

Mountain Goat Physical Impacts in the La Sal Mountains Alpine Area, Including the Mount Peale Research Natural Area

Semester in the West ecology course, Whitman College, Walla Walla, WA, 9/22/2014

I. Introduction

On September 3 and 4, 2013, the Utah Division of Wildlife Resources (UDWR) released twenty mountain goats (*Oreamnos americanus*) to the La Sal Mountains of southeastern Utah. The UDWR released 15 | 15 additional goats on September 2, 2014. They were netted and transported by helicopter from the Tushar Mountains of south central Utah to State Institute Trust Lands Administration property on the south slope of Waas Mountain in Beaver Basin, which is surrounded by the Manti-La Sal National Forest.

Mountain goats were first introduced to Utah in the 1960's. The UDWR is now considering a third release of an additional 5 mountain goats at an unspecified date in 2015 and is now monitoring the mountain goats using both GPS and telemetry tracking devices.

On July 26th, 2014 the Grand Canyon Trust took georeferenced photos of goat sign at NAD83, UTM zone 12N, elevation 11,500', west of Laurel Ridge, just outside the Mt. Peale Research Natural Area (Attachment A).

On September 18, 2014, 21 Whitman College students took georeferenced photos and simple measurements of goat sign in four general areas: Mount Peale, Mount Tukuhnikivatz, Laurel Ridge, and Mann's Peak. The first three areas were within the Mt. Peale Research Natural Area of the Manti-La Sal National Forest.

This document thus reports on physical impacts of the 20 mountain goats in portions of the alpine area of the La Sal Mountains within one year of their introduction including scat, hoof prints, trampled plants, grazed plants, and dust wallows. It's important to note that an additional 15 mountain goats were introduced two weeks before the time of this study.

II. Background: Physical

A. The La Sal Mountains

The La Sal Mountains are part of the southern Rockies and are located in the Manti-La Sal National Forest. They lie south of the town of Moab along the Utah/Colorado border. The second highest mountain range in Utah, they stretch for 10 miles with a highest point of 12,721 feet on Mount Peale. The range is an intrusive laccolith formed deep in the earth's surface that is now exposed due to tectonic uplift.

B. Alpine Area

The alpine area of the La Sal Mountains consists of all land above 10,000 feet in elevation and covers 27,228.76 acres, of which 8,087.83 acres are above 11,000 feet. Surrounded by low elevation desert canyons, the La Sal alpine area exists as an isolated island of high alpine terrain. The La Sal alpine environment encompasses Mann's Peak, Mount Waas, Mount Meltenthin, Mount Peale, and Mount Tukuhtnikivatz, including the entirety of the Mount Peale Research Natural Area (RNA). The Mt. Peale RNA covers 967 acres of terrain ranging in elevation from the top of Mt. Peale at 12,721 feet down to 10,450 feet, an elevation range of 2271 feet.

C. Areas Surveyed

The first Mountain Goat survey group planned to go towards Mount Peale from the south, the second to Mann's Peak and Mount Tomasaki from the southwest, the third towards Mount Tukuhtnikivatz from the southeast and the fourth towards Laurel Ridge and Mount Meltenthin from the northeast. The first, third and fourth groups followed their planned routes with only the third group summiting a peak. The second group split into two groups, one surveying Mann's Peak and Pilot Peak to the northwest and the other setting up a utilization cage between Mann's Peak and Mount Tomasaki and surveying that area. All four groups surveyed around the summits of peaks and along ridges connecting the peaks, sampling mostly in areas of alpine vegetation and in saddles between peaks.

III. Background: Ecological

A. Alpine Area

Rising to a height of 12,721 feet, the La Sal Mountains are one of a very few alpine tundra communities in the Colorado Plateau. Within the 360 acres of the mountains covered by herbaceous alpine vegetation are 10 plant species found nowhere else in Utah and one found nowhere else in the world. These plants include the La Sal daisy (*Erigeron mancus*), *Podistera eastwoodiae*, *Oreoxis bakeri*, *Besseyia alpina*, *Saxifragea bronchialis*, *Carex perglobosa* and *Senecio fremontii* var. *inexpectatus*. Many of these species are labeled as "imperiled" or "critically imperiled" under NatureServe rankings. Four La Sal Mountains alpine species are listed as sensitive by the Forest Service: *Androsace chamaejasme* ssp. *carinatus*, *Draba abajoensis*, *Erigeron mancus*, and *Erigeron abajoensis*.

As a result of the harsh climates these plants live in, alpine tundra vegetation is often small and low to the ground both to avoid strong winds and to retain heat and moisture. Threats to this fragile environment include invasive plant and animal species, recreational use, warming climates, and acid deposition. Cushion plants grow very slowly, and have corresponding longevity,

B. Mount Peale Research Natural Area

Composed of three peaks (Mt. Peale, Mt. Meltenthin, and Mt. Tukuhtnikivatz), and the intervening summits and ridges, the Mt. Peale RNA consists mainly of alpine areas occasionally bordered

by fir forest. Most of the alpine area is covered in talus piles, and herbaceous plants are the predominant flora.

Alpine rocky communities and barrens cover 1,990 acres (86.3%) of the total 2,380 acres of the RNA. Alpine turf and turf-rock communities cover 260 acres (10.9%); subalpine fir and mountain gooseberry cover 260 acres (4.2%); and subalpine communities cover 30 acres (1.3%). Forbs compose the majority of the RNA's flora. Although several species of graminoids occur naturally in the area, the variety and quantity of forbs greatly exceed that of grasses.

Four sensitive plant species are found in the RNA. *Erigeron mancus* (La Sal Daisy) is a flower endemic to the La Sal Mountains, and found only at high elevations. *Androsace chamajasma* var. *carinata* (Sweetflower Rockjasmine) grows from 10,000 to 12,700 feet in alpine rocky areas in the La Sal Mountains. *Senecio fremontii* var. *inexpectatus* (Groundsel) grows only above 11,000 feet on the crest of the ridge that runs from Mt. Peale to Mt. Meltenthin and Mt. Tukuhtnikivatz. *Erigeron abajoensis* (Abajo Daisy) is native to the Abajos in San Juan County, but is found in the La Sal Mountains at high elevations (from 10,000 to 12,300 feet). The La Sal Mountains host the only communities of *Androsace chamajasma* var. *carinata*, *Senecio fremontii* var. *inexpectatus*, and *Erigeron abajoensis* in Utah.

The area also provides habitat to several animals, mainly rodents and birds. The sensitive avian species *Aquila chrysaetos* (golden eagle) has been sighted in the RNA. The American pika (*Ochotona princeps saxatilis*) and marmots both reside in the alpine talus areas. The La Sal alpine ecosystem is also home to several other species of plants and animals, each filling their own niche.

C. Mountain Goats

Mountain Goats (*Oreamnos americanus*) are bovid ungulates native to mountainous regions of northwestern North America. They historically have existed in alpine and subalpine ecosystems ranging from southeastern Alaska southwards to the Columbia River of Washington, eastwards to Idaho and western Montana and northwards into southern Yukon. Adult males tend to be larger, weighing between 209 to 342 pounds. Females, called nannies, comparatively weigh between 132 and 165 pounds. Mountain goats have multiple mates and breed in the fall months with offspring birthed in spring. The goats do not always reproduce annually, regular breeding depending on social dynamics and health. Both males and females reach sexual maturity at 18 months. Nannies usually birth a single kid, with less likely occurrences of twins and triplets. Social animals, mountain goats usually associate in herds called 'bands,' which typically consist of more than 100 goats.

Mountain goats characteristically dig away at soil and plant cover to form 'bedding sites,' also known as 'wallows,' which they use for resting. The goats are generalists with a wide-ranging diet, eating anything from tree bark to lichens and roots. Mountain goats migrate according to food availability and seasonality but tend to return to the same areas year to year, reusing wallows. Goats usually live to about twelve years of age, with sources of mortality including hunting, accidents related to steep gradients and avalanches, and more rarely in La Sal Mountains, predation (e.g., by bear or cougar).

Mountain goats are not native to Utah. Favored for their hunting appeal, they were introduced to Utah alpine areas in 1967. Although the Utah Department of Wildlife Resources (UDWR) expects introduced

goats could be preyed upon by cougars, there has been no documented evidence of cougar predation of mountain goats in Utah.

IV. Methods of Study

Data were gathered by four different groups of six or seven people. Three groups hiked around three different peaks in the Mt. Peale Research Natural Area (Mt. Peale, Mt. Tukuhnivatz, and Mt. Meltenthin) and the fourth group hiked around Mann's Peak outside the RNA. Each group included one mountain guide, two photographers, two data recorders, and one or two scouts. All team members were responsible for searching their designated alpine areas for goat sign. Group members searched for sign primarily above tree line in order to limit mistaking elk sign for goat sign. Groups searched for sign in both vegetated areas and talus fields along alpine slopes. The primary goal of this project was to locate and record where in the La Sal Mountains the mountain goats have a presence and what the impact of that presence is on alpine habitat for sensitive vegetation and wildlife.

Goat sign to be searched for and documented included scat, hoof prints, wallows, vegetation trampled, and vegetation grazed. Photographers were responsible for documenting goat sign within the observed alpine areas. When goat sign was found, photographers took two close-up photos and one landscape photo including the compass direction in order to indicate where the sign was found. Each photographer was equipped with a GPS unit that linked each photo to its coordinates and elevation. When scat was found, GPS waypoints were marked in order to create a scat map of mountain goat activity. When hoof prints were found, the length, width, and depth of the print were recorded in inches. Some photographs of goat sign included a 6" plastic strip within the image for scale. Wallows were also measured for length and width. Data recorders were responsible for recording wallow and hoof print dimensions as well as image number, landscape direction, and any other pertinent notes and comments regarding the sign found.

V. Discussion

The major goat sign observed within the Mt. Peale RNA (and outside, near Manns Peak) was hoof prints, with those most obvious in soil among the talus. The most frequently observed adverse impact of goat hoofprints was in vegetation. The measurements taken of the hoofprints are compatible with being those of mountain goats, and they are the ungulate expected to be present most frequently at this point in time. Elk and deer sign, near tree line, were not knowingly recorded in this report, but any use by elk or deer of the La Sal Mountains alpine area is cumulative with that of mountain goats – they are all large ungulates.

When hoof prints were observed in vegetation, the impact often included tearing or trampling of the plant(s). Given that individual cushion plants, lichens, and mosses grow slowly in alpine areas, and may be quite old (100–300 years or more), plants that are torn or trampled may not easily recover, and thus inevitably such plant damage would be cumulative over time, and with larger numbers of mountain goats. Occasionally, plants were compressed and matted, indicative of being used as a resting place.

