AJAR VALLEY RAPID RANGELAND RECONNAISSANCE

Introduction

A rapid rangeland analysis methodology was used to examine rangeland conditions of Ajar Valley[1] between 3 June and 8 June 2008. Previous to the survey I reviewed three 1970's reports on Ajar Valley Wildlife Reserve (Larsson, 1978; Shank and others 1977, Skogland, 1976). During the rapid rangeland assessment I familiarized myself with the vegetation and rangelands by hiking through some of the area and comparing vegetation communities observed with information on rangeland communities by Skogland (1976) and Larsson (1978). I next established 20 transects for evaluating vegetation cover, determining rangeland health, and for use as permanent photo transects and monitoring sites. For each transect we determined aspect, slope, latitude/longitude, estimate of rangeland health, and cover of species using a line intercept and point intercept methodology. Ajar Valley is a difficult area to survey as topography is dissected by many canyons and water is very limited. As such, the area surveyed was not as extensive as desired, but I was able to observe a number of sites with different conditions associated with grazing use. I believe this provided me with some very interesting site comparisons and indicators regarding rangeland health[2] which are discussed in the following sections.

Rangelands of Ajar Valley

Rangelands of Ajar Valley vary greatly in this mountainous area associated with different physical characteristics (soils, climate, elevation, aspect, and slope) and grazing use. Information on climate, soils, and historic and current grazing use are very limited as no detailed site specific studies exist. In general, Ajar Valley weather is strongly continental with low air humidity, high evaporation, wide temperature fluctuations, and a winter/spring dominated precipitation pattern. The closest weather station is Bamian City located about 70 km southeast. This station, at an elevation of 2550 m, reports an annual average of 130 mm of precipitation (Fig. 1). Larsson (1978) estimated that annual precipitation varied from about 160 mm in the valley bottoms to over 400 mm in the upper mountainous sections of Ajar. It seems that the 160

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[1] In this report Ajar Valley refers to an area of canyons and uplands mostly east of Chiltan Lake of the former Ajar Valley Wildlife Reserve.

[2] Indicators of rangeland health are estimates of rangeland site indicators (vegetation and soil) associated with comparison of the site to potential for the site.

mm annual average estimate of Larsson (1978) for the low elevation areas of Ajar Valley is probably somewhat high when compared with Bamian City. It is likely that the lower elevation sites of Ajar receive less than 130 mm annual precipitation and perhaps closer to 100 mm. As the elevation increases precipitation may approach the 400 mm as suggested by Larsson (1978) but exact estimates are not currently possible.

No known soil surveys exist for the Ajar Valley. Larsson (1978) states that soils are predominantly grey soils with low humus and high carbon content but above 3000 m the organic matter content increases and the soils fall into the chestnut group. He also reported that soils are generally rather permeable with a single grain structure and low water-retention capacity except in the valley bottoms where silty soils may be found (as stated below I believe finer textured soils were also more common in depressions that often had high composition of *Carex stenophylla*). Because the soils are relatively young and topography is extremely varied, relatively large soil differences, such as differences in depth, coarse fragments, textural classes, and texture are found throughout Ajar.

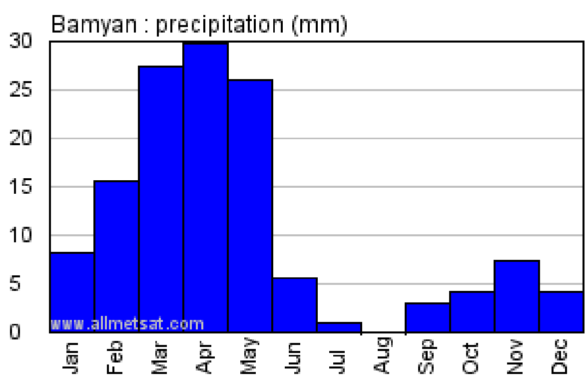

Fig. 1. Precipitation measures at Bamian town (www.allmetsat.com – 20 September 2008).

