

Modified by Mountain Goats

Mountain Goat Impacts (2015-2017)
in the Mount Peale Research Natural Area
of the La Sal Mountains, Utah

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Abstract

Impacts of non-native mountain goats on the soil and plants of the alpine area of the La Sal Mountains (southeast Utah) were evaluated at 52 sites in the Mount Peale Research Natural Area (RNA). Change in condition over time was determined for 44 of those sites that had previously been surveyed in 2015, and for 14 of those sites that had been surveyed in 2008. Over the objection of the Forest Service, 35 mountain goats were introduced to the La Sal Mountains during 2013 and 2014 by the Utah Division of Wildlife Resources. These mountain goats now reside in the Mount Peale RNA, established by the Forest Service in 1988 to protect the rare alpine habitat of the La Sal Mountains in a “virgin or unmodified condition.” These goats are year-round residents, altering and damaging the native alpine habitat by grazing, browsing, trampling, and digging wallows in the vegetation and shallow alpine soil. The alpine area of the La Sal Mountains has unique vegetation, including five Forest Service “Species of Conservation Concern” (SCC): the La Sal daisy (*Erigeron mancus*) which is endemic to the La Sal Mountains, meaning it has not been found anywhere else in the world; Baker's alpineparsley (*Oreoxis bakeri*); Blackheaded fleabane (*Erigeron melanocephalus*); Dwarf mountain ragwort (*Senecio fremontii* var. *inexpectatus*); and Sweetflower rockjasmine (*Androsace chamaejasme* subsp. *lehmanniana*). We documented at least minor impacts (from goats or humans) at 79% of the sites surveyed in 2017. Impacts increased since 2015 at 59% of the sites. For 14 sites that were first assessed in 2008, 71% of those sites had a lower condition class in 2017. At least one of the SCC plants was observed at 62% of sites; and 63% of sites with an SCC had goat impacts; so goat disturbance is occurring where there are plants of conservation concern. Damage to soil and vegetation was also documented with georeferenced photos.

Background

The La Sal Mountains are a spectacular and rare alpine ecosystem high above the red rock canyons in southeastern Utah. There is a very limited amount of alpine habitat in the Colorado Plateau (Fig. 1). Within the La Sal Mountains is the Mount Peale Research Natural Area (RNA) which the Forest Service established in 1988 to protect this high alpine ecosystem. This 2,380-acre area ranges in elevation from 10,450 feet up to the rugged peak of Mount Peale at 12,726 feet. Research natural areas are established by the Forest Service “to illustrate adequately or typify for research or educational purposes, the important forest and range types in each forest region... [and] they will be retained in a virgin or unmodified condition” ([36 CFR § 251.23](#)).

Takeaways

- Non-native mountain goats have caused observable physical damage to plants and soil in the four years since they were introduced to the La Sal Mountains in 2013.
- Most (59%) of the 44 survey sites within the Mount Peale Research Natural Area declined in condition from 2015 to 2017.
- Five Forest Service SCC plants were found throughout the Mount Peale RNA (62% of sites had at least one) but so were mountain goat impacts; most sites (63%) with SCC plants also had mountain goat impacts.