Another impact observed was grazed grasses and forbs. Given that elk and deer are not frequently observed far above treeline in the La Sal Mountains, most of this grazing would appear to be attributable to the mountain goats. The documented grazing can't be attributed to pika cuttings (observed, but not photographed) because they had a larger and more frayed appearance and was not near pika talus. Again, to the degree that some grazing might be done by elk or deer, mountain goat grazing in the alpine area would be cumulative with the other ungulate grazing.

Three wallows were observed within the Mt. Peale RNA and one resting area in vegetation. Another resting area was observed near Pilot Peak. The wallows were found in areas devoid of vegetation.

There are 34 goats currently in the alpine area, 15 of which were brought to the area only two weeks before the study. The fact that goat wallows and shearing and trampling of biological soil crust and other plants were observed so frequently on one day (September 18, 2014) would indicate that over multiple years, and with a growing population of goats, the adverse impacts to vegetation would be cumulative and extensive and only slowly if at all repaired.

VI. Conclusion

Observation and photography of physical damage to biological soil crusts (lichen, mosses) and other plants constitute direct evidence of adverse impacts by mountain goats to the forb-based alpine vegetation of Mount Peale Research Natural Area and the rest of this small alpine area. Population declines of individual plant species or changes in plant community composition or cover arguably may be attributed to a variety or combination of causes, e.g., drought, climate change, multiple species, or natural plant population dynamics. However, a torn, crushed, or sheared sensitive plant or protective biological soil crust in the hoofprint of a mountain goat is incontrovertible evidence of mountain goat damage to those plant communities.

This physical damage constitutes direct modification of the Mount Peale Research Natural Area due to a short-term, human-introduced ecological change (i.e., one year of exotic mountain goat use), which short-circuits the ability to study long-term ecological change in the Mount Peale Research Natural Area and eliminates the pristine nature of this, rare alpine area with its slow-growing suite of alpine plants within the Colorado Plateau, long-ungrazed by large ungulates.

