Ungulate Baseline Inventory of the Gardiner Basin

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Part 2.

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In late December 2015 Montana Governor Bullock issued a decision allowing a year-round presence of bison on the perimeters of Yellowstone National Park. A critical component of the Governor's decision was "bison will be permitted to occupy suitable habitat in Montana outside of the park within manageable confines and subject to seasonal limits on numbers." In an effort to address the suitable habitat and seasonal limits portions of this decision the Custer-Gallatin National Forest entered into a contract with the Animal and Range Sciences Department, Montana State University to develop an ecological baseline that would provide managers with the information necessary to identify suitable habitat and the capacity of that habitat to sustain bison along with native wildlife. Ecological conditions in the Gardiner Basin were the primary goal of the original effort but by 2017 the Forest Service was becoming increasingly concerned about habitat information for other perimeter areas outside the park. One area that was already experiencing bison occupancy was the Hebgen Basin surrounding the community of West Yellowstone, Montana (Fig. 1). Accordingly, the contract was modified and ecological information was gathered in the Hebgen Basin in 2017 and 2018. This section describes the outcome of field sampling on Forest Service lands in the eastern half of the Hebgen Basin.

To make management decisions as seamless as possible the same sampling protocol described for the Gardiner Basin inventory (Part 1, Appendix A) was used to measure soil and vegetation conditions on Forest Service lands in the Hebgen Basin. In an abbreviated description sampling areas were randomly selected from a suite of mapping polygons based on the same parameters used in the Gardiner Basin namely, forest cover (< 20%), aspect (NE and SW), slope class (0 – 4%, 4 – 15%, 15 – 35% and 35 – 60%) and geology (unconsolidated materials, bedrock). While this approach had generated 58 sample locations in the Gardiner Basin, only 13 sites could be located in the Hebgen Basin (Fig. 2). Fewer sampling locations were generated for Hebgen Basin because the greater proportion of private lands and forest cover limited the area from which to draw samples. Field data is summarized and reported in the same format followed in Part 1. Statistical comparisons use the same format as in Part 1; comparisons producing an alpha or p value less than 0.10 are considered different.

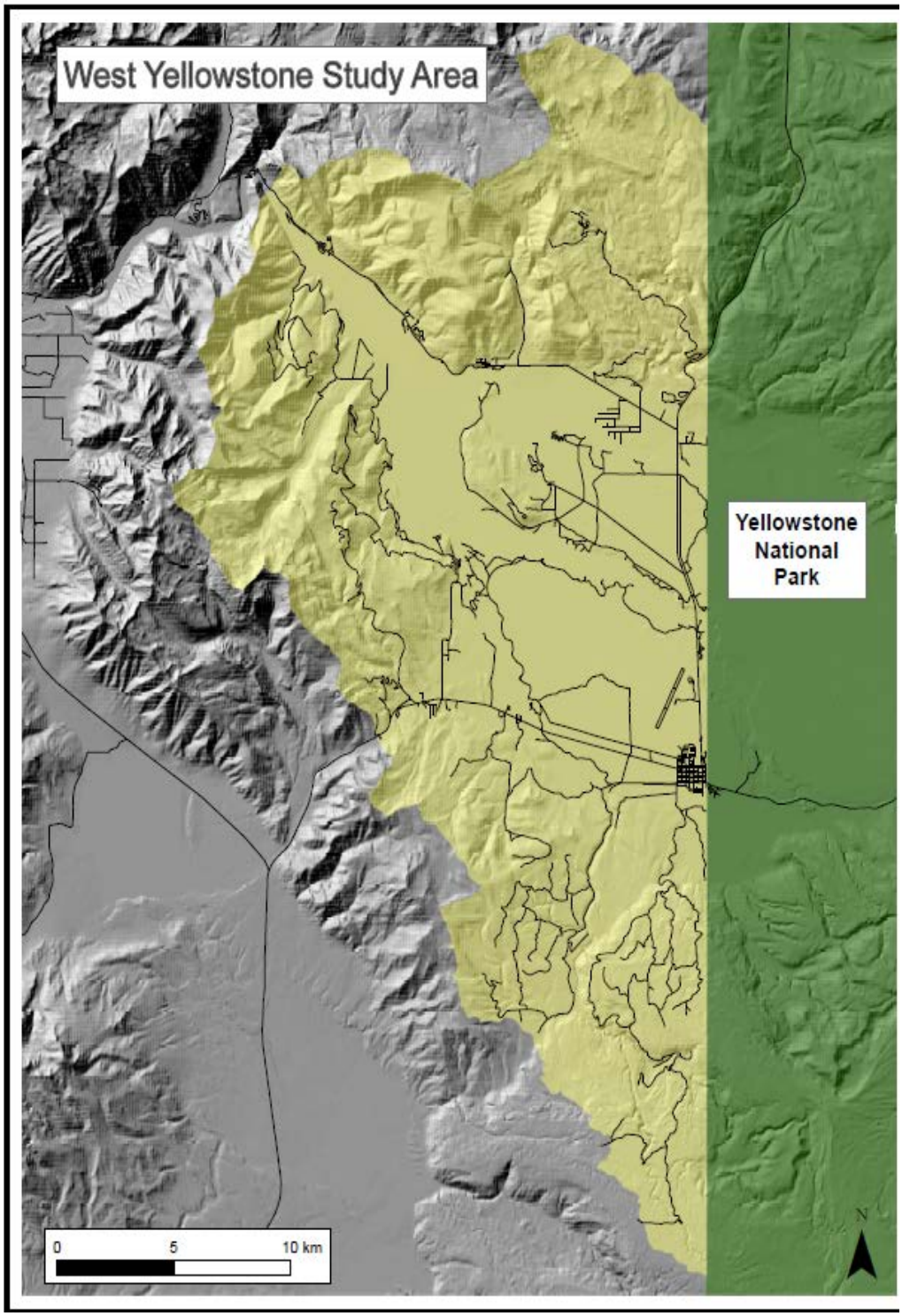


Fig. 1. Ecological baseline study area within the Hebgen Basin, West Yellowstone, Montana.

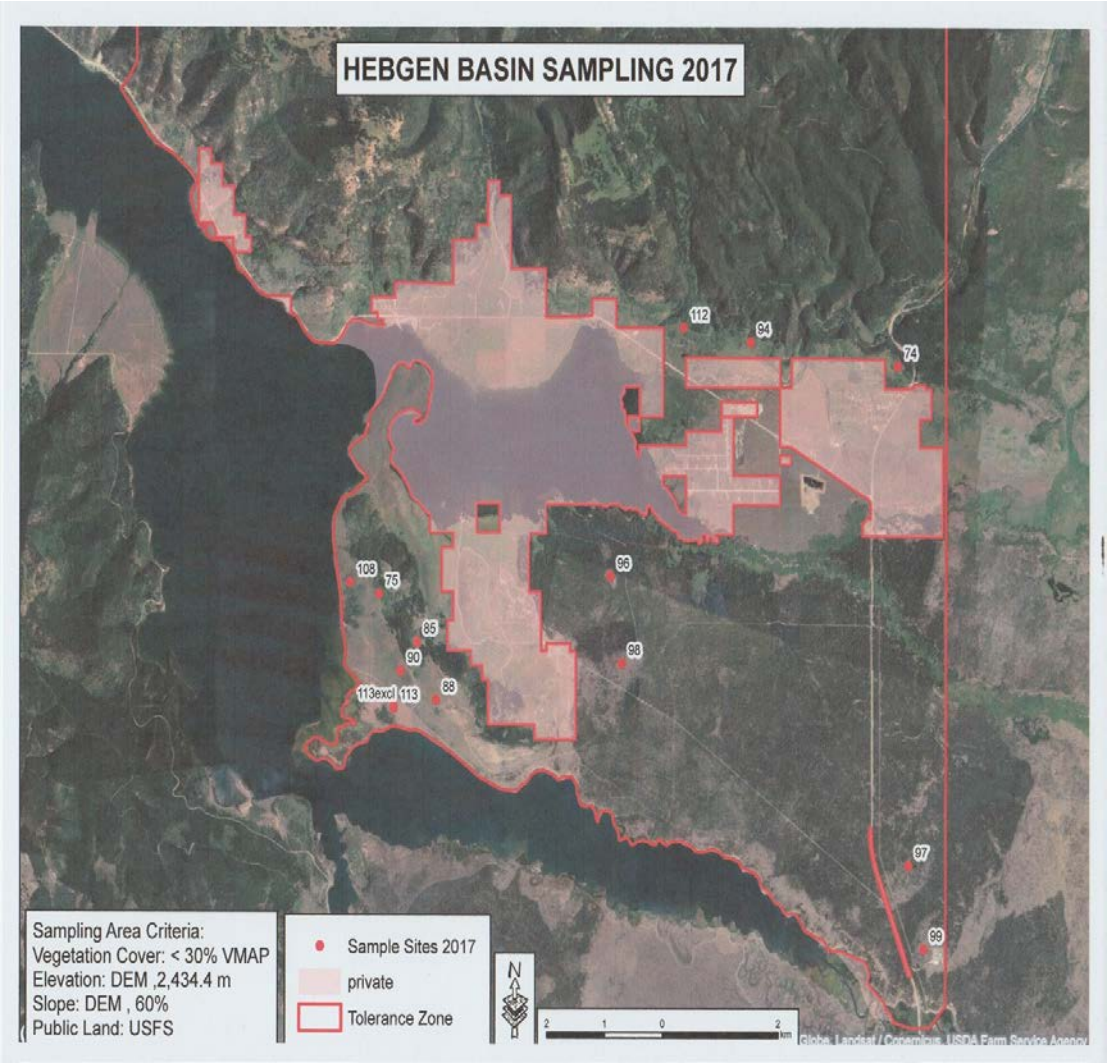


Fig. 2. Ecological baseline sampling locations in the Hebgen Basin, West Yellowstone, MT

