1. VEGETATION EVALUATION

TASK 1: EVALUATE VEGETATION TO DETERMINE ECOLOGICAL CONDITION AND PRODUCTIVITY OF THE RANGELAND HABITATS

ERG used data collected from 14 double sampling sites, 15 utilization sites, and 209 SI sites to determine productivity and to map the ecological condition of the rangeland habitats. Ecological condition was determined by using standardized NRCS range inventory techniques (USDA NRCS, 1997) and comparing the current plant community percent species composition by weight with the HCPC composition. The present ecological condition is related to long-term plant frequency data trends from the data collected at five resampled Parker 3-Step plots. The present ecological condition was also compared to the most recent USFS data sets. Total annual production was calculated and standardized NRCS techniques were used to apply acceptable stocking rates (USDA NRCS, 1997). These initial stocking rates are provided to show total acceptable levels of use.

1.1 LONG-TERM PLANT DATA TRENDS

The present-day ecological condition of rangeland habitats is the result of historic impacts, or lack thereof. Permanently established Parker 3-Step plots with records dating back to the 1950s allow us to track plant communities changes through time and help reveal how the rangeland habitats reached their present ecological condition. For a full explanation and critique of the Parker 3-Step Method see Section 3.1 of the Elkhorn Vegetation Study Phase I Final Report (ERG, 2004).

The USFS has tracked the condition and trend of rangeland vegetation using the Parker 3-Step method since the early-1960s. Monitoring was discontinued by 1980, thus hindering the ability to track condition and trend over the long term. ERG relocated several of the USFS Parker 3-Step plots, however, in most cases the permanent transect stakes were missing. Five Parker 3-Step plots were relocated by ERG with the permanent transect stakes still in place. Four were located in the Kimber EHU and one was found in the North Crow EHU. Although the plots were originally intended for a five-year remeasurement schedule, the data collected during the Elkhorn Vegetation Study can still provide an accurate description of the overall condition and trend of the rangeland vegetation.

The NRCS defines rangeland trend as the direction of change in an existing plant community relative to the HCPC (USDA NRCS, 1997). It can be determined as apparent trend or measured trend. The Parker 3-Step method determines measured trend, which requires measurements of the trend indicators over a period of time. Trend is then described as one of three conditions:

1. **Toward** – Moving towards the HCPC
2. **Not Apparent** – No change detectable
3. **Away From** – Moving away from the HCPC

Indicators used to measure trend are:

- Composition
- Abundance of seedling and young plants
- Plant residue
- Plant vigor
- Condition of soil surface.

Of the Parker 3-Step plots that ERG reestablished, the historically collected data included composition, plant residue (litter), and condition of soil surface (bare soil). ERG remeasured these attributes. Although the historic forms had fields for documenting the abundance of seedlings, conifer encroachment, and plant vigor, these fields were seldom recorded.

Perhaps one of the most useful components in the Parker 3-Step method is the photographic record. The Phase I Final Report (ERG, 2004) discusses the drawbacks to Parker's methods in detail. One of the main drawbacks is the small sampling area along the transect. The photographic series is a terrific, albeit qualitative, description of vegetation changes, that gives the user an undeniable feel for changes over time. The following sections describe the interpretation of long-term trend for the five re-established Parker 3-Step plots.

1.1.1 Plot C-6

Parker 3-Step plot C-6 is in the Vosburg pasture of the East Pacific Allotment. This site was established in 1957 and was reread in 1966, 1974, 1980, and by ERG and USFS range staff in 2005. C-6 has two transects. Transect #1 was lost between 1966 and 1974 and therefore is lacking data for the 1974 and 1980 readings. It was reestablished in 2005 via the use of one of the permanent stakes and an azimuth from the original 1957 files.

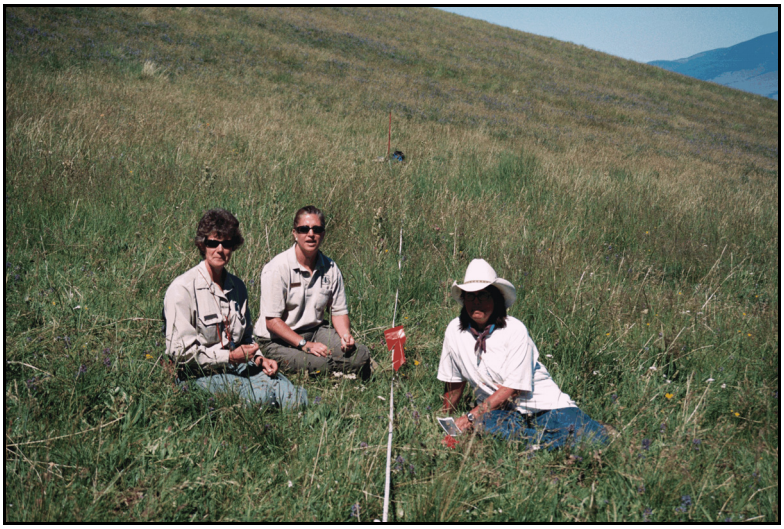

Figure 1.1.1-1 HNF staff reading Transect #1 at C-6 in 2005

The determination of trend using data from one Parker 3-Step read in a range of dates from 1966 through 2005 is not defensible. Therefore, ERG looked at the indicators through time and presents the following discussion.

Figure 1.1.1-2 shows bluegrasses (POA's) decreasing along Transect 1 in Plot C-6. The POA's are considered to be increasers, which proliferate as a result of past overuse. The fact that they are decreasing is one indicator of a positive trend toward HCPC. Idaho fescue (*Festuca idahoensis*) [FEID] and bluebunch wheatgrass (*Pseudoroegneria spicata*) [AGSP] are both decreasing which makes it difficult to determine a trend, since both these species have been considered increasers and decreasers in their response to grazing (Mueggler and Stewart, 1980). However, the fact that they are still present on the site is also positive. The principle forage producer for this habitat type, rough fescue *(Festuca campestris*) [FESC] (Mueggler and Stewart, 1980), is increasing slightly which could indicate a trend towards HCPC.

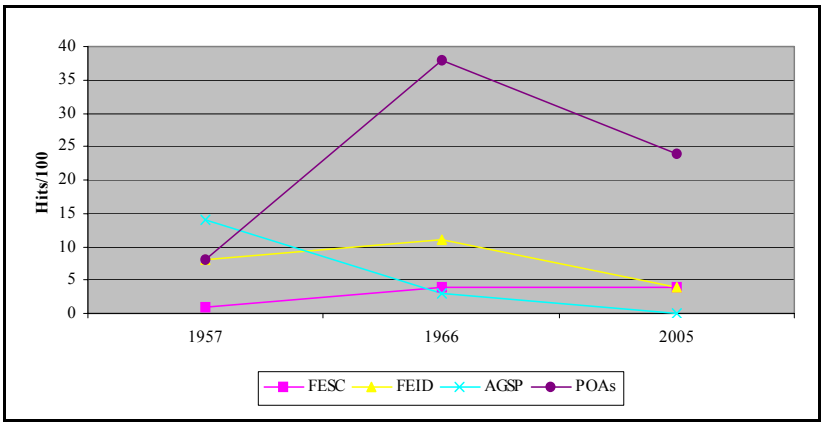

Figure 1.1.1-2 Hits by species for Plot C-6 Transect 1

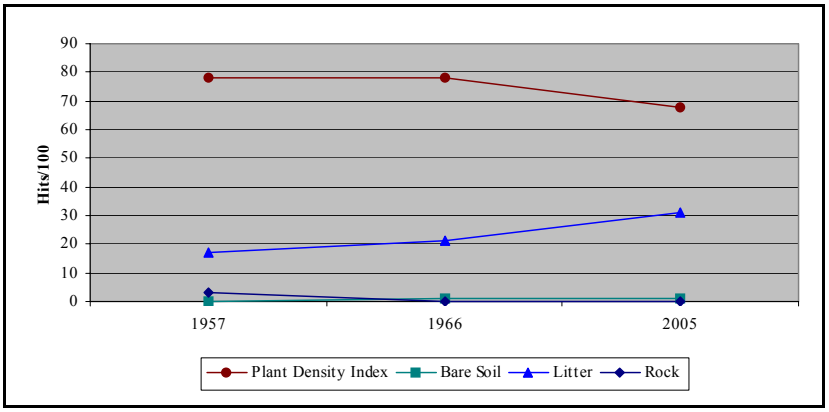

Figure 1.1.1-3 Plot C-6 summary of Transect 1

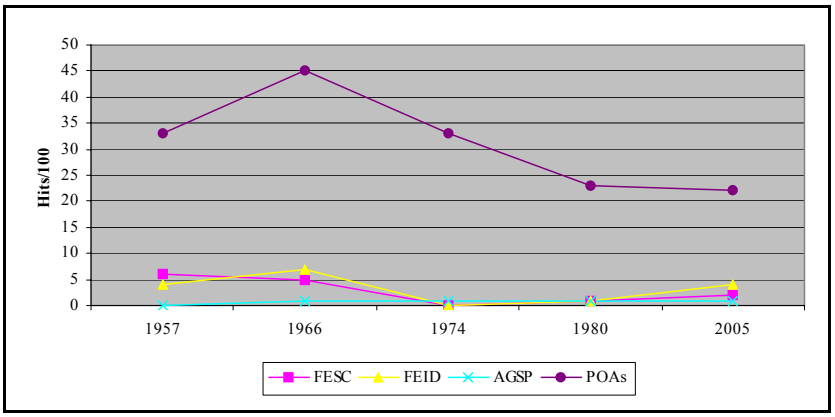

Figure 1.1.1-4 Hits by Species for Plot C-6 Transect 2

Of the other indicators used to measure trend, bareground and rock have not changed. This implies a positive trend for the site (See Figure 1.1.1-3). In addition, litter has increased the most along this transect and this provides insight into moisture retention functions and suggests improved water infiltration into the soil.