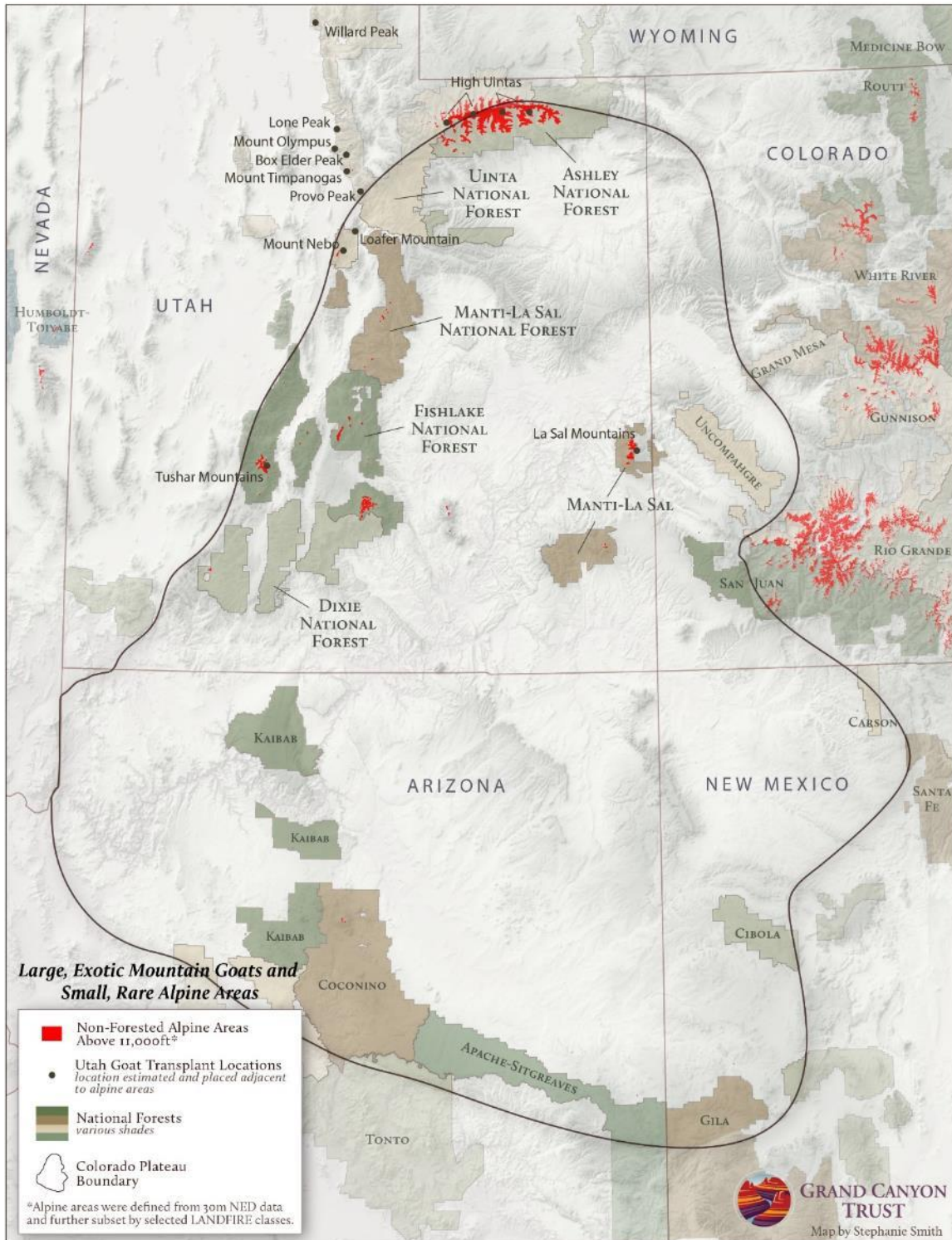


Fig. 1. Map, showing how little alpine area (red) there is in the Colorado Plateau.

Mountain goats (*Oreamnos americanus*; Fig. 2) are not native to Utah (Fig. 3) but have been introduced beginning in 1967 to the Wasatch Mountains, Uinta Mountains, and Tushar Mountains (left part of the Colorado Plateau in Fig. 1). Introduction of mountain goats to the La Sal Mountains was done by the Utah Division of Wildlife Resources (UDWR) in 2013 (20 goats) and 2014 (15 goats) when goats were transported by helicopter from herds in the Tushar Mountains of central Utah to a patch of state land on a south slope of the La Sal Mountains. This was done over the objection of the Forest Service, because, as anticipated, the goats soon moved up to their preferred habitat above 11,000 feet, which includes the Mount Peale RNA.



Fig. 2. Introduced mountain goats in the Mount Peale RNA of southeast Utah (photo by author).

The La Sal Mountains' mountain goat population has increased from the 35 animals introduced in 2013 and 2014 to over 70 in 2017 (personal communication, U.S. Forest Service, September 2017). The Utah Division of Wildlife Resources plans for a herd of 200 mountain goats in the La Sal Mountains (UDWR 2013a).

The La Sal Mountain alpine area supports at-risk animals such as pika and bumblebees, as well as more common animals such as marmots.

The Utah Native Plant Society has determined that “there are a total of 29 [plant] species that could be detrimentally impacted by the introduction of mountain goats” ([UNPS 2016](#)).

In the La Sal Mountains there are at least nine plant species that represent the only known populations of those species in the state of Utah (Smith 2008), including the five alpine plants listed as Forest Service “Species of Conservation Concern” in Table 1 (photos of these plants are in Appendix B). A Species of Conservation Concern (SCC) is a species “. . . for which the regional forester has determined that the best available scientific information indicates substantial concern about the species' capability to persist over the long-term in the plan area [in this case, the Manti-La Sal National Forest]” ([USDA-FS 2012](#)).

One of those plants for which there is “substantial concern” about its ability to persist in the long term, the La Sal daisy (*Erigeron mancus*), is endemic to the La Sal Mountains, meaning it is not known to be anywhere else in the world (Smith 2008).



Fig. 3. Map showing the native range of mountain goats, which does not include the La Sal Mountains of Utah (red flag).

Table 1. Species of conservation concern of the La Sal Mountains alpine area.

| Species | Conservation Status |
|---|---|
| Baker's alpineparsley (<i>Oreoxis bakeri</i>) | Species of conservation concern (USDA-FS 2017a); High conservation priority (UNPS 2016); Critically imperiled status in Utah (NatureServe) |
| Blackheaded fleabane (<i>Erigeron melanocephalus</i>) | Species of conservation concern (USDA-FS 2017a); Watch list (UNPS 2016); Critically imperiled status in Utah (NatureServe) |
| Dwarf mountain ragwort (<i>Senecio fremontii</i> var. <i>inexpectatus</i>) | Species of conservation concern (USDA-FS 2017a); High conservation priority (UNPS 2016); Critically imperiled status in Utah (NatureServe) |
| La Sal daisy (<i>Erigeron mancus</i>) | Species of conservation concern (USDA-FS 2017a); High conservation priority (UNPS 2016); Imperiled status in Utah (NatureServe); Endemic to La Sal Mountains (found nowhere else) |
| Sweetflower rockjasmine (<i>Androsace chamaejasme</i> subsp. <i>lehmanniana</i> [Syn. <i>Androsace chamaejasme</i> var. <i>carinata</i>]) | Species of conservation concern (USDA-FS 2017a) |

An additional plant that was searched for, but is not on the SCC list, is spotted saxifrage (*Saxifraga bronchialis*), which is on the UNPS (2016) “watch list.”