Chapter 1

The Physical Setting

Even though the Hebgen Basin landscape has been influenced by volcanism and glaciation the soils and landforms of this area are not as complex as the Gardiner Basin. For example, most of the study area is composed of gravels and sands transported into the Hebgen basin by glacial meltwater flowing off the Yellowstone Plateau to the east (O'Neill and Christiansen 2004). Horse Butte, the most prominent feature within the basin interior has a granite gneiss core surrounded by hardened tuffaceous material from the Huckleberry Ridge explosion of the Yellowstone caldera. In the portion of the study area lying north and west of Grayling Creek sedimentary materials representing the Madison group limestones are interbedded with shales from the Park complex (O'Neill and Christiansen 2004). Lacking the turbulent geologic history of the Gardiner Basin soils in the Hebgen Basin correlate well with the local geologic parent material (Table 1.1).

Table 1.1. Association of soil texture classes and geologic groups described for the Hebgen Basin, West Yellowstone, Montana. Refer to Fig. 2 for location of the various study sites.

Site ID	Parent Material	Soil Texture
74	Madison Group Limestone	Silt loam
94	Madison Group Limestone	Silt loam
112	Madison Group Limestone	Silt loam
96	Glacial Outwash	Sandy loam
97	Glacial Outwash	Loamy sand
98	Glacial Outwash	Loamy sand
99	Glacial Outwash	Sandy loam
75	Huckleberry Tuff/Granite Gneiss	Silt loam
85	Huckleberry Tuff/Granite Gneiss	Silt loam
90	Huckleberry Tuff/Granite Gneiss	Silt loam
88	Glacial Outwash	Sandy loam
108	Glacial Outwash	Sandy loam
113	Glacial Outwash	Sandy loam

Finer grained materials, volcanic tuff, gneiss and limestone, tend to erode into silt sized materials while the glacial outwash has produced larger grained or sand sized particles. Hebgen Basin sites 96, 97, 98, 99 and 113 had significantly higher percentages of sand ($p < 0.10$) in the A horizon than found in the same horizon at the other sites. Sites 88, 90, 108 and 112 had a sandier textured A horizon ($p < 0.10$) than found at sites 74, 75, 85 and 94. Not surprisingly, these last sites (74, 75, 85 and 94) had significantly higher ($p < 0.10$) amounts of silt sized materials in the A horizon than recorded for any of the other sites. This initial soil inventory indicates there are more silt loam and loamy textured soils in the Hebgen Basin, 38%, than in the Gardiner Basin, 8%. Only one Hebgen Basin site, 108, contained clay textured materials and this was found in the lower C horizon. Equally important is that soil depth did not differ ($p > 0.10$) among the Hebgen Basin inventory sites while there was a highly significant difference ($p < 0.10$) in soil depth among the Gardiner Basin sites (Part 1). In terms of plant community composition and potential grazing recovery it is worth noting that these physical properties can be used to identify sites that can sustain grazing (see Chapter 2 for more details).

Chapter 2

Reference communities. The Vegetation Baseline

Following the statistical procedures used in Part 1 of this report we were able to identify 5 distinct community types (Fig. 2.1) with a sixth that may represent a degraded phase of one of the five. Excluding the abandoned agricultural fields and various community type phases 5 primary community types were also described for the Gardiner Basin (Table 2.1). Similar to outcomes for the Gardiner Basin analyses Hebgen Basin community types group according to the dominate shrub cover recorded

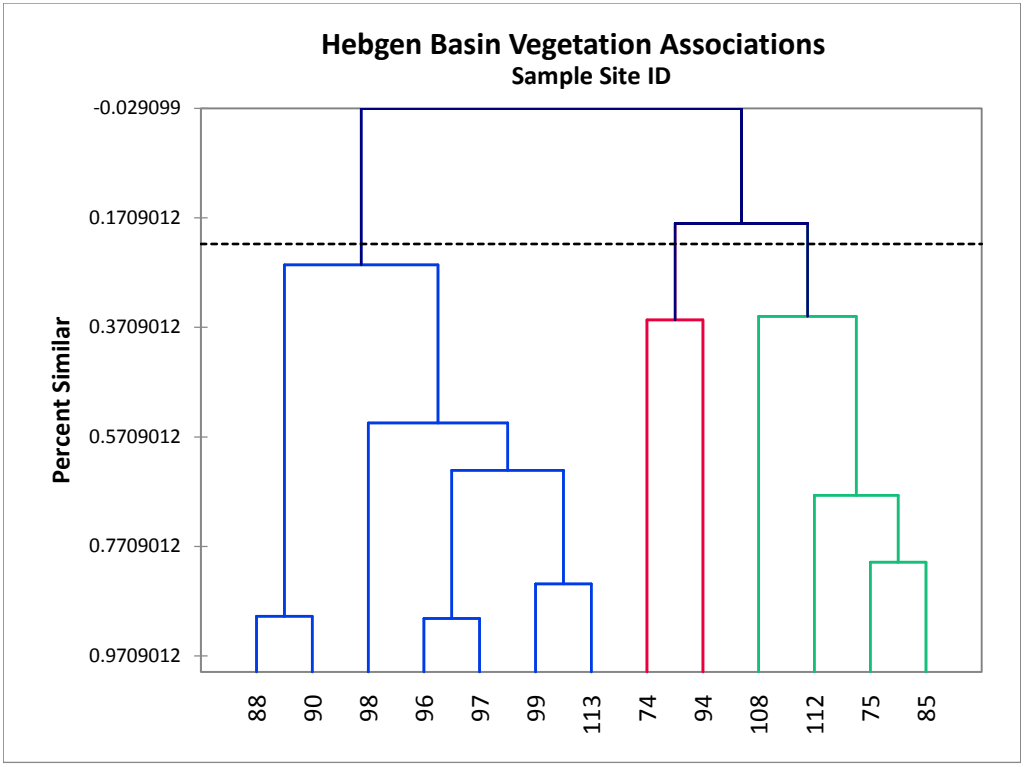


Fig. 2.1. Results of hierarchal cluster analysis of vegetation attributes for the 13 inventoried sites in the Hebgen Basin, West Yellowstone, MT

at each site. However, unlike communities inventoried in the Gardiner Basin tree cover was a secondary metric for community type delineation in the Hebgen Basin. Other than the drought tolerant Rocky Mountain Juniper (*Juniperus scopulorum)* trees were relatively uncommon in the Gardiner Basin (Fig 2.2) while two Hebgen Basin community types were differentiated by the presence of aspen (*Populus tremuloides*) and lodgepole pine (*Pinus contorta)*. Even though Hebgen and Gardiner Basin shared several community types dominated by Mountain big sagebrush (*Artemisia tridentata vaseyana)* a fourth community type was dominated by antelope bitterbrush (*Purshia tridentata*), a shrub species not encountered in the Gardiner Basin. Most importantly, the community types identified in the Hebgen Basin were closely associated with soil texture.

Table 2.1. Non-forested community types identified in the Gardiner and Hebgen Basins of southwestern Montana.