In previous reports by Skogland (1976) and Larsson (1978) vegetation community descriptions were included for major vegetation types. Skogland classified 5 major vegetation types. These were a *Carex stenophylla* short grass type, a *Stipa szowitsiana* tall grass type, an *Artemisia* type, a *Amygdalus* type and a *Cousinia* type. Larsson (1978) included seven vegetation types (River-bank willow community, Canyon-bottom scrub community, *Ephedra* steppe, *Zygophyllum* steppe, *Acantholimon* steppe, *Carex stenophylla* meadow, and *Juniperus excelsea* woodland) and also referred to a Bare rock type and a Scree type which have some vegetation but very little. Larsson (1978) also developed a vegetation type map for the area. Only the *Carex stenophylla* type is designated by both Skoagland and Larsson as a vegetation type and this type seems quite small and likely associated with overgrazing but also with site characteristics such as depressions that help hold additional water and finer soils (these areas are also higher elevation sites). Any vegetation classification is a human construct and I was not able to determine the criteria used by either Larsson or Skogland in the development of their classification systems. However, it is my opinion that Larsson's vegetation types are more useful than Skogland's, but with that said, I believe that much more work needs to be done to provide a more useful plant community classification. From my short time at Ajar I would argue that most of the upland rangelands are predominately either a Chenopod type (*Zygophyllum, Ceratoides, Haxolyon* genera shrub dominated) at lower elevations; a *Artemisia* shrub steppe type at moderate elevations; and a *Artemisia-Acantholimon* steppe at higher elevations[3]. As stressed by Larsson a Juniper woodland type may have existed, but currently the *Juniper* is found only in rocky steep areas, protected in canyons or in canyon valleys, or as isolated single trees in a few areas. Out of the uplands a River-bank willow community type (along the Ajar River) and Canyon-bottom scrub community type (distributed widely and extremely variable in plant composition) can be identified. Appendices 1-3 are photos showing some of the communities of the canyon bottoms. A very unique (for this very dry environment) forest type (*Juniperus*) exists in some of the narrow valleys (Appendices 1 and 3), but much of the canyon bottoms are a scrub shrub type (Appendix 2) and likely greatly modified by human uses. The River-bank willow community type (Appendix 4) is found only along the Ajar River. It is an important vegetation type but quite restricted to a narrow area along the river valley.

Ajar Valley was a wildlife reserve used by the Afghanistan royal family as a hunting area beginning in the early 20th century. All grazing of domestic stock was forbidden within the reserve boundaries, an area of approximately 50,000 ha, in the mid-20th century and apparently shrub harvest and local hunting was also mostly eliminated (Shank and others 1977). This resulted in what was believed to be the largest area in Afghanistan where livestock grazing was restricted and thus was considered as a potential reference area for determining how grazing was impacting central Afghanistan rangelands. However, by the 1980s the changing socio-political situation resulted in a loss of livestock grazing control and it is unknown how many livestock have grazed in this area during the recent past.

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[3] Later I will suggest the *Artemisia-Acantholimon* steppe may have been once dominated by *Acantholimon*, a slow growing species often used as fuel.

Rapid Reconnaissance of Rangeland Health

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 Ajar Valley [4]. However, I believe the procedure does allow for an estimation of rangeland condition and health attributes. We established 20 transects for use as permanent photo points, to establish a benchmark for vegetation conditions and to examine rangeland health attributes. These transects were not randomly placed across Ajar Valley but were placed in areas in which we were working or traveling through. Twenty transects is certainly not sufficient to provide sound statistical information but does provide general information on site characteristics and conditions for those particular sites and most importantly could be used for permanent monitoring sites. The mean site characteristics and canopy cover values of shrubs, forbs, and grasses are shown in Table 1. Mean site characteristics and foliar cover, basal cover, and foliar cover by line intercept methodology are presented in Appendices 5-7. Electronic copies of original data forms with genera and species cover values and photos are archived on DVD.

Transect elevation varied from 2170 m to 3340 m providing a representative elevation gradient of Ajar Valley. Total canopy cover (%) varied from 4% to 82% and total grass canopy cover varied from < 1 to 52%. As would be expected lower elevation sites had lower total cover and generally lower grass cover but many of the high elevation sites also had very low grass cover. I suggest that perennial grass cover is a strong indicator of rangeland condition in Ajar Valley with those sites having little or no measured grass cover as being “unhealthy” or not providing forage grasses in levels that would be expected for “healthy” sites. Rangeland health will be discussed in the following paragraph. For 17 of the sites *Artemisia* was the dominant shrub type. These sites were above 2575 m and would have been mostly in the *Acantholimon* steppe (those sites > about 2800 m) and *Zygophyllum* steppe of Larsson (1978). None of the sites measured had an *Acantholimon* dominated shrub cover and this may be a significant finding in that Larsson (1978) states that these communities are dominated by *Acantholimon*. It is

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[4] 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”. Ecological sites are not available for Afghanistan so my estimates of rangeland health are based on subjective judgment of my hypothesis of current conditions related to what I believe potential conditions might be based on current climate conditions and my experience on similar sites.

possible that the use of *Acantholimon* for fuel by local peoples has reduced its stature as the plant is likely very slow growing. Without permanent photo-points or transects it is impossible to determine if *Acantholimon* has actually decreased in these communities. If it has changed from a dominant to a subdominant, it is a significant change in plant communities of this area. Certainly the *Artemisia* shrubs are also used as a fuel source, but I hypothesize that growth rates are much greater for *Artemisia* shrubs compared to *Acantholimon* cushion shrubs and the *Artemisia* often have very high seed production.

Table 1. Site characteristics and canopy cover (%) of vegetation groupings for transects measured in June 2008 in Ajar Valley using a point intercept method.

