RANGELAND CONDITIONS OF THE BAND-I-AMIR AREA

Introduction

Between June 10th and June 14th, 2007, I visited Band-i-Amir to initiate a rapid rangeland reconnaissance of the area to determine concerns regarding rangeland conditions. I was guided by Mr. Sayed Humayoon, MoA and Mr. Muhammad Ayub Alavi, Hazarajat Conservation Specialist, WCS. Allocating 5 days for a rangeland survey for an area as large as Band-i-Amir (approximately 56,000 ha) allowed for only an overview of conditions; however, I am confident that I was able to understand the most significant rangeland problems during this time. I also established 13 transects for use as training/demonstration with Mr. Sayed Humayoon and Mr. Muhammad Ayub Alavi, as potential permanent photo-points, and also for quantification of site conditions in these specific areas. The small number of transects does not provide enough samples for delineation of plant communities, but I considered transects helpful as a way to have our group concentrate on site conditions and to make some comparisons (established a paired plot measurement of plowed versus unplowed sites) discussed below. During this rangeland reconnaissance we also interviewed a few individuals, generally a herder or someone harvesting shrubs, who were in the area in which we were doing our reconnaissance.

The most significant rangeland natural resource problems in Band-i-Amir are: (1) unsustainable shrub harvest for use as fuel, (2) plowing of fragile (prone to erosion) areas for growing grain, and (3) overgrazing. Each of these problems impact the rangelands of Band-i-Amir in different ways and the above numbering does not imply one problem as being more significant than another. Overgrazing has the most widespread impact and the most striking feature of these rangelands is the low cover and poor productivity of grasses. It is difficult to ascertain how much poor forage plant growth is associated with the natural conditions of the area and how much is exacerbated by current and historic grazing. However, there is little doubt that livestock grazing has major impacts on vegetation composition and production. I did not evaluate reed harvesting in wetland areas so I was not able to determine the significance of reed harvesting on these communities. During the next sections I discuss concerns regarding dry-land farming, shrub harvest, overgrazing, and rangeland health. In addition, a summary of the data from our vegetation transects is provided and all transect data are provided in attached appendices.

Dryland Farming

Dryland farming (lalmi) has the most visual and direct impact on rangelands, although on a smaller scale than livestock grazing or shrub collection. Some of the more observable impacts of the plowing of rangelands observed were a loss of natural vegetation cover, increased wind/water erosion, increased "weeds", and decreased aggregate soil structure associated with loss of surface soil structure. There is no doubt that the plowing of these areas is also leading to decreased soil carbon, lowered fertility, decreased water holding capacity and therefore a loss of natural productivity. Although apparently dry-land farming is illegal on government land, Shank and Larrson (1977) reported that there were traditional and inheritable rights to access of lalmi land in Band-i-Amir. They reported 3000 – 5000 jeribs (600 – 1000 ha) of dryland wheat were being

farmed every year. The current extent of *lalmi* is not known and should be determined, buit the total area impacted by dry-land farming should be considered as not only the area farmed but also recently abandoned or fallowed areas.

Using conservation tillage practices, some of the area could be sustainably farmed. However, it is certainly obvious that the steeper hillsides should not be plowed. Therefore, there is the immediate need to provide a land capability classification for placing or delineating sites into areas with low, moderate, high, and severe potential for soil erosion and crop failure based on site characteristics such as soils, soil depths and slope. Also, there is a need to better understand the costs/benefits of plowing rangelands in the Band-i-Amir. This will require a research/demonstration project. I would hypothesize that it is unlikely that in most years the dry-land wheat-fields produce enough grain to make the practice economical. Indeed one farmer we interviewed said the straw was more valuable than the grain. However, without a research/demonstration project to examine costs/benefits it is unlikely the farmers would be willing to restrict any plowing of areas. As stated previously, the plowing of steeper slopes will result in significant ecological damage and is certainly not sustainable. The reduction in livestock forage, increased weeds, and loss of soil are all costs that should be considered in setting up land use practices in this area (land classification system needs to be established). It is likely that as better equipment (tractors and plows) become available the impacts will increase as more area will be plowed. As such, conservation farming practices need to be explored/adapted for areas that farming is allowed. In one interview I was told that only about 25% of the area previously dry-land farmed is now used. Again, this would seem to suggest that the amount of cultivated area will likely increase as the needs for the increasing number of families to produce more food increases. In any decision to restrict land use, it would be desirable to have locals participate and agree on the type of sites where rangelands should not be plowed (for example, slopes greater than 5% incline).