Gardiner Basin	Hebgen Basin
Abandoned Agricultural Fields	Mountain Big Sagebrush/Bluebunch Wheatgrass
Basin Big Sagebrush	Mountain Big Sagebrush/Idaho Fescue
Black Sagebrush	Mountain Big Sagebrush/Western Snowberry
Grasslands	Antelope Bitterbrush/Bluebunch Wheatgrass
Mountain Big Sagebrush	Aspen/Showy Cinquefoil
	Kentucky bluegrass/Sticky Geranium

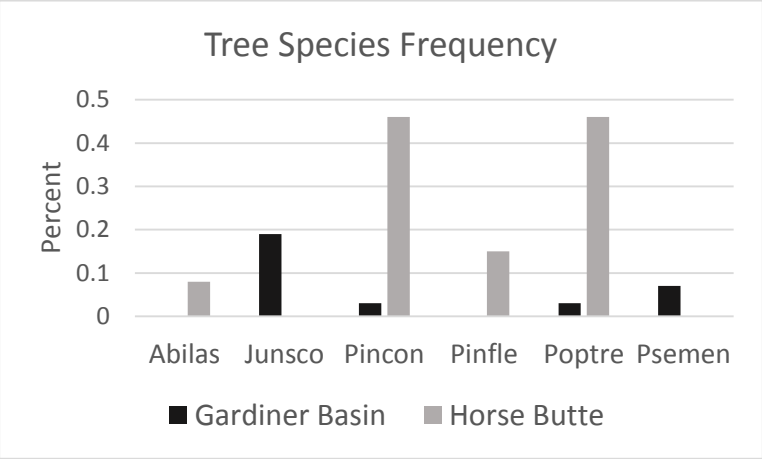
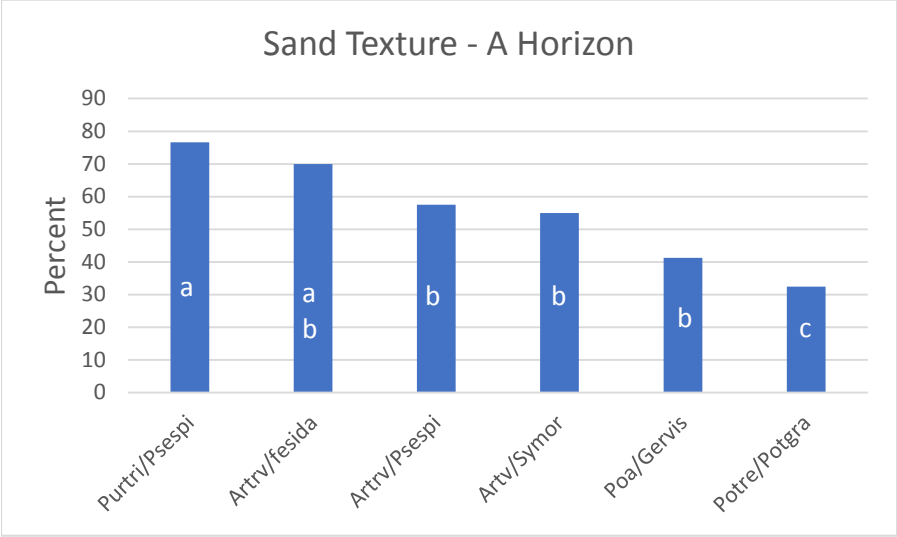


Fig. 2.2. Species frequency of occurrence based on the number of tree species occurring at each inventoried site in the Gardiner and Hebgen Basins, Montana. Higher percentages indicate more tree species were recorded in the Hebgen basin during the field surveys.

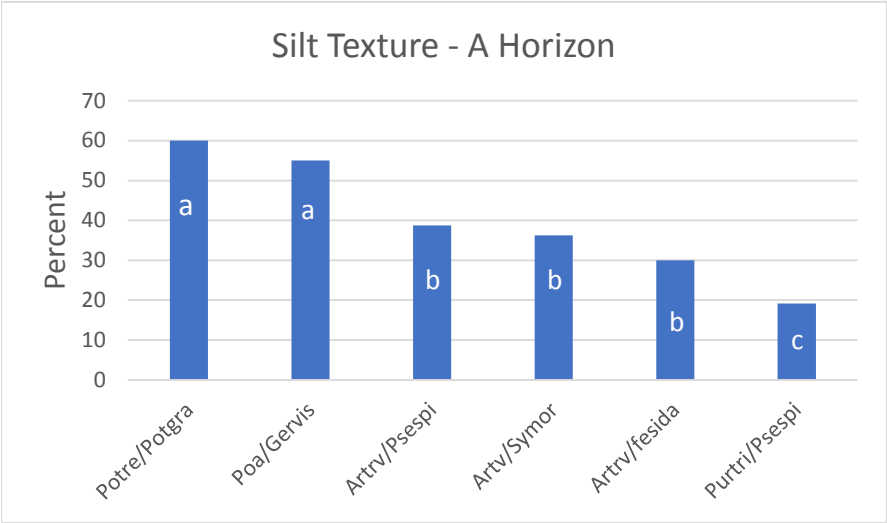
Hebgen basin vegetation community types occurred along a sand content gradient (Fig. 2.3a). Antelope bitterbrush/bluebunch wheatgrass (*Purshia tridentata/Pseudoroegneria spicata*) and mountain big sagebrush/Idaho fescue (*Artemisia tridentata vaseyana/Festuca idahoensis)* community types had the highest amount of sand ($p < 0.10$) in the A soil horizon with progressively less sand in the mountain big sagebrush/bluebunch wheatgrass (*A. trid. vaseyana/Pseudoroegneria spicata),* mountain big sagebrush/western snowberry (*A. trid. vaseyana/Symphoricarpos albus)*, Kentucky bluegrass/sticky geranium (*Poa pratensis/Geranium viscosissimum)* and aspen/slender cinquefoil (*Populus tremuloides/Potentilla gracilis)* type. The strength of the texture – community type relationship is reinforced by the reverse ranking based on the amount of silt.

The community type with the least amount of sand in the A horizon, aspen/showy cinquefoil, had the greatest amount of silt (Fig. 2.3b). Silt content was progressively lower in the remaining community types with the antelope bitterbrush/bluebunch wheatgrass type having the least amount of silt in the A

horizon (Fig 2.3b). This texture-community type relation provides an opportunity to predict community type from soil inventories on sites where the plant community type is questionable. Equally important is the ability to use soils information to identify those community types (silt loam to loam) that have the greatest potential to sustain grazing.



(a)



(b)

Fig. 2.3 Texture of the A horizon in each of the vegetation community types identified in the Hebgen Basin, West Yellowstone, Montana. Bars with different letters are statistically different at $p < 0.10$.

Having been identified these community types can now be used as the ecological baseline for monitoring the sustainability of grazing in the Hebgen Basin. A general description of each community type follows with the detailed reference description presented in Appendix A.

Mountain Big Sagebrush/Bluebunch Wheatgrass Community Type Description

Sites – 88, 90

This community type is found primarily on bedrock dominated sites with a southwest exposure. Soils range from sandy to silt loams on moderate (15 – 35%) to steep slopes (35 – 60%). Mountain big sagebrush (*Artemisia tridentata vaseyana)* is the dominate vegetative cover and these communities have more than 3 times the amount of bluebunch wheatgrass (*Pseudoroegneria spicata*) as the other types in the basin. Idaho fescue (*Festuca idahoensis)* and lupine (*Lupinus caudatus)* have less than half the cover of bluebunch wheatgrass but still make up more than 5% of the community composition. In this community type total grass cover (25%) exceeds forb cover (11%).

Mountain Big Sagebrush/Idaho Fescue Community Type Description

Sites – 99, 113

This community type is found on unconsolidated landforms with little to no slope (0 – 4%). Soils are sandy loams with nearly as much sand in the A horizon as the Antelope bitterbrush/Bluebunch wheatgrass type. Mountain big sagebrush cover is roughly half of that found in the mountain big sagebrush/bluebunch wheatgrass type but comparable to the level found in the mountain big sagebrush/western snowberry community type. The greater amount of Idaho fescue cover separates this type from the other two mountain big sagebrush dominated community types. This community type can also be differentiated from the other mountain big sagebrush types because it has the greatest cover of Small-leafed Pussytoes (*Antennaria microphylla).* Records indicate this forb species increases in sagebrush-grassland communities that are heavily grazed (FEIS 2019). The greater abundance of forbs (26%) as compared to total grass cover (18%) is another indicator of low ecological condition.

Mountain Big Sagebrush/Western Snowberry Community Type Description

Sites – 108, 112

This community type is found on unconsolidated landforms with a southwest aspect. Soils are sandy to silt loams occurring on gentle (4- 15%) to moderately steep (15 – 35%) slopes. Mountain big sagebrush and western snowberry (*Symphoricarpos albus*) dominate and are nearly equal in cover. Unlike the herbaceous composition in the other two sagebrush dominated communities the non-native Kentucky bluegrass (*Poa pratensis)* is the most abundant grass species. Forb cover (23%) exceeds that of the grasses (16%). Due in part to the high forb composition this is the most productive community type in the basin.