Similar to Transect 1, the POA's along Transect 2 have decreased. FEID, FESC and AGSP have all shown slight increases, and as discussed above, it is difficult to determine trend because of the discrepancy in the responses to grazing by FEID and AGSP. However, the increase in the amount of FESC is positive (See Figure 1.1.1-4).

The other indicators show that plant density is increasing, litter is decreasing, bareground has not changed, and rock has slightly increased (See Figure 1.1.1-5). Based on these indicators, trend is difficult to determine and scientifically defend.

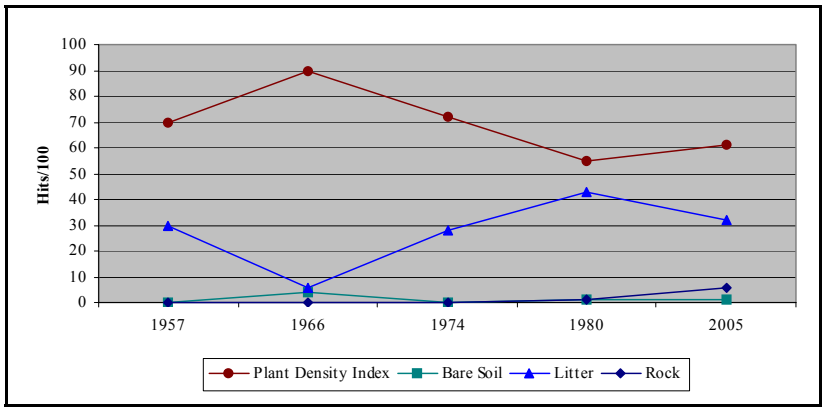

Figure 1.1.1-5 Plot C-6 summary of Transect 2

In conclusion, on both these transects FESC, FEID and AGSP are still present, and the changes in these plant communities appear to be moving in a positive direction. However, based on the small sample size and the fact that other indicators have not changed, or have changed so little, it is impossible to determine a trend . Figures 1.1.1-7 and 8(a, b, and c), on the next page present the plots of the two transects, from 1957 through the present.

Figure 1.1.1-6a Parker 3-Step C-6 T-1 in 1957

Figure 1.1.1-7a Parker 3-Step C-6 T-2 in 1957

Figure 1.1.1-6b Parker 3-Step C-6 T-1 in 1966

Figure 1.1.1-7b Parker 3-Step C-6 T-2 in 1974

Figure 1.1.1-6c Parker 3-Step C-6 T-1 in 2005

Figure 1.1.1-7c Parker 3-Step C-6 T-2 in 2005

1.1.2 Plot C-29

Parker 3-Step plot C-29 is in the Elkhorn pasture of the North Crow Allotment at the intersection of USFS Roads 4031 and 405. This site was established in 1959, and it was reread in 1962, 1966, 1968, 1978, and by ERG in 2004. This plot had two transects, both of which had their permeant marker stakes still in place.

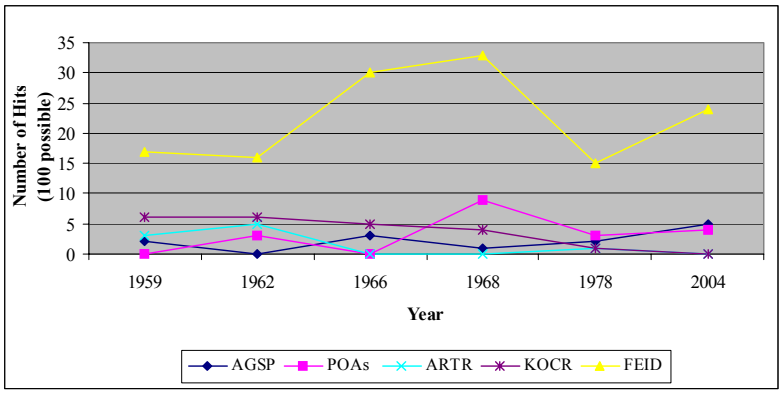

Figure 1.1.2-1 Hits by species for Plot C-29 Transect 1

Figures 1.1.2-1 and 1.1.2-2 present hits on selected species for each transect. Both of these figures track the hits on five species: bluebunch wheatgrass, bluegrasses (*Poa* spp), mountain big sagebrush (*Artemisia tridentata)* [ARTR], prairie Junegrass (*Koeleria macrantha)*[KOCR], and Idaho fescue.

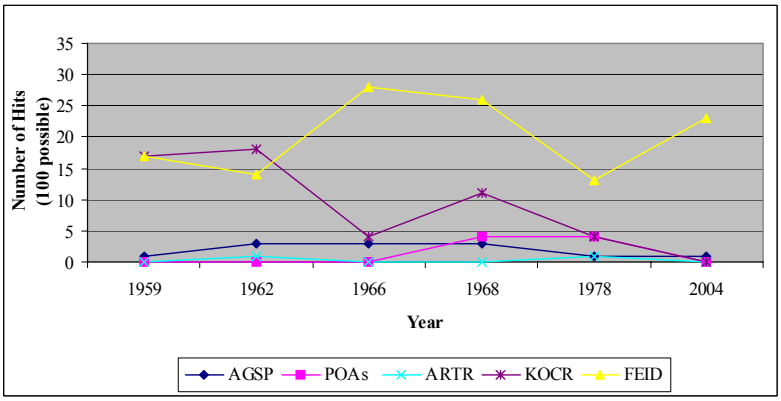

Figure 1.1.2-2 Hits by species for Plot C-29 Transect 2

Figure 1.1.2-3 shows changes in bare soil, litter, and plant density index (PDI) [sic.]. Parker 3-Steps only record frequency, and do not record density. Bare soil has decreased since 1978, but litter has increased. The PDI has decreased in recent years from a maximum of over 120 hits in 1968 to just over 80 in 2004.

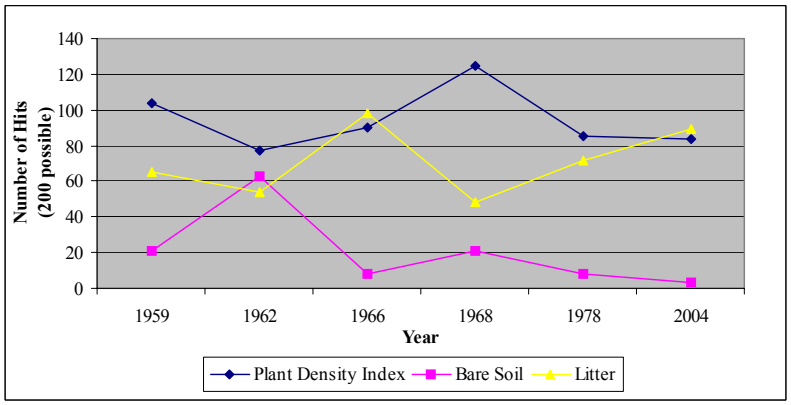

Figure 1.1.2-3 Plot C-29 summary of both transects

From 1959 to 1962 the combined trend was *Away From* due to the increase in bare soil, and decreases in plant density and litter. However, from 1962 to 1966 the trend appeared to reverse and started moving *Toward* the HCPC. From 1966 to 1968 the trend was *Not Apparent* because litter decreased, and bare soil and plant

density increased. From 1968 to 1978 trend is *Not Apparent* due to inversely related changes in litter and PDI. From 1978 to present it appears the trend is again moving *Toward* because of increased litter, decreased bare ground and a constant plant density.

Figure 1.1.2-4 Remeasurement of Plot C-29 Transect 1

The species composition for Plot C-29 is dominated by Idaho fescue which peaked between 1962 and 1968, decreased between 1968 and 1978, and has increased from 1978 to present. Idaho fescue is considered an increaser, therefore it's likely that this site may have had heavy disturbance prior to 1959 and the increaser or climax species that might be expected on this site are gone. Furthermore, rough fescue was found in protected areas around rocks and decadent sagebrush which leads us to believe that this site should be composed of additional rough fescue as a climax species. The other species found on the site have remained relatively stable with no significant increases or decreases over the time of the measurements.

ERG used the C-29 Parker 3-Step as an informational stop on a field trip on August 31, 2004 (Figures 1.1.2-4). Those attending the field trip were familiarized with the Parker 3-Step data collection technique through hands-on reading of both of the transects.

Figures 1.1.2-5 through 1.1.2-8 present views of transects 1 and 2 at Plot C-29 in 1959 and 2004. Photo sets from the Parker 3-Step plots provide valuable information beyond the changes in graminoids alone. These photos show clear visual evidence of conifer encroachment.

Figure 1.1.2-5 Transect 1 at Plot C-29 in 1959 (USDA Forest Service, 2210 files)

Figure 1.1.2-6 Transect 1 at Plot C-29 in 2004

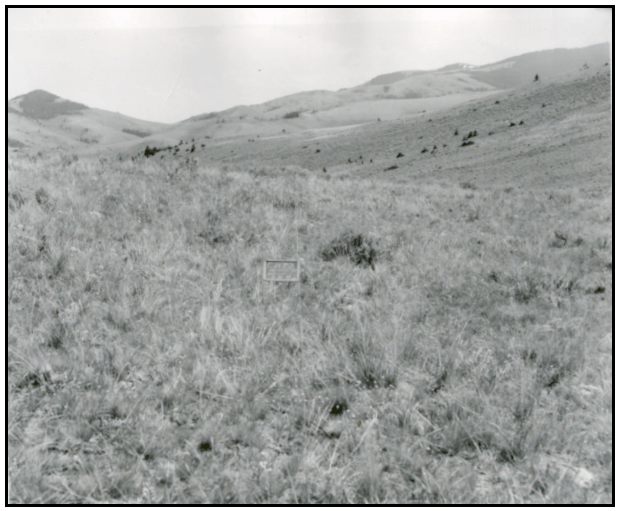

Figure 1.1.2-7 Transect 2 at Plot C-29 in 1959 (USDA Forest Service, 2210 files)