Transect	Elevation (m)	Aspect	Slope	*Acantholimon*	*Ephedra*	Legumes[1]	*Artemisia* shrubs	Annual grasses	Forbs	Perennial Grass	Grass-likes	Salt Desert Shrubs	Total Cover
Jun04_08_1025	3100	352	24	6	4	2	10	0	0	52	0	0	74
Jun04_08_1150	3132	330	20	<1	0	0	8	0	4	52	0	0	64
Jun04_08_1435	3080	18	38	<1	0	2	8	0	10	52	0	0	72
Jun05_08_0820	2912	244	18	<1	0	0	42	0	0	<1	0	0	42
Jun05_08_0920	2936	323	22	6	0	2	16	0	10	10	0	4	48
Jun05_08_1115	3126	310	8	2	0	2	26	0	0	<1	4	0	34
Jun05_08_1155	3160	12	10	6	0	0	22	0	16	16	22	0	82
Jun05_08_1430	2610	300	15	2	0	0	18	0	2	4	0	0	26
Jun05_08_1510	2538	298	8	4	0	0	44	0	0	<1	0	0	48
Jun06_08_1535	2980	340	19	0	8	10	26	0	0	20	6	0	70
Jun06_08_1630	2980	175	16	6	2	0	40	0	0	2	0	0	50
Jun06_08_1725	2953	0	3	0	0	0	32	0	0	8	28	0	68
Jun07_08_0700	3304	320	34	8	0	2	14	0	6	18	0	0	48
Jun07_08_0835	2912	340	8	2	0	2	40	0	0	12	10	0	66
Jun07_08_0945	2724	300	5	6	0	0	18	0	0	4	14	4	46
Jun07_08_1030	2698	32	15	4	0	0	20	0	0	2	0	2	28
Jun07_08_1130	2575	331	8	0	0	0	18	0	0	6	2	4	30
Jun07_08_1200	2537	144	16	0	0	0	0	2	0	<1	0	2	4
Jun07_08_1340	2170	0	0	0	0	0	0	0	0	<1	0	42	42
Jun07_08_1750	2360	313	10	0	0	0	0	2	4	<1	0	2	8

[1] Legumes included herbaceous *Astragalus* and *Oxytropis* species (mostly *Astragalus*) and an occasional *Astragalus* shrub.

A summary of rangeland health attributes determined at the transect sites is presented in Table 2. In the procedure for categorizing rangeland health, I hypothesize that those sites in "Extreme" and "Moderate to Extreme" departure classes are sites with high degradation and little doubt that rangeland health is compromised. Those sites classified with "Slight to Moderate" and "None to Slight" departure are sites where degradation is not evident and these sites are currently or until recently being grazed in an intensity that allows for sustainable use. The mid class (moderate) is where indicators are not clear and these sites could be degrading or perhaps improving although in general I suspect the former and describe the sites as having slight "unhealthy" conditions.

Table 2. Summary of rangeland health evaluation indicators determined in June 2008 for Ajar Valley using a rapid rangeland reconnaissance methodology (20 sites measured).

	Descriptors/Rating Classes				
Indicators	Extreme	Moderate to Extreme	Moderate	Slight to Moderate	None to Slight
1. Rills	1	6	3	5	5
2. Water Flow Patterns	2	6	5	3	4
3. Pedestals or Terrecettes	2	5	8	2	3
4. Bare Ground	3	8	5	2	2
5. Gullies	1	1	2	5	11
6. Wind Scoured Areas	1	3	6	4	6
7. Litter Movement	2	5	8	3	2
8. Physical & Chemical Soil Crusts	1	7	4	7	3
9. Soil Surface Organic Matter	0	8	5	5	2
10. Plant Composition/ Distribution Relative to Infiltration/RO	3	9	2	4	2
11. Plant Functional/Structural Groups	6	4	3	5	2
12. Plant Mortality	3	5	5	4	3
13. Litter Amount	2	7	5	4	2
14. Annual Production	2	9	4	2	3
15. Noxious & Invasive Plants	0	2	6	8	4
16. Perennial Plant Reproductive Capability	0	10	5	3	2
Indicator Summary	Mostly Disagre	Moderate Disagree	Slightly Disagree	Moderate Agreement	Mostly Agree
Soil/Site Stability (Indicator 1-9)	4	7	5	2	2
Biotic Integrity (Indicator 10 -16	4	7	5	2	2