It was beyond the scope of our survey to do detailed analysis of difference between plowed and unplowed sites; however, I did initiate a preliminary study on site cover differences between plowed and unplowed areas. We measured 2 sites that had been plowed and allowed to "go back" and 3 adjacent sites that showed no signs of plowing. I estimated that one of the plowed sites had been abandoned for about 4 years whereas the second site was estimated to be abandoned for 10 years. This information, however, was not confirmed. On these sites we estimated canopy cover, foliar cover, and basal cover by species and are included as Appendix 1 as the original data forms. We categorized life-forms into shrubs, forbs, perennial grasses and annual grasses. We also summed all values for a total cover estimate and one where annual grasses were excluded for a perennial total cover. The summary results are presented in Table 1. For these areas the plowed sites had lower shrub and perennial grass cover and an increase in annual grass and forb cover. Total cover (%) measured using canopy cover or foliar cover methods were similar between plowed and unplowed sites; however, for the unplowed sites basal cover and total perennial cover were greater compared to the plowed sites. These results are certainly not surprising, but show that plowing eliminated shrubs for an unknown period (hypothesized at 20 years as site estimated to be abandoned for 10-years had no shrubs) and also greatly decreases forage grasses. Most of what had come back were weeds with *Cousinia* sp. and *Saussaurea griffithi* being most prevalent. Annual grasses and annual weeds were more common in recently abandoned areas, but as stated previously the two sites measured had been

abandoned for a number of years. Litter cover was 18% and 11%, respectively for the plowed and unplowed sites. The plowed sites still had some straw and other dead plant material scattered on the surface which increased litter compared to the unplowed sites. As such, mean total soil cover was similar on the unplowed sites compared to the plowed sites averaging 56% and 52%, respectively. However, there is no doubt that erosion is greater on plowed sites for several years following the initial cultivation. I observed other plowed areas where soil erosion was very significant but localized in that the plowed areas are quite small in size. For example, in figure 1 soil erosion is evident as rills (small gullies) on this recently plowed area. Figure 2 is a photo showing a site where soil loss was estimated at 30 cm compared to the unplowed hillside. This plowed area had been abandoned, and since much of the soil has been eroded, subsoils are evident in part of the photo. Therefore, it is likely that cultivation would not be successful on the site and site productivity for other uses has been significantly degraded.

Table 1. Comparison of total shrub, forb, perennial grass, annual grass and total cover for plowed and unplowed sites at Band-i-Amir measured using three cover estimation methods.

Site	**SHRUB**	**FORB**	**Perennial Grass**	**Annual grass**	**Total Cover**	**Perennial Cover**
	Canopy Cover (%)					
Plowed	1.0	39.0	0.0	8.3	48.3	40.0
Unplowed	17.0	16.0	12.7	0.0	44.7	44.7
	Foliar Cover (%)					
Plowed	0.0	26.0	0.0	6.1	32.1	26.0
Unplowed	12.0	14.0	9.3	0.0	35.3	35.3
	Basal Cover (%)					
Unplowed	0.0	3.0	0.0	4.1	7.1	3.0
Plowed	8.0	2.7	8.0	0.0	18.7	18.7

One interesting aspect of having the area used for dry-land farming is that it provides some “rest” from livestock grazing to adjacent unplowed sites. As such, grass vigor was much greater around these areas contrasted to other areas grazed throughout the grazing season. Figure 3 is a photo illustrating a site with vigorous grass growth. Sites with vigorous grass growth were not observed outside of these cultivated areas. I believe the photograph provides some evidence of the potential grassland productivity for this area.

Fig. 1. Photo of site showing rill erosion (small gullies) on a recently cultivated area. Erosion was severe on steep slopes.

Fig. 2. Photo of site showing formerly cultivated area (left and with light subsoils revealed) where soil loss was estimated at 30 cm.

Fig. 3. Photo of site showing vigorous grass growth (Stipa sp.) where grazing has been restricted during the growing season because of the dryland farming in the area. This shows potential grass growth with reduced grazing. Most grass plants outside of this area were significantly smaller.