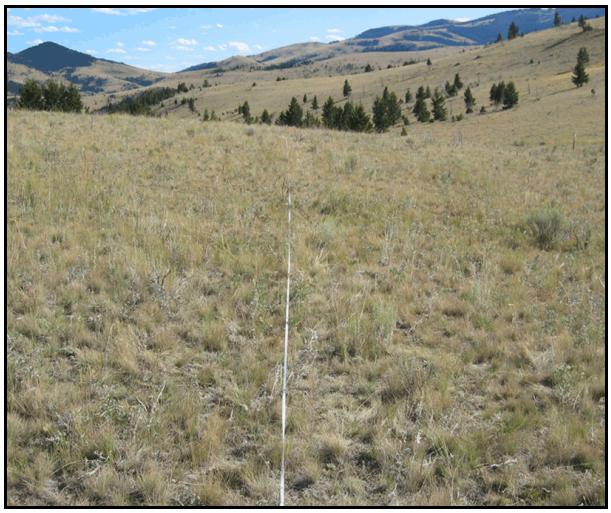

Figure 1.1.2-8 Transect 2 at Plot C-29 in 2004

1.1.3 Plot C-51

Parker 3-Step plot C-51 is in the Elkhorn pasture of the North Crow Allotment in the head of Weston Creek, southwest 1/4 of Section 27, Township 7 North, Range 1 West. This site was established in 1964 and was reread in 1967, 1969, 1978, and by ERG in 2004. This plot has two transects, both of which have permanent transect stakes still in place. Figures 1.1.3-1 and 1.1.3-2 present hits on selected species for each transect. These figures track the hits on Idaho fescue, bluebunch wheatgrass, and bluegrasses. Species composition in figures 1.1.3-1 and 1.1.3-2 indicate a general increase in Idaho fescue from 1964 to 1969, followed by a modest, sustained decrease to 2004. Bluegrasses generally decrease throughout the sampling period, and no major trend is evident in bluebunch wheatgrass.

Figure 1.1.3-3 presents a summary of both transects for graphing the changes in

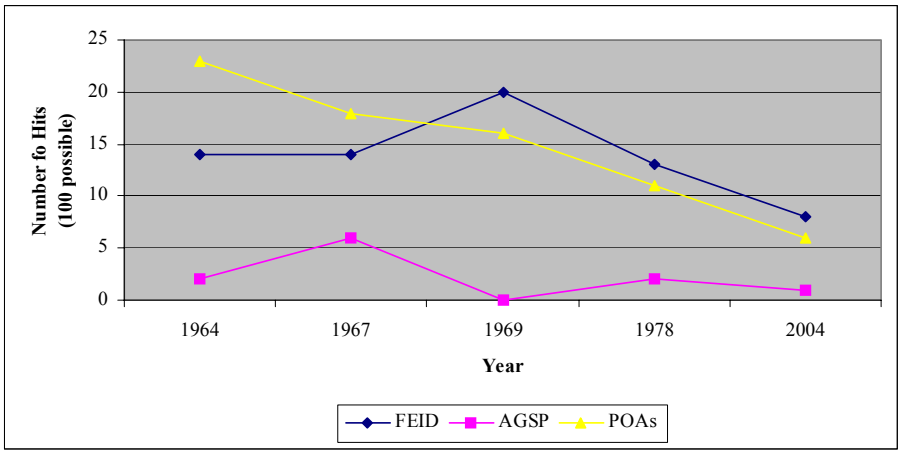

Figure 1.1.3-1 Hits by species for C-51 Transect 1

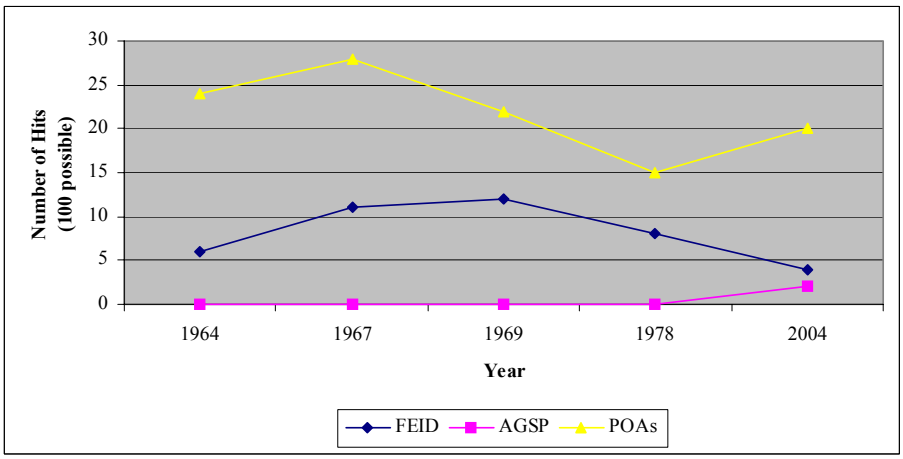

Figure 1.1.3-2 Hits by species for C-51 Transect 2

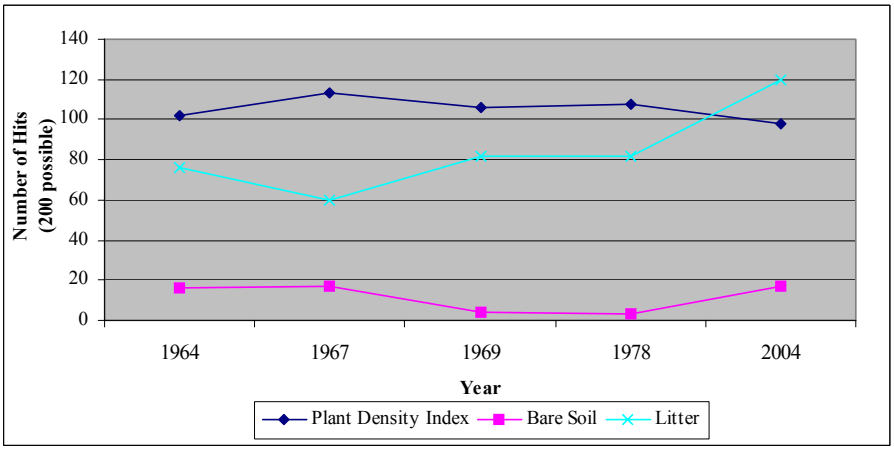

Figure 1.1.3-3 C-51 summary of both transects

Figure 1.1.2-4 Transect 1 at Plot C-51 in 1967 (USDA Forest Service, 2210 files)

Figure 1.1.2-5 Transect 1 at Plot C-51 in 2004

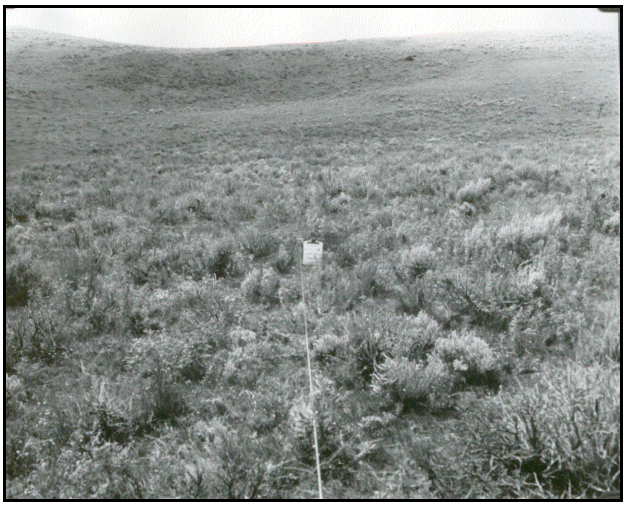

Figure 1.1.2-6 Transect 2 at Plot C-51 in 1967 (USDA Forest Service, 2210 files)

Figure 1.1.2-7 Transect 2 at Plot C-51 in 2004

bare soil, litter, and PDI. Bare soil has increased from 3 hits in 1978 to 17 hits in 2004. Litter has increased by almost 50% since 1978. Figure 1.1.2-3 indicates that the trend is *Not Apparent,* as there is relatively little change in PDI and bare soil, and most of the changes in litter are associated with slight declines in PDI. It is worthy to note that litter has increased substantially since 1964. In 1978 there was one hit on the introduced grass smooth brome (*Bromus inermis)*, while in 2004 there were seven hits on smooth brome. This change in species composition resulted in a 47% ecological condition, in the area of C-29 in Hidden Basin.

1.1.3 Plot C-56

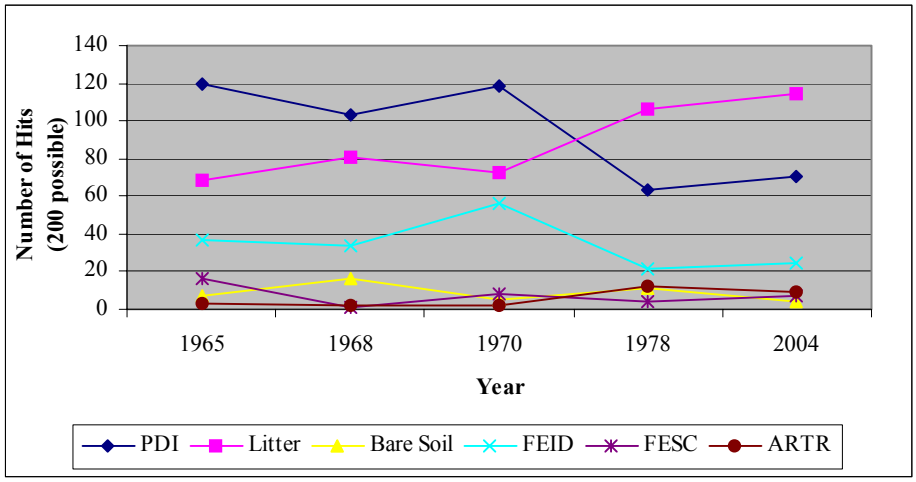

Figure 1.1.3-1 Plot C-56 summary of both transects

Parker 3-Step plot C-56 is in the Upper Spring pasture of the North Crow Allotment in the north central portion of Section 3, Township 6 North, Range 1 West, in the head of Power Gulch. This site was established in 1965, and it was reread in 1968, 1970, 1978, and by ERG in 2004. This plot has two transects, both of which have their permanent transect stakes still in place. Present trend is *Not Apparent* due to generally inverse relationships between PDI and litter, as well as no discernable pattern in bare soil changes (Figure 1.1.3-1).