VII. Maps of Goat Scat Locations

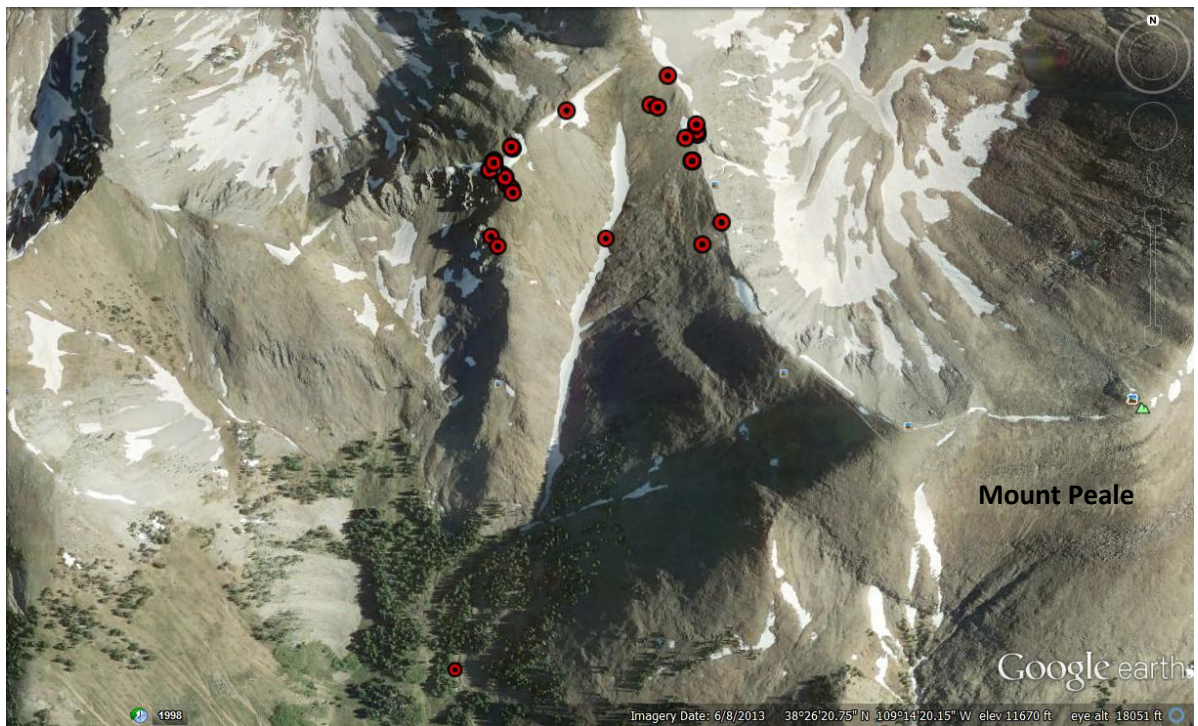


Fig. 1: Team 1- Mount Peale

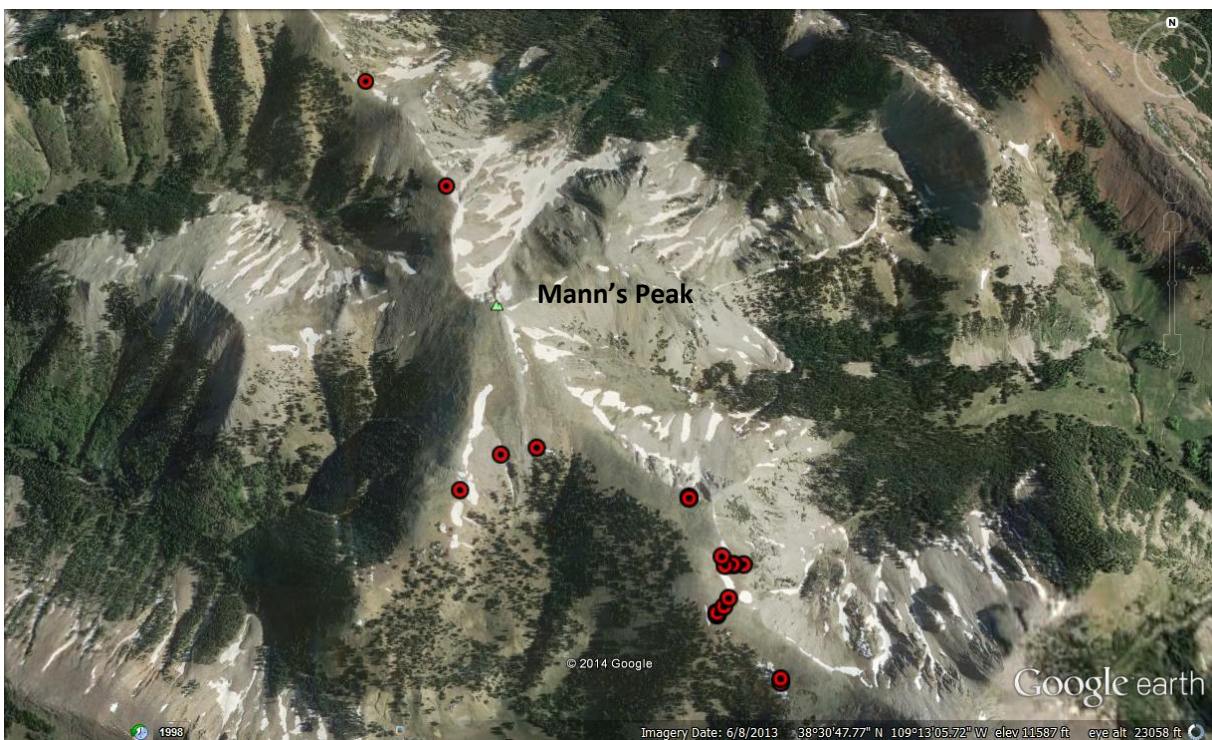


Fig. 2: Team 2- Manns Peak

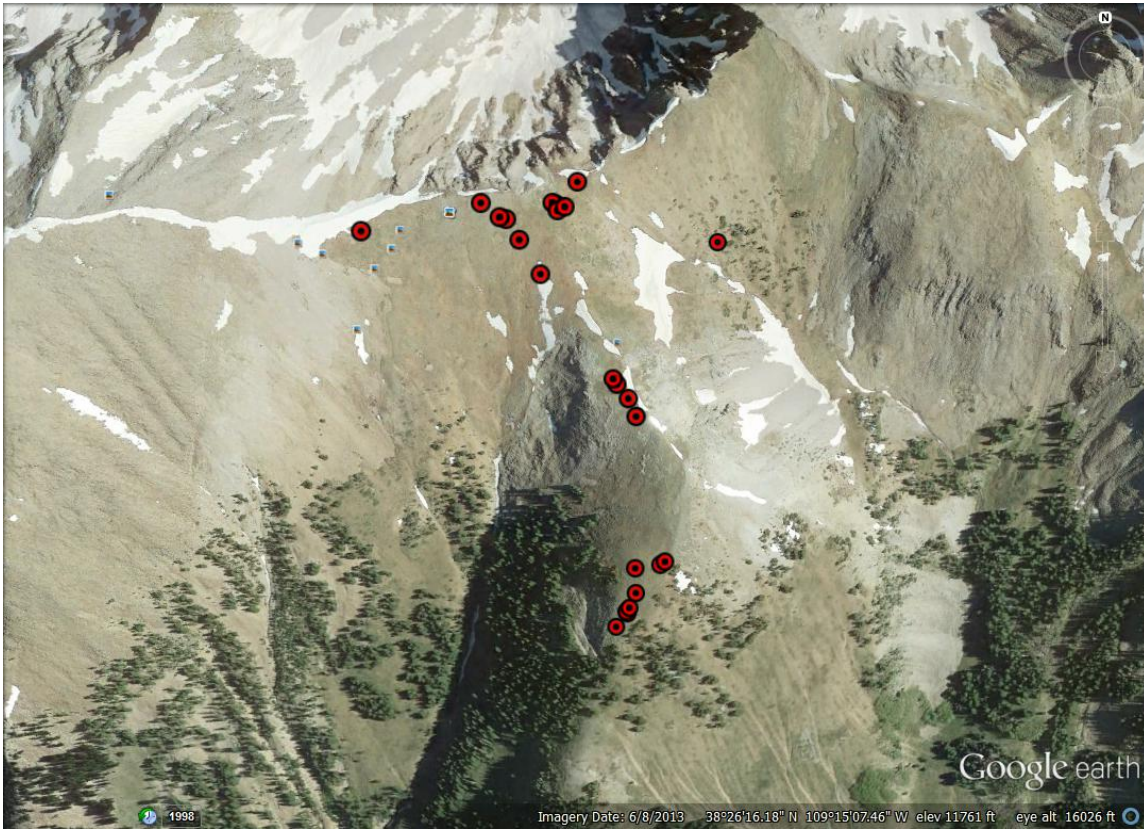


Fig. 3: Team 3- Mount Tukuhiwivatz Area

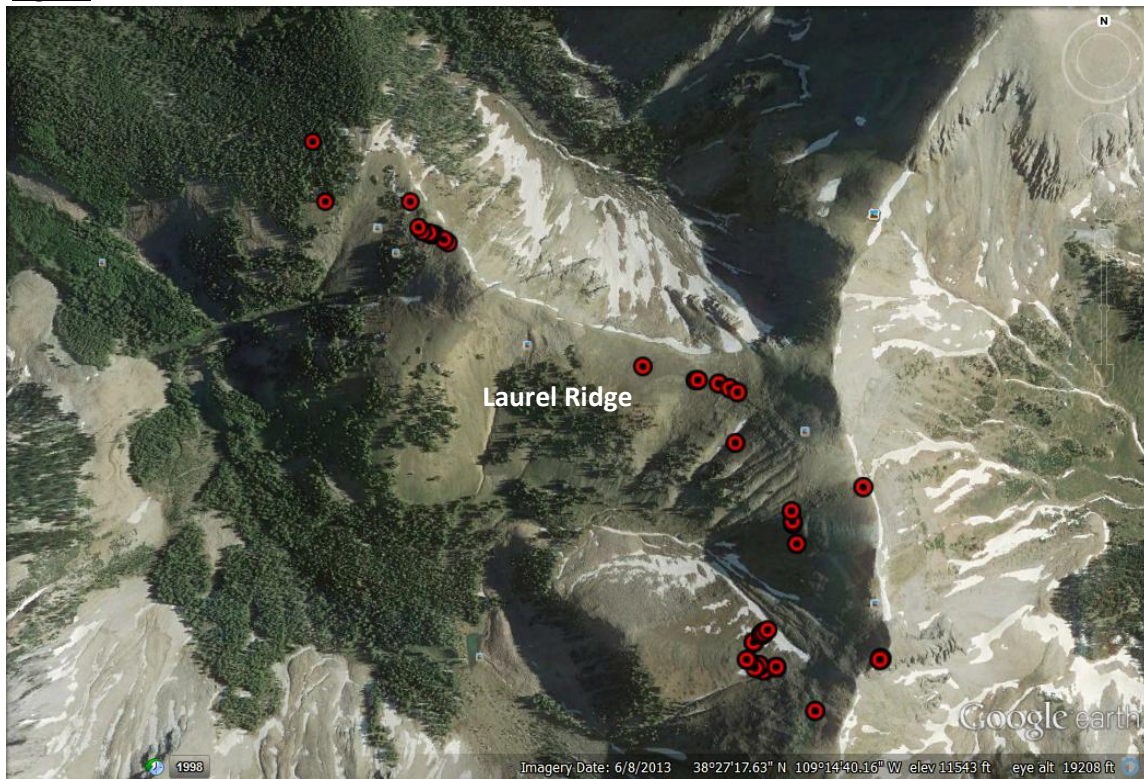


Fig. 4: Team 4- Laurel Ridge

VIII. Locations of Photos Taken

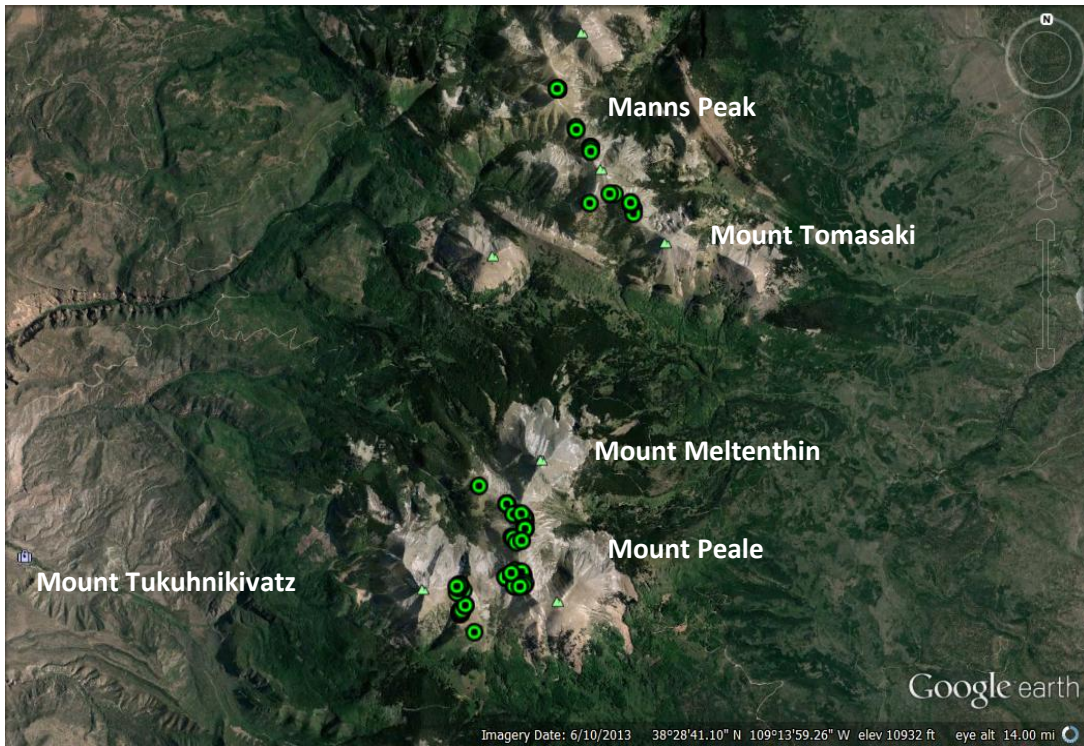


Fig. 5: All Photo Locations

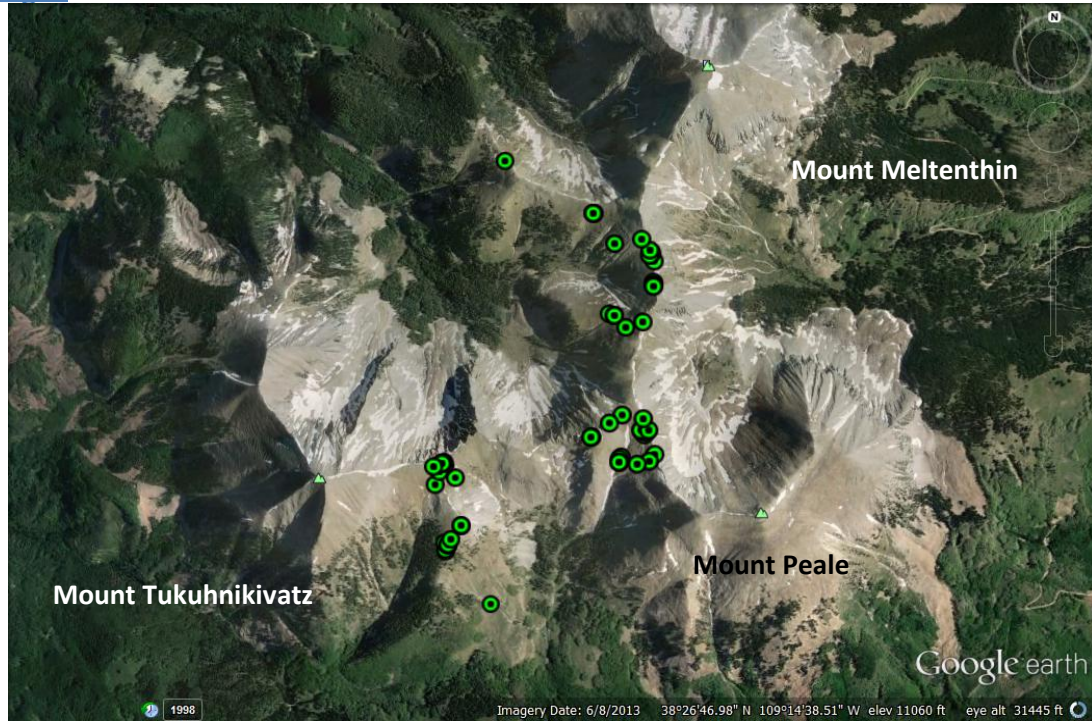


Fig. 6: All Photo Locations Within or Adjacent to Mount Peale RNA

Team One: Mt. Peale RNA

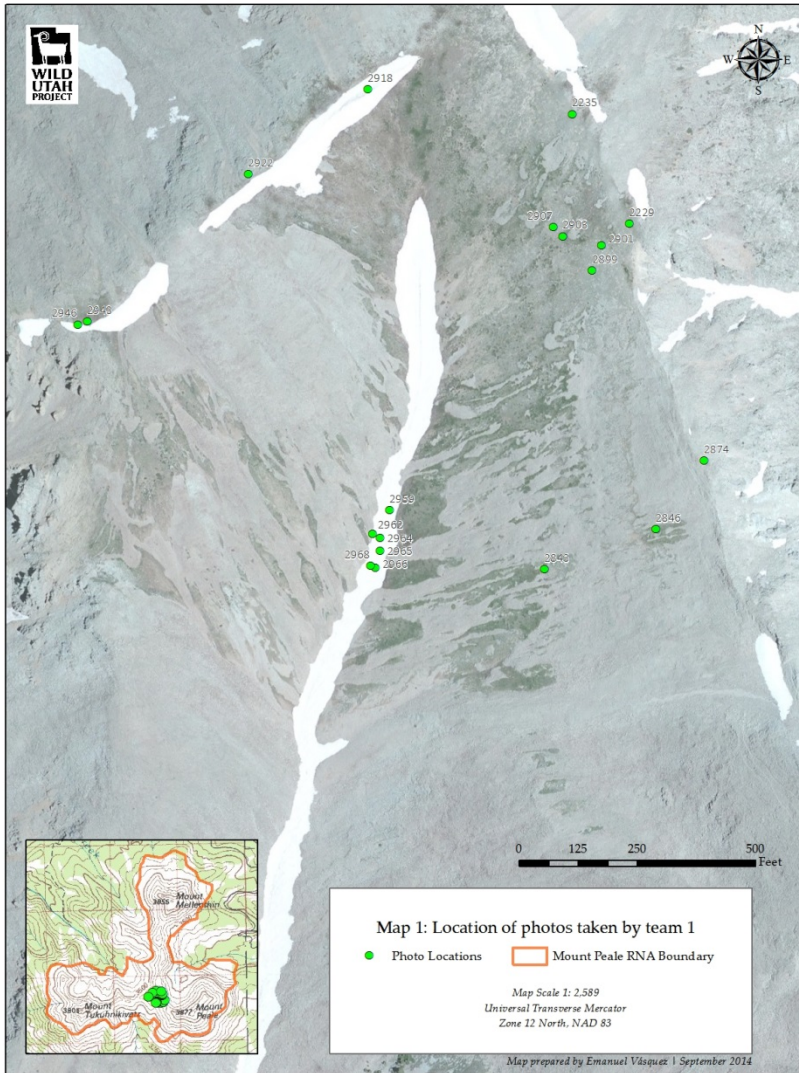
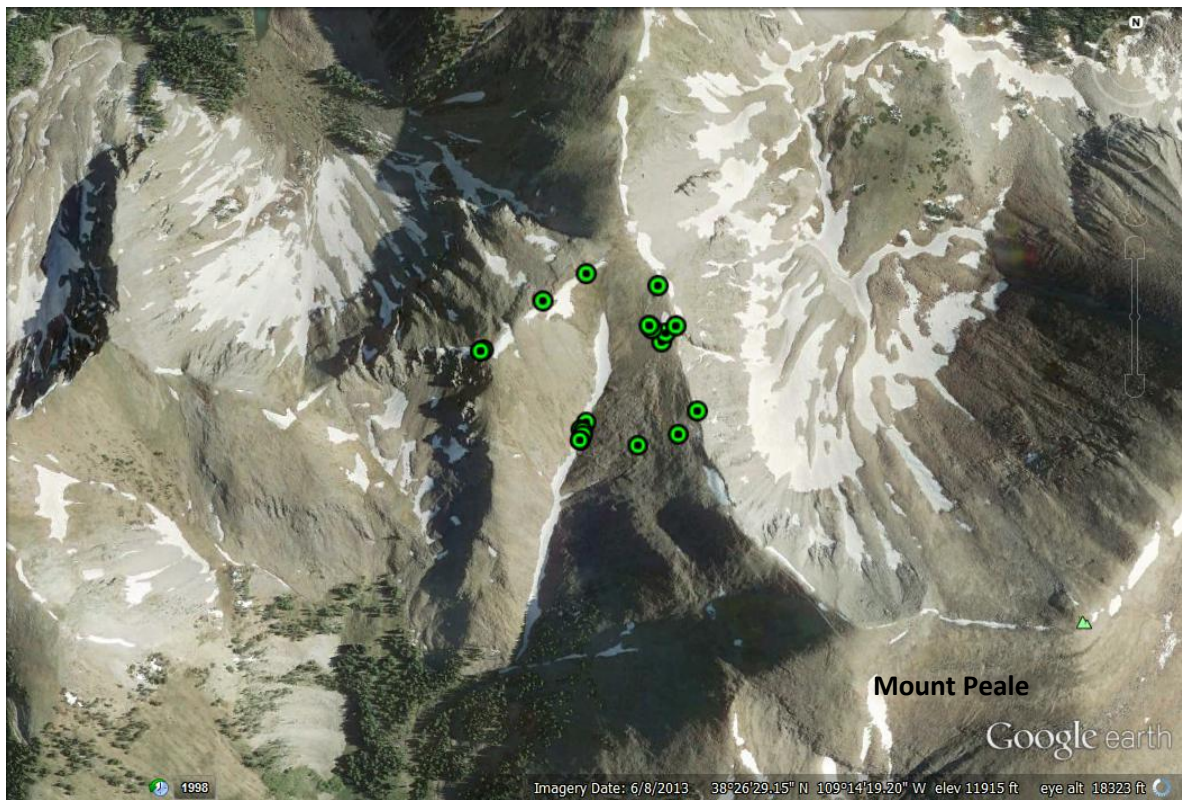
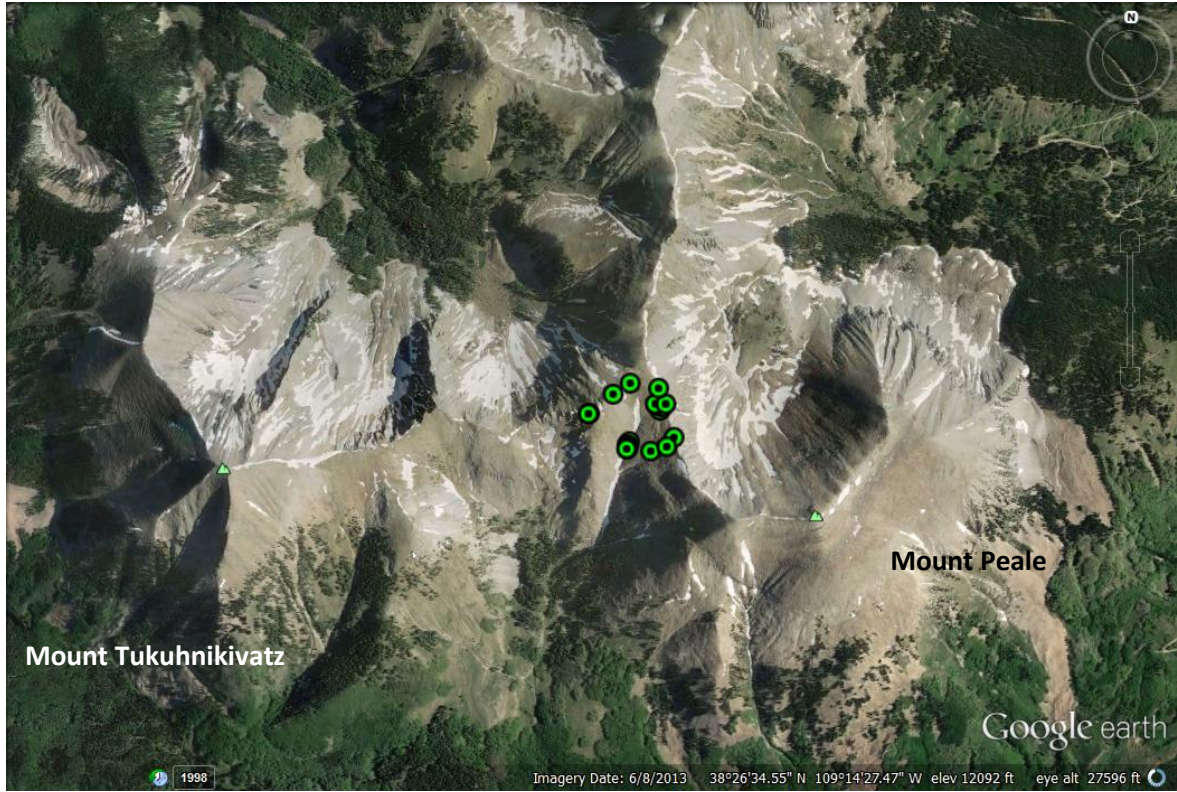


Fig. 7 Team 1 photo locations in relation to the Mt. Peale Research Natural Area



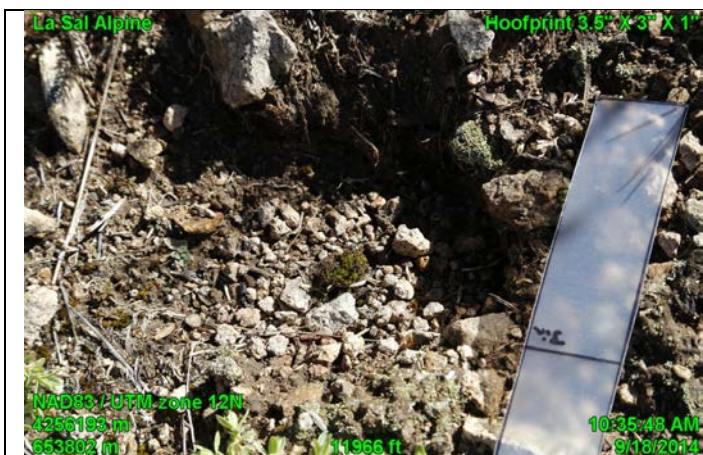


Fig. 8: Hoof print 3.5" x 3" x 1", trampled plants



Fig. 9: Scat near possibly grazed plants



Fig. 10: Two mountain goats (center of slope)



Fig. 11: Hoof print 3" X 2.5" X 1", grazed plants



Fig. 12: Scat



Fig. 13: Hoof print 3" X 3" X 1.5", trampled plants



Fig. 14: Grazed plants



Fig. 15: Goat wallow, 3.5' X 2'



Fig. 16: Hoof print 3" x 3" x 1", trampled plants



Fig. 17: Hoof print 3.5" X 3" X 2", trampled plants



Fig. 18: Hoof print 3" x 3" x 0.5", trampled plants



Fig. 19: Hoof print incision, trampled plants



Fig. 20: Browsed vegetation, near probable goat trail



Fig. 21: 3" deep hoof print (3" x 3" x 3"), trampled vegetation near probable goat trail



Fig. 22: Browsed vegetation, near probable goat trail (Fig. 25)



Fig. 23: Browsed vegetation, near probable goat trail (Fig. 25)



Fig. 24: Browsed vegetation, near probable goat trail (Fig. 25)



Fig. 25: Multiple hoof print incisions, trampled vegetation



Fig. 26: Hoof print 3" x 3" x 2", trampled vegetation



Fig. 27 Lichen biological crust eliminated in hoof print (4" x 3" x 1")