Livestock Grazing

There are approximately 7000 sheep and goats, 1360 cattle and 1540 horses and donkey owned by Band-i-Amir residents (ADB 2006). Ali (2006) states that the grazing is predominately "free-grazing" without rotation and suggests the stocking levels may have exceeded carrying capacity and a decline in pasture conditions. Considering the number of livestock within the grazing area[1], there is a mean of 3.98 ha/head/year of livestock. This would be a very high grazing rate if accurate and will continue to cause increased rangeland degradation. To determine an accurate stocking pressure (animal unit/ha), it will be necessary to determine grazing areas (for individual and/or communities) as well as timing of grazing and type and class of livestock using those areas (number of sheep/goats, cattle, etc. and age classes).

To reduce the overgrazing problem is certainly a formidable task as livelihoods of local people are mostly based on livestock, and there are few to no opportunities to grow supplemental feeds or to open new grazing areas. Examining figures on livestock per family shows a relatively low number of livestock per household. On an average there are 11.2 sheep/goats and 4.64 large animals (cattle, horses or donkeys) for each household. Also, when considering past livestock numbers (see Shank and Larrson 1977), it appears that livestock numbers are probably at levels below historic numbers.

[1] I was not able determine if significant numbers of these local livestock may graze outside of Band-i-Amir or how many other livestock may be moved into the area by Kuchi or other people.

Table 1. Families, total population, tribal division and livestock by village in the proposed Band-i-Amir National Park (ADB, 2006).

Village Name	Families	Population	Livestock			Tribal Division (%)	
			Sheep	Cattle	Donkey/ Horse	Hazara	Sayeed
Khakdaw	50	300	1000	150	100	95	5
Abtugak	5	30	100	10	10	100	0
Abghol	25	150	250	50	60	5	95
Kopruk	200	1200	2500	400	450	3	97
Koykinak	50	300	400	100	120	100	0
Sharistan	35	210	350	80	90	97	3
Sabzil	45	240	400	100	130	10	90
Jarukashan	50	300	300	80	100	5	95
Qalai Jafar	50	300	450	120	150	10	90
Dewkhana	60	360	650	150	180	5	95
Kotak	20	120	100	40	50	0	100
Boghondak Cheshma	20	120	300	50	60	100	0
Sailayak	15	90	200	30	40	95	5
TOTAL	**625**	**3720**	**7000**	**1360**	**1540**	**31**	**69**

Therefore, livestock numbers will likely continue to increase as households expand their livestock numbers. Also, the few herders we talked with (while we were doing our reconnaissance) did not consider overgrazing as being a significant problem and speculated much of the poor growth of forage plants was drought related. Two herders interviewed at 42.33183E; 38.50270N (3178 m) both thought *Artemisia* shrubs and grass had decreased in this area since the war but did not attribute the low grass production to livestock. To determine methods that may help alleviate overgrazing would take additional field work and interviews with users of these grazing lands. Perhaps stressing a rotational grazing system where the same areas are not grazed continually or the same time each year could be one approach that may show some improvement in forage plant vigor. However, without some control on stocking levels any rotational grazing system will likely produce disappointing results.

Shrub Collection

Almost all fuel used by families in Band-i-Amir is from shrubs and manure. Shrubs are used for cooking and manure mainly for heating. Ali (2006) states that, according to his survey, people prefer *Astragalus* and *Epehdra* species for fire wood purposes because of high calorie values of these plant species. However, with the lack of fuel most of the woody species were being collected resulting in large areas without the protection of shrub cover. In an interview with a shrub collector, we were told that a family uses about 70 kg of shrubs in 3 days (a donkey load is about 70 kg and he was paid 80 Afs/load) which would be equivalent to 8517 kg/yr. In a second interview we were told the average household used 7000-8000 kg/yr. Considering a total of 625

families in Band-i-Amir and estimating household use at 7500 kg/yr, the total use would be 4,687,500 kg/yr or 83.7 kg/ha for Band-i-Amir. We were also told that many came from outside the area and collected shrubs which were transported back to Bamiyan town. When considering the areas where there are no shrubs (cultivated areas, lakes, roads, and wetlands) the amount of shrub use/ha must average well over 100 kg/ha. There is no doubt that the level of shrub removal is not sustainable and is an area of conflict that needs to be addressed.