1.1.4 Plot C-74

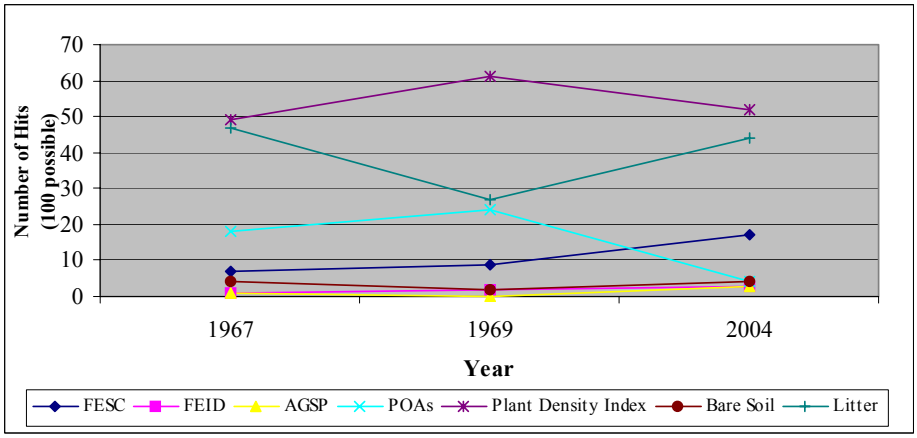

Figure 1.1.4-1 Plot C-74 summary of both transects

Parker 3-Step plot C-74 is in the Eagle pasture of the North Crow Allotment above USFS Road 405 in the center of Section 21, Township 7 North, Range 1 West. This site was established in 1967, and it was reread in 1969 and by ERG in 2004. This plot has only one transect, which is still in place. Since 1969 there has been a drastic decrease in bluegrasses, with an increase in rough fescue (Figure 1.1.4-1). Trend since 1969 is *Not Apparent* at this plot, due to inversely related litter and PDI and no discernable trajectory in bare soil. There is an increasing abundance of two decreasers, rough fescue and bluebunch wheatgrass, since 1969.

1.2 ECOLOGICAL CONDITION OF RANGELAND HABITATS

The rangeland habitats in the Kimber and North Crow are in acceptable condition. In 2004, ERG calculated that 99% of the rangelands were in good and excellent condition; and in 2005 the rangelands of Kimber EHU were calculated to have 98% in good and excellent condition.

In order to determine the present condition of rangeland habitats they must be compared to potential climax vegetation for the site, or HCPC. The NRCS defines HCPC as:

> The plant community that was best adapted to the unique combination of factors associated with the ecological site. It was in a natural dynamic equilibrium with the historic biotic, abiotic, climatic factors on its ecological site in North America at the time of European immigration and settlement. (USDA NRCS, 1997)

The NRCS uses ecological site descriptions (ESD) which compare present plant communities to HCPC in terms of percent similarity. However, ecological site descriptions have never been developed for the Elkhorns. Without ecological site descriptions, ERG determined the present condition of rangeland habitats as a percent of the HCPC, by comparing percent composition by weight. The abovementioned ecological conditions were calculated from using old range site descriptions, once ESDs are developed these figures will most likely show a lower percent similarity.

ERG used *Technical Range Site Descriptions* (USDA SCS, 1981) to determine similarity index, however, these guides were developed to use percent composition by weight, whereas similarity index is based on composition and actual weight at the time of inventory. In addition, the similarity index method reconstructs the production of the plant community by taking into consideration percent of normal production, percent of growth curve completed and percent of current growth ungrazed. The range site method only takes into consideration the number of plants by species, not the current production.

In following example (Figure 1.2-1), a silty droughty range site is composed of 60% bluebunch wheatgrass, 8% rough fescue, 7% blue grama (*Bouteloua gracilis)* and 6% Kentucky bluegrass (*Poa pratensis)* with the remaining 17% of composition being shrubs and forbs. Using the range site description for silty droughty 15–19 inch precipitation zone you can count all the bluebunch, rough fescue and blue grama as climax, plus all the forbs and shrubs. Therefore, 92% of the species currently on this site count towards climax giving the site a range condition of "excellent".

Worksheet for Determining Ecological Condition and Stocking Rate

ECOLOGICAL SITE: Silty Droughty 15"-19" P.Z. **DATE:** 9/28/04 **SITE I.D.** SI#86 (BN#9)

		Ecological Condition									Stocking Rates		
	A	B	C	D	E	F	G	H	I	J	Potential Consumed (H X HE*)		
	Plant Name (Common Name/Symbol)	Green wt. Lbs. (lbs./acre)	% dry weight	% current growth ungrazed	% growth curve completed	% of normal production	Reconstruction factor C/(D*E*F)	Reconstructed present weight	% Composition	% Composition climax	P	D	UD
GRASS & GRASS-LIKE	rough fescue / FECA4	25	0.74	0.40	1.00	0.57	3.25	81.1	8	8			
	bluebunch wheatgrass / PSSPS	300	0.81	0.70	1.00	0.57	2.03	609.0	60	60			
	Kentucky bluegrass / POPR	40	0.85	1.00	1.00	0.57	1.49	59.6	6				
	blue gramma / BOGR2	50	0.85	1.00	1.00	0.57	1.49	74.6	7	7			
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FORBS									0				
	cutleaf daisy / ERCO4	5	0.85	1.00	1.00	0.57	1.49	7.5	1	8			
	crazyweed / OXSE	8	0.80	1.00	1.00	0.57	1.40	11.2	1				
	green sagewort / ANDR4	10	0.80	1.00	1.00	0.57	1.40	14.0	1				
	salsify / TRDU	10	0.80	1.00	1.00	0.57	1.40	14.0	1				
	silky lupine / LUSE4	20	0.90	1.00	1.00	0.57	1.58	31.6	3				
	littleleaf pussytoes / ANMI3	10	0.75	1.00	1.00	0.57	1.32	13.2	1				
	dandylion / TAOF	5	0.80	1.00	1.00	0.57	1.40	7.0	1				
									0				
									0				
									0				
									0				
SHRUBS	rubber rabbitbrush / CHNAA4	10	0.65	1.00	1.00	0.57	1.14	11.4	1	9			
	mountain big sagebrush / ARTRV	50	0.65	1.00	1.00	0.57	1.14	57.0	6				
	prairie sagewort / ARFR4	15	0.65	0.85	1.00	0.57	1.34	20.1	2				
									0				
									0				
									0				
								1011.4	100				

Notes:

K. Total normal annual production in reference state (RV from ecological site description).	
L. Total pounds of allowable present (total of pounds in column J).	
M. Ecological Condition	**92.00**

Total By Preference (Total of of each colum)	0	0	0
Pounds of forage available for consumption: (P+D+UD)	0		
Pounds per AUM:			
AUM/ac (Forage Available for consumption/ 790.8):			
Ac/AUM (1 / AUM/ac):			

* Harvest efficiency factor (HE): P = .35, D = .25, UD = .05

(190-vi, NRPH, September 1997) 4ex–15

Figure 1.2-1 Example Worksheet Number 1

Using the same community, ERG completed a similarity index by extrapolating the pounds in reference state from the range site description (Figure 1.2-2). For this site the pounds allowable of native species was 643, the range site description mid-range for production on this site is 1500. Therefore, 643 divided by 1500 gives a similarity index of 43%. Therefore, this site is producing 43% of HCPC. A problem with trying to extrapolate similarity index from range site descriptions is the lack of production data by species, needed to determine similarity indexes. Therefore, the finding of 43% on the following work sheet may be incorrect.

Worksheet for Determining Similarity Index and Stocking Rate

ECOLOGICAL SITE: Silty Droughty 15"-19" P.Z. **DATE:** 9/28/04 **SITE I.D.** SI#86 (BN#9)

		Similarity Index									Stocking Rates		
	A	B	C	D	E	F	G	H	I	J	Potential Consumed (H X HE*)		
	Plant Name (Common Name/Symbol)	Green wt. Lbs. (lbs./acre)	% dry weight	% current growth ungrazed	% growth curve completed	% of normal production	Reconstruction factor C/(D*E*F)	Reconstructed present weight	Pounds in reference state	Pounds allowable	P	D	UD
GRASS & GRASS-LIKE	rough fescue / FECA4	25	0.74	0.40	1.00	0.57	3.25	81.14	648	81			
	bluebunch wheatgrass / PSSPS	300	0.81	0.70	1.00	0.57	2.03	609.02	480	480			
	Kentucky bluegrass / POPR	40	0.85	0.80	1.00	0.57	1.86	74.561					
	blue gramma / BOGR2	50	0.85	1.00	1.00	0.57	1.49	74.561	60	60			
									1200				
FORBS	cutleaf daisy / ERCO4	5	0.80	1.00	1.00	0.57	1.40	7.0175					
	crazyweed / OXSE	8	0.80	1.00	1.00	0.57	1.40	11.228					
	green sagewort / ANDR4	10	0.80	1.00	1.00	0.57	1.40	14.035					
	salsify / TRDU	10	0.80	1.00	1.00	0.57	1.40	14.035					
	silky Lupine / LUSE4	20	0.90	1.00	1.00	0.57	1.58	31.579					
	littleleaf pussytoes / ANMI3	10	0.75	1.00	1.00	0.57	1.32	13.158					
	dandylion / TAOF	5	0.80	1.00	1.00	0.57	1.40	7.0175					
									11	11			
SHRUBS	rubber rabitbrush / CHNAA4	10	0.65	1.00	1.00	0.57	1.14	11.404					
	mountain big sagebrush / ARTRV	50	0.65	1.00	1	0.57	1.14	57.018					
	prairie sagewort / ARFR4	15	0.65	0.85	1.00	0.57	1.34	20.124					
									11	11			
								1025.9					

Notes: From the Silty Droughty Range Site Description we took normal pounds of production (1500) and stratified by % composition. To come up with pounds in reference by species we took the midpoint of the range expected, and multiplied this percentage by the % compostion stratified by life form.
For Example: PSSPS can make up 10-70% of the grasses. Therefore we took the mid range of these two (40%) multiplied by 1200 lbs. and came up with 480 pounds as reference.

