PERMANENT MONITORING SITES: METHODOLOGY AND EXAMPLES OF PHOTO PLOTS AND DATA

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Introduction

During the WCS rangeland field work it was realized that it was impossible to determine site potential of most rangeland areas as no sites in the Wakhan have been protected from grazing and likely few if any sites escape relatively intensive livestock grazing. Other human impacts included shrub collecting, ditching for irrigation, cutting of hay on a few areas, digging peat sod for burning and using around yurts, and cutting of trees (birch, juniper and willow) in some areas for building materials and fuel. Determining if site conditions are improving or degrading is possible only with measurement over time. A trend in range condition was estimated for sites, but with no information on site potential or conditions under low levels of grazing it was clear that monitoring sites or previous photos would have been especially helpful to determine changes in vegetation over time. A few earlier photographs were found in Petocz (1978), but these photos had no geographic coordinates, the duplicated images were poor in quality and black and white photos, and the lack of photograph description and having so few photographs made their use for determining changes very limited. As such, the WCS rangeland team considered it important to establish permanent monitoring sites. With GPS, digital cameras, and the ability to store large amounts of information the WCS rangeland team stressed recording of site information for future monitoring. All transects have geographic coordinates and are part of the rangeland GIS, starting point direction (degrees), physiographic measurements (elevation, aspect, slope), plant cover attributes and landscape and close-up photographs of the transect area, and in 2007 and 2009 individual plot photos. It was determined by the WCS rangeland team that numerous sites would be established rather than few sites with more intensive measurements.

In the following sections the methodology and an example of a photo plot is presented for 2006, 2007, and 2008. Methodology varied by year and to a certain extent within a year because of changes in field personnel and objectives of site measurements. This document is provided to aid future workers in comparing sites measured by the WCS rangeland team by describing techniques and methodology. During each year the associated photographs (high resolution) are stored electronically for each transect and photographs are identified by transect, date, time, and direction. Word documents of photographs and location description are also stored electronically. Data collected at each plot in all years included latitude and longitude, slope (%), aspect (degrees), elevation (meters) and transect directions (degrees). Elevation was determined with a GPS and slope and aspect were determined with a compass. Cover measurements in 2006 and 2007 consisted of a point sampling and line-intercept methodology. The point intercept and line intercept methods were used to confine the Afghan students to very specific areas to reduce problems with plant identification. Basal cover was determined using a point sampling technique and consisted of defining “hits” or percentage of contacts of plants (by species), soil, and rock.

Monitoring Plots 2006

During the first season the WCS team established 42 monitoring plots. The monitoring plots were generally comprised of two transects (50 m) spaced 5 or 10 m apart (depending on site). Plant cover and ground cover (litter, rock, or bareground) were measured using a point technique at each meter mark. Foliar cover by species was measured using both a point intercept methodology and a line-intercept method. Basal cover was determined using a point sampling technique.

An example of an established transect and site photographs is shown below for site 2-August 8, 2006 (the photographs shown are from a separate file, *Aug08_06_Site2.pdf*, named in the GIS data base and stored as separate electronic file). A landscape and close-up photograph of each transect was taken with direction of photographs. The photographs were taken to allow someone to find the approximate transect location using landscape photographs. Vegetation can be more clearly seen in the close-up photographs. As stated previously, the rangeland GIS contains the data for sites and includes transect number, date, transect identification name, photo document name, latitude and longitude, elevation transect direction, aspect, slope, and basal, foliar, and line-intercept cover of vegetation.

Photo Monitoring Plot: Aug08_06 Site 2.

Photo 1. Aug08_06_Site2. West transect (photos from north to south).

Photo 2. Aug08_06_Site2. West transect (photos from north to south).

Photo 3. Aug08_06_Site2. East transect (photos from north to south).

Photo 4. Aug08_06_Site2. East transect (photos from north to south).

Photo 5. Aug08_06_Site2. West transect (photos from south to north).

Photo 6. Aug08_06_Site2. West transect (photos from south to north).

Photo 7. Aug08_06_Site2. East transect (photos from south to north).

Photo 8. Aug08_06_Site2. East transect (photos from south to north).

Photo 9. Aug08_06_Site2. Middle photo.

Photo 10. Aug08_06_Site2. Middle photo.

Photo 11. Aug08_06_Site2. Middle photo.

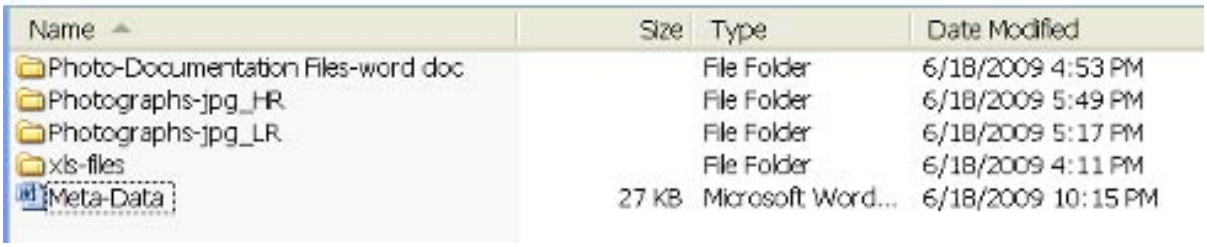
Photo 12. Aug08_06_Site2. Middle photo.

Photo 13. Aug08_06_Site2. Middle photo.

All data are electronically stored with a "Meta-data.doc" file providing information on files and procedures (Fig. 1). The location (geographic coordinates) of the photo file documents are associated with the excel (xls) files where the photo file name is associated with transect name, transect id, and latitude and longitude and site cover and physiographic characteristics.

Photo files are separate files stored under the file folder ***Transect Photo Documents***. Under the file Photographs-jpg (HR= high resolution and LR= low resolution) individual photos are stored. For these the original time and date of photo are available.

Fig. 1. Screen print of folders and files for monitoring site information for 2006.



There are separate files for basal cover, foliar cover, and line intercept cover (Table 1) and separate summary files. Information found in data files is also summarized in tables for basal cover, foliar cover, and line intercept are shown as Appendix 1-3.

Table 1. Description of data files for 2006 permanent plots.

File	Description
Basalcover06-final.xls Foliar cover06-final.xls LI_Cover06_final.xls	Includes all transects and a mean transect value when there were two transects per site. These files have all data including GPS coordinates, transect direction, photo documentation file name, elevation, aspect etc. and are usable in a GIS. For sites where two transects were measured the third value is the mean of the two transects. These are identified as means or a ½ value (eg, 22.5) for transect number as mean of two transects.
Basalcover06-final-summary.xls Foliar cover06-final-summary.xls	Includes photo-documentation file name the mean values for elevation, aspect, slope, and soil, rock, litter, shrub*, subshrub, grass, sedge, legume, Lamiaceae, other forbs, total forbs and vegetation type. There are no geographic coordinates and as such this summary file is not usable in a GIS as presented. The data is provided only for viewing mean values for sites and photo documentation. However, GPS coordinates are available in the previous files and could be copied to these files.
* The data is summarized into major life-forms. Subshrubs include *Acantholimon* sp., *Artemisia gemelina*, and *Ephedra* sp. Shrubs include most *Artemisia* sp (excludes sufrutescents and herbaceous species) and other woody species. Sedges were all Carices and a few *Juncus* were included although rarely was *Juncus* encountered. Legumes included all species in the Fabaceae family (no shrub types were found). Lamiaceae includes all species of the mint family. Other forbs included miscellaneous forbs not in the Fabaceae or Lamiaceae families and total forbs included the three groups (Fabaceae, Lamiaceae, and other forbs).	

Monitoring Plots 2007

During the second season the WCS rangeland team established 134 point intercept/line intercept transects that varied in elevation from 3465 m to 4690 meters. At each site we measured the same site characteristics as in 2006 but added a longitude and latitude of the ending points of transects. All sites were photographed by taking landscape and close-up photos along each transect similar to methodology of 2006, but additional "plot" photographs were included as standing crop was determined on most monitoring sites. Measurement of plant cover included foliar cover and basal cover using similar methodology as during 2006, but in 2007 an estimate of canopy cover was also determined. In some of the *Carex* meadows where individual plants were not easy to discern, only the point sampling procedure was used. In general, we used two transects to characterize site conditions. Transects were generally 50 m long and were spaced 10 m apart. For most sites we also measured current standing crop by species to provide an estimate of forage production and productivity of these communities on a dry weight basis. An estimate of standing crop was determined in 4, 0.5 m^2 plots. The plots were placed randomly between the two transects.

The following photographs are for transects established August 16, 2007 at 0715 (time transect work was initiated for the site). The document file is named "August 16_2007_0715-photos" for this monitoring site.

Photo Monitoring Plot: August 16_2007_0715

August 16_2007_0715-photos. Photos of both transects with 2 at each starting point and ending point. Two photos toward the center of each transect with photos perpendicular to plot. Close-up photos at 15m, 30m, and 45 m of each transects. Directions of photos are approximate. Photo descriptions are date and time (eg., August15_2007_1442 is for 15 August at 2:42 pm).