The concern with unsustainable use of shrubs for fuel seemed to be realized by all communities. As such, it is an area that should receive participatory planning to control shrub use and to make sure there are some mature shrubs to reseed harvested sites and to reduce soil loss. I will also stress that shrubs facilitate grasses (protect some grasses from continual livestock grazing), allowing for a seed source for the grasses. Removal of all shrubs will likely decrease grass vigor and production. Figure 4 is a photo of a site where we established a transect and also interviewed a herder that was grazing his animals in the area. He told us that a few years ago it had been very difficult to walk through this area because of the shrubs. All shrubs were collected from this area by people outside of the community.

As stated previously, I would suggest a participatory planning effort to begin the process of determining ways of managing for sustainable shrub use. Since all communities seem to see this as a significant problem, it should be initiated immediately. I would use participatory planning to characterize the problem, determine potential solutions, possibly agree on leaving a number of mature shrubs per area (perhaps 1 mature shrub/25m^2), and possibly to restrict shrub collection on steeper slopes (such as leaving more shrubs and perhaps 2 shrubs/25m^2). I would also suggest conservation (reducing shrub use by adoption of better stoves) should also be initiated.

Fig. 3. Photo 13 Jun2007-1036 showing a lack of shrubs, low cover and vigor of grasses for a site at 3360 m. We were told that this site had almost all shrubs removed by someone from outside the community and the site had been dominated by shrubs where it had been difficult to walk through the site.

General Rangeland Conditions and Transect Summaries

Our determination of rangeland conditions was a modified health assessment using indicators of rangeland conditions. A U.S. approach to classifying rangeland health attributes is problematic in that there are no reference sites in Band-i-Amir[2]. However, I believe the procedure does allow for an estimation of rangeland condition and health attributes. We established 8 transects (in addition to the 5 used in dryland farming areas) for use as permanent photo points to examine rangeland health attributes and also estimated rangeland health attributes on five other selected areas (where no detailed transect information was collected). The mean site characteristics and cover values of shrubs, forbs, and grasses are shown in Table 2. A summary of canopy cover, foliar cover, and basal cover of species is presented in Appendices 1-3. Data forms and photos are found hyperlinked at: Data summaries.

Table 2. Summaries of site characteristics for 8 transects measured in the area outside of the cultivated areas of Band-i-Amir in June 2007.

Site	Elevation (m)	Aspect (degrees)	Slope (%)	Soil Cover (%)	Litter (%)	CC SHRUBS (%)	CC FORBS (%)	CC PER GRASS (%)	Total Canopy Cover (%)	B.A. SHRUBS (%)	B.A. FORBS (%)	B.A. GRASS (%)	Total Basal Cover (%)
11Jun-1445	**2988**	**345**	**1**	**62**	**20**	**14**	**16**	**2**	**32**	**0**	**0**	**0**	**0**
12Jun-1000	**3668**	**32**	**12**	**54**	**18**	**6**	**12**	**14**	**32**	**0**	**6**	**10**	**16**
12Jun-1515	**3252**	**212**	**3**	**60**	**26**	**14**	**14**	**8**	**36**	**0**	**0**	**2**	**2**
12Jun-1640	**3254**	**148**	**12**	**68**	**16**	**4**	**28**	**4**	**36**	**0**	**2**	**4**	**6**
12Jun-1710	**3250**	**322**	**6**	**40**	**36**	**10**	**16**	**22**	**48**	**2**	**4**	**4**	**10**
13Jun-0930	**3354**	**270**	**9**	**40**	**48**	**18**	**2**	**12**	**32**	**4**	**0**	**8**	**12**
13Jun-1030	**3360**	**158**	**7**	**60**	**12**	**16**	**6**	**10**	**32**	**4**	**0**	**4**	**8**
13Jun-1200	**3386**	**51**	**10**	**30**	**34**	**10**	**24**	**26**	**60**	**12**	**2**	**8**	**22**
MEAN	**3314**	**192**	**8**	**52**	**26**	**12**	**15**	**12**	**39**	**3**	**2**	**5**	**10**

On transect sites the elevation varied from 2988 m to 3668 m capturing much of the elevation variation of Band-i-Amir. Total canopy cover averaged 39% and varied from 32% to 60%. Grass canopy cover varied from 2% to 26%, forb canopy cover from 2 to 28%, and shrub canopy cover from 4 to 18%. Total basal cover averaged 10% and varied from 0 to 22%. Grass basal cover varied from 0% to 10%, forb canopy cover from 0 to 6%, and shrub canopy cover from 0 to 12%. Species and life-forms will vary associated with soils, climate, and biotic factors (human, livestock, and natural herbivory). However, on all sites (transects and areas of rapid