K. Total normal annual production in reference state (RV from ecological site description).	1500
L. Total pounds of allowable present (total of pounds in column J).	643
M. Similarity index (L divided by K x 100 = M).	**43%**

	P	D	UD
Total By Preference (Total of of each colum)	0	0	0

Pounds of forage available for consumption: (P+D+UD)	0
Pounds per AUM:	
AUM/ac (Forage Available for consumption/ 790.8):	
Ac/AUM (1 / AUM/ac):	

* Harvest efficiency factor (HE): P = .35, D = .25, UD = .05

Figure 1.2-2 Example Worksheet Number 2

To determine stocking rates ERG will use the actual production data collected for the 141 data sites taken. This stocking rate will be adjusted by a harvest efficiency factor of .35 for preferred species, .25 for desired species and a .05 for undesirable species. The pounds of forage available for consumption will then be divided by 790 to arrive at AUM/acre. This will be used as a guide for suggested stocking rates.

Percent composition by weight of climax vegetation, was depicted by "Range Site Descriptions" in the *Broadwater County Soil Survey* (USDA SCS, 1977) and in the *Technical Range Site Descriptions* (USDA SCS, 1981). Range sites are the predecessors to the present day NRCS ecological sites. The range site descriptions in these two documents had differences in percent composition by life form, as well as in average production figures (Table 1.2-1). Notice the difference between the two range site descriptions in normal production and in percent composition by lifeform. The percentage of forbs in the *Broadwater County Soil Survey* range site descriptions are one-third to one-half the amount of forbs described by the *Technical Range Site Descriptions*. Conversely, the *Broadwater County Soil Survey* has a generally higher percentage of composition by grasses.

Table 1.2-1 Comparison of Range Site Descriptions

Range Site Description Comparison		**Stony**		**Shallow**		**Very Shallow**		**Silty**	
		BCSS	**TRSD**	**BCSS**	**TRSD**	**BCSS**	**TRSD**	**BCSS**	**TRSD**
Production (Air Dry)	Normal	1800	1500	1500	1500	425	800	2200	2200
	High	2200	1900	1800	1800	550	1000	2600	2600
	Low	1400	1100	1200	1000	300	500	1800	1500
Percent Composition	Grasses	90	75	82	80	77	55	90	70
	Forbs	5	10	3	10	5	15	5	15
	Woody	5	15	15	10	18	30	5	15

BCSS= *Broadwater County Soil Survey* (USDA NRCS, 1977)
TRSD= *Technical Range Site Descriptions* (USDA SCS, 1981)

ERG chose to use the range site descriptions from the *Technical Range Site Descriptions* publication, as these were closer to the production and percent composition figures from the Grassland and Shrubland Habitat Types of Western Montana (Mueggler and Stewart, 1980). Table 1.2-2 outlines the five Range Sites common to the Elkhorns from the *Technical Range Site Descriptions*, and presents production (high, low, and normal), percent composition by life form, and percent composition by species.

Table 1.2-2 Range Site Description Comparison from *Technical Range Site Descriptions* Publication

		Range Sites				
		Stony	**Shallow to Gravel**	**Silty**	**Silty Droughty**	**Thin Hilly**
Production (Air Dry)	Normal	1500	1500	2200	1500	1700
	High	1900	1800	2600	1800	2000
	Low	1100	1000	1500	1100	1200
Percent Composition by Life Form	Grasses	75	80	70	80	75
	Forbs	10	10	15	10	10
	Woody	15	10	15	10	15
Percent Composition by Species	bluebunch wheatgrass	40-60	40-70	10-70	10-70	25-60
	rough fescue	40-60	0-15	20-75	20-75	20-40
	Idaho fescue	10-20	30-50	5-20	5-20	10-20
	needlegrasses	0-5	5-10	5-15	5-10	0-10
	wheatgrasses	0-15	0-5			5-15
	sedges	5-10	5-10			5-10
	other grasses	5-15	10-15			5-15
	Forbs	5-15	5-15	10-15	5-10	5-10
	Shrubs	5-15	0-10	5-15	5-10	5-10
Percent Climax Vegetation / AUMs per Acre	Excellent	76-100/ .5-.6	76-100/ .3-.4	76-100/ .5-.6	76-100/ .4-.5	76-100/ .4-.5
	Good	51-75/ .35-.5	51-75/ .2-.3	51-75/ .3-.5	51-75/ .3-.4	51-75/ .3-.4
	Fair	26-50/ .2-.35	26-50/ .15-.2	26-50/ .15-.3	26-50/ .2-.3	26-50/ .2-.3
	Poor	0-25/ .1-.2	0-25/ <.15	0-25/ 0-.015	0-25/ .1-.2	0-25/ .1-.2

ERG determined percent ecological condition of the rangeland habitats using several steps. (For illustration, refer to Figure 1.2-3 on the following page.) First, rangeland habitats were assigned a range site from slope and soil characteristics described in each range site description. Percent composition for each species were added (up to the percentage, by species, in Table 1.2-2), until all native species were totaled, or the percent composition by life form was met (i.e., a stony range site could only have up to 75% grasses). These percentages were carried over to the percent composition in climax column. Finally, the percent composition in climax column was totaled, providing percent climax vegetation (i.e., percent ecological condition). Note that non-native species are not factored into percentage ecological condition.

Figure 1.2-3, presents an example of an ecological condition worksheet for a thin hilly range site. Column "H" was converted into percent composition (column "I") by dividing the reconstructed weight for each species by the total reconstructed weight. Idaho fescue was 31% of the composition by weight on site, however the range site description for a thin hilly range site stipulates that only 20% of Idaho fescue can contribute towards percent composition in climax (Table 1.2-2). Cheatgrass (*Bromus tectorum)* made up 2% of the composition by weight, but none of this is counted towards percent climax because it is a non-native species. Forbs made up 18% of the percent composition by weight, but only 10% was counted towards

percent climax because on a thin hilly range site forbs can only make up 10% of the climax vegetation (Table 1.2-2). On a thin hilly range site, woody species (shrubs) can make up to 15% of the climax vegetation, however, this site only had 5% woody species.

Worksheet for Determining Ecological Condition and Stocking Rate

ECOLOGICAL SITE: Thin Hilly 15"-19" P.Z. **DATE:** 9/28/04 **SITE I.D.** SI#72 (TB#55)

		Ecological Condition									Stocking Rates		
	A	B	C	D	E	F	G	H	I	J	Potential Consumed (H X HE*)		
	Plant Name (Common Name/Symbol)	Green wt. Lbs. /(lbs./acre)	% dry weight	% current growth ungrazed	% growth curve completed	% of normal production	Reconstruction factor C/(D*E*F)	Reconstructed present weight	% Composition	% Composition climax	P	D	UD
GRASS & GRASS-LIKE	rough fescue / FECA4	25	0.74	0.50	1.00	1.00	1.48	37.0	5	5			
	Idaho fescue / FEID	150	0.87	0.60	1.00	1.00	1.45	217.5	31	20			
	bluebunch wheatgrass / PSSPS	75	0.81	0.50	1.00	1.00	1.62	121.5	17	17			
	prairie Junegrass / KOMA	30	0.85	0.50	1.00	1.00	1.70	51.0	7	7			
	western needlegrass / ACOCO	50	0.85	0.50	1.00	1.00	1.70	85.0	12	10			
	cheatgrass / BRTE	10	0.85	0.50	1.00	1.00	1.70	17.0	2	0			
									0				
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FORBS	cutleaf daisy / ERCO4	8	0.85	0.80	1.00	1.00	1.00	8.0	1	10			
	yellow paintbrush / CALU14	8	0.80	0.80	1.00	1.00	1.00	8.0	1				
	crazyweed / OXSE	10	0.80	0.80	1.00	1.00	1.00	10.0	1				
	pucoon / LIRU4	8	0.70	0.80	1.00	1.00	0.88	7.0	1				
	silky lupine / LUSE4	40	0.90	0.80	1.00	1.00	1.13	45.0	6				
	old man's whiskers / GETR	10	0.70	0.80	1.00	1.00	0.88	8.8	1				
	raceme pussytoes / ANRA	15	0.75	0.80	1.00	1.00	0.94	14.1	2				
	littleleaf pussytoes / ANMI3	10	0.75	0.80	1.00	1.00	0.94	9.4	1				
	wooly cinquefoil / POHI6	5	0.80	0.80	1.00	1.00	1.00	5.0	1				
	common yarrow / ACMI2	10	0.80	0.80	1.00	1.00	1.00	10.0	1				
	spotted knapweed / CEBI2	2	0.80	0.80	1.00	1.00	1.00	2.0	0				
	dandylion / TAOF	5	0.80	0.80	1.00	1.00	1.00	5.0	1				
	false dandylion / AGGLA	5	0.80	0.80	1.00	1.00	1.00	5.0	1				
									0				
									0				
SHRUBS	mountain big sagebrush / ARTRV	10	0.65	0.85	1.00	1.00	0.76	7.6	1	5			
	prairie sagewort / ARFR4	40	0.65	0.85	1.00	1.00	0.76	30.6	4				
									0				
									0				
									0				
									0				
								704.4	100				

Notes:

K. Total normal annual production in reference state (RV from ecological site description).	
L. Total pounds of allowable present (total of pounds in column J).	
M. Ecological Condition	**74.00**

	P	D	UD
Total By Preference (Total of of each colum)	0	0	0
Pounds of forage available for consumption: (P+D+UD)	0		
Pounds per AUM:			
AUM/ac (Forage Available for consumption/ 790.8):			
Ac/AUM (1 / AUM/ac):			

* Harvest efficiency factor (HE): P = .35, D = .25, UD = .05

(190-vi, NRPH, September 1997) 4ex–15

Figure 1.2-3 Example of an Ecological Condition Worksheet for a Thin Hilly Range Site

Ecological condition represents a measure of divergence from HCPC. The value is expressed as a relative percentage of similarity. Thus a survey site, like the example in Figure 1.2-3, yielding an ecological condition of 74%, has undergone a 26% change in species composition from the HCPC.

