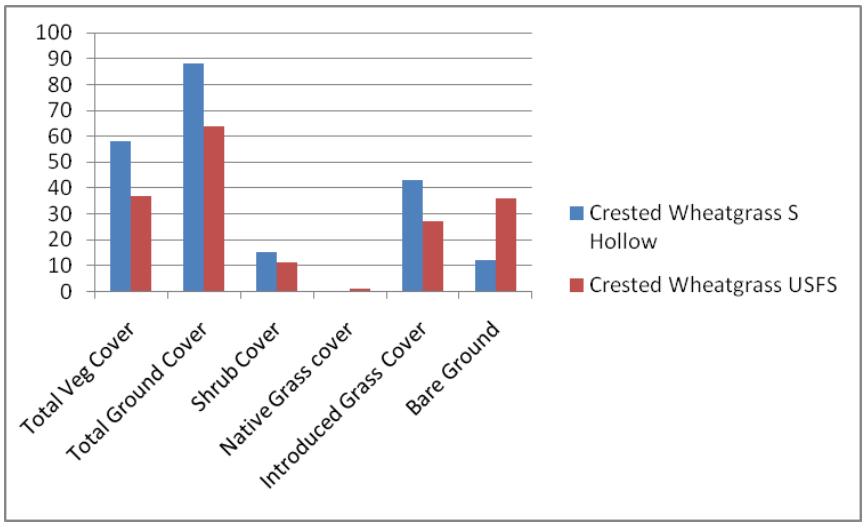
Transect 5 - Crested wheatgrass (South Hollow) – The crested wheatgrass community on South Hollow is generally lightly grazed only in the fall. The total vegetation cover was 58%, with crested wheatgrass 74% of the vegetation cover. Sagebrush contributed 26% of the vegetation cover. Ground cover was dominated by litter at 26%, followed by bare soil at 12% and gravel at 1%. Litter increased to 58% when the ground cover under the vegetation is included, whereas bare soil more or less remained the same (13%). The average height of crested wheatgrass was 1.8 feet and sagebrush 2.9 feet.

Twenty-one vole casting piles were encountered along this transect.

Transect 5 – Crested wheatgrass (USFS) – This transect was established just south of the South Hollow property line, and is grazed in the spring and summer. Total vegetation cover was 37% in this area, with 69% of that vegetation cover crested wheatgrass. Sagebrush contributed 28% of the vegetation cover. Ground cover was dominated by bare ground at 36%, followed by litter at 20%. Bare ground and litter were 40% and 59% respectively when the ground cover under the vegetation is included. The average height of crested wheatgrass was 0.7 feet and sagebrush averaged 4 feet.

No vole cache mounds were found along this transect.

September 2010



SHALLOW GULLY

Two transects (100') were placed within a shallow gully in the northeastern region of South Hollow and a comparable area on the adjacent Forest Service property. The transects were 100 feet long and followed the bottom of these gullies.

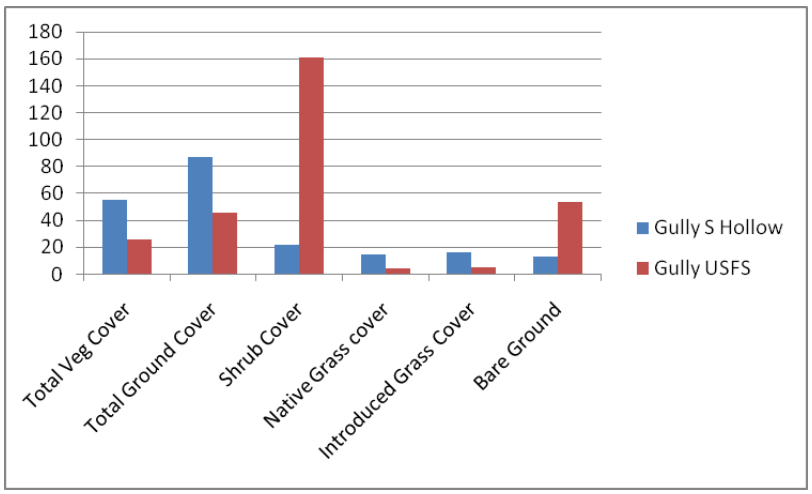
Transect 7 – South Hollow - On the South Hollow transect, the vegetation cover was 55%, with the majority of that vegetation attributed to shrubs (40% relative cover). Cool season perennial grasses attributed 25% cover and cheatgrass comprised 29% cover. Ground cover was dominated by litter at 20% along the transect, followed by bare soil at 13%. Litter and bare soil increased to 70% and 25% when the ground cover under the vegetation is included. Wheatgrasses (*Elymus* spp and *Agropyron cristatum*) averaged 16 inches.

Transect 7 – USFS – Total vegetation cover in the gully on Dixie NF property was 26%, with the majority of the cover shrubs at 62% relative cover. A wheatgrass (*Elymus* sp.) and cheatgrass each afforded 15% relative cover . Ground cover was dominated by bare soil at 54%, followed by litter at 13%, and increased to 70% and 29% respectively when ground cover under the vegetation is included. The average height of the wheatgrasses along this transect was 5 inches.

Transect 7- S Hollow

Transect 7- USFS

September 2010



DISCUSSION

Vegetation cover, composition and height differ considerably between South Hollow and adjacent Dixie National Forest lands. In fact, some of these differences can be seen on aerial photographs due to the contrasts in the amount of bare ground between the two areas. For instance, transects placed within the sagebrush within South Hollow and Dixie NF lands clearly difffered in bare ground in June with 10% and 33% bare ground respectively. The difference was exacerbated after the grazing season with bare ground at 9% on South Hollow and 55% on adjacent Dixie NF lands in late September. Similar clear differences were seen in the southern region of the South Hollow property and adjacent Dixie NF lands (crested wheatgrass transects) as well as the eastern area of South Hollow and forest lands (alkali meadow and breaks/badlands transects).

The combination of reduced vegetation litter and associated reduction of surface moisture from consistent grazing has led to dramatic differences in vegetation cover and composition between these two areas. The increased sequestration of water within the alkali meadow and breaks/badlands areas has led to a marked decrease in sagebrush with an associated marked increase in grass cover. The areas have become essentially too moist for sagebrush to survive.

Another notable difference between South Hollow and adjacent Dixie NF lands occurs within the crested wheatgrass dominated areas. The higher grass cover within South Hollow has allowed for significant vole activity as observed by the dramatic difference in the number of vole caches encountered along the transects (21 vole caches observed, versus zero vole caches observed on adjacent Dixie NF lands). The increase in vole activity can have a much wider effect on the ecosystem as a whole as voles can serve as change agents to vegetation communities (as mentioned previously) in addition to being an essential food source for other species. This increase in vole activity is but one effect of reduced grazing pressure. There are likely many other yet-to-be-discovered ecological elements and processes that are significantly recovering and will recover on South Hollow with relief from spring/summer livestock grazing.

BIRDS

Several bird surveys have been conducted on the South Hollow property over the years. Kathy Munthe surveyed birds on three dates in 2006 and made observations regarding vocalizations, sightings and nesting birds (May 30, June 13 and July 5). In 2007, bird sightings, vocalizations, and nesting birds were noted over a period of several weeks by Benny Goller.

On June 24 and 25, 2010, Craig Sorensen observed birds throughout South Hollow. Mr. Sorensen reported no unusual bird sightings (and no birds that had not been previously seen before on the property), but noted several meadowlarks, which generally indicate good riparian habitat. Additionally, a great horned owl sighted on these dates was likely feeding on the voles that are making use of the meadow.

Nesting/ Confirmed breeders

Blue-gray gnatcatcher- 1 nest in a large sage (high in sage), found 1 fledgling
Brewer's Sparrow - found numerous fledglings, 1 nest in rabbitbrush (small bush, nest low)
Green-tailed towhee-1 ground nest, 1 nest in short snowberry bush, fledglings
Marsh hawk (northern harrier) -2 fledged young, nest in riparian zone the past 2 years
Pinyon jays-arrived in a group of ~30 with fledged young
Say's phoebe-nested in the overhang of the shed roof, young fledged (1 died pre-fledging)
Rock wren-2 groups of fledglings-1 below Howard's Hill, 1 in one of the side ravines off the riparian arroyo
Mountain bluebird-nesting in nest box on south fence, feeding young
Western bluebird-fledged young
White-breasted nuthatch-fledged young in pinyons by shed
Pygmy nuthatch-feeding young in pine forest
American kestrel-at least 2 fledged young above Alvey Spring
Western scrub jay
Mountain chickadee
Western tananger
Chipping sparrow

Birds Observed

Turkey vulture
Marsh hawk (northern harrier)
Golden eagle
Cooper's hawk
Northern goshawk
Red-tailed hawk
American kestrel
Peregrine falcon
Mourning dove

Great horned owl
Common nighthawk
Common poorwill
Black-chinned hummingbird
Broad-tailed hummingbird
Northern flicker
Empidonax flycatcher (sp. unknown)
Say's phoebe
Clark's nutcracker
Western scrub-jay
Pinyon jay
Black-billed magpie
Common raven
Tree swallow
Violet-green swallow
Cliff swallow
Juniper titmouse
Mountain chickadee
Bushtit
Brown creeper? (not a positive identification)
White-breasted nuthatch
Pygmy nuthatch
Rock wren
Blue-gray gnatcatcher
Western bluebird
Mountain bluebird
American robin
Black-throated gray warbler
Common yellowthroat
Western tanager
Green-tailed towhee
Spotted towhee
Chipping sparrow
Solitaire vireo
Brewer's sparrow
Vesper sparrow
Dark-eyed junco
White crowned sparrow
Olive sided flycatcher
Meadowlark

Brewer's blackbird
Grace's warbler
Cassin's finch
Ash throated flycatcher
Hermit thrush
Juniper titmouse
Red shafted flicker
Plumbeous vireo
Black throated gray warbler

An annual breeding survey transect to note trends, perhaps in cooperation with Forest Service, would be informative as restoration proceeds.

HERPETOFAUNA

Douglas Regan, Herpetologist

All species of amphibians and reptiles (herps) observed or potentially occurring on the South Hollow site are listed in Table 2. All of these species are widely distributed and relatively common in similar habitats throughout the Escalante region and western United States. None of these species are classified as rare, threatened, or endangered. The most common and widely distributed amphibian and reptile species on site were the sagebrush lizard and greater short-horned lizard, both of which are insectivorous.

The high elevation and low winter temperatures are factors limiting the diversity of cold-blooded terrestrial vertebrates (amphibians and reptiles) at South Hollow. Small areas of standing water and wetland habitat are limited on and near South Hollow. These areas probably support other amphibian species (e.g., Woodhouse's toad, western chorus frog) not seen during field surveys. These species are best observed during the spring season when males are calling.

Table 2. Species of amphibians and reptiles potentially occurring or observed at the South Hollow Site. Potential occurrence was based on distribution maps and habitat associations from Stebbins (2003). Species listed as observed on site include those seen during site surveys performed 24-27 June 2010 and by other qualified observers on previous occasions.

COMMON NAME	SCIENTIFIC NAME	Observed on Site
AMPHIBIANS		
Tiger salamander	*Ambystoma tigrinum*	
Woodhouse's toad	*Bufo woodhousii*	
Red-spotted toad	*Bufo punctatus*	
Western chorus frog	*Pseudacris triseriata*	
Northern leopard frog	*Rana pipiens*	X
REPTILES		
Eastern fence lizard	*Sceloperus undulates*	
Sagebrush lizard	*Sceloperus graciosus*	X
Ornate tree lizard	*Urosaurus ornatus*	
Greater short-horned lizard	*Phrynosoma hernandesi*	X
Western whiptail	*Cnemidophorus tigris*	
Racer	*Coluber constrictor*	X
Gopher snake	*Pituophis catenifer*	X
Western terrestial garter snake	*Thamnophis elegans*	
Night snake	*Hypsiglena torquata*	
Western rattlesnake	*Crotalus viridis*	

MAMMALS

The following list is based on data collected by Dennis Bramble, 1992- 2009. Identifications are based on one or more of the following: direct visual observation, droppings or scat, tracks, skeletal remains. The list is considered reasonably complete for large and medium-sized species, but inadequately reflects the true diversity of small mammals - *e.g.,* rodents, insectivores, bats. Cougar are known to be present in the South Hollow watershed, but no definite sign of this large cat has been found on South Hollow.

Lagomorpha
Nuttall cottontail
Black-tailed jackrabbit

Rodentia
Golden-mantled ground squirrel
Rock squirrel
Least chipmunk
Deer mouse
Pinyon mouse
Pocket mouse (sp?)

Montane meadow vole
Porcupine[1]

Carnivora
Coyote
Red fox
Gray fox
Black bear
Raccoon[2]
Bobcat
Striped skunk[2]
Long-tailed weasel
Badger (?)

Artiodactyla
Mule deer
Rocky Mountain elk[3]

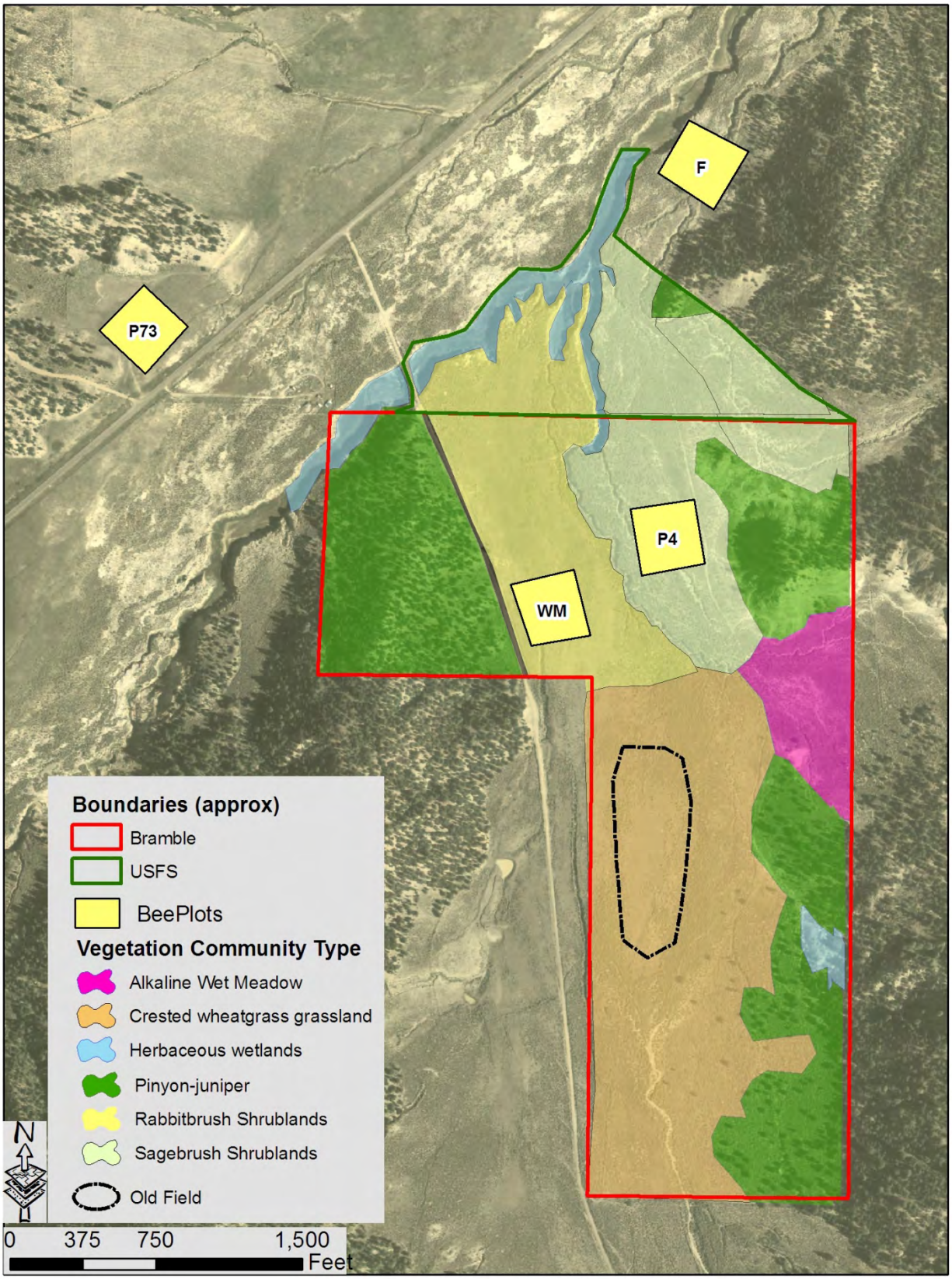
Notes:
[1.] Apparently extinct since the 1960's but previously common. A majority of mature pinyon pine in South Hollow bear datable porcupine feeding scars.
[2.] Raccoons and skunks are very recent arrivals - the first sightings were not until 2007.
[3.] Elk were historically absent from this area, but were introduced in the 1960s or early 1970s and have become increasingly common on the property over the past decade.

