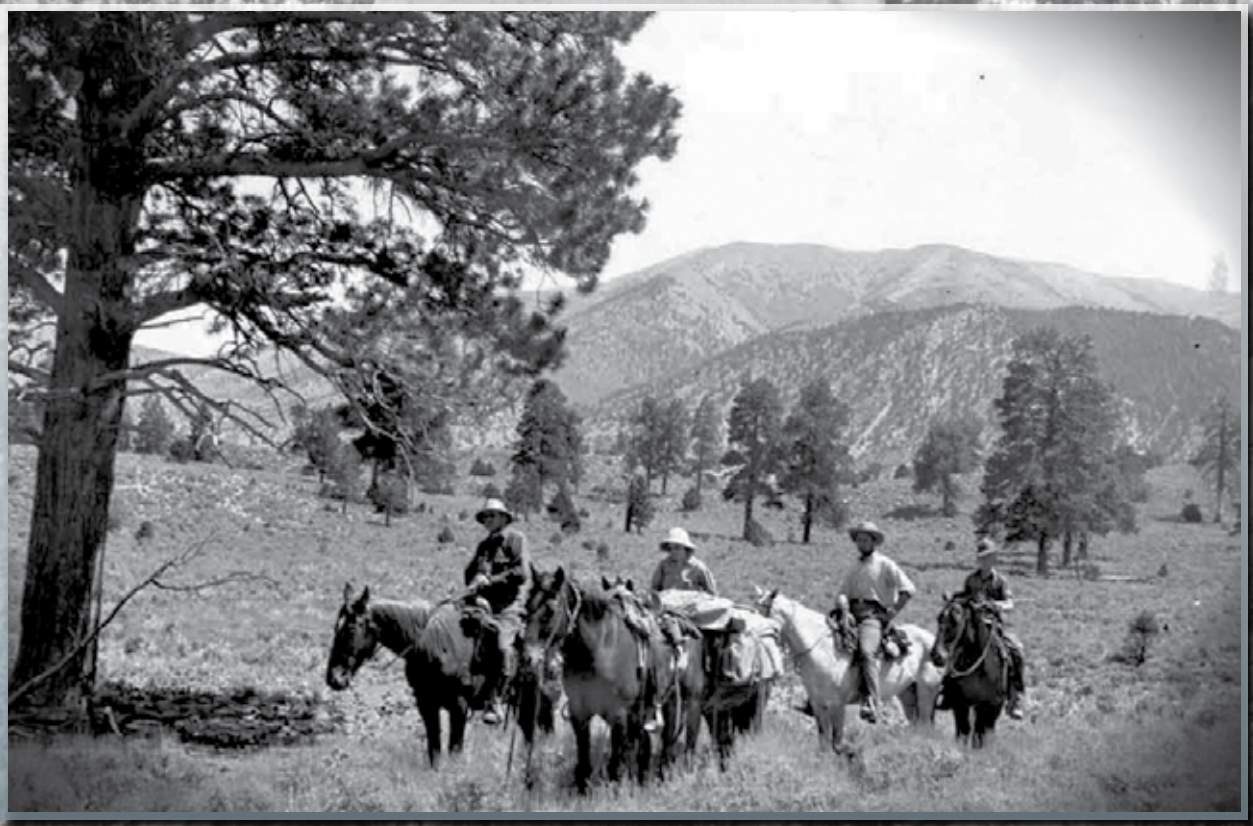
BLM

Long-Term Vegetation Change in Utah's Henry Mountains

A Study in Repeat Photography



Charles E. Kay, Ph.D.

June 2015

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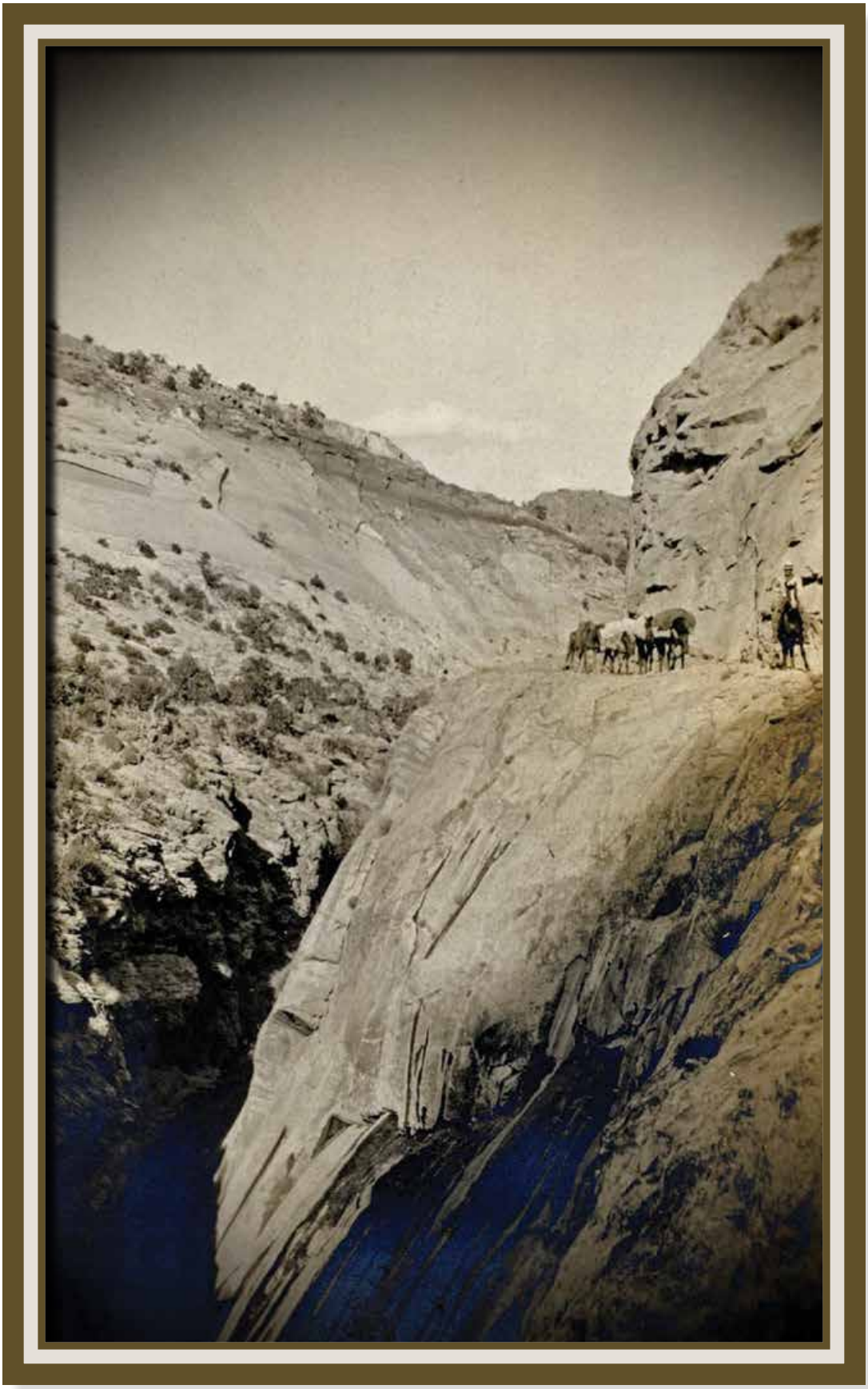

Oak Creek Canyon – 1915

Abstract

An extensive search was conducted of archival and other sources to locate as many historical photographs as possible for the Henry Mountains in south-central Utah. Those images were then taken into the field, the original camera stations relocated, and modern pictures made of the historical scenes to evaluate long-term vegetation change and land management activities. In all, 626 repeat photo sets were compiled—608 by the author and 18 by Earl Hindley. This book includes 126 photo sets that were representative of the areas studied.

As might be expected, most photo sets contained more than one vegetation type. Grasslands were depicted in 152 photo sets, sagebrush in 99, pinyon-juniper in 293, mountain brush in 72, aspen in 37, conifers in 145, blackbrush in 71, and woody riparian species in 142. In addition, all photo sets were evaluated for plant cover and to determine whether the sites showed accelerated soil erosion.

In general, grasslands, sagebrush, and aspen have declined, while blackbrush, mountain brush, pinyon-juniper, and conifers have increased. Utah's rangelands are generally in much better condition today than they were during the early 1900s because plant cover has increased and soil erosion has declined. Repeat photos also show that woody riparian vegetation has significantly increased regardless of whether livestock have been excluded. Contrary to popular perception, coniferous trees and forests are more abundant today than at any time in the past. In fact, the overriding problem on most Utah rangelands has been a major increase in woody plants, which in turn has dramatically reduced forage production for both livestock and wildlife. As conifers, including pinyon and juniper, have increased, so have forest fuels, thereby setting the stage for large-scale, high-intensity crown fires (a type of fire behavior that seldom, if ever, occurred in the past). As judged by stand age and forest conditions seen in early photographs, large stand-clearing fires are outside the normal range of historical variability. Historically, frequent, low-intensity surface fires, most likely set by Native Americans, kept most conifers from increasing.

About the Author

Charles E. Kay received his Ph.D. in wildlife ecology from Utah State University, his M.S. in environmental studies from the University of Montana, and his B.S. in wildlife biology also from the University of Montana. He has conducted ecological research for Parks Canada, the U.S. Forest Service, the Bureau of Land Management, the Agricultural Research Service, and the Utah Division of Wildlife Resources, among others. Dr. Kay specializes in ungulate ecology, range ecology, large mammal predation, and riparian management. In addition, he is one of the foremost experts on aspen ecology and has personally made more than 3,000 repeat photographs throughout the western United States and Canada.

Dr. Kay has co-edited a book on aboriginal influences and the original state of nature, *Wilderness and Political Ecology,* published by the University of Utah Press. His research has appeared in *Human Nature,* the *Journal of Range Management, Conservation Biology, The Canadian Field-Naturalist,* the *Western Journal of Applied Forestry,* the *Wildlife Society Bulletin,* and the *Journal of Forestry,* among other publications. Dr. Kay has

contributed to the books *The Greater Yellowstone Ecosystem; Humans as Components of Ecosystems; Plants and Their Environment;* and *Ecology and Conservation of Wolves in a Changing World.* Dr. Kay's work on *Long-Term Ecosystem States and Processes in Banff National Park and the Central Canadian Rockies* was published as an Occasional Paper by Parks Canada. Utah State University Extension and the U.S. Forest Service published a selection of Dr. Kay's earlier repeat photographs in *Long-Term Vegetation Change on Utah's Fishlake National Forest: A Study in Repeat Photography.*

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I would like to extend my appreciation to Senator Stowell and Commissioner Leonard Blackham, as well as BLM officials Doug Page, Kyle Jackson, Sam Brown, and Sue Fivecoat. I would also like to thank the many archivists who helped locate photographs for this study, as well as the private property owners, who allowed access to their lands so that I could reoccupy several original camera stations. Ranch manager Steve Dalton allowed me to repeat photographs on the Sandy Ranch, while Forrest Sims permitted access to his private lands along the Fremont River and Calvin Bastian gave permission to repeat early images on his Trachyte Ranch. Borge Andersen Photo, now Atelier A.F.A. Foto Digital, in Salt Lake City processed and printed the black-and-white film.

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Introduction

Many people are concerned about Utah's forests and rangelands. Are ecological conditions better today than they were in the past? Or are they worse? One way to address these and similar issues is through repeat photography, where scenes depicted in historical photographs are rephotographed as they appear today, forming sets of images taken or repeated from the same camera stations (Rogers et al. 1984; Hall 2002a, 2002b; Webb et al. 2007, 2010). Repeat photographs are extremely valuable because they provide a long-term perspective that is often missing from other studies and because the photo pairs can readily be interpreted by the public. Want to know what things were like a hundred years ago? Find an old photograph. Want to see how things have changed? Locate the original camera station, and rephotograph the scene as it appears today. After all, if a picture is worth a thousand words, repeat photographs are priceless.

Repeat photography works best for vegetation types that are clearly identifiable by photographic analysis, such as grasslands, sagebrush, pinyon-juniper, aspen, cottonwoods, willows, and conifers (including *Abies* spp., *Picea* spp., *Pinus* spp., and *Pseudotsuga* sp.). Repeat photographs can also be used to estimate rates of soil erosion and plant cover (Rogers et al. 1984; Webb et al. 2010). While the process seems simple, it can often be very time-consuming, because early photographers usually failed to record exactly where their pictures were taken. It may take days to find the camera station for a single photograph.

Study Area

The Henry Mountains study area is bounded by the Fremont River in the north and extends east to the Dirty Devil River, south to Lake Powell, and west to the Waterpocket Fold and Capitol Reef National Park (Figure 1, Henry Mountains Study Area). Even by Utah standards, the Henrys are a very remote and little-known mountain range. The U.S. Geological Survey sent G.K. Gilbert to the Henrys in 1875 and 1876, but it was not until the 1930s that Charles Hunt finally worked out the geology for the entire mountain range (Hunt et al. 1953; Hunt 1977). Newell and Talbot (1998), Murphy (1999), and Hunt et al. (1953) provide an overview of the area's history, while Thompson (1982) and Carr (2009) provide additional information on ghost towns in the Henrys, most of which occur along the Fremont River. Kelsey (2009) provides a modern guide to the roads and hiking trails in the study area, while Hunt et al. (1953) provide a general overview of the area's plant communities and vegetation types.

The overwhelming majority of lands within the study area are managed by the Bureau of Land Management (BLM). There is very little private land in the Henrys, although there are the usual number (i.e., 4 sections per township; sections 2, 16, 32, and 36) of state-owned sections. The Utah Division of Wildlife Resources (DWR) manages the area's mule deer as a premiere, trophy-hunting unit—not only the best in Utah but one of the best in the entire western United States. Landowner rifle permits have sold for as much as $75,000 (Steve Dalton, personal communication). The Henrys are also noted for their free-ranging bison, which originally came from Yellowstone National Park (Nelson 1965; Van Vuren 1983; Van Vuren and Bray 1983, 1986). As with mule deer, all bison hunting in the Henrys

is by limited-entry state permits. Only a handful of elk live in the study area, and it is DWR's policy not to allow any increase in elk numbers. Historically, as many as 100,000 domestic sheep may have grazed the Henrys during the late 1800s and early 1900s. Since the Taylor Grazing Act passed in 1934 and the BLM was established in 1946, however, sheep use has gradually been converted to cattle use. Today, most of the study area is grazed by cattle under BLM-managed grazing permits and regulations.

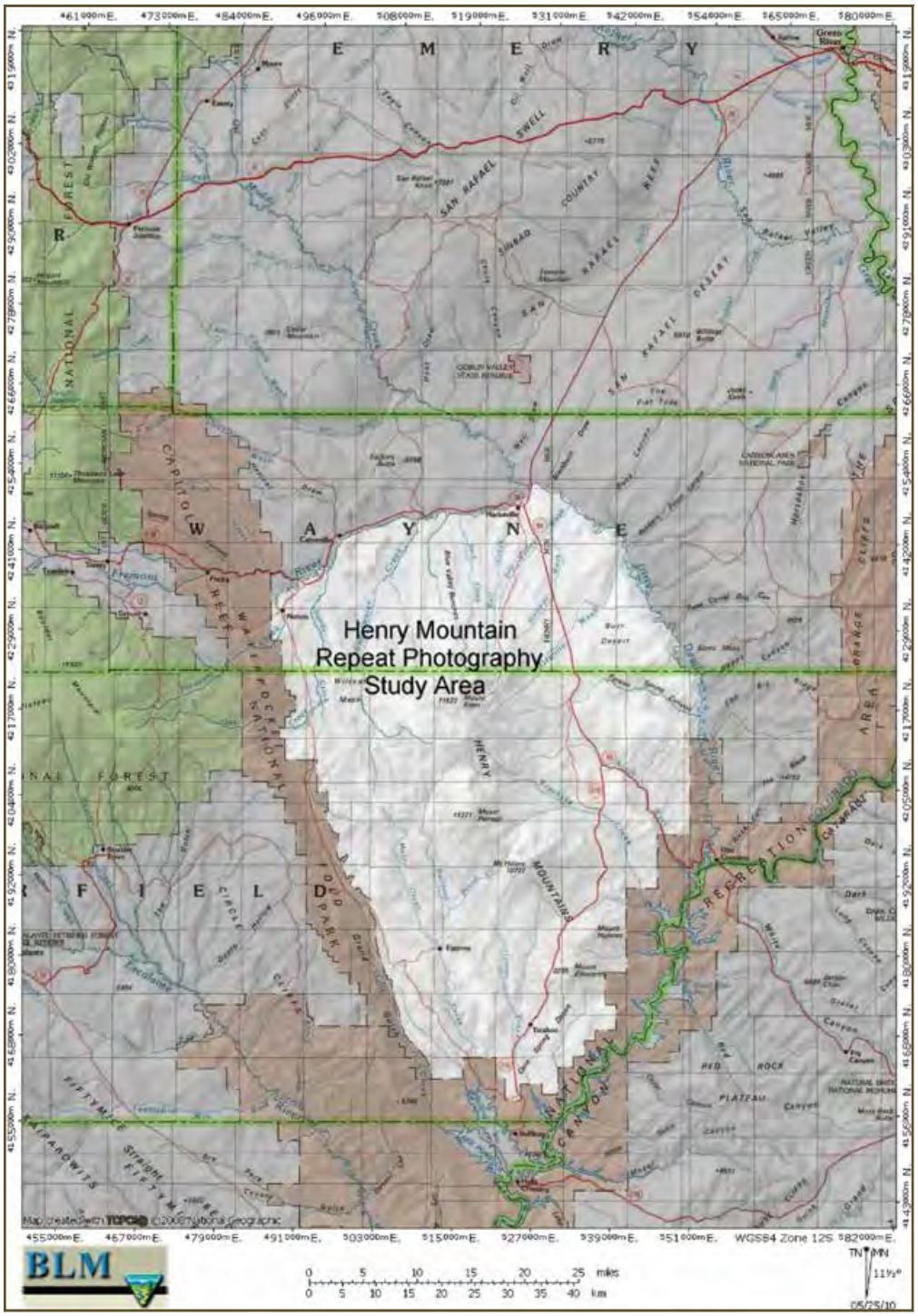


Figure 1. Henry Mountains Study Area. GIS map produced by Doug Page, BLM, Cedar City, UT.

Methods

I first searched various archives for historical photographs taken in the Henry Mountains. My search included: (1) the U.S. Geological Survey's Photographic Library in Denver, CO; (2) the Utah State Historical Society in Salt Lake City, UT; (3) the LDS Church History Department archives in Salt Lake City, UT; (4) Southern Utah University's Special Collections and Archives, Cedar City, UT; (5) Utah State University's Special Collections and Archives, Logan, UT; (6) the University of Utah's Special Collections and Archives, Salt Lake City, UT; (7) the George C. Fraser (2005) collection in the Princeton University Archives, Princeton, NJ; (8) the Rancho Santa Ana Botanic Garden Collection of slides taken by Marcus E. Jones in 1894 (Gray 2011); and (9) the range files held by the BLM at the agency's field office in Hanksville, UT. An effort was also made to locate photographs in private collections. A total of 608 repeat photo sets was taken, and 126 were selected as representative of the areas covered.

Repeat photographs were taken with both color slide film (Fujichrome 100) and black-and-white print film (Kodak Plus-X). I used a Nikon FM2 with a 24-50mm lens and an L-37 filter for the color slides, and a Nikon FM2 with a 24-50mm lens and a Y-48 filter for the black-and-white prints. Nikon 28-80mm and 80-200mm lenses were also used, as needed, to match original focal lengths. Multiple images were made at each site with both color and black-and-white film. Depending on the focal length of the original photograph, wider-angle retakes were also taken. All retakes were generally made at the same time of day as the original photograph. In addition, each photo point was marked on U.S. Geological Survey 1:24,000 scale topographic maps. A hand-held global positioning system (GPS) was used to record camera station elevation and UTM coordinates (NAD 83). During each site visit, a description of the present vegetation was recorded, as were any changes from the original photograph. Upon returning from the field, a systematic evaluation of all photo sets was conducted and detailed descriptions written for each photo pair (Kay 2003; Kay and Reid 2011). The photo sets or plates were consecutively numbered according to the order in which the repeat photographs were completed—i.e., Plate HM-1, or photo set one, was made first and Plate HM-608 last.