Antelope Bitterbrush/Bluebunch wheatgrass Community Type Description

Sites – 96, 97, 98

This community type occupies the sandiest soils in the basin. Nearly the entire soil profile is sand (Fig. 2.4). Under these conditions soil moisture will be restricted and lead to limited vegetative production and slow recovery from grazing. This type commonly occurs on the glacial outwash landforms with little

to no slope (0 – 4%). Antelope bitterbrush (*Purshia tridentata)* is the most common shrub in this type. Bluebunch wheatgrass and Idaho fescue are the dominate grass species but the grazing tolerant forb, Small-leafed Pussytoes, is the most abundant herbaceous cover. The next most common forbs, sulfur-flowered buckwheat (*Eriogonum umbellatum)* and long-leafed phlox (*Phlox longifolia),* are also reported to increase under grazing pressure (Wambolt nda). Overall forb cover (15%) exceeds grass cover (9%) in this type.

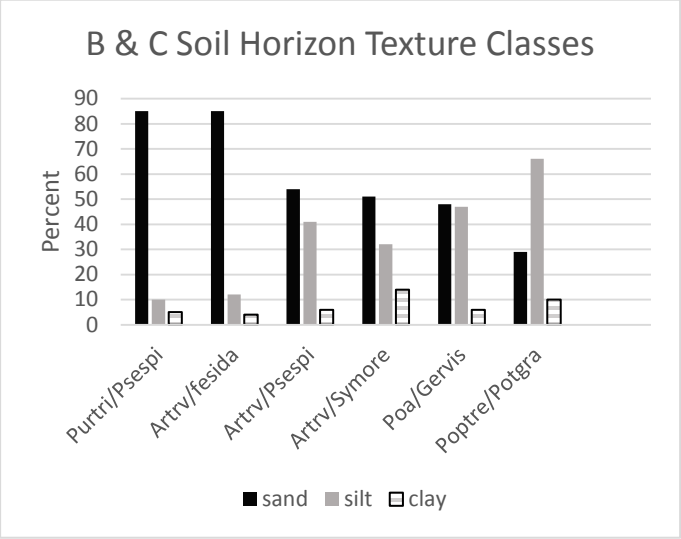


Fig. 2.4. Comparison of sand content in lower soil horizons occupied by non-forested vegetation community types in the Hebgen Basin, West Yellowstone, Montana.

Kentucky bluegrass/Sticky Geranium Community Type Description

Sites - 75, 85

This community type occurs on bedrock dominated sites with flat to north easterly aspects. Slopes run from nearly level (0 – 4%) to gently sloping (4 – 15%) and the soil horizon has significantly more ($p < 0.10$) silt than the sagebrush and antelope bitterbrush dominated sites. Even though low amounts of aspen (*Populus tremuloides)* are present, the non-native Kentucky bluegrass (*Poa pratensis*) dominates total herbaceous cover. The forbs sticky geranium (*Geranium viscosissimum),* slender cinquefoil (*Potentilla gracilis)* and sulfur-flower buckwheat (*Eriogonum umbellatum)* provide secondary cover. Native grasses, like Idaho fescue, make up less than 10% of the remaining vegetative cover. The remnant amounts of aspen, Idaho fescue and bluebunch wheatgrass coupled with the high amount of non-native grasses and the shade intolerant sticky geranium suggest this type may represent a degraded phase of the aspen/showy cinquefoil community type.

Aspen/Slender Cinquefoil Community Type Description

Sites – 74, 94

This community type occupies flat to gentle slopes (4 – 15%) on bedrock controlled landforms. Soils in the aspen (*Populus tremuloides)/*slender cinquefoil (*Potentilla gracilis)* type have high amounts of silt in the A horizon like the Kentucky bluegrass/sticky geranium type and significantly more ($p < 0.10$) silt than in the same soil horizon of any of the shrub dominated types. Aspen and smaller amounts of mountain big sagebrush form the woody component of this community type with a variety of forb species making up over 34% of the vegetative cover. While grass species constitute 15% of the remaining herbaceous cover, over half of this is made up of two non-native species timothy (*Phleum pratense)* and Kentucky bluegrass. Both non-native species are highly palatable to wildlife and livestock but timothy will decline under heavy grazing.

Chapter 3

Shrub Intercept Cover and Density Baseline

With the focus on wildlife use within Forest Service lands in the Hebgen Basin it would be helpful to have a second vegetation metric that could be used in tracking ecological condition of non-forested vegetation communities. Shrubs and trees are generally considered the most persistent vegetation groups on the landscape so we obtained a second group of metrics describing the current status of the identified community types. It is important to understand that the cover measures reported in this chapter will not match those reported in Appendix A. The difference arises because the cover estimates in Appendix A were drawn from 0.2m x 0.5m microplots placed at 20m intervals long a 50m tape. Consequently, this sampling protocol missed some shrubs long the transect line. The measures listed in this chapter were derived from direct measurements of all shrubs intercepted by the transect line. The line intercept measure produces a more robust estimate of shrub cover at the sample locality and is less subject to sampling error in later years.

Woody species cover varied considerably among the six community types (Table 3.1). Mountain big sagebrush cover is greater ($p < 0.10$) in the three sagebrush types than in the other community types.

Table 3.1. Woody species cover in Hebgen Basin community types. Values within rows with different superscripts are different at $p < 0.10$.

Woody Species	Artri Psesp	Artri Fesida	Artri Symalb	Purtri Psespi	Poapra Gervis	Poptre Potgra
A. tridentata vaseyana	18.4[a]	8.6[b]	12.3[c]	0.4[d]	0.07[d]	2.5[d]
Symphoricarpos alba	1.2[a]	0[c]	6.6[b]	0[c]	.02[c]	.05[c]
Pinus contorta	0[a]	1.6[b]	0[a]	3.9[c]	0[a]	0[a]
Populus tremuloides	0[a]	0[a]	0.8[b]	0[a]	0.6[a]	1.4[c]
Purshia tridentata	0[a]	0.3[a]	0[a]	1.1[b]	0[a]	0[a]

Importantly, there are differences in sagebrush cover among the three types with the mountain big sagebrush/bluebunch wheatgrass community type having the highest sagebrush cover. Western snowberry co-dominates with mountain big sagebrush in the mountain big sagebrush/western snowberry type and fills a minor role in the other mountain big sagebrush types. The impact of lodgepole pine cover on sample site selection becomes apparent through more robust sampling.

As expected antelope bitterbrush cover was highest in the antelope bitterbrush/bluebunch wheatgrass type but even with efforts to avoid areas with forest canopy cover lodgepole pine cover still exceeded that of bitterbrush. The significant amount of lodgepole pine cover in the antelope bitterbrush/bluebunch wheatgrass type heightens concern about the grazing resiliency of this community type. Elevated competition for water and sunlight because of the

presence of pines in the overstory coupled with the low water holding capacity of sandy soils means low forage production and, importantly, very limited capacity to recover from grazing. Another tree species, aspen, contributed low amounts of cover in 3 of the six community types.

There was more aspen cover in the aspen/slender cinquefoil type ($p < 0.10$) than recorded in the mountain big sagebrush/western snowberry type but the latter type also had more aspen cover than the other four grass/shrub types. Aspen cover measures in the aspen/slender cinquefoil and mountain big sagebrush/western snowberry community types represent small trees (< 2m in height) which are vulnerable to browsing damage because of their short stature. This vulnerability is noteworthy because these young aspen represent recruits needed to fill in stands when mature trees die. Loss of this small size class unhinges the sustainability of the forest canopy component of the aspen/slender cinquefoil type. The Kentucky bluegrass/sticky geranium type may actually be an aspen community type that has lost the tree overstory through repeated browsing of small aspen suckers.

Density (number of individual stems/m^2) of the most common woody species in this inventory differs among the six community types (Table 3.2). All of the sagebrush dominated community

Table 3.2. Woody species density (stems/m^2) within the various non-forested community types described for the Hebgen Basin, West Yellowstone, Montana. Values in rows with different superscripts are different at $p < 0.10$.