Alpine vegetation is highly vulnerable to disturbance:

The alpine ecosystem, with short growing seasons, shallow soils and steep slopes, is a harsh environment for plants. The subsequent long-term recovery times, limited restoration potential and specialized, endemic species make any impacts significant (Smith 2008).

Because of these unique ecological characteristics of an alpine ecosystem, and vulnerability of the Mount Peale RNA to disturbance, the Grand Canyon Trust (“Trust”) conducted field work in 2017 to assess visible impacts of the mountain goats in the RNA.

Methods

In the summer of 2017, Trust staff and volunteers assessed impacts of non-native mountain goats at 52 sites within the Mount Peale RNA (Fig. 4). Of those, 44 sites had been assessed in 2015 (Wild Utah Project 2015). Of those 44 sites surveyed in 2015 and 2017, 14 had been assessed by the Forest Service (Rocky Mountain Research Station field crew) in 2008 to assess recreation impacts on the alpine habitat of the La Sal Mountains, which was prior to mountain goat introduction (Forest Service personal communication).

The eight new sites that we added in 2017 included seven sites randomly selected with GIS from points within the RNA and a slope of less than 30% (for surveyor safety) as well as one site that was not correctly relocated from the 2015 dataset.

Our surveys were completed on five trips between July 9 and October 24, 2017. The author, an experienced vegetation ecologist, led the field trips, and had help from three other Trust staff and 11 volunteers (Fig. 5). The author was involved in the assessment of all of the sites in 2017, providing consistency in the method used for the 2017 field surveys. The surveys by Wild Utah Project were done by a group of biologists and volunteers from Wild Utah Project and a U.S. Forest Service wildlife biologist on July 17 and 18, 2015.

The 2017 site assessment protocol was based on a protocol by Rochefort and Swinney (2000) that was designed to assess recreation impacts in alpine areas. That protocol was used in the 2008 Forest Service study of recreation impacts noted above, and was slightly adapted by Wild Utah Project in 2015 to assess mountain goat impacts in the La Sal Mountains. We repeated use of this same protocol in 2017 to characterize basic physical disturbance to vegetation and soil, document presence of SCC plants, and assign a condition class.

A GPS was used to find the sites that Wild Utah Project had surveyed in 2015. That point was used as the center of a circular plot with a radius of 37.2 feet (i.e., 0.1 acre). The area was surveyed by walking circles within the plot to look for SCC plants and impacts from animals (particularly goats) and people.

Data were recorded on the following:

- Dominant vegetation or physical cover type.
- Bare ground, vegetation and rock (cover estimates).
- Species of conservation concern (Table 1).
- Common plant species.
- Disturbances caused by wildlife (generally mountain goats) such as scat, fur, wallows, grazed plants, and sheared turf; and disturbed ground and trails (by wildlife or humans).

Georeferenced plot overview photos were taken from the outer edge of the plot in the four cardinal directions, and of disturbances or SCC plants within the plot.

Based on the data collected at each site, we assigned a condition class (Box 1), using the same protocol that was used by the Forest Service in 2008 and by Wild Utah Project in 2015. This allowed for comparison of sites at three different points in time.

Box 1. Condition Classes

The following condition classes (from Rochefort and Swinney 2000) were used to characterize each site. The numbers are codes for classes relative to pristine, natural condition.

- 0 = pristine
- 1 = slightly degraded
- 2 = significantly degraded
- 3 = severely degraded
- 4 = excessive degradation