The USDA NRCS (1997) classifies ecological condition into four categories: excellent (76-100%), good (51-75%), fair (26-50%), and poor (0-25%). Out of 141 SIs, only one was rated less than "good" condition, and there were no ratings of "poor." Our 2004 findings for ecological condition are presented in Table 1.2-3, and the results for 2005 are presented in Table 1.2-4.

Table 1.2-3 Ecological Condition of the Rangeland in the North Crow Allotment (Acres and Percentages)

Excellent	Good	Fair	Poor	Totals
6,710 (78%)	1,806 (21%)	86 (1%)	0	8,602

Table 1.2-4 Ecological Condition of the Rangeland on Allotments in the Kimber EHU (Acres and Percentages)

Allotment	Excellent	Good	Fair	Poor	Totals
East Pacific	833 (57%)	641 (43%)	0	0	1,474
North Beaver	149 (67%)	74 (33%)	0	0	223
Pole Creek	167 (50%)	119 (36%)	47 (14%)	0	333
Whitehorse	483 (42%)	580 (50%)	97 (8%)	0	1,160
Outside WMU	3,180 (71%)	1,300 (29%)	0	0	4,480
Totals	**4,812 (63%)**	**2,714 (35%)**	**144 (2%)**	**0**	**7,670**

Once ecological conditions were determined, grids were created by interpolating measurements from SI surveys. This was calculated in non-forested areas only. Forested areas were determined by using Timber Stand Management Record System (TSMRS) data with supplemental digitizing from digital orthographic quadrangles (DOQs). The inverse distance weighted function was used in ArcInfo's Spatial Analyst with settings for a variable search radius, 12 point minimum, and a power of one (lower powers value closer points higher than points further away). Values were reclassified for display purposes. The ecological condition map is presented on the following page (Figure 1.2-4).

INSERT ECOLOGICAL CONDITION MAP HERE

Figure 1.2-4 Ecological Condition Map

Other techniques have been used in the Elkhorns to describe site conditions. "Stand Stage" was developed by the Helena National Forest (HNF) and basically relates present day range condition to HCPC. A rangeland with a Stand Stage of 1 would be as close to HCPC as possible, and a Stand Stage 4 is the most removed from HCPC. For a full explanation of the stand stage rating system see Section 1.2.2.1 of the Phase I Elkhorn Vegetation Study Final Report (ERG, 2004). Figure 1.2-5 and Table 1.2-5 present stand stage ratings for the North Crow EHU. Notice the areas of Stand Stages 3 and 4, which are comparable to the areas of low ecological condition. ERG mapped the ecological condition of rangeland habitats. If historic rangelands that conifers have encroached upon would have been included in this analysis, there would be an increase in the lower ecological condition ratings. The USFS has mapped areas of Stand Stage 4 in the southern portion of the North Crow Allotment which are attributable to encroachment. However, a majority of the encroachment is not mapped by the USFS. In Section 5.2.1 ERG uses GIS and the most recent data to identify 2,080 acres of encroachment in the North Crow allotment. Our analysis documents encroachment occurring mainly on the south facing slopes in Crow Creek. If these areas of encroachment were considered to be in poor ecological condition, ERG's ecological condition ranking for the North Crow Allotment would be: 63% excellent, 17% good, less than one percent fair, and 19% poor.

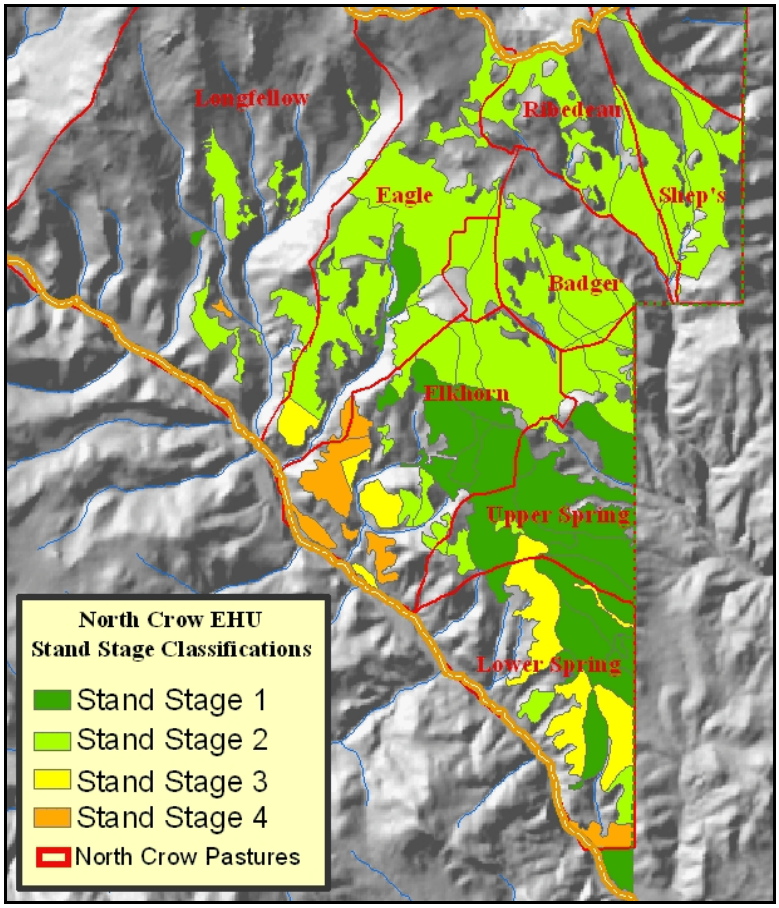

Figure 1.2-5 Stand Stage Ratings for the North Crow EHU (USFS, GIS)

Table 1.2-5 Stand Stage of the Rangeland in the North Crow EHU (Acres and Percentages)

Stage 1	Stage 2	Stage 3	Stage 4	Totals
2,130 (27%)	4,742 (60%)	689 (8%)	366 (5%)	7,927

Figure 1.2-6 and Table 1.2-6 present stand stage ratings for the Kimber EHU. Figure 1.2-7, on the following page, compares ecological conditions of rangeland habitats across both EHUs. With Stand Stage polygons representing rangeland habitats, notice the differences in the amount of rangeland verses forest between the two northern allotments (Pole Creek and North Beaver) compared to the two southern allotments (East Pacific and Whitehorse). Compared to the North Crow EHU, the rangeland habitats of the Kimber EHU have slightly lower ecological conditions. The stocking rates on the rangeland habitats on the Kimber EHU USFS allotments average over twice the stocking rates for the North Crow Allotment. See Section 7 for a full discussion of stocking rates.

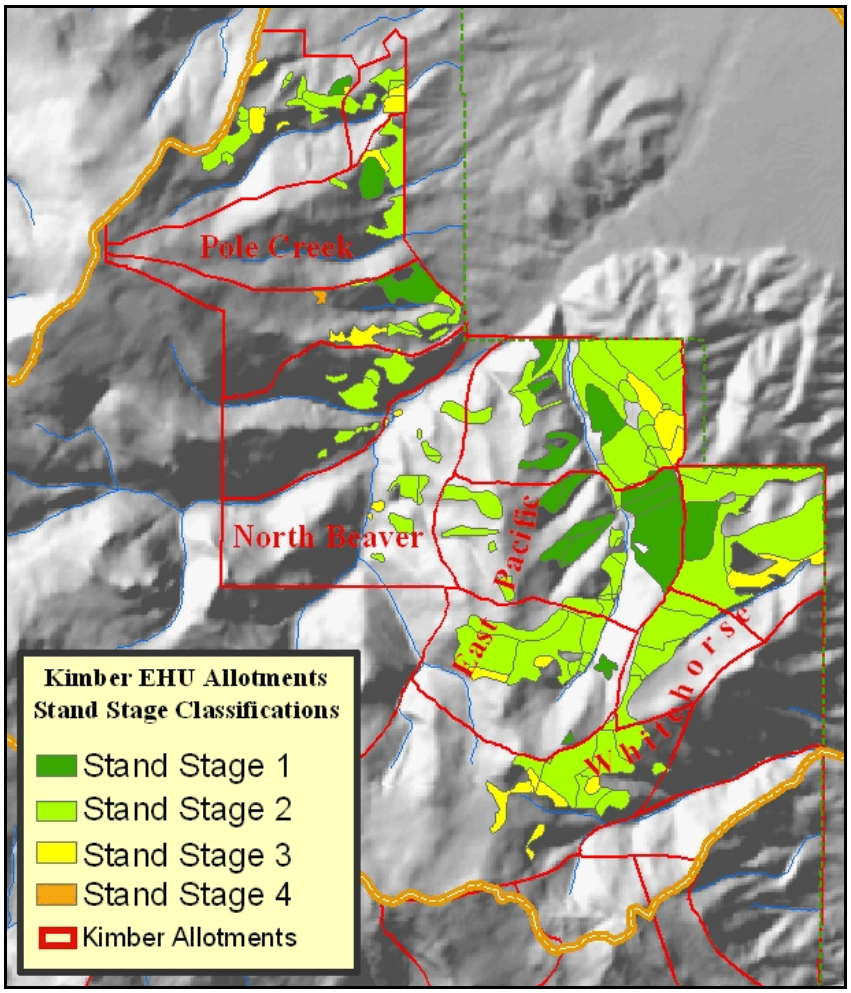

Figure 1.2-6 Stand Stage Ratings for the Kimber EHU (USFS, GIS)