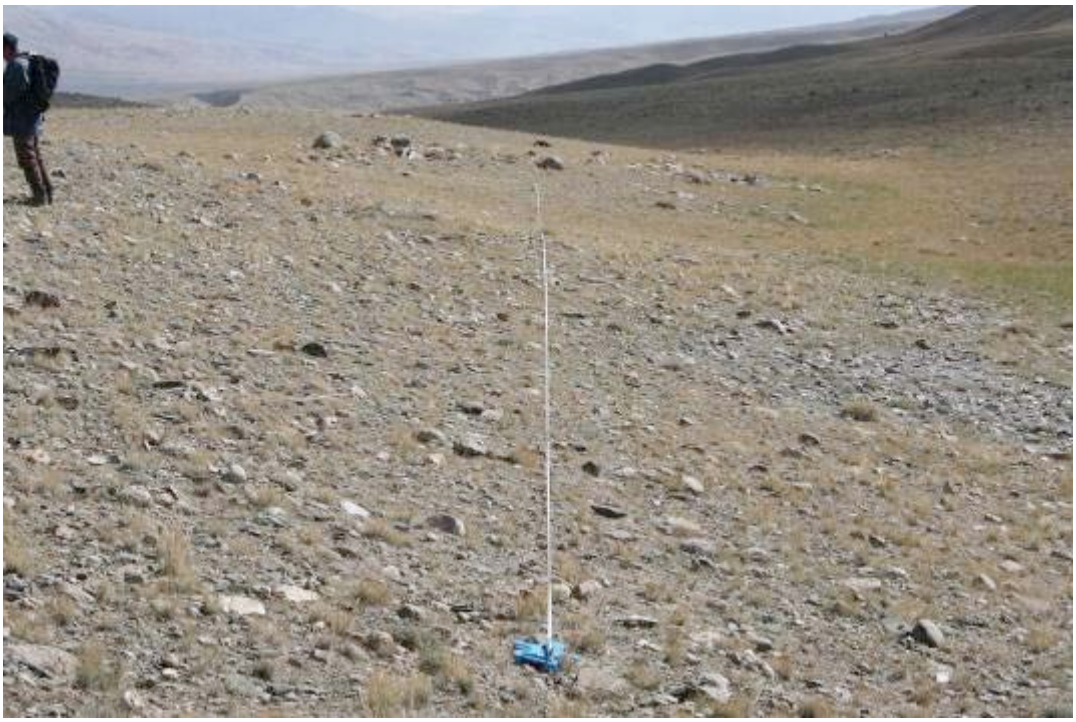
August 16_2007_0759 (Start to End South Transect, photo northeast to southwest).

August 16_2007_0759a (Start to End South Transect, photo northeast to southwest).

August 16_2007_0800 (Start to End North Transect, photo northeast to southwest).

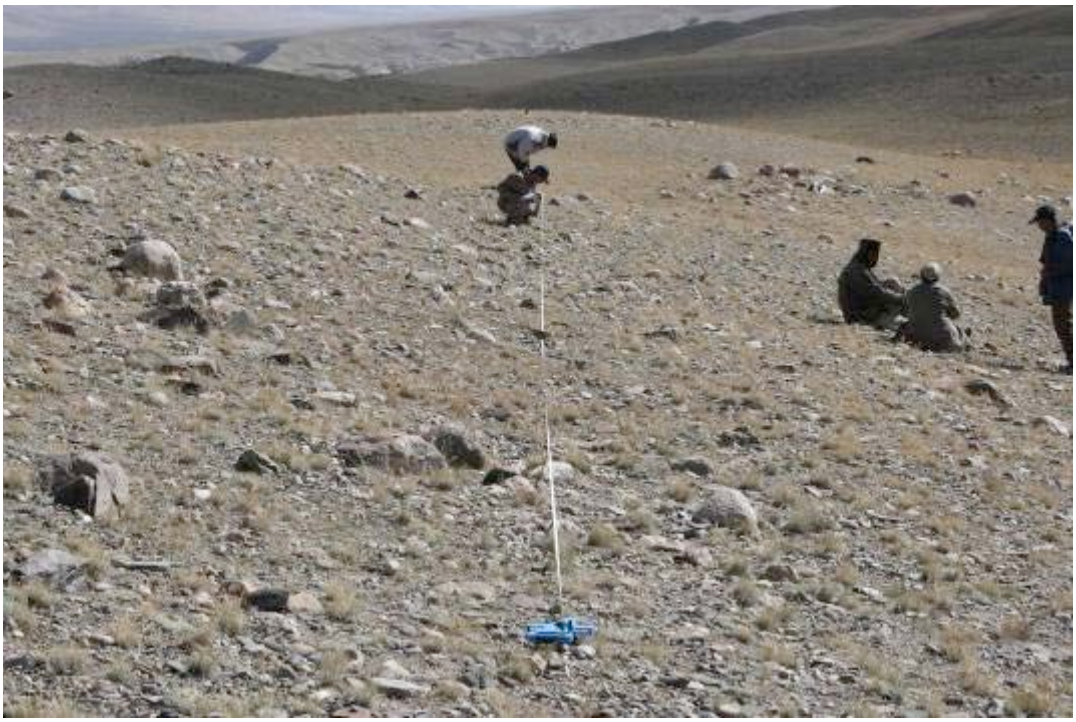
August 16_2007_0800aa (Start to End, North Transect, photo northeast to southwest).

August 16_2007_0801(End to start, South Transect, photo southwest to northeast).



August 16_2007_0801a (End to start, South Transect, photo southwest to northeast).

August 16_2007_0802 (End to start, North Transect, photo southwest to northeast).



August 16_2007_0802a (End to start, North Transect, photo southwest to northeast).

August 16_2007_0803 (South Transect, photo north to south).

August 16_2007_0803a (South Transect, photo north to south).

August 16_2007_0804 (North Transect, photo north to south).

August 16_2007_0804a (North Transect, photo north to south).

August 16_2007_0806 (North Transect, 15m).

August 16_2007_0806a (North Transect, 30 m).

August 16_2007_0807 (North Transect, 45 m).

August 16_2007_0808 (South Transect, 15 m).

August 16_2007_0809 (South Transect, 30 m).

August 16_2007_0810 (South Transect, 45 m).

All data are electronically stored with a "Meta-data.doc" file providing information on files and procedures (Fig. 2). The location (geographic coordinates) of the photo file documents are associated with the excel (xls) files where the photo file name is associated with transect name, transect id, and latitude and longitude and site cover and physiographic characteristics. Photo files are separate files stored under the file folder ***Transect Photo Documents***. Under the file Photographs-jpg (HR= high resolution and LR= low resolution) individual photos are stored. For these the original time and date of photo are available. The information presented in the xls files is presented in the table 2. In 2007 only the file "2007_CC-Biomass-Species-Categories" includes transect direction. Information found in data files is also summarized in tables for basal cover, foliar cover, and line intercept. Summary information is shown in Appendix 4.

Fig. 2. Screen print of folders and files for monitoring site information for 2007.

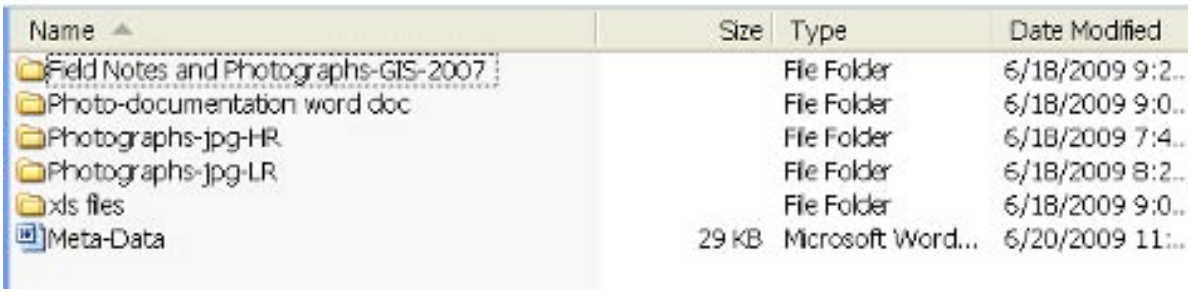


Table 2. Description of data files for 2007 permanent photo plots.

File	Description
BigPamir-Foliar-Basal Cover Final 2007.xls LittlePamir-Foliar-Basa Cover Final 2007.xls LI_Cover06_final.xls	Includes all transects with basal cover and foliar cover values separated into two files from data taken during two separate field times. These files include 4 worksheets with two including the groups of species or species and the other worksheets includes life-form categories (subshrub, shrub,grass, sedge, legume, Lamiaceae, other forbs, and trees)* for both foliar cover and basal cover. These files have all data including GPS coordinates, photo documentation file name, elevation, aspect, and initial vegetation type name and are usable in a GIS, but do not include the transect direction (see below).
2007-LI-ALL-Final.xls	This file includes line intercept cover values by species and categories for all transects measured in 2007. This file includes 3 worksheets with one including groups of species or species and the second worksheet includes life-form categories (subshrub, shrub,grass, sedge, legume, Lamiaceae, other forbs, and trees) and the third showing calculated values. This files has all data including GPS coordinates, photo documentation file name, elevation, aspect etc. and is usable in a GIS, but does not includes the transect direction (see below).
2007_CC-Biomass-Species-Categories	This file includes canopy cover estimates by species/categories and summed for life-form as in previous files and includes all transects measured in 2007. This file also includes biomass and photo-documentation file name the mean values for elevation, aspect, slope, and soil, rock, litter, vegetation type, geographic coordinates and transect direction.