POLLINATORS/FLORAL VISITORS: BEES

Dave and Emma Gardner and Harold Ikerd gathered data on the abundance and diversity of bees in four plots, two on South Hollow as well as two on adjacent USFS lands. Colored (blue, yellow, white) dessert cups with water and a small amount of detergent were laid out at regular (~4') intervals in an X within the plot for several hours. Bees captured in the cups were identified by Harold Ikerd of Agricultural Research Services Bee Laboratory.

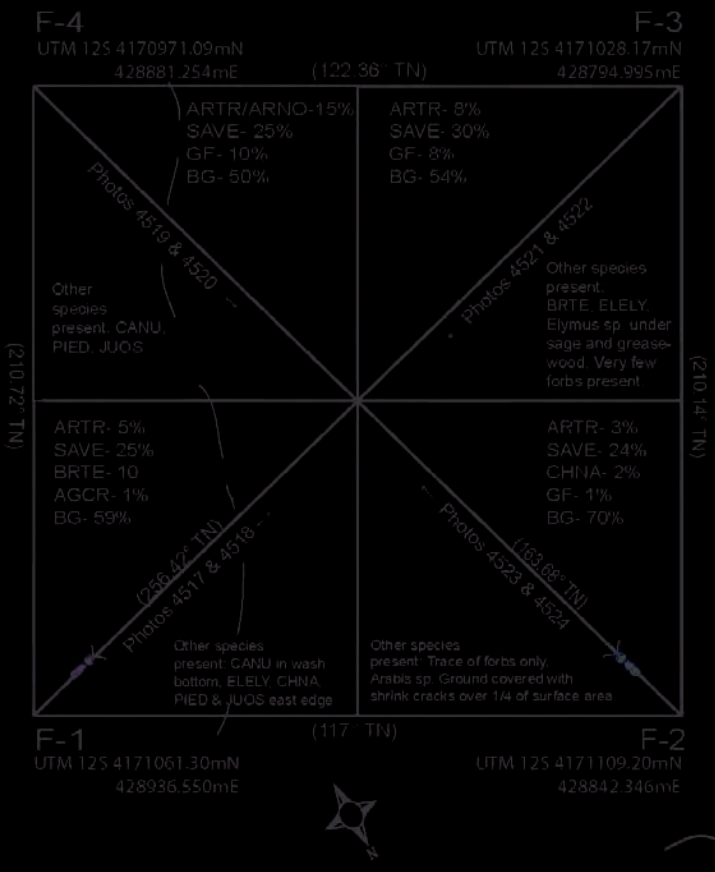
Figure 4 shows the locations of the pollinator plots followed by photographs and vegetative characteristics of each plot. Table 3 summarizes the frequency of bee genera captured in each plot

Figure 5. Pollinator plots and vegetation transects at South Hollow


F
P73
P4
WM
Boundaries (approx)
Bramble
USFS
BeePlots
Vegetation Community Type
Alkaline Wet Meadow
Crested wheatgrass grassland
Herbaceous wetlands
Pinyon-juniper
Rabbitbrush Shrublands
Sagebrush Shrublands
Old Field
N
0
375
750
1,500
Feet

South Hollow Bee Plot Characterization
USFS Property- Plot F

Forest Service ownership, N of Bramble Property
Greasewood/Sagebrush
Soil type P4: Alldown loam, alkali, 1 to 2% slopes
Heavy early to late season grazing



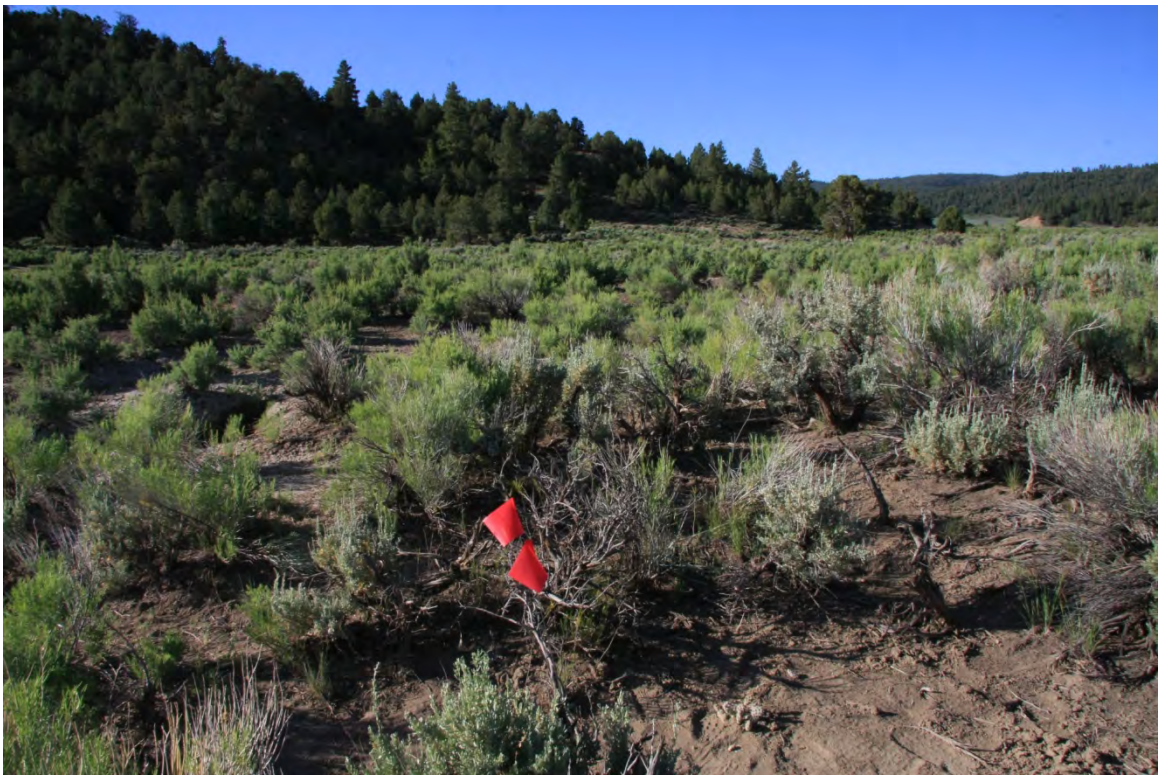
Species Abbrev.	Recorded Species or Note
AGCR	Agropyron cristatum
ARNO	Artemisia nova var. nova
ARTR	Artemisia tridentata var. tridentata
BG	Bare ground
BRTE	Bromus tectorum
CANU	Calochortus nutallii
CHNA	Chrysothamnus naseosus
DW	Dead wood
ELELY	Elymus elymoides
GF	Grass/forb
JUOS	Juniperus osteosperma
PIED	Pinus edulis
SAVE	Sarcobatus vermiculatus

Denotes bee cup trap line

Approx. position of wash

Percent Cover	Q-1	Q-2	Q-3	Q-4	Total % Cover
Shrubs	30	29	38	40	34.25
Grass/Forb	11	1	8	10	7.5
Bare/Litter/Dead wood	59	70	54	50	58.25

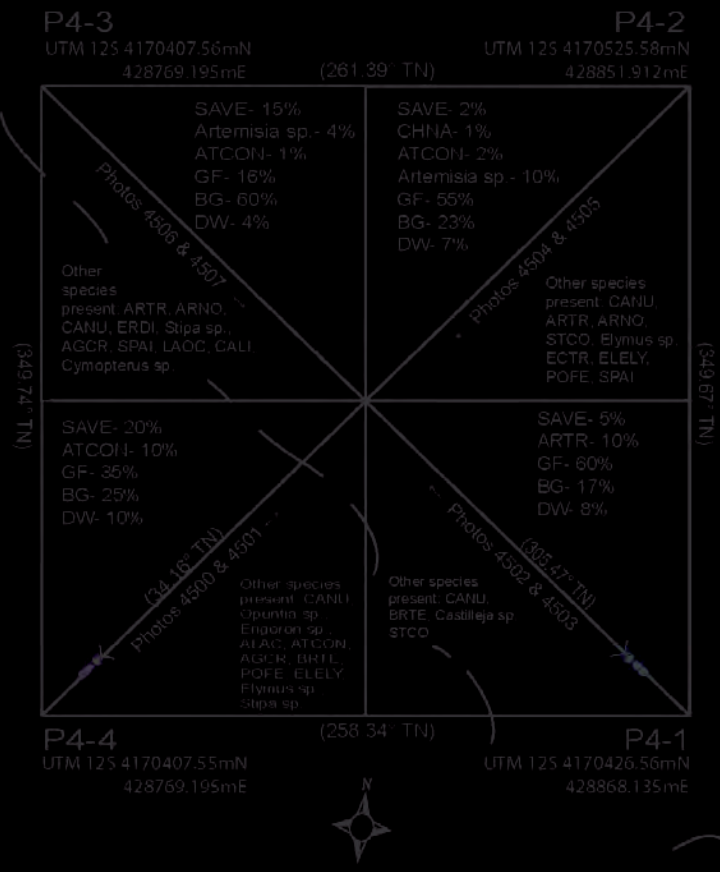
Total Vegetative Cover= 41.75%
Bare/Litter/Dead wood= 58.25%



Vegetation of Bee Plot F

South Hollow Bee Plot Characterization
Bramble Property- Plot P4

East Meadow, west of Howard's Hill
Sagebrush/Greasewood
Soil type P4: Alldown loam, alkali
Autumn grazing only, excluding drought years



Species Abbrev. / Note	Recorded Species or Note
AGCR	Agropyron cristatum
ALAC	Allium acuminatum
ARNO	Artemisia nova var. nova
ARTR	Artemisia tridentata var. tridentata
ATCON	Atriplex confertifolia
BG	Bare ground
BRTE	Bromus tectorum
CALI	Castilleja linariifolia
CANU	Calochortus nutallii
CHNA	Chrysothamnus naseosus
DW	Dead wood
ECTR	Echinocereus triglochidiatus var. melanacanthus
ELELY	Elymus elymoides
ERDI	Erigeron divergens
GF	Grass/forb
LAOC	Lappula occidentalis
POFE	Poa fendleriana
SAVE	Sarcobatus vermiculatus
SPAI	Sporobolus airoides
STCO	Stipa comata

Denotes bee cup trap line

Approx. position of wash

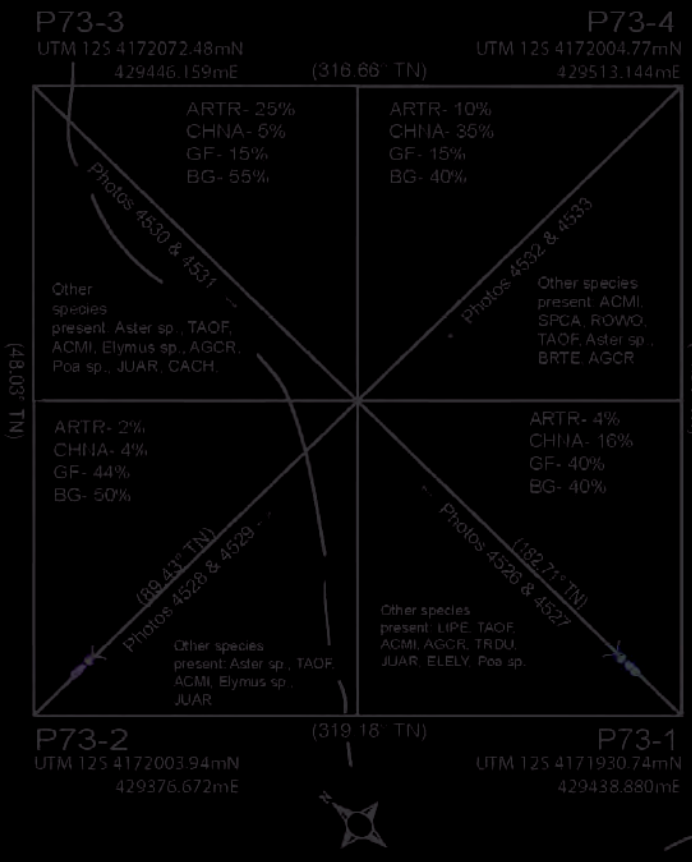
Percent Cover	Q-1	Q-2	Q-3	Q-4	Total % Cover
Shrubs	15	15	20	30	20
Grass/Forb	60	55	16	35	41.5
Bare/Litter/Dead wood	25	30	64	35	38.5

Total Vegetative Cover= 61.5%
Bare/Litter/Dead wood= 38.5%

Vegetation of Bee Plot P4

South Hollow Bee Plot Characterization
USFS Property- Plot P73

Forest Service ground across Highway 54, NE of Bramble Property
Rabbit brush/Sagebrush
Soil type P73: Jodero Loam, moist, 2 to 8% slopes
Heavy early to late season grazing



Species Abbrev. / Note	Recorded Species or Note
ACMI	Achillea millefolium
AGCR	Agropyron cristatum
ARTR	Artemisia tridentata var. tridentata
BG	Bare ground
BRTE	Bromus tectorum
CACH	Castilleja chromosa
CHNA	Chrysothamnus nauseosus
DW	Dead wood
ELELY	Llymus elymoides
GF	Grass/forb
IRMI	Iris missouriensis
JUAR	Juncus arcticus var. balticus
LAOC	Lappula occidentalis
LIPE	Linum perenne
ROWO	Rosa woodsii
SPCO	Sphaeralcea coccinea
TAOF	Taraxacum officinale
TRDU	Tragopogon dubius