Table 1.2-6 Stand Stage of the Rangeland in the Kimber EHU (Acres and Percentages)

Allotment	Excellent	Good	Fair	Poor	Totals
East Pacific	473 (31%)	968 (62%)	105 (7%)	0	1,546
North Beaver	0	168 (96%)	10 (4%)	0	178
Pole Creek	120 (23%)	290 (57%)	97 (19%)	6 (1%)	513
Whitehorse	76 (7%)	871 (81%)	129 (12%)	0	1,076
Totals	**669 (20%)**	**2,297 (69%)**	**341 (10%)**	**6 (1%)**	**3,316**

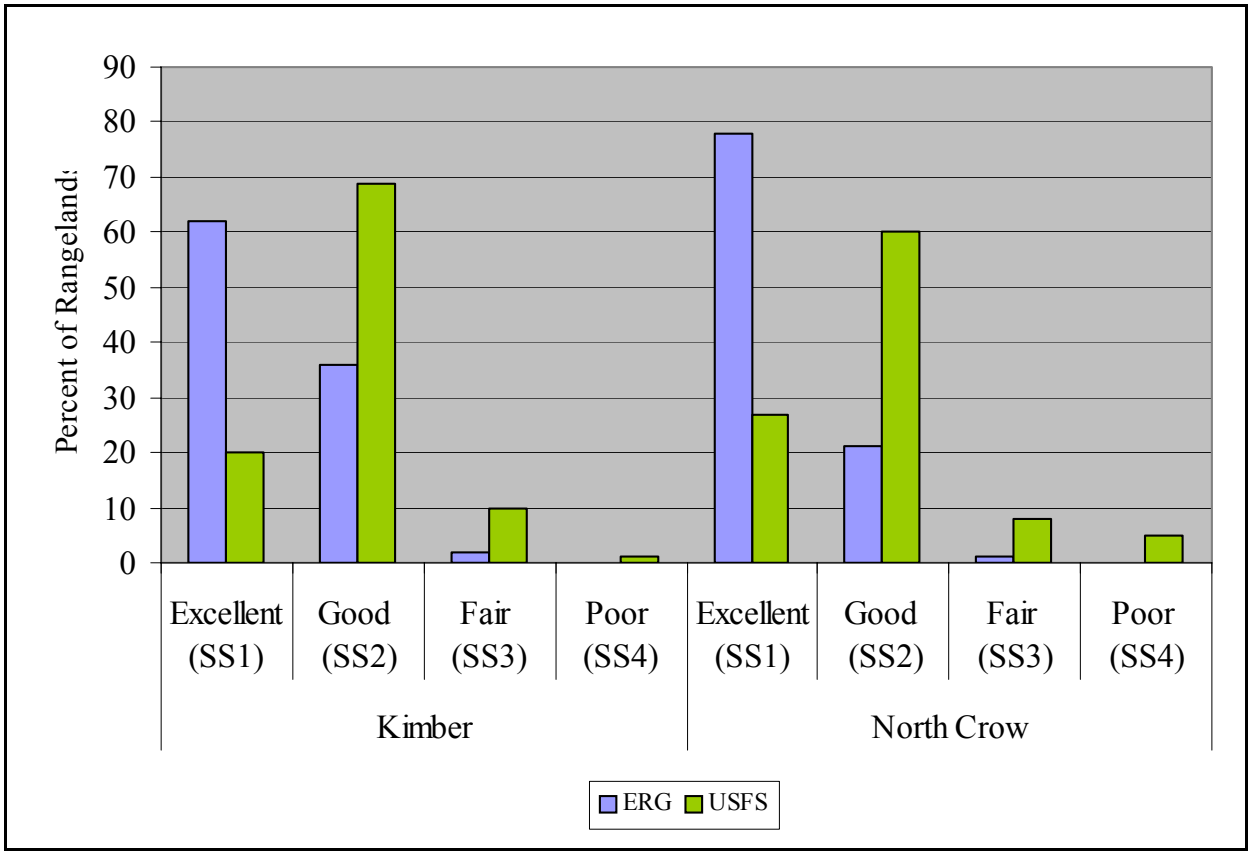

Figure 1.2-7 USFS and ERG Comparison of Ecological Condition of Rangeland Habitats within the WMU for Kimber and North Crow EHUs

1.3 PRODUCTIVITY OF RANGELAND HABITATS

Productivity of rangeland habitats was determined through an inventory of the rangeland on the North Crow and Kimber EHUs. Information from the 14 double sampling sites as well as the 15 utilization sites conducted were used for this task (see Figure 1.3-1.) The 209 SI sites also provided production figures from ocular weight estimates which were reconstructed to account for grazing, growth curve completed, and percent of normal production. Clipped data calculated total production values from 1,332 to 2,419 pounds (oven dry) per acre; while the ocular estimated at the SIs recorded production ranging from 630 to 2,719 pounds per acre, with an average of 1,610 pounds per acre.

Double sampling is a common technique used in range science used to accurately assess the available forage on a given acreage of rangeland. This practice yields an extrapolated weight of herbage based on the clipped and weighed vegetation of smaller, more accessible fixed-sized plots (USDA NRCS, 1997). In addition to providing verifiable stocking rate data, wet and dry weights can be compared to create dry weight regressions

with temporal and regional specificity. Most importantly, double sampling offers the field technician a systematic and reproducible means of scientific training. The dynamic interactions of growth habit, water availability, soil type, disturbance regimes, and other unique attributes of plant communities puts carrying capacity and production values in a state of flux throughout the growing season. Simply said, favorable growing conditions yield greater production, and vice versa. Double sampling allows the field technician to systematically "calibrate the eye" to obtain accurate and precise ocular estimates as growing conditions and production values change throughout the season (USDA NRCS, 1997).

Representative double sampling plots were chosen for the surrounding grasslands. Double sampling was also used as a training exercise for field personnel before they began the SI ratings. Double sampling protocols were modified from the National Pasture and Range Handbook (USDA NRCS, 1997). The framework of the protocol calls for plot selection, species classification, weight estimations, harvest, and data collection. Ten fixed-size 4.8 square-foot vegetation plots were randomly selected 0 to 50 feet off a 100-yard transect to represent the dominant species composition within ecological sites. Two of the ten plots were selected at random and marked for harvesting (clipping) prior to species classification and ocular estimations. At every sample plot all grass, forb, and shrub species were recorded by common name and/or NRCS symbol, and estimated weights were noted in grams for each species. The two previously marked plots were then revisited to harvest and record the weight of each species, individually, for the two harvest plots, separately. Upon collecting raw data from estimations and harvest, field technicians converted green-weights from grams per 4.8 square-feet into dry weight, pounds per acre. Estimates of harvested species were also adjusted by multiplying the averaged estimated weights with a corresponding correction factor. The correction factor was obtained by respectively

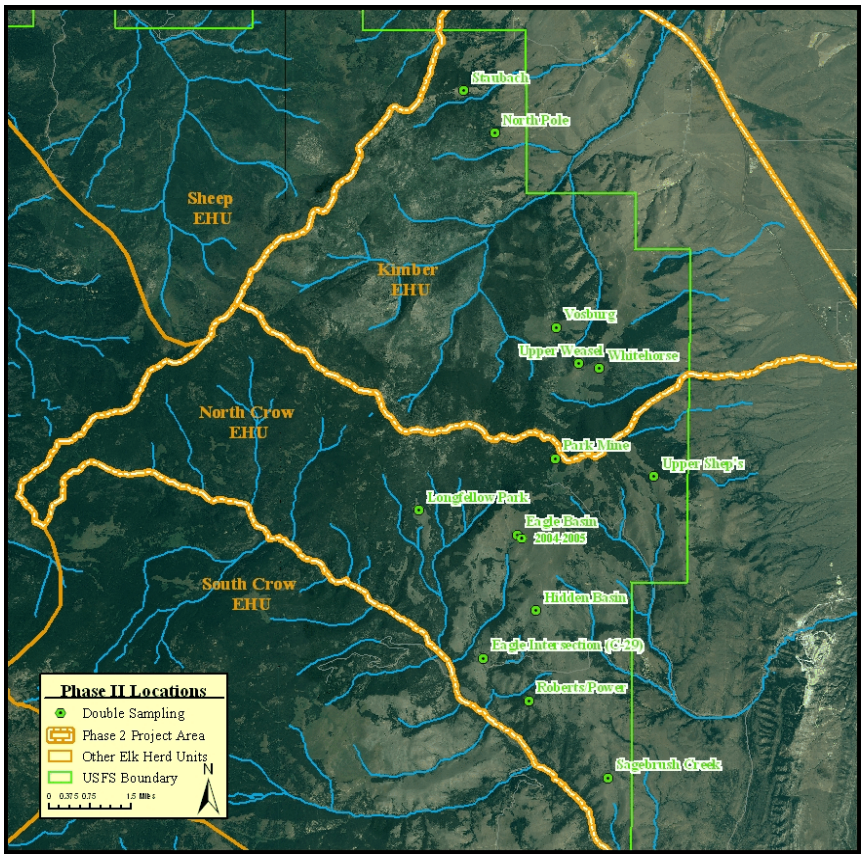

Figure 1.3-1 Double sampling locations

totaling the estimated weights and harvest weights from the harvest plots, then dividing the total harvested weights by the total estimated weights. The resulting quotient is formally called the quadrant correction factor (QCF). Estimates of harvested species adjusted with the QCF are noted as reconstructed weights. These reconstructed weights were then averaged to provide an average plot weight for individual species. By multiplying grams per 4.8 square-feet by 20, averaged plot weights were converted from grams per 4.8 square-feet to pounds per acre. A dry weight multiplier, obtained from NRCS data, specific to growth stages and species groups, was applied to each species surveyed to convert measurements into standardized forage production data. The QCF can be applied to the wet-weight actually present on the site, providing field technicians the ability to transfer harvested-weight values directly to stocking rate and SI forms. In this manner, double sampling offers a reproducible means of collecting accurate quantitative data (USDA NRCS, 1997).