Team Two: Manns Peak

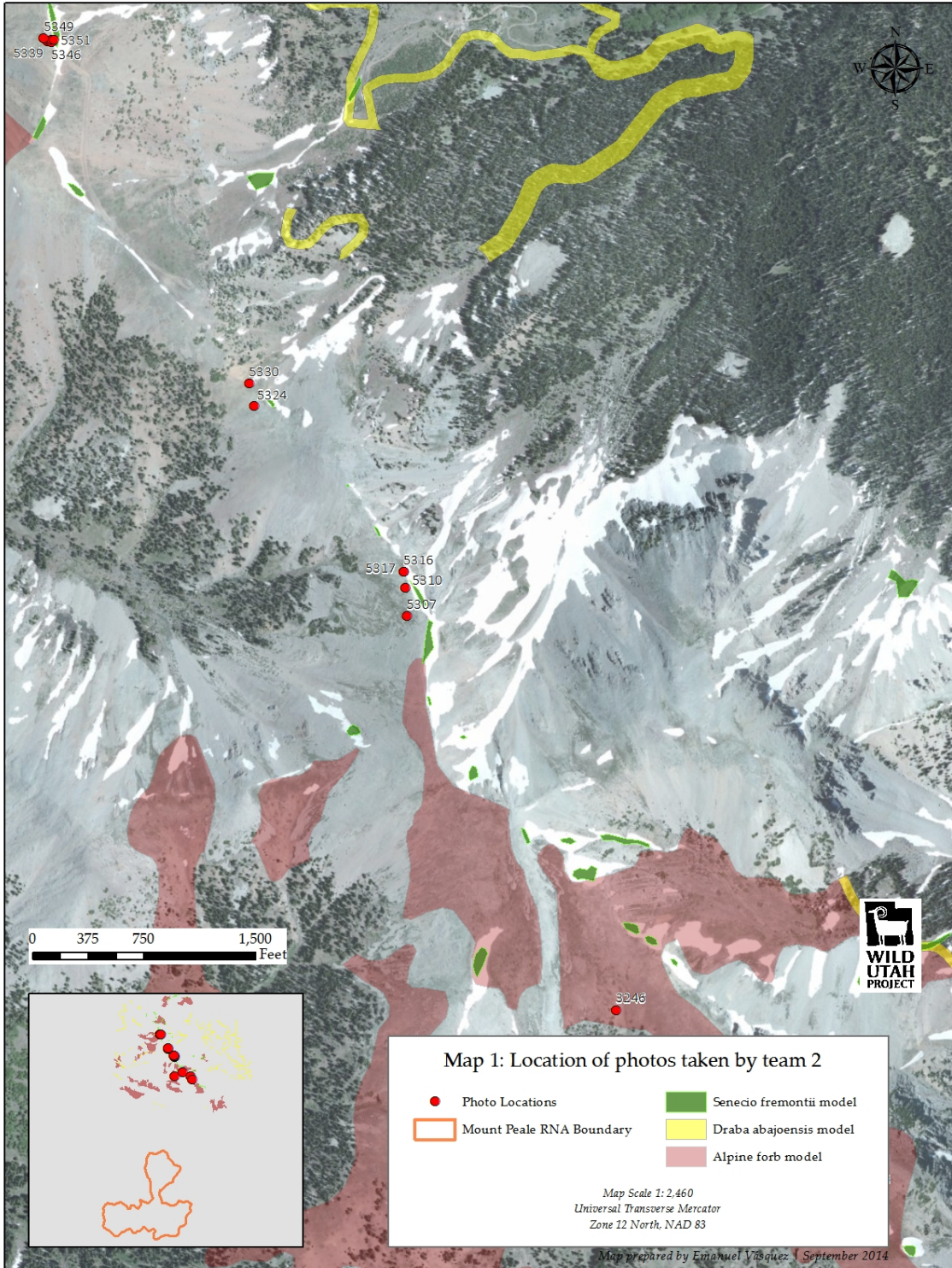


Fig. 28. Team 2 Manns Peak area photo locations relative to habitat for alpine forbs and two sensitive species

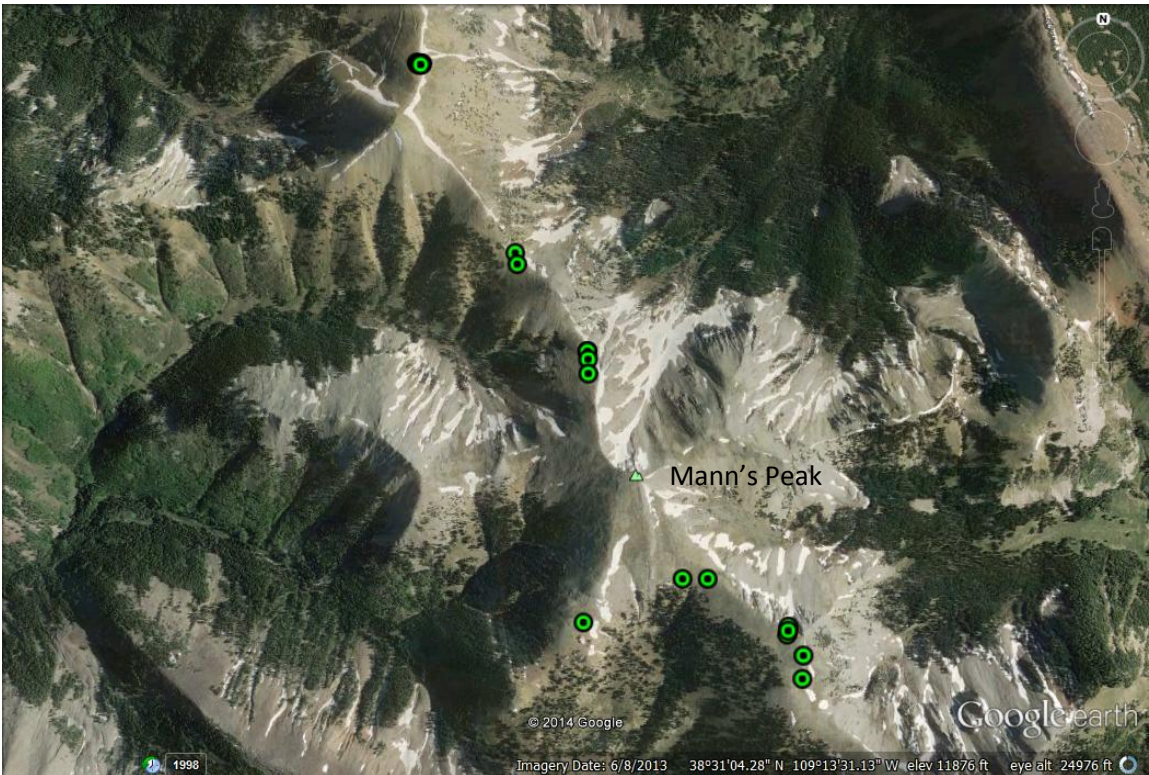




Fig. 29: Hoof print - Crushed vegetation



Fig. 30: Hoof print – crushed vegetation



Fig. 31: Hoof print – Crushed plant
N38 30.664 W109 13.135



Fig. 32: Hoof print – crushed plants
N38 30.565 W109 12.909



Fig. 33: Hoof print – Crushed vegetation



Fig. 34: Zoom out of Fig. 33
N38 30.504 W109 12.863



Fig. 35: Hoof print – crushed vegetation



Fig. 36: Hoof print with 6" scale



Fig. 35: Hoof print – crushed moss and plants
N38 30.559 W109 12.903

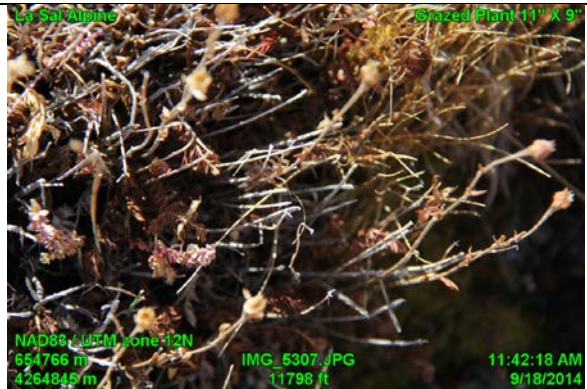


Fig. 36: Grazed plant, 11" x 9"



Fig. 38: Hoof print 2.5" x 2.5" x 1"



Fig. 39: Hoof prints (3.5" x 3.5" x 2"; and 2.5" x 2.5" x 1"); sheared plants



Fig. 40: Hoof print (4" X 3.5" X 1"); torn moss



Fig. 41: Goat resting place body imprint and tracks



Fig. 42: Grazed plant (12" x 6.5") with ruler



Fig. 43: Grazed plant (12" x 6")



Fig. 44: Hoof print (3.5" x 3" x 1.5")



Fig. 45: Grazed area (10' x 4')