Denotes bee cup trap line

Approx. position of wash

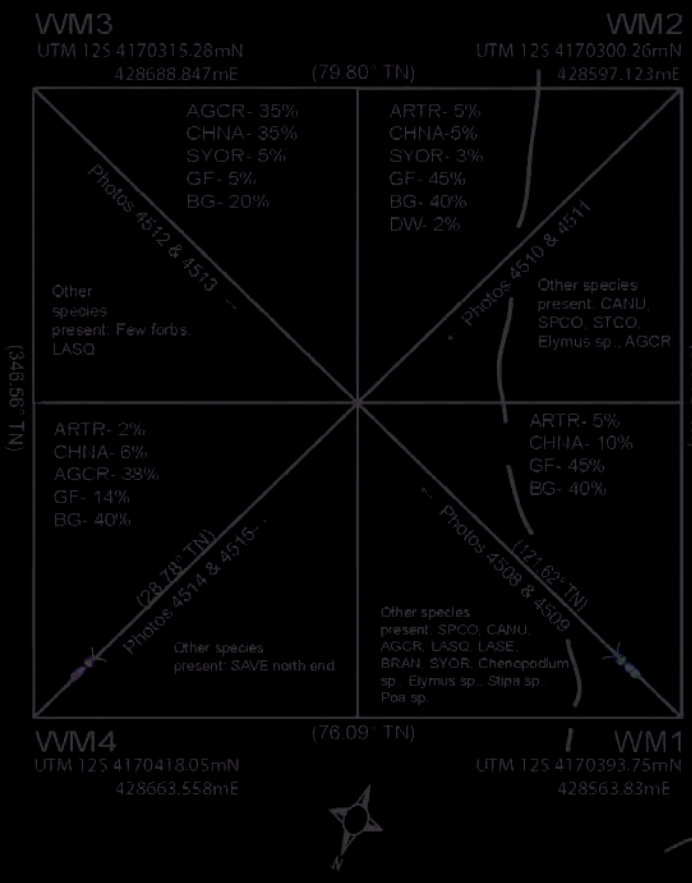
Percent Cover	Q-1	Q-2	Q-3	Q-4	Total % Cover
Shrubs	20	6	30	45	25.25
Grass/Forb	40	44	15	15	28.5
Bare/Litter/Dead wood	40	50	55	40	46.25

Total Vegetative Cover= 53.75%
Bare/Litter/Dead wood= 46.25%

Vegetation of Bee Plot P73

South Hollow Bee Plot Characterization
BRAMBLE PROPERTY- Plot WM

West Meadow, near South Hollow Road
Grass/Forb/Rabbitbrush
Soil type P73: Jodero Loam, moist, 2 to 8% slopes
Autumn grazing only, excluding drought years



Species Abbrev.	Recorded Species or Note
AGCR	Agropyron cristatum
ARTR	Artemisia tridentata var. tridentata
BG	Bare ground
BRIN	Bromus inermus
CANU	Calochortus nutallii
CHNA	Chrysothamnus naseosus
DW	Dead wood
GF	Grass/forb
LAOC	Lappula occidentalis
LASE	Lactuca serriola
SAVE	Sarcobatus vermiculatus
SPCO	Sphaeralcea coccinea
STCO	Stipa comata
SYOR	Symphoricarpos oreophillus

Denotes bee cup trap line

Approx. position of wash

Percent Cover	Q-1	Q-2	Q-3	Q-4	Total % Cover
Shrubs	15	13	40	8	19
Grass/Forb	45	45	40	52	45.5
Bare/Litter/Dead wood	40	42	20	40	35.5

Total Vegetative Cover= 64.5%
Bare/Litter/Dead wood= 35.5%

Vegetation of Bee Plot VM

Table 3. Bee genera in four floral visitor/pollinator plots

Genus	**F Plot (USFS) Greasewood/ sagebrush**	**P4 Plot (South Hollow) Sagebrush/ greasewood**	**P73 Plot (USFS) Rabbitbrush/sagebrush**	**WM Plot (South Hollow) Grass/forb/rabbitbrush**
	8 bee species	**9 bee species**	**15 bee species**	**11 bee species**
Agapostemon		3	6	8
Anthidium			1	
Ceratina (total)	10	16	152	7
C. nanula	*9*	14	151	6
C.eratina neomexicana	1	2	1	1
Diadasia			1	
Eucera		1		2
Halictus	2		3	1
Heriades	1	1	1	
Hoplitis	1		1	
Hylaeus			10	10
Lasioglossum (total)	12	45	129	43
L. dialictus sp.	12	43	121	36
L. Lasioglossum sisymbri		1	5	2
L. Lasioglossum sp.		1	3	5
Lithurgus			1	
Megachile				1
Osmia	1			
Perdita	26	38	1	22
Sphecodes			1	

Notes by Harold Ikerd:

Plot P73 with 15 species had more bare ground and more plant species. One magnet plant might be drawing numerous bees.

Also, this was just a one-time collection event. Bees partition resources in time as much if not more than they do space. An example is the species for which only one individual was seen. They could be flying through, just emerging, or the last of the season

Ceratina nanula (151 individuals caught in Plot P73) is a pith specialist. *Ericameria nauseosa* (rubber rabbitbrush) may be providing the pith. Rubber rabbitbrush is not palatable for cattle, but many of the plants showed signs of grazing.

Lasioglossum dialictus sp. is also present in large numbers in Plot P73. It is an early colonoizer generalist, meaning it will go to any plant with pollen and/or nectar and tend to show no constancy to one plant species. If bowls were set in a parking lot, you would expect to see *Dialictus* sp. in the traps.

Early colonizer generalists have very plastic life histories that range from solitary to semi-social, sometimes within the same species.

The only specialist that we caught was *Diadasia* which is a *Sphaeralcea* (mallow) or *Opuntia* (cactus) specialist. It was likely a mallow specialist, as mallow was in all four of the plots. The *Diadasia* individual we caught was a male. Females will probably only visit the bowls looking for nectar when they have their preferred flower present. They visit flowers for pollen hundreds of times for a single visit to a flower for nectar.

The *Perdita* species we caught may or may not be a specialist but *Perdita* species tend to be much more limited than any other genera that we caught. Many *Perdita* have a foraging range of 10 meters as some just nest in the ground at the base of their preferred pollen and nectar source.

Finally, some bees will show a preference (constancy) to the flower species they first learn to work, or to the flower that is in the majority at a particular time in the season, and thus overlook the flowers of any other species.

Stark open areas can lead to great bee catches. For example, bowls set in a denuded salt flat can still have a good catch because bees flying through need nectar to keep going.

ANTS

The mounds of western harvester ant (*Pogonomyrmex occidentalis*) are among the most conspicuous natural features on the landscape of the South Hollow Reference Area. As the name suggests, harvester ants are dietary specialists whose primary food source consists of plant seeds that the workers collect through active foraging in the areas surrounding the colony. These insects are the focus of long-term studies aimed at gaining a better understanding of their role in the ecological dynamics of healthy rangelands on this part of the Colorado Plateau. As a consequence of this work, over 300 individual colonies of this ant have been identified, marked, and geo-referenced on the private land in South Hollow and a substantial number of additional colonies were located on the adjacent Forest Service land by Whitman College students in September 2010. In all, this represents one of the largest monitored populations of this widely distributed ant in the United States (Fig. 5).

Many of the sites currently occupied by harvester ants in South Hollow appear to be surprisingly old, very probably predating the first introduction of livestock in 1880s. Several lines of evidence likewise suggests that the lifespan of the queen of this species may be 50 years or more, which, if confirmed, would make these the longest lived insects known. *P. occidentalis* creates a very distinctive colony consisting of a large central mound, covered by gravel, and surround by a large "cleared zone" (CZ) from which all vegetation is actively excluded (see below)

Mature Harvester Ant Colony With Indian Rice Grass Border

Harvester ants thus provide a long-term, stable microhabitat that supports a substantial fraction of the South Hollow Indian grass population. Other observations indicate that these insects and the physical conditions

generated and maintained by them in the immediate vicinity of their colony can provide an initial port of reentry for other native grasses (e.g., western wheatgrass) into areas otherwise dominated by crested wheatgrass, a Eurasian species seeded into South Hollow in the 1940s and millions of acres of degraded rangeland elsewhere in the Intermountain West beginning in the 1930s (see below).

Harvester Ant Colony Supporting Native Grasses in Sea of Crested Wheatgrass

It is hypothesized that harvester ants may help maintain plant local diversity by selectively increasing predation (i.e., seed harvesting) on any species that begins to dominate the plant community. Future studies will be required to see if the ants in South Hollow support this idea.

The initial survey of harvester ant colonies on the FS land adjacent to the SH restoration project points to decidedly lower densities of this insect. Because the physical conditions (soil, temperature, precipitation) of the two areas do not differ, the most likely explanation for the difference in population density is management history. The FS land was plowed and seeded with crested wheatgrass in the late 1960s. This "treatment" was intended to improve range conditions and grazing opportunities by reducing woody shrubs (primarily sagebrush) and increasing grass production. The area has since been grazed annually at medium to high levels during the warm season and the grass flora continues to be a near monoculture of crested wheatgrass, with little or no contribution from native species. Historic aerial photographs taken shortly before the "treatment" show that the density of harvester ant colonies on the FS land was at least as high as that on the private land in South Hollow. Plowing appears to have killed most of these colonies and their numbers have not recovered in the ensuing half-century.

The Dixie NF pasture on which the Whitman students surveyed ant colonies is grazed every other year in the early summer, which effectively eliminates the crested wheat seed crop for that year. Because this is the only grass of any consequence on the pasture, the food supply available to harvester ants is severely diminished in

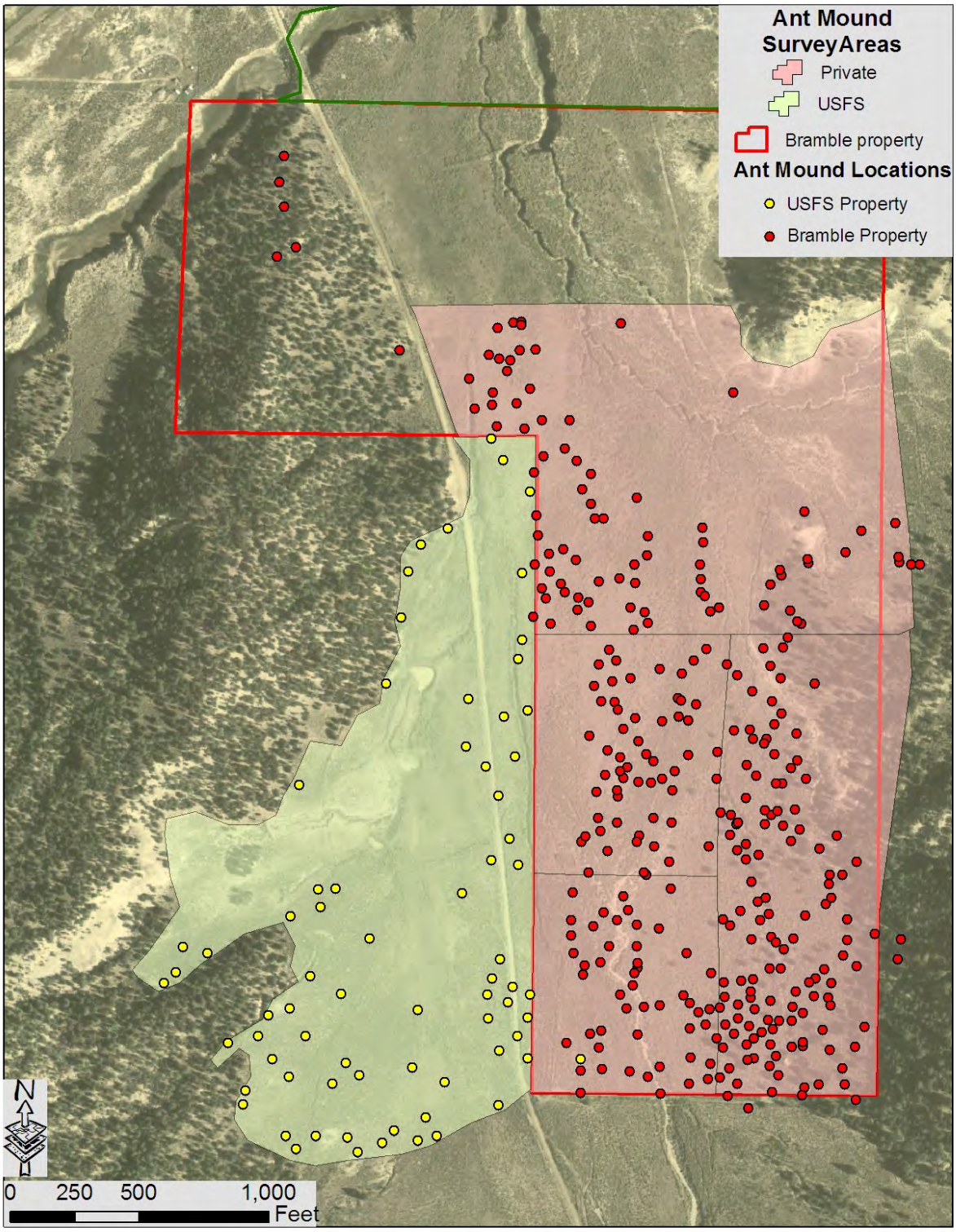
alternate years. Grazing-induced restriction on food supply may be one of the primary explanations for why harvester ant densities remain relatively low on the Forest Service land. Another grazing-related factor is physical damage to harvester ant mounds through trampling. Harvester ants are extremely protective of their mounds which, during the growing season, contain chambers for seed storage ('granaries") and nurseries for developing brood. Repair of damage to the mound immediately becomes a top priority for the colony, and tens of thousands of worker hours may be devoted to this task. Physical damage to colonies by trampling on the FS property is common during the growing season and must therefore reduce the time and energy available for food procurement. This problem is considerably less on the restoration site because stocking rates for cattle are modest and grazing takes place in the fall after most of the seed harvesting by ants has been completed. A growing elk population is now increasing the incidence of trampling on ant mounds in South Hollow, but damage is restricted to the early spring and late fall when ant activity is minimal (due to low ground temperatures).

Finally, harvester ants are an important food source for many invertebrate (e.g., spiders) and vertebrate predators. Short-horned lizards (*Phrynosoma hermandesi*) are known to be harvester ant specialists in terms of dietary preference and their local population is probably most affected by the abundance of this ant. The short-horned lizard is commonly encountered on the southern half of the restoration site where ant colonies are abundant, but it appears to be fairly rare on the neighboring FS land. Likewise, red-shafted flickers (*Colaptes auratus cafer*) target harvester ant colonies for feeding during the fall, a time of year when lower ground and air temperatures slow the movements of worker ants, likely making it easier for the birds to capture them.

The mounds of western harvester ant (*Pogonomyrmex occidentalis;* Fig. 6) are among the most conspicuous natural features on the landscape of the South Hollow Reference Area. As the name suggests, harvester ants are dietary specialists whose primary food source consists of plant seeds that the workers collect through active foraging in the areas surrounding the colony. These insects are the focus of long-term studies aimed at gaining a better understanding of their role in the ecological dynamics of healthy rangelands on this part of the Colorado Plateau. As a consequence of this work, over 300 individual colonies of this ant have been identified, marked, and geo-referenced on the private land in South Hollow and a substantial number of additional colonies were located on the adjacent Forest Service land by Whitman College students in September 2010. In all, this represents one of the largest monitored populations of this widely distributed ant in the United States

Many of the sites currently occupied by harvester ants in South Hollow appear to be surprisingly old, very probably predating the first introduction of livestock in 1880s. Several lines of evidence likewise suggest that the lifespan of the queen of this species may be 50 years or more, which, if confirmed, would make these the longest-lived insects known. *P. occidentalis* creates a very distinctive colony

Figure 6. Ant mound locations and survey areas in and around South Hollow



South Hollow Bioblitz Ant Identification

Excerpted from a report by Donald H. Feener Jr. & Adrian T. Feener

Ants were collected at the South Hollow private property during a BioBlitz on June 24-26, 2010. We focused our collecting in three areas on or near South Hollow, which included the South Upland area (pinyon-juniper woodland), Thistle Basin (herbaceous wetland) and Indian Hills (pinyon-juniper forest). All collecting was done by hand at nest entrances, in foraging areas, under litter, wood or rocks, or at baits consisting of crumbled Pecan Sandies cookies. A total of 10-15 species of ants were collected.. Tentative genus and species identifications are listed below and are divided into the three areas we examined.