Woody Species	Artri Psespi	Artri Fesida	Artri Symalb	Purtri Psespi	Poapra Gervis	Poptre Potgra
A. tridentata vaseyana	0.9^a	0.5^a	0.8^a	0.03^b	0.01^b	0.2^{ab}
Symphoricarpos alba	0.1^a	0^a	$0.b^b$	0^a	0.1^a	$.03^a$
Pinus contorta	0^a	0.01^a	0^a	0.1^b	0.01^a	0.02^a
Populus tremuloides	0^a	0^a	0.1^a	0^a	0.2^a	0.4^b
Purshia tridentata	0^a	0^a	0.4^b	0.04^c	0^a	0^a

types were equivalent in shrub density and similar to the sagebrush density in the aspen/slender cinquefoil type. However, mountain big sagebrush cover was nearly absent from sites dominated by the antelope bitterbrush/bluebunch wheatgrass and Kentucky bluegrass/sticky geranium types. The significantly greater western snowberry cover ($p < 0.10$) in the mountain big sagebrush/western snowberry type coupled with the higher cover measures for snowberry (Table 3.1) expands the evidence that this association is a distinct community type. The same relationship exists for lodgepole pine in the antelope bitterbrush/bluebunch wheatgrass type. Both conifer cover and density are higher ($p < 0.10$) in the antelope bitterbrush/bluebunch wheatgrass type than in any of the other types. Even though pine cover in the mountain big sagebrush/Idaho fescue type was higher than most of the other community

types (Table 3.1) conifer density was not different from that recorded in the other community types. Aspen sucker and small tree density was highest in the aspen/slender cinquefoil type even though low counts were recorded in two other communities. Unexpectedly, antelope bitterbrush density was higher in the mountain big sagebrush/western snowberry type than in the antelope bitterbrush/bluebunch wheatgrass type. The disconnect between shrub density and cover measures for antelope bitterbrush, high stem density but low cover, in the mountain big sagebrush community type suggests a greater amount of young bitterbrush shrubs in the sagebrush community. Higher soil water content due to the silt loam soils and little to no shading from lodgepole pine in the sagebrush/snowberry community type provides better growing conditions for bitterbrush. Better growing conditions are important because antelope bitterbrush is one of the most palatable shrubs and is browsed throughout the year. Consequently, the limited bitterbrush density in the antelope bitterbrush/bluebunch wheatgrass type reinforces the point that lacking the better growing conditions found in the sagebrush/snowberry type the antelope bitterbrush component of the antelope bitterbrush/bluebunch wheatgrass type is unlikely to survive under heavy or frequent browsing by elk and bison.

Outcomes from repeat sampling of listed sites can be compared to information in Tables 3.1 and 3.2 to gain an objective view of the sustainability of the Hebgen Basin shrub component under current and future bison and elk population levels.

Chapter 4

Application of the Reference Baseline

Using this Information to Determine Ecosystem Sustainability

This chapter demonstrates how to use the soils and vegetation cover data in Chapter 2 to determine the ecological condition of a site or sites in the Hebgen Basin. The first step is to determine the community type using the identification key shown in Fig. 4.1. In this example exercise, data has been drawn from the Gardiner field survey (Part 1) to demonstrate how to use Fig. 4.1 to identify the community type under review. The demonstration information for the new stand is shown in Table 4.1. With 9% sagebrush cover, the site would fall into the mountain big sagebrush (*Artemisia tridentata vaseyana*) cover greater than 5% so we can ignore community types that have little or no sagebrush. The next criteria in Fig. 4.1, moves the reviewer to the native grass heading because there are no non-native or introduced grasses at the new site. Under this heading the reviewer can choose between bluebunch wheatgrass (*Pseudoroegneria spicata*) cover exceeding that of Idaho fescue (Festuca idahoensis) or the

Table 4.1. Actual soils and vegetation canopy cover data used to represent a new monitoring site in the Hebgen Basin, West Yellowstone, MT

Species	Cover %	Soils
A. trid. vaseyana	9	
Festuca idahoensis	21.75	
Pseudoroegneria spicata	10.75	Sandy loam
Poa secunda	1.75	
Koeleria macrantha	0.5	
Total forbs	7.6	

fescue cover exceeding that of the wheatgrass. On this new site Idaho fescue is nearly 2 times as abundant as that of bluebunch wheatgrass so the site appears to fall into the mountain big sagebrush/Idaho fescue community type. Even though total forb cover fails to exceed 11%, sandy loam soils on the site strengthen the decision that the new site is occupied by the mountain big sagebrush/Idaho fescue type (see community type description in Chapter 2). Once the community type has been identified then we can proceed with evaluation of the sites ecological condition by comparing the information in Table 4.1 to the appropriate community type reference found in Appendix A. Table 4.2 contains the comparison between canopy cover measures obtained at the new sites and those developed for the ecological baseline.

Fig. 4.1. Key to the identification of non-forested community types in the Hebgen Basin, West Yellowstone, Montana.

1. *Artemisia tridentata vaseyana* cover > 5%

    2. Native grass cover > 5 %; introduced grasses absent or less than 3%

        3. Pseudoroegneria spicata cover 2 to 3 times Festuca idahoensis cover; forb cover < 11%; sandy to silt loam soils

            ……..***Artemisia tridentata vaseyana/Pseudoroegneria spicata*** Type

        3. Festuca idahoensis cover 2 to 3 times Pseudoroegneria spicata cove; forb cover > 11%; sandy loam soils

            …… ***Artemisia tridentata vaseyana/Festuca idahoensis*** Type

    2. Non-native or introduced grass cover > 5%, native grasses absent or less than 3%

        3. Artemisia tridentata vaseyana cover > 5%; Symphoricarpos albus cover > 5%; introduced grass cover > 5%; sandy loams to loams …….. ***Artemisia tridentata vaseyana/Symphoricarpos albus*** Type

1. *Artemisia tridentata vaseyana* absent or < 5% cover

    2. Purshia tridentata cover 3% or higher; Pseudoroegneria spicata cover > Festuca idahoensis cover; soils sandy loams to loamy sands …… ***Purshia tridentata/Pseudoroegneria spicata*** Type

    2. Populus tremuloides cover 1 – 3% cover; silt loam soils

        3. Populus tremuloides cover < 2%; Poa pratensis cover > 10%; Geranium viscosissimum cover > 5%

            ……..... ***Poa pratensis/Geranium viscosissimum*** Type

        3. Populus tremuloides cover > 2%; Poa pratensis cover < 10%; Potentilla gracilis cover > 5%;

Phleum Pratense cover > 5%..... ***Populus tremuloides/Potentilla gracilis*** Type

Table 4.2. Comparison of canopy cover values between a newly inventoried mountain big sagebrush/Idaho fescue community type and the reference baseline for the same community type.

Species	New Site Cover %	Reference Cover %
A. trid. vaseyana	9	6.2
Purshia tridentata	0	0.4
Festuca idahoensis	21.75	10.7
Pseudoroegneria spicata	10.75	2.9
Carex filifolia	0	1.6
Poa secunda	1.75	1.1
Koeleria macrantha	0.5	0.5
Danthonia intermedia	0	0.3
Carex geyeri	0	0.2
Total forbs	7.6	26.4

Grass and forb cover at the new site exceed the levels listed in the baseline reference so this site could be considered in good ecological condition. Even though the new site has a third of the forb cover found in the reference community this difference must be viewed with care because over half of the forb cover in the Hebgen Basin baseline reference is made up of small-leafed pussytoes (*Antennaria microphylla*) which is an indicator of heavy grazing pressure (see the mountain big sagebrush/Idaho fescue community type description in Chapter 2). Improvement or decline in ecological condition at the reference sites (site locations are described in Appendix B) or other new sites can be determined by comparing vegetation canopy cover measures to the community type reference values listed in Appendix A. This process was followed for each of the community types identified in the Hebgen Basin (Tables 4.3 – 4.8).

Few of the reference community types closely match the ecological potential described by Mueggler and Stewart (1980) or Mueggler (1988). For example, the Hebgen Basin Mountain Big Sagebrush/Bluebunch Wheatgrass type (Table 4.3) has less than half the expected bluebunch wheatgrass (*Pseudoroegneria spicata)*, junegrass (*Koeleria macrantha)* and Sandberg bluegrass (*Poa secunda*) cover listed for a similar community type. In contrast, the same Hebgen Basin type has more sagebrush and forb cover than expected. This suggests the Hebgen Basin community type occupies a moister micro-environment than did the indicator state described by Mueggler and Stewart (1980). Moister conditions coupled with more productive soils (Fig. 2.4) should produce grass cover very near the anticipated amount in the available ecological potential. The fact that the potential grass cover was not recorded in the Hebgen Basin supports the interpretation that this reference community type is in low ecological condition and vulnerable to grazing impacts. Even though the Hebgen Basin reference community reflects a low ecological condition it can still serve as an effective baseline for determining management outcomes. The same general pattern is apparent in the other 5 community types (Tables 4.4 – 4.8), each is below its ecological potential.

Table 4.3. Comparison of Hebgen Basin the mountain big sagebrush/bluebunch wheatgrass community type with the description for the sagebrush/bluebunch wheatgrass community type in Mueggler and Stewart 1980. Artr/Psespi = mountain big sagebrush/bluebunch wheatgrass C.T., Artr/Fesida = mountain big sagebrush/Idaho fescue C.T., Artr/Symalb = mountain big sagebrush/western snowberry C.T.