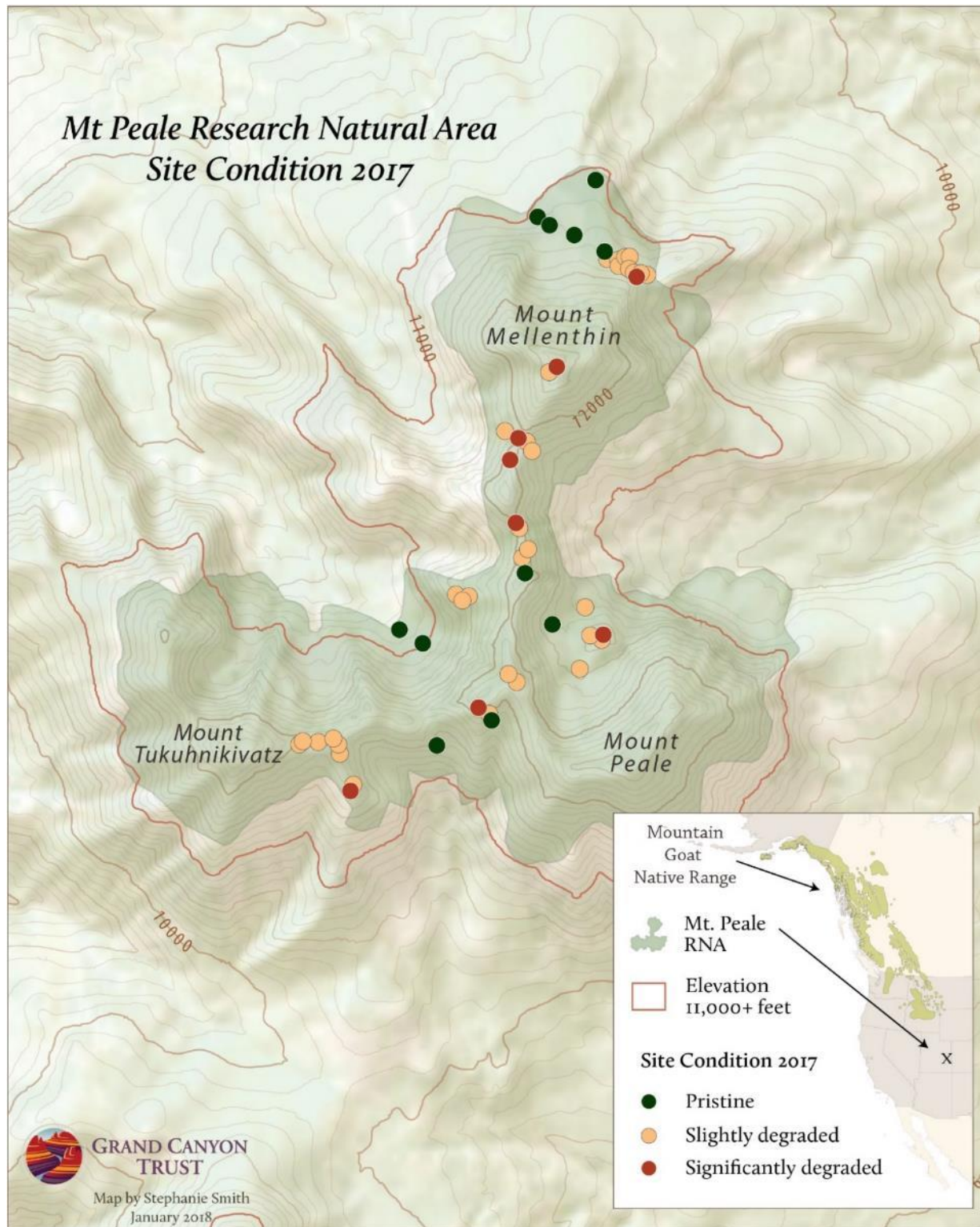


Fig. 4. Map showing sites (n=52) surveyed in the Mount Peale RNA in 2017, with the condition class indicated by color. Green dots (n=11) indicate pristine condition; peach dots (n=33) indicate sites that are slightly degraded; and red dots (n=8) indicate sites that are significantly degraded.



Fig. 5. A volunteer recording data at a site in Mount Peale RNA (photo by author).

Results

In our surveys in Mount Peale RNA, evidence (Appendices A and B) of mountain goats was commonly observed, including:

- Sightings of mountain goats (groups of more than 10 animals in some cases)
- Goat fur on plants and on the ground
- Goat droppings – both winter and summer types
- Wallows – where goats have removed plants and dug into the soil
- Trails – with fur and droppings along them

The mountain goats are causing damage of various types to alpine plants and soils (Appendices A and B), including:

- Broken and sheared alpine vegetation
- Trampling
- Intensive grazing
- Uprooted plants
- Bare ground, where goats have overgrazed or dug wallows

Mountain goat impacts were often observed on ridges and saddles where the terrain is somewhat flatter. These areas are probably favored by mountain goats because they have more plants for grazing and deeper soil for digging wallows. In the La Sal Mountains, steeper slopes are usually rocky talus areas with scattered, minimal vegetation and soil

Condition Class

The 52 sites surveyed in the Mount Peale RNA in 2017 were in three condition classes (Figs. 4 and 6):

Pristine = 21%

Slightly degraded = 64%

Significantly degraded = 15%

No sites were recorded in the more disturbed classes of “severely degraded” or “excessive degradation.”