Fig. 47: Goat scat



Fig. 48: Grazed/browsed slope

Team Three: Mount Tukuhnikivatz

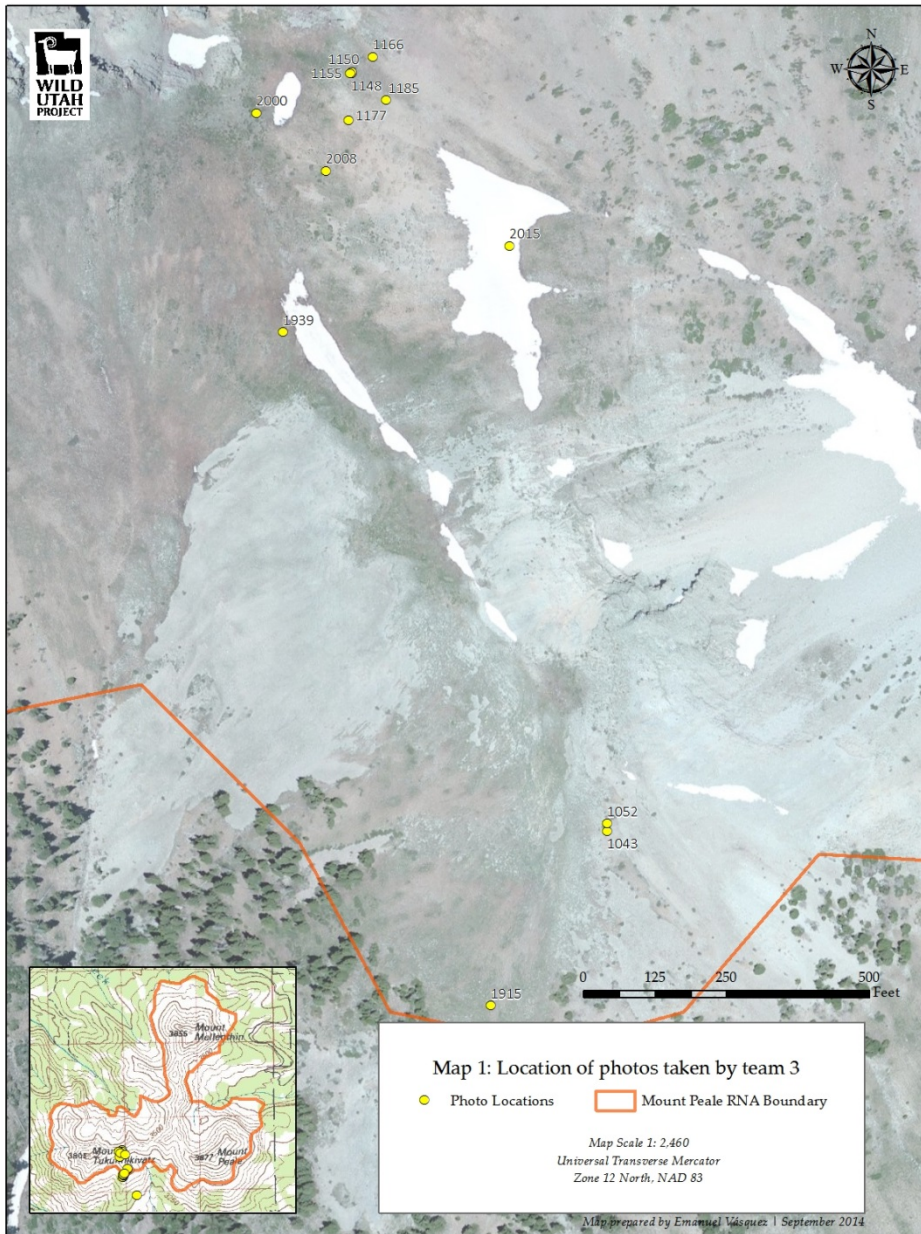
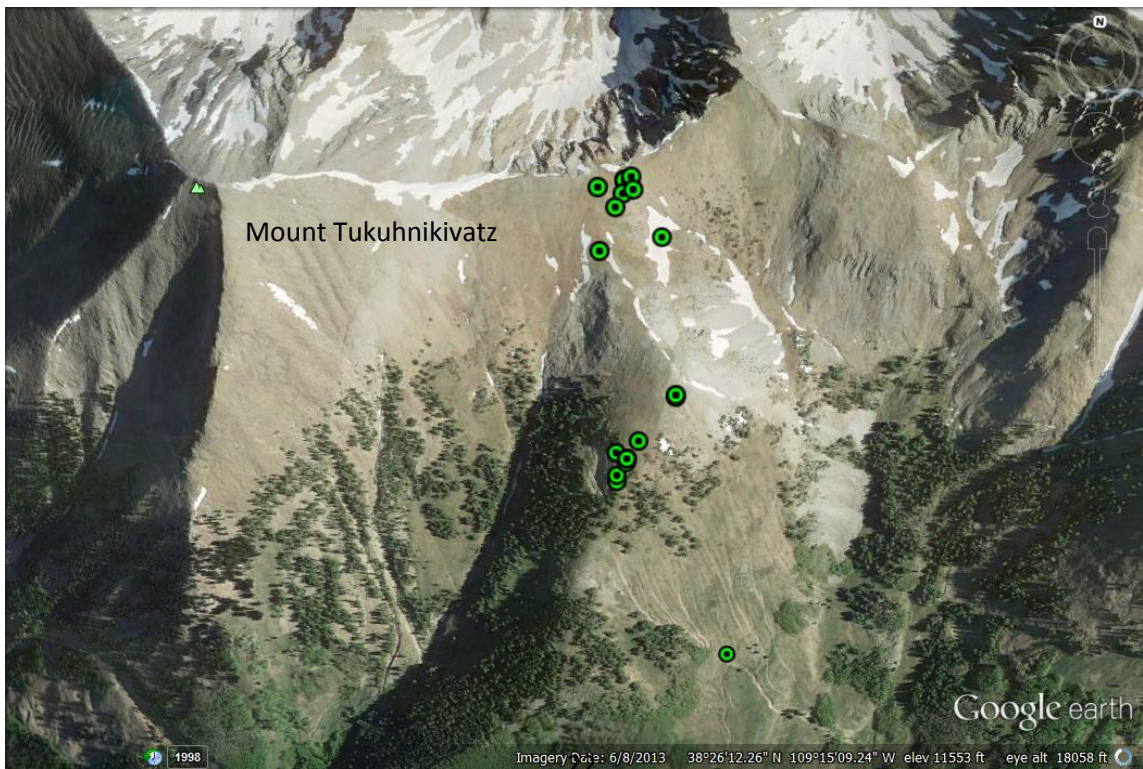
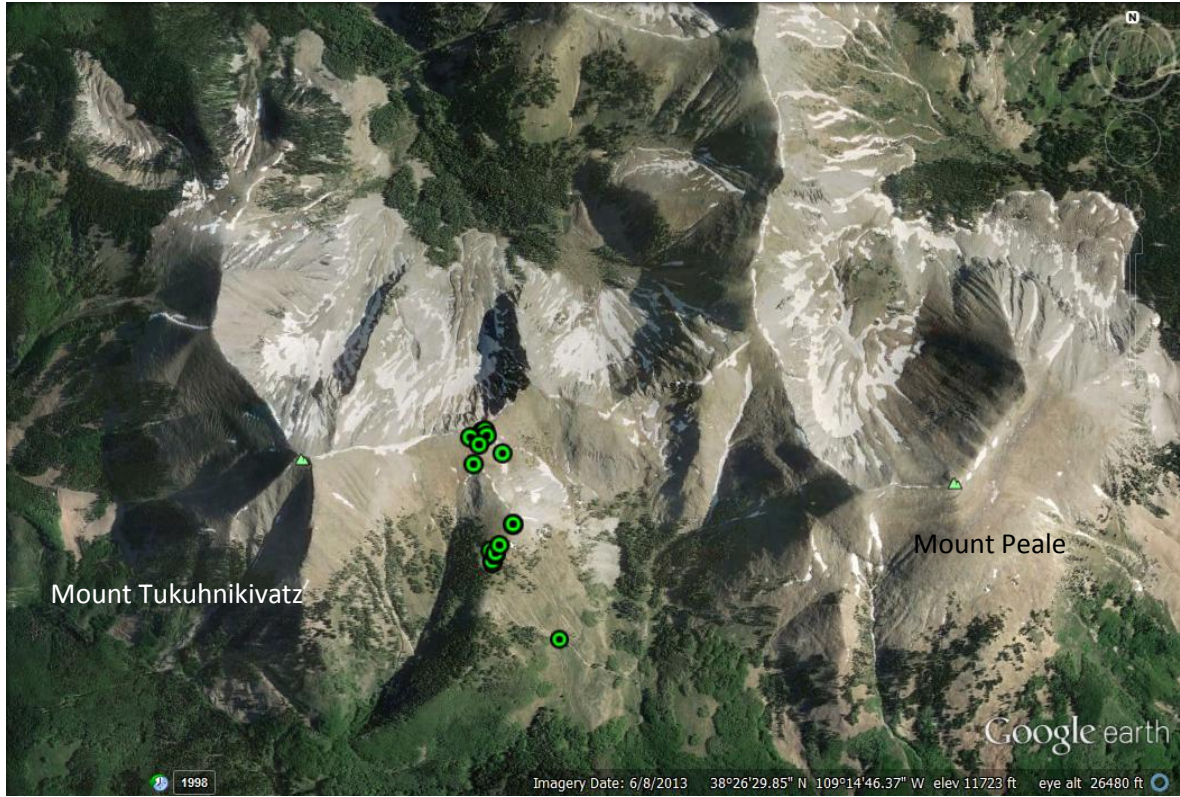


Fig. 49 Team 3 photo locations within the Mount Peale Research Natural Area

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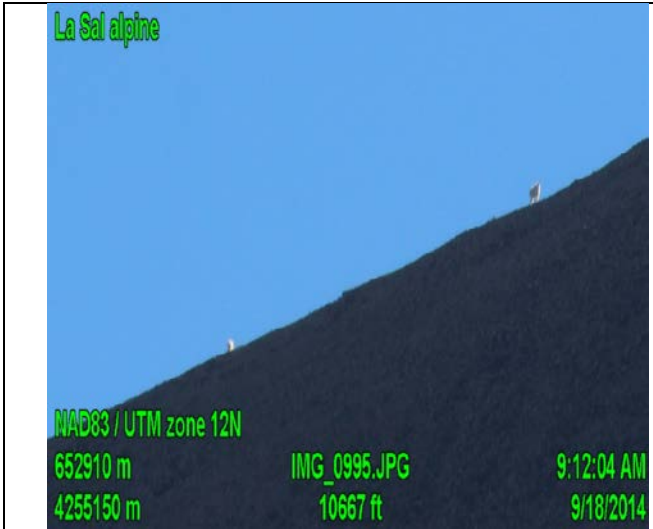


Fig. 50: Two goats on Mt. Peale ridge



Fig. 51: Hoof print (3.5" x 2.5" x 0.5")



Fig. 52: Summer Scat



Fig. 53: Moss sheared in hoof print (4" x 3.0" x 1.5")



Fig. 54: Hoof print (3.5" x 2.5" x 2")



Fig. 55: Hoof print (3.0" x 2.0" x 0.5")



Fig. 56: Hoof print (3" x 2.0" x 1")



Fig. 57: Hoof print (3" x 2" x 2"), incised through plant



Fig. 58: Hoof print (3" x 2" x 0.5")



Fig. 59: Sheared lichen biocrust; Hoof print (3.5" X 2.5" x 1")



Fig. 60: Hoof print (3" x 2" x 2")

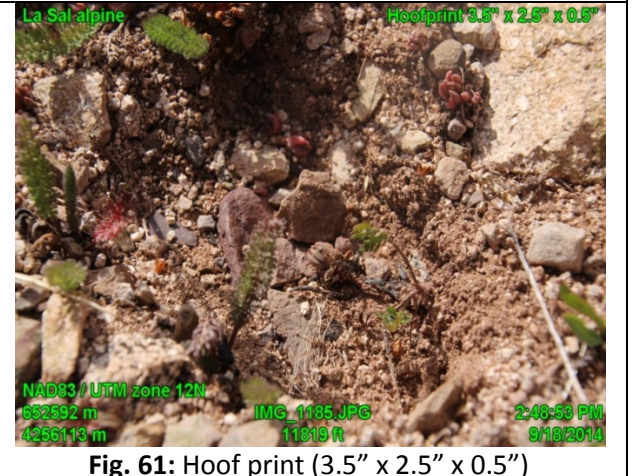


Fig. 61: Hoof print (3.5" x 2.5" x 0.5")



Fig. 62: Scat



Fig. 63: Trampled plant in hoof print (2.5" x 1.5" x 0.5")



Fig. 64: Torn plants in hoof print (3" x 3" x 1")



Fig. 65: Hoofprint (3" x 3", x 0.5")



Fig. 66: 2 hoofprints? (3" x 5" x 1")



Fig. 67: Hoof print (2" x 2.5" x 0/5")