* The data is summarized into major life-forms. Subshrubs include *Acantholimon* sp., *Artemisia gemelina*, and *Ephedra* sp. Shrubs include most *Artemisia* sp (excludes sufrutescents and herbaceous species) and other woody species. Sedges were all Carices and a few *Juncus* were included although rarely was *Juncus* encountered. Legumes included all species in the Fabaceae family (no shrub types were found). Lamiaceae includes all species of the mint family. Other forbs included miscellaneous forbs not in the Fabaceae or Lamiaceae families and total forbs included the three groups (Fabaceae, Lamiaceae, and other forbs).

Monitoring Plots 2008

During 2008 the rangeland team established 28 monitoring plots to determine different site and plant community characteristics. A transect was established with a latitude and longitude and transect direction recorded. Transects were 50 m long as in previous years, but at each site only 1 transect was established. Photos were taken of the starting point to the end point and vice-versa with landscape and more close-up photos similar to previous years, but point intercept data was not collected. The canopy cover estimates were obtained using a systematic placement of $0.5m^2$ plots at 10m, 20m, 30m, and 40m. These plots were also photographed and clipped for standing crop. All canopy estimates were done by the WCS rangeland team leader. For standing crop measures all vegetation was clipped to ground level, placed in a paper bag, and weighed with a Pesola spring balance in grams. Green weights were recorded and a minimum 10 g sample of each species was air-dried, and then weighed to allow for green weights to be converted to air dry weights. All weights are therefore on an air-dry basis and reported as kg/ha. Notes on grazing use, land-form, other plant species present but not found in $0.5m^2$, and an estimate of site conditions associated with rangeland condition/health were recorded.

The following photographs are for transects established 4 August 2008 at 0945 (time transect work was initiated for the site). In 2008, as there was only 1 transect per site, detail information on photographs were not included. The procedure was to photograph the start point to end point with a landscape and close-up view of each transect. Next, plot photographs at 10m, 20m, 30m, and 40 m were taken. Two photographs were taken from the end to start of the transect using again a landscape and then a more close-up photograph. The soil pit established for extracting soil samples was also photographed at all sites.

Photo Monitoring Plot: August 16_2007_0715

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4 August 2008-0945: 37.09691, 73.48757, 4490.


Aug-04-2008 09:44


Aug-04-2008 09:47


Aug-04-2008 10:00


Aug-04-2008 10:10


Aug-04-2008 10:24


Aug-04-2008 10:39


Aug-04-2008 10:39


Aug-04-2008 10:42

All data are electronically stored with a "Meta-data-2008.doc" file providing information on files and procedures (Fig. 3). The location (geographic coordinates) of the photo file documents are associated with the excel (xls) files where the photo file name is associated with transect name, transect id, and latitude and longitude and site cover and physiographic characteristics. Photo files are separate files stored under the file folder ***Transect Photo Documents***. Under the file Photographs-jpg (HR= high resolution and LR= low resolution) individual photos are stored. For these the original time and date of photo are available. The location of files are associated with the xls files where the photo file name is associated with transect name, transect id, and latitude and longitude. There are separate files for canopy cover and biomass (see table 3) and separate summary files. Data examples are shown as Appendices 5 and 6.

Fig. 3. Screen print of folders and files for monitoring site information for 2008.

Name	Size	Type	Date Modified
Photographs-jpg-HR		File Folder	6/18/2009 8:55 PM
Photographs-jpg-LR		File Folder	6/18/2009 8:23 PM
TransectPhoto_Docs		File Folder	6/18/2009 8:27 PM
xls files		File Folder	6/18/2009 8:45 PM
Meta-Data-2008	27 KB	Microsoft Word...	6/21/2009 12:02 AM

Table 2. Description of data files for 2008 permanent photo plots.

File	Description
2008_CC-BiomassFinal Summary.xls	This file has physiographic characteristics, biomass (grass, forb, shrub and total) and canopy cover by life-form (shrub, subshrub, grass, sedge, legume, Lamiaceae, other forbs, and total forb)* and initial vegetation type. The values are a mean of the 4 plots taken on each transect. This file does not include geographic information (see below).
2008_plot Mean CC-spp-cat-final.xls	This file is all species used for life-forms associated with the file above. It is a mean of 4 plots taken across each transect.
2008_Prod-Cover-pH-all-Means.xls	This file includes transect direction, geographic coordinates and summation values for biomass, canopy cover, soil information, and site characteristics.
* The data is summarized into major life-forms. Subshrubs include *Acantholimon* sp., *Artemisia gemelina*, and *Ephedra* sp. Shrubs include most *Artemisia* sp (excludes sufrutescents and herbaceous species) and other woody species. Sedges were all Carices and a few *Juncus* were included although rarely was *Juncus* encountered. Legumes included all species in the Fabaceae family (no shrub types were found). Lamiaceae includes all species of the mint family. Other forbs included miscellaneous forbs not in the Fabaceae or Lamiaceae families and total forbs included the three groups (Fabaceae, Lamiaceae, and other forbs).	

Under the file Photographs-jpg individual photos are stored. For these the original time and date of photo can be found. The original large jpg files are located as individual jpg files by date and time.

Appendix 1. Transect means of basal cover (BC) and physiographic characteristics on different vegetation types measured in 2006.

Photo Document	Elevation	Aspect	Slope	Transect Direction	Soil_BC	Rock_BC	Litter_BC	Shrub_BC	SubSrub-BC	Grass_BC	Sedge-BC	Legume-BC	Lamiaceae	Other Forb-BC	Total Forb BC	Total Vegetation	Vegetation Type
July28_06Site1.pdf	3660	md	4	134	76	21	2	0	1	0	0	0	0	0	0	1	Halgri-Kralan/Stipa CD
July29_06Site2Alisu.pdf	3677	295	2	205	36	0	64	0	0	0	0	0	0	0	0	0	Salix-Elymus
July29_06Site3.pdf	3795	96	27	95	62	22	14	0	0	2	0	0	0	0	0	2	Kralan CD
July30_06Site1Tulabi.pdf	4004	0	3	124	73	8	8	1	9	0	0	1	0	0	1	11	Artemisia-Acano-Kralan-Stipa
July31_06Site2Tulabi.pdf	3999	100	5	10	0	0	86	0	0	0	8	6	0	0	6	14	Sedge Meadow
July31_06Site3-4Tulabi.pdf	4030	93	9	84	72	5	16	6	1	0	0	0	0	0	0	7	Artemisia-Kralan/Stipa
July31_06Site5Tulabi.pdf	4034	90	1	338	89	0	9	0	0	1	0	1	0	0	1	2	Elymus sandy site
July31_06Site6Tulabi.pdf	4043	49	17	114	1	0	39	0	0	0	60	0	0	0	0	60	Sedge Meadow (degraded)
Aug01Cam300.pdf	4372	330	5	330	66	5	4	0	4	6	0	14	0	1	15	25	Acano-Artemisia/Astragalus
Aug01Cam150.pdf	4366	324	9	324	62	21	2	2	11	0	0	2	0	0	2	15	Acano-Artemisia/Astragalus
Aug01Cam450.pdf	4374	330	8	325	54	11	7	0	5	3	0	20	0	0	20	28	Artemisia-Astragalus/Acano
Aug02_Cam1.pdf	4417	317	12	330	67	17	10	2	2	1	0	1	0	0	1	6	Acano-Artemisia/Astragalus
Aug02_Cam1_5.pdf	4442	322	7	322	54	20	5	0	0	5	1	10	3	2	15	21	Astragalus-Neptea/Artemisia
Aug02_Cam2.pdf	4467	281	8	281	57	15	11	1	1	6	0	8	0	1	9	17	Artemisia-Astragalus,
Aug02_Cam22.pdf	4345	304	9	304	66	20	4	1	4	2	0	3	0	0	3	10	Astragalus-Artemisia/Acano
Aug02_Cam42.pdf	4350	330	8	123	57	33	2	1	7	0	0	0	0	0	0	8	Acano-Artemisia
Aug02_Cam005.pdf	4338	0	10	340	75	5	3	0	0	1	0	14	2	0	16	17	Astragalus-Nepeta
Aug02_Cam65.pdf	4350	327	9	327	69	19	4	1	5	0	0	1	1	0	2	8	Astragalus-Neptea/Artemisia
Aug02_Cam11.pdf	4339	310	6	310	65	11	2	4	15	0	0	1	2	0	3	22	Acano-Artemisia/Astragalus
Aug06_06_Site01-Men.pdf	4158	19	18	320	46	21	6	0	7	2	3	11	4	0	15	27	Astragalus-Bromus sten