Upon my retirement, all project photographs, maps, and notes were donated to the Special Collections and Archives housed at Southern Utah University (SUU) in Cedar City. All photographs, prints, and slides have been clearly identified and have been checked by SUU Archivist Janet Seegmiller. All photographs are protected in clear, archival quality, plastic sheets—plus all prints and documents for each of the photo sets are stored in numbered, Velcro-sealed, individual plastic envelopes, while all slide pages are housed in numbered three-ring binders. Finally, all repeat photo sets and descriptive text will eventually be placed on Utah State University's Extension website by Chad Reid—and will be accessible at *http://extension.usu.edu.rra*—once that work is completed (Kay and Reid 2011).

BLM Range Monitoring Photos

In the 1950s and early 1960s, the BLM established a number of Parker 3-step transects on agency grazing allotments in the Henrys to measure range conditions (Hutchings and Holmgren 1959; Smith 1962; Francis et al. 1972). Each of those plots was marked with a numbered wooden sign attached to a thin steel post visible from the nearest road. There also were written directions on how to reach the actual monitoring plot, or plots, from each signpost.

In addition, each Parker 3-step transect was marked with a short, usually less than 1-foot tall, section of steel rebar. Landscape photos were taken of each transect with a 50mm normal lens mounted on a 35mm camera. As the Parker 3- step method was later shown to be a poor measure of long-term range conditions (Reppert and Francis 1973; Cook et al. 1992), the BLM abandoned those plots. Many of those files were subsequently misplaced; however, some photos still exist in the BLM's range files. Although most of the roadside steel posts have gone missing, I was able to repeat many of the photographs that still exist, or at least those that could be located. Where multiple landscape photos were taken in different directions, I was able to locate all the short, unpainted steel stakes through triangulation. If, however, the landscape photos were taken in only one direction, some of the short steel stakes could not be relocated. In those instances, repeat photographs were made as near as possible to the original location, judging by distant landmarks.

During the late 1960s and early 1970s, the BLM established new range monitoring sites throughout the Henry Mountain Resource Area, including the Henry Mountains. Each of those sites was marked with a steel fencepost, as well as a 1-meter-square plot 100 feet north of said fencepost. The 1-meter-square plots, in turn, were marked with short steel stakes, usually painted yellow. In addition to various plant measurements (not reported here), every 1-meter-square plot was photographed each time the BLM monitored a site. The BLM also made a general landscape photo from above the 1-meter-square plot looking south to the steel fencepost every time a range monitoring site was visited. The BLM's landscape photos were taken with a 28mm wide-angle lens mounted on a 35mm camera. Only the general landscape photos were repeated for the present study. As the BLM visits its range monitoring sites at least once every 5 years, multiple photos exist for each monitoring site, but only the earliest photos are included in this report. The other images are in the BLM's range files at the agency's Hanksville office.

At most of BLM's current range monitoring sites, both the steel fencepost and the shorter steel stakes marking the 1-meter-square plot still exist, while at some, one or more of the steel marking devices are missing—either the steel fencepost or the shorter steel stakes. At a few sites, though, all the steel stakes are missing. In those instances, retake photographs were made by matching distant landscape features.

Earl Hindley's Repeat Photographs

In 2005 the BLM contracted Earl Hindley to repeat some early images in the Henrys (see Figure 2, Earl Hindley's Repeat Photo Sites in the Henry Mountains). Hindley's study was limited primarily to forest ecotones. In all, Hindley repeated 79 photos at 60 different camera stations. Most of the historical photographs that Hindley used in his project were also repeated during the present study. I did not, however, revisit 18 of Hindley's photo sets, as it was deemed more important to repeat other early images not used in Hindley's study. Nevertheless, to be as thorough as possible, I included the Hindley photo pairs that I did not redo in my 2013 report to the BLM, and they are tabulated here as well. A copy of Hindley's entire 2005 report is on file in the BLM's Hanksville office, and in my personal files.

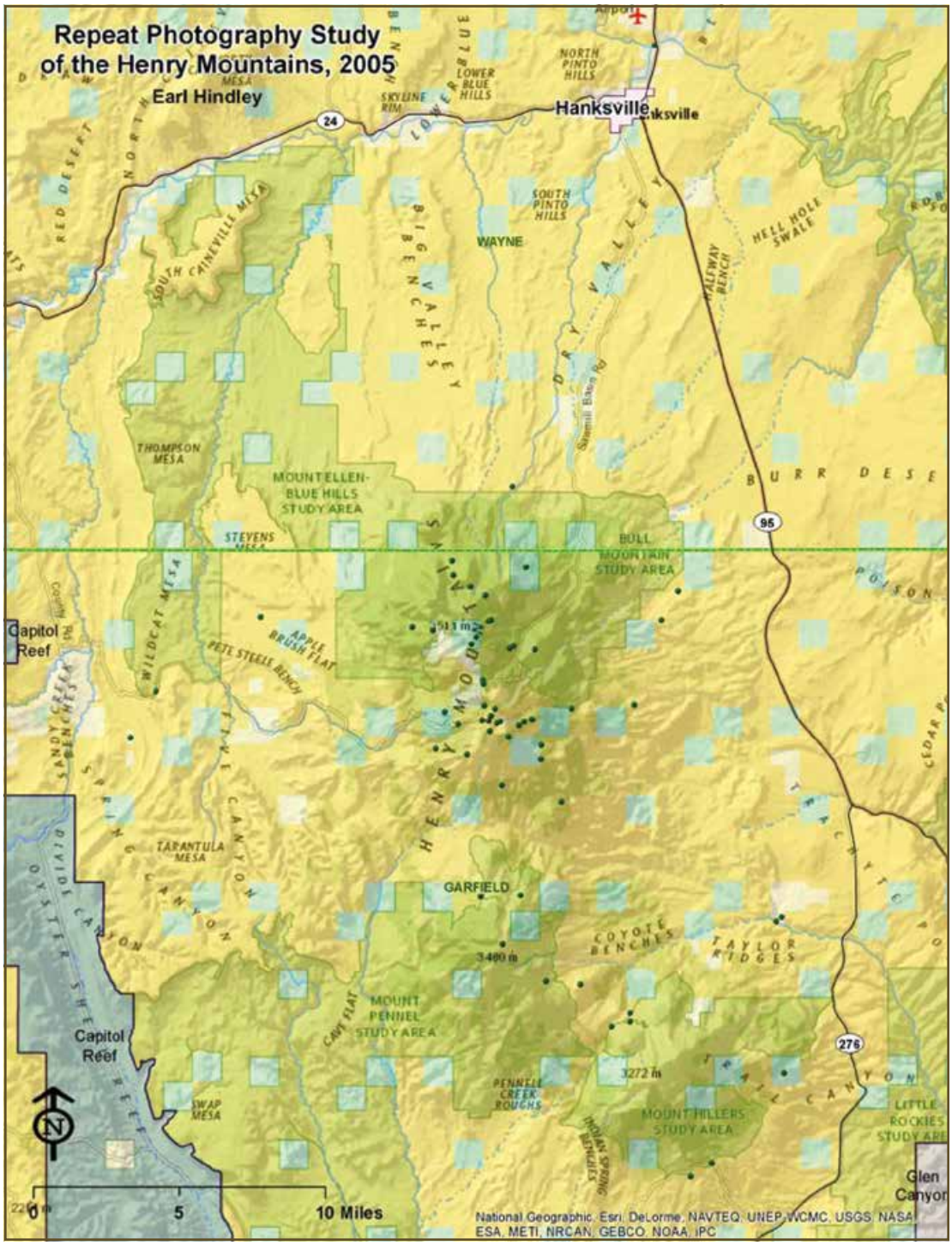


Figure 2. Earl Hindley's Repeat Photo Sites in the Henry Mountains. GIS map produced by Doug Page, BLM, Cedar City, UT.

Photo Analysis

Once all photo sets were completed, each photo pair was visually evaluated to determine if the following vegetation types were present and to assess plant cover, erosion, and evidence of change:

- Grasslands
- Sagebrush (all species included)
- Pinyon-juniper
- Mountain brush (including primarily oak brush, Utah serviceberry, true or birch-leaf mountain mahogany, curl-leaf mountain mahogany, and chokecherry)
- Aspen
- Conifers (including primarily ponderosa pine, limber pine, Douglas-fir, and spruce)
- Woody riparian species (including primarily willows, cottonwoods, tamarisk, water or river birch, and Russian olive)
- Blackbrush
- Plant cover (including primarily grasses, low-growing shrubs, and forbs)
- Soil erosion
- If the vegetation and conditions listed above had increased, remained unchanged, or decreased since the original photograph based on previously established protocols (Kay 2003; Kay and Reid 2011). That is to say, an increase or decrease refers to a change in the abundance (number), area (acreage), and/or size of the species in question. A change in one or more of these factors results in change in the density and dominance of the species in question.

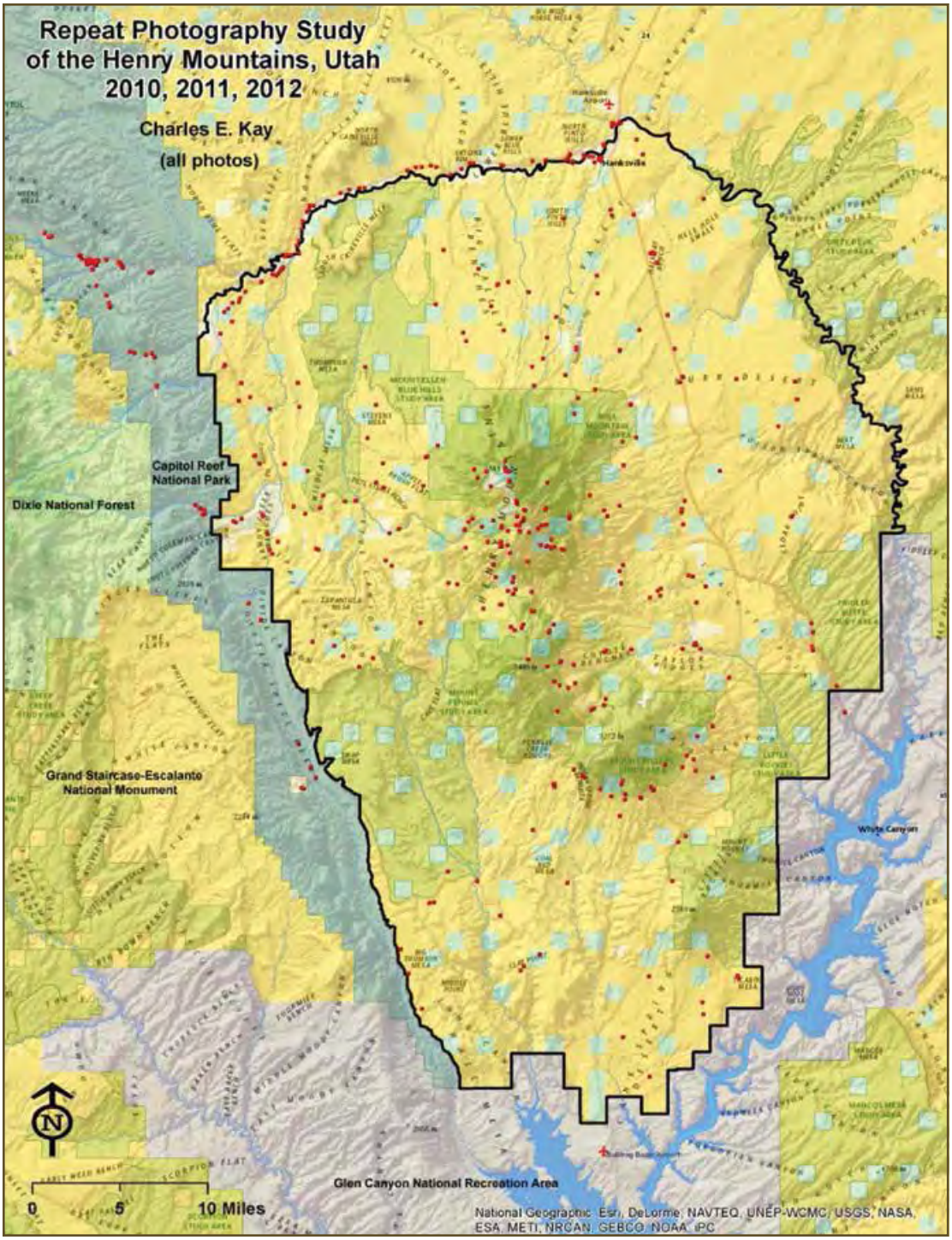


Figure 3. Locations of the 608 Photo Sets Made in the Henry Mountains. Multiple photo sets were made from some camera stations. GIS map produced by Doug Page, BLM, Cedar City UT.

Results and Discussion

To eliminate possible bias, I attempted to locate as many early photographs as possible for Utah's Henry Mountains. To be repeated, however, photographs need to contain features that can be relocated in the field. Closeups of vegetation, or pictures in which there were no clearly identifiable landmarks, proved impossible to relocate, despite help from long-time area residents. In all, 608 photo sets were completed, with 3 dating to the 1872 Powell survey (Fowler 1989) (see Figure 3, Locations of the 608 Photo Sets made in the Henry Mountains). As the photo sets cover a broad array of vegetation types, time periods, elevation zones, and historical photo collections, I believe they are representative of the changes that have occurred throughout the study area. See Table 1, The Decade in Which the Original Photographs Were Taken in the Henry Mountains, and Table 2, Photo Point Elevations in the Henry Mountains (per 1,000 ft.).

While repeat photos can readily be used to document various woody species and changes in major plant community boundaries, they are of limited value in monitoring the species composition of herbaceous and grassland communities. This is especially true in mesic environments, where many similar species grow in close proximity (Webb 1996; Webb et al. 2010). That is to say, repeat photographs are usually incapable of detecting herbaceous plant community composition shifts, as may occur when grassland and forb communities are grazed. For a summary of long-term vegetation changes, see Table 3, Summary of Vegetation Changes in the Henry Mountains. Estimated changes for each individual photo set are found on the Utah State University Extension website previously referenced. This includes the 18 photo sets compiled by Earl Hindley, for a total of 626 (i.e., 608 + 18 = 626).

Table 1. The Decade in Which the Original Photographs Were Taken in the Henry Mountains (n=626)

Decade	Number of Photographs
1870	3
1880	0
1890	12
1900	1
1910	48
1920	33
1930	261
1940	49
1950	62
1960	117
1970	21
1980	19

Table 2. Photo Point Elevations in the Henry Mountains (n=626)

Elevation (ft.)	Number of Photo Points
3,000	2
4,000	167
5000	229
6,000	67
7,000	36
8,000	48
9,000	30
10,000	17
11,000	30

Table 3. Summary of Vegetation Changes in the Henry Mountains

		Number of Photosets Showing Change			Percent of Photosets Showing Change (%)		
VEGETATION TYPE	TOTAL PHOTOSETS	DECREASED	NO CHANGE	INCREASED	DECREASED	NO CHANGE	INCREASED
Aspen	37	18	11	8	49	30	21
Conifers	145	0	1	144	0	1	99
Pinyon-Juniper	293	12	61	220	4	21	75
Woody Riparian-Fremont River							
In Park-No Grazing*	38	0	0	38	0	0	100
BLM and Private-Grazed	59	0	9	50	0	15	85
Woody Riparian-Other BLM	45	2	2	41	4	4	92
Mountain Brush	72	0	5	67	0	7	93
Sagebrush	99	48	9	42	49	9	42
Blackbrush	71	0	18	56	0	24	76
Grasslands	152	64	27	56	42	18	40
Plant Cover	626	11	275	340	2	44	54
Erosion	626	192	431	3	31	69	0.5

* Inside Capitol Reef National Park, where there is no livestock grazing, compared with the BLM and private lands outside the park, which are grazed by cattle.

Grasslands

Grassland communities were depicted in 152 repeat photo sets and in 42% of those photographs, grasslands declined in aerial extent or canopy cover. This decline was due primarily to replacement of grasslands by sagebrush, blackbrush, pinyon-juniper, and conifers. That is to say, woody species expanded into grasslands, and by shading and/or competition, eliminated the herbaceous communities that were depicted in the earlier photos. In only a few cases did grassland communities appear more heavily grazed in the retakes than they did in the originals. Instead, most grasslands appeared more heavily grazed in the past than they did when rephotographed. In 18% of the photo sets, grasslands showed little or no change, while in 56 photo sets (40%), grasslands increased where vegetation treatments had removed competing woody species. This included not only pinyon-juniper chainings, but areas burned by wildfires in 2003 (as described further below).

Sagebrush

Sagebrush, mostly *Artemisia tridentata*, communities occurred in 99 repeat photo sets. In 49% of those cases, sagebrush declined; it appeared unchanged in 9% and increased in 42%. Most of the decrease in sagebrush occurred because pinyon, juniper, and other conifers replaced shrub communities. Sagebrush also declined where it had been burned. Conversely, sagebrush increased by invading grasslands, especially in seeded chainings (Kay and Reid 2011). Sagebrush communities in the Henry Mountains appear to be heavily used by mule deer during winter, as judged by the number of pellet groups that were observed.

Blackbrush

In the Henrys, blackbrush is found at lower elevations than sagebrush. Blackbrush occurred in 71 photo sets, and in none of those images did blackbrush decline. Instead, blackbrush increased in 76% of the photo pairs and remained unchanged in 24%. Domestic sheep will readily graze blackbrush but, in general, cattle will not. Thus, the increase in blackbrush is most likely due to the elimination of sheep grazing. Very few mule deer pellet groups were observed in blackbrush communities. Where blackbrush increased, grass cover declined.

Pinyon-Juniper

Pinyon-juniper was depicted in 293 photo sets, and in 75% of those photo pairs it increased, often dramatically. Pinyon-juniper readily expanded into grasslands, sagebrush, mountain brush, and even conifers. That is to say, pinyon-juniper increased both up-slope and down-slope. Because the Henry Mountains are so dry compared with other mountain ranges in south-central Utah, at some locations there was no down-slope movement of pinyon-juniper. In other instances where pinyon-juniper was growing on harsh sites, such as rocky slopes, it showed little change. In 21% of the photo sets, pinyon-juniper appeared unchanged, and in only 4% of the photo pairs had it declined. Pinyon-juniper declined where it was burned by the 2003 Bulldog and Lonesome Beaver wildfires. Judging by the lack of pinyon-juniper in early images, however, and the prevalence of fire-killed pinyon-juniper in the retakes, pinyon-juniper had increased before the 2003 wildfires. Unlike the fire behavior that was observed in 2003, where large areas of pinyon-juniper woodlands were killed by high-intensity crown fire (Bureau of Land Management 2003), there is no evidence of crown fire behavior in any of the early pinyon-juniper photographs.

Mountain Brush

Mountain brush species occurred in 72 repeat photo sets. In 93% of those instances mountain brush increased, while it remained unchanged in 7%, and did not decline in any photo pair. Mountain brush readily replaced grassland and sagebrush communities. In nearly all cases, mountain brush species increased in height and density, as well as aerial extent. Oak brush temporarily declined where it had been overrun by wildfire in 2003, but those plants all resprouted and many actually increased in aerial extent. Aside from a few blackened stems, in many areas it is hard to imagine that the oak brush burned in 2003, as that species' recovery has been so prolific.

Aspen

Aspen was depicted in 37 repeat photos. In 49% of the photo sets aspen declined; it remained unchanged in 30%, and increased in 21%. Other research has similarly reported a major decline in aspen across the Intermountain West (Houston 1982; Kay 1985, 1990, 1997a, 1997b, 1997c, 1997d; Kay and Wagner 1994; Kay and White 1995; Baker et al. 1997; Bartos and Campbell 1998; White et al. 1998; Kay and Bartos 2000; Rogers and Mittanck 2013; Seager et al. 2013). Where aspen had declined, it usually was replaced by conifers. Compared with other mountain ranges in south-central Utah, though, there is not much aspen in the Henry Mountains. Unlike other areas in Utah where repeated elk browsing has suppressed or eliminated aspen regeneration following fire (Kay 2011), aspen burned by the Bulldog and Lonesome Beaver fires in the Henrys has successfully regenerated and is not heavily browsed. This undoubtedly is due to the fact that there are few elk in the Henrys and that mule deer numbers are also low. In all photo sets, individual aspen stems (ramets) increased in height over time, and otherwise matured, even though the aerial extent of some clones declined.