Fig. 7. Typical ant mound on South Hollow property.

South Upland area

Pogonomyrmex occidentalis (Subfamily Myrmicinae). Very common in this area at widely spaced nest sites. Restricted to open areas. Dennis Bramble has studied marked colonies of this species for several years. Common throughout the Intermountain West.

Myrmica? Sp. (Subfamily Myrmicinae). Could be one of several species.

Monomorium minimum (Subfamily Myrmicinae). Very small black ant collected at baits in sagebrush scrub. Common throughout the Intermountain West.

Dorymyrmex insanus (Subfamily Dolichoderinae). Very common in open areas at crater-shaped nest mounds. Highly predaceous. Collected with termite prey. Common throughout the Intermountain West.

Camponotus modoc (Subfamily Formicinae). Nest in tree stump in front of cabin. Large black species. Common throughout the Intermountain West.

Camponotus sp. (Subfamily Formicinae). Reddish brown species, probably *C. vicinus*.

Formica sp. (Subfamily Formicinae). Large red and black thatch mound-building species. Common in closed-canopy area behind cabin.

Formica/Lasius sp. (Subfamily Formicinae). Medium size black species found in more shaded areas.

Thistle Basin area

Myrmica? Sp. (Subfamily Myrmicinae). Nesting and foraging in extremely water saturated area. Seems unusual to us.

Formica spp. (Subfamily Formicinae). One to several species all black. One species builds soil mounds that may serve as colonization sites for particular plant species in low-lying areas. The same or a similar species tends spittle bugs on vegetation.

Indian Hills area

Camponotus spp. (Subfamily Formicinae). Two species collected as lone foragers in close proximity to one another. Different species from those collected in Upland South area.

Formica sp.? (Subfamily Formicinae). Medium size black species collected from nest under rock.

The admittedly brief and incomplete survey of the ant species of the Bramble Ranch indicate a fauna that is typical of higher elevation areas in the Intermountain West, with the Formicine genera *Camponotus* and *Formica* being the most diverse. A more comprehensive survey would likely yield close to 20 species total.

Areas that were subjected to continual grazing pressure were not surveyed in the June survey, so conclusions were not drawn as to whether grazing has any impact on ant diversity and abundance. These comparisons are hoped to be studied in the near future. It is recommended that pitfall trap lines be developed along transects that were established for the bee surveys in grazed and ungrazed areas in order to measure the impact of grazing on montane ant communities.

SNAILS

Excerpted from report by J. H. Hutchison, P.O.Box 261, Escalante, UT 87726; howard.hutchison@gmail.com

Dates of primary survey: 24-26 June 2010. Previous records also included. GPS standard: NAD 27 (degrees, minutes decimal) or NAD 83 (degrees decimal and Degrees, minutes, seconds)

Evidence of mollusks was found on all the areas of the study area except Area 8 (See Figure 5) where the collected samples yielded no snails. The East Meadows (Area 4) and the southern part of the West Meadows (Area 3) yielded *Catinella* sp. and other taxa on the surface but no live or fresh specimens were found and these appear to be exhumed pre-settlement and early post-settlement records and indicate that these areas were previously moist to wet meadows. The presence of live *Catinella* sp. in Thistle Basin (Area 6) may represent a relict population of this once widespread snail. The only specimens of *Oreohelix srigosa* were found in Area 7 and were old; this taxon may be extinct now in the study area.

Living specimens occur in the lower parts of the Upper Valley.

Taxa sampled are represented by dead shells unless otherwise noted.

Areas surveyed: Dennis Bramble property (South Hollow) and adjacent Dixie National Forest to the north, east and south. See Figure 1 and text for numbered (1-12) area definitions. DMB = Bramble property; NFS = Dixie National Forest.

1. Indian Hill (DMB)
2. (E) East and (W) West Riparian (NFS)
3. East Meadows (DMB, NFS)
4. West Meadows (DMB, NFS)
5. East meadows slopes (DMB, NFS)
6. Thistle Basin (NFS)
7. East Side Hills and Ridges (NFS)
8. Developing Meadow, the Blowout and Flats South of Howard's Hill (DMB, NFS)
9. Old Field (DMB)
10. South uplands (DMB)
11. East Uplands (DMB, NFS)
12. Hobbit (NFS)and Alvey Springs (DMB)
13. Willow Spring Run (NFS)

Area by area results:

AREA 1.

Site 1 (10H6-24-7): 37.67682N; 111.81105W. Litter/soil under old patch of Gamble oak on the upper slope of Indian Hill.

Taxa found: Gastropods - 2 *Vallonia cyclophorella.*

Site 2 (10H6-24-9): 37.67747N; 111.811595W. Litter/soil under Alderleaf Mountain Mahogany on the upper slope of Indian Hill.

Taxa found: Gastropods - *Vallonia cyclophorella.*

Site 3 (09H6-24-4): 37°41.752N; 111 ° 48.614W. Drift deposit on west side of Upper Valley wash culvert.

Taxa found: Gastropods – *Vallonia cyclophorella*.

AREA 2 E.

Site 1 (08H8-16-1): 37°41.052N; 111 ° 48.444W. Litter under rabbitbrush, sagebrush and grass on slope above flood level on north talus bank of Upper Valley wash.

Taxa found: Gastropods – *Vallonia cyclophorella, Catinella* sp., and juvenile *Pupilla* sp..

Site 2 (09H6-23-2): 37°40.949N; 111 ° 48.486W. Drift in Upper Valley wash.

Taxa found: Gastropods – *Vallonia cyclophorella.*

Site 3 (09H6-25-8): 37.68345 N; 111.80758W. Litter in rushes in Upper Valley wash.

Taxa found: Pelecypods – *Pisidium* sp.

AREA 2 W.

Site 1 (09H6-26-5): 37.68012; N; 111.81241W. Base of rushes in wet meadow on west side of culvert over Upper Valley wash near west fence.

Taxa found: Gastropods – live *Catinella* sp., *Fossaria* sp., and Pelecypods – *Pisidium* sp.

Site 2 (09H10-29-2): 37°40.7459N; 111 ° 48.798W. Drift in Upper Valley wash on grass bottom, west of the west fence.

Taxa found: Gastropods – *Vallonia cyclophorella, Pupilla sp*., juvenile *Catinella* sp

Site 3 (09H6-26-6): 37.68083N; 111.81154W. In algae on west side of culvert over Upper Valley wash.

Taxa found: Pelecypods – *Pisidium* sp.

AREA 3.

Site 1 (08H7-29-10): 37°40.803N; 111 ° 48.656W. Litter near area of rose bushes.

Taxa found: Gastropods – *Vallonia cyclophorella, Catinella* sp.

Site 2 (09H7-5-1): 37°40.895N; 111 ° 48.527W. Litter near area of rose bushes.

Taxa found: Gastropods – *Vallonia cyclophorella, Catinella* sp.

Site 3 (09H10, site 1): 37°40.701N; 111 ° 48.527W.

Taxa found: Gastropods – *Catinella* sp.

Site 4 (09H10, site 2): 37°40.814N; 111 ° 48.504W.

Taxa found: Gastropods – *Catinella* sp.

AREA 4.

Site 1 (08H7-16-4): 37°40.687N; 111 ° 48.401. Soil under greasewood on flats above the Upper Valley gorge –probably pre-settlement residue.

Taxa found: Gastropods – *Pupilla muscorum, Vallonia cyclophorella,* abundant *Catinella* sp.

AREA 5.

Site 1 (08H7-29-2): 37°40.776N; 111 ° 48.257W. From black ant hill

Taxa found: Gastropods – *Catinella* sp.

Site 2 (08H7-29-3): 37°40.768N; 111 ° 48.264W. From small grassy area

Taxa found: Gastropods – *Catinella* sp.

Site 3 (08H7-29-4): 37°40.739N; 111 ° 48.283W. From grassy hillside around a dead ponderosa pine.

Taxa found: Gastropods – *Catinella* sp.

Site 4 (08H7-29-5): 37°40.785N; 111 ° 48.251W. Under greasewood and black sagebrush.

Taxa found: Gastropods – *Catinella* sp.

AREA 6.

Site 1 (10H6-7-6): 37.68174N; 111.80850W. Muck under rushes in north part of Thisle Basin.

Taxa found: Gastropods – *Vallonia cyclophorella, Catinella* sp., *Pupilla blandi,* abundant *Fossaria sp.*

Site 2 (10H6-7-7): 37.68195N; 111.80843W. Muck under sedges in north part of Thistle Basin.

Taxa found: Gastropods –*Catinella* sp.

Site 3 (10H6-7-8): 37.68217N; 111.80902W. Muck under rushes in north part of Thisle Basin..

Taxa found: Gastropods – *Vallonia?* sp., *Fossaria* sp.

AREA 7.

Site 1 (08H7-29-1): 37°40.716N; 111 ° 48.228W. In pinyon pine and juniper on east side of Howard's Hill

Taxa found: Gastropods – *Oreohelix strigosa* (old)

AREA 8.

Site 1 (DMB observ.): 37°40'33.9"N; 111 ° 48'19.9W. Sagebrush.

Taxa found: Gastropods –*Catinella* sp.

Site 2 (DMB observ.): 37°40'33.8"N; 111 ° 48'19.7W. Sagebrush.

Taxa found: Gastropods –*Catinella* sp.

AREA 9.

Site 1 (10H6-7-5): 37.67391N; 111.80466W. Litter under small dead sagebrush or greasewood.

Taxa found: Gastropods – abundant *Catinella* sp. and 1 *Pupilla* sp.

AREA 10.

Site 1 (08H11-1-4): 37°40.168N; 111 ° 48.365W. From drift deposit on east side of wash near fence line.

Taxa found: Gastropods – *Vallonia cyclophorella and Pupilla* sp.

Site 2 (09H8-4-1): 37°40.167N; 111 ° 48.2485W. From drift deposit in wash SE of cabin on edge of juniper-pinyon and pondersosa pine area.

Taxa found: Gastropods – *Vallonia cyclophorella*

AREA 11.

Site 1 (09H10-11-1): 37°40.308N; 111 ° 48.306W. From drift deposit in area of sagebrush and greasewood.

Taxa found: Gastropods – *Vallonia cyclophorella and Pupilla* sp.

AREA 12.

Site 1 (10H6-7-2) Alvey Spring 37.67314N; 111.80367W. Seep with grass and false Solomon seal under a Pinyon pine.

Taxa found: Gastropods - abundant *Pupilla blandi* (some live), 1 *Vallonia cyclophorella,* Pelecypods – 1 *Pisidium* sp. (probably washed down from above)

Site 2 (10H6-7-3) Hobbit Spring 37.67314N; 111.80176W. Grasses of north side of Hobbit Spring pond.

Taxa found: Pelecypods – *Pisidium* sp. Ostracoda

Site 3 (10H6-7-4) Hobbit Spring Sample 37.67314N; 111.80176W. Litter under water birch on east side of Hobbit Spring pond.

Taxa found: no mollusks

Site 4 (10H6-7-1) Alvey Spring: 37.67300N; 111.80336W. Under sedge at Alvey Spring flat.

Taxa found: Gastropods – *Catinella* sp..

Site 5 (10H6-24-3) Alvey Spring: 37.67298N; 111.80332W. In pond at Alvey Spring.

Taxa found: Pelecypods – *Pisidium* sp. common.

Site 6 (10H6-24-4) Alvey Spring: 37.67298N; 111.803325W. Soil/litter under roses on slope immediately east of Alvey Spring pond

Taxa found: Gastropods - *Vallonia cyclophorella*

Site 7 (08H11-1-1): 37°43.392N; 111 ° 48.103W. From Hobbit Spring area under fallen branches and under rose

Taxa found: Gastropods – *Pupilla sp., Vallonia cyclophorella, Microphysula ingersolli* sp..

Site 8 (09H10-31-1): 37°40.544N; 111 ° 48.022W. From Hobbit Spring "fault" below pinyon and oak.

Taxa found: Gastropods –*Vallonia cyclophorella*

Site 9 (09H10-31-3): 37°40.483N; 111 ° 48.000W. Drift deposit from east of Hobbit Spring along a small spring fed creek.

Taxa found: Gastropods –*Vallonia cyclophorella*

Site 10 (09H10-31-5): 37°40.387N; 111 ° 48.105W. Litter under water birch and fir just east of Hobbit Spring.

Taxa found: Gastropods – *Pupilla sp., Vallonia cyclophorella*

Site 11 (10H6-25-4) 37.67316N; 111.80026W. Wet meadow east of Hobbit Spring pond

Taxa found: Pelecypods – *Pisidium* sp.

Site 12 (10H6-25-5) 37.67306N; 111.80243W. Litter under Utah serviceberry, Wood's rose, water birch, and oak west of Hobbit Spring pond

Taxa found: Gastropods – *Pupilla blandi, Vallonia cyclophorella*

AREA 13. Willow Spring run

Site 1 (09H6-23-3): 37°40.885N; 111 ° 48.487W. From drift deposit Willow Spring creek

Taxa found: Gastropods – *Vallonia cyclophorella, Fossaria* sp*., Pupilla* sp., and juvenile *Microphysula?*

Site 2 (09H6-25-7): 37.68078; 111.80798W. Litter under moss, rushes, and willow on bank of Willow Spring creek

Taxa found: Gastropods – *Catinella* sp.

Taxa found in general study area of South Hollow Bioblitz.

Summary of taxa found by area. * indicates live specimens or clearly fresh shells.

1. Indian Hill: *Vallonia cyclophorella**.

2E. East Riparian: *Vallonia cyclophorella, Pupilla* sp., *Catinella* sp.*, *Pisidium* sp.*

2W. West Riparian: *Vallonia cyclophorella, Pupilla* sp., *Catinella* sp.*, *Fossaria* sp.*, *Pisidium* sp.*

3. West Meadows: *Vallonia cyclophorella, Catinella* sp.

4. East Meadows: *Vallonia cyclophorella, Pupilla muscorum*, *Catinella* sp.

5. East meadows slopes: *Catinella* sp.

6. Thistle Basin (NFS): *Vallonia cyclophorella*, Pupilla blandi**, *Catinella* sp.*, *Fossaria* sp.*

7. East Side Hills and Ridges: *Oreohelix strigosa*

8. Developing Meadow, the Blowout and Flats South of Howard's Hill: *Catinella* sp.*

9. Old Field: *Pupilla* sp., *Catinella* sp.

10. South uplands: *Vallonia cyclophorella, Pupilla* sp.

11. East Uplands: *Vallonia cyclophorella, Pupilla* sp.

12. Hobbit (NFS)and Alvey Springs (DMB): *Vallonia cyclophorella*, Pupilla blandi**, *Catinella* sp.*, *Fossaria* sp*., *Microphysula ingersolli**, *Pisidium* sp*.

13.Willow Spring Run *Vallonia cyclophorella*, Pupilla* sp., *Catinella* sp.*, *Fossaria* sp.*, *Microphysula?*

SUMMARY OF TAXA FOUND IN STUDY AREA (*live or fresh specimens found)

Class Gastropoda

Subclass Pulmonata Cuvier 1807

Order Geophila Férussac 1812

Suborder Orthurethra Pilsbry 1900

Superfamily Pupilloidea Turton 1831

Family Valloniidae Morse 1864

Vallonia Risso 1826

Vallonia cycloporella Sterki 1892*

Family Pupillidae Turton 1832

Pupillinae Turton 1831

Pupilla Leach (in Fleming) 1828

Pupilla blandi Morse 1865*

Pupilla muscorum (Linnaeus 1758)*

Suborder Heterurethra Pilsbry 1900

Superfamily Succineoidea Beck 1837

Family Succineidae Beck 1837

Catinella sp.*

Suborder Sigmurethra Pilsbry 1900

Infraorder Aulacopoda Pilsbry 1896

Superfamily Limacoidea Rafinesque 1815

Family Vitrinidae Fitzinger 1833 (=Zonitidae Mörch 1864) indet.