Aug06_06_Site02-Men.pdf	4257	30	28	320	48	28	8	0	2	8	0	6	0	0	6	16	Astragalus-Bromus sten
Aug07_06_Dar.pdf	4100	220	6	39	88	2	5	0	5	0	0	0	0	0	0	5	Artemisia-Acantholimon
Aug07_06_Maw01-.pdf	4718	10	4	183	46	42	10	0	0	0	0	0	0	2	2	2	Alpine grassland
Aug07_06_She01-.pdf	4577	179	5	275	44	1	14	0	0	1	40	0	0	0	0	41	Sedge Meadow
Aug08_06_Site2.pdf	4196	310	8	126	73	12	11	1	1	2	0	0	0	0	0	4	Artemisia-Festuca/Acano
Aug08_06_Site3.pdf	4239	183	12	16	70	18	6	2	2	0	0	2	0	0	2	6	Artemisia-Acano-Festuca
Aug08_06_Site4.pdf	4129	196	4	20.5	80	13	5	0	0	3	0	0	0	0	0	3	Artemisia-Acano-CarexDL
Aug08_06_Site5.pdf	4118	223	5	47	80	10	6	0	4	0	0	0	0	0	0	4	Artemisia-Acano-CarexDL
Aug08_06_Site6.pdf	4115	207	6	30.5	82	12	2	2	0	0	2	0	0	0	0	4	Artemisia-Acano-CarexDL
Aug08_06_Site7.pdf	4115	223	5	57.5	84	10	0	0	6	0	0	0	0	0	0	6	Artemisia-Acano-CarexDL
Aug08_06_Site8-.pdf	4118	249	5	62.5	78	18	0	0	2	0	2	0	0	0	0	4	CarexDL-Acano
Aug09_06_Site01.pdf	4299	15	5	198	76	0	10	0	0	8	4	2	0	0	2	14	Sedge Meadow (degraded)
Aug09_06_Site2.pdf	4319	53	5	53	78	22	0	0	0	0	0	0	0	0	0	0	Acano-Artemisia
Aug20_TR01.pdf	4716	120	15	235	50	12	12	0	0	6	4	2	2	12	16	26	Alpine grassland
Aug21_TR01.pdf	4371	237	3	md	52	2	24	0	0	12	2	0	0	8	8	22	Alpine/Festuca grassland
Aug21_TR02.pdf	4288	250	1	90	30	46	14	0	0	4	0	0	0	6	6	10	Alpine/Festuca grassland
Aug21_TR03.pdf	4272	153	6	340	78	10	8	2	0	0	0	2	0	0	2	4	Artemisia-Astragalus
Aug22_Transect01_.pdf	4216	170	7	340	62	30	0	6	0	2	0	0	0	0	0	8	Low Sage-Stipa
Aug22_TR02.pdf	4257	195	12	350	52	36	8	2	0	0	2	0	0	0	0	4	Artemisia-Stipa/Low sage
Aug22_06_TR03.pdf	4126	200	10	31	78	4	6	8	2	0	2	0	0	0	0	12	Artemisia-Acano/Stipa
Aug22_06_TR04.pdf	4002	0	0	314	84	4	6	0	2	2	0	2	0	0	2	6	Low Sage-Stipa

Appendix 2. Transect means of foliar cover (FC) and physiographic characteristics on different vegetation types measured in 2006.

PhotoDoc	Elevation	Aspect	Slope	Shrub FC	Subshrub FC	Grass FC	Sedg FCs	Legume FC	Lamiaceae FC	Other Forbs FC	Total Forbs FC	Salix FC	Total FC	Community Type
July28_06Site1.pdf	3660		4	0	1	0	0	0	0	0	0	0	1	Halgri-Kralan/Stipa CD
July29_06Site2Alisu.pdf	3677	295	2	0	0	29	0	0	0	0	0	16	45	Salix-Elymus
July29_06Site3.pdf	3795	96	27	12	0	10	0	0	0	0	0	0	22	Kralan CD
July30_06Site1Tulabi.pdf	4008	0	5	10	11	1	0	1	0	0	1	0	23	Artemisia-Acano-Kralan-Stipa
July31_06Site2Tulabi.pdf	3999	100	5	0	0	0	44	23	0	0	23	0	67	Sedge Meadow
July31_06Site3-4Tulabi.pdf	4030	93	9	21	1	5	1	0	0	0	0	0	28	Artemisia-Kralan/Stipa
July31_06Site5Tulabi.pdf	4034	90	1	0	0	36	0	2	0	0	2	0	38	Elymus sandy site
July31_06Site6Tulabi.pdf	4043	49	17	0	0	0	90	0	0	0	0	0	90	Sedge Meadow (degraded)
Aug01Cam300.pdf	4372	330	5	5	5	9	0	20	0	1	21	0	40	Acano-Artemisia/Astragalus
Aug01Cam150.pdf	4366	324	9	3	4	3	0	5	0	0	5	0	15	Acano-Artemisia/Astragalus
Aug01Cam450.pdf	4374	330	8	3	6	3	0	26	0	0	26	0	38	Artemisia-Astragalus/Acano
Aug02_Cam1.pdf	4417	317	12	9	2	6	1	2	3	1	6	0	24	Acano-Artemisia/Astragalus
Aug02_Cam1_5.pdf	4442	322	7	0	0	8	4	18	13	1	32	0	44	Astragalus-Neptea/Artemisia
Aug02_Cam2.pdf	4467	281	8	18	1	11	0	11	1	2	14	0	44	Artemisia-Astragalus,
Aug02_Cam22.pdf	4345	304	9	7	4	3	0	9	0	0	9	0	23	Astragalus-Artemisia/Acano
Aug02_Cam42.pdf	3854	330	8	5	8	0	0	0	0	0	0	0	13	Acano-Artemisia
Aug02_Cam005.pdf	4338	0	10	0	0	1	2	20	6	0	26	0	29	Astragalus-Nepeta
Aug02_Cam65.pdf	4350	327	9	5	5	1	0	4	4	0	8	0	19	Astragalus-Neptea/Artemisia
Aug02_Cam11.pdf	4339	310	6	10	15	1	0	1	3	0	4	0	30	Acano-Artemisia/Astragalus
Aug06_06_Site01-Men.pdf	4158	19	18	0	8	8	4	17	5	6	28	0	48	Astragalus-Bromus sten
Aug06_06_Site02-Men.pdf	4257	30	28	0	2	32	0	8	6	0	14	0	48	Astragalus-Bromus sten
Aug07_06_Dar.pdf	4100	220	6	11	13	1	2	2	0	0	2	0	29	Artemisia-Acantholimon
Aug07_06_Maw01-.pdf	4718	10	4	0	0	12	0	4	2	2	8	0	20	Alpine grassland
Aug07_06_She01-.pdf	4577	179	5	0	0	3	72	0	0	3	3	0	78	Sedge Meadow

Aug08_06_Site2.pdf	4196	310	8	10	1	6	2	3	0	1	4	0	23	Artemisia-Festuca/Acano
Aug08_06_Site3.pdf	4239	183	12	14	6	0	0	0	0	0	0	0	20	Artemisia-Acano-Festuca
Aug08_06_Site4.pdf	4129	196	4	8	8	8	0	0	0	0	0	0	23	Artemisia-Acano-CarexDL
Aug08_06_Site5.pdf	4118	223	5	2	14	0	0	0	0	0	0	0	16	Artemisia-Acano-CarexDL
Aug08_06_Site6.pdf	4115	207	6	4	2	0	14	0	0	0	0	0	20	Artemisia-Acano-CarexDL
Aug08_06_Site7.pdf	4115	223	5	6	18	0	0	0	0	2	2	0	26	Artemisia-Acano-CarexDL
Aug08_06_Site8-.pdf	4118	249	5	2	2	0	12	0	0	0	0	0	16	CarexDL-Acano
Aug09_06_Site01.pdf	4299	15	5	0	0	0	30	2	0	2	4	0	34	Sedge Meadow (degraded)
Aug09_06_Site2.pdf	4319	53	5	4	8	0	0	0	0	0	0	0	12	Acano-Artemisia
Aug20_TR01.pdf	4716	120	15	0	0	12	8	2	4	8	14	0	34	Alpine grassland
Aug21_TR01.pdf	4371	237	3	0	0	34	4	0	0	16	16	0	54	Alpine/Festuca grassland
Aug21_TR02.pdf	4288	250	1	0	0	10	2	2	0	18	20	0	32	Alpine/Festuca grassland
Aug21_TR03.pdf	4272	153	6	18	0	4	2	2	0	0	2	0	26	Artemisia-Astragalus
Aug22_Transect01_.pdf	4216	170	7	12	0	2	0	0	0	4	4	0	18	Low Sage-Stipa
Aug22_TR02.pdf	4257	195	12	6	2	0	6	0	0	0	0	0	14	Artemisia-Stipa/Low sage
Aug22_06_TR03.pdf	4126	200	10	10	2	4	12	0	0	0	0	0	28	Artemisia-Acano/Stipa
Aug22_06_TR04.pdf	4002	0	0	2	2	2	0	2	0	0	2	0	8	Low Sage-Stipa

Foliar cover measured using point interception.