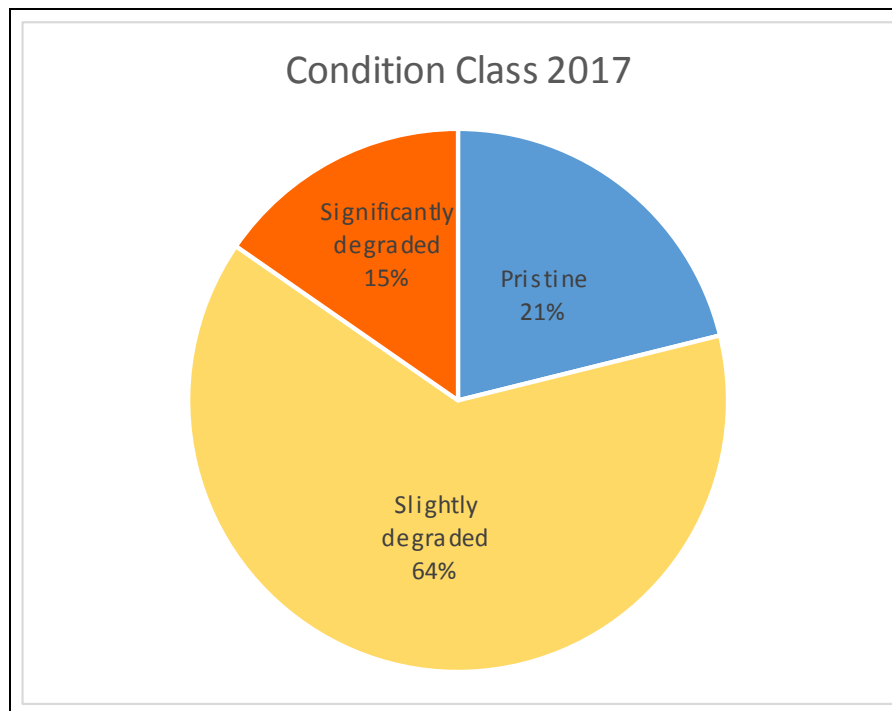


Fig. 6. The 2017 condition classes for the 52 alpine sites surveyed in the Mount Peale RNA. There were 11 sites in “pristine” condition; 33 sites in “slightly degraded” condition; and 8 sites in “significantly degraded” condition.

Comparing the condition class change from 2015 to 2017, 59% (n=26) declined to a more disturbed condition class and 41% of sites (n=18) remained in the same condition (Figs. 7 and 8). Of the sites that changed condition, 23 of 26 declined by one condition class, and 3 sites declined by two condition classes, from “pristine” to “significantly degraded.”

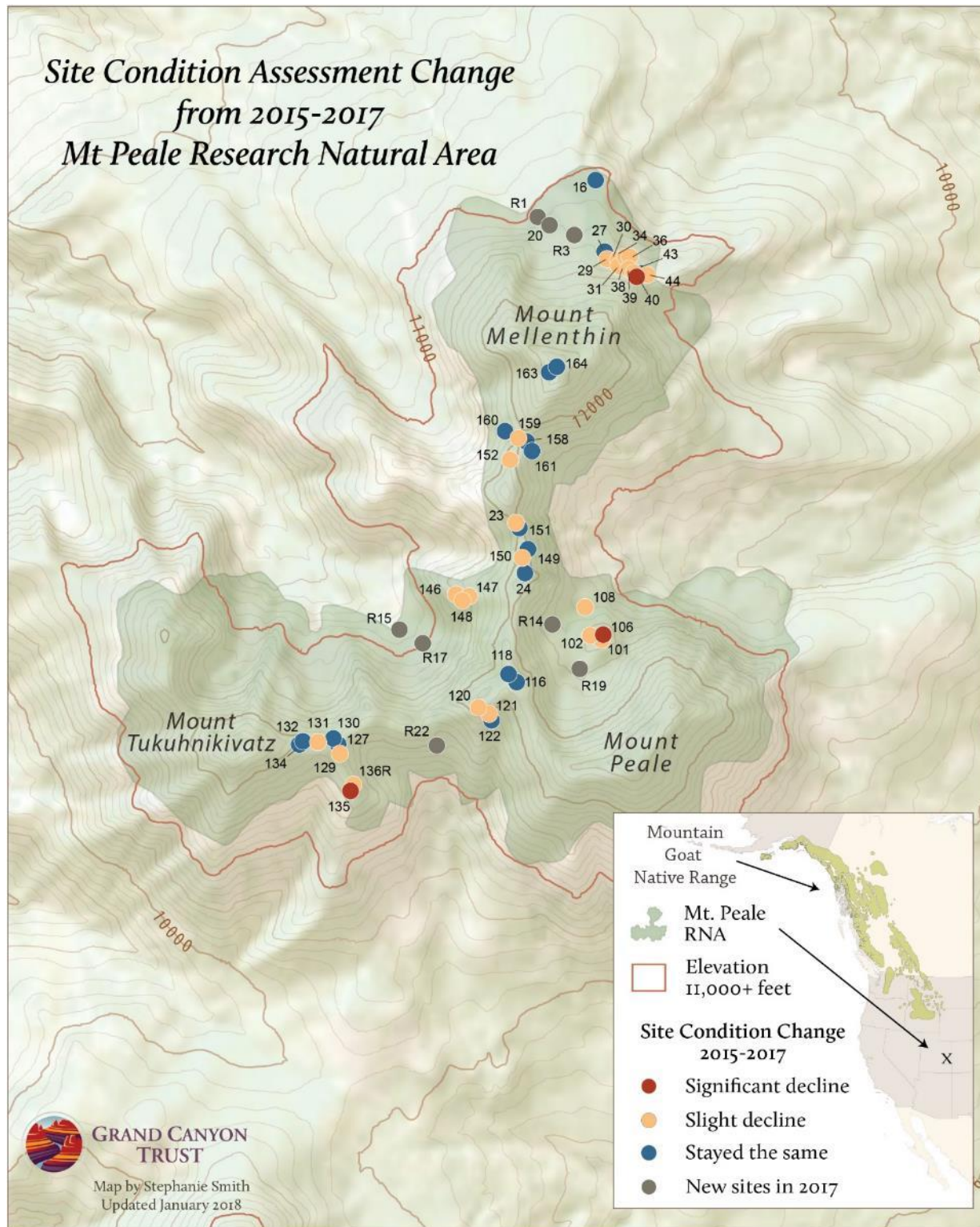


Fig. 7. Map of the Mount Peale RNA, showing sites (n=52) where mountain goat impacts were surveyed by Grand Canyon Trust in 2017 and in most cases (n=44) by Wild Utah Project in 2015. Red dots (n=3) indicate sites where the condition declined two classes between 2015 and 2017; peach dots (n=23) are sites that declined one condition class; blue dots (n=18) are sites that had the same condition class; and grey dots (n=8) are sites that were surveyed for the first time in 2017.