I rated four sites (20%) as having little evidence of site degradation and three of these sites were in areas where livestock grazing was believed to be limited by topographical features. I rated 11 sites (55%) with clear evidence of soil/site stability or biotic integrity degraded conditions. The remaining sites (25%) were less clear in their trends regarding site and biotic integrity and I estimated that these sites as only slightly "unhealthy". Of the categories used to indicate changes in health, I believe the most important of these sites are generally associated with bare ground, plant composition/distribution relative to infiltration, plant functional/structural groups and annual production. Livestock grazing has reduced grass cover and grasses are mostly found beneath shrubs or protected by rocks and this situation is seen as a change in plant composition, plant functional groups (reduced perennial grasses) and in annual production as a decline in grass productivity. Very little litter is present on most sites except occasionally around shrubs. Obviously, in the dryer low elevation sites low soil organic matter and low amounts of litter are natural, but I believe grazing has exacerbated the situation by removing almost all grasses. For most sites, signs of significant water erosion (gullies, rills, water flow patterns) were not evident. I suspect much of the precipitation occurs in the winter/spring runoff from intense rainfall events (thunderstorms are not a common event). Wind erosion signs were more evident but not extreme. Again, I suspect the area is not overly impacted by high winds. Also, harvesting of shrubs and other plants (e.g., *Ferula asafoetida*) creates site degradation by decreasing vegetation cover and disturbing soil surface conditions. I observed many donkey loads of shrubs being transported through the Ajar Valley. Larsson mentions large donkey loads of *Haloxylon griffithii* (*Arthrophytum griffithii* syn) being transported by donkeys for fuel, and although I am sure it is still being used for fuel I observed mostly *Artemisia* and *Juniperus* being transported on donkeys during the short time I was in the area.

Comparison of Two Areas Receiving Different Livestock Grazing Use

As stated above I believe one of the most useful indicators of a change in rangeland conditions or health is associated with a change in grasses. I base this finding partially on a comparison of two areas with similar site characteristics (physiographic features and soil) but different livestock accessibility. I will refer to these sites as site 1, an area with predominately low to moderate grazing use, and site 2, an area with predominately high grazing use or impacts. Locating sites that received no livestock grazing was not possible.

Site 1 was a site that was difficult to access associated with the area being dissected by canyons and rock outcrops. This site received some livestock grazing and there were sheep and goats in the area when we were doing the transect measurements. Site 1 was sampled on 4 June 2008 with 3 transects. The three transects had a mean elevation of 3090 m, moderate slopes and mostly northerly aspects (Table 3) and likely would have been included in Larsson's (1978) *Acantholimon* steppe vegetation type[5]. These sites had some of the highest total canopy, foliar, and basal cover of any sites measured, but what is apparent is that perennial grass cover (and estimated grass standing crop) was significantly greater than for any other sites measured. The dominant shrub was *Artemisia lehmanniana* (with *A. rutifolia* present). *Acantholimon* spp and cushion Carophyllaceae were common. Dominant grasses were *Festuca ovina* and *Stipa* spp. (probably *S. szowitsiana*). *Elymus* spp. (probably *E. dahuricus* or perhaps *E. pobanus*) was observed mostly on sites with low grazing pressure or where plants were in "protected" sites" such as around rocks or shrubs or in steep canyons. *Cousinia sp.* was the dominant forbs observed on these sites but no forbs were found at high cover levels.

Table 3. Comparison of transects from two areas with similar physical characteristics (elevation, slopes and aspect) but with different grazing use.

Transect	Elevation (m)	Aspect^0	Slope^0	Shrubs CC*	Shrubs FC	Shrubs BC	Forbs CC	Forbs FC	Forbs BC	Grass/Grass Like CC	Grass/ Grass Like FC	Grass/GL BC	Total Cover CC	Total Cover FC	Total cover BC	Rangeland Heath
Jun04_1025	3100	352	24	18	12	6	0	2	2	52	38	14	74	52	22	G
Jun04_1150	3132	330	20	10	12	2	4	2	0	52	26	14	64	40	16	G
Jun04_1435	3080	18	38	10	6	0	10	4	0	52	32	22	72	42	24	E
Site 1** Mean	3104	233	27	13	10	3	5	3	1	52	32	17	70	45	21	
Jun05_0920	2936	323	22	22	20	4	10	4	0	10	8	0	48	34	4	P
Jun05_1115	3126	310	8	30	22	2	0	0	0	4	4	0	34	26	2	VP
Jun05_1155	3160	12	10	24	16	2	16	10	2	22	18	0	82	44	14	F
Site 2 Mean	3074	215	13	25	19	3	9	5	1	12	10	<1	55	35	7	

* CC, FC, and BC refer to canopy cover, foliar cover, and basal cover, respectively.
** Site 1 was estimated to have light to moderate grazing associated with topography. Site 2 was estimated to have a greater livestock grazing intensity as the site had few topographic barriers to livestock movement.

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5 A comparison of transect location to the georeferenced scan of Larsson's (1978) map placed all of the June 4 transects in the *Carex stenophylla* vegetation type (but very little or no *Carex stenophylla* was present). June 5 transect locations overlaid on Larsson's (1978) map had sites on bare rock vegetation type, canyon and *Acantholimon* steppe.