Conifers

Conifers were depicted in 145 repeat photo sets, and in 99% of those images conifers increased, often markedly. This increase generally occurred at the expense of grasslands, aspen, sagebrush, mountain brush, and even some pinyon-juniper communities. In no photo sets did conifers decline, and in only 1 photo set were conifers unchanged. Large areas of conifers were killed by the Bulldog and Lonesome Beaver wildfires in 2003, but the number of dead trees in the repeat photographs makes it clear that conifers had increased before being burned. This occurred in 46 photo sets. Unlike photos taken after the 2003 fires, none of the earliest photographs show any evidence of large-scale, crown-fire behavior in conifers. Historical photographs clearly show that prior to European settlement there were few old-growth coniferous forests, as that term is commonly used today, except for open, parklike ponderosa pine communities (see Plate HM-124). Fire history studies (Arno and Gruell 1983, 1986; Chapell 1997; Ogle and DuMond 1997; Murray et al. 1998; U.S. Forest Service 1998) and stand-age models (Johnson et al. 1995; Lesica 1996; Andison 1998) support this conclusion. Since the late 1800s, however, conifers have increased not only in height but also in density, numbers, and aerial extent. There are now coniferous forests where none existed in the past. This has led to a decline in biodiversity (Covington et al. 1994, 1997), and a decrease in forage production (Ffolliott and Clary 1982; Kay 2003), as conifers have increased at the expense of aspen, meadows, and even riparian communities.

Upper Treeline

In the Henrys both Mount Pennell and Mount Hillers have conifers all the way to their summits. Only North Summit Ridge, South Summit Ridge, and Mount Ellen Peak have alpine areas about treeline. Nevertheless, upper treeline was depicted in 49 photo sets, and it remained unchanged in all photo pairs. Conifers at treeline increased in height, but they did not generally increase in numbers or invade new areas. Subalpine forests immediately below treeline, however, have both grown up and thickened up since the early 1900s. Similar observations have been reported

throughout western North America (Klasner and Fagre 2002; Korner 2012), where the pattern has usually been attributed to climatic change. A slight drying and warming trend since the mid- to late-1800s is thought to have favored tree growth at higher elevations (Hansen-Bristow, Ives, and Wilson 1988; Rochefort et al. 1994; Taylor 1995; Weisberg and Baker 1995; Woodward et al. 1995; Rochefort and Peterson 1996; Hessl and Baker 1997a, 1997b; Lloyd and Graumlich 1997). As discussed below, however, I believe that this has more to do with fire suppression and the elimination of native burning (Kay 1995, 1998, 2000, 2003, 2007) than with climatic variation.

Woody Riparian Species

The condition and trend of riparian communities has been and is a major issue throughout the Intermountain West, where their decline has generally been attributed to livestock grazing (Platts 1991; Kauffman et al. 1997; Donahue 2007, 2010), especially by those who would like to eliminate all livestock from public lands. Fleischner (2010), for instance, specifically stated that all livestock should be removed from BLM and U.S. Forest Service lands to protect riparian areas. Fleischner (2010) also claimed that woody riparian vegetation along the Fremont River in Capitol Reef National Park recovered only after livestock grazing was eliminated. He implied that areas along the Fremont River outside the park, on BLM and private lands where cattle still occur, are in exceedingly poor condition and will never recover until all livestock are removed.

To test Fleischner's (2010) assertion, I made a special effort to repeat every early photo that I could find of the Fremont River inside Capitol Reef National Park, as well as photos from the park boundary downstream to Hanksville, Utah, which lies at the northeast corner of the Henry Mountain study area. The land along the Fremont River outside the park is a mixture of BLM and private property and is grazed by cattle every year. I was able to repeat 38 photographs dating to 1894 inside the park. In all cases, woody riparian vegetation had increased, often dramatically. In addition, I repeated 59 images along the Fremont outside the park. In 50 of those photo sets woody riparian vegetation had increased, such that there was no difference inside or outside the park.

In 9 photos outside the park, however, there was no change in woody riparian vegetation. All 9 of those images, though, were of the old irrigation dam and former highway bridge just west of Hanksville. Due to the disturbance in that area caused by frequent dam washouts, there was no woody riparian vegetation in any of the 9 original images or in any of the retakes. If those 9 photo sets are not included because of their unique disturbance history, then all the repeat photographs along the Fremont outside the park show the same dramatic increase in woody vegetation, contrary to Fleischner's (2010) claims.

In addition to taking repeat photo sets along the Fremont River, I repeated 45 historical images of other riparian areas in the Henry Mountains. In 41 or 92% of those photo pairs, woody riparian vegetation had increased. Two of those photo sets showed a decline in woody riparian species; both were at Notom, Utah, where irrigated hay fields had been enlarged at the expense of native plant communities. In two other photo sets, one at Muddy Creek and the other at Bull Creek, there was no apparent change in woody riparian vegetation.

Thus, in the Henry Mountains there has been no widespread decline in woody riparian species attributable to livestock grazing. This finding is similar to what I found on Utah's Fishlake National Forest (Kay 2003) and in the Centennial Mountains along the Montana-Idaho border (Kay and Walker 1997; Kay 1999). It is also similar to what has been observed in Utah's San Juan County (Hindley et al. 2000) and to what has been reported along Kanab Creek in southern Utah (Webb et al. 1991). In addition, Klement et al. (2001) noted that woody riparian vegetation had increased on the northern Great Plains despite continued livestock grazing.

More recently, Webb et al. (2007) reported on 3,103 repeat photo sets they had compiled of riparian vegetation in the Southwest, primarily in Arizona and southern Utah. Woody riparian species increased in 80% of their photo pairs, declined in 10%, and remained unchanged in 10% (Webb et al. 2007, 390). Webb et al. (2010) also found no evidence that 90% of riparian vegetation had been lost in the southwestern United States, as commonly claimed by various environmental groups and reported in the popular press (Wuerthuer and Matteson 2002). Webb et al. (2007) noted that "[woody] riparian vegetation…increased significantly in many reaches [of major waterways] irrespective of the presence of grazing animals." Both Donahue (2010) and Fleischner (2010) failed to mention, let alone discuss, the massive repeat photo collection in Webb et al. (2007), or the work of Webb et al. (1991), Hindley et al. (2000), or Kay (2003).

Plant Cover and Soil Erosion

According to early accounts, the Henrys were very heavily grazed during the late 1800s and early 1900s (Hunt et al. 1953; Hunt 1977, 1988; Newell and Talbot 1998; Murphy 1999). "Mount Pennell had been so overgrazed [by domestic sheep] that [we] had trouble finding a place where [we] could pasture our horses.... En route we came on a sheep herd and stopped to visit with the herder. Under the boulder [where we were] sitting, I noticed a blade of grass, the first of the day. I commented on it [and] the herder almost apologetically said, 'Yeh yu see, we've only been over this part once'" (Hunt 1977, 103). "At the time of our fieldwork (1935–1939) the range in the Henry Mountains region had been greatly damaged, not only by erosion, but by deterioration in the type and quantity and forage. In large parts of the desert, the shrubs were closely trimmed and stubby; [while] in the mountains oak brush thickets were leafless as high as sheep could reach [termed highlining].... The overgrazing was caused not only by too many animals but by grazing too early in the spring and by crowding stock near watering places" (Hunt et al. 1953, 35).

Before the Taylor Grazing Act was passed and the BLM was established, grazing in the Henry Mountains was not regulated in any way. There were no restrictions on animal numbers, season of use, or areas grazed. Everyone tried to beat everyone else to the first and last blades of grass. Under this system of scramble competition, there was no incentive to practice range management or conservation. Not only did the BLM establish livestock use permits, but those grazing permits were tied to base property as a way to eliminate the itinerant bands of domestic sheep, once common in the West. As management improved, so did conditions out on the range (Kay 2003).

Plant cover and soil erosion were compared on all 626 repeat photos to determine if Henry Mountain rangelands were being negatively impacted by livestock grazing and other multiple-use activities. In 44% of the photo pairs, there was no apparent change in plant cover; in 54% plant cover had increased, often markedly. In only 2% of the photo sets was plant cover judged to have declined. Similarly, in 69% of the photo pairs, there was no apparent evidence of

accelerated soil erosion; in 31% of the paired images, active soil erosion had declined. In only 3 (0.5%) photo sets was soil erosion judged to have increased. While rangelands throughout Utah were very heavily grazed during the late 1800s and early 1900s (Cottam 1929, 1947, 1976; Bailey et al. 1934, 1937; Cottam and Evans 1945; Copeland 1960), repeat photographs show that is no longer true in the Henry Mountains and that, in general, range conditions have improved. Other repeat photo studies in Utah show that same pattern—i.e., range conditions have improved since the turn of the last century (Rogers 1982; U.S. Forest Service 1993a; Hindley 1996; Hindley et al. 2000; Kay 2003).

Comparison with Other Repeat Photo Studies

Repeat photo studies throughout the Intermountain West have reported long-term vegetation changes similar to those observed in the Henry Mountains. (See Bureau of Land Management 1969, 1971, 1979, 1980, 1984; Progulske 1974; Wyoming State Historical Society 1976; Heady and Zinke 1978; Vankat and Major 1978; Gruell 1980a, 1980b, 1983, 2001; Hastings and Turner 1980; Houston 1982; Pierce 1982; Rogers 1982; Rogers et al. 1984; Sallach 1986; Baker 1987; Johnson 1987; Kay 1990, 1997d, 2003; McGinnies et al. 1991; Reid et al. 1991; Veblen and Lorenz 1991; Webb et al. 1991, 2007; Goin 1992; Webb and Bowers 1993a, 1993b; U.S. Forest Service 1993a, 1993b; Vale and Vale 1994; Skovlin and Thomas 1995; Hart and Laycock 1996; Webb 1996; Athearn 1998; Jackson et al. 1999; Gifford and Terrill 2000; Hersh 2000; Hindley et al. 2000; Idso and Idso 2000; Till 2000; Klement et al. 2001; Fuchs 2002; Grafe and Horsted 2002; Turner et al. 2003; Bradford et al. 2004; Klett et al. 2004, 2005; Clinger et al. 2006; Shea and Key 2006; White and Hart 2007; Kay and Reid 2011; Amundson 2013.) That is, continued grazing has not destroyed major plant communities, and western rangelands are generally in better condition today than they were during the early 1900s. Rangelands across the West, though, are being lost to encroaching conifers and increasing sagebrush due to an absence of fire (Vale 1981; Arno and Gruell 1983, 1986). Historically, low-intensity surface fires repeatedly swept the range, limiting woody vegetation, and promoting biodiversity (Covington et al. 1997; Kay 2000, 2007). The problem now is one of too many trees, not too few trees, as many people believe.

See also Table 4, Comparison of Long-Term Vegetation Change in the Henry Mountains and on the Fishlake and Dixie National Forests. In addition to the 626 repeat photographs in the Henrys, I repeated 355 early images on the Fishlake and 1,524 on the Dixie for a total of 2,505 repeat photo sets. This is the largest repeat photo collection in Utah and the second largest in the West (Webb et al. 2007). Aside from the fact that there is no blackbrush on the Fishlake or Dixie national forests, other vegetation trends are similar, given that the Henrys contain fewer upper elevation areas than either of these national forests.

Table 4. Comparison of Long-Term Vegetation Change in the Henry Mountains and on the Fishlake and Dixie National Forests

		Number of Photosets	Percent of Photosets Showing Change (%)		
			DECREASED	NO CHANGE	INCREASED
ASPEN					
	Henry Mountains	37	49	30	21
	Fishlake NF	223	64	27	9
	Dixie NF	495	82	8	10
	TOTAL	755	75	15	10
CONIFERS					
	Henry Mountains	145	0	1	99
	Fishlake NF	221	0	8	92
	Dixie NF	913	5	3	92
	TOTAL	1,279	4	3	93
PINYON-JUNIPER					
	Henry Mountains	293	4	21	75
	Fishlake NF	98	1	5	94
	Dixie NF	914	1	3	96
	TOTAL	1,305	2	7	91
WOODY RIPARIAN					
	Henry Mountains	142	1	8	91
	Fishlake NF	90	20	52	28
	Dixie NF	307	15	13	72
	TOTAL	539	12	18	70
MOUNTAIN BRUSH					
	Henry Mountains	72	0	7	93
	Fishlake NF	92	2	18	79
	Dixie NF	379	2	1	97
	TOTAL	543	2	5	93
SAGEBRUSH					
	Henry Mountains	99	49	9	42
	Fishlake NF	237	17	54	29
	Dixie NF	689	32	22	46
	TOTAL	1,025	30	28	42
BLACKBRUSH					
	Henry Mountains	74	0	24	76
	Fishlake NF	0	0	0	0
	Dixie NF	0	0	0	0
	TOTAL	74	0	24	76

(continued)

Table 4. Comparison of Long-Term Vegetation Change in the Henry Mountains and on the Fishlake and Dixie National Forests

		Number of Photosets	Percent of Photosets Showing Change (%)		
			DECREASED	NO CHANGE	INCREASED
GRASSLANDS					
	Henry Mountains	152	42	18	40
	Fishlake NF	321	39	58	4
	Dixie NF	709	50	42	8
	TOTAL	1,182	46	43	11
PLANT COVER					
	Henry Mountains	626	2	44	54
	Fishlake NF	355	8	64	27
	Dixie NF	1,524	2	60	38
	TOTAL	2,505	3	57	40
EROSION					
	Henry Mountains	626	31	69	0.5
	Fishlake NF	355	19	81	1
	Dixie NF	1,524	31	67	2
	TOTAL	2,505	29	70	1

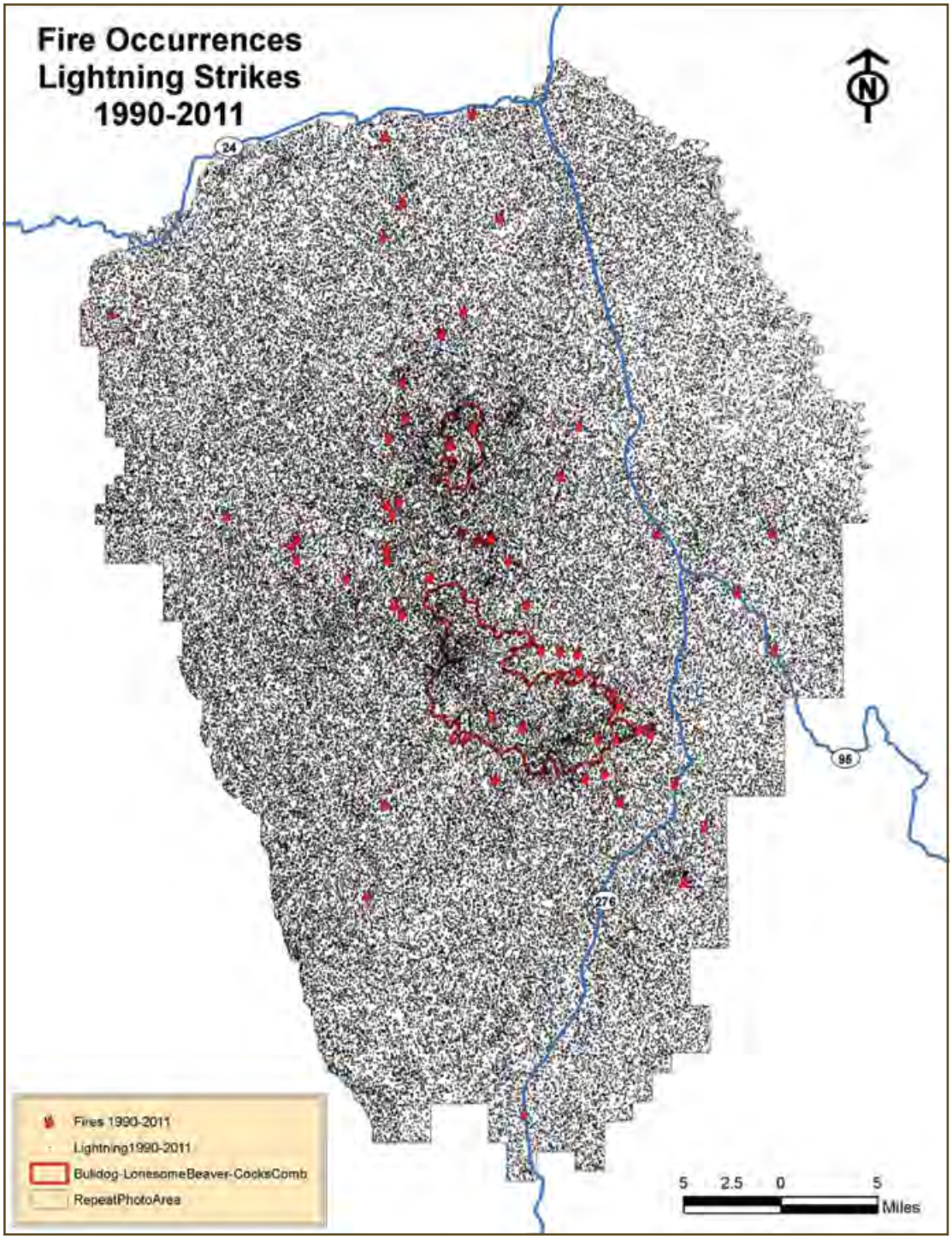


Figure 4. Lightning Strikes and Fire Occurrence in the Henry Mountains, 1990–2011. GIS map produced by Doug Page, BLM, Cedar City, UT.

Fire Ecology

Heyerdahl et al. (2006, 2011) collected fire history data in Utah and Nevada, including the Henry Mountains. They sampled 30 plots over an area of 2,280 acres near Willow, Dugout, and North Fork creeks on the west side of Mount Ellen in the Henrys (Heyerdahl et al. 2006, 33–45; Heyerdahl et al. 2011, 19–27). The data they collected showed that low-intensity surface fires were common in the Henrys until about 1870, after which there were no fires. Although Heyerdahl et al. (2006, 2011) cored, or aged, only trees greater than 8 inches DBH, conifers increased markedly after 1870 (see Plate HM-124, which is in their study area). That is to say, once burning ceased, woody vegetation and forest fuels increased. Heyerdahl et al. (2006, 2011) also reported that fires before1870 were small and that there was no evidence of large-scale crown fires, as was observed in the Henry Mountains during 2003.

While lightning strikes are common in the Henrys, lightning-caused fires are very rare, averaging only 1.5 fires per year (see Figure 4, Lightning Strikes and Fire Occurrence in the Henry Mountains, 1990–2011). This most likely is due to the fact that summer thunderstorms, which generate lightning, also bring rain, making lightning ignition and spread less likely. Besides, the absence of fires since 1870 cannot be attributed to a lack of lightning strikes during the last 144 years. Elsewhere, I have calculated known lightning-fire ignition rates for every national forest in the contiguous 48 states and then compared those data with data about potential fires started by Native Americans (Kay 2007). I documented that potential fires started by aboriginal peoples were 270 to 30,000 times more frequent than known lightning-ignition rates. The first Europeans to enter the Henrys reported an extensive network of Indian trails (Hunt 1988, 4), while Martineau (1992, 155) noted that a band of Southern Paiutes permanently occupied the Henrys at historical contact. With the low rate of lightning-caused fires in the Henrys, it should then come as no surprise that, historically, the vast majority of natural fires were set by native people to manage their environment. Once the original inhabitants were displaced by white settlers around 1870, landscape burning ceased.

Determining how fires started is critical because "fires set by hunter-gatherers differ from [lightning] fires in terms of seasonality, frequency, intensity, and ignition patterns" (Lewis 1985, 75). Most aboriginal fires were set during spring, between snowmelt and vegetation greenup, or late in the fall when burning conditions were not severe. Unlike lightning fires, which tend to be infrequent, high-intensity infernos, native burning produced a higher frequency of low-intensity fires. So, aboriginal burning and lightning fires create different vegetation mosaics and in many instances, entirely different plant communities (Lewis 1973, 1977; Lewis and Ferguson 1988; Turner 1991; Anderson 1993, Blackburn and Anderson 1993). Moreover, aboriginal burning reduces or eliminates the number of high-intensity, lightning-caused fires (Pyne 1982, 1991, 1993, 1994, 1995a, 1995b; Reid 1987, 34; Gottesfeld 1994; Boyd 1999). Once aboriginal fires opened up the vegetation, then subsequent lightning fires behaved like those set by Native Americans.