[2] In the U.S. an Ecological Reference Area is necessary for site comparisons. The Ecological Reference Area used for comparisons will be the same site (climate, soils) with information on the natural variability of rangeland attributes such as litter cover, percentage of different life-forms, rills, bare ground etc. This allows an estimate on "the degree to which the integrity of the soil, vegetation, water, and air, as well as ecological process of the rangeland ecosystem, are balance and sustained".

reconnaissance) the lack of grass and the high coverage of forbs (often with anti-herbivory characteristics such as thorns, oils, etc) provide evidence of the overgrazed condition of much if not all of the landscape. It has been hypothesized by some that the dominance and the occurrence of *Artemisia* is predominately associated with overgrazing. I believe that significant cover of *Artemisia* shrub would naturally occur on these rangelands. These rangelands are semi-arid with a high percentage of winter/spring precipitation. In this type of rangeland *Artemisia* shrubs compete effectively with grasses where fire is not a prevalent force. There is, however, little doubt that the lack of grass productivity and vigor in much of Band-i-Amir is associated with overgrazing. Annual precipitation was estimated to be 400 mm by Freitag (1971). If this area does receive this amount of average precipitation (this probably needs additional verification as it seems somewhat high), it would appear that plant productivity is significantly below its potential. As shown in the plot data, grasses are not uncommon and "remnants" of perennial grasses are common and provide the potential for improvement in grass production and cover with rest from intensive grazing.

In the modified rangeland health assessment I considered most sites with moderate to extreme departures from a "healthy condition" (Table 3 and Appendix 3). For all sites the amount of bare ground was considered excessive relative to site potential and recent weather. Life-forms were considered to depart from expected where most sites had a lack of grasses, but a number of sites also showed a loss of shrubs associated with shrub harvest for fuel wood. Soils appeared to exhibit a lack of aggregate stability and increased surface crusting and the sites had lower litter levels than I would have expected under the climate and weather conditions. Grass productivity and often other life-forms were considered below potential. For all sites, signs of significant water erosion (gullies, rills, water flow patterns) was not evident. I suspect as much of the precipitation occurs in the winter/spring runoff from intense rainfall events (thunderstorms are not a common event). Signs of wind erosion were more evident but not extreme. Again, I suspect the area is not overly impacted by high winds.

The moderate to extreme level of site degradation suggested by the rangeland health evaluation is likely a result of long-term grazing pressure and shrub harvest (sites in plowed areas were not evaluated). I would suggest that there is a strong potential for improvement in site conditions on most of the sites I measured because of "remnant" forage plants. The removal of shrubs and thus the reduction of "protection" associated with the shrubs is a large concern. The shrubs not only provide some protection to the grasses and other forage species but modify soil conditions by holding some litter and organic matter at the shrub base, reduce flow of wind/water across the site, and hold snow.

Table 3. Summary of rangeland health evaluation indicators (10 sites).

	Descriptors/Rating Classes				
Indicators	Extreme	Moderate to Extreme	Moderate	Slight to Moderate	None to Slight
1. Rills			1	8	1
2. Water Flow Patterns			1	8	1
3. Pedestals or Terrecettes		1	1	6	2
4. Bare Ground		1	5	5	
5. Gullies					10
6. Wind Scoured Areas				9	1
7. Litter Movement			5	5	
8. Physical & Chemical Soil Crusts		1	4	5	
9. Soil Surface Organic Matter		1	5	4	
10. Composition/Distribution-		3	6	1	
11. Compaction layer		1	5	4	
12. Plant Functional/Structural	2	6	2		
13. Plant Mortality		3	6	1	
14. Litter Amount	2	6	2		
15. Annual Production	1	6	3		
16. Noxious & Invasive Plants	1	1	6	2	
17. Perennial Plant Reproductive Capability	1	5	4		
Indicator Summary	Mostly Disagree	Moderate Disagree	Intermediate Agreement	Moderate Agreement	Mostly Agree
Soil/Site Stability Summary	1	8	1		
Biotic Integrity Summary	1	8	1		