Appendix 3. Transect means of foliar cover by line intercept method (LI) and physiographic characteristics on different vegetation types measured in 2006.

Photo Documentation	Elev	Shrub LI	Subshrub LI	Grass LI	Sedge LI	Legume LI	Lamiaceae LI	Other Forbs	Total Forbs	Salix LI	Total-LI	VEG TYPE
July28_06Site1.pdf	3660	4.0	0.0	0.1	0.0	0.0	0.0	0.4	0.4	0.0	4.4	Halgri-Kralan/Stipa CD
July29_06Site2Alisu.pdf	3677	0	0	4.7	0	0	0	0	0	4.8	9.46	Salix-Elymus
July29_06Site3.pdf	3795	9.8	0	0.1	0	0	0	0.3	0.3	0	10.17	Kralan CD
July30_06Site1Tulabi.pdf	4004	9.9	7.1	1.8	0.0	1.6	0.0	0.0	1.6	0.0	20.3	Artemisia-Acano-Kralan-Stipa
July31_06Site2Tulabi.pdf	3999	0.0	0.0	0.0	5.1	0.0	0.0	0.9	0.9	0.0	6.0	Sedge Meadow
July31_06Site3-4Tulabi.pdf	4030	16.4	1.6	2.4	0.8	0.0	0.0	0.0	0.0	0.0	21.2	Artemisia-Kralan/Stipa
July31_06Site5Tulabi.pdf	4034	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	Elymus sandy site
July31_06Site6Tulabi.pdf	4043	0.0	0.0	0.0	10.7	0.0	0.0	0.0	0.0	0.0	10.7	Sedge Meadow (degraded)
Aug01Cam300.pdf	4372	5.9	3.9	4.1	0.0	16.7	0.0	0.2	16.9	0.0	30.7	Acano-Artemisia/Astragalus
Aug01Cam150.pdf	4366	9.5	10.6	1.0	0.0	2.7	0.0	0.0	2.7	0.0	23.9	Acano-Artemisia/Astragalus
Aug01Cam450.pdf	4374	6.8	2.4	3.6	0.0	15.6	0.0	0.7	16.2	0.0	29.0	Artemisia-Astragalus/Acano
Aug02_Cam1.pdf	4417	11.8	2.3	2.9	0.2	3.7	0.2	0.5	4.4	0.0	21.6	Acano-Artemisia/Astragalus
Aug02_Cam1_5.pdf	4442	1.4	0.0	4.8	2.0	16.7	12.1	1.0	29.8	0.0	38.0	Astragalus-Neptea/Artemisia
Aug02_Cam2.pdf	4467	17.2	0.2	3.3	0.0	12.6	2.5	0.8	15.9	0.0	36.6	Artemisia-Astragalus,
Aug02_Cam22.pdf	4345	5.1	3.4	1.2	0.0	7.2	1.1	0.0	8.3	0.0	17.9	Astragalus-

												Artemisia/Acano
Aug02_Cam42.pdf	4350	4.4	5.2	1.1	0.0	0.0	0.0	0.0	0.0	0.0	10.7	Acano-Artemisia
Aug02_Cam005.pdf	4338	0.0	0.0	1.5	7.9	20.1	5.1	0.0	25.2	0.0	34.5	Astragalus-Nepeta
Aug02_Cam65.pdf	4350	4.3	8.1	1.6	0.0	3.3	2.4	0.4	6.1	0.0	20.0	Astragalus-Neptea/Artemisia
Aug02_Cam11.pdf	4339	5.9	6.3	0.9	0.0	1.1	1.1	0.0	2.2	0.0	15.3	Acano-Artemisia/Astragalus
Aug05_06_Site01-Men.pdf	4158	5.1	5.7	6.6	1.0	12.6	1.0	3.6	17.3	0.0	35.6	Astragalus-Bromus sten
Aug06_06_Site02-Men.pdf	4257	0.2	0.0	10.7	0.0	8.7	5.8	3.2	17.7	0.0	28.6	Astragalus-Bromus sten
Aug06_06_Dar.pdf	4100	6.2	4.0	1.0	1.8	0.2	0.0	0.1	0.4	0.0	13.3	Artemisia-Acantholimon
Aug07_06_Maw01-Photos.pdf	4718	0.0	0.0	7.9	0.0	4.7	1.6	5.1	11.4	0.0	19.3	Alpine grassland
Aug07_06_She01-Photos.pdf	4577	0.0	0.0	1.8	45.5	0.0	0.0	5.4	5.4	0.0	52.6	Sedge Meadow
Aug08_06_Site2Photos.pdf	4196	5.2	4.7	3.7	0.7	0.8	1.3	2.3	4.4	0.0	18.7	Artemisia-Festuca/Acano
Aug08_06_Site3Photos.pdf	4239	14.0	9.1	1.0	0.7	0.2	0.0	0.0	0.2	0.0	25.0	Artemisia-Acano-Festuca
Aug08_06_Site4Photos.pdf	4129	5.5	6.6	0.1	1.5	0.0	0.0	0.0	0.0	0.0	13.7	Artemisia-Acano-CarexDL
Aug08_06_Site5Photos.pdf	4118	0.9	11.7	0.5	0.1	0.0	0.0	0.3	0.3	0.0	13.4	Artemisia-Acano-CarexDL
Aug08_06_Site6Photos.pdf	4115	3.0	4.4	0.0	8.2	0.0	0.0	0.1	0.1	0.0	15.8	Artemisia-Acano-CarexDL
Aug08_06_Site7Photos.pdf	4115	2.7	8.4	0.0	0.3	0.0	0.0	0.6	0.6	0.0	12.1	Artemisia-Acano-CarexDL
Aug08_06_Site8-Photos.pdf	4118	0.3	0.2	0.0	21.7	0.0	0.0	0.3	0.3	0.0	22.5	CarexDL-Acano
Aug09_06_Site01.pdf	4299	0.0	0.0	0.1	20.9	3.0	0.0	0.3	3.3	0.0	24.3	Sedge Meadow (degraded)
Aug09_06_Site2.pdf	4319	1.0	7.8	0.5	0.0	0.2	0.1	0.6	0.8	0.0	10.1	Acano-Artemisia
Aug20_TR01Photos.pdf	4716	0.0	0.0	10.4	4.3	3.8	1.3	9.4	14.5	0.0	29.2	Alpine grassland
Aug21_TR01Photos.pdf	4371	0.0	0.0	14.6	2.7	0.0	0.0	11.9	11.9	0.0	29.2	Alpine/Festuca

												grassland
Aug21_TR02Photos.pdf	4288	0.0	0.0	3.4	0.2	1.8	0.0	16.2	17.9	0.0	21.5	Alpine/Festuca grassland
Aug21_TR03Photos.pdf	4272	6.5	2.1	1.6	0.3	3.6	0.0	0.3	3.9	0.0	14.3	Artemisia-Astragalus
Aug22_Transect01_photos.pdf	4216	7.3	0.5	3.2	0.4	0.0	0.0	0.4	0.4	0.0	11.7	Low Sage-Stipa
Aug22_TR02Photos.pdf	4257	7.6	0.0	4.5	0.3	0.0	0.0	0.5	0.5	0.0	12.9	Artemisia-Stipa/Low sage
Aug22_06_TR03Photos.pdf	4126	5.7	2.0	4.5	2.8	0.8	0.0	0.1	0.9	0.0	16.0	Artemisia-Acano/Stipa
Aug22_06_TR04Photos.pdf	4002	1.7	1.1	1.1	1.0	1.2	0.0	0.3	1.5	0.0	6.3	Low Sage-Stipa

Appendix 4. Summary of site characteristics and plant cover (%) attributes for all transects established in 2007. In the GIS the data includes start and end point latitude and longitude, transect direction, photo documentation information, and species or genera groupings for foliar, basal, and canopy cover estimates and standing crop (kg/ha).