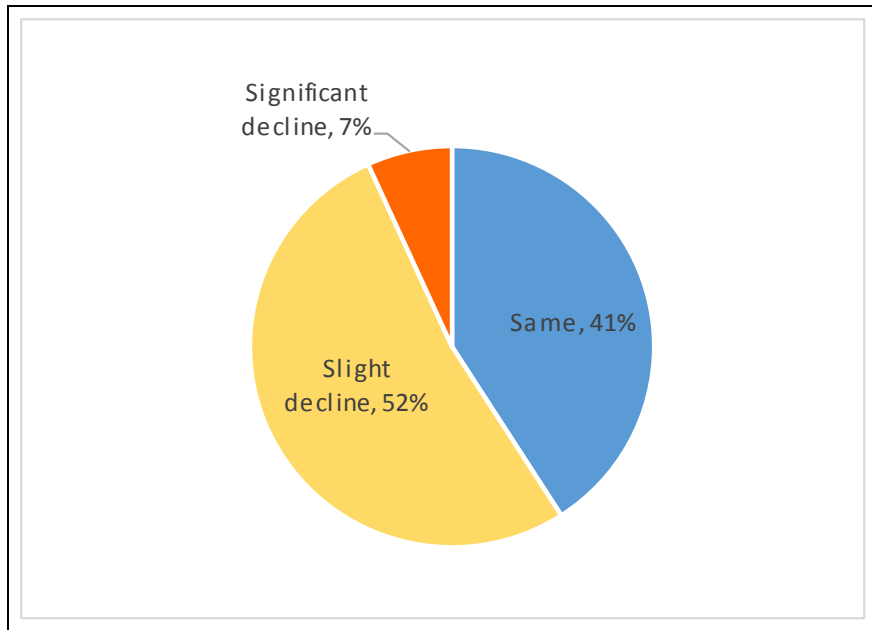


Fig. 8. Summary of change in site condition class from 2015 to 2017. There were 18 sites that had the same condition class in both years; 23 sites declined one condition class which is referred to as a “slight decline”; and three sites dropped two classes which is referred to as a “significant decline” (all three of these went from “pristine” to “significantly degraded” class).

Species of Conservation Concern

We documented the presence of at least one of the five SCC plants at 62% of the 52 sites surveyed. The most commonly observed SCCs were the La Sal daisy at 44% of sites and sweetflower rockjasmine at 40% of sites (Table 2).

Table 2. Species of conservation concern observed at sites in the Mount Peale RNA, listed in descending order of frequency observed.

| Species of Conservation Concern | Sites (n=52) | Percent of Sites |
|--|--------------|------------------|
| La Sal daisy (<i>Erigeron mancus</i>) | 23 | 44% |
| Sweetflower rockjasmine (<i>Androsace chamaejasme</i>) | 21 | 40% |
| Baker's alpineparsley (<i>Oreoxis bakeri</i>) | 19 | 37% |
| Dwarf mountain ragwort (<i>Senecio fremontii</i>) | 9 | 17% |
| Blackheaded fleabane (<i>Erigeron melanocephalus</i>) | 0* | 0% |

*Observed a few times outside monitoring sites

A species of interest that is on the “watch list” of UNPS ([2016](#)), spotted saxifrage (*Saxifraga bronchialis*), was recorded at 12 sites (23%).

For each site, a comparison was made between the number of SCC plants observed in 2015 and our surveys in 2017. SCC plants were observed at more sites in 2017 compared to 2015 (Table 3). This was probably due to greater field time in 2017 (10 days across four months in 2017 vs. two consecutive days in July 2015). In 2015 the field crew primarily used flowers to find SCCs, so plants without flowers were likely occasionally missed (Wild Utah Project, personal communication). The field time across multiple months in 2017 allowed the field team (in particular the author) to see the plants at different stages of development, therefore leaves could be used to find these small, difficult-to-spot plants in the 2017 surveys. There was probably not an increase in SCCs from 2015 to 2017, but rather, the greater effort and experience developed during the 2017 field season allowed more species to be observed.

Table 3. Site-specific comparison of number of species of conservation concern observed in 2015 compared to 2017.

| Difference in Species Observation | Number of Sites |
|--|------------------------|
| Fewer observed in 2017 | 5 |
| Same number observed both years | 20 |
| More observed in 2017 | 19 |
| Total | 44 |

Clear evidence of mountain goats (scat, fur, wallows, or actual goats) was observed in 60% of sites and 15% more had evidence of ground disturbance and trampling that appeared (e.g., by hoof size/shape) to be due to mountain goat activity. No evidence of mountain goats was observed at the 8% of sites that were steep, talus slopes with no vegetation.