Infraorder Holopoda Pilsbry 1896

Superfamily Mesodontoidea Tryon 1866

Family Thysanophoridae Pilsbry 1926

Oreohelicinae Pilsbry 1939

Oreohelix strigosa (Gould) 1846

Thysanophorinae Pilsbry 1926

Microphysula ingersolli (Bland) 1875*

Order Basommatophora

Family Lymnaeidae

Fossaria sp.*

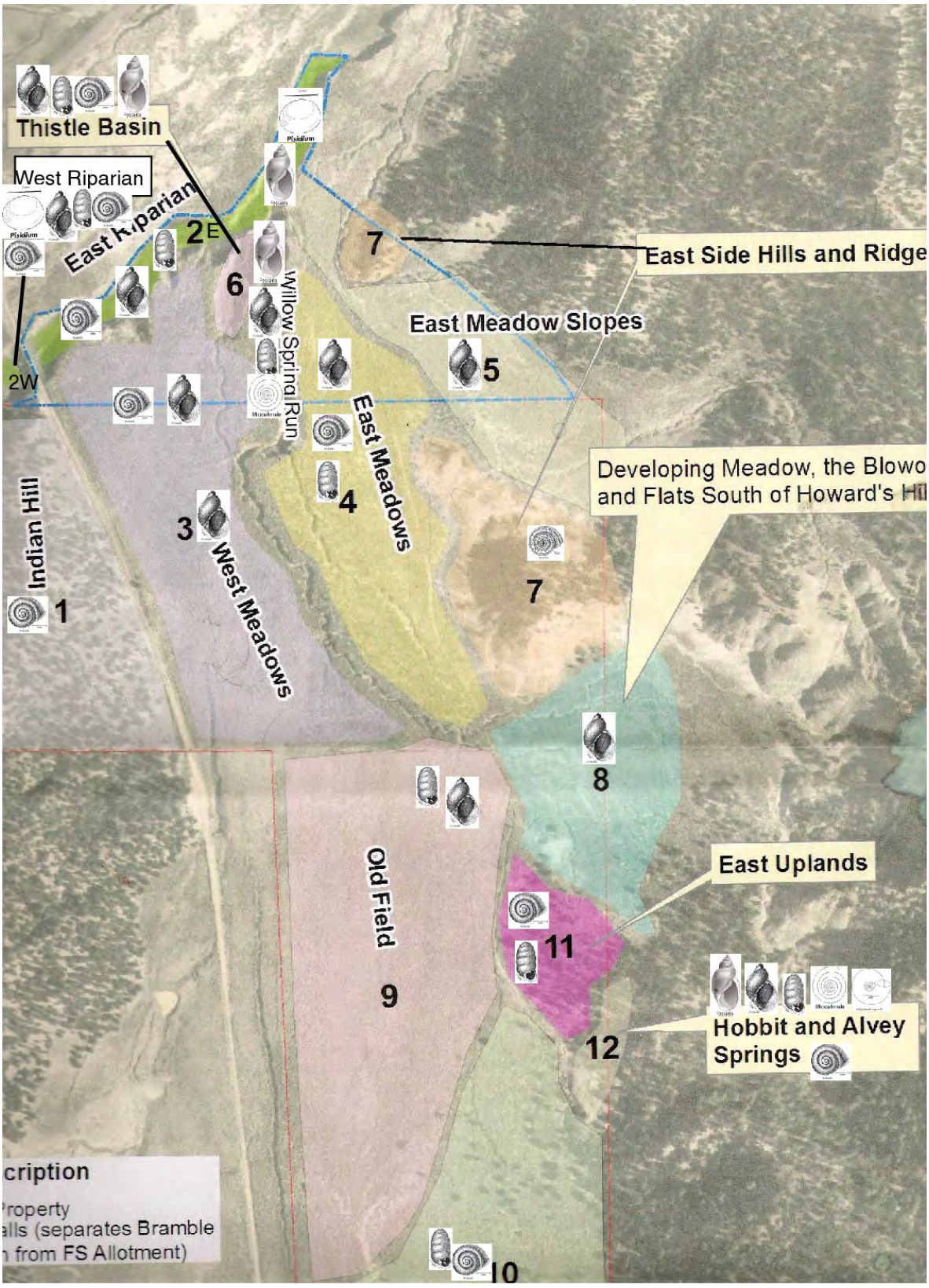
Class Bivalvia

Order Veneroidea

Family Sphaeriidae

Pisidium sp.*

Figure 8. Pictorial of diversity of snails at South Hollow



MACROINVERTEBRATES

Macroinvertebrate sampling was done by Sarah Gerould and Dennis Bramble on June 23 and 24, 2010 on South Hollow and adjacent property.

Method: Several samples were taken at different sites along permanent aquatic habitats located on Upper Valley Creek; its spring-fed tributary, Willow Spring Run; and a sizeable pool associated with Hobbit Spring, an isolated perched water source on the northeast edge of South Hollow. At each location, bottom sediments were dredged and the contents spread on a white plate where living macro-invertebrates could be examined and identified either by eye or with hand lens magnification. At sites with rocky bottoms, several stones were removed for a search of animals clinging or attached to the surface, generally the undersurface.

Figure 9. Macroinvertebrate sample

East Riparian (South Hollow)

Upper Valley Creek

Sample 1 location: 37º 40’55.66”N; 111º 48’36.23”W

Habitat: Muddy bottom with abundant aquatic vegetation (rushes/ sedges); low gradient without riffles and pools; fairly shallow channel.

Macroinvertebrates

Odonata: dragonfly larva

Diptera: midge larvae (Chironomidae)

Comments: Depauperate fauna

Sample 2 location: 37º 41'00.78"N; 111º 48'29.82"W

Habitat: Narrow, deep channel with overhanging vegetation (mostly rush, some sedge and grass); riffles and pools

Macroinvertebrates

Ephemeroptera: mayfly nymph (possibly two types)

Odonata: damselfly nymph (two types)

Coleoptera: water beetles (three types based on size): one is a Hydrophilidae

Trichoptera: caddisfly larvae (abundant)

Diptera: blackfly larvae (very common); midge larvae (Chironomidae)

Comment: Sample 2 had more abundant and diverse fauna than Sample 1 site. Most likely reason is the more complex structure of the channel but also this site is just downstream from the confluence with Willow Spring Run. Input from this water source may influence chemistry, temperature and organic content of the stream at this sample site.

Willow Spring Run (South Hollow)

Location: Perennial spring above the confluence with Upper Valley Creek (37º 40'54.40"N; 111º 48'31.21"W)

Habitat: Strong flowing spring run with abundant aquatic vegetation (mostly rushes, algae) and banks lined with coyote willow, grasses and various forbs. Small riffles and bottom of alternating stretches of sandy silt and rocks or small cobbles.

Macroinvertebrates

Bryozoa: colonial bryozoan

Ephemeroptera: mayfly nymphs (common) (two types)

Oligochaeta: unidentified segmented worm

Nematoda: unidentified round worm

Trichoptera: caddisfly larvae (abundant) stone-case builder

Diptera: blackfly larvae (common); gnat larvae; horsefly larva

Comment: Diversity and abundance of macro-invertebrates relatively high. This spring run has a very high mineral content and many bottom structures (*e.g.*, rocks ,pebbles and bases of rushes) are cemented together.

West Riparian (USFS)

Sample 1 Location: Upper Valley Creek (37º 40'50.17"N; 111º 48'45.40"W)

Habitat: Muddy bottom with some small rocks: relatively wide and shallow channel; aquatic vegetation chiefly rush and some algae, but not densely vegetated.

Macroinvertebrates

Oligochaeta: unidentified segmented worm

Arcarina: Mite

Diptera: blackfly larvae (common); midge larvae (Chironomidae)

Comments: Relatively low diversity due to simple bottom and relatively low stream gradient.

Sample 2 Location: Upper Valley Creek (37º 40'49.25"N; 111º 48'45.15"W)

Habitat: Complex bottom with large rocks and fairly high stream gradient with turbulence; riffles and pool system; aquatic vegetation common (mostly rush) but not overhanging water; channel relatively wide but not deep.

Macroinvertebrates

Oligochaeta: unidentified segmented worm

Odonata: damselfly larvae

Neuroptera: unidentified Dobsonfly or fishfly

Trichoptera: caddisfly larvae (abundant); two types – *i.e*., stone-case (dominant) and sand-case forms

Coleoptera: water beetles (abundant – adults & larvae); at least two types (Hydrophilidae and possibly Elmidae)

Diptera: blackfly larvae (very abundant); midge larvae (common) (Chironomidae)

Comment: Relatively high diversity and abundance related to complex bottom structure and high stream gradient.

Hobbit Spring (Lower South Hollow #3)

Location: (37º 40'22.76"N; 111º 48'09.15"W)

Habitat: Large, shallow spring-fed pond on north facing bench; surrounded by abundant aquatic vegetation (algae – some calcareous?; sedges and rushes) and bordered by large water birch, Douglas fir and stands of Wood's rose.

Macroinvertebrates

Ephemeroptera: mayfly larvae (abundant; possibly Siphloneuriae)

Odonata: dragonfly larvae; adult dragonflies & damselflies (ovipositing)

Plecoptera: stonefly exuvium(?)

Coleoptera: water beetles (adults); small species

Diptera: mosquito larvae (abundant – all stages; some adults) Culicidae

Copepods

Comment: Reasonable diversity but abundance less than might be expected given the fairly large size of this pool, shaded conditions, and dense protective vegetation surrounding much of it. No evidence of amphibian larvae, but they have been observed here in past years.

Recommended future studies:

Our sampling of macroinvertebrates is based on a single point in time and therefore does not capture likely changes in these communities over the year (esp. the warm season). Future work should include multiple samples in different seasons (spring, mid-summer, early fall, winter). At the present time we do not know how South Hollow macroinvertebrate abundance and diversity vary with important physical features of the aquatic environment, particularly temperature and chemistry. Subjectively, Willow Spring Run had the coolest water temperatures of all the sites sampled and perhaps the highest concentration (abundance) of macroinvertebrates, but its water also appeared to have the highest salt content. Thus, additional work will be required to see which, if either, of these physical parameters promotes the relatively abundant macroinvertebrate populations at this site.

Another question deserving future exploration is the impact of land management on aquatic macroinvertebrate communities. The grazed West Riparian site (Sample 2) exhibited surprisingly high diversity but, as already noted, some of this may be attributed to the well-developed riffles and rocky bottom found at this site. These conditions that were not matched elsewhere, including the un-grazed/lightly grazed East Riparian localities. Periodic flash floods, as occurred this August, scour the Upper Valley Creek channel and flood plain. They also deposit considerable quantities of silt and sand that may temporarily suffocate the benthic community. Future studies should examine the time course over which macro-invertebrate communities recover from natural disturbance of this sort and whether fall grazed (or un-grazed) riparian zones are buffered more from flood impact than those grazed during the late spring and summer.

Finally, should Hobbit Spring be protected from livestock, it will be important to track any changes in the aquatic invertebrate assemblage that may be triggered by the decrease in physical disturbance and nutrient inputs associated with livestock utilization of this unusual spring.

CONCLUSION

The Bio-blitz efforts in June of 2010 as well as the data gathered by the 21 students from Whitman College in September of 2010 showed both expected and unexpected results for the South Hollow area and surrounding Dixie NF lands. Differences in vegetation cover and composition on these areas can be seen on aerial photographs in many places. However, it is still essential to gather quantitative data to confirm or reject assumptions on the effects of different forms of land management. The data are also needed to provide a baseline for both areas to effectively monitor trends in the future.

An important message from the Bio-blitz and data gathering and analysis within these areas is there is so much yet to be discovered regarding the effects of different land management approaches. Future monitoring efforts for vegetation, birds, mammals, herpetofauna, macroinvertebrates, and ants will likely yield more informative and pertinent data on the ecological effects of differences in grazing management.

Furthermore, future data gathered within these areas will likely provide important information on how these areas may withstand other stressors such as the projected changes in temperature and precipitation due to climate change.

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APPENDIX A. SOIL TYPES IN AND AROUND SOUTH HOLLOW

The following are short soil descriptions (from Dixie National Forest and USDA Soil Survey, 1976). Runoff and erosion characteristics are based on normal precipitation events throughout the year.

628: Bruman, 20 to 55 percent slopes (Indian Hill)

The Bruman soil is very deep and well-drained and occurs on south facing sideslopes of foothills of Canaan Mountain and the Table Cliff Plateau and formed in residuum and colluvium derived from limestone. The vegetation on this soil type is generally pinyon-juniper woodland. Typically, the surface layer is a gravelly loam about 3 inches thick. The next layer is a very stony sandy clay loam about 7 inches thick. The underlying layer is a very stony sandy loam to 60 inches or more. The soil is strongly calcareous throughout, but has a significant increase in lime below 10 inches. Rock fragments cover about 25 to 75 percent of the surface and are mostly gravels, cobbles and stones. Runoff is high and the hazard of water erosion is moderate.

636: Amalia - Bruman, 5 to 20 percent slopes (Howard's Hill)

This soil unit is on hillslopes, canyon sideslopes and benches in the vicinity of Upper Valley and Canaan Mountain. The vegetation found on this soil type is typically pinyon-juniper woodland. It should be noted that the Amalia soils, and the Bruman soils in this unit are so intricately intermingled that they were not mapped separately at the scale used.

The Amalia soil is very deep and well-drained and formed in residuum and colluvium derived from sandstone. The surface layer is typically a very gravelly loam about 3 inches thick. The subsoil is a very gravelly clay loam about 29 inches thick. The underlying layer is a very gravelly loam to 60 inches or more. The soil is strongly calcareous below 32 inches. Rock fragments cover 30 to 85 percent of the surface and are mostly gravels. Runoff is high and the hazard of water erosion is moderately low.

The Bruman soil is very deep and well-drained and formed in colluvium and residuum derived from sandstone and tertiary volcanic rocks. The surface layer is generally a gravelly loam about 3 inches thick. The next layer is a very stony sandy clay loam about 7 inches thick. The underlying layer is a very stony sandy loam to 60 inches or more. The soil is strongly calcareous throughout, but has a significant increase in lime below 10 inches. Rock fragments cover about 25 to 75 percent of the surface and are mostly gravels, cobbles and stones. Runoff is medium and the hazard of water erosion is moderately low.

P4: Alldown loam, alkali, 1 to 2 percent slopes (North End)

The Alldown soil is very deep and well drained. It occurs on alluvial fans and valley plains and formed in alluvium derived from sandstone and shale. The surface layer is typically a loam about 4 inches thick. The upper 8 inches of the underlying material is a sandy loam, the next 37 inches is a loam and clay loam and the lower part to a depth of 60 inches or more is a sandy clay loam. Runoff is low and the hazard of water erosion is low. The pH ranges from 7.9 at the surface to 11.0 at 4 inches depth.

P73: Jodero loam 2 to 8% slopes (South end)

The Jodero soil is a very deep, well drained loam found on alluvial fans and valley plains formed from alluvium from igneous and sedimentary rock. The soil layers are various colored loams to 60 inches in depth with a pH ranging from 7.9 at the surface to 9.0 at depth. Runoff is rated as medium and erosion hazard is rated as slight to moderate.