Artr/Psespi Mueggler & Stewart		Artr/Psespi	similarity
A. trid. vaseyana	15	19	above
Artemisia frigida	2	0	absent
Gutierrezia sarothrae	2	0	absent
Pseudoroegneria spicata	32	13	below
Festuca idahoensis	0	6	above
Koeleria macrantha	5	0.4	below
Poa pratensis	0	3	above
Poa secunda	2	0.3	below
Hesperostipa comata	2	0	absent
Bouteloua gracilis	1	0	absent
Carex spp	1	2	above
Achnatherum nelsonii	0	0.5	absent
Lupinus sericeus	1	6	above
Oxytropis besseyi	1	0	absent
Phlox hoodii	1	0	absent
Antennaria microphylla	P	3	above
Geranium viscosissimum	0	1	above
Eriogonum umbellatum	P	0.2	similar
Phlox longifolia	0	0.1	above

Table 4.4. Comparison of Hebgen Basin mountain big sagebrush/Idaho fescue community type with descriptions for the sagebrush/Idaho fescue community type in Mueggler and Stewart 1980. Artr/Fesida = mountain big sagebrush/Idaho fescue C.T. Species with * indicate current binomial rather than the one used in the 1980 publication.

Artr/Fesida Mueggler and Stewart		Artr/Fesida	similarity
A. trid. vaseyana	23	6	below
Purshia tridentata	0	0.4	similar
Festuca idahoensis	36	11	below
Pseudoroegneria spicata*	2	3	similar
Carex ssp	9	2	below
Poa secunda*	6	1	below
Koeleria macrantha	3	0.5	below
Danthonia intermedia	16	0.3	below
Antennaria microphylla*	1	17	above
Eriogonum umbellatum	10	4	below
Phlox hoodii	0	2	above
Phlox longifolia	3	1	below
Arenaria congesta	3	1	below
Lupinus wyethii	1	0.3	below
Geum trifolium	10	0.1	below

Table 4.5. Comparison of Hebgen Basin mountain big sagebrush/western snowberry community type with descriptions for the sagebrush/Idaho fescue community type in Mueggler and Stewart 1980. Artr/Symalb = mountain big sagebrush/western snowberry C.T. Species with * indicate current binomial rather than the one used in the 1980 publication.

Artr/Fesida Mueggler and Stewart		Artr/Symalb	similarity
A. trid. vaseyana	23	10	below
Symphoricarpos albus	0	9	similar
Festuca idahoensis	36	1	below
Danthonia intermedia	16	0.5	below
Achnatherum nelsonii*	14	0	below
Bromus porteri*	13	1	below
Elymus trachycaulus*	12	0	below
Carex spp	9	2	below
Poa secunda*	6	1	below
Koeleria macrantha	3	0.5	below
Hesperostipa comata*	2	0	absent
Pseudoroegneria spicata*	2	3	similar
Phleum pratense	0	0.2	above
Pascopyrum smithii	0	0.1	above
Antennaria microphylla*	1	0	absent
Eriogonum umbellatum	10	1	below
Geum trifolium	10	1	below
Achillea millefolium	8	1	below
Helianthella uniflora	7	4	below
Geranium viscosissimum	5	3.5	below
Potentilla arguta	4	0	absent
Arenaria congesta	3	0	absent
Phlox longifolia	3	0	absent
Potential gracilis	3	2	similar
Erigeron compositus	2	3	similar
Astragalus miser	2	0	absent
Cerastium arvense	2	0	absent
Phlox multiflora	2	0	absent
Campanula rotundifolia	1	0	absent
Linum perenne	1	0	absent
Lomatium triternatum	1	0	absent
Lupinus wyethii	1	3	above
Polygonum douglasii	1	0	absent
Potentilla glandulosa	1	0	absent
Chamerion angustifolium	0	1	above
Symphyotrichum campestre	0	1	above

Table 4.6. Comparison of Hebgen Basin antelope bitterbrush/bluebunch wheatgrass community type with the description for the antelope bitterbrush/bluebunch wheatgrass community type in Mueggler and Stewart 1980. Purtri/Psespi = antelope bitterbrush/bluebunch wheatgrass C.T. Species with * indicate current binomial rather than the one used in the 1980 publication.

Purtri/Psespi Mueggler and Stewart		Purtri/Psespi	similarity
Purshia tridentata	15	3	below
Pseudoroegneria spicata*	58	4	below
Hesperostipa comata*	5	0	absent
Nassella viridula	0.5	0	absent
Koeleria macrantha	0.5	0.5	similar
Poa secunda	0.5	0.1	below
Achnatherum nelsonii*	0	0.2	above
Festuca idahoensis	0	2	above
Carex geyeri	0	2	above
Poa pratensis	0	1	above
Balsamorhiza sagittata	12	0	absent
Phlox hoodii	2	1	similar
Mysotis micrantha	1	0.2	similar
Phacelia linearis	1	0	absent
Stellaria spp	1	0	absent
Antennaria microphylla*	0.5	7	above
Achillea millefolium	0.5	0.2	similar
Heterotheca villosa*	0.5	0	absent
Chaenactis douglasii	0.5	0	absent
Crepis spp	0.5	0	absent
Lithospermum ruderale	0.5	0	absent
Lupinus sericea	0.5	1	similar
Oxytropis spp	0.5	0	absent
Phlox longifolia	0.5	1	similar
Arenaria congesta	0	0.2	similar
Eriogonum umbellatum	0	3	above
Symphyotrichum ericoides	0	0.3	similar

Table 4.7. Comparison of Hebgen Basin Kentucky bluegrass/sticky geranium community type with the description for the aspen/western snowberry community type in Mueggler 1988. Poapra/Gervis = kentucy bluegrass/sticky geranium C.T. Species with * indicate current binomial rather than the one used in the 1988 publication.

Poptre/Symalb/Tall forb Mueggler 1988		Poapra/Gervis	similarity
Populus tremuloides	68	1.5	below
Pinus flexilis	4	0	below
Abies concolor	2	0	below
Abies lasiocarpa	2	0	below
Picea engelmanni	2	0	below
Pinus contorta	1	0	below
Pseudotsuga menziesii	2	0	below
Symphoricarpos albus	57	0.4	below
Pachistima myrsinites	7	0	below
Ribes lacustre	6	0	below
Ribes cereum	5	0	below
Amelanchier alnifolia	2	0	below
Poa palustris	38	0	absent
Calamagrostis rubescens	20	0	absent
Carex geyeri	12	2	below
Poa pratensis	12	26	above
Elymus glaucus	9	0	absent
Bromus porteri*	8	2	below
Phleum pratense	7	1	below
Leymus cinereus*	6	0	absent
Elymus trachycaulus	5	0	absent
Festuca idahoensis	0.5	3	above
Pseudoroegneria spicata	0	1	absent
Poa secunda	0	0.1	similar
Artemisia ludoviciana	14	0	absent
Rubeckia occidentalis	13	0	absent
Thalictrum fendleri	11	0	absent
Geranium richardsonii	11	0	absent
Trifolium longipes	10	0	absent
Arnica cordifolia	9	0	absent
Geranium viscosissimum	6	8	above
Lupinus caudatus	2	1	below
Symphyotrichum ericoides	2	0.2	
Potentilla gracilis	1	4	above
Achillea millefolium	1	1	similar
Antennaria microphylla	0.5	2	above
Arenaria congesta	0	0.1	similar
Geum trifolium	0	0.1	similar
Eriogonum umbellatum	0	3	above

Table 4.8. Comparison of Hebgen Basin aspen/slender cinquefoil community type to the description for the aspen/Kentucky bluegrass community type in Mueggler 1988. Poptre/Potgra = aspen/slender cinquefoil C.T. Species with * indicate current binomial rather than the one used in the 1988 publication.

Poptre/Poapra Mueggler 1988		Poptre/Potgra	similarity
Populus tremuloides	71	3	below
Abies concolor	5	0	absent
Picea pungens	5	0	absent
Pinus contorta	4	0	absent
Picea engelmanni	3	0	absent
Abies lasiocarpa	2	0	absent
Pseudotsuga menziesii	1	0	absent
Pinus flexilis	1	0	absent
Symphoricarpos albus	3	0	absent
Berberis repens	3	0	absent
Rosa woodsii	2	0	absent
Amelanchier alnifolia	1	0	absent
A. trid. vaseyana	0	2	above
Poa pratensis	35	4	below
Carex geyeri	7	1	below
Bromus porteri*	6	0.3	below
Poa nervosa	6	0	absent
Elymus trachycaulus	3	0	absent
Festuca idahoensis	3	2	below
Calamagrostis rubescens	2	0	absent
Leymus cinereus*	2	0	absent
Phleum pratense	0	7	above
Koeleria macrantha	0	0.1	similar
Pseudoroegneria spicata	0	0.1	similar
Poa secunda	0	0.1	similar
Lathyrus leucanthus	26	0	absent
Trifolium longipes	5	0	absent
Arnica cordifolia	5	0	absent
Lupinus argenteus	5	3	below
Astragalus miser	3	0	absent
Achillea millefolium	3	2	below
Geranium viscosissimum	2	4	above
Symphyotrichum ericoides	2	3	above
Frasera speciosa	2	0	absent
Galium boreale	2	0	absent
Potentilla gracilis	0.5	9	above
Arenaria congesta	0	1	above
Geum trifolium	0	2	above
Eriogonum umbellatum	0	2	above

To add another dimension to the evaluation of ecological condition in the Hebgen Basin three other useful indices have been included in Appendix A. Each indicator can be used alone or in combination with the other two for determining changes in the sustainability of the respective community type. The disturbance species measure is the combined total of early, mid-seral and non-native species within the vegetation community. This represents the vegetation cover most likely to decrease as the community moves in an upward recovery trend or will exhibit an increase should the community begin to unravel ecologically.