Summary and Recommendations

I initiated a rapid rangeland reconnaissance survey with the aid of Mr. Sayed Humayoon, MoA and Mr. Muhammad Ayub Alavi, Hazarajat Conservation Specialist, WCS between June 10th and June 14th, 2007. For these rangelands, overgrazing, dry-land farming, and unsustainable shrub harvest for use as fuel are areas of management concern. There seems to be consensus that overharvesting of shrubs is occurring and should receive immediate attention for development of improved management. I suggest a participatory planning process to initiate potential solutions to the problem. It is difficult for me to state if local communities see either overgrazing or dry-land farming as significant natural resource problems. I propose that studies be initiated on the returns of dry-land farming and the adoption of a land classification restricting dry-land farming

on highly erodible sites (steep slopes to be determined at a later time). If planning/study exercises are successful in shrub harvest and dry-land farming, it may "pave the way" for discussion and management practices that would reduce livestock grazing impacts. Additional rangeland surveys and plant community analysis would also provide managers with a site classification system to better define rangeland site potential. A rangeland site classification system would provide managers with information on indicators of degradation, levels of degradation, and provide better information on sites where improved grazing management would result in more rapid improvement in forage production.

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Fig. 5. *Dactylorhiza umbrosa,* an orchid found in wetlands in Band-i-Amir.

Appendices

Appendix 1. Summary of basal area by transect and species (species names are currently being verified and will be updated).

Site	11Jun07-1445	12Jun07-1000	12Jun07-1515	12Jun07-1640	12Jun07-1710	13Jun07-0930	13Jun07-1030	13Jun07-1200	14Jun07-0845	14Jun07-0910	14Jun07-0945	14Jun07-1005	14Jun07-1110
Aconthillum	0	6	2	0	2	14	4	10	2	0	2	0	2
Artemisia	6	0	8	4	4	4	6	0	8	0	8	0	6
Astragalus shrub	0	0	2	0	0	0	2	0	4	0	0	0	6
CERLAN	0	0	0	0	0	0	0	0	6	2	0	0	0
Atraphix spinosa	8	0	2	0	2	0	4	0	0	0	2	0	0
Ephedra	0	0	0	0	0	0	0	0	0	0	0	0	2
Allium	0	0	0	0	0	0	2	0	0	0	0	0	0
Arenaria	0	4	0	0	0	0	0	0	0	0	0	0	0
Artbiennial	0	0	0	0	8	2	0	0	0	4	0	2	10
Astragalus	4	0	0	0	0	0	0	0	0	2	6	4	0
Cousinia	6	6	12	26	6	0	4	24	12	12	8	8	2
Saussaurea	0	0	0	0	0	0	0	0	0	18	2	10	2
Saussaurea	0	0	0	0	0	0	0	0	2	0	0	0	0
Melilotus	4	0	0	0	0	0	0	0	0	0	0	0	0
Mertensia	0	2	0	0	0	0	0	0	0	0	0	0	0
POLPAR	0	0	0	0	0	0	0	0	0	4	0	6	0
Taraxacum	0	0	0	0	0	0	0	0	2	0	0	0	0
UNKF1	2	0	2	2	2	0	0	0	2	4	0	4	0
Carex	2	0	0	0	14	0	0	6	4	0	2	0	0
Annual grass	0	0	0	0	4	0	0	0	0	16	0	0	0
Elymus	0	2	0	0	0	0	0	0	0	0	0	0	0
Festuca	0	12	0	0	0	12	6	18	0	0	0	0	0
Hordeum	0	0	4	0	0	0	2	0	0	0	0	0	0
Stipa	0	0	2	4	4	0	0	2	4	0	18	0	10
Poa	0	0	2	0	0	0	2	0	0	0	0	0	0
TOTAL	32	32	36	36	46	32	32	60	46	62	48	34	40

Appendix 2. Summary of basal area by transect and species (species names are currently being verified and will be updated).