DATE	TIME	ELEVATION (M)	ASPPECT	SLOPE (%)	Total Canopy Cover	Total Foliar Cover	Total Litter Cover	Total Soil Cover	Total Basal Cover	Rock Cover	Canopy Cover Grass	Canopy Cover Carexdl	Canopy Cover Sedges	Canopy Cover Forbs	Canopy Cover Subshrubs	Canopy Cover Shrub	Canopy Cover Juniper	Canopy Cover Birch	Canopy Cover Salix	Cover Type/ Community Type [1]
7_27_2007	730	4352	344	22	34	28	20	68	18	14	2	0	0	32	0	0	0	0	0	ALP
7_27_2007	1000	4356	344	24	46	30	20	76	14	10	10	0	10	26	0	0	0	0	0	ALP
6_27_2007	1730	4172	8	10	46	28	22	46	10	4	6	0	8	32	0	0	0	0	0	ALLIUM
6_29_2007	800	4131	224	14	28	20	8	68	4	28	0	0	0	4	0	24	0	0	0	ART-GRS
6_29_2007	1000	4142	md	18	30	18	12	94	4	2	6	0	0	2	0	22	0	0	0	ART-GRS
6_29_2007	1400	4133	240	14	36	28	2	41	12	6	14	0	0	4	0	20	0	0	0	ART-GRS
6_29_2007	1500	4121	270	md	16	10	4	82	4	14	10	0	2	4	0	0	0	0	0	OVGRZ
6_29_2007	1600	4121	md	8	18	12	4	68	2	30	8	0	0	10	0	0	0	0	0	OVGRZ
6_30_2007	635	4109	267	16	28	22	0	48	16	36	16	0	0	12	0	0	0	0	0	OVGRZ
6_30_2007	730	4102	270	12	20	18	0	50	10	36	14	0	0	6	0	0	0	0	0	OVGRZ
6_30_2007	830	4108	260	8	32	8	4	74	6	20	8	14	14	10	0	0	0	0	0	OVGRZ
6_30_2007	900	4108	260	8	30	12	0	72	2	26	8	14	16	6	0	0	0	0	0	OVGRZ
6_30_2007	md	4402	md	md	md	md	md	md	md	md	md	md	md	md	md	md	md	md	md	SED/ ALP
7_2_2007	1610	4453	300	10	58	46	34	68	18	18	26	0	0	32	0	0	0	0	0	NEP/ ACAN

7_3_2007	1530	4185	311	0	34	22	20	84	4	12	0	12	12	2	4	16	0	0	0	ART/ SBSRB
7_3_2007	1600	4187	311	3	30	20	30	84	10	6	0	8	8	0	10	12	0	0	0	ART/ SBSRB
7_3_2007	1640	4205	322	7	48	24	38	92	4	4	22	0	0	26	0	0	0	0	0	ASTMA
7_3_2007	1745	4206	322	9	58	32	40	88	12	0	32	10	10	12	0	4	0	0	0	ART-GRS
7_4_2007	730	4166	360	2	88	60	74	76	24	0	2	0	86	0	0	0	0	0	0	WL
7_4_2007	830	4173	360	2	88	36	80	84	16	0	0	0	86	0	0	0	0	0	0	WL
7_4_2007	900	4154	238	3	28	18	22	72	12	16	4	2	2	0	8	14	0	0	0	ART-SBSRB
7_4_2007	930	4154	238	3	30	14	20	80	6	14	4	8	8	0	4	14	0	0	0	ART-SBSRB
7_4_2007	1115	4137	md	md	52	30	50	94	6	0	42	0	0	6	4	0	0	0	0	UNC
7_5_2007	715	4140	1	1	26	16	2	90	6	4	2	0	0	0	4	20	0	0	0	KRLA/ ACAN
7_5_2007	730	4140	md	md	22	8	22	66	4	0	10	0	0	0	2	10	0	0	0	KRLA/ ACAN
7_6_2007	700	4419	50	4	52	34	6	72	28	2	2	0	0	20	6	24	0	0	0	ART-SBSRB
7_6_2007	700	4410	50	4	48	28	8	80	20	0	10	0	0	32	0	6	0	0	0	ART-GRS
7_6_2007	810	md	md	md	32	14	18	80	12	8	8	0	0	8	0	16	0	0	0	ART-GRS
7_6_2007	910	4407	0	8	30	20	12	80	16	4	0	0	0	4	4	22	0	0	0	ART-SBSRB
7_6_2007	910	4409	0	8	36	26	12	72	24	4	4	0	0	12	6	14	0	0	0	ART-SBSRB
7_6_2007	1000	4391	16	8	62	46	42	22	28	4	20	0	0	26	0	16	0	0	0	ART-GRS
7_6_2007	1000	4373	40	9	62	46	12	40	28	4	12	0	0	38	0	12	0	0	0	ART-GRS
7_6_2007	1100	4373	40	9	54	36	14	48	30	0	20	0	0	26	0	8	0	0	0	ART-GRS
7_6_2007	1110	4373	40	9	52	40	28	34	22	2	10	0	0	10	0	32	0	0	0	ART-GRS

7_6_2007	1110	4382	40	10	58	44	28	46	16	0	4	0	0	54	0	0	0	0	0	NEP/ ASTMA
7_6_2007	1230	4382	40	10	56	34	16	90	10	0	8	0	0	48	0	0	0	0	0	NEP/ ASTMA
7_8_2007	1615	4190	326	3	22	10	10	80	6	2	4	0	0	0	10	8	0	0	0	ART-SBSRB
7_8_2007	1730	4214	326	2	32	20	16	38	14	2	0	0	0	0	10	22	0	0	0	ART-SBSRB
7_10_2007	1520	4499	61	22	70	26	26	16	18	20	24	0	4	42	0	0	0	0	0	ALP/ OVGRZ
7_10_2007	1613	4590	299	24	54	28	18	28	14	34	16	2	2	34	2	0	0	0	0	ALP/ OVGRZ
8_15_2007	1340	4060	42	1	28	12	14	80	6	14	8	6	6	2	2	10	0	0	0	ART/ KRLA/ ACONT/ STIPA
8_15_2007	1340	4067	42	1	32	12	6	80	4	14	14	6	6	2	4	6	0	0	0	ART/ KRLA/ ACONT/ STIPA
8_15_2007	320	4077	322	6	60	24	14	94	6	0	20	2	2	38	0	0	0	0	0	ART-GRS-OVGRZD
8_15_2007	320	4087	322	6	64	18	12	86	6	8	30	6	6	24	0	4	0	0	0	ART-GRS-OVGRZD
8_16_2007	715	4071	142	11	46	10	2	60	0	40	16	24	24	0	0	6	0	0	0	ART-ARARGRS
8_16_2007	715	4053	140	11	18	2	4	64	0	36	2	14	14	0	0	2	0	0	0	ART-ARARGRS
8_16_2007	325	4060	330	10	24	12	12	92	6	2	4	8	8	2	4	6	0	0	0	ART/ KRLA/ ACONT/ STIPA
8_16_2007	325	4060	330	10	26	16	12	86	8	14	14	2	2	4	2	4	0	0	0	ART/ KRLA/ ACONT/ STIPA
8_20_2007	200	4033	324	24	58	10	8	60	3	38	15	35	35	0	5	3	0	0	0	ART-SBSRB

8_20_2007	200	4055	324	2	40	13	0	53	3	45	10	20	20	2.5	5	3	0	0	0	ART-SBSRB
8_20_2007	300	4075	338	3	46	8	50	88	0	12	46	0	0	0	0	0	0	0	0	SALT GRS
8_20_2007	300	4075	338	3	62	8	52	88	4	8	62	0	0	0	0	0	0	0	0	SALT GRS
8_20_2007	410	4096	341	3	14	6	2	90	2	8	4	0	0	0	2	8	0	0	0	KRLA/ ART/ SBSRB
8_20_2007	410	4096	341	3	16	6	2	90	2	8	8	0	0	2	0	6	0	0	0	AR/ KR/ ACO/
8_20_2007	510	4142	340	11	32	6	10	94	6	0	26	0	0	0	2	4	0	0	0	FESCUE
8_20_2007	510	4150	340	11	54	8	4	96	2	2	38	0	0	14	0	2	0	0	0	FESCUE
8_21_2007	500	4277	330	19	42	20	58	90	10	0	32	0	0	10	0	0	0	0	0	FESCUE
8_21_2007	500	4288	330	19	56	18	66	96	4	0	52	2	2	2	0	0	0	0	0	FESCUE
8_23_2007	220	4690	29	12	70	24	24	80	16	4	30	0	2	38	0	0	0	0	0	FESCUE
8_23_2007	220	4690	29	12	56	26	18	76	14	10	28	0	0	28	0	0	0	0	0	POA
8_23_2007	410	4609	120	10	66	14	49	88	6	6	12	0	50	4	0	0	0	0	0	CAREX MEADOW
8_23_2007	410	4607	120	10	84	30	36	70	20	10	2	0	68	14	0	0	0	0	0	CAREX MEADOW
8_24_2007	800	4490	24	6	68	8	56	96	2	2	10	0	26	28	0	4	0	0	0	CAREX/ FESCUE
8_24_2007	800	4490	24	6	62	12	36	90	8	2	18	0	30	12	2	0	0	0	0	CAREX/ FESCUE
8_24_2007	915	4503	40	22	64	8	64	94	6	0	30	0	20	14	0	0	0	0	0	CAREX/ FESCUE
8_24_2007	915	4503	40	22	66	8	60	94	4	2	46	0	12	8	0	0	0	0	0	CAREX/ FESCUE
8_25_2007	710	4164	180	14	28	8	6	68	8	25	20	0	0	0	0	8	0	0	0	ARAR-KRLA TRAN
8_25_2007	710	4164	180	14	25	8	8	70	3	28	13	10	10	0	0	3	0	0	0	ARAR/ STIPA
8_25_2007	810	4164	0	20	25	8	20	78	8	15	20	0	0	0	3	3	0	0	0	FESCUE
8_25_2007	810	4164	0	20	48	15	15	78	8	15	33	8	7.5	7.5	0	0	0	0	0	FESCUE
8_25_2007	245	4030	332	3	12	2	0	80	2	18	8	0	0	0	0	4	0	0	0	ARAR
8_25_2007	245	4030	332	3	18	6	0	88	4	8	0	0	0	2	0	16	0	0	0	ARAR