Biomass production (kg/ha) is important along two avenues of thought. First, higher levels of production are generally associated with communities in stable or improving ecological condition. However, in contrast to conditions recorded in the Gardiner Basin where grass production averaged 46% of the total community biomass forbs made up 70% of the total in the Hebgen Basin. This dichotomy reflects the higher precipitation and more productive soils in the Hebgen Basin. The high forb component of the community type the second most productive in the Gardiner Basin so collection of biomass information (clipping studies) must be accompanied by detailed species composition inventories to avoid misinterpretation of community condition. The greatest utility of the biomass reference production is for calculating ungulate carrying capacity.

The percent grass value is included with the biomass production to avoid over calculation of how many grazers can be supported within the Hebgen Basin over a given period of time. An example follows.

1. Carrying capacity model = $\dfrac{\text{Kg/ha x ha x FA}}{\text{Intake (kg/animal/month)}}$

2. Where kg/ha is biomass from Appendix A, ha is the size of the area under consideration and FA is the proportion of the forage base to be allocated to the target grazer. Intake is derived from animal weight (kg) x 0.025/day x 30 days

3. The initial estimate of bison carrying capacity using an average bison weight of 408kg, biomass production of 330kg/ha for the antelope bitterbrush/bluebunch wheatgrass community type (Appendix A) and 25% forage allocation would work out as follows.

$$\frac{\text{330kg/ha x 1,000ha x 0.25}}{\text{10kg/day x 30 days}} = 275 \text{ animals for 1 month, 92 for 3 months or 46 for 6 months}$$

4. However, this is an over estimate because bison forage primarily on grasses and sedges and the 330kg includes all herbaceous material. Accordingly, management based on this initial calculation would lead to heavy overuse of the level shrub/grasslands in the Hebgen Basin. A more sustainable carrying capacity can be derived by correcting the initial calculation with the 23% grass composition occurring within the antelope bitterbrush/bluebunch wheatgrass community type.

5. The available forage generated in the initial calculation (model numerator) is 82,500kg so this value is multiplied by 0.23 to yield the actual amount of grass-based forage available to bison.

When divided by the 300kg monthly intake the resulting value is 18,975kg or 63 animals for 1 month. A short hand approach would be to multiple the initial carrying capacity of 275 animals for 1 month by 0.23. This produces the same value, 63 bison for 1 month, as does recalculating the model numerator. Importantly, this modeling exercise provides a base herd level (63 bison) that can forage outside the Park for 1 month without causing negative changes in the target plant community.

There are three important rules to keep in mind when calculating carrying capacity from this model and information supplied in Appendix A. First, FA or forage allocation provides a mathematical approach for dividing the forage resource among the various grazing classes while safeguarding forage plant health and vigor. In this example bison, the target species, are allocated 25% of the available forage base, leaving 15% for elk and 10% for mule deer or bighorn sheep. To maintain overall ecological condition the sum of allocations to all grazers should not exceed 50%. Second, care should be exercised in choosing the amount of area thought to be used by the grazers. Slope, distance to water, private land and road density must be taken into account to avoid over estimating the amount of forage available to the anticipated population. Finally, estimation of animal intake in this model is based on the weight of the most common age and gender in the targeted population. Using the body weight of mature bull elk and bison to estimate monthly intake will under estimate the number of cows, calves and subadults the area can support.

Current Ecological Status and Condition

Without ecological site descriptions for the Hebgen Basin or grazing exclosures for comparison purposes the status and ecological condition of the delineated ecological community types must be determined based on published descriptions of grassland and aspen community types. In Part 1 the ecological status of the identified community types was based on comparisons to similar grass and shrub communities in Mueggler and Stewart (1980). However, the appearance of aspen in the Hebgen Basin vegetation inventory required the use of a second community type description, *Aspen Community Types of the Intermountain Region* (Mueggler, 1988) to evaluate the ecological status of two of the community types, Kentucky bluegrass/Sticky Geranium and Aspen/Showy Cinquefoil. As already pointed out the Hebgen Basin types appear to be in a lower ecological condition. However, these measures represent a “point in time” and, as such, provide only an overview of ecological sustainability. The most objective measure of sustainability is generated through long term monitoring because this provides a trend line (Fig. 4.1) of ecological conditions at each site. The direction (up or down) indicates the sustainability of the site. In the example in Fig. 4.1 data from Cedar Creek in the Gardiner Basin has been pooled into three ecological succession stages, early, mid and climax. Over time the slow increase in the percent cover contributed by early successional species coupled with the decline in climax cover indicates a shift away from long term sustainability. Frequent re-sampling of the original inventory sites described in Appendix will provide the requisite data to establish trend and therefore sustainability.

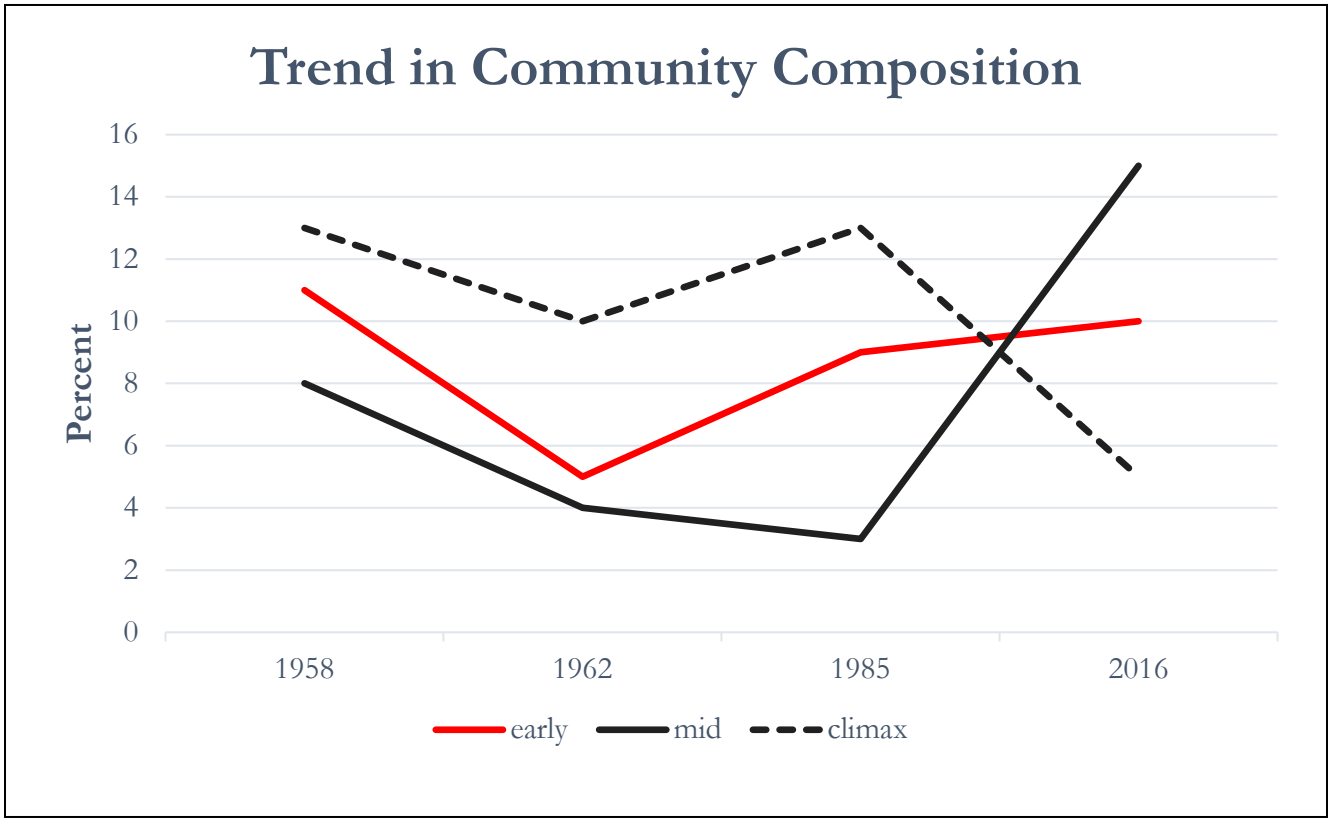


Fig. 4.1. Community trend constructed from rangeland inventory data collected within the same community type in the Cedar Creek drainage, Gardiner Basin. Line direction indicates improvement (upward trend), stasis (nearly level over time) or degradation (downward trend).