APPENDIX B- VEGETATION TRANSECT DATA

Transect 1 Sagebrush – S Hollow (June 2010)

Mountain Big Sagebrush	Transect 1						
	Scientific Name	Common Name	Avg	St Deviation	Rel Cover	Frequency	Avg Height
Total Vegetation Cover			59.5	9.2			
Litter			24.0	1.4			
Bare Soil			10.0	5.7			
Total Ground Cover			90.0	5.7			
Standing Dead			6.5	2.1			
Cool season perennial grasses							
	Agropyron dasystachyum	Thickspike Wheatgrass	20.5	5.0	34.5	100.0	9
	Oryzopsis hymenoides	Indian Ricegrass	0.0	0.0	0.0	50.0	
	Poa sandbergii	Sandberg Bluegrass	0.0	0.0	0.0	50.0	
	Stipa columbiana	Nelson's Needle grass	0.5	0.7	0.8	100.0	14
	Stipa comata	Needle-and-thread Grass	2.0	0.0	3.4	100.0	22
		Sub-total	**23.0**		**38.7**		
Warm season perennial grasses							
	Sporobolus airoides	Alkali Sacaton	8.5	2.1	14.3	100.0	8
		Sub-total	**8.5**		**14.3**		
Introduced perennial grasses							
	Agropyron cristatum	Crested Wheatgrass	3.5	0.7	5.9	100.0	15
		Sub-total	**3.5**		**5.9**		
Annual grasses							
	Bromus tectorum	Cheatgrass	3.5	2.1	5.9	100.0	7
		Sub-total	**3.5**		**5.9**		
Perennial forbs							
	Calochortus nuttallii	Mariposa Lily	0.0	0.0	0.0	50.0	
	Cymopterus purpureus	Purple spring parsley	0.0	0.0	0.0	50.0	
	Phlox longifolia	Long leaved phlox	0.0	0.0	0.0	50.0	
		Sub-total	**0.0**		**0.0**		
Annual and biennial forbs							
	Chenopodium album	Lamb's Quarters Goosefoot	0.0	0.0	0.0	50.0	
	Gayophytum ramosissimum	Groundsmoke	1.0	0.0	1.7	100.0	
	Lappula occidentalis	Western stick seed	2.5	2.1	4.2	100.0	5
		Sub-total	**3.5**		**5.9**		
Shrubs							
	Artemisia tridentata	Big Sagebrush	4.0	1.4	6.7	100.0	19
	Atriplex confertifolia	Shadscale	1.0	0.0	1.7	100.0	
	Chrysothamnus nauseosus	Rubber Rabbitbrush	3.0	1.4	5.0	100.0	40
	Sarcobatus vermiculatus	Black Greasewood	9.5	9.2	16.0	100.0	35
		Sub-total	**17.5**		**29.4**		
Overall Ground Cover							
Litter	85%						
Bare Ground	12%						
Basal Vegetation	3%						
# of second hits/ vegetation strata							
12							

Transect 1 Sagebrush - USFS June 2010

	Scientific Name	Common Name	Percent Cover	Rel Cover	Avg Height
Total Vegetation Cover			44.0		
Litter			19.0		
Bare Soil			33.0		
Total Ground Cover			67.0		
Standing Dead			4.0		
Cool season perennial grasses					
	Elymus lanceolatus	Thickspike Wheatgrass	3.0	6.8	7
	Elymus elymoides	Bottlebrush Squirreltail	4.0	9.1	12
	Oryzopsis hymenoides	Indian Ricegrass	0.0	0.0	
	Poa canbyi	Canby Bluegrass	0.0	0.0	
	Poa sandbergii	Sandberg Bluegrass	0.0	0.0	
		Sub-total	7.0	15.9	
Warm season perennial grasses					
	Sporobolus airoides	Alkali Sacaton	2.0	4.6	
		Sub-total	2.0	4.6	
Grasslike plants					
	Carex sp.	Sedge	0.0	0.0	
		Sub-total	0.0	0.0	
Introduced perennial grasses					
	Agropyron cristatum	Crested Wheatgrass	0.0	0.0	
		Sub-total	0.0	0.0	
Annual grasses					
	Bromus tectorum	Cheatgrass	8.0	18.2	4
		Sub-total	8.0	18.2	
Perennial forbs					
	Calochortus nuttallii	Mariposa Lily	0.0	0.0	
	Sphaeralcea coccinea	Scarlet Globe Mallow	0.0	0.0	
		Sub-total	0.0	0.0	
Annual and biennial forbs					
	Lappula occidentalis	Beggars-tick	1.0	2.3	
		Sub-total	1.0	2.3	
Sub-shrubs					
	Gutierrezia sarothrae	Broom Snakeweed	2.0	4.6	7
		Sub-total	2.0	4.6	
Shrubs					
	Artemisia tridentata	Big Sagebrush	13.0	29.6	27
	Atriplex confertifolia	Shadscale	2.0	4.6	
	Chrysothamnus nauseosus	Rubber Rabbitbrush	2.0	4.6	
	Sarcobatus vermiculatus	Black Greasewood	7.0	15.9	33
		Sub-total	24.0	54.6	
Total Ground Cover					
Litter	52				
Bare ground	48				
# of second hits/ vegetation strata					
4					

Transect 4 Rabbitbrush–S Hollow June 2010

	Scientific Name	Common Name	Percent Cove	Rel Cover	Avg Height
Total Vegetation Cover			61.0		
Litter			27.0		
Bare Soil			9.0		
Total Ground Cover			91.0		
Standing Dead			3.0		
Cool season perennial grasses					
	Elymus lanceolatus	Thickspike Wheatgrass	2.0	3.3	13
	Agropyron trachycaulum	Slender Wheatgrass	1.0	1.6	
	Stipa columbiana	Nelson's Needle grass	0.0	0.0	
		Sub total	**3.0**	**4.9**	
Grasslike plants					
	Carex praegracilis	Sedge	1.0	1.6	
		Sub total	**1.0**	**1.6**	
Introduced perennial grasses					
	Agropyron cristatum	Crested Wheatgrass	31.0	50.8	12
	Bromopsis inermis	Smooth brome	1.0	1.6	18
	Poa pratensis	Kentucky Bluegrass	0.0	0.0	
		Sub total	**32.0**	**52.5**	
Annual grasses					
	Bromus tectorum	Cheatgrass	8.0	13.1	
			8.0	**13.1**	
Perennial forbs					
	Achillea millefolium	Yarrow	0.0	0.0	
	Aster ascendens	Pacific aster	4.0	6.6	3
	Sphaeralcea coccinea	Scarlet Globe Mallow	0.0	0.0	
	Taraxacum officinale	Common Dandelion	0.0	0.0	
		Sub total	**4.0**	**6.6**	
Annual and biennial forbs					
	Chenopodium fremontii	Fremont Goosefoot	0.0	0.0	
	Lactuca serriola	Prickly Lettuce	0.0	0.0	
	Lappula occidentalis	Beggars-tick	0.0	0.0	
	Tragopogon dubius	Salsify	0.0	0.0	
		Sub total	**0.0**	**0.0**	
Shrubs					
	Artemisia tridentata	Big Sagebrush	0.0	0.0	
	Chrysothamnus nauseosus	Rubber Rabbitbrush	13.0	21.3	57
	Sarcobatus vermiculatus	Black Greasewood	0.0	0.0	
		Sub total	**13.0**	**21.3**	
Ground Cover					
Litter	86%				
Bare Soil	11%				
# of second hits/ Vegetation Strata					
14					

Transect 4 Rabbitbrush USFS (S Hollow) June 2010

	Scientific Name	Common Name	Percent Cover	Rel Cover	Avg Height
Total Vegetation Cover			61.0		
Litter			21.0		
Bare Soil			13.0		
Total Ground Cover			87.0		
Standing Dead			3.0		
Cool season perennial grasses					
	Elymus lanceolatus	Thickspike Wheatgrass	9.0	14.8	11
	Agropyron trachycaulum	Slender Wheatgrass	4.0	6.6	11
	Stipa columbiana	Nelson's Needle grass	0.0	0.0	
		Sub total	13.0	21.3	
Grasslike plants					
	Carex praegracilis	Sedge	2.0	3.3	9
		Sub total	2.0	3.3	
Introduced perennial grasses					
	Agropyron cristatum	Crested Wheatgrass	12.0	19.7	18
		Sub total	12.0	19.7	
Annual grasses					
	Bromus tectorum	Cheatgrass	1.0	1.6	7
		Sub total	1.0	1.6	
Perennial forbs					
	Achillea millefolium	Yarrow	1.0	1.6	
	Allium sp	Wild Onion	0.0	0.0	
	Aster adscendens	Blue Aster	1.0	1.6	3
	Calochortus nuttallii	Mariposa Lily	0.0	0.0	
	Sphaeralcea coccinea	Scarlet Globe Mallow	5.0	8.2	7
	Taraxacum officinale	Common Dandelion	0.0	0.0	
	Unknown Perennial Forb		1.0	1.6	
		Sub total	8.0	13.1	
Annual and biennial forbs					
	Chenopodium album	Lamb's Quarters Goosefoot	0.0	0.0	
	Chenopodium fremontii	Fremont Goosefoot	0.0	0.0	
	Dracocephalum parviflorum	Smallflower dragonhead	0.0	0.0	
	Lappula occidentalis	Beggars-tick	2.0	3.3	
	Salsola iberica	Russian Thistle	0.0	0.0	
	Tragopogon dubius	Salsify	0.0	0.0	
		Sub total	2.0	3.3	
Shrubs					
	Artemisia tridentata	Big Sagebrush	1.0	1.6	
	Chrysothamnus nauseosus	Rubber Rabbitbrush	22.0	36.1	42
	Symphorocarpos oreophilus	Snowberry	0.0	0.0	
		Sub total	23.0	37.7	
Ground Cover					
Litter	79%				
Bare Soil	21%				
# of second hits/ Vegetation Strata					
12					

Transect 3 Wet Meadow- S Hollow June 2010

	Scientific Name	Common Name	Percent Cover	Rel Cover	Avg Height
Total Vegetation Cover			75.0		
Litter			25.0		
Total Ground Cover			100.0		
Cool season perennial grasses					
	Unknown perennial grasses		9.0	12.0	13
	Puccinellia distans	Weeping alkaligrass	0.0	0.0	
		Sub total	**9.0**	**12.0**	
Warm season perennial grasses					
	Spartina gracilis	Alkali Cordgrass	0.0	0.0	
Grasslike plants					
	Carex praegracilis	Sedge	8.0	10.7	12
	Juncus balticus	Baltic rush	55.0	73.3	22
	Scirpus pungens	Bulrush	3.0	4.0	9
		Sub total	**66.0**	**88.0**	
Shrubs					
	Chrysothamnus nauseosus	Rubber Rabbitbrush	0.0	0.0	
	Tamarix chinensis	Salt Cedar	0.0	0.0	
Gound Cover					
Litter	100%				
# of second hits/ vegetation strata					
24					

Transect 3 Wet Meadow FS June 2010

	Scientific Name	Common Name	Percent Cover	Rel Cover	Avg Height
Total Vegetation Cover			86.0		
Litter			1.0		
Bare Soil			13.0		
Total Ground Cover			87.0		
Cool season perennial grasses					
	Hordeum jubatum	Foxtail Barley	0.0	0.0	
	Muhlenbergia richardsonis	Mat Muhly	0.0	0.0	
	Puccinellia distans	Weeping alkaligrass	2.0	2.3	
		Sub total	**2.0**	**2.3**	
Warm season perennial grasses					
	Spartina gracilis	Alkali Cordgrass	1.0	1.2	
		Sub total	**1.0**	**1.2**	
Grasslike plants					
	Carex praegracilis	Sedge	15.0	17.4	8
	Eleocharis acicularis	Needleleaf Spikerush	8.0	9.3	5
	Eleocharis palustris	Common Spikerush	3.0	3.5	8
	Juncus balticus	Baltic rush	40.0	46.5	13
	Scirpus pungens	Bulrush	10.0	11.6	9
	Triglochin maritima	Arrowgrass	2.0	2.3	4
		Sub total	**78.0**	**90.7**	
Perennial forbs					
	Pyrrocoma lanceolata	Meadow goldenweed	3.0	3.5	5
	Unknown Perennial Forb		2.0	2.3	10
		Sub total	**5.0**	**5.8**	
Ground cover					
Litter	55%				
bare soil	39%				
# of second hits/ vegetation strata					
54					

Transect 1- Sagebrush S Hollow September 2010

Sagebrush South Hollow				
	Scientific Name	Common Name	% Cover	Relative Cover
Total Vegetation Cover			74.0	
Litter			9.0	
Standing Dead			8.0	
Bare Soil			9.0	
Total Ground Cover			91.0	
Cool season perennial grasses				
	Agropyron dasystachyum	Thickspike Wheatgrass	36.0	48.7
	Agropyron smithii	Western Wheatgrass	1.0	1.4
		Sub-total	**37.0**	**50.0**
Warm season perennial grasses				
	Sporobolus airoides	Alkali Sacaton	18.0	24.3
Introduced perennial grasses				
	Agropyron cristatum	Crested Wheatgrass	3.0	4.1
Annual grasses				
	Bromus tectorum	Cheatgrass	1.0	1.4
Shrubs				
	Artemisia tridentata	Big Sagebrush	1.0	1.4
	Chrysothamnus nauseosus	Rubber Rabbitbrush	5.0	6.8
	Sarcobatus vermiculatus	Black Greasewood	9.0	12.2
		Sub-total	**15.0**	**20.3**

Transect 1- Sagebrush USFS September 2010

Sagebrush USFS				
	Scientific Name	Common Name	% Cover	Relative Cover
Total Vegetation Cover			32.0	
Standing Dead			2.0	
Litter			6.0	
Bare Soil			55.0	
Total Ground Cover			45.0	
Introduced perennial grasses				
	Agropyron cristatum	Crested Wheatgrass	1.0	3.3
Annual grasses				
	Bromus tectorum	Cheatgrass	1.0	3.3
Shrubs				
	Artemisia tridentata	Big Sagebrush	8.0	26.7
	Chrysothamnus nauseosus	Rubber Rabbitbrush	4.0	13.3
	Sarcobatus vermiculatus	Black Greasewood	16.0	53.3
		Sub-total	**28.0**	**93.3**

Transect 2 Alkaline Meadow –S Hollow September 2010

Alkaline Meadow South Hollow				
	Scientific Name	Common Name	% Cover	Relative Cover
Total Vegetation Cover			68.0	
Standing Dead			6.0	
Litter			3.0	
Gravel			1.0	
Bare Soil			22.0	
Total Ground Cover			78.0	
Cool season perennial grasses				
	Elymus salina	Salina wildrye	11.0	15.9
	Other cool season perennial grasses		6.0	8.7
		Sub-total	**17.0**	**24.6**
Warm season perennial grasses				
	Bouteloua gracilis	Blue Grama	6.0	8.7
	Sporobolus airoides	Alkali Sacaton	22.0	31.9
		Sub-total	**28.0**	**40.6**
Introduced perennial grasses				
	Agropyron cristatum	Crested Wheatgrass	1.0	1.5
		Sub-total	**1.0**	**1.5**
Annual grasses				
	Bromus tectorum	Cheatgrass	5.0	7.3
		Sub-total	**5.0**	**7.3**
Annual and biennial forbs				
	Chenopodium fremontii	Fremont Goosefoot	1.0	1.5
		Sub-total	**1.0**	**1.5**
Shrubs				
	Artemisia nova	Black sagebrush	4.0	5.8
	Sarcobatus vermiculatus	Black Greasewood	13.0	18.8
		Sub-total	**17.0**	**24.6**