8_27_2007	400	4039	329	0	16	6	6	78	4	18	8	0	0	0	0	8	0	0	0	ARAR
8_27_2007	400	4039	329	0	6	0	0	76	0	24	0	0	0	0	0	6	0	0	0	ARAR
8_28_2007	830	4033	322	15	16	8	0	80	4	16	6	0	0	0	0	10	0	0	0	ARAR
8_28_2007	830	4033	322	15	12	8	0	68	6	26	2	0	0	0	0	10	0	0	0	ARAR
8_28_2007	920	4040	350	11	12	8	0	66	6	26	2	0	0	0	0	10	0	0	0	ARAR
8_28_2007	920	4040	350	11	10	4	2	86	2	8	0	4	0	2	0	8	0	0	0	ARAR
8_28_2007	1015	4037	342	9	10	0	0	78	0	22	6	0	0	0	0	4	0	0	0	KRLA
8_28_2007	1015	4037	342	9	6	4	4	78	4	18	2	0	0	0	0	4	0	0	0	KRLA
8_28_2007	1100	4056	350	12	14	2	0	80	0	20	4	0	0	2	0	8	0	0	0	ARAR/ KRLA
8_28_2007	1100	4056	350	12	10	4	0	88	4	8	8	0	0	0	0	2	0	0	0	ARAR/ KRLA
8_28_2007	1130	4056	10	11	24	6	0	82	2	16	16	0	0	0	0	8	0	0	0	ARAR/ KRLA
8_28_2007	1130	4056	10	11	14	4	0	84	4	12	2	0	0	0	0	12	0	0	0	ARAR/ KRLA
8_28_2007	1415	4019	0	0	72	12	22	90	10	0	6	0	58	6	2	0	0	0	0	CAREX MEADOW
8_28_2007	1415	4019	0	0	66	36	54	70	30	0	6	14	58	2	0	0	0	0	0	CAREX/ MEADOW
8_28_2007	1520	4030	0	0	92	44	30	76	24	0	2	0	76	14	0	0	0	0	0	CAREX/ MEADOW
8_28_2007	1520	4030	0	0	78	0	0	94	6	0	2	0	64	12	0	0	0	0	0	CAREX/ MEADOW
8_29_2007	1445	4063	162	3	18	4	10	88	2	10	12	0	0	6	0	0	0	0	0	SALT GRS
8_29_2007	1445	4063	162	3	40	2	6	62	36	2	36	0	0	4	0	0	0	0	0	SALT GRS
8_29_2007	1340	4037	168	3	42	10	22	42	58	0	34	0	0	8	0	0	0	0	0	SALT GRS
8_29_2007	1340	4037	168	3	36	8	40	54	2	0	36	0	0	0	0	0	0	0	0	SALT GRS
8_29_2007	1530	4085	150	3	24	10	4	82	6	12	16	0	0	0	0	8	0	0	0	ARAR
8_29_2007	1530	4085	150	3	24	10	4	82	4	14	0	0	0	0	0	0	0	0	0	ARAR
8_29_2007	1630	4152	142	18	18	0	4	66	0	34	10	6	6	0	0	2	0	0	0	ART-KRLA-ARAR

8_29_2007	1630	4152	142	18	32	20	0	58	6	36	6	24	24	0	0	2	0	0	0	ART-KRLA-ARAR
8_30_2007	1420	4073	160	8	18	6	0	98	0	2	4	0	0	0	0	14	0	0	0	ARAR
8_30_2007	1420	4073	160	8	20	6	2	90	4	6	4	2	2	0	0	14	0	0	0	ARAR
8_30_2007	1520	4094	160	4	10	4	0	96	4	0	0	0	0	0	0	10	0	0	0	ARAR
8_30_2007	1520	4094	160	4	16	2	0	86	2	12	10	0	0	2	0	4	0	0	0	ARAR
8_30_2007	1620	4087	320	0	14	4	4	99	0	0	12	0	0	0	2	0	0	0	0	ARAR
8_30_2007	1620	4087	320	0	32	10	0	80	10	0	10	10	10	0	2	10	0	0	0	ARAR
8_31_2007	1530	3970	166	12	16	4	8	94	0	6	6	0	0	0	0	10	0	0	0	KRLA
8_31_2007	1530	3970	166	12	20	4	6	92	0	8	10	0	0	0	0	10	0	0	0	KRLA
8_31_2007	1610	4006	166	10	8	2	2	99	0	0	2	0	0	0	0	6	0	0	0	KRLA
8_31_2007	1610	4006	166	10	6	2	2	70	0	30	4	0	0	0	0	2	0	0	0	KRLA-SBSRB
9_1_2007	800	3960	142	14	16	8	4	84	8	8	0	0	0	0	2	14	0	0	0	KRLA
9_1_2007	800	3960	142	14	10	4	10	96	0	4	0	0	0	0	4	6	0	0	0	KRLA
9_1_2007	840	3972	152	13	16	2	6	94	0	6	6	0	0	0	0	10	0	0	0	KRLA
9_1_2007	840	3972	152	13	2	2	2	98	0	2	0	0	0	0	2	0	0	0	0	KRLA-SBSRB
9_1_2007	910	3963	156	12	8	2	8	92	2	6	6	0	0	0	2	0	0	0	0	KRLA-SBSRB
9_1_2007	910	3963	156	12	18	4	4	99	0	0	6	0	0	0	0	12	0	0	0	KRLA-SBSRB
9_1_2007	945	3958	136	11	28	6	8	70	4	26	22	0	0	2	2	2	0	0	0	KRLA LEYMUS
9_1_2007	945	3958	136	11	18	2	2	82	0	18	12	0	0	2	2	0	0	0	0	KRLA LEYMUS
9_1_2007	1030	3948	154	8	34	6	10	72	6	18	14	10	10	6	0	6	0	0	0	ARAR
9_1_2007	1030	3948	154	8	40	0	14	92	0	8	26	0	0	0	2	12	0	0	0	KRLA ARAR/ LEYMUS
9_1_2007	1115	3936	15	12	6	2	2	90	0	10	0	0	0	0	0	6	0	0	0	KRLA
9_1_2007	1115	3936	15	12	6	4	0	88	0	12	0	0	0	0	0	6	0	0	0	KRLA
9_2_2007	1515	3850	186	1	92	56	82	92	8	0	92	0	0	0	0	0	0	0	0	SALT GRS
9_2_2007	1515	3850	186	1	76	24	6	88	12	0	74	0	0	2	0	0	0	0	0	SALT GRS

9_2_2007	1630	3841	0	0	99	60	44	0	80	0	0	0	96	0	0	0	0	0	4	WL
9_2_2007	1630	3882	0	0	99	98	66	0	88	0	0	0	98	0	0	0	0	0	0	WL
9_3_2007	800	3945	342	25	40	28	10	74	14	12	16	0	0	12	10	2	0	0	0	ART-SBSRB
9_3_2007	800	3945	342	25	36	26	8	86	8	6	22	0	0	2	8	4	0	0	0	ART-SBSRB
9_3_2007	915	3887	0	0	32	12	0	96	4	0	12	8	8	4	0	8	0	0	0	ART-SBSRB
9_3_2007	915	3887	0	0	32	14	2	92	8	0	12	12	12	0	0	8	0	0	0	ARAR/ ARGRSS
9_3_2007	1030	3923	155	1	24	8	4	52	0	48	8	0	0	0	0	16	0	0	0	ART-STIPA
9_3_2007	1030	3923	155	1	18	8	6	32	2	66	8	0	0	2	0	8	0	0	0	ART-STIPA
9_4_2007	705	3465	160	1	30	16	30	52	4	44	0	0	0	0	6	8	16	0	0	JUNIPER
9_4_2007	700	3435	161	1	44	32	18	46	10	44	0	0	0	12	0	0	18	0	0	JUNIPER
9_4_2007	1100	3491	176	5	53	40	18	43	3	53	0	0	0	3.3	0	3	0	30	17	BIRCH
9_4_2007	1100	3491	176	5	83	69	40	50	3	47	0	0	0	0	0	0	0	53	30	BIRCH
9_4_2007	1330	3717	208	40	14	8	2	48	4	48	0	0	0	0	2	10	2	0	0	ARWH-JUN
9_4_2007	1330	3707	208	40	12	8	2	34	0	66	0	0	0	0	0	12	0	0	0	ARWH-JUN

[1] Cover type/Community type were designated in the field.

Data on life-forms for basal cover, foliar cover by point and line intercept are not shown.

Appendix 5. Canopy cover (%) by life-form of permanent monitoring plots established in 2008. In GIS the data includes latitude and longitude, transect direction, photo documentation information, and species or genera groupings canopy cover estimates and standing crop (kg/ha).