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APPENDIX A

Reference Vegetation Community Types for the Hebgen Basin

1. Reference Composition for Mountain Big Sagebrush/Bluebunch Wheatgrass Community Type, Hebgen Basin, West Yellowstone, Montana

Geology	Aspect	Slope%	Species	% Cover	Disturbance Species (%)	Biomass (kg/ha)	Grass as % of Biomass
Bedrock	SW	15 – 35	*Shrubs*:				
		35 - 60	Artemisia tridentata vaseyana	19.3			
			Symphoricarpos albus	1			
			Grasses and Grass-likes:				
			Pseudoroegneria spicata	13.2			
			Festuca idahoensis	6.3			
			Poa pratensis	2.5	3.2	725	32
			Carex filifolia	2.1			
			Achnatherum nelsonii	0.5			
			Koeleria macrantha	0.4			
			Poa secunda	0.3			
			Forbs:				
			Lupinus caudatus	6.2			
			Antennaria microphylla	3			
			Geranium viscosissimum	1			
			Eriogonum umbellatum	0.2			
			Phlox longifolia	0.1			

2. Reference Composition for Mountain Big Sagebrush/Idaho Fescue Community Type, Hebgen Basin, West Yellowstone, Montana

Geology	Aspect	Slope%	Species	% Cover	Disturbance Species (%)	Biomass (kg/ha)	Grass as % of Biomass
Unconsolidated	Flat	0 - 4	*Shrubs*:				
			Artemisia tridentata vaseyana	6.2			
			Purshia tridentata	0.4			
			Grasses and Grass-likes:				
			Festuca idahoensis	10.7			
			Pseudoroegneria spicata	2.9			
			Carex filifolia	1.6			
			Poa secunda	1.1	1.6	622	27
			Koeleria macrantha	0.5			
			Danthonia intermedia	0.3			
			Carex geyeri	0.2			
			Forbs:				
			Antennaria microphylla	17.4			
			Eriogonum umbellatum	4.2			
			Phlox hoodii	2.4			
			Phlox longifolia	1			
			Arenaria congesta	1			
			Lupinus caudatus	0.3			
			Geum trifolium	0.1			

3. Reference Composition for Mountain Big Sagebrush/Western Snowberry Community Type, Hebgen Basin, West Yellowstone, Montana

Geology	Aspect	Slope%	Species	% Cover	Disturbance Species (%)	Biomass (kg/ha)	Grass as % of Biomass
Unconsolidated	SW	4 – 15	*Shrubs*:				
		15 - 35	Artemisia tridentata vaseyana	9.8			
			Symphoricarpos albus	9.4			
			Grasses and Grass-likes:				
			Poa pratensis	10.7			
			Pseudoroegneria spicata	2.1			
			Festuca idahoensis	1			
			Bromus porteri	1			
			Danthonia intermedia	0.5	1.2	2081.7	24
			Phleum pratense	0.2			
			Pascopyrum smithii	0.1			
			Forbs:				
			Helianthus annuus	3.7			
			Geranium viscosissimum	3.5			
			Unknown forbs	3.2			
			Lupinus caudatus	3.1			
			Erigeron speciosus	2.8			
			Potentilla gracilis	1.8			
			Symphyotrichum ericoides	1.2			
			Eriogonum umbellatum	1.1			
			Achillea millefolium	1.1			
			Chamerion angustifolium	1			
			Geum trifolium	0.8			

4. Reference Composition for Antelope Bitterbrush/Bluebunch Wheatgrass Community Type, Hebgen Basin, West Yellowstone, Montana

Geology	Aspect	Slope%	Species	% Cover	Disturbance Species (%)	Biomass (kg/ha)	Grass as % of Biomass
Unconsolidated	Flat	0 - 4	*Shrubs*:				
			Purshia tridentata	3.4			
			Grasses and Grass-likes:				
			Pseudoroegneria spicata	4			
			Festuca idahoensis	2.3			
			Carex geyeri	1.9			
			Poa pratensis	0.6	0.7	330	23
			Achnatherum nelsonii	0.2			
			Poa secunda	0.1			
			Forbs:				
			Antennaria microphylla	6.7			
			Eriogonum umbellatum	2.6			
			Phlox longifolia	2.5			
			Lupinus caudatus	1.1			
			Phlox hoodii	0.7			
			Symphyotrichum ericoides	0.3			
			Arenaria congesta	0.2			
			Achillea millefolium	0.2			
			Unknown forb	0.2			

5. Reference Composition for Kentucky Bluegrass/Sticky Geranium Community Type, Hebgen Basin, West Yellowstone, Montana

Geology	Aspect	Slope%	Species	% Cover	Disturbance Species (%)	Biomass (kg/ha)	Grass as % of Biomass
Bedrock	Flat	0 - 4	*Trees and Shrubs*:				
	NE	4 - 15	Populus tremuloides	1.5			
			Symphoricarpos albus	0.4			
			Grasses and Grass-likes:				
			Poa pratensis	26			
			Festuca idahoensis	3.3			
			Bromus porteri	1.5			
			Carex geyeri	1.6	2.3	1,605	27
			Pseudoroegneria spicata	1			
			Phleum pratense	0.6			
			Poa secunda	0.1			
			Forbs				
			Geranium viscosissimum	7.6			
			Potentilla gracilis	3.8			
			Eriogonum umbellatum	3.3			
			Antennaria microphylla	1.7			
			Achillea millefolium	1			
			Lupinus caudatus	0.5			
			Symphyotrichum ericoides	0.2			
			Arenaria congesta	0.1			
			Geum trifolium	0.1			

6. Reference Composition for Aspen/Slender Cinquefoil Community Type, Hebgen Basin, West Yellowstone, Montana

Geology	Aspect	Slope%	Species	% Cover	Disturbance Species (%)	Biomass (kg/ha)	Grass as % of Biomass
Bedrock	Flat	0 - 4	*Trees and Shrubs*:				
	SW	4 - 15	Populus tremuloides	3.2			
			Artemisia tridentata vaseyana	1.6			
			Grasses and Grass-likes:				
			Phleum pratense	7.1			
			Poa pratensis	4			
			Festuca idahoensis	2.3			
			Carex geyeri	1.3			
			Bromus porteri	0.3	0.2	1648	44
			Pseudoroegneria spicata	0.1			
			Koeleria macrantha	0.1			
			Poa secunda	0.1			
			Achnatherum nelsonii	0.1			
			Forbs				
			Unknown forbs	9.1			
			Potentilla gracilis	8.8			
			Geranium viscosissimum	3.9			
			Symphyotrichum ericoides	2.8			
			Lupinus caudatus	2.5			
			Achillea millefolium	2.1			
			Eriogonum umbellatum	2.1			
			Geum trifolium	1.9			
			Arenaria congesta	0.8			

APPENDIX B

Physical Description of Hebgen Basin Inventory Sites

Community Type sampling locations in the Hebgen Basin, West Yellowstone, Montana

Site ID	Location		Geology	Aspect	% Slope	Community Type
	Latitude	longitude				
88	44.756687	-111.208661	Bedrock	SW	15 - 35	Mountain Big Sagebrush/Bluebunch Wheatgrass
90	44.760291	-111.2164	Bedrock	SW	35 - 60	Mountain Big Sagebrush/Bluebunch Wheatgrass
96	44.771996	-111.170514	Unconsolidated	FLAT	0 - 4	Antelope Bitterbrush/Bluebunch Wheatgrass
97	44.73649	-111.105365	Unconsolidated	FLAT	0 - 4	Antelope Bitterbrush/Bluebunch Wheatgrass
98	44.761307	-111.168082	Unconsolidated	FLAT	0 - 4	Antelope Bitterbrush/Bluebunch Wheatgrass
99	44.726229	-111.102106	Unconsolidated	FLAT	0 - 4	Mountain Big Sagebrush/Idaho Fescue
113	44.755696	-111.217917	Unconsolidated	FLAT	0 - 4	Mountain Big Sagebrush/Idaho Fescue
75	44.76973	-111.221131	Bedrock	FLAT	0 - 4	Kentucky Bluegrass/Sticky Geranium
85	44.763832	-111.212857	Bedrock	NE	4 - 15	Kentucky Bluegrass/Sticky Geranium
108	44.771105	-111.2275	Unconsolidated	SW	15 - 35	Mountain Big Sagebrush/Western Snowberry
112	unavailable		Unconsolidated	SW	4 - 15	Mountain Big Sagebrush/Western Snowberry
74	44.798052	-111.107825	Bedrock	FLAT	0 - 4	Aspen/Showy Cinquefoil
94	unavailable		Bedrock	SW	4 - 15	Aspen/Showy Cinquefoil