Lost Forage Production

There is also a correlation between sagebrush, pinyon-juniper, and conifer encroachment and herbaceous forage production (Ffolliott and Clary 1982; Riggs et al. 1996). As woody species increase, the production of forbs, grasses, and palatable shrubs declines in a nonlinear, negative relationship. That is to say, a small increase in

sagebrush, pinyon-juniper, or conifers can cause a significant decrease in forage production (Cook and Lewis 1963; Frischknecht 1963; Hedrick et al. 1966; Sneva 1972; Rittenhouse and Sneva 1976; Sturges 1983; Tanaka 1986; Uresk and Severson 1989, 1998; Moore and Deiter 1992; Bates et al. 2000; Kay 2003; Kay and Reid 2011). Thus, as sagebrush, pinyon-juniper, and conifers have encroached on grasslands, aspen stands, and meadows in the Henry Mountains, the amount of available forage has declined. If this trend is allowed to continue, there will be less and less forage for domestic livestock and wildlife—circumstances that can lead to overgrazing, as animals are forced to concentrate on smaller and smaller areas.

Conclusions

Based on 626 repeat photo sets, the following long-term vegetation changes were observed in the Henry Mountains:

- Grasslands and aspen communities have generally declined.
- Conifers, both montane and subalpine, have increased, invading and replacing grasslands and aspen.
- Mountain brush and pinyon-juniper have increased.
- Woody riparian species have increased, except where dams or other developments have altered riparian vegetation.
- Fires were once common in the Henrys, and most were likely started by native people as a way to manage their environment.
- In earlier times, fires were frequent, but most were low-intensity surface fires, not stand-replacing crown fires.
- Modern fire suppression and the elimination of aboriginal burning are primarily responsible for the long-term vegetation changes seen in the Henrys.
- Dense coniferous forests were historically very rare and are more common today. The problem is one of too many trees, not too few. On most sites, forest fuels have increased markedly.
- As conifers and pinyon-juniper have increased, forage production has fallen precipitously. This fall has decreased the carrying capacity of the range for both domestic livestock and wildlife.
- Unless fire is restored to its historical role, forage production will continue to decline, and grazing opportunities for both livestock and wild ungulates will steadily be eliminated. Where appropriate, mechanical treatments can have effects similar to fire, but without the associated risk. In addition, mechanical treatments may be necessary to reduce fuel loads before fire can be reintroduced.
- At present, there is little sign of widespread overgrazing in the Henry Mountains, and range conditions are generally better today than they were during the early 1900s.
- Soil erosion occurred on some sites in the past, but improved management has largely corrected that problem.

Plates

The plates that follow were selected because they are representative of the long-term vegetation changes observed in Utah's Henry Mountains (see Figure 5, Locations of the Plates Published in This Report). As the photo sets were initially made, they were assigned a number in the order they were completed in the field (i.e., Plate 1 was completed first and Plate 608 last). To make this report and Utah State University's Extension website compatible, the original numbers have been retained on the plates selected for this publication. That is, the plates were not renumbered for this report but follow the numbers found on the website. Thus, while the plates herein are presented sequentially, there are often gaps in the numbering sequence. If readers are interested in the other plates, those images may be found on the Extension website (*http://extension.usu.edu/rra*) or in the annual reports that were submitted to the BLM.

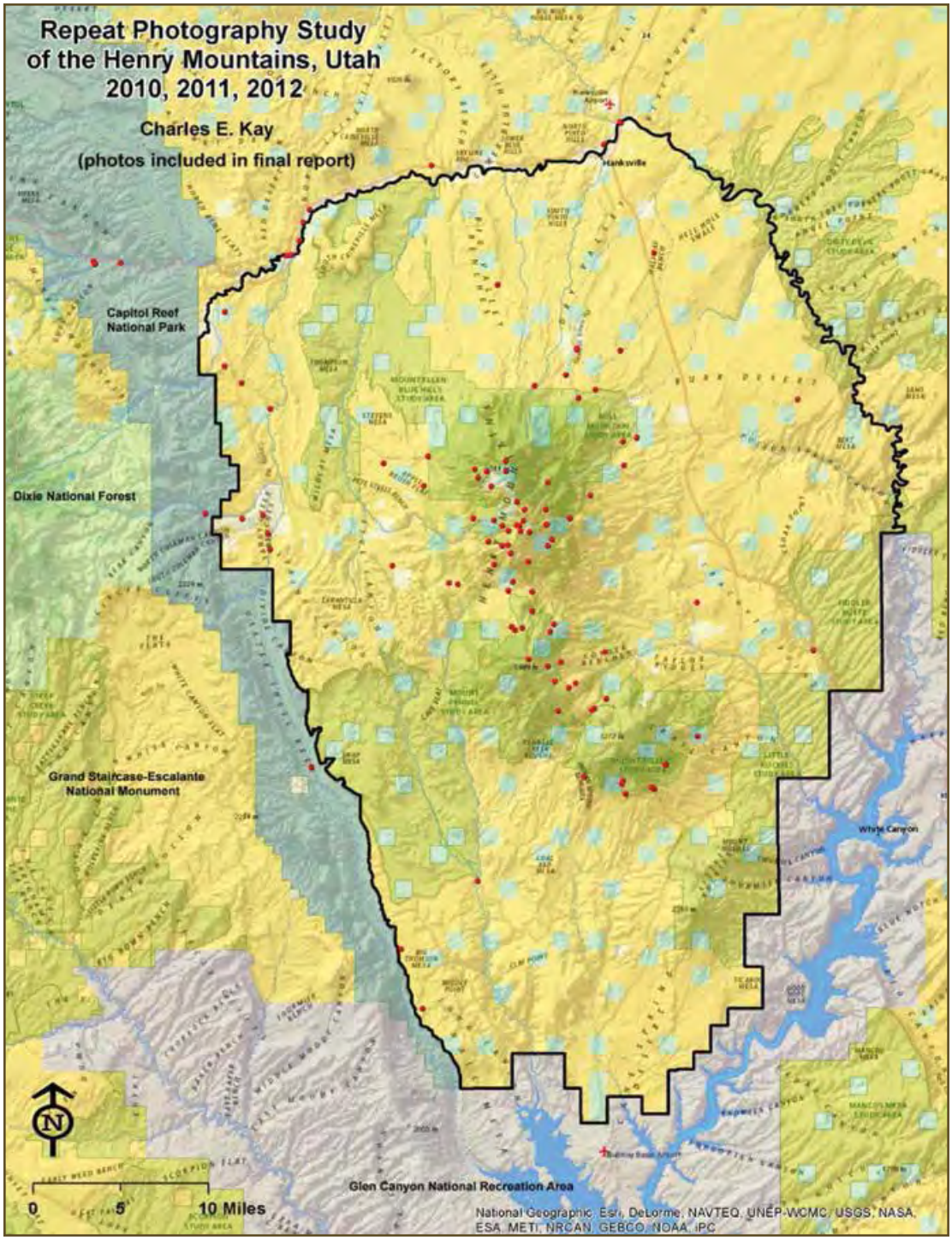


Figure 5. Locations of the Plates Published in This Report. Multiple photo sets were made from some camera stations. GIS map produced by Doug Page, BLM, Cedar City, UT.

Plate HM-1

Fremont River – Capitol Reef National Park

1950 † 2009

Viewed northwest up the Fremont River in Capitol Reef National Park. The original photograph was taken before Utah Highway 24 was built along the river. Because woody riparian vegetation is abundant today, unlike in the past, the retake had to be made from the nearest open area to show the distant sandstone formations.

The highway is at the base of the cliffs on the left but is hidden from view by woody riparian vegetation—primarily cottonwood and willows. The river channel, which is now at the base of the cliffs on the right, has narrowed and deepened. Beaver have felled some of the cottonwoods, and the National Park Service has removed nonnative tamarisk and Russian olive.

Original photograph taken by Charles Kelly ca. 1950; retake made by Charles E. Kay on June 27, 2009 (Photo No. 5941-17). Section 13, Range 6 East, Township 29 South; UTM 480746E, 4237574N; elevation 5,338 ft. Original image (P0100, Number 1-33-18) held by the University of Utah, Marriott Library Special Collections, Salt Lake City, UT.

HM-1, 1950

HM-1, 2009

Plate HM-32

Fremont River

1937 † 2010

Viewed to the northeast down the Fremont River approximately 3 ½ miles southwest of Caineville, the valley bottom at this location is a mixture of private lands and BLM lands. A dense growth of cottonwoods now blocks the original camera station, so the retake was made from the southwest corner of the bridge on Utah Highway 24.

In 1937 the Fremont River was wide and shallow, and the banks generally lacked woody riparian vegetation. Today, the stream has stabilized, while the channel has narrowed and deepened. Cottonwoods and willows are abundant, despite yearly cattle grazing.

Original photograph taken by an unknown photographer on April 19, 1937; retake made by Charles E. Kay on June 10, 2010 (Photo No. 6025-4A). Section 15, Range 8 East, Township 29 South; UTM 495980E, 4238279N; elevation 4,678 ft. Original image (C-231, Box 10, Number 254) held by the Utah State Historical Society, Salt Lake City, UT.

HM-32, 1937

HM-32, 2010

Plate HM-40

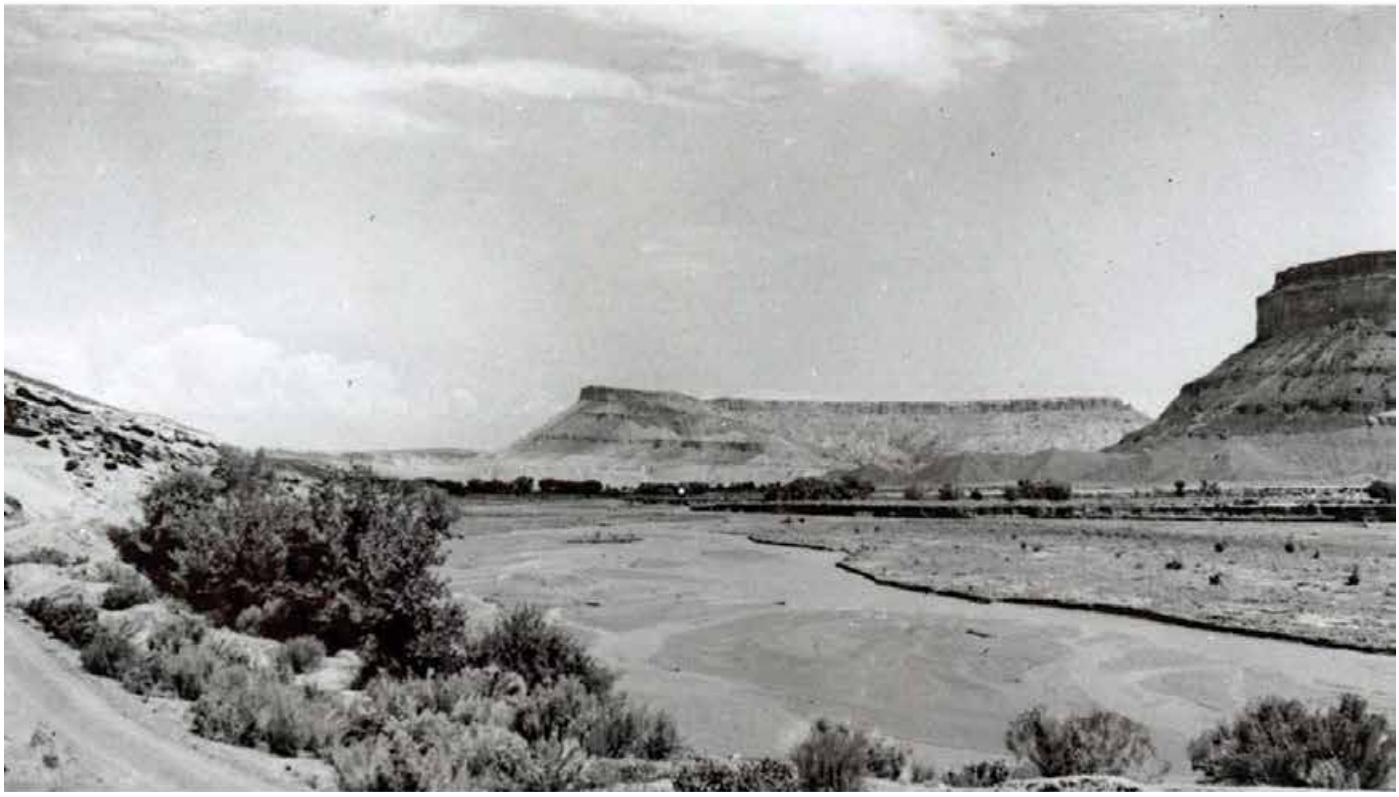
Fremont River

1939 † 2010

Viewed northeast down the Fremont River about 2 ½ miles southwest of Caineville on the old gravel road. South Caineville Mesa is on the right. North Caineville Mesa is in the distance.

In 1939 the Fremont River was wide and shallow, and the banks generally lacked woody riparian vegetation. Today, the river has narrowed and deepened, and woody riparian vegetation—primarily cottonwoods and willows—is abundant. The valley bottom at this location is private property and is grazed yearly by cattle. Contrary to Fleischner's 2010 report, there is no evidence that livestock grazing is destroying riparian areas along the Fremont River below the national park boundary.

Original photograph taken by Arther Leroy Inglesby in 1939; retake made by Charles E. Kay on June 10, 2010 (Photo No. 6029-2). Section 10, Range 8 East, Township 29 South; UTM 497265E, 4239619N; elevation 4,679 ft. Original image (C-345, Box 2, Folder 8, Number 16) held by the Utah State Historical Society, Salt Lake City, UT.



HM-40, 1939

HM-40, 2010

Plate HM-44

Factory Butte

1935 † 2010

Viewed north-northwest to Factory Butte, west of Hanksville. The camera station is just north of Utah Highway 24 and just east of the Factory Butte road.

Shrubs and grasses appear to have increased. The main species include fourwing saltbush, Indian ricegrass, Mormon tea, curly grass (a local term for galleta), and desert trumpet. The foreground in the retake has been disturbed by construction-related activities.

Original photograph taken by Charles B. Hunt (Number 412) in 1935; retake made by Charles E. Kay on June 11, 2010 (Photo No. 6029-27). Section 24, Range 9 East, Township 28 South; UTM 509425E, 4246581N; elevation 4,637 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-44, 1935

HM-44, 2010

Plate HM-51

Fremont River

1921 † 2010

Viewed northeast down the Fremont River, immediately north of Hanksville. The photo point is on the old gravel road north of town. The original camera station was washed away before the channel stabilized, hence the slightly different view in the retake. Note the old bridge abutment (left-center in both photos). The bridge was destroyed by floodwaters sometime before 1921.

Clearly, the river has stabilized and excessive erosion has ceased. Today the banks are heavily vegetated, unlike conditions in the past. Cottonwoods and willows are common, as are tamarisk and Russian olive. Contrary to Fleischner's 2010 report, continued livestock grazing is not destroying riparian areas along the Fremont River on BLM lands or private lands; instead, ecological conditions have improved.

Original photograph taken by an unknown photographer on September 1, 1921; retake made by Charles E. Kay on June 11, 2010 (Photo No. 6032-27). Section 10, Range 11 East, Township 28 South; UTM 525320E, 4248528N; elevation 4,290 ft. Original image (C-231, Box 10, Number 231) held by the Utah State Historical Society, Salt Lake City, UT.

HM-51, 1921

HM-51, 2010

Plate HM-56

Dirty Devil and Fremont Rivers

1939 † 2010

Viewed southwest up the Dirty Devil River and Fremont River to the Henry Mountains in the distance. Muddy Creek enters the Fremont on the right, 200 yards upstream, to form the Dirty Devil River seen in the foreground. The camera station is northwest of the present-day Utah Highway 24 bridge and just to the west of the old wooden bridge pilings.

In 1939 both rivers were wide, shallow, and nonvegetated, except for a few mature cottonwoods. As upstream erosion has been controlled, the rivers have stabilized and narrowed, allowing woody riparian vegetation to become established, despite continued livestock grazing. This plate provides another example of the error of Fleischner's 2010 report that claimed livestock were denuding the Fremont River drainage. Note that what was riverbed in 1939 is now an irrigated field. Willows and cottonwoods are common, as are tamarisk and Russian olive.

Original photograph taken by Charles B. Hunt (Number 840) in 1939; retake made by Charles E. Kay on June 12, 2010 (Photo No. 6034-13A). Section 2, Range 11 East, Township 28 South; UTM 526792E, 4250631N; elevation 4,311 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-56, 1939

HM-56, 2010

Plates HM-74, HM-75, and HM-76

Mount Hillers and Big Ridge

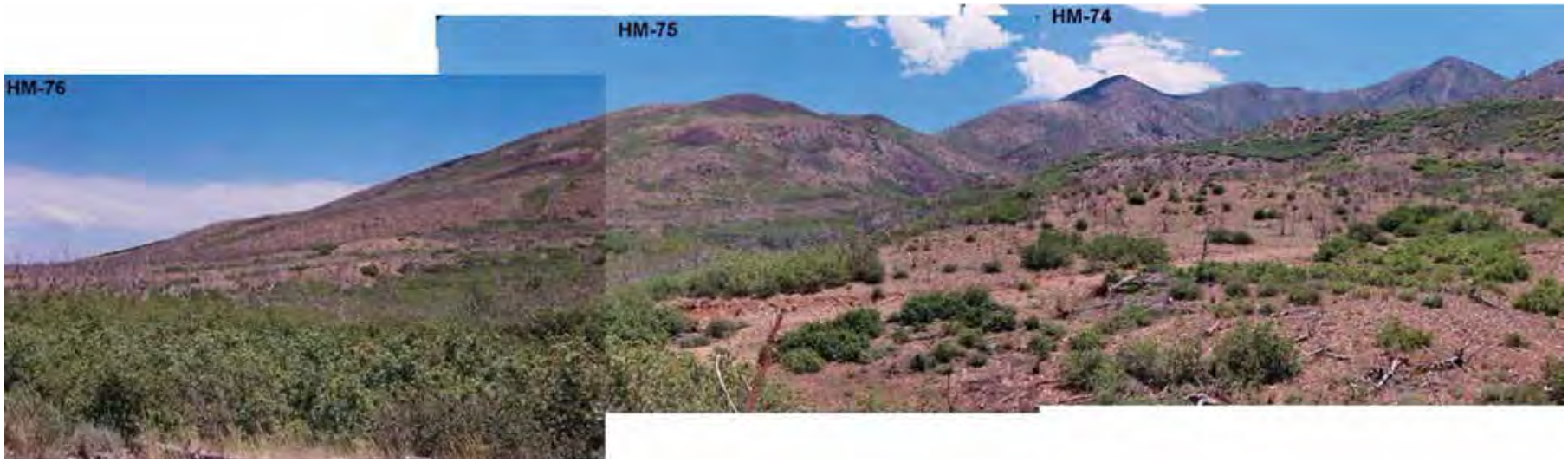
1937 † 2010

Viewed south to Mount Hillers (right distant skyline) and Big Ridge. Plates HM-74, HM-75, and HM-76 form a panorama and were taken from a camera station just north of the Stanton Pass road and southwest of Quaking Aspen Spring.

The vegetation in 1937 was primarily Douglas-fir, oak brush, and sagebrush, with a scattering of pinyon-juniper. In 2003 the area was swept by high-intensity crown fire, a type of fire behavior not seen in any early photograph taken in the Henry Mountains. Based on the number of dead trees in the retake, Douglas-fir, pinyon-juniper, and oak brush increased before the 2003 Bulldog Fire. In part, that increase in forest fuels drove the extreme fire behavior seen in 2003, where nearly 32,000 acres burned in a matter of days (Bureau of Land Management 2003). Look carefully at the 1937 photos. There is no evidence of large-scale, crown fire behavior or even any dead trees or snags. Oak brush resprouted after the 2003 fire.

Original photographs taken by Charles B. Hunt (Numbers 653, 654, 655) in August 1937; retakes made by Charles E. Kay on July 7, 2010 (Photo Nos. 6042-2, 6042-4, and 6042-9). Section 21, Range 11 East, Township 33 South; UTM 525524E, 4197320N; elevation 7,065 ft. Original images held by the U.S. Geological Survey Photographic Library, Denver, CO. Photo mosaic compiled by Doug Page, BLM, Cedar City, UT.

HM-74-75-76, 1937



HM-74-75-76, 2010

Plate HM-77

Cass Creek Peak

1937 † 2010

Viewed southeast to Cass Creek Peak from just east of Stanton Pass.