Fig. 68: Grazed Plant

Team Four: Laurel Ridge

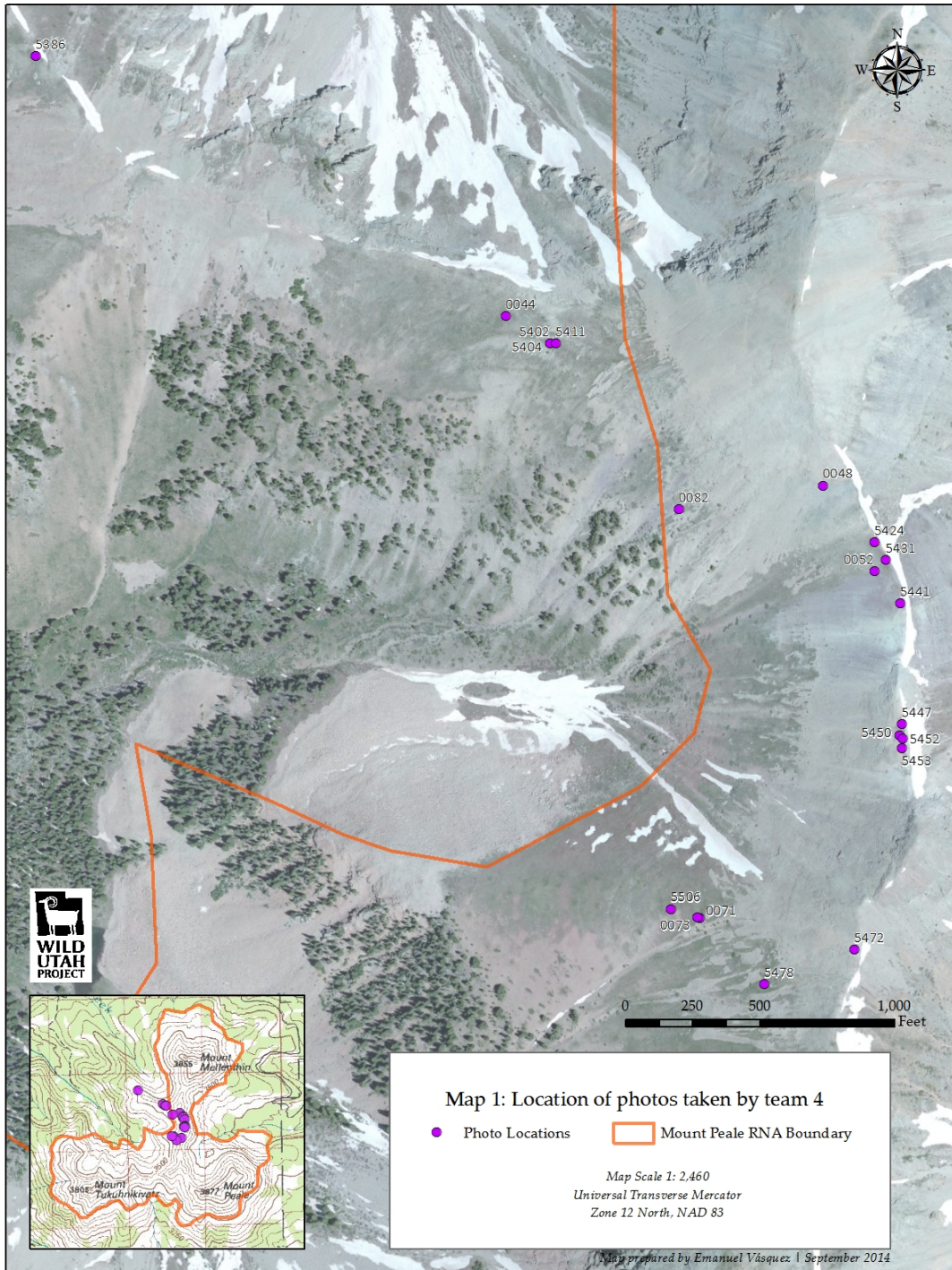


Fig. 69. Team 4 photo locations within and just outside Mt. Peale RNA

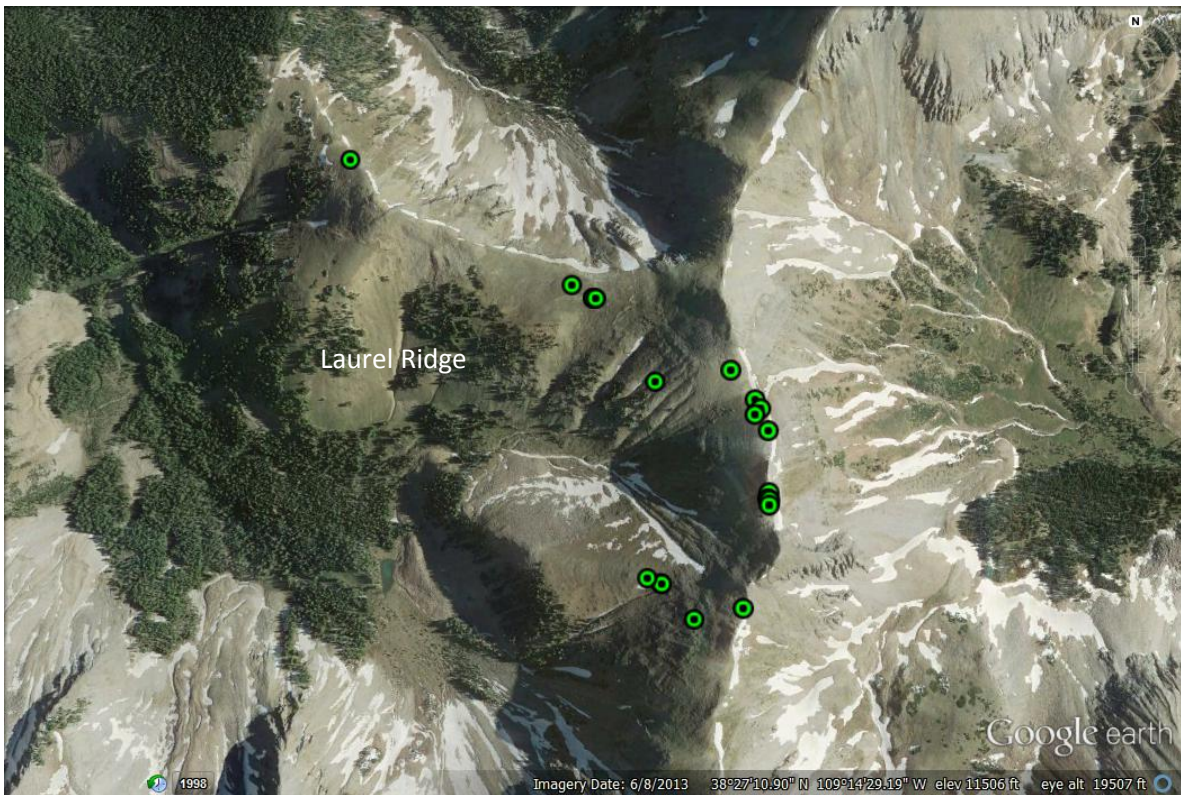
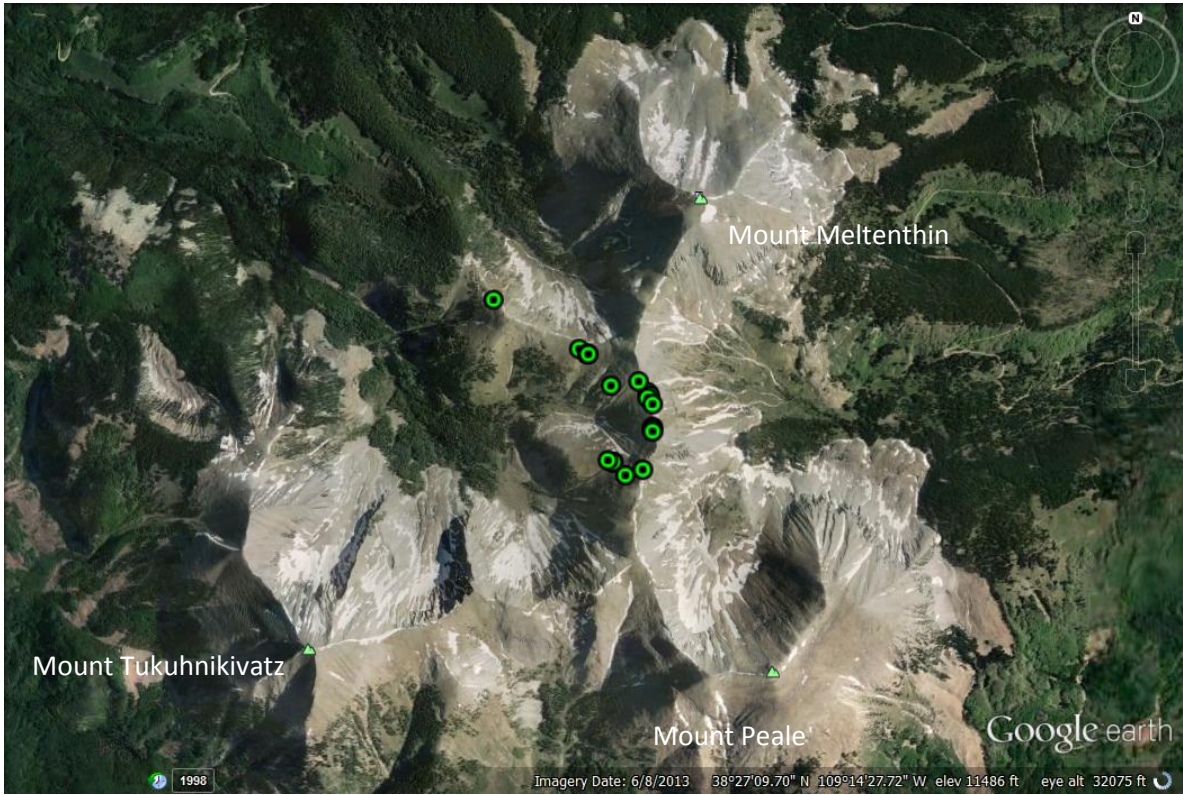




Fig. 70: Hoof print (3" x 3" x 2")



Fig. 71: Wallow (43" X 24" X 2.5")



Fig. 72: Grazed plant



Fig. 73: Crushed plant in hoof print (3" x 2.5" x 0.5")



Fig. 74: Torn plant in hoofprint (3" x 2.5" x 0.5")



Fig. 75: Grazed plant



Fig. 76: Crushed plant in hoof print (3" X 2.5" X 1")



Fig. 77: Scat



Fig. 78: Scat



Fig. 79: Scat



Fig. 80: Hoofprint (2.5" X 2" X 0.5")



Fig. 81: Hoofprint (3" X 2" X 2")



Fig. 82: Grazed grass



Fig. 83: Hoofprint (3" x 2" x 0.1") in plant



Fig. 84: Wallow (42" x 26" x 2")