Transect 2 Alkaline Meadow –USFS September 2010

Alkaline Meadow USFS				
	Scientific Name	Common Name	% Cover	Relative Cover
Total Vegetation Cover			49.000	
Standing Dead			6.0	
Litter			8.0	
Rock			1.0	
Gravel			1.0	
Bare Soil			33.0	
Total Ground Cover			67.0	
Cool season perennial grasses				
	Other cool season perennial grasses		3.0	8.1
Warm season perennial grasses				
	Sporobolus airoides	Alkali Sacaton	8.0	21.6
Annual grasses				
	Bromus tectorum	Cheatgrass	3.0	8.1
Annual and biennial forbs				
	Chenopodium fremontii	Fremont Goosefoot	6.0	16.2
Shrubs				
	Artemisia nova	Black sagebrush	4.0	10.8
	Chrysothamnus nauseosus	Rubber Rabbitbrush	2.0	5.4
	Sarcobatus vermiculatus	Black Greasewood	11.0	29.7
		Sub-total	**17.0**	**46.0**

Transect 2B- S Hollow September 2010

Rough Breaks/ Badlands South Hollow				
	Scientific Name	Common Name	% Cover	Relative Cover
Total Vegetation Cover			49.0	
Standing Dead			5.0	
Litter			11.0	
Gravel			1.0	
Bare Soil			34.0	
Total Ground Cover			66.0	
Cool season perennial grasses				
	Other cool season perennial grasses		41.0	83.7
		Sub-total	**41.0**	**83.7**
Warm season perennial grasses				
	Sporobolus airoides	Alkali Sacaton	2.0	4.1
		Sub-total	**2.0**	**4.1**
Perennial forbs				
	Unknown Composite		0.0	0.0
	Unknown Perennial Forb		3.0	6.1
		Sub-total	**3.0**	**6.1**
Annual and biennial forbs				
	Chenopodium album	Lamb's Quarters Goosefoot	<1	<1
Shrubs				
	Artemisia nova	Black sagebrush	1.0	2.0
	Atriplex confertifolia	Shadscale	1.0	2.0
	Chrysothamnus nauseosus	Rubber Rabbitbrush	1.0	2.0
	Sarcobatus vermiculatus	Black Greasewood	0.0	0.0
	Unknown Shrub	Unknown shrub	0.0	0.0
		Sub-total	**3.0**	**6.1**

Transect 2B – USFS September 2010

Rough Breaks/ Badlands USFS				
	Scientific Name	Common Name	% Cover	Relative Cover
Total Vegetation Cover			20.0	
Standing Dead			4.0	
Litter			6.0	
Gravel			1.0	
Bare Soil			69.0	
Total Ground Cover			31.0	
Cool season perennial grasses				
	Other cool season perennial grasses		8.0	40.0
Perennial forbs				
	Unknown Perennial Forb		2.0	10.0
Shrubs				
	Artemisia nova	Black sagebrush	9.0	45.0
	Chrysothamnus nauseosus	Rubber Rabbitbrush	1.0	5.0
		Sub-total	**10.0**	**50.0**

Transect 3- S Hollow September 2010

Riparian South Hollow				
	Scientific Name	Common Name	% Cover	% Relative Cov
Total Vegetation Cover			91.0	
Litter			6.0	
Bare Soil			3.0	
Total Ground Cover			97.0	
Cool season perennial grasses				
	Other cool season perennial grasses		9.0	9.9
Grasslike plants				
	Juncus balticus	Baltic rush	57.0	62.6
	Scirpus pungens	Bulrush	25.0	27.5

Transect 3- USFS September 2010

Riparian USFS				
	Scientific Name	Common Name	% Cover	% Relative Cov
Total Vegetation Cover			71.0	
Litter			8.0	
Bare Soil			21.0	
Total Ground Cover			79.0	
Cool season perennial grasses				
	Other cool season perennial grasses		1.0	1.4
Warm season perennial grasses				
	Spartina gracilis	Alkali Cordgrass	1.0	1.4
Grasslike plants				
	Juncus balticus	Baltic rush	55.0	77.5
	Scirpus pungens	Bulrush	14.0	19.7

Transect 4 – S Hollow September 2010

Rabbitbrush South Hollow				
	Scientific Name	Common Name	% Cover	Relative Cover
Total Vegetation Cover			71.0	
Standing Dead			6.0	
Litter			5.0	
Bare Soil			18.0	
Total Ground Cover			82.0	
Cool season perennial grasses				
	Agropyron dasystachyum	Thickspike Wheatgrass	4.0	5.6
	Other cool season perennial grasses		11.0	15.5
		Sub-total	15.0	21.1
Introduced perennial grasses				
	Agropyron cristatum	Crested Wheatgrass	20.0	28.2
Perennial forbs				
	Achillea millefolium	Yarrow	4.0	5.6
	Aster chilensis	Blue Aster	2.0	2.8
	Unknown Fabaceae		1.0	1.4
	Unknown Perennial Forb		2.0	2.8
		Sub-total	9.0	12.7
Annual and biennial forbs				
	Lappula occidentalis	Beggars-tick	1.0	1.4
Shrubs				
	Chrysothamnus nauseosus	Rubber Rabbitbrush	25.0	35.2
	Unknown Shrub	Unknown shrub	1.0	1.4
		Sub-total	26.0	36.6

Transect 4 – USFS (S Hollow) September 2010

Rabbitbtush USFS (South Hollow)				
	Scientific Name	Common Name	% Cover	Relative Cover
Total Vegetation Cover			85.0	
Standing Dead			2.0	
Litter			1.0	
Bare Soil			12.0	
Total Ground Cover			88.0	
Cool season perennial grasses				
	Other cool season perennial grasses		25.0	29.4
Introduced perennial grasses				
	Agropyron cristatum	Crested Wheatgrass	34.0	40.0
Annual grasses				
	Bromus tectorum	Cheatgrass	3.0	3.5
Perennial forbs				
	Aster chilensis	Blue Aster	10.0	11.8
Shrubs				
	Chrysothamnus nauseosus	Rubber Rabbitbrush	11.0	12.9
	Sarcobatus vermiculatus	Black Greasewood	2.0	2.4
		Sub-total	**13.0**	**15.3**

Transect 5 – S Hollow September 2010

Crested Wheatgrass South Hollow				
	Scientific Name	Common Name	% Cover	Relative Cover
Total Vegetation Cover			58.0	
Standing Dead			3.0	
Litter			26.0	
Gravel			1.0	
Bare Soil			12.0	
Total Ground Cover			88.0	
Introduced perennial grasses				
	Agropyron cristatum	Crested Wheatgrass	43.0	74.1
Shrubs				
	Artemisia tridentata	Big Sagebrush	15.0	25.9

Transect 5 – USFS September 2010

Crested Wheatgrass USFS				
	Scientific Name	Common Name	% Cover	Relative Cover
Total Vegetation Cover			37.0	
Standing Dead			5.0	
Litter			20.0	
Bare Soil			36.0	
Total Ground Cover			64.0	
Warm season perennial grasses				
	Bouteloua gracilis	Blue Grama	1.0	2.6
Introduced perennial grasses				
	Agropyron cristatum	Crested Wheatgrass	27.0	69.2
Shrubs				
	Artemisia tridentata	Big Sagebrush	11.0	28.2

Transect 7 – S Hollow September 2010

Shallow Gully South Hollow				
	Scientific Name	Common Name	% Cover	Relative Cover
Total Vegetation Cover			55.0	
Standing Dead			12.0	
Litter			20.0	
Bare Soil			13.0	
Total Ground Cover			87.0	
Cool season perennial grasses				
	Agropyron dasystachyum	Thickspike Wheatgrass	5.0	9.1
	Other cool season perennial grasses		9.0	16.4
		Sub-total	14.0	25.5
Warm season perennial grasses				
	Sporobolus airoides	Alkali Sacaton	1.0	1.8
		Sub-total	1.0	1.8
Annual grasses				
	Bromus tectorum	Cheatgrass	16.0	29.1
		Sub-total	16.0	29.1
Annual and biennial forbs				
	Chenopodium album	Lamb's Quarters Goosefoot	2.0	3.6
		Sub-total	2.0	3.6
Shrubs				
	Artemisia tridentata	Big Sagebrush	12.0	21.8
	Atriplex confertifolia	Shadscale	0.0	0.0
	Chrysothamnus nauseosus	Rubber Rabbitbrush	1.0	1.8
	Sarcobatus vermiculatus	Black Greasewood	9.0	16.4
		Sub-total	22.0	40.0

Transect 7 – USFS September 2010

Shallow Gully USFS				
	ScientificName	CommonName	% Cover	% Relative Cov
Total Vegetation Cover			26.0	
Standing Dead			7.0	
Litter			13.0	
Bare Soil			54.0	
Total Ground Cover			46.0	
Cool season perennial grasses				
	Other cool season perennial grasses		4.0	15.4
		Sub-total	4.0	15.4
Introduced perennial grasses				
	Agropyron cristatum	Crested Wheatgrass	1.0	3.9
		Sub-total	1.0	3.9
Annual grasses				
	Bromus tectorum	Cheatgrass	4.0	15.4
		Sub-total	4.0	15.4
Perennial forbs				
	Unknown Perennial Forb		1.0	3.9
		Sub-total	1.0	3.9
Annual and biennial forbs				
	Chenopodium album	Lamb's Quarters Goosefoot	0.0	0.0
		Sub-total	0.0	0.0
Shrubs				
	Artemisia tridentata	Big Sagebrush	5.0	19.2
	Chrysothamnus nauseosus	Rubber Rabbitbrush	6.0	23.1
	Sarcobatus vermiculatus	Black Greasewood	5.0	19.2
		Sub-total	16.0	61.5

APPENDIX C. ANNOTATED CHECKLIST OF VASCULAR PLANTS AT SOUTH HOLLOW

Family	Scientific Name	Common Name	Form	UT Dist	Comments
Agavaceae	*Yucca angustissima*	Narrow-leaved yucca	S	RE	Local – Indian Hill, South Uplands, East Side Hills
Amaranthaceae	*Amaranthus albus*	Tumble pigweed	AF	I	Uncommon – South Uplands
Anacardiaceae	*Rhus aromatica* var. *trilobata*	Skunkbush	S	W	Uncommon – Indian Hill, West Riparian
Apiaceae (Umbelliferae)	*Cymopterus purpureus* var. *purpureus*	Variable spring-parsley	PF	RE	Uncommon – South Uplands, Indian Hill, East Uplands, East Side Hills
	Lomatium nevadense var. *parishii*	Nevada lomatium	PF	W	Rare – West Meadows
Asteraceae (Compositae)	*Achillea millefolium* var. *lanulosa*	Yarrow	PF	W	Common - throughout
	Artemisia frigida	Fringed sagebrush	S	W	Local – East Side Hills
	Artemisia ludoviciana	Louisiana wormwood	PF	W	Uncommon – Indian Hill. Variety not determined
	Artemisia nova var. *nova*	Black sagebrush	S	W	Local – Indian Hill, East Side Hills, East Uplands
	Artemisia tridentata var. *tridentata*	Basin big sagebrush	S	W	Common throughout area
	Aster ascendens	Pacific aster	PF	W	Uncommon – West Meadows, Alvey Spring
	Aster glaucodes	Blueleaf aster	PF	W	Uncommon – Alvey Spring
	Chrysothamnus depressus	Dwarf rabbitbrush	S	W	Uncommon – Indian Hill
	Chrysothamnus nauseosus (*Ericameria nauseosa*)	Rubber rabbitbrush	S	W	Common – South Uplands, Indian Hill, West Meadows. Variety not determined.
	Chrysothamnus viscidiflorus var. *stenophyllus*	Slenderleaf rabbitbrush	S	W	Uncommon – east side
	Chrysothamnus viscidiflorus var. *viscidiflorus*	Viscid rabbitbrush	S	W	Local – Indian Hills; probably elsewhere
	Cirsium calcareum	Beautiful thistle	PF	W	Rare – Thistle Basin. Variety not determined

Family	Scientific Name	Common Name	Form	UT Dist	Comments
Asteraceae (Compositae)	*Cirsium vulgare*	Bull thistle	PF	I	Uncommon – East Riparian. Observed only on USFS lands
	Cirsium wheeleri var. *wheeleri*	Wheeler's thistle	PF	W	Local – Indian Hill
	Crepis intermedia	Gray hawksbeard	PF	W	Uncommon – West Meadows, East Uplands
	Crepis occidentalis var. *occidentalis*	Western hawksbeard	PF	W	Uncommon – Indian Hill
	Crepis runcinata var. *hispidulosa*	Hispidulous hawksbeard	PF	W	Uncommon – East Riparian, Thistle Basin. Observed only on USFS lands.
	Erigeron divergens var. *divergens*	Spreading daisy	PF	W	Uncommon – South Uplands
	Erigeron eatonii	Eaton's daisy	PF	W	Uncommon – Developing Meadow
	Erigeron flagellaris	Trailing daisy	PF	W	Uncommon – West Meadows, Thistle Basin
	Erigeron pumilus var. concinnus	Navajo fleabane	PF	W	Common – upland areas throughout
	Gutierrezia sarothrae	Broom snakeweed	S	W	Common – upland areas throughout
	Haplopappus lanceolatus (*Pyrrocoma lanceolata*)	Meadow goldenweed	PF	W	Uncommon – West Riparian, Alvey Spring
	Helianthus petiolaris var. *fallax*	Prairie sunflower	AF	W	Uncommon – South Uplands
	Hymenopappus filifolius var. *cinereus*	Hyalineherb	PF	W	Local – Indian Hill – probably elsewhere
	Hymenoxys acaulis var. *arizonica*	Arizona woollybase	PF	W	Uncommon – Indian Hill
	Hymenoxys acaulis var. *ivesiana*	Ives' woollybase	PF	W	Uncommon – East Side Hills
	Hymenoxys richardsonii var. *floribunda*	Colorado rubberweed	PF	W	Uncommon – West Riparian, East Uplands
	Lactuca serriola	Prickly lettuce	AF	I	Uncommon - West Meadows
	Lygodesmia grandiflora var. *grandiflora*	Showy rushpink	PF	W	Uncommon - South Uplands, Indian Hill
	Lygodesmia spinosa	Thorny wirelettuce	AF	W	Local – South Uplands, Indian Hill
	Machaeranthera grindelioides var. *grindelioides*	Gumweed aster	PF	W	Uncommon – East Side Hills
	Petradoria pumila var. *pumila*	Rock goldenrod	PF	W	Local – Indian Hill
	Senecio multilobatus	Uinta groundsel	PF	W	Uncommon – West Riparian, Alvey Spring
	Taraxacum laevigatum	Red-seeded dandelion	PF	I	Uncommon – Indian Hill, probably elsewhere