In 1937 the vegetation was primarily oak brush and sagebrush, with a scattering of pinyon-juniper on the lower slopes and more widely spaced Douglas-fir at higher elevations. In 2003 the area was swept by a high-intensity crown fire known as the Bulldog Fire. Based on the number of dead trees in the retake, Douglas-fir, pinyon-juniper, and oak brush increased before that fire. In part, that increase in forest fuels (along with dry conditions and high winds) drove the extreme fire behavior in 2003, where nearly 32,000 acres burned in a matter of days (Bureau of Land Management 2003). Look carefully at the 1937 photo, there is no evidence of large-scale, crown-fire behavior or even any dead trees or snags. Oak brush resprouted after the 2003 fire.

Original photograph taken by Charles B. Hunt (Number 656) in August 1937; retake made by Charles E. Kay on July 7, 2010 (Photo No. 6042-16). Section 20, Range 11 East, Township 33 South; UTM 524453E, 4196429N; elevation 7,410 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-77, 1937

HM-77, 2010

Plate HM-80

Bulldog Ridge

1937 † 2010

Viewed southwest to Bulldog Ridge on the southeast flank of Mount Pennell. The camera station for this photo point is the same as that for Plates HM-78 and HM-79.

In 1937 the vegetation was primarily sagebrush, oak brush, and Douglas-fir. There were also several patches of aspen. In fact, one of the aspen stands near the top of the distant ridge (upper-right-center) appears to have regenerated after a small burn. Both the Douglas-fir forest and oak brush appear to have been subjected to repeated, low-intensity fires. Much of the area was swept by the 2003 Bulldog Fire that blackened nearly 32,000 acres in a matter of days (Bureau of Land Management 2003). Nonetheless, it is clear from the standing dead material that oak brush and Douglas-fir had increased before the 2003 wildfire, while aspen had declined. Aspen has since resprouted vigorously, but this is difficult to see in the retake. As would be expected, oak brush also resprouted after the 2003 fire.

Original photograph taken by Charles B. Hunt (Number 610) in July 1937; retake made by Charles E. Kay on July 7, 2010 (Photo No. 6042-27). Section 13, Range 10 East, Township 33 South; UTM 520794E, 4198944N; elevation 8,351 ft. Original photograph held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-80, 1937

HM-80, 2010

Plate HM-81

Mount Pennell

1937 † 2010

Viewed northwest from Browns Knoll to Mount Pennell.

In 1937 there were no pinyon or juniper in the area shown in the foreground. Utah serviceberry and birchleaf mountain mahogany appear to have been very heavily grazed, most likely by domestic sheep. Grasses, too, were absent near the camera station. In the distance, oak brush was common on the lower slopes of Mount Pennell, as were open areas and sagebrush. Douglas-fir was restricted to the highest slopes on Mount Pennell. There was a stringer of aspen down Straight Creek. Except for the uppermost rocky pinnacles, everything in the photo was swept by high-intensity crown fire in 2003.

Based on what can be seen in the retake, as well as the standing dead material, Douglas-fir, oak brush, and pinyon-juniper all increased before the wildfire. In fact, the increase in forest fuels, in part, drove the 2003 fire. Domestic sheep are no longer present in the Henrys, and the shrubs in the foreground today appear largely ungrazed. Grasses have increased, as several species were reseeded after the fire. Although the stringer of aspen along Straight Creek appears in the retake as a line of dead trees, these aspen regenerated profusely after the wildfire (this may be hard to pick out in the photo, but it is easy to see when onsite where the road crosses the creek and from the road up Straight Creek). As would be expected, oak brush resprouted after the 2003 fire. A road now traverses the eastern slopes of Mount Pennell.

Original photograph taken by Charles B. Hunt (Number 607) in July 1937; retake made by Charles E. Kay on July 8, 2010 (Photo No. 6045-2). Section 18, Range 11 East, Township 33 South; UTM 522684E, 4198774N; elevation 8,163 ft. Original photograph held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-81, 1937

HM-81, 2010

Plate HM-84

Mount Pennell

1985 † 2010

Viewed west up Corral Canyon to Mount Pennell.

The vegetation in the foreground area of the original image is primarily oak brush, Utah serviceberry, and sagebrush, with a scattering of invading pinyon, juniper, and Douglas-fir, while Douglas-fir and spruce grew at higher elevations. The 2003 Bulldog Fire swept most of the area. Both oak brush and Utah serviceberry resprouted thereafter.

Original photograph taken with a normal lens by Charles E. Kay on May 23, 1985 (print from a color slide); retake made by Charles E. Kay on July 8, 2010 (Photo No. 6045-16). Section 12, Range 10 East, Township 33 South; UTM 521356E, 4200705N; elevation 7,910 ft. Original photograph held by Charles E. Kay in his private collection.

HM-84, 1985

HM-84, 2010

Plate HM-87

Mount Pennell

1985 † 2010

Viewed south to Mount Pennell from just above the road to Willow Spring.

In 1985 the vegetation on the northern slopes of Mount Pennell was primarily Douglas-fir, spruce, aspen, and oak brush, with areas of sagebrush and grass. In addition, pinyon, juniper, and Douglas-fir were invading the open areas. The 2003 Bulldog Fire swept most of Mount Pennell, significantly reducing all coniferous species except those in the area shown in the foreground, which was not burned.

Original photograph taken by Charles E. Kay on May 23, 1985, with a normal lens (print from a color slide); retake made by Charles E. Kay on July 8, 2010 (Photo No. 6045-25). Section 35, Range 10 East, Township 37 South; UTM 520355E, 4203498N; elevation 8,403 ft. Original photograph held by Charles E. Kay in his private collection.

HM-87, 1985

HM-87, 2010

Plate HM-88

Ragged Mountain

1937 † 2010

Viewed north across Slate Creek to Ragged Mountain, from northwest of Gibbons Springs on the northeast slopes of Mount Pennell.

Pinyon and juniper appear to have increased except in the foreground and on the far left, areas that were both burned by the high-intensity Bulldog Fire in 2003. Pinyon and juniper have not increased on the dry, south-facing, rocky slopes of Ragged Mountain.

Original photograph taken by Charles B. Hunt (Number 625) in July 1937; retake made by Charles E. Kay on July 8, 2010 (Photo No. 6045-27). Section 36, Range 10 East, Township 32 South; UTM 520724E, 4204159N; elevation 8,094 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-88, 1937

HM-88, 2010

Plate HM-89

Mount Pennell

1937 † 2010

Viewed east to the western slopes of Mount Pennell. This part of Mount Pennell was not burned by the 2003 Bulldog Fire. Pinyon and juniper now block the original camera station, so the retake was made from the nearest open area, which is below where the road forks. One fork goes east toward Hancock Spring; the other goes south into the head of Pipe Spring Canyon.

In the absence of fire, woody vegetation has increased, including pinyon, juniper, oak brush, Douglas-fir, spruce, and ponderosa pine. Black sage, mountain big sagebrush, needle and thread, squirreltail, and Sandberg bluegrass may be found in the foreground area. Note how conifers have invaded the open areas. Current tree mortality was caused by the Douglas-fir beetle.

Original photograph taken by Charles B. Hunt (Number 637) in August 1937; retake made by Charles E. Kay on July 8, 2010 (Photo No. 6045-32). Section 33, Range 10 East, Township 32 South; UTM 517120E, 4203641N; elevation 8,707 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-89, 1937

HM-89, 2010

Plate HM-91

The Horn

1938 † 2010

Viewed west to The Horn on the north side of Mount Pennell.

The tall shrubs in the foreground of the 1938 image are oak brush, beyond which is a scattering of pinyon-juniper. The trees immediately above and on the cliff are ponderosa pine. In 2003 the area was swept by the Bulldog Fire—a high-intensity crown fire that burned nearly 32,000 acres in a matter of days (Bureau of Land Management 2003). Based on the standing dead materials in the retake, it is clear that pinyon and juniper invaded the site between 1938 and when the area was overrun by wildfire. Oak brush has resprouted, but it will be a long time before ponderosa pine becomes reestablished.

Original photograph taken by Charles B. Hunt (Number 821) in September 1938; retake made by Charles E. Kay on July 9, 2010 (Photo No. 6048-10A). Section 27, Range 10 East, Township 32 South; UTM 518716E, 4205369N; elevation 7,912 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-91, 1938

HM-91, 2010

Plates HM-93 and HM-94

Mount Ellen

1937 † 2010

Viewed north-northeast across the head of the North Fork of Bullfrog Creek to South Summit Ridge on Mount Ellen. The Horn is on the far right. Plates HM-93 and HM-94 form a panorama. The camera station for these photo sets is on a ridge south of Horn Hole Spring.

Note how open the foreground to midground area was in 1937. Sagebrush and grasses were common, with scattered oak brush and only a handful of pinyon-juniper. Just beyond the open areas was a stringer of ponderosa pine descending from The Horn. Pennellen Pass and the area to the west (left), however, were covered with a dense growth of pinyon-juniper.

Pinyon, juniper, and Douglas-fir have increased near the camera station, as has birchleaf mountain mahogany. Pinyon-juniper has also expanded up-slope on Mount Ellen. Oak brush has spread and thickened. In 2003 the Bulldog Fire burned a small part of the area. As pinyon and juniper have expanded and thickened, forage production for wildlife and livestock has been lost (Kay 2003). Note the new road through Pennell Pass and across the slopes of South Summit Ridge.

Original photographs taken by Charles B. Hunt (Numbers 634 and 635) in August 1937; retakes made by Charles E. Kay on July 9, 2010 (Photo Nos. 6048-15A and 6048-25A). Section 33, Range 10 East, Township 32 South; UTM 516807E, 4203945N; elevation 8,519 ft. Original images held by the U.S. Geological Survey Photographic Library, Denver, CO. Photo mosaic compiled by Doug Page, BLM, Cedar City, UT.

HM-93-94, 1937

HM-93-94, 2010

Plate HM-97

Pennellen Pass

1985 † 2010

Viewed south to Pennellen Pass, with The Horn and Mount Pennell in the distance.

In 1985 the slope below The Horn was open, with a scattering of pinyon, juniper, and ponderosa pine. Because the 2003 Bulldog Fire swept from east to west, that entire area now lacks conifers. In the original image, the foreground and the open areas in the midground had just been treated to remove pinyon-juniper.

In the retake, mountain big sagebrush has increased in the foreground area. Pinyon and juniper also increased until the latter were recently hand-felled to maintain the chaining for wildlife, both mule deer and bison, and livestock. The chainings in the midground were not treated, and pinyon-juniper has heavily invaded those areas.

Original photograph taken by Charles E. Kay with a 28mm wide-angle lens on May 23, 1985 (print from a color slide); retake made by Charles E. Kay on July 10, 2010 (Photo No. 6050-7). Section 16, Range 10 East, Township 32 South; UTM 516952E, 4208084N; elevation 7,953 ft. Original image held by Charles E. Kay in his private collection.

HM-97, 1985

HM-97, 2010

Plate HM-99

Slate Creek

1937 † 2010

Viewed north up Slate Creek to South Summit Ridge on Mount Ellen. Since the original camera station is now blocked by a dense growth of pinyon-juniper, the retake was made from the only open area available, the main road that runs from Pennellen Pass to Copper Ridge.

Note how open and parklike the area was in 1937. All that has changed. Pinyon, juniper, oak brush, limber pine, ponderosa pine, Douglas-fir, spruce, Utah serviceberry, and birchleaf mountain mahogany have all increased. In the past, the open nature of the vegetation would not have allowed large-scale, high-intensity crown fires to occur. As forest fuels have increased, however, the stage has been set for extreme fire behavior, such as occurred in 2003 on both the Bulldog and Lonesome Beaver fires (Bureau of Land Management 2003). The aspen along Slate Creek in the 1937 image is still present.

Original photograph taken by Charles B. Hunt (Number 564) in May 1937; retake made by Charles E. Kay on July 10, 2010 (Photo No. 6050-10). Section 10, Range 10 East, Township 32 South; UTM 518352E, 4209962N; elevation 8,573 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-99, 1937

HM-99, 2010

Plate HM-100

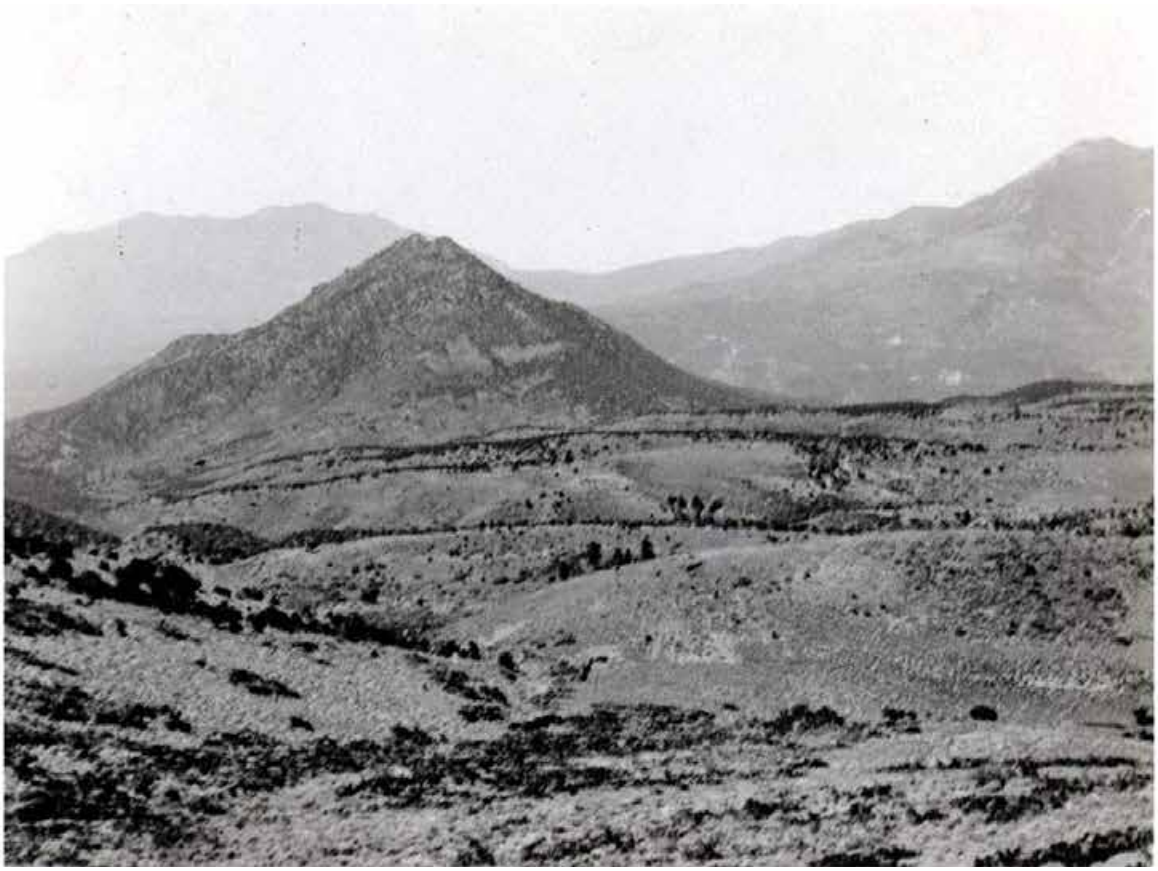
Ragged Mountain

1915 † 2010

Viewed south-southeast to Ragged Mountain from Copper Ridge. In the distance, Mount Pennell is on the right; Mount Hillers is on the left. Although the original image is slightly out of focus, this is still a highly instructive photo set.

In 1915 the area, including Ragged Mountain, was open and parklike. The dark shrubs in the 1915 photo are oak brush. At that time there was only a scattering of pinyon, juniper, and ponderosa pine. Today, a dense growth of pinyon-juniper covers much of the area, and oak brush, Utah serviceberry, birchleaf mountain mahogany, and ponderosa pine have increased. As forest fuels have increased, so has the probability that the area will be overrun by a high-intensity crown fire.

Original photograph taken by David Rust in 1915; retake made by Charles E. Kay on July 10, 2010 (Photo No. 6050-29). Section 2, Range 10 East, Township 32 South; UTM 520168E, 4211405N; elevation 9,050 ft. Original image (Box 1, Folder—Fraser second trip, Number 8-9) held in the David Rust Collection by the LDS Church Archives, Salt Lake City, UT.



HM-100, 1915

HM-100, 2010

Plate HM-106

Copper Basin Spring

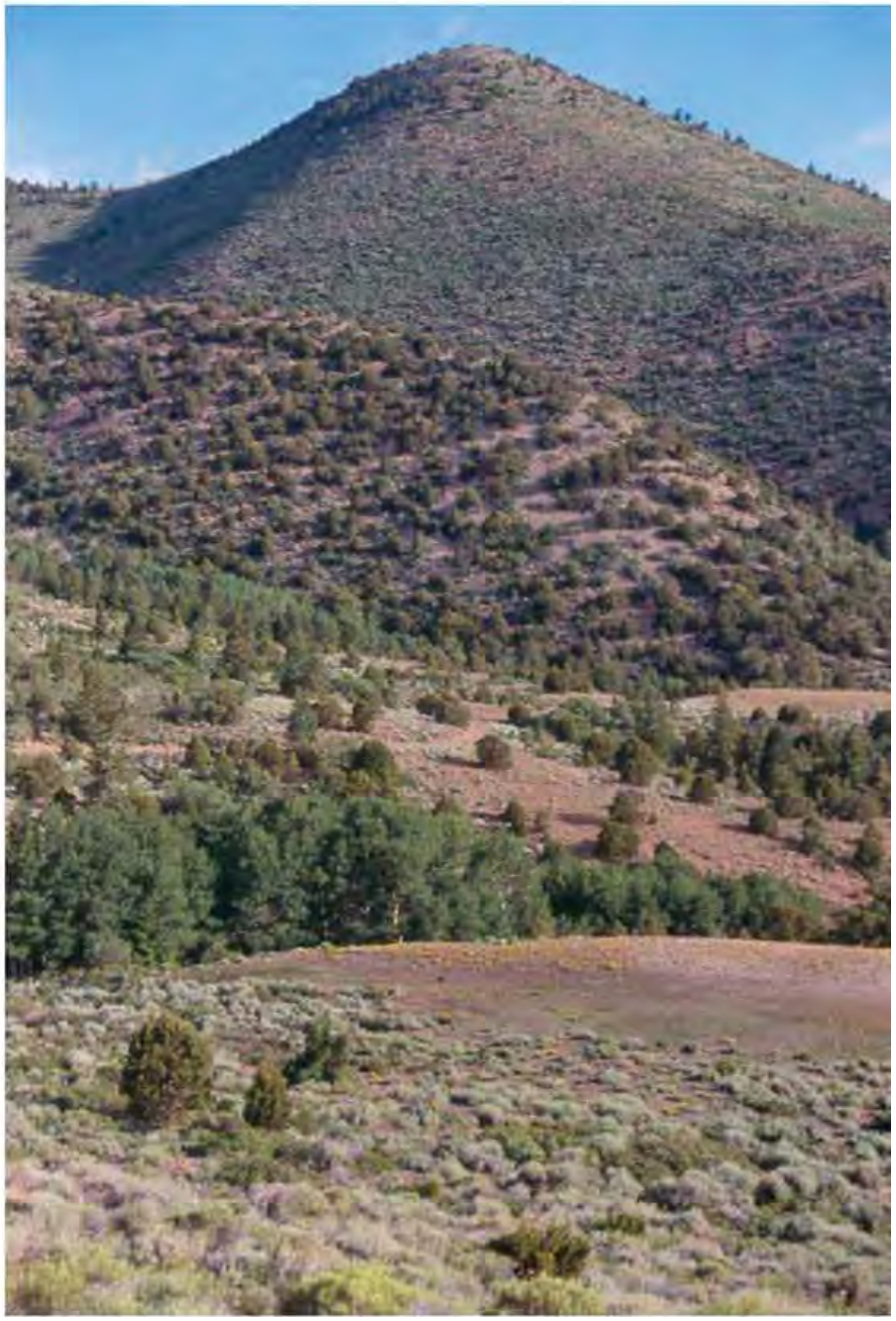
1937 † 2010

Viewed northwest to Copper Basin Spring, with Bartons Peak in the distance.

The area in the foreground was very heavily grazed in 1937, and soil erosion was evident. Today, that area is more vegetated, and soil erosion has ceased. Aspen around Copper Basin Spring and in the next drainage to the north, Copper Creek, appears to have increased. As the original image was made in May, aspen had not yet leafed out. Mountain big sagebrush has increased in the foreground area. Elsewhere in the photo pair, oak brush, pinyon, juniper, Douglas-fir, limber pine, Utah serviceberry, and birchleaf mountain mahogany have all increased, as have forest fuels. Cattle and mule deer currently use the spring. Note the road in the retake.