Site	11Jun07-1445	12Jun07-1000	12Jun07-1515	12Jun07-1640	12Jun07-1710	13Jun07-0930	13Jun07-1030	13Jun07-1200	14Jun07-0845	14Jun07-0910	14Jun07-0945	14Jun07-1005	14Jun07-1110
Aconthillum	0	6	6	0	6	14	4	12	2	0	2	0	0
Artemisia	6	0	4	0	2	2	4	0	8	0	4	0	6
Astragalus shrub	0	0	0	0	0	0	2	0	4	0	0	0	6
CERLAN	0	0	0	0	0	0	0	0	4	0	0	0	0
Atraphixis spinosa	4	0	0	0	2	0	0	0	0	0	0	0	0
Artbiennial	0	0	0	0	8	0	0	0	0	2	2	2	2
Astragalus	4	0	0	0	0	0	0	0	0	2	6	4	0
Ephedra	0	0	0	0	0	0	0	0	0	0	0	0	0
Allium	0	0	0	0	0	0	0	0	0	0	0	0	10
Arenaria	0	4	0	0	0	0	0	0	0	0	0	0	0
Cousinia	4	4	10	20	4	0	6	14	8	10	6	4	0
Saussaurea	0	0	0	0	0	0	0	0	0	10	0	8	2
Eremus	0	0	0	0	0	0	0	0	2	0	0	0	0
Melilotus	4	0	0	0	0	0	0	0	0	0	0	0	0
Mertensia	0	2	0	0	0	0	0	0	0	0	0	0	0
POLPAR	0	0	0	0	0	0	0	0	0	4	0	4	0
Taraxacum	0	0	0	0	0	0	0	0	2	0	0	0	0
UNKF1	0	0	2	2	2	0	0	0	2	2	0	0	0
Carex	0	0	0	0	10	0	0	0	2	0	0	0	0
Annual grass	0	0	0	0	0	0	0	0	0	12	0	0	0
Elymus	0	2	0	0	0	0	0	0	0	0	0	0	0
Festuca	0	10	0	0	0	12	4	16	0	0	0	0	2
Hordeum	0	0	2	0	0	0	0	0	0	0	0	0	0
Stipa	0	0	2	2	2	0	0	0	4	0	16	0	4
Poa	0	0	0	0	0	0	2	0	0	0	0	0	0
TOTAL	22	28	26	24	36	28	22	42	38	42	36	22	32

Appendix 3. Summary of basal area by transect and species (species names are currently being verified and will be updated).

SPECIES	11Jun07-1445	12Jun07-1000	12Jun07-1515	12Jun07-1640	12Jun07-1710	13Jun07-0930	13Jun07-1030	13Jun07-1200	14Jun07-0845	14Jun07-0910	14Jun07-0945	14Jun07-1005	14Jun07-1110
Acantholimon	0	0	0	0	2	4	4	12	0	0	0	0	0
Artemisia	0	0	0	0	0	0	0	0	4	0	2	0	2
Astragalus shrub	0	0	0	0	0	0	0	0	0	0	0	0	4
CERLAN	0	0	0	0	0	0	0	0	4	0	0	0	0
Atraphaxis spinosa	0	0	0	0	0	0	0	0	2	0	0	0	0
Ephedra	0	0	0	0	0	0	0	0	0	0	0	0	6
Allium	0	0	0	0	0	0	0	0	0	0	0	0	0
Arenaria	0	2	0	0	0	0	0	0	0	0	0	0	2
Artbiennial	0	0	0	0	0	0	0	0	0	2	0	0	0
Astragalus	0	0	0	0	0	0	0	0	0	0	0	0	0
Cousinia	0	2	0	2	4	0	0	2	2	2	2	0	0
Echinops	0	0	0	0	0	0	0	0	0	0	0	0	0
Eremus	0	0	0	0	0	0	0	0	0	0	0	0	0
Melilotus	0	0	0	0	0	0	0	0	0	0	0	0	0
Mertensia	0	2	0	0	0	0	0	0	0	0	0	0	0
POLPAR	0	0	0	0	0	0	0	0	0	0	0	2	0
Taraxacum	0	0	0	0	0	0	0	0	0	0	0	0	0
UNKF1	0	0	0	0	0	0	0	0	2	0	0	0	0
Carex	0	0	0	0	2	0	0	0	2	0	0	0	0
Annual grass	0	0	0	0	0	0	0	0	0	8	0	0	0
Elymus	0	0	0	0	0	0	0	0	0	0	0	0	0
Festuca	0	10	0	0	0	8	4	8	0	0	0	0	4
Hordeum	0	0	0	0	0	0	0	0	0	0	0	0	0
Stipa	0	0	2	4	2	0	0	0	4	0	12	0	2
Poa	0	0	0	0	0	0	0	0	0	0	0	0	0
TOTAL	0	16	2	6	10	12	8	22	20	12	16	2	20