Wallows were noted at 13% of sites. A systematic survey of wallows was not done, but wallows were documented in at least 27 places in the Mount Peale RNA during this field work; those mountain goat wallows are described in a separate report ([Coles-Ritchie 2017](#)).

Of the sites with SCC plants, 62% had observable goat impacts. An example is seen in Fig. 9 which shows the La Sal daisy as well as goat fur and goat trampling and grazing.



Fig. 9. La Sal daisy (yellow flowers in center) surrounded by mountain goat trampling and grazing impacts in the Mount Peale RNA (photo by author).

Discussion

The U.S. Forest Service regulations governing research natural areas mandate that they be maintained in a “virgin or unmodified condition” ([CFR 36 § 251.23](#)).

The Utah Division of Wildlife Resources’ 2013 “Utah Mountain Goat Statewide Management Plan” would allow for mountain goat damage in the La Sal Mountains alpine area, including within the Mount Peale RNA:

Given the fragile nature of alpine habitats, mountain goat utilization of the available forage must be closely monitored. Although goat densities are typically low, local areas may exhibit heavier use and cause resource damage. If mountain goat use is demonstrated to be excessive, the Division must work cooperatively with the Forest Service to manage goat populations to acceptable numbers. ([UDWR 2013b, p. 5](#))

The data that we evaluated in this report indicate that mountain goats are having an “excessive” impact on the Mount Peale RNA which was established to protect this unique and uncommon alpine habitat (Smith 2008) in a “virgin or unmodified condition” ([CFR 36 § 251.23](#)). In 2015, two years after the initial goat introduction, a Wild Utah Project ([2015](#)) survey found that 43% of the 35 sites surveyed by the Forest Service in 2008 (including sites within and outside the RNA) had declined in condition. Our data followed a similar pattern: we found that 59% of the 44 sites that had been surveyed in 2015 had declined in condition by 2017. Of the 14 sites that were surveyed at three different times over the past decade, the percentage of sites in pristine condition declined from 87% (in 2008), to 80% (in 2015), to 20% (in 2017). These data were all collected using the same protocol. The protocol was implemented by different field crews, so there is some possibility of observer variability, but the large differences suggest a pattern of declining conditions that has

occurred since mountain goats were introduced in 2013 and 2014. The goat population has increased to at least 70 individuals (Forest Service personal communication) and it is expected to continue to increase, which will increase the disturbance and damage to this unique alpine ecosystem and RNA.

In 2014, just one year after mountain goats were introduced to the La Sal Mountains, Grand Canyon Trust staff and students from Whitman College photographed impacts from mountain goats, including sheared turf, trampling, grazed plants, wallows, soil disturbance, and damage to SCC plants ([Grand Canyon Trust 2014](#)).

As stated by Smith (2008), such disturbances in an alpine ecosystem are not easily reversed: “The subsequent long-term recovery times, limited restoration potential and specialized, endemic species make any impacts significant.”

Disappearing Goat Fur

It was interesting to note the temporary status of mountain goat fur at some locations. Goat fur was often observed associated with physical damage such as wallows. This probably resulted from goats lying down and the fur getting caught on plants. In some cases, when we returned to a spot where we had seen numerous pieces of fur a few weeks before, the fur was no longer present. It seems that the fur had been removed, perhaps by the wind, or maybe animals (possibly birds, pika, or others) who gathered it for a nest or den.

During the past century, mountain goats have been introduced into Colorado, Nevada, Wyoming ([UDWR 2013b](#)), and even to Olympic National Park and Yellowstone National Park. In Olympic National Park, and the adjacent Olympic National Forest, “mountain goats cause soil erosion, impact native plant communities, and occupy habitat for native species” ([USDOI-NPS 2017, Executive Summary p. i](#)). That National Park Service report also expressed concern about mountain goat wallowing that causes soil disturbance which later leads to colonization by disturbance-oriented plant species. There is also concern about human safety because a hiker was killed by a mountain goat in Olympic National Park in 2010, so another reason to remove mountain goats is to avoid more hazardous interactions between goats and people ([USDOI-NPS 2017](#)). The alpine and mountain goat habitat of the La Sal Mountains is a comparatively small area visited by numerous hikers, including families.

In Olympic National Park the mountain goat impacts have prompted a review by the National Park Service which is considering alternatives to address problems associated with non-native mountain goats. The preferred alternative of that draft Environmental Impact Statement is to “use a combination of capture and translocation and lethal removal to reduce or eliminate mountain goats from the park and adjacent Olympic National Forest lands” ([USDOI-NPS 2017](#)).

The Forest Service, like the National Park Service in the case of Olympic National Park, could review the problem of non-native mountain goat impacts in the Mount Peale RNA and consider alternatives to prevent further mountain goat degradation of this important and beautiful place.