Original photograph taken by Charles B. Hunt (Number 547) in May 1937; retake made by Charles E. Kay on July 11, 2010 (Photo No. 6054-10). Section 1, Range 10 East, Township 32 South; UTM 520534E, 4211972N; elevation 8,734 ft. Original image held in the U.S. Geological Survey Photographic Library, Denver, CO.

HM-106, 1937



HM-106, 2010

Plates HM-107 and HM-108

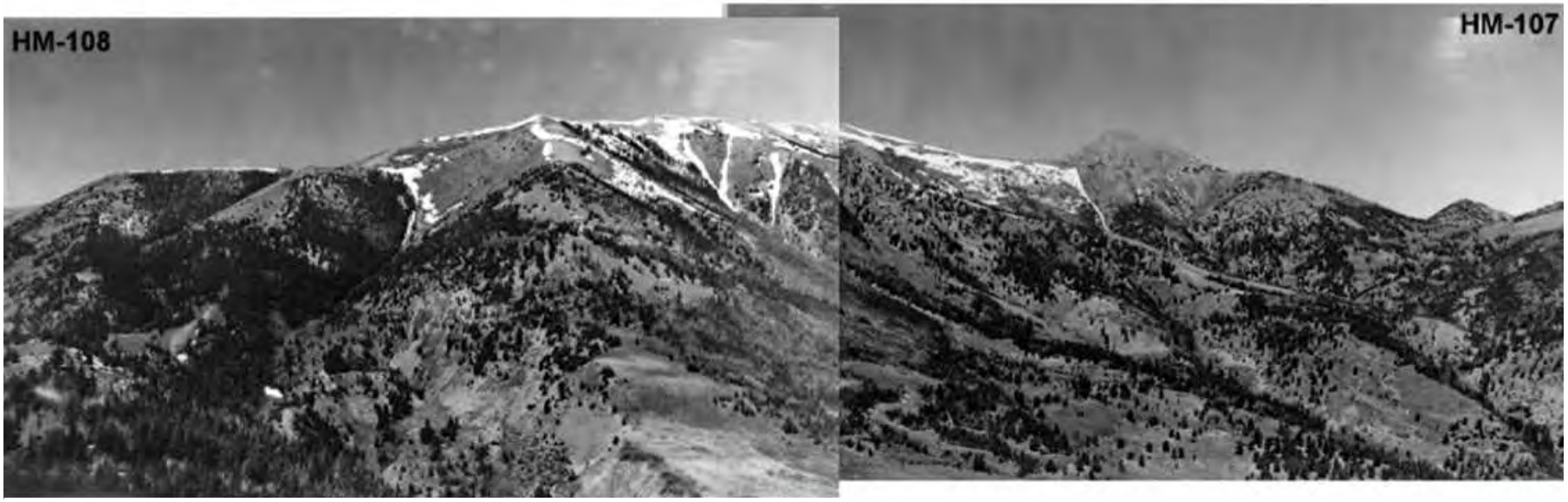
Mount Ellen and North Summit Ridge

1937 † 2010

Viewed north and west across Bull Creek to Mount Ellen and North Summit Ridge from Wickiup Ridge. Plates HM-107 and HM-108 form a panorama.

Ponderosa pine, Douglas-fir, spruce, limber pine, pinyon, juniper, and oak brush have all increased, as have forest fuels. Parts of the area burned in the 2003 Lonesome Beaver Fire (Bureau of Land Management 2003). Aspen appears unchanged and has successfully regenerated where it was burned in 2003.

Original photographs taken by Charles B. Hunt (Numbers 545 and 546) in May 1937; retakes made by Charles E. Kay on July 11, 2010 (Photo Nos. 6054-15 and 6054-19). Section 13, Range 10 East, Township 31 South; UTM 520169E, 4217291N; elevation 9,779 ft. Original images held in the U.S. Geological Survey Photographic Library, Denver, CO. Photo mosaic compiled by Doug Page, BLM, Cedar City, UT.



HM-107-108, 1937

HM-107-108, 2010

Plate HM-112

Bull Creek Pass

1937 † 2010

Viewed south to Bull Creek Pass.

Note the road and parking area in the retake. The spruce forest has thickened. In the very center of the 1937 image are two white tents, which was the U.S. Geological Survey camp. Note the opening in the forest to the right of the tents, which was likely caused by a small, wind-driven crown fire. That area was very heavily eroded in 1937, as was the area below the patch of timber on the right. Except for a couple of gullies below the road, that erosion has stopped. Spruce has been very slow to reforest the opening, so the burn pattern has been visible for at least 100 years.

Original photograph taken by Charles B. Hunt (Number 599) in June 1937; retake made by Charles E. Kay on July 11, 2010 (Photo No. 6057-1). Section 27, Range 10 East, Township 31 South; UTM 517289E, 4215499N; elevation 10,503 ft. Original image held in the U.S. Geological Survey Photographic Library, Denver, CO.

HM-112, 1937

HM-112, 2010

Plates HM-116 and HM-117

Durfey Butte

1937 † 2010

Viewed south-southeast across the head of South Creek from Durfey Butte. In the distance are Dry Lake Flat, South Creek Ridge, and Mount Pennell.

Note how open and parklike the ponderosa pine forest was in 1937 in contrast with the forest shown in the 2010 photo. Douglas-fir, ponderosa pine, limber pine, pinyon, juniper, oak brush, and Utah serviceberry have all increased. The dead and dying conifers in the 2010 retake are Douglas-fir, killed by the Douglas-fir beetle and overly dense stand conditions. Some aspen clones have increased, while others have been replaced by conifers.

In 1937 the forest would not carry a crown fire, as the trees were too widely spaced. With the observed increase in forest fuels, however, high-intensity crown fires are now possible, as happened on Mount Pennell in 2003 (Bureau of Land Management 2003). As seen in the distance, the eastern portion of Pennell was burned by the 2003 Bulldog Fire, while the western side was not. (See the earlier plates on Mount Pennell for additional details.) Note the roads in the retake and the BLM radio tower on South Creek Ridge.

Original photograph taken by Charles B. Hunt (Number 569) in May 1937; retake made by Charles E. Kay on July 12, 2010 (Photo No. 6057-19). Section 32, Range 10 East, Township 31 South; UTM 515183E, 4213802N; elevation 9,590 ft. The original image is held in the U.S. Geological Survey Photographic Library, Denver, CO.

HM-116-117, 1937

HM-116-117, 2010

Plate HM-121

Nasty Flat and Durfey Butte

1937 † 2010

Viewed west to Nasty Flat and Durfey Butte from the western slope of South Summit Ridge. Dugout Creek is on the right; South Creek is to the left. The Waterpocket Fold and Boulder Mountain are in the far distance.

Douglas-fir, ponderosa pine, spruce, limber pine, and pinyon-juniper have all increased, as have forest fuels. The open areas in the retake below and to the west of Nasty Flat are sites where the pinyon-juniper has been treated to improve forage production for wildlife and livestock (Kay 2003). A few aspen stands have increased, but many more have declined or been replaced by conifers. Some aspen clones successfully regenerated in the past, but today those new aspen saplings and trees are being high-lined by mule deer (Kay and Bartos 2000).

Original photograph taken by Charles B. Hunt (Number 577) in June 1937; retake made by Charles E. Kay on July 12, 2010 (Photo No. 6059-7). Section 34, Range 10 East, Township 31 South; UTM 517254E, 4213339N; elevation 10,467 ft. The original image is held in the U.S. Geological Survey Photographic Library, Denver, CO.

HM-121, 1937

HM-121, 2010

Plates HM-122 and HM-123

South Creek

1937 † 2010

Viewed north-northwest across South Creek. In the distance are Dry Lake Flat (left-center), Durfey Butte (left-center), Nasty Flat (center), North Summit Ridge (right-center skyline), and South Summit Ridge (right skyline). The camera station is on the upper part of South Creek Ridge. Plates HM-122 and HM-123 form a panorama.

Douglas-fir, limber pine, ponderosa pine, spruce, and pinyon-juniper have all increased, as have forest fuels. In general, aspen has declined, especially where it has been replaced by conifers. Upper treeline appears unchanged.

Original photographs taken by Charles B. Hunt (Numbers 572 and 573) in June 1937; retakes made by Charles E. Kay on July 12, 2010 (Photo Nos. 6059-16 and 6059-14). Section 4, Range 10 East, Township 32 South; UTM 516488E, 4211474N; elevation 9,978 ft. The original image is held in the U.S. Geological Survey Photographic Library, Denver, CO. Photo mosaic provided by Doug Page, BLM, Cedar City, UT.

HM-122-123, 1937

HM-122-123, 2010

Plate HM-124

McClellan Spring

1915 † 2010 † 2012

Viewed northeast from just above McClellan Spring. In the distance are Corral Point and North Summit Ridge. The camera station for this photo point is in the BLM McMillan Spring Campground, approximately 100 feet southwest of campsite number eight.

The first retake (2010) was made from the original camera station. To help prevent wildfires, the BLM reduced forest fuels by pruning off the lower branches of conifers.

The 2012 retake was made after the area was treated under a BLM stewardship contract in which the BLM removed most of the small pinyon and juniper trees from around the ponderosa pines. Unlike most areas of the West, the large ponderosa pines in this area have never been logged, because the site is remote with poor access. Most ponderosa pine in-growth has not been eliminated and still blocks much of the original distant view.

The open, parklike character of the pine forest in 1915 resulted from frequent low-intensity surface fires, which were most likely set by native people (Kay 2007). Historically, the trees were few and widely spaced, with an understory of grasses, forbs, and shrubs. Due to the very low level of forest fuels, high-intensity crown fires were impossible, as was extreme fire behavior, even during droughts or high-wind events.

Original photograph made by David Rust ca. 1915; first retake made by Charles E. Kay on July 13, 2010 (Photo No. 6059-29); second retake made by Charles E. Kay on September 15, 2012 (print from a color slide). Section 31, Range 10 East, Township 31 South; UTM 513271E, 4213970N; elevation 8,383 ft. Original image (Box 6, unnumbered negative) held in the David Rust Collection of the LDS Church Archives, Salt Lake City, UT.

HM-124, 1915

HM-124, 2010

HM-124, 2012

Plates HM-132 and HM-133

Mount Ellen Peak

1936 † 2010

Viewed south-southeast up Birch Creek on the north side of Mount Ellen. The mountain on the far right is Dry Lakes Peak; Mount Ellen is immediately to the left. Further on the left is Horseshoe Ridge, part of which was burned in the 2003 Lonesome Beaver Fire (Bureau of Land Management 2003). Plates HM-132 and HM-133 form a panorama.

Pinyon and juniper have increased markedly; therefore, most stands would now support a high-density crown fire. Oak brush, Utah serviceberry, and birchleaf mountain mahogany have increased at higher elevations, as have Douglas-fir and spruce. Pricklypear cactus has increased in the foreground area, along with snakeweed, curly grass, and blue grama.

Original photographs taken by Charles B. Hunt (Numbers 449 and 450) in May 1936; retakes made by Charles E. Kay on September 16, 2010 (Photo Nos. 6067-8A and 6067-2A). Section 24, Range 10 East, Township 30 South; UTM 518926E, 4226245N; elevation 6,180 ft. Original images held by the U.S. Geological Survey Photographic Library, Denver, CO. Photo mosaic compiled by Doug Page, BLM, Cedar City, UT.

HM-132-133, 1936

HM-132-133, 2010

Plate HM-146

Cottonwood Wash

1937 † 2010

Viewed north across Cottonwood Wash from Trachyte Point.

The 1937 image shows the old Trachyte Ranch road, which was abandoned in favor of an alignment 200 yards to the west (left). That alignment was also abandoned and is now passable only to ATVs. Although the old roadway was 3–4 feet lower than the surrounding area, it has naturally revegetated. The most common shrub is blackbrush, followed by Mormon tea. Indian ricegrass and curly grass have also increased.

Original photograph taken by Charles B. Hunt (Number 701) in September 1937; retake made by Charles E. Kay on September 18, 2010 (Photo No. 6098-28). Section 20, Range 12 East, Township 32 South; UTM 533911E, 4206183N; elevation 5,012 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-146, 1937

HM-146, 2010

Plate HM-153

Mount Hillers

1953 † 2010

Viewed southwest to Mount Hillers from the Hogsback road, about 5 miles from where it leaves Utah Highway 276. The camera station is just to the east of the present-day road and the older road at the top of the divide. The 1953 image was taken before the current road was built.

Pinyon and juniper have increased in the distance, as have oak brush and other conifers on Mount Hillers. Much of Mount Hillers was burned by high-intensity crown fire in 2003. Trail Canyon is the first canyon on the right; Gold Creek is the second. Both canyons burned in 2003.

Original photograph taken by Gregory Crampton in March 1953; retake made by Charles E. Kay on September 20, 2010 (Photo No. 6102-16). Section 32, Range 12 East, Township 33 South; UTM 533960E, 4193840N; elevation 6,244 ft. Original image held by University of Utah, Marriott Library Special Collections, Salt Lake City, UT.

HM-153, 1953

HM-153, 2010

Plate HM-154

Star Ranch

1953 † 2010

Viewed northwest to the southern slopes of Mount Hillers from Star Ranch. The meadow from which the original photo was taken is now a dense growth of willows and rubber rabbitbrush, so the retake was made from the nearest open area on top of a low hill east of the Hogsback road and north of the road to the Star Springs Campground.

Oak brush and pinyon-juniper have increased in the distance. Cottonwoods have increased around the meadow.

Original photograph was taken by R.G. Luedke (Number 25) ca. 1953; retake made by Charles E. Kay on September 20, 2010 (Photo No. 6104-9). Section 14, Range 11 East, Township 34 South; UTM 529976E, 4188974N; elevation 6,091 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-154, 1953

HM-154, 2010

Plate HM-168

Bert Avery Seep

1936 † 2010

Viewed northeast from Bert Avery Seep down the Birch Creek Valley. The original camera station was destroyed by road construction.

Note the U.S. Geological Survey camp in the 1936 photo. This photo was taken shortly after a thunderstorm had passed over the area, and the normally dry wash was in flood. Note how steep-walled the gully was in 1936, as well as the total lack of woody riparian vegetation. Today the wash has stabilized, and tamarisk is common. There are two parts to Bert Avery Seep. The part south of the present road, and the part north of the present road (seen in this photo set). The BLM has fenced both parts of the seep to exclude livestock. Fourwing saltbush and Russian thistle are common below the seep.

Original photograph taken by Charles B. Hunt (Number 462) on July 10, 1936; retake made by Charles E. Kay on October 26, 2010 (Photo No. 6110-5). Section 22, Range 10 East, Township 29 South; UTM 515517E, 4235573N; elevation 4,879 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-168, 1936

HM-168, 2010

Plate HM-201

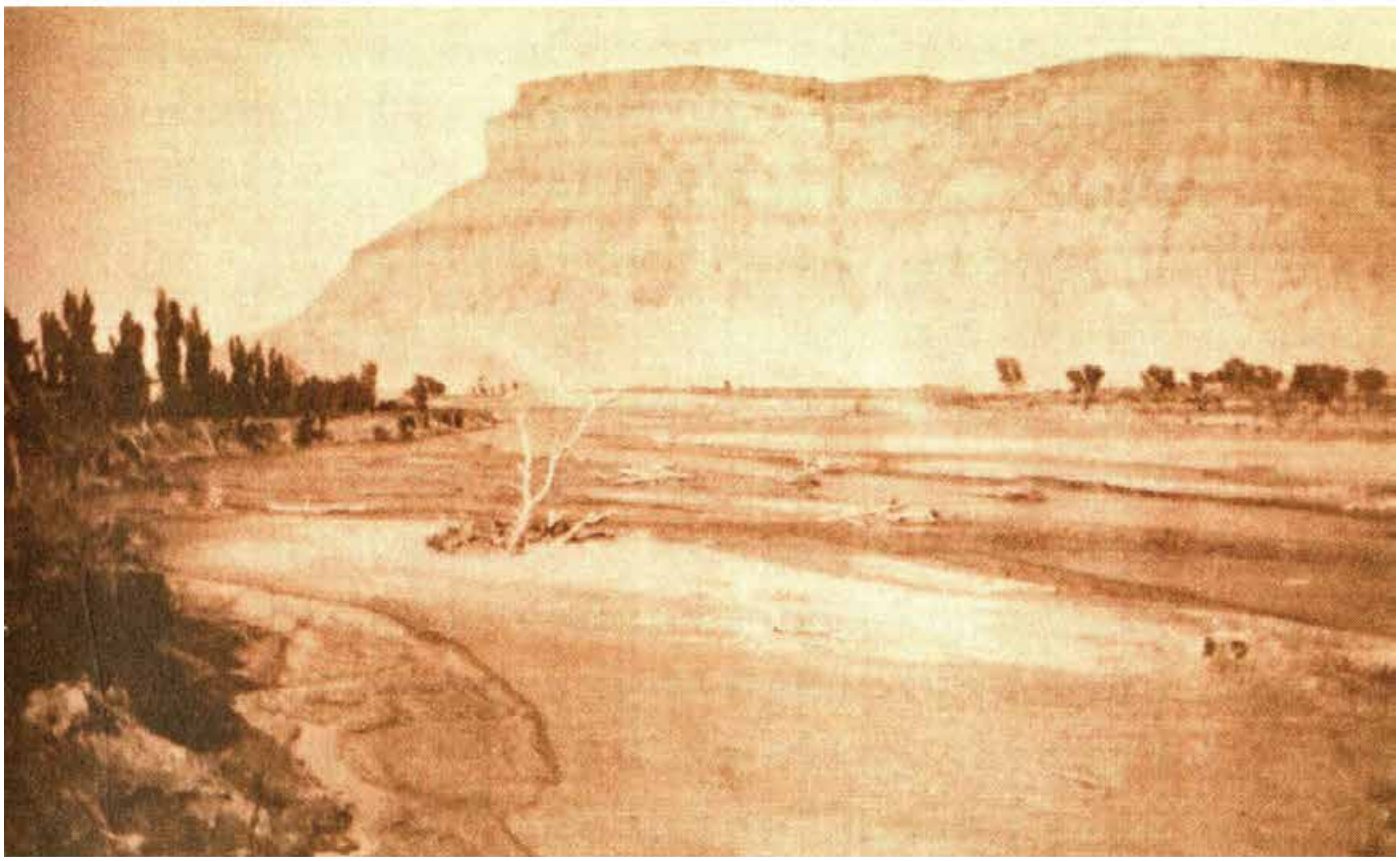
Fremont River

1930 † 2011

Viewed east-northeast down the Fremont River to South Caineville Mesa about 1 ½ miles south of Caineville, on the old gravel road.

The active river channel has narrowed and moved to the right, where it is now hidden from view by a new growth of willows and cottonwoods. Except for a few old cottonwoods, woody riparian vegetation was absent when the original photograph was taken. It is, however, abundant today despite continued livestock grazing by the private landowner. Today, cattails and beaver are also common, unlike conditions in the past.

Original photograph taken by Hattie Mulford Robison ca. 1930; retake made by Charles E. Kay on May 8, 2011 (Photo No. 6125-5A). Section 3, Range 8 East, Township 29 South; UTM 497614E, 4241335N; elevation 4,640 ft. Original photograph published by Robinson and Robinson (2004, 35).



HM-201, 1930

HM-201, 2011

Plate HM-215

Stanton Pass

1969 † 2011

In 1969 the BLM established the Bulldog 6 range monitoring site in Stanton Pass on the Pennell Allotment. The view is to the south, with Cass Creek Peak on the left. Note the steel fencepost in the original and the retake.

Cass Creek Peak burned in the 2003 Bulldog Fire that blackened nearly 32,000 acres. The land in the foreground of the more recent photograph has been root-plowed and reseeded to crested wheatgrass. The seeding is heavily used by cattle and bison.

Original photograph taken by the BLM on September 11, 1969; retake made by Charles E. Kay on May 13, 2011 (print from a color slide). Section 29, Range 11 East, Township 33 South; UTM 524206E; 4196297N; elevation 7,392 ft. Original photograph held in the BLM's range files, Hanksville, UT.