Family	Scientific Name	Common Name	Form	UT Dist	Comments
Asteraceae (Compositae)	*Tetradymia canescens*	Gray horsebrush	S	W	Uncommon – South Uplands, Indian Hill, East Side Hills
	Tragopogon dubius	Yellow salsify	PF	I	Uncommon – West Meadows
	Viguiera multiflora (*Heliomeris multiflora*)	Showy goldeneye	PF	W	Reported- uncommon – West Meadows
	Xylorhiza confertifolia (*Machaeranthera confertifolia*)	Henrieville woodyaster	PF	LE	Local – East Side Hills, East Uplands
Berberidaceae	*Mahonia fremontii*	Fremont barberry	S	W	Reported – rare, Indian Hill
	Mahonia repens	Oregon grape	S	W	Uncommon – Indian Hill
Boraginaceae	*Cryptantha flavoculata*	Yellow-eye cryptanth	PF	W	Uncommon – uplands throughout area
	Lappula occidentalis var. *cupulata* (*L. redowskii*)	Western stickseed	AF	W	Common – uplands throughout area
Brassicaceae (Cruciferae)	*Arabis perennans* var. *perennans* (*Boechera perennans*)	Perennial rockcress	PF	W	Uncommon – Indian Hill, East Uplands
	Chorispora tenella	Blue mustard	AF	I	Local – South Uplands, West Meadow
	Lepidium densiflorum	Dense pepperplant	AF	W	Uncommon – West Meadow, East Meadow
	Physaria chambersii var. *chambersii*	Chambers's twinpod	PF	W	Uncommon – East Side Hills
	Physaria intermedia (*Lesquerella intermedia*)	Watson's bladderpod	PF	W	Uncommon – Indian Hill
	Schoenocrambe linifolia	Slenderleaf schoenocrambe	PF	W	Uncommon – East Meadows
Cactaceae	*Coryphantha vivipara* var. *arizonica*	Arizona pincushion cactus	PF	W	Uncommon – Indian Hills, East Uplands
	Echinocereus triglochidiatus var. *melanacanthus*	Claretup	PF	W	Uncommon – South Uplands
	Opuntia erinacea var. *utahensis*	Grizzlybear pricklypear	PF	W	Common – upland areas throughout
	Opuntia fragilis	Fragile pricklypear	PF	W	Local – much of East Side uplands
Caprifoliaceae	*Symphoricarpos oreophilus* var. *utahensis*	Mountain snowberry	S	W	Common – upland areas throughout
Chenopodiaceae	*Atriplex argentea* var. *argentea*	Silver orache	AF	W	Uncommon – East uplands
	Atriplex canescens var. *canescens*	Fourwing saltbush	S	W	Reported – rare in South Uplands
	Atriplex confertifolia	Shadscale	S	W	Common – East Meadow, East Side Hills
	Atriplex rosea	Tumbling orache	AF	I	Rare – West Meadows
	Bassia scoparia (*Kochia scoparia*)	Summer-cypress	AF	I	Local – West Meadows, East Meadows
	Chenopodium fremontii	Fremont goosefoot	AF	W	Local – upland areas

	var. *fremontii*				throughout
Family	**Scientific Name**	**Common Name**	**Form**	**UT Dist**	**Comments**
Chenopodiaceae	*Krascheninnikovia lanata* (*Ceratoides lanata*)	Winterfat	S	W	Reported - rare at base of Howard's Hill
	Monolepis nuttalliana	Poverty-weed	AF	W	Uncommon – East Side Hills
	Sarcobatus vermiculatus	Greasewood	S	W	Common – throughout uplands and meadows
	Suaeda calceoliformis	Broom seepweed	AF	W	Uncommon – East Riparian, East Uplands, Alvey Spring
	Zuckia brandegeei var. *plummeri*	Plummer's siltbush	S	RE	Local – East Side Hills, East Uplands
Cupressaceae	*Juniperus osteosperma*	Utah juniper	T	W	Common – uplands throughout area
	Juniperus scopulorum	Rocky Mountain juniper	T	W	Reported – uncommon in East Riparian, Alvey Spring, Thistle Basin, & N slopes Indian Hill
Cyperaceae	*Carex aquatilis*	Water sedge	PG	W	Local – Thistle Basin – only on USFS land
	Carex aurea	Golden sedge	PG	W	Local – East Riparian, Thistle Basin – only on USFS land
	Carex douglasii	Douglas's sedge	PG	W	Reported - uncommon – East Meadows, South Uplands
	Carex duriuscula (*C. eleocharis, C. stenophylla*)	Narrowleaf sedge	PG	W	Local – East Uplands
	Carex hystericina	Bottlebrush sedge	PG	W	Common – East Riparian, only on USFS land
	Carex nebrascensis	Nebraska sedge	PG	W	Reported – uncommon in East Riparian
	Carex occidentalis	Western sedge	PG	W	Uncommon – Indian Hill
	Carex pellita (*C. lanuginosa*)	Woolly sedge	PG	W	Common – East Riparian, only on USFS land
	Carex praegracilis	Blackcreeper sedge	PG	W	Common, East Riparian, Thistle Basin, Alvey Spring
	Carex rossii	Ross's sedge	PG	W	Local – South Uplands Indian Hill
	Carex simulata	Analogue sedge	PG	W	Uncommon – Thistle Basin, Alvey Spring
	Eleocharis acicularis?	Slender spikerush	PG	W	Uncommon - East Riparian, Alvey Spring. Plants immature – confirmation needed
	Eleocharis palustris	Common spikerush	PG	W	Local - East Riparian, Alvey Spring
	Scirpus pungens var. *longispicatus*	Common threesquare bulrush	PG	W	Common – East Riparian, only on USFS lands
Elaeagnaceae	*Elaeagnus angustifolia*	Russian-olive	T	I	Uncommon - E Riparian, only on USFS lands

Family	Scientific Name	Common Name	Form	UT Dist	Comments
Elaeagnaceae	*Shepherdia rotundifolia*	Roundleaf buffaloberry	S	RE	Local – East Side Hills
Fabaceae (Leguminosae)	*Astragalus amphioxys*	Crescent milkvetch	PF	W	Uncommon – South Uplands, Indian Hill. Variety not determined
	Astragalus kentrophyta var. *elatus*	Tall kentrophyta milkvetch	PF	W	Rare – East Riparian, only on USFS lands
	Astragalus lonchocarpus	Great rushy milkvetch	PF	W	Uncommon – East Riparian, East Side Hills
	Astragalus oophorus var. *caulescens*	Pallid egg milkvetch	PF	W	Local - throughout uplands
	Hedysarum boreale var. *boreale*	Northern sweetvetch	PF	W	Uncommon – Alvey Spring, Indian Hill
	Lotus utahensis	Utah trefoil	PF	RE	Local – Indian Hill
	Lupinus caudatus	Silver lupine	PF	W	Common – South Uplands, Indian Hill, probably elsewhere. Variety not determined
	Lupinus kingii var. *kingii*	King's lupine	AF	W	Uncommon – Indian Hill
	Melilotus officinalis	Yellow sweet-clover	PF	I	Local – roadsides, West Riparian
	Trifolium gymnocarpon?	Hollyleaf clover	PF	W	Uncommon – South Uplands, Indian Hill. Vegetative- confirmation needed
	Vicia americana var. *americana*	American vetch	PF	W	Common – uplands throughout area
Fagaceae	*Quercus gambelii* var. *gambelii*	Gambel oak	T	W	Common – uplands throughout area
Iridaceae	*Iris missouriensis*	Missouri iris	PF	W	Rare – Alvey Spring
	Sisyrinchium demissum	Blue-eyed grass	PF	W	Rare- West Riparian, only on USFS lands
Juncaceae	*Juncus arcticus* var. *balticus*	Baltic rush	PG	W	Common – all riparian areas
	Juncus ensifolius var. *montanus*	Swordleaf rush	PG	W	Uncommon – Willow Run, only on USFS lands
Juncaginaceae	*Triglochin maritima*	Seaside arrowgrass	PG	W	Uncommon – West Riparian, Alvey Spring
Lamiaceae (Labiatae)	*Dracocephalum parviflorum*	Smallflower dragonhead	PF	W	Uncommon – West Meadows
Liliaceae	*Allium acuminatum*	Taper-tip onion	PF	W	Uncommon – Indian Hill, East Meadows
	Calochortus nuttallii	Sego lily	PF	W	Uncommon – uplands throughout area
	Smilacina stellata (*Maianthemum stellatum*)	False Solomon's-seal	PF	W	Uncommon – Alvey Spring
Malvaceae	*Sphaeralcea coccinea*	Scarlet globemallow	PF	W	Local – uplands throughout area
Onagraceae	*Epilobium ciliatum*	Northern willowherb	PF	W	Uncommon – East Riparian, only on USFS lands
	Gayophytum	Branching	AF	W	Uncommon – uplands

	ramosissimum	groundsmoke			throughout area
Family	**Scientific Name**	**Common Name**	**Form**	**UT Dist**	**Comments**
Onagraceae	*Oenothera caespitosa*	Cespitose evening--primrose	PF	W	Uncommon – uplands throughout area. Variety not determined
	Oenothera pallida var. *pallida*	Pale evening-primrose	PF	W	Local – uplands throughout area
Pinaceae	*Picea pungens*	Blue spruce	T	W	Reported, single young tree, N side Indian Hill
	Pinus edulis	Two-needle pinyon	T	W	Local – uplands throughout area
	Pinus ponderosa var. *scopulorum*	Ponderosa pine	T	W	Local – Indian Hill
	Pseudotsuga menziesii var. *glauca*	Douglas-fir	T	W	Reported, single young tree, N side Indian Hill
Poaceae (Gramineae)	*Agropyron cristatum*	Crested wheatgrass	PG	I	Common – uplands throughout area
	Bouteloua gracilis	Blue grama	PG	W	Uncommon – uplands throughout area
	Bromus inermis var. *inermis*	Smooth brome	PG	I	Common – upland areas throughout
	Bromus tectorum	Cheatgrass	AG	I	Local – upland areas throughout
	Elymus elongatus (*Thinopyrum elongatum*)	Tall wheatgrass	PG	I	Uncommon – South Uplands
	Elymus elymoides (*Sitanion hystrix*)	Squirreltail	PG	W	Common – uplands throughout area
	Elymus hispidus (*Agropyron intermedium*)	Intermediate wheatgrass	PG	I	Local – South Uplands
	Elymus junceus (*Psathyrostachys juncea*)	Russian wildrye	PG	I	Reported, Rare – West and East Meadows
	Elymus lanceolatus (*Agropyron dasystachyum*)	Thickspike wheatgrass	PG	W	Common – uplands throughout area
	Elymus salinus	Salina wildrye	PG	W	Uncommon – West Meadows, East Side Hills
	Elymus smithii (*Agropyron smithii*)	Western wheatgrass	PG	W	Uncommon – East Side
	Elymus spicatus (*Agropyron spicatum*)	Bluebunch wheatgrass	PG	W	Reported – uncommon East and West Meadows
	Elymus trachycaulus (*Agropyron caninum*)	Slender wheatgrass	PG	W	Uncommon – West Meadows, East Riparian, Thistle Basin
	Glyceria striata	Fowl mannagrass	PG	W	Uncommon – Willow Run
	Hilaria jamesii (*Pleuraphis jamesii*)	Galleta	PG	W	Uncommon – East Side Hills
	Hordeum jubatum	Foxtail barley	PG	W	Common – riparian areas throughout
	Muhlenbergia asperifolia	Scratchgrass	PG	W	Reported – locally abundant East and West Meadows
	Muhlenbergia	Mat muhly	PG	W	Rare- West Riparian, only

	richardsonis				on USFS lands
Family	**Scientific Name**	**Common Name**	**Form**	**UT Dist**	**Comments**
Poaceae (Gramineae)	*Munroa squarrosa*	False buffalograss	AG	W	Reported – locally common, South Highlands
	Poa fendleriana	Muttongrass	PG	W	Uncommon – East side
	Poa pratensis	Kentucky bluegrass	PG	I	Common – throughout area
	Poa secunda (Includes var. *secunda* & var. *juncifolia* forms)	Sandberg bluegrass	PG	W	Common – throughout area
	Puccinellia distans	Weeping alkaligrass	PG	I	Uncommon – East Riparian, Willow Run, Alvey Spring
	Puccinellia nuttalliana	Nuttall's alkaligrass	PG	W	Uncommon – East Riparian, only on USFS lands
	Spartina gracilis	Alkali cordgrass	PG	W	Uncommon- East Riparian, West Riparian, only on USFS lands
	Sporobolus airoides var. *airoides*	Alkali sacaton	PG	W	Local – East Meadows
	Sporobolus cryptandrus	Sand dropseed	PG	W	Reported - common – South Uplands
	Stipa comata	Needle-and-thread	PG	W	Common – throughout area
	Stipa hymenoides (*Oryzopsis hymenoides*)	Indian ricegrass	PG	W	Local – upland areas throughout
	Stipa lettermanii	Letterman's needlegrass	PG	W	Uncommon – West Meadows
	Stipa nelsonii var. *nelsonii*	Nelson's needlegrass	PG	W	Uncommon – West Meadows
Polemoniaceae	*Ipomopsis aggregata (Gilia aggregata)*	Scarlet gilia	PF	W	Uncommon – South Uplands and probably elsewhere. Probably var. *arizonica*.
	Phlox hoodii var. *canescens*	Carpet phlox	PF	W	Reported – rare, South Uplands, East Uplands
	Phlox longifolia	Longleaf phlox	PF	W	Uncommon – South Uplands
Polygonaceae	*Eriogonum alatum*	Winged buckwheat	PF	W	Uncommon – Indian Hill
	Eriogonum racemosum var. *racemosum*	Redroot buckwheat	PF	W	Uncommon – Indian Hill
	Eriogonum salsuginosum (*Stenogonum salsuginosum*)	Smooth buckwheat	AF	W	Local – East Side Hills
	Eriogonum umbellatum var. *subaridum*	Arid buckwheat	PF	W	Local – Indian Hill
	Polygonum aviculare	Knotweed	AF	I	Local – roadsides
	Polygonum douglasii var. *johnstonii*	Douglas's knotweed	AF	W	Uncommon – Indian Hill
Ranunculaceae	*Ranunculus cymbalaria*	Marsh buttercup	PF	W	Uncommon – Thistle

					Basin, Alvey Spring
Rosaceae	*Amelanchier utahensis*	Utah serviceberry	S	W	Uncommon – Developing Meadow
Family	**Scientific Name**	**Common Name**	**Form**	**UT Dist**	**Comments**
Rosaceae	*Cercocarpus montanus*	Alder-leaf mountain mahogany	S	W	Local – Indian Hill, East Side Hills, East Uplands
	Purshia tridentata	Antelope bitterbrush	S	W	Uncommon – Indian Hill
	Rosa woodsii	Woods's rose	S	W	Local – South Uplands, East Riparian, Alvey Spring
Salicaceae	*Salix exigua* var. *stenophylla*	Coyote willow	S	W	Common – East Riparian, Willow Run
Santalaceae	*Comandra umbellata* var. *pallida*	Bastard toadflax	PF	W	Uncommon – Indian Hill, East Side Hills
Scrophular-iaceae	*Castilleja chromosa*	Common paintbrush	PF	W	Uncommon – uplands throughout area
	Castilleja linariifolia	Wyoming paintbrush	PF	W	Uncommon – uplands throughout area
	Cordylanthus wrightii	Wright's birdbeak	AF	W	Local – Indian Hill, South Uplands, East Side Hills
	Pedicularis centranthera	Pinyon-juniper lousewort	PF	W	Uncommon – South Uplands, Indian Hill
	Penstemon comarrhenus	Dusty penstemon	PF	RE	Uncommon – South Uplands, Indian Hill
	Penstemon eatonii var. *undosus*	Undulate firecracker penstemon	PF	W	Uncommon – South Uplands
Solanaceae	*Nicotiana attenuata*	Coyote tobacco	AF	W	Reported - rare – West Meadows
	Solanum triflorum	Cutleaf nightshade	AF	W	Uncommon – West Meadows
Tamaricaceae	*Tamarix chinensis*	Salt-cedar	S	I	Uncommon – East Riparian, only on USFS lands
Verbenaceae	*Verbena bracteata*	Prostrate vervain	PF	W	Uncommon – South Uplands
Viscaceae	*Arceuthobium divaricatum*	Pinyon dwarf-mistletoe	PF	W	Uncommon – East Side Hills
	Phoradendron juniperinum	Juniper mistletoe	PF	W	Uncommon – South Uplands