	Shrub cover	Subshrub cover	Grass Cover	Sedge Cover	Legume cover	Lamiaceae cover	Other forb cover	Total forb cover	Total Vegetation	Total shrub cover	Total Veg Cover	Vegetation Type
July 20_08_1620Sitephoto	0.0	0.0	2.0	75.0	2.0	0.0	3.0	5.0	82.0	0.0	82.0	Carex meadow
July 20_08_1700Sitephoto	0.0	2.0	6.1	10.0	15.0	0.1	12.0	27.1	45.2	2.0	45.0	Astragalus/Carex meadow
July22_08_1615-30Sitephoto	0	0	5	5	55	10	0	60	70.0	0	100	Carex meadow/alpine
July22_08_1615-30Sitephoto	0.0	0.0	1.0	90.0	2.0	0.0	3.0	5.0	96.0	0.0	100	Carex meadow/degrading
July22_08_1730Sitephoto	0.0	0.0	2.0	0.1	10.0	0.0	30.0	40.0	42.1	0.0	43.0	Dried Carex meadow
July24_08_1500TRphoto	3.8	2.0	0.7	0.0	0.0	0.0	0.1	0.1	6.6	5.8	13.2	Art/Acano-Stipa/Poa
July24_08_1600TRphoto	1.3	0.4	3.5	2.0	0.3	0.0	0.1	0.3	7.4	1.6	14.9	Artemisia/Acano-Stipa/Hordeum
July25_08_1100TRphoto	0.0	8.8	14.0	1.8	31.3	0.0	5.3	36.5	61.0	8.8	61.0	Astmatty/Hordeum
July25_08_1200TRphoto	0.0	0.0	5.0	0.0	0.8	2.0	2.3	5.1	10.1	0.0	10.1	Poa/Neppam/Hordeum
July25_08_1400TRphoto	0.0	8.5	1.3	0.0	0.0	0.0	0.3	0.3	10.0	8.5	10.0	Acano/Hordeum
July25_08_1530TRphoto	6.0	7.8	0.2	0.3	0.1	0.0	0.0	0.1	14.3	13.8	14.3	Artemisia-Acano
July27_08_1140TRphoto	0.0	0.0	16.7	7.5	2.6	0.0	8.2	10.8	35.0	0.0	35.0	Alpine Grassland
2007 transect	1.0	0.0	1.0	0.0	0.0	0.0	0.0	0.0	2.0	1.0	2.0	Cerlan/Artemisa-Leymus
2007 transect	5.0	2.0	1.0	0.0	0.0	0.0	0.0	0.0	8.0	7.0	8.0	Artemisa/Ceraln-Stipa
2007 transect	10.0	2.0	2.0	0.0	0.0	0.0	0.0	0.0	14.0	15.0	17.0	Artemisa/Cerlan-Stipa
2007 transect	5.0	1.0	2.0	0.0	0.0	0.0	0.0	0.0	8.0	6.0	8.0	Artemisa/Cerlan-Stipa
July29_08_1630/1700sitephoto	0.0	0.0	5.0	80.0	2.0	0.0	3.0	5.0	90.0	0.0	90.0	Carex meadow
July29_08_1630/1700sitephoto	0.0	0.0	20.0	5.0	40.0	0.0	10.0	50.0	75.0	0.0	75.0	Deg. Carex or Alpine GL

Aug 1_08_0900-Trphoto	8.0	0.3	6.3	0.0	0.1	1.3	8.4	9.7	24.2	8.3	24.2	Artemisia-Festuca/Poa
Aug 1_08_1000-Trphoto	10.8	1.8	5.1	0.0	0.5	0.2	16.9	17.6	35.2	12.5	37.2	Artemisia-Festuca/Poa
Aug 1_08_1130-Trphoto	10.9	0.0	7.3	0.0	1.4	0.0	16.3	16.3	34.4	9.8	32.6	Artemisia-Festuca/Poa
Aug 1_08_1530-Trphoto	9.3	0.1	6.4	0.1	0.0	0.2	14.5	14.7	30.6	9.4	30.6	Artemisia-Festuca/Poa
Aug 1_08_1700-Trphoto	8.3	1.0	6.9	0.0	0.0	0.1	17.5	17.6	33.7	9.3	33.7	Artemisia-Festuca/Poa
Aug 2_08_1430-Trphoto	13.0	0.0	5.8	0.0	6.5	3.5	8.5	18.5	37.3	13.0	37.3	Artemisia/Bromus/Stipa
Aug 2_08_1600-Trphoto	9.3	0.0	16.0	0.0	6.3	0.0	3.3	9.5	34.8	9.3	34.8	Artemisia/Bromus/
Aug 2_08_1700-Trphoto	1.3	0.0	12.3	0.0	11.3	0.1	6.5	17.8	31.3	1.3	31.3	Artemisia/Bromus/
Aug 4_08_0830-Trphoto	0.0	0.0	7.3	1.3	13.3	0.0	7.8	21.0	29.6	0.0	29.6	Astmatty/Poa
Aug 4_08_0945-Trphoto	0.0	0.0	2.0	0.0	20.0	0.0	26.2	46.2	48.2	0.0	48.2	Astmatty/Potentilla
Aug 5_08_0715-Trphoto	0.0	0.0	17.0	0.0	7.0	15.0	6.0	28.0	45.0	0.0	45.0	Bromus/Neppod

Appendix 6 . Summary of site characteristics and standing crop by total grass (kg/ha), total forb (kg/ha) and total shrub (kg/ha) for permanent photo points established in 2008. In GIS data includes latitude and longitude, transect direction, photo documentation information, and species or genera groupings canopy cover estimates and standing crop (kg/ha).

Photo Documentation	Elevevation (m)	Aspect	Slope	Rock	Litter	BG	Total Dry grass wt (kg/ha)	Total Forb DWT kg/ha	Total Shrub DWT kg/ha	Vegetation Type
July 20_08_1620Sitephoto	4093	225	5	0	20	10	380	5	0	Carex meadow
July 20_08_1700Sitephoto	4113	225	25	15	1	45	150	50	0	Astragalus/Carex meadow
July22_08_1615-30Sitephoto	4404	0	0	10	5	25	nd	nd	nd	Carex meadow/alpine
July22_08_1615-30Sitephoto	4418	0	0	0	5	5	nd	nd	nd	Carex meadow/degrading
July22_08_1730Sitephoto	4433	325	1	15	5	40	nd	nd	0	Dried Carex meadow
July24_08_1500TRphoto	4104	120	8	2	1	92	9	0	142	Artemisia/Acano-Stipa/Poa
July24_08_1600TRphoto	4076	273	4	2	3	88	145	4	49	Artemisia/Acano-Stipa/Hordeum
July25_08_1100TRphoto	4345	190	2	3	7	36	128	100	0	Astmatty/Hordeum
July25_08_1200TRphoto	4350	45	4	40	1	55	85	105	0	Poa/Neppam/Hordeum
July25_08_1400TRphoto	4322	220	1	2	1	90	30	0	0	Acano/Hordeum
July25_08_1530TRphoto	4266	80	1	7	1	86	6	67	0	Artemisia-Acano
July27_08_1140TRphoto	4588	278	2	26	9	35	335	158	0	Alpine Grassland
2007 transect	3962	166	11	5	0	95	40	0	40	Cerlan/Artemisa-Leymus
2007 transect	3962	166	11	5	0	90	50	0	80	Artemisa/Ceraln-Stipa
2007 transect	3967	166	11	15	1	80	50	0	150	Artemisa/Cerlan-Stipa
2007 transect	3966	166	11	2	0	95	50	0	125	Artemisa/Cerlan-Stipa
July29_08_1630/1700sitephoto	4446	300	2	0	15	15	380	20	0	Carex meadow

July29_08_1630/1700sitephoto	4450	300	4	10		20	150	50	0	Degraded Carex or Alpine GL
Aug 1_08_0900-Trphoto	4205	284	18	15	3	71	91	105	35	Artemisia-Festuca/Poa
Aug 1_08_1000-Trphoto	4244	278	18	11	11	55	49	209	114	Artemisia-Festuca/Poa
Aug 1_08_1130-Trphoto	4192	240	3	27	4	43	65	163	98	Artemisia-Festuca/Poa
Aug 1_08_1530-Trphoto	4207	286	20	6	7	63	89	276	74	Artemisia-Festuca/Poa
Aug 1_08_1700-Trphoto	4195	260	18	7	5	59	84	222	99	Artemisia-Festuca/Poa
Aug 2_08_1430-Trphoto	4062	86	12	11	9	53	122	247	153	Artemisia/Bromus/Stipa
Aug 2_08_1600-Trphoto	4080	131	16	16	20	49	314	218	87	Artemisia/Bromus/
Aug 2_08_1700-Trphoto	4103	116	28	14	39	26	134	254	14	Artemisia/Bromus/
Aug 4_08_0830-Trphoto	4482	22	8	5	1	69	45	248	0	Astmatty/Poa
Aug 4_08_0945-Trphoto	4490	20	12	26	8	29	8	369	0	Astmatty/Potentilla
Aug 5_08_0715-Trphoto	4078	80	34	59	16	4	234	223	0	Bromus/Neppod