HM-215, 1969

HM-215, 2011

Plate HM-216

Indian Spring Bench

1968 † 2011

In 1968 the BLM established the Blue Hills 6 range monitoring site about 1 ½ miles southwest of Squaw Spring, on the Bullfrog Allotment. The view is to the south. All the steel stakes are still present (note the red steel fencepost in the original and that same fencepost painted yellow in the retake). Navajo Mountain is on the left skyline in the retake.

Juniper has increased, as has mountain big sagebrush. Blue grama is the most abundant native grass. Phlox, locoweed, and pricklypear cactus are also present. There was little sign of livestock use.

Original photograph taken by the BLM on August 30, 1968; retake made by Charles E. Kay on May 14, 2011 (print from a color slide). Section 18, Range 11 East, Township 34 South; UTM 523496E; 4190125N; elevation 6,486 ft. Original photograph held in the BLM's range files, Hanksville, UT.

HM-216, 1968

HM-216, 2011

Plate HM-223

Sandy Creek Bench

1964 † 2011

The view is to the southeast, approximately 600 yards south of where the main road crosses Dogwater Creek. The photo point is just east of the road.

The BLM took this photo to illustrate the "severe wind erosion" that was occurring on the Sandy 3 Allotment in 1964. "Note [the] pedestaling of plants and lack of ground cover" in the original photograph. Today, that is no longer the case, as perennial grass and shrub cover have increased, stabilizing the site. The most common species are Indian ricegrass and fourwing saltbush. Juniper appears to have increased in the distance.

Original photograph taken by Sheridan Hansen and Kenneth Drew on February 25, 1964; retake made by Charles E. Kay on May 15, 2011 (Photo No. 6132-10). Section 31, Range 8 East, Township 31 South; UTM 494347E, 4212504N; elevation 5,359 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-223, 1964

HM-223, 2011

Plate HM-224

Sandy Creek Bench

1964 † 2011

The view is to the northwest, approximately 2 miles south of where the main road crosses Dogwater Creek. The photo point is located about 100 yards east of the main road and is on the Sandy 3 Allotment. Note the short steel stake in the original and the retake.

Greasewood and cheatgrass have both increased, as has juniper in the distance. Indian ricegrass and pricklypear cactus are also present.

Original photograph taken by Sheridan Hansen and Kenneth Drew on February 25, 1964; retake made by Charles E. Kay on May 15, 2011 (Photo No. 6132-13). Section 7, Range 8 East, Township 32 South; UTM 494550E, 4211059N; elevation 5,407 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-224, 1964

HM-224, 2011

Plate HM-229

Sandy Creek Benches

1964 † 2011

Viewed southwest to the Sandy Creek Benches. The photo point is on the west edge of the main county road, about 100 feet south of where that road drops over the hill on the Sandy Ranch. Note the two large lava boulders (lower right) in both the original and the retake. The area from the camera to behind the dunes seen in the distance is owned by the Sandy Ranch and is still grazed by cattle.

The lack of plant cover and the shifting sand in the 1964 image are signs of overgrazing. Today, plant cover has increased, and all but one of the sand dunes has stabilized. Indian ricegrass, Mormon tea, and fourwing saltbush are the most common plants. Juniper appears to have increased.

Original photograph taken by Sheridan Hansen and Kenneth Drew on February 25, 1964; retake made by Charles E. Kay on May 16, 2011 (Photo No. 6132-31A). Section 30, Range 8 East, Township 31 South; UTM 493876E, 4214235N; elevation 5,537 ft. Original photograph held in the BLM's range files, Hanksville, UT.

HM-229, 1964

HM-229, 2011

Plate HM-246

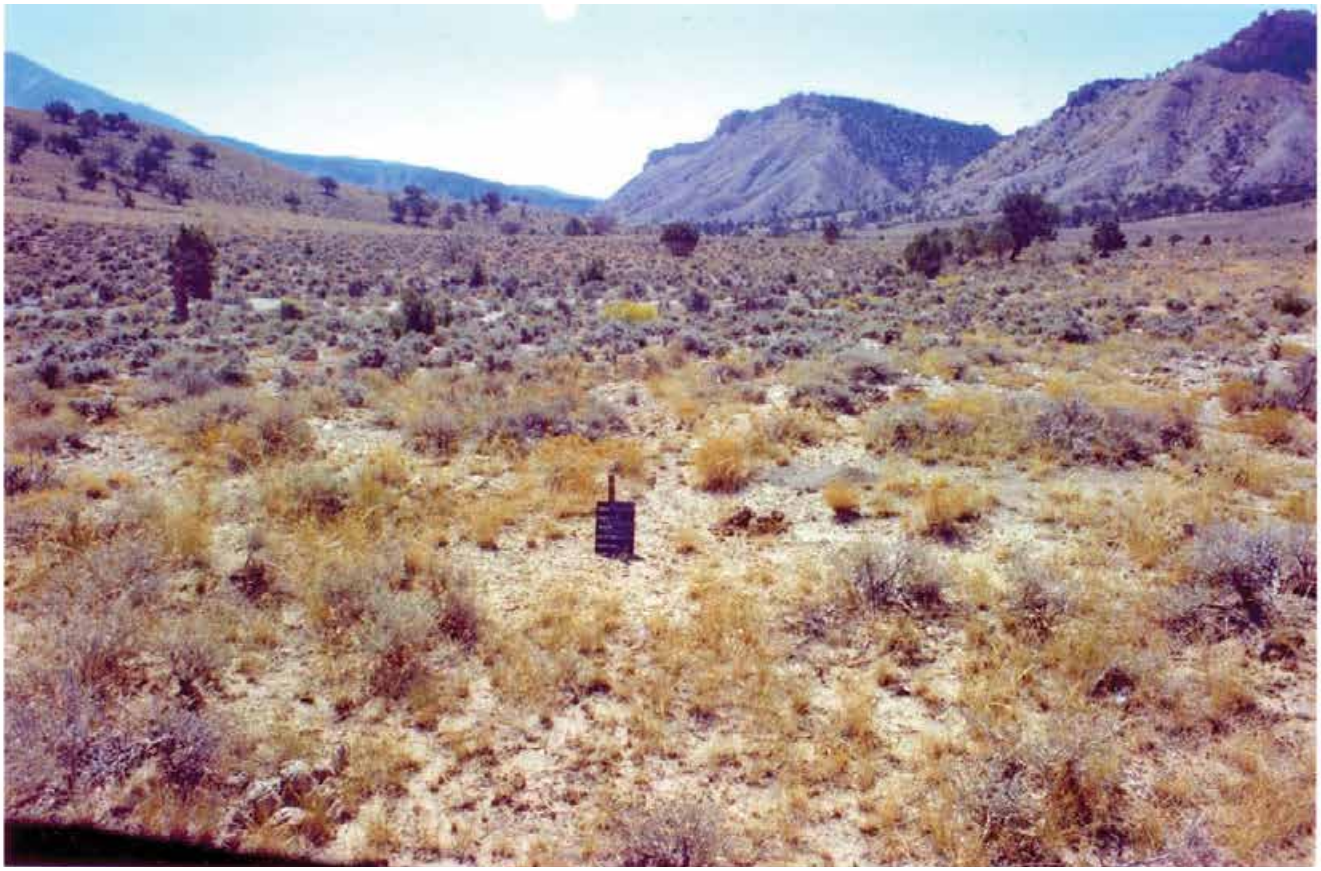
North Fork of Bulldog Creek

1967 † 2011

In 1967 the BLM established the Plot 1 range monitoring site on the Steele Butte Allotment. The view is south, down the North Fork of Bulldog Creek, about 1 mile north of the turnoff to Tarantula Mesa (right skyline). Mount Pennell is on left skyline. The camera station is 100 yards west of the Sweetwater road. All the steel stakes are still present. The red steel fencepost, now painted yellow, is difficult to see in the retake due to growth of sagebrush and juniper.

The area is heavily used by wintering mule deer. Juniper and mountain big sagebrush have both increased. Shadscale, Indian ricegrass, blue grama, needle and thread, snakeweed, locoweed, and pricklypear cactus are also present, as is a minor amount of cheatgrass.

Original photograph taken by the BLM on September 27, 1967; retake made by Charles E. Kay on May 20, 2011 (print from a color slide). Section 13, Range 9 East, Township 32 South; UTM 511854E, 4207891N; elevation 6,665 ft. Original photograph held in the BLM's range files, Hanksville, UT.



HM-246, 1967

HM-246, 2011

Plate HM-247

Apple Brush Flat

1911 † 2011

Viewed east, up Dry Wash to Mount Ellen from the lower part of Apple Brush Flat.

Pinyon and juniper have increased, both in the foreground and on the lower slopes of Mount Ellen, except for the gray marine shales (right-center), which are naturally nonvegetated. Other species include fourwing saltbush (mostly dead), Mormon tea, snakeweed, curly grass, Indian ricegrass, needle and thread, locoweed, and globemallow.

Original photograph taken by C.T. Lupton (Number 281) in 1911; retake made by Charles E. Kay on May 21, 2011 (Photo No. 6142-28). Section 8, Range 9 East, Township 31 South; UTM 504998E, 4219046N; elevation 5,789 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-247, 1911

HM-247, 2011

Plate HM-251

Swap Canyon

1918 † 2011

Viewed east-southeast across upper Halls Creek and Grand Gulch to the mouth of Swap Canyon. The photo point is approximately 200 yards east of the Notom road and about 1 mile north of Burr Canyon.

Greasewood appears to have declined. Tamarisk has become established along Halls Creek (not a perennial stream). A few juniper have become established. Other plants include Indian ricegrass, shadscale, curly grass, and cheatgrass.

Original photograph taken by Herbert E. Gregory in June 1918; retake made by Charles E. Kay on May 21, 2011 (Photo No. 6149-4). Section 10, Range 8 East, Township 34 South; UTM 498334E, 4191026N; elevation 5,084 ft. The original image is damaged. Original image (P0013, Box 8, Number 1429) held by the University of Utah, Marriott Library Special Collections, Salt Lake City, UT.

HM-251, 1918

HM-251, 2011

Plate HM-265

Bull Mountain

1974 † 2011

In 1974 the BLM established the Plot 5 range monitoring site on the Hanksville Allotment. The photo point is near the head of Halfway Wash; the view is southwest to Bull Mountain. All the steel stakes are still present, but the red steel fencepost in the original photo has been painted white.

Blackbrush has increased, as has pinyon-juniper in the distance. Horseshoe Ridge (far-right skyline) burned in the 2003 Lonesome Beaver Fire. Other plants in the foreground include curly grass, cheatgrass, rubber rabbitbrush, Mormon tea, and big sagebrush. Mule deer have heavily browsed the sagebrush.

Original photograph taken by the BLM on August 22, 1974; retake made by Charles E. Kay on June 16, 2011 (print from a color slide). Section 28, Range 11 East, Township 30 South; UTM 524529E, 4225861N; elevation 5,742 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-265, 1974

HM-265, 2011

Plate HM-269

Upper Poison Spring Flat

1972 † 2011

In 1972 the BLM established the Plot 1 range monitoring site on the Burr Point Allotment. The photo point is approximately 1 ½ miles west of Poison Spring. The view is to the southeast, and all the steel stakes are still present.

Blackbrush has increased, as has juniper in the distance. Other species include curly grass, snakeweed, cheatgrass, and locoweed. Ground cover appears to have improved.

Original photograph taken by the BLM on August 17, 1972; retake made by Charles E. Kay on June 17, 2011 (print from a color slide). Section 3, Range 11 East, Township 31 South; UTM 528345E, 4221421N; elevation 5,445 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-269, 1972

HM-269, 2011

Plate HM-270

Granite Creek

1937 † 2011

Viewed northwest across Granite Creek to the northeastern slopes of Bull Mountain. The photo point is approximately 2 miles east of Poison Spring and is on top of a small, white-colored hill.

Blackbrush has increased, as has juniper. Mormon tea and rubber rabbitbrush are also present, as is curly grass and Indian ricegrass.

Original photograph taken by Charles B. Hunt (Number 551) in May 1937; retake was made by Charles E. Kay on June 17, 2011 (Photo No. 6156-1). Section 3, Range 11 East, Township 31 South; UTM 527094E, 4221083N; elevation 5,658 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-270, 1937

HM-270, 2011

Plate HM-272

Butler Wash Bench

1967 † 2011

In 1967 the BLM established the Eagle Bench 2 range monitoring site on the Crescent Creek Allotment, just after the area had been treated to remove pinyon-juniper. The view is to the south across Butler Wash, with Mount Hillers on the distant skyline. All the steel stakes are still present.

Pinyon and juniper that became established after the 1967 treatment were recently cleared by hand-felling. Mountain big sagebrush and black sagebrush have increased. Other plants include snakeweed, phlox, Mormon tea, crested wheatgrass, and squirreltail.

Original photograph taken by the BLM on August 31, 1967; retake made by Charles E. Kay on June 18, 2011 (print from a color slide). Section 20, Range 11 East, Township 31 South; UTM 524075E, 4216071N; elevation 6,866 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-272, 1967

HM-272, 2011

Plate HM-277

Coyote Benches

1968 † 2011

In 1968 the BLM established the Wolverton 6 range monitoring site on the Pennell Allotment. The view is south to Mount Hillers, most of which burned in the 2003 Bulldog Fire.

This monitoring site was established shortly after the area was chained to remove pinyon and juniper, but before the area was reseeded with crested wheatgrass. Much of the area shown in the foreground was recently re-treated to remove pinyon and juniper established since the earlier treatment, and in that process all the steel stakes were destroyed. The area on the right and in the distance was not re-treated and is again dominated by pinyon-juniper. The most common plants in the foreground include crested wheatgrass, alfalfa, and mountain big sagebrush, with only a trace of cheatgrass.

Original photograph taken by the BLM on July 25, 1968; retake made by Charles E. Kay on June 19, 2011 (print from a color slide). Section 4, Range 11 East, Township 33 South; UTM 525426E, 4201679N; elevation 6,467 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-277, 1968

HM-277, 2011

Plate HM-278

Browns Knoll

1969 † 2011

In 1969 the BLM established the Bulldog 8 range monitoring site on the Pennell Allotment. The view is to the southwest. The entire area burned in the 2003 Bulldog Fire. All the steel stakes were destroyed when, after the fire, the site was scarified before reseeding. The boulder seen behind the red steel fencepost in the 1969 image was moved down-slope to plug a small gully.

Mountain big sagebrush, which is killed by fire, has decreased; oak brush, which resprouts after fire, has increased. The grasses are primarily crested and intermediate wheatgrass, both of which were planted. Lupine and yarrow are also present.

Original photograph taken by the BLM on August 31, 1969; retake made by Charles E. Kay on June 20, 2011 (print from a color slide). Section 18, Range 11 East, Township 33 South; UTM 522083E, 4198357N; elevation 8,011 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-278, 1969

HM-278, 2011

Plate HM-279

Mud Spring

1968 † 2011

In 1968 the BLM established the Bulldog 7 range monitoring site on the Pennell Allotment. The view is to the southwest and is approximately ¾ of a mile west of the fenced area at Mud Spring, on the southern shoulder of Mount Pennell. Most of the area was burned by the 2003 Bulldog Fire. The site, though, was not reseeded after the fire, and all the steel stakes still exist. The camera station is 50 yards north of where the 4x4 track forks (note the vehicle in the retake).

Oak brush has resprouted in the distance, and mountain big sagebrush has regrown from seed. The area is heavily used by cattle and bison, and there are few grasses—needle and thread and cheatgrass being the most common. Lupine and yarrow are also present.

Original photograph taken by the BLM on July 31, 1968; retake made by Charles E. Kay on June 20, 2011 (print from a color slide). Section 25, Range 10 East, Township 33 South; UTM 521106E, 4196187N; elevation 7,731 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-279, 1968

HM-279, 2011

Plate HM-283

Horn Spring Basin

1968 † 2011

In 1968 the BLM established the Horn 7 range monitoring site on the Pennell Allotment. The view is to the south, on the northern slopes of Mount Pennell. The site is about 300 yards north of the road to Hancock Spring. All the steel stakes are still present.

Conifers, primarily Douglas-fir and limber pine, have increased on the distant hill, while aspen (right-center edge) has successfully regenerated without fire or other disturbance. In the retake, significant tree mortality caused by the Douglas-fir beetle can be seen on the peak in the distance. Mountain big sagebrush and black sage have increased, as has soil erosion from the gully (left-center). The low mound (left-center edge) is the berm of a stock pond. Sheep fescue, locoweed, phlox, groundsel, and fleabane daisy are also present.

Original photograph taken by the BLM on August 23, 1968; retake made by Charles E. Kay on June 20, 2011 (print from a color slide). Section 34, Range 10 East, Township 32 South; UTM 517785E, 4203840N; elevation 8,850 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-283, 1968

HM-283, 2011

Plate HM-284

Pennell Pass

1969 † 2011

In 1969 the BLM established the Horn 1 range monitoring site on the Pennell Allotment. The site is approximately 400 yards northwest of Pennell Pass. Mount Pennell is on the left skyline. All steel stakes are still present, although the original red steel fencepost has been painted yellow.

Immediately before the 1969 photo, the site had been chained to eliminate pinyon-juniper and was reseeded with crested wheatgrass. Pinyon and juniper that subsequently became established were recently removed by hand-felling. The tall, dark green shrubs in the retake are Utah serviceberry. Mountain big sagebrush and bitterbrush have also become established. The most common grass is crested wheatgrass.

Original photograph taken by the BLM on September 10, 1969; retake made by Charles E. Kay on June 21, 2011 (print from a color slide). Section 21, Range 10 East, Township 32 South; UTM 516532E, 4207239N; elevation 7,775 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-284, 1969

HM-284, 2011

Plate HM-289

Slate Creek

1938 † 2011

Viewed north-northwest up Slate Creek to South Summit Ridge. To provide an unobstructed view, the retake was made from the top of a large boulder. The photo point is northeast of The Horn and about ⅔ of a mile below the main road.

Pinyon, juniper, oak brush, and other woody species have all increased. (See also Plate HM-99.) The area in the lower left of the retake burned in the 2003 Bulldog Fire.

Original photograph taken by Charles B. Hunt (Number 818) in September 1938; retake made by Charles E. Kay on June 21, 2011 (Photo No. 6162-14). Section 22, Range 10 East, Township 32 South; UTM 518712E, 4207179N; elevation 7,669 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-289, 1938

HM-289, 2011

Plates HM-292 and HM-293

Cedar Creek Bench

1936 † 2011

Viewed southwest across Dry Wash from Cedar Creek Bench. Apple Brush Flat is in the distance; Steele Butte is on the skyline (right-center). Plates HM-292 and HM-293 form a panorama. Range monitoring site Steele Butte 7 is on the flat below the 4x4 track in the retake.

Pinyon and juniper have increased.

Original photographs taken by Charles B. Hunt (Numbers 493 and 494) in 1936; retakes made by Charles E. Kay on June 23, 2011 (Photo Nos. 6162-34 and 6162-31). Section 11, Range 9 East, Township 31 South; UTM 509086E, 4219704N; elevation 6,409 ft. Original images held by the U.S. Geological Survey Photographic Library, Denver, CO. Photo mosaic compiled by Doug Page, BLM, Cedar City, UT.

HM-292-293, 1936

HM-292-293, 2011

Plate HM-294

Nasty Flat

1968 † 2011

In 1968 the BLM established the Homestead 1 range monitoring site on the Nasty Flat Allotment. The view is to the south, and all the steel stakes still exist.

Mountain big sagebrush has increased, while the aspen stand on the right skyline has declined.

Original photograph taken by the BLM on August 26, 1968; retake made by Charles E. Kay on July 18, 2011 (print from a color slide). Section 33, Range 10 East, Township 31 South; UTM 515957E, 4213277N; elevation 9,570 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-294, 1968

HM-294, 2011

Plate HM-296

North Fork of South Creek

1937 † 2011

Viewed south-southwest across the North Fork of South Creek on the western slopes of South Summit Ridge. Note the white wall tent and horses in the 1937 image (lower-right-center) for scale. The exposure on the 1937 image was adjusted so that the tent could be seen more readily. The photo point is just above the main road, as seen in the retake.

Conifers, primarily Douglas-fir and limber pine, have increased. Aspen has increased in the foreground area; on the distant ridge, conifers have invaded the aspen. Sagebrush has also increased. Aspen above the stream regenerated 30–40 years ago when mule deer numbers fell, but it has not done so since, as mule deer repeatedly browse any new suckers (Kay and Bartos 2000).