Table 1.3-1 presents a comparison of the double sampling location information. The information ERG collected is compared to the USFS' site information as recorded in the GIS layer entitled "pasture polygon." The field entitled "Stand Stage" was developed by the HNF, and basically relates present day range condition to HCPC. As previously noted, a stand stage of one would be as close to HCPC as possible, while a stand stage rating of four would be the most removed from HCPC. For a full explanation of the stand stage rating system, see Section 1.2.2.1 of the Phase I Final Report.

Table 1.3-1 Double Sampling and Stand Stage Production Comparison

Site Name	Habitat Type (USFS)[a]	Stand Stage (USFS)[a]	Reconstructed Present Weight (ERG)[b]	Habitat Type (ERG)	Year Sampled
C-29	FEID/AGSP	4	1,677	FESC/AGSP	2004
Eagle Basin	FESC/FEID	2	2,375	FESC/FEID	2004
Eagle Basin	FESC/FEID	2	2,419	FESC/FEID	2005
Hidden Basin	FEID/AGSP	2	1,327	FESC/FEID	2004
Longfellow Park	FESC/FEID	2	1,406	FESC/FEID	2004
North Pole	FESC/AGSP	2	1,332	FESC/AGSP	2004
Park Mines	FESC/FEID	2	1,485	FEID/CAFI	2004
Roberts/Power	FEID/AGSP	2	1,267	FESC/AGSP	2004
Sagebrush Creek	FESC/FEID	1	1,820	FEID/AGSP	2004
Staubach	FESC/AGSP	2	2,118	FESC/AGSP	2005
Upper Shep's	FESC/FEID	2	1,805	FESC/FEID	2004

Site Name	Habitat Type (USFS)[a]	Stand Stage (USFS)[a]	Reconstructed Present Weight (ERG)[b]	Habitat Type (ERG)	Year Sampled
Upper Weasel	FESC/AGSP	1	1,353	FESC/AGSP	2005
Vosburg	FESC/FEID	2I	2,023	FESC/AGSP	2005
Whitehorse	FESC/FEID	2	1,684	FESC/AGSP	2005

[a] All USFS information came from GIS layer entitled "pasture polygon," data collected in 2002
[b] Oven dry weight (pounds./acre)

Table 1.3-2 presents a comparison of the production recorded by ERG at the 14 double sampling locations. These production figures are stratified by graminoids, forbs, and shrubs, and they are presented in pounds (oven dry weight) per acre and in percent of total production. For a full presentation of the data collected at the double sampling sites see the companion data document to this report .

Table 1.3-2 Double Sampling Production Comparison by Site

Site Name	Total Production Pounds per acre[a]	Percent Composition		
		Graminoids[b]	Forbs	Shrubs
C-29	1,677	60%	37%	3%
Eagle Basin	2,375	55%	45%	0
Eagle Basin	2,419	65%	34%	1%
Hidden Basin	1,327	64%	22%	14%
Longfellow Park	1,406	65%	35%	0
North Pole	1,332	67%	33%	0
Park Mines	1,485	32%	68%	0
Roberts/Power	1,267	68%	25%	7%
Sagebrush Creek	1,820	65%	27%	8%
Staubach	2,118	77%	22%	1%
Upper Shep's	1,805	68%	31%	1%
Upper Weasel	1,353	68%	32%	0
Vosburg	2,023	62%	36%	2%
Whitehorse	1,684	69%	31%	0

[a] Reconstructed Present Weight (Oven Dry)
[b] Sedges included

On the following page, Figure 1.3-2 shows total production (air dry weight) for all rangeland habitats in the WMU for the Kimber and North Crow EHUs. Production information from the 14 double sampling sites, 15 utilization sites, and 200+ SIs were used in preparing this map. ERG calculated over 25 millions pounds of production annually within the Kimber and North Crow EHUs, this was just for rangelands, within the extended WMU.

This was calculated in non-forested areas only. Forested areas were determined by using Timber Stand Management Record System (TSMRS) data with supplemental digitizing from digital orthographic quadrangles (DOQs). The inverse distance weighted function was used in ArcInfo's Spatial Analyst with settings for a variable search radius, 12 point minimum, and a power of one (lower powers value closer points higher than points further away). Values were reclassified for display purposes.

INSERT MAP HERE

Figure 1.3-2 Total production for Kimber and North Crow EHUs

1.4 INITIAL STOCKING RATES

The forage resource in the Kimber and North Crow EHUs is more than adequate for the current elk population plus the permitted use by domestic livestock within the WMU. The rangelands on the USFS allotments within the WMU are producing over 16 million pounds (oven dry weight) annually within the Kimber and North Crow EHUs. In 2005 elk and cattle within the WMU on the Kimber and North Crow EHUs consumed only 4.1 million pounds of forage. This total production was assigned to grazing animals using the NRCS's SI form, which uses species specific harvest efficiency factors to set appropriate stocking rates. Harvest efficiency factors were applied as follows: 35% for preferred species, 25% for desirable species, 5% for undesirable species, and zero for poisonous plants (USDA NRCS, 1997). This means that the most any species can be assigned to grazing is 35%. Table 1.4-1 presents a comparison of USFS permitted stocking rates to ERG's initial stocking rates, determined from the 200-plus SIs.

Table 1.4-1 Stocking Rate Comparison for USFS Allotments within the WMU

Allotment	Acres		Percent Rangeland	Stocking Rate AUMs	
	Range[1]	Total		ERG	USFS[2]
Diorite	535	1,615	25	265	174
East Pacific	1,474	3,629	40	1,151	560
North Beaver	223	2,294	10	196	107
North Crow	8,602	18,923	45	4,043	1,780
Pole Creek	333	3,157	11	253	258
Whitehorse	1,160	3,261	36	813	544
Total	**12,327**	**33,478**	**37**	**6,716**	**3,423**

[1] Range determined from large scale digitizing by ERG.
[2] USFS permitted stocking rates.

Table 1.4-2 presents ERG's initial stocking rates by pasture, for USFS allotments within the WMU. Stocking rate figures are broken out by AUMs from rangeland and AUMs from timbered areas. For forested areas, ERG used methodology from the NRCS' Woodland Grazing Guides (USDA NRCS, 1997) and assigned available forage according to canopy closure of the timber stand. The following AUMs/acre were assigned to timbered area as follows: 10-30% canopy closure = 0.1 AUM/acre (79.08 pounds/acre), 30-50% canopy closure = 0.05 AUM/acre (39.54 pounds/acre), 50-70% canopy closure = 0.03 AUM/acre (23.7 pounds/acre), and areas with greater than 70% canopy closure = 0 AUM/acre. Total pounds of production are also presented, these figures come only from rangeland polygons and were calculated by multiplying total production (pounds/acre) by the acres in each rangeland polygon.

Table 1.4-2 Initial Stocking Rates by Pasture for USFS Allotments within the WMU

Allotment	Pasture	Acres		Percent Rangeland	Stocking Rate AUMs			Total Pounds (oven dry weight)
		Rangeland	Total		From Rangeland	From Timber	Total	
Diorite	North Half	221	783	28	108	28	136	307,655
	South Half	315	1,367	23	105	24	129	62,419
	Total	**536**	**2,150**	**25**	**213**	**52**	**265**	**370,074**
East Pacific	Dry Gulch	644	1,293	50	419	27	446	1,095,659
	Vosburg	343	1,107	31	270	19	289	668,652
	Weasel	487	1,292	38	389	27	416	1,025,726
	Total	**1,474**	**3,692**	**40**	**1,078**	**73**	**1,151**	**2,790,037**
North Beaver	Badger	108	1,402	8	60	52	112	168,688
	Sawmill	115	892	13	53	31	84	198,015
	Total	**223**	**2,294**	**10**	**113**	**83**	**196**	**366,703**
North Crow	Badger	727	1,172	62	342	19	361	977,615
	Eagle	1,587	2,876	55	707	42	749	2,048,073
	Elkhorn	1,624	2,429	67	571	49	620	1,786,337
	Longfellow	663	5,913	11	278	199	477	845,467
	Lower Spring	1,159	2,036	57	463	59	522	1,307,200
	Ribedeau	665	1,494	45	352	25	377	891,875
	Shep's	968	1,303	74	439	12	451	1,126,977
	Upper Spring	1,209	1,700	71	459	28	487	1,338,713
	Total	**8,602**	**18,923**	**45**	**3,611**	**433**	**4,044**	**10,372,257**
Pole Creek	Little Pole	110	884	12	50	28	78	170,961
	Pole	67	984	7	28	40	68	91,161
	Staubach	159	1,066	15	69	37	106	208,096
	Total	**336**	**2,934**	**11**	**147**	**105**	**252**	**470,218**

Allotment	Pasture	Acres		Percent Rangeland	Stocking Rate AUMs			Total Pounds (oven dry weight)
		Rangeland	Total		From Rangeland	From Timber	Total	
Whitehorse	Kelly	576	894	64	340	11	351	879,528
	Kimber	204	275	74	157	9	166	375,472
	Whitehorse	380	1,887	20	258	38	296	650,886
	Total	**1,160**	**3,065**	**38**	**755**	**58**	**813**	**1,923,866**
Grand Totals		**12,331**	**33,049**	**37**	**5,917**	**804**	**6,721**	**16,275,175**

The stocking rates presented above (Table 1.4-2) are initial stocking rates for all grazing animals. These are called initial because they are a sum of acceptable pounds of forage available, with no reductions made for slope or distance to water, and the stocking rates have not been assigned to cattle or elk. ERG is not recommending that these stocking rates be assigned to cattle, but instead is presenting the total possible levels of acceptable use, from the NRCS' stocking rate determination (USDA NRCS, 1997). In addition to the 5,917 AUMs calculated within the cattle allotments within the WMU, ERG has also calculated an additional 4,826 AUMs for the rest of the extended WMU, these AUMs coming from USFS lands above the cattle allotments and from areas outside the WMU but within the extended WMU.