The Forest Service does not have a goat management plan for the La Sal Mountains, although they do have a joint USFS-UDWR alpine vegetation monitoring plan for the La Sal Mountains ([USDA-FS 2017b](#)). That plan is intended to address the question: “Is the Forest Service preserving and maintaining natural conditions and processes, and biological and genetic diversity, including

threatened, endangered, and sensitive species in the Mt Peale RNA?” (USDA-FS 2017b, p. 1). That question, however, is vague (e.g., what does “maintaining conditions and processes” mean?) and provides no quantitative thresholds that would trigger action in response. The regulations for Mount Peale RNA are not vague: the RNA is to remain in “virgin or unmodified condition.”

Prior to the mountain goat introduction, a study of the La Sal daisy (*Erigeron mancus*) in the La Sal Mountains reported that the species “seems to be persisting under current levels of anthropogenic activity and the current climate pattern” but the researchers stated it is an “open question” whether this small alpine plant can survive in a warming climate (Fowler and Smith 2010). Concerns about the persistence of the La Sal daisy in light of climate change are magnified now that mountain goats are in the La Sal Mountains alpine area, eating and digging up La Sal daisy plants. The impacts of mountain goats on the La Sal daisy and other SCC plants are documented in photos in Appendices A and B.

This study and previous studies described here as well as in Jones et al. (2015), document multiple indications that mountain goats are having, as would have been expected, a negative and widespread impact on the alpine area of the La Sal Mountains. This is particularly troubling given the unique and relatively small area that this alpine ecosystem represents.

The Forest Service should eliminate further modifications to Mount Peale Research Natural Area by non-native mountain goats.

Acknowledgements

Mary O’Brien, Grand Canyon Trust, oversaw this monitoring and has worked since 2013 to prevent and document detrimental impacts of mountain goats in the La Sal Mountains. In 2017, Lisa Winters and Julia Sullivan, Grand Canyon Trust staff, provided valuable logistical support and field work. Volunteers who enthusiastically helped conduct the 2017 field work were Betty Ann Kolner, Dennis Silva, Gail Solomon, Hope Woodward, Jeff Mattson, Jim Grajek, Jonathan Barth, Lisa Nirio, Pam Hackley, Roy May, and Sandy Hinck. The informative maps were produced by Stephanie Smith of the Grand Canyon Trust. Allison Jones and Mary Pendergast of Wild Utah Project provided valuable site locations, data and other information from their 2015 survey. Most of the photos in this report are by the author, and some are by dedicated Trust volunteer and photographer Jonathan Barth.

Cover photos: top photo is the saddle east of Mount Tukuñkivatz looking toward Mount Peale peak; bottom left photo is alpine wildflowers in the Mount Peale RNA, including sky pilot (*Polemonium viscosum*) with blue flowers and Ross' avens (*Geum rossii*) with yellow flowers; and lower right photo is a mountain goat wallow on the saddle east of Mount Tukuñkivatz looking into Gold Basin.

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Appendix A. Photographs of impacts from mountain goats in the Mount Peale Research Natural Area.



Fig. A1. Mountain goat scat, ground disturbance, and grazed alpine plants.



Fig. A2. Mountain goat-sheared alpine turf and ground disturbance.



Fig. A3. Wallow, where mountain goats have removed plants, dug up soil, and left white fur.



Fig. A4. Mountain goat scat, ground disturbance, and sheared alpine turf.



Fig. A5. Wallow, dug by mountain goats, and goat fur (yellow arrow).



Fig. A6. Uprooted plants and ground disturbance, presumably by mountain goats.

Appendix B. Species of Conservation Concern of the La Sal Mountain alpine area and mountain goat impacts.



Fig. B1. The La Sal daisy (*Erigeron mancus*), endemic to the La Sal Mountains, with its yellow flowers (left photo); and surrounded by mountain goat scat and ground disturbance (right photo).



Fig. B2. Baker's alpineparsley (*Oreoxis bakeri*) in bloom (yellow flowers in left photo) and surrounded by mountain goat scat and ground disturbance (right photo). La Sal daisy is also present in right photo as tan, senesced flowers.



Fig. B3. Sweetflower rockjasmine (*Androsace chamaejasme*) in bloom (left photo) and surrounded by ground disturbance by mountain goats (right photo).



Fig. B4. Dwarf mountain ragwort (*Senecio fremontii*) with yellow flowers (left photo) and surrounded by disturbed soil (right photo).

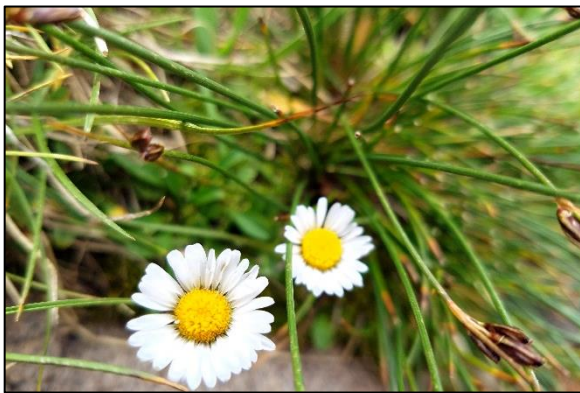


Fig. B5. Blackheaded fleabane (*Erigeron melanocephalus*) in flower, with white ray flowers and yellow disc flowers (left photo) and showing the black hairs on bracts below the white petals (right photo).