Site 2 was measured on 5 June using three transects. The three transects had a mean elevation of 3074 m and generally had similar aspects and slope to site 1 transects (4 June transects) (Table 3). This site had relatively easy access to livestock grazing when compared to site 1 as trails into the area were not as steep, or perhaps more importantly not as dissected by many steep canyons. This site was 2.7 km from the lightly grazed site and access to permanent water was about 3 km from this site compared to 5 km for site 1. Two transects measured on this site would be classified in Larsson's (1978) *Acantholimon* steppe vegetation type and the third a mix of *Acantholimon* steppe and the *Carex stenopylla* meadow vegetation type. Data from these two sites are presented in Table 3 to illustrate some the differences in vegetation associated with livestock grazing in these two areas (species information can be found in Appendices 5-8). I have also used four photos (Figures 2-5), two transect overview photos and 2 close-up photos, to show the similarity of the sites (transect photos) and differences in the site (close-up photos).

The light-moderate grazed site had greater grass/grass-like cover and total cover and less forbs and shrub cover. For these shrub steppe sites perennial grass cover is the most significant attribute in regards to rangeland condition. Overgrazing is resulting in a loss of grass cover which is critical in protecting the soil surface and the lack of grass cover increases soil crusts (see Fig.5). The impact of livestock trailing is also evident in canyons, major trails, and on many hillsides through the area as increased bare ground (Appendix 8). For site 1 (04 June transects) I rated rangeland health during fieldwork as either excellent or good based on greater grass cover, grass productivity, flower-head production and litter (Table 3). The rangeland health estimates of transects measured on site 2 varied from very poor to fair associated with poor grass cover, less grass production, vigor of grasses was very poor (no flower production or standing litter) and soil crusting was evident when compared to the light to moderately grazed site. This area also had It is my belief that much of the upper elevation plateau areas with proper grazing should be producing 800-1000 kg/ha of grasses rather than the current estimate of 200 kg/ha of grasses seen on most of the upper plateau areas. Without livestock grazing controls (numbers and season of use) in this area, we will have continued degradation and a loss of rangeland productivity for both livestock and wild ungulates.

Fig. 2. Photo of site 1 transect with low to moderate livestock grazing. Note evident grass cover (transect Jun04_08_1150: Photo 04-06-2008_12.02.26).

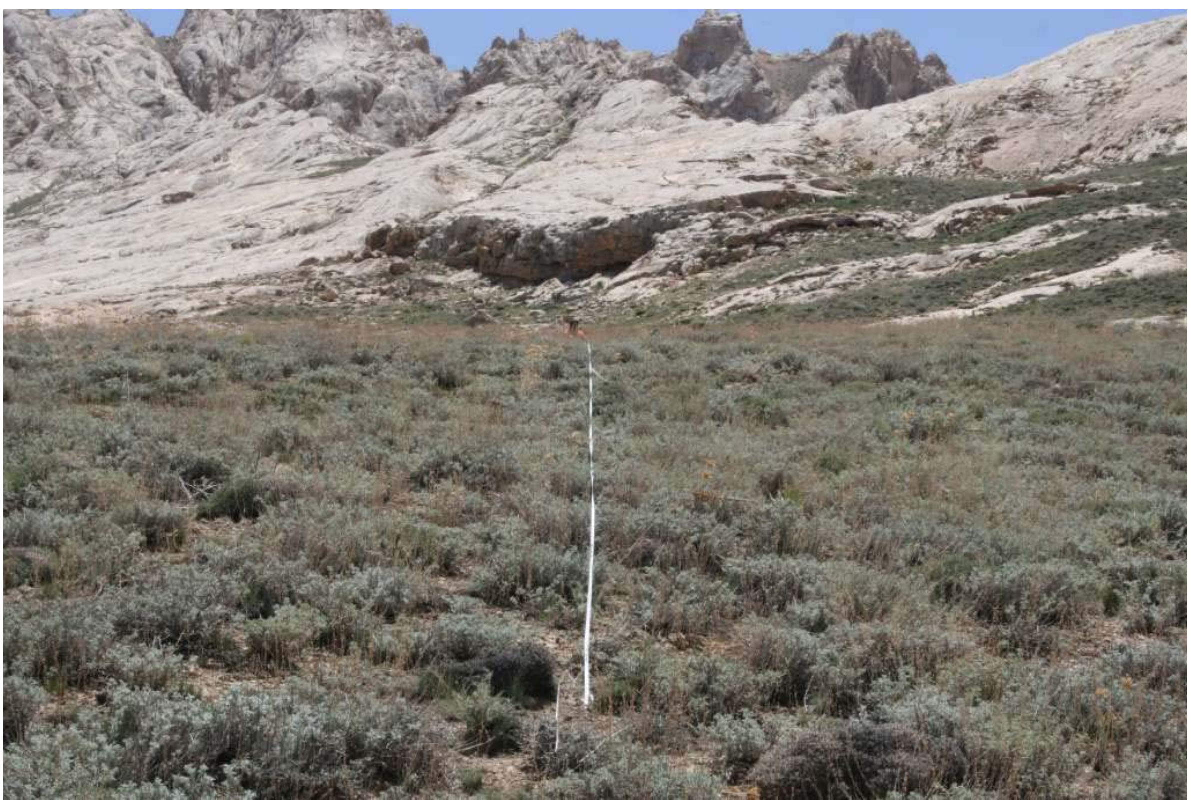

Fig. 3. Photo of site 2 with heavy livestock grazing. Note "heavier shrub cover and lack of grass (transect Jun05_08_0920: Photo 05-06-2008_09.45.12).