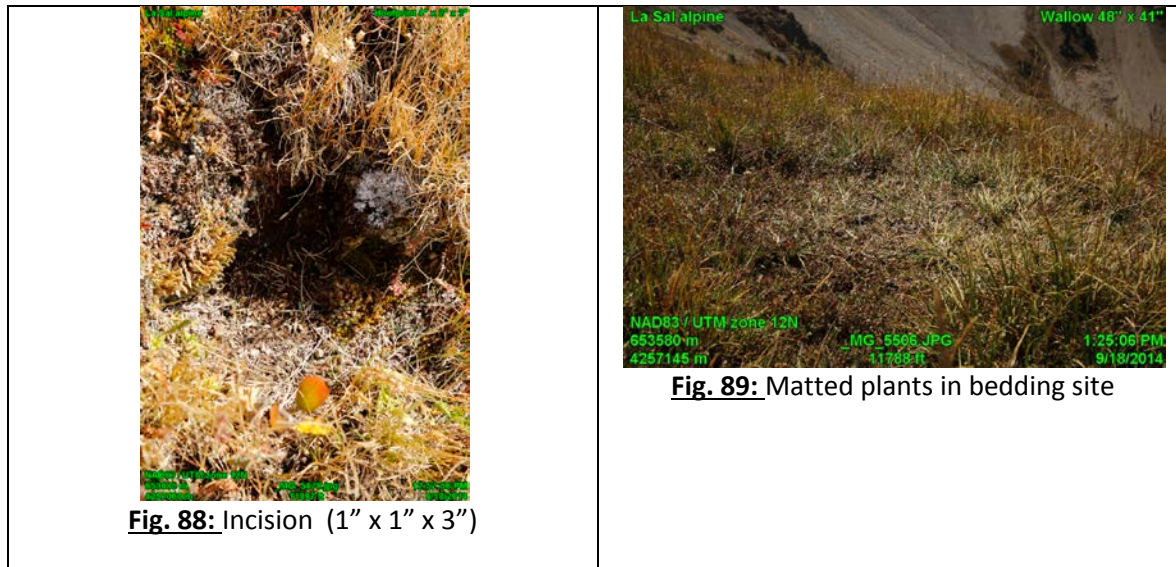
Fig. 85: Wallow closeup (42" x 26" x 2")



Fig. 86: Grazed plant



Fig. 87: Crushed moss in hoofprint (3.5" x 2" x 1")



Attachment A:

O'Brien, Mary, July 26, 2014 Trampling, Incision, and Torn Alpine Vegetation and Species of Concern Below and West of Laurel Ridge, Adjacent to Mt. Peale Research Natural Area La Sal Mountains, Moab-Monticello Ranger District, Manti-La Sal National Forest

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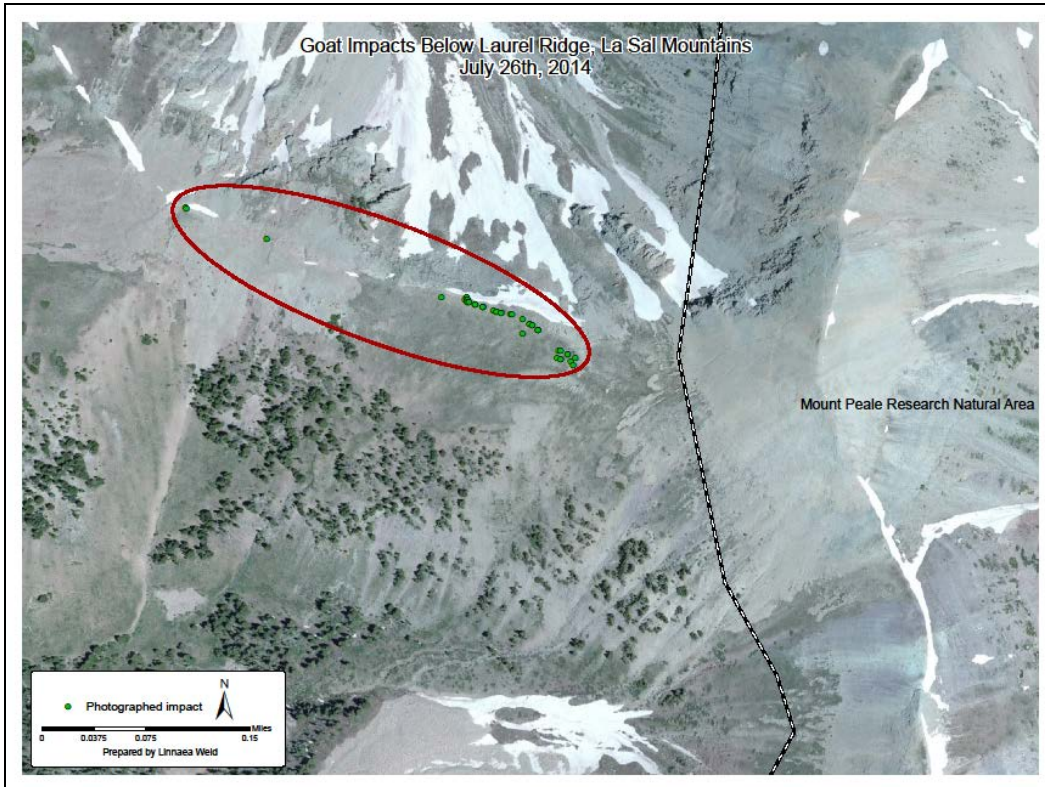
**Trampling, Incision, and Torn Alpine Vegetation and Species of Concern
Below and West of Laurel Ridge,
Adjacent to Mt. Peale Research Natural Area
La Sal Mountains
Moab-Monticello Ranger District
Manti-La Sal National Forest
July 26, 2014
Mary O'Brien, Grand Canyon Trust**

On July 26, 2014, as part of a three-day volunteer effort to locate and map locations of plant species of concern in the alpine area of La Sal Mountains of Manti-La Sal NF, the following georeferenced photographs were taken in a short time in a small area west of and below Laurel Ridge (Map 1) above 11,500' elevation and immediately adjacent to the Mt Peale Research Natural Area (RNA). The density of incisions and apparent hoofprints are consistent with independent observations of introduced mountain goats (*Oreamnos americanus*) using the area. Others in the volunteer group photographed and took waypoints at several goat wallows within the RNA. Additional reports are being assembled from this July 24-26 volunteer trip.

The "hoofprint" incisions are smaller and with sharper edges than would be found with human hiking boots. On the chance that some of the prints might be due to other ungulates (e.g., deer, small elk) that are coming up above 11,500', they would be simply cumulative with those of the introduced goats. Perhaps the photos of scat (e.g., Figs. 42-44) can be confirmed as (or at least consistent with) that of mountain goats.

Several photos document the trampling and tearing of *Androsace chamaejasme* var. *carinata* (sweetflower rockjasmine; Figs. 23-25; 27) a Forest Service species of concern; shearing of lichen and moss biological soil crust (e.g., Figs. 45-46, 48-49); and uprooting of graminoids (e.g., Figs. 15-16; 18). **This physical evidence within the first year of only 20 mountain goats indicates that with continued mountain goat presence, extensive damage will be brought to the small Mt. Peale RNA, Forest Service species of concern, and the protective and slow-growing lichen biological soil crusts.** Visits to the immediately-adjacent Mt. Peale RNA will surely yield similar evidence of physical disturbance of the alpine plant community and biological soil crust.

This evidence is far more immediately detectable than would be a gradual decline in the density of species of concern, depletion of plant biodiversity, or decline of any of the diverse native pollinators observable within the La Sal Mountains' alpine communities. Additionally, the physical damage (which is similar in type, but not size, to that of other exotic ungulates in southern Utah) cannot be attributed, as might painstakingly-measured plant density decline, to "drought" or "climate change." It is direct, obvious, measurable, and disturbing.



Map 1. 7/26/2014 Goat Impacts Below Laurel Ridge; La Sal Mountains. Each green circle represents a photo of an impact.



Fig. 1 Soil incision



Fig. 2 Plant torn into soil incision



Fig. 3 Grazed grass; *Erigeron mancus*



Fig. 4 Recent trampling into soil; torn moss



Fig. 5 Recent trampling into soil



Fig. 6 Close-up of Fig. 5



Fig. 7 Recent trampling into soil



Fig. 8 Recent trampling into soil



Fig. 9 Recent trampling into soil



Fig. 10 Close-up of Fig. 9



Fig. 11 Recent trampling into soil



Fig. 12 Trampling into soil



Fig. 13 Dislodged moss patch has been flipped over



Fig. 14 Close-up of Fig. 13



Fig. 15 Trampling and grazed and uprooted grass



Fig. 16 Grazed and uprooted grass/sedge



Fig. 17 Trampled vegetation, hoofprint incision



Fig. 18 Grazed and uprooted grasses



Fig. 19 Hoofprint incision; compacted



Fig. 20 Trampled vegetation; hoofprint



Fig. 21 Trampled vegetation; hoofprint incision



Fig. 22 Uprooted, grazed, trampled grass/sedge



Fig. 23 Hoofprint incision; torn *Androsace chamaejasme*



Fig. 24 Close-up; torn *Androsace chamaejasme*



Fig. 25 Trampled, torn *Androsace chamaejasme*



Fig. 26 Torn vegetation; trampling



Fig. 27 Close-up of Fig. 25; torn *Androsace chamaejasme*



Fig. 28 Hoofprint incision; trampled vegetation



Fig. 29 Recently-torn vegetation in hoofprint



Fig. 30 Incised hoofprint



Fig. 31 Trampled *Androsace chamaejasme* and sedge/grass



Fig. 32 Torn moss, *Erigeron mancus*



Fig. 33 Recent hoofprint incision; trampled vegetation



Fig. 34 Close-up of Fig. 33; trampled vegetation



Fig. 35 Torn moss; incised hoofprint



Fig. 36 Close-up of Fig. 35; torn moss



Fig. 37 Trampling; hoofprint incision



Fig. 38 Trampling; incised hoofprint



Fig. 39 Incised hoofprint; trampled vegetation



Fig. 40 Grazed, trampled vegetation



Fig. 41 Incised hoofprint; torn vegetation



Fig. 42 Goat scat? Trampled vegetation



Fig. 43 Trampling near *Erigeron mancus*



Fig. 44 Goat scat?



Fig. 45 Torn lichen biological soil crust



Fig. 46 Torn lichen biocrust; incision



Fig. 47 Recent hoofprint incision



Fig. 48 Incision into lichen biocrust



Fig. 49 Trampled, torn lichen biocrusts and moss

Comments and suggestions for further documentation of physical damage to the alpine plant community are welcome.

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