Fig 4. Close-up photo of plot on site 1 showing greater grass cover (Transect Jun04_08_1150: Photo 04-06-2008_11.07.50). The site was moderately grazed and although in much better condition than other sites may be digressing in condition.

Fig. 5. Photo of close-up plot on site 2 illustrating soil crusting and lack of grass (Transect Jun05_08_0920: Photo 05-06-2008_09.54.14).

Concluding Statements

Ajar Valley is a diverse landscape with many values that need immediate conservation attention. There is certainly the potential that livestock grazing and cutting of shrubs and trees will increase site degradation and potentially eliminate the juniper seed source as juniper trees are often cut and those remaining are often isolated and in poor condition . It is reported that the wild ungulate population (ibex and urial) have dramatically decreased during the last several decades, and it seems very possible that wild ungulates could be eliminated from the area. I suspect that competition for forage and water with livestock is impacting wild ungulate populations, but likely past poaching by local peoples have been the major driving force for a reduction in these populations. I base this subjective judgment on my belief that there are still many sites in Ajar Valley that are producing moderate amounts of forage that would be available for wild ungulate populations when not continually used by livestock.

From my rapid rangeland assessment, I have documented that overgrazing is a problem and grass cover is a major indicator in rangeland condition. My time in Ajar Valley was not sufficient for a detailed survey to quantify overall rangeland conditions and additional surveys are needed to better define vegetation types, assess rangeland conditions and to determine a livestock population level that would not significantly compete with wild ungulates and provide for improved grass forage production. Additional work is also needed to determining the impact of shrub/tree harvest for fuel on these rangelands, especially on the impact on juniper and *Acantholimon* types. Information on livestock grazing (timing, numbers, and distribution) is also limited and necessary to determine how livestock grazing could be balanced with conservation needs of the area. Larsson (1978) stated that "compared to the adjacent, over-exploited rangelands, the Ajar Valley Wildlife Reserve show throughout its history of protection signs of general range improvement that are considered unique for the central Afghanistan highland" as the area had been protected from grazing by domestic livestock and shrub-collection for nearly 30 years. It is extremely unfortunate that this protection was lost by the 1980s and there is little doubt that current human uses are degrading rangelands. However, I believe that some of the rangelands of the Ajar Valley are still some of the least degraded I have observed in Band-i-Amir or in the Wakhan Corridor, my two major study areas. The lightly grazed "Site 1 area" was one such area with high grass productivity and good species diversity of perennial grasses that I have not seen in other areas of Bamian and I would hypothesize that there were other similar sites that could be located with additional surveys.

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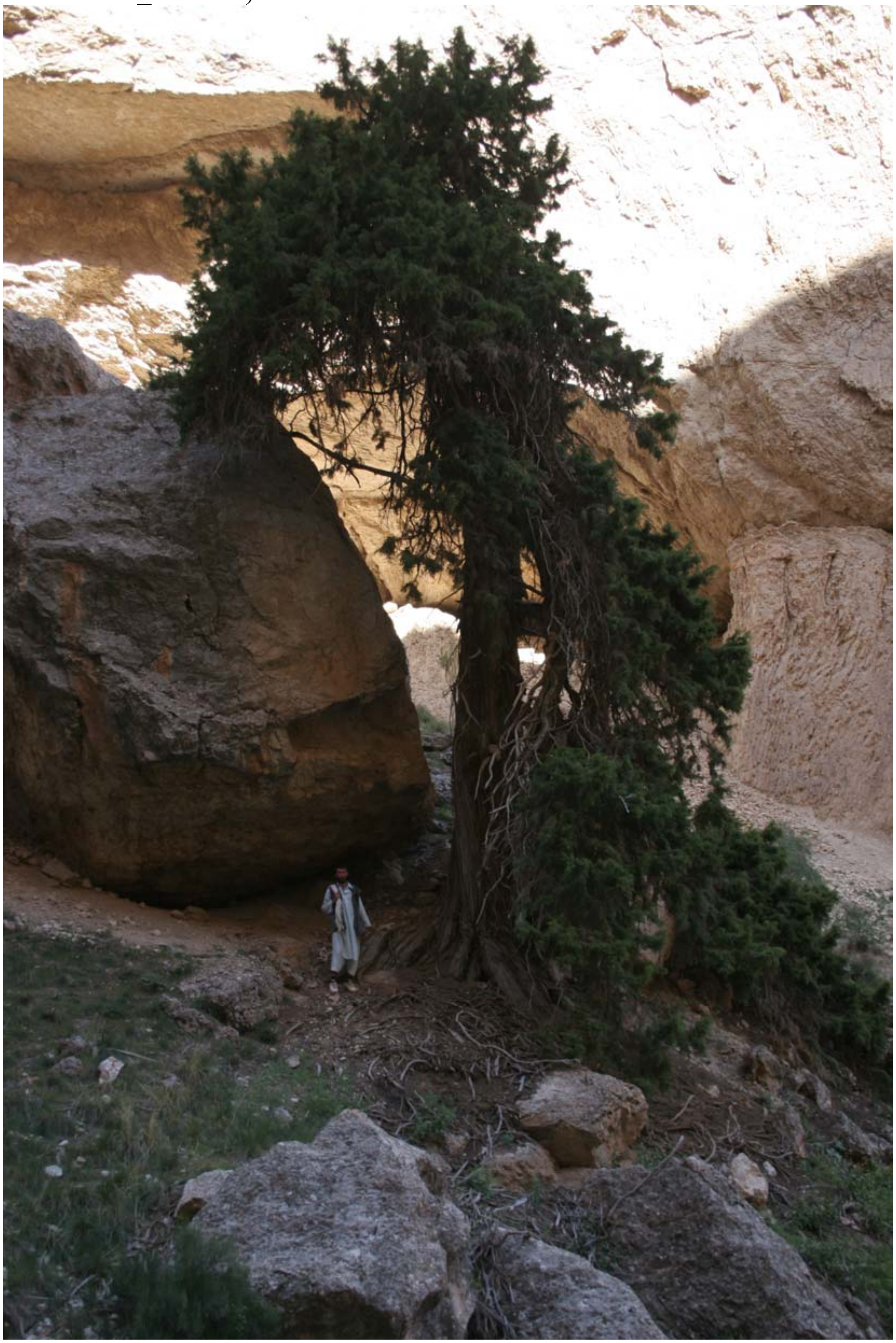
APPENDICES

Appendix 1. Canyon valley forest type (*Juniperus* and *Lonicera*) that is believed to be unique as "oases" in the dry surrounding environment of the area (Photo 04-06-2008_07.42.14).

Appendix 2. Canyon scrubland vegetation type of wider and dryer valleys (Photo 07-06-2008_15.94.54).



Appendix 3. One of the larger juniper trees observed. Note good grass cover here (Photo 04-06-2008_07.56.10).

Appendix 4. Photo of a River-band willow community type located in the upper Ajar river valley.

Appendix 5. Site characteristics (elevation in meters, aspect and slope in degrees) and foliar cover (%) of vegetation groupings for transects measured in June 2008 in Ajar Valley using a point intercept methodology (point at each meter using a 50 m transect).

Transect	Elevation	Aspect	Slope	*Acantholimon*	*Ephedra*	Legumes	*Artemisia* shrubs	Annual grasses	Forbs	Perennial Grass	Grass-likes	Salt Desert Shrubs	Total Cover
Jun04_08_1025	3100	352	24	6	0	0	6	0	2	38	0	0	52
Jun04_08_1150	3132	330	20	6	0	0	6	0	2	26	0	0	40
Jun04_08_1435	3080	18	38	0	0	0	6	0	4	32	0	0	42
Jun05_08_0820	2912	244	18	0	0	0	22	0	2	0	0	0	24
Jun05_08_0920	2936	323	22	6	0	2	12	0	4	8	0	2	34
Jun05_08_1115	3126	310	8	2	0	0	20	0	0	0	4	0	26
Jun05_08_1155	3160	12	10	6	0	0	10	0	10	12	6	0	44
Jun05_08_1430	2610	300	15	2	0	0	6	0	2	0	0	0	10
Jun05_08_1510	2538	298	8	4	0	0	28	0	0	0	0	0	32
Jun06_08_1535	2980	340	19	2	6	4	12	0	0	14	2	0	40
Jun06_08_1630	2980	175	16	6	4	0	20	0	2	0	0	0	32
Jun06_08_1725	2953	0	3	0	2	0	14	0	0	4	12	0	32
Jun07_08_0700	3304	320	34	8	0	2	8	0	6	16	0	0	40
Jun07_08_0835	2912	340	8	2	0	0	14	0	0	2	2	0	20
Jun07_08_0945	2724	300	5	4	0	0	14	0	0	0	0	4	22
Jun07_08_1030	2698	32	15	4	0	0	8	0	0	0	0	2	14
Jun07_08_1130	2575	331	8	0	0	0	10	0	0	2	0	2	14
Jun07_08_1200	2537	144	16	0	0	0	0	0	0	0	0	0	0
Jun07_08_1340	2170	0	0	0	0	0	0	0	0	0	0	16	16
Jun07_08_1750	2360	313	10	0	0	0	0	0	0	0	0	2	2

Appendix 6. Site characteristics (elevation in meters, aspect and slope in degrees) and basal cover (%) of vegetation groupings for transects measured in June 2008 in Ajar Valley using a point intercept methodology (point at each meter using a 50 m transect).

Transect	Elevation	Aspect	Slope	*Acantholimon*	*Ephedra*	Legumes	*Artemisia* shrubs	Annual grasses	Forbs	Perennial Grass	Grass-likes	Salt Desert Shrubs	Total cover
Jun04_08_1025	3100	352	24	6	0	0	0	0	2	14	0	0	22
Jun04_08_1150	3132	330	20	2	0	0	0	0	0	14	0	0	16
Jun04_08_1435	3080	18	38	0	0	2	0	0	0	22	0	0	24
Jun05_08_0820	2912	244	18	0	0	0	0	0	0	0	0	0	0
Jun05_08_0920	2936	323	22	4	0	0	0	0	0	0	0	0	4
Jun05_08_1115	3126	310	8	2	0	0	0	0	0	0	0	0	2
Jun05_08_1155	3160	12	10	2	0	0	0	0	2	10	0	0	14
Jun05_08_1430	2610	300	15	2	0	0	0	0	0	0	0	0	2
Jun05_08_1510	2538	298	8	4	0	0	0	0	0	0	0	0	4
Jun06_08_1535	2980	340	19	2	2	0	0	0	0	4	0	0	8
Jun06_08_1630	2980	175	16	4	0	0	0	0	2	0	0	0	6
Jun06_08_1725	2953	0	3	0	0	0	0	0	0	2	0	0	2
Jun07_08_0700	3304	320	34	8	0	0	0	0	2	10	0	0	20
Jun07_08_0835	2912	340	8	0	0	0	0	0	0	2	0	0	2
Jun07_08_0945	2724	300	5	2	0	0	0	0	0	0	0	0	2
Jun07_08_1030	2698	32	15	2	0	0	0	0	0	0	0	0	2
Jun07_08_1130	2575	331	8	0	0	0	0	0	0	0	0	0	0
Jun07_08_1200	2537	144	16	0	0	0	0	0	0	0	0	0	0
Jun07_08_1340	2170	0	0	0	0	0	0	0	0	0	0	0	0
Jun07_08_1750	2360	313	10	0	0	0	0	0	0	0	0	0	0

Appendix 7. Site characteristics (elevation in meters, aspect and slope in degrees) and foliar cover (%) of vegetation groupings for transects measured in June 2008 in Ajar Valley using a line intersect methodology (50-m line).

Transect	Elevation	Aspect	Slope	*Acantholimon*	*Ephedra*	Legumes	*Artemisia* shrub	Annual grass	Forbs	Grass	Grass-Likes	Desert Shrub	TOTAL COVER
Jun04_08_1025	3100	352	24	2	0	1	4	0	1	14	0	0	21.6
Jun04_08_1150	3132	330	20	3	0	0	4	0	9	8	0	0	23.6
Jun04_08_1435	3080	18	38	0	0	1	4	0	5	13	0	0	23.6
Jun05_08_0820	2912	244	18	0	0	0	30	0	0	1	0	0	30.7
Jun05_08_0920	2936	323	22	0	0	7	11	0	2	2	0	3	24.6
Jun05_08_1115	3126	310	8	3	0	1	22	0	0	1	1	0	28.6
Jun05_08_1155	3160	12	10	5	0	0	10	0	4	7	0	0	26.1
Jun05_08_1430	2610	300	15	8	0	0	6	0	1	0	0	0	15.2
Jun05_08_1510	2538	298	8	4	0	0	20	0	0	0	0	0	24.4
Jun06_08_1535	2980	340	19	2	6	4	12	0	1	12	3	0	40.6
Jun06_08_1630	2980	175	16	4	2	0	34	0	1	2	0	0	42.4
Jun06_08_1725	2953	0	3	0	2	0	24	0	1	3	0	0	31.1
Jun07_08_0700	3304	320	34	6	0	3	12	0	3	11	0	0	34.7
Jun07_08_0835	2912	340	8	1	0	0	27	0	0	2	0	1	31.0
Jun07_08_0945	2724	300	5	5	0	0	12	0	0	1	0	2	18.9
Jun07_08_1030	2698	32	15	3	0	0	15	0	0	2	0	1	20.4
Jun07_08_1130	2575	331	8	0	0	0	17	0	0	1	0	2	20.5
Jun07_08_1200	2537	144	16	0	0	0	0	1	2	0	0	0	3.3
Jun07_08_1340	2170	0	0	0	0	0	0	0	0	0	0	28	27.6
Jun07_08_1750	2360	313	10	md	md	md	md	md	md	md	md	md	md

Appendix 8. Trailing across north slope of *Artemisia* steppe (approximately 2800 m)(Photo 05-06-2008_07.23.50).