Original photograph taken by Charles B. Hunt (Number 578) in June 1937; retake made by Charles E. Kay on July 18, 2011 (Photo No. 6165-14A). Section 33, Range 10 East, Township 32 South; UTM 516528E, 4212793N; elevation 9,596 ft. Original image held in the U.S. Geological Survey Photographic Library, Denver, CO.

HM-296, 1937

HM-296, 2011

Plate HM-297

North Fork of South Creek

1937 † 2011

Viewed northeast up the North Fork of South Creek to South Summit Ridge. The original photo point, which is on a small hill, is now blocked by a dense growth of pinyon-juniper, so the retake was made from the nearest open area.

Pinyon and juniper have increased, as have oak brush, Douglas-fir, limber pine, and ponderosa pine. In the distance aspen has been invaded by conifers and has declined. Also present are snowberry, birchleaf mountain mahogany, and mountain big sagebrush.

Original photograph taken by Charles B. Hunt (Number 571) in June 1937; retake made by Charles E. Kay on July 18, 2011 (Photo No. 6165-21A). Section 5, Range 10 East, Township 32 South; UTM 514667E, 4211801N; elevation 8,608 ft. Plates HM-297 and HM-298 (available on Utah State University's Extension website) were taken from the same camera station, but they do not form a panorama. Original image held in the U.S. Geological Survey Photographic Library, Denver, CO.

HM-297, 1937

HM-297, 2011

Plates HM-302 and HM-303

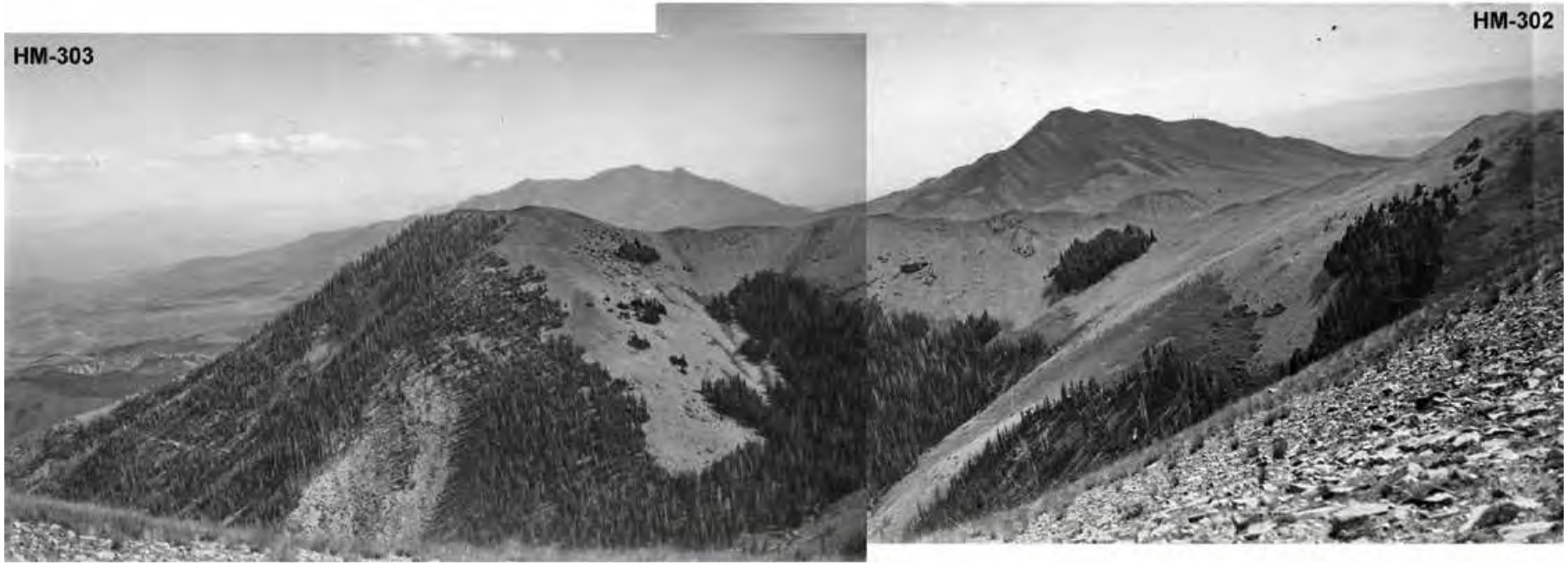
Bromide Basin

1938 † 2011

Viewed south-southwest across the head of Bromide Basin from South Summit Ridge. Plates HM-302 and HM-303 form a panorama. Note the new mining roads.

The eastern slopes of Mount Pennell in the distance burned in the 2003 Bulldog Fire. The upper treeline has been stable, but the spruce-subalpine fir forest has increased in height and density. The patches of shrubs are mostly currants. The landslide on the lower, northern slopes of Kimble and Turner Peak has naturally reforested.

Original photographs taken by Charles B. Hunt (Numbers 807 and 807b) in September 1938; retakes made by Charles E. Kay on July 20, 2011 (Photo Nos. 6167-9 and 6167-9). Section 34, Range 10 East, Township 31 South; UTM 517878E, 4213769N; elevation 11,267 ft. Original images held by the U.S. Geological Survey Photographic Library, Denver, CO. Photo mosaic compiled by Doug Page, BLM, Cedar City, UT.



HM-302-303, 1938

HM-302-303, 2011

Plate HM-304

South Summit Ridge

1938 † 2011

Viewed north-northwest along the upper slopes of South Summit Ridge, with Mount Ellen in the distance. The camera station for the photo point is the same as that for Plates HM-302 and HM-303.

The upper treeline has been stable. The patches of shrubs are mostly currants.

Original photograph taken by Charles B. Hunt (Number 804) in September 1938; retake made by Charles E. Kay on July 20, 2011 (Photo No. 6167-20). Section 34, Range 10 East, Township 31 South; UTM 517878E, 4213769N; elevation 11,267 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-304, 1938

HM-304, 2011

Plate HM-310

South Creek

1937 † 2011

Viewed west-southwest down South Creek from South Summit Ridge. Nasty Flat is on the lower right; South Creek Ridge is on the left.

Conifers have increased, including pinyon, juniper, Douglas-fir, limber pine, spruce, and ponderosa pine. In general, aspen has declined as conifers have invaded the various stands. Some aspen clones regenerated 30–40 years ago when mule deer numbers fell. They have not done so since, however, as any new suckers are repeatedly browsed, mostly by wildlife (Kay and Bartos 2000).

Original photograph taken by Charles B. Hunt (Number 591) in May 1937; retake made by Charles E. Kay on July 20, 2011 (Photo No. 6173-3). Section 34, Range 10 East, Township 31 South; UTM 517556E, 4213292N; elevation 11,067 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-310, 1937

HM-310, 2011

Plates HM-312 and HM-313

Bromide Basin

1938 † 2011

Viewed southeast across the head of Bromide Basin to Kimble and Turner Peak. Plates HM-312 and HM-313 form a panorama. The horsemen in the 1938 images moved between photographs. Note the new mining roads.

The upper treeline has not changed, but the mixed conifer forest has increased in height and density. The dark-colored shrubs are currants. Ground cover appears to have increased.

Original photographs taken by Charles B. Hunt (Numbers 800 and 801) in September 1938; retakes made by Charles E. Kay on July 20, 2011 (Photo Nos. 6173-16 and 6173-22). Section 34, Range 10 East, Township 31 South; UTM 517633E, 4212776N; elevation 11,005 ft. Original images held by the U.S. Geological Survey Photographic Library, Denver, CO. Photo mosaic compiled by Doug Page, BLM, Cedar City, UT.

HM-312-313, 1938

HM-312-313, 2011

Plate HM-314

Bromide Basin

1937 † 2011

Viewed north-northwest across Bromide Basin, from Kimble and Turner Peak to the crest of South Summit Ridge.

The upper treeline appears unchanged. Most of the trees are spruce or limber pine. The dark-colored shrubs are currants. Ground cover appears to have increased. A number of new mining roads have been constructed.

Original photograph taken by Charles B. Hunt (Number 589) in June 1937; retake made by Charles E. Kay on July 20, 2011 (Photo No. 6173-28). Section 34, Range 10 East, Township 31 South; UTM 518474E, 4212704N; elevation 11,086 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-314, 1937

HM-314, 2011

Plate HM-318

Upper Cedar Creek

1936 † 2011

Viewed east, up Cedar Creek to Mount Ellen and North Summit Ridge.

The area around the photo point burned a number of years ago, as did the area to the left of Cedar Creek (left-center edge). Otherwise, conifers have increased, including pinyon, juniper, Douglas-fir, ponderosa pine, spruce, and subalpine fir. The upper treeline, though, appears unchanged. Undisturbed aspen has not regenerated in many years due to repeated browsing of any new suckers, primarily by wildlife. In the recently burned area to the left of Cedar Creek, however, aspen has successfully regenerated (defined as producing new stems more than 6 feet tall). This area is heavily used by summering bison and mule deer.

Original photograph taken by Charles B. Hunt (Number 500) in September 1936; retake made by Charles E. Kay on July 22, 2011 (Photo No. 6177-15). Section 7, Range 10 East, Township 31 South; UTM 513392E, 4218480N; elevation 8,926 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-318, 1936

HM-318, 2011

Plates HM-320 and HM-321

Upper Cedar Creek

1936 † 2011

Viewed northwest across Cedar Creek to Deer Heaven. Plates HM-320 and HM-321 form a panorama.

Aspen has increased in height but has not successfully regenerated in many years. Conifers have increased, including Douglas-fir, limber pine, and spruce. Conifer mortality in the retake has been caused by the Douglas-fir beetle. The area shown in the foreground is heavily used by summering bison.

Original photographs taken by Charles B. Hunt (Numbers 519 and 518) in September 1936; retakes made by Charles E. Kay on July 22, 2011 (Photo Nos. 6177-24A and 6177-27A). Section 17, Range 10 East, Township 31 South; UTM 514534E, 4218312N; elevation 9,524 ft. Original images held by the U.S. Geological Survey Photographic Library, Denver, CO. Photo mosaic compiled by Doug Page, BLM, Cedar City, UT.

HM-320-321, 1936

HM-320-321, 2011

Plate HM-322

Star Flat

1972 † 2011

In 1972 the BLM established the Homestead 4 range monitoring site on the Nasty Flat Allotment. The view is to the south on the northern edge of Star Flat. All the steel stakes are still present.

Ponderosa pine have increased, while mountain big sagebrush have declined. Other species include lupine, needle and thread, squirreltail, and Indian paintbrush. The area is heavily used by summering bison.

Original photograph taken by the BLM on August 9, 1972; retake made by Charles E. Kay on July 22, 2011 (print from a color slide). Section 18, Range 10 East, Township 31 South; UTM 513710E, 4217714N; elevation 8,856 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-322, 1972

HM-322, 2011

Plate HM-339

Notom Desert

1940 † 2012

Viewed southeast from south of the old Notom road, approximately 1 mile northeast of Notom, Utah. In the distance are Mount Ellen (center skyline) and Mount Pennell (far-right skyline).

Shadscale is more common in the foreground today than it was in the past. Other species include curly grass, Indian ricegrass, yellow (green) rabbitbrush, and juniper.

Original photograph taken by an unknown photographer in 1940; retake made by Charles E. Kay on April 14, 2012 (Photo No. 6226-21A). Section 36, Range 7 East, Township 29 South; UTM 490352E, 4233046N; elevation 5,227 ft. Original image (No. 10,902) held by the Utah State Historical Society, Salt Lake City, UT.

HM-339, 1940

HM-339, 2012

Plate HM-346

Bull Creek

1921 † 2012

Viewed southeast up Bull Creek to the Henry Mountains. Horseshoe Ridge is on the left skyline, with Mount Ellen in the center, and Dry Lakes Peak on the right. Little Meadow is in the foreground. The photo point is approximately 1 ½ miles south of the Fairview Ranch and 400 yards west of the Bull Creek road.

Pinyon and juniper have increased. The site was heavily grazed by domestic sheep in 1921, while today the area is grazed by cattle. The Lonesome Beaver Fire burned much of Horseshoe Ridge in 2003. Cottonwoods and other woody riparian vegetation appear to have increased. Common species include needle and thread grass, curly grass, sagebrush, tamarisk, Utah serviceberry, oak brush, fourwing saltbush, rubber rabbitbrush, and snakeweed.

Original photograph taken by R.C. Moore (No. 65) in 1921; retake made by Charles E. Kay on April 16, 2012 (Photo No. 6229-17). Section 18, Range 11 East, Township 30 South; UTM 521809E, 4227228N; elevation 5,608 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-346, 1921

HM-346, 2012

Plate HM-347

Bull Mountain

1894 † 2012

Viewed southwest to Bull Mountain from just east of the Bull Creek road. Pinyon and juniper have increased and now block the original camera station, so the retake was made from the nearest open area with a somewhat clear view of the large boulder in the left foreground. The original image was printed in reverse. Today, there is an ATV trail between the photo point and the large boulder, which in 1894 most likely was the main road up Bull Creek.

Pinyon and juniper have increased. The understory vegetation is primarily blue grama and sagebrush. Of the more than 1,200 repeat photographs that I have made of pinyon-juniper in southern Utah, this is the only historical image in which pinyon and juniper stumps are visible. As this is the nearest pinyon-juniper to the town of Hanksville, 15 miles to the north, these trees were probably cut for firewood or fenceposts.

Original photograph taken by Marcus E. Jones (Slide 46) in 1894; retake made by Charles E. Kay on April 16, 2012 (Photo No. 6229-19). Section 29, Range 11 East, Township 30 South; UTM 522983E, 4225106N; elevation 6,109 ft. Original image held by the Rancho Santa Ana Botanic Garden, Claremont, CA. Image digitized and provided by Dr. William R. Gray (2011), Emeritus Professor of Biology, University of Utah, Salt Lake City, UT.

HM-347, 1894

HM-347, 2012

Plate HM-349 and HM-350

Granite Creek

1939 † 2012

Viewed west-northwest up Granite Creek. Mount Ellen is on the left skyline; Bull Mountain is on the right-center skyline. Plates HM-349 and HM- 350 form a panorama that is most informative.

First, it is clear from the 1939 images that a surface fire thinned out the pinyon-juniper some years before those photos were made. That surface fire also removed blackbrush, which is common in the surrounding area, and lead to an increase in various grasses—primarily blue grama, needle and thread, and Indian ricegrass. Thus, fire has maintained a pinyon-juniper-grass savanna in this area. Judging by the present vegetation mosaic, this surface fire covered a relatively large area—indicating that fine fuels, mainly grasses, must have been even more abundant in the past to have allowed that fire to spread as far as it did. There is no evidence of crown fire anywhere in the original photographs.

The dead pinyon and juniper seen in the 1939 images, although weathered, are still present today, having likely lasted at least 100 years. Pinyon and juniper present in 1939 have increased in size and to a lesser extent in number. Some ecologists claim that, historically, pinyon-juniper savannas have been maintained by climate, not by fire. These photos, however, indicate that both climate and fire are important.

The area is far from water and is seldom used by cattle today. Grazing by sheep may have been more common in earlier times, though, because sheep can be herded relatively long distances to and from water. In addition to the species discussed above, Mormon tea, winterfat, and snakeweed are present, although in very small amounts.

Original photographs taken by Charles Hunt (Nos. 887 and 888) in 1939; retakes made by Charles E. Kay on April 17, 2012 (Photo Nos. 6229-28 and 6229-32). Section 15, Range 11 East, Township 31 South; UTM 527195E, 4218894N; elevation 6,184 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO. Photo mosaic compiled by Doug Page, BLM, Cedar City, UT.

HM-349-350, 1939

HM-349-350, 2012

Plate HM-355

North Wash

1938 † 2012

Viewed northwest up North Wash, just above Hog Springs. The original photo point was eliminated when Utah Highway 95 was built along North Wash.

The cliff on the right has been blasted away, and North Wash has been channelized further to the left. Livestock grazing has been eliminated. Cottonwoods and willows have increased, as has tamarisk.

Original photograph taken by Charles Kelly in 1938; retake made by Charles E. Kay on April 19, 2012 (Photo No. 6232-26). Section 4, Range 13 East, Township 32 and ½ South; UTM 544655E, 4201817N; elevation 4,078 ft. Original image (No. 10,636) held by the Utah State Historical Society, Salt Lake City UT.

HM-355, 1938

HM-355, 2012

Plates HM-363 and HM-365

Fairview Ranch

1940 † 2012

Viewed south-southwest from just south of the Fairview Ranch, south of Hanksville, Utah. From right to left on the skyline are Table Mountain, Deer Heaven, Dry Lakes Peak, Mount Ellen, and Horseshoe Ridge. Plates HM-363 and HM-365 form a panorama.

The area around Fairview Ranch was denuded in 1940 due to excessive grazing by thousands of domestic sheep, brought to the ranch each spring to be sheared. According to Murphy (1999, 161), an estimated 50,000 domestic sheep were sheared each year at Notom and the Sandy Ranch; thousands more were sheared at the Fairview and Starr ranches. Thus, as many as 100,000 sheep may have grazed the Henry Mountains in earlier times. Today, the sheep are gone, and most grazing allotments have been converted to cattle.

The few shrubs in the foreground of the 1940 image were growing along an irrigation ditch that is still in use. The cottonwood growing along the irrigation ditch in 1940 (center) is still alive, despite having recently been struck by lightning. The area is more heavily vegetated today than it was in the past. Common plants now include curly grass, rubber rabbitbrush, shadscale, snakeweed, and pricklypear cactus. In the distance, cottonwoods have increased along Bull Creek, as have pinyon and juniper. The 2003 Lonesome Beaver Fire burned part of Horseshoe Ridge.

Original photographs taken by the BLM in 1940; retakes made by Charles E. Kay on May 16, 2012 (Photo Nos. 6234-20 and 6234-28). Section 8, Range 30 East, Township 30 South; UTM 522840E, 4229700N; elevation 5,182 ft. Original images held in the BLM's range files, Hanksville, UT. Photo mosaic compiled by Doug Page, BLM, Cedar City, UT.

HM-363-365, 1940

HM-363-365, 2012

Plate HM-400

Fremont River

1894 † 2012

Viewed east-northeast down the Fremont River, just below where Utah Highway 24 crosses the river north of the Blue Dugway. The old road to Caineville is located at the base of the nearest cliff. South Caineville Mesa is in the distance. The photo point is on privately owned property and is grazed yearly by cattle. (See also Plate HM-401.)

At this location, the river turns east and flows through a gap in the Caineville Reef. Note that in the foreground of the 1894 photo there were no willows or cottonwoods, only greasewood. Today, the area is a cottonwood forest. Clearly, this plate does not support the contention of Fleischner (2010) that continued livestock grazing has prevented the recovery of woody riparian vegetation along the Fremont River outside Capitol Reef National Park.

Original photograph taken by Marcus E. Jones (Slide 246) in 1894; retake made by Charles E. Kay on May 20, 2012 (Photo No. 6245-33A). Section 15, Range 8 East, Township 29 South; UTM 496538E, 4238304N; elevation 4,678 ft. Original image held by the Rancho Santa Ana Botanic Garden, Claremont, CA. Image digitized and provided by Dr. William R. Gray (2011), Emeritus Professor of Biology, University of Utah, Salt Lake City, UT.

HM-400, 1894

HM-400, 2012

Plate HM-401

Fremont River

1942 † 2012

Viewed east where the Fremont River flows through a gap in the Caineville Reef. (See also Plate HM-400.) The rock wall beyond the vehicle in the 1942 image is part of the Caineville Reef. The distant cliff on the left skyline is South Caineville Mesa. The original camera station is now blocked by a dense growth of cottonwoods, so the retake was made from the nearest open area that allowed a view of both the stream and Caineville Reef.

Repeated floods after 1894 completely transformed the Fremont River into a stream 200–300 yards wide, with an absence of woody riparian vegetation, as seen in this 1942 image. Since that time the river's channel has narrowed and down-cut, as seen in the retake. In contrast with conditions in 1942, the Fremont is now lined with willows and cottonwoods. Many of the cottonwoods in the retake were defoliated by tent caterpillars, while others were felled by beaver. Clearly this plate does not support the contention of Fleischner (2010) that continued livestock grazing has prevented the recovery of woody riparian vegetation along the Fremont River outside Capitol Reef National Park.

Original photograph taken by Charles Kelly on April 10, 1942; retake made by Charles E. Kay on May 20, 2012 (Photo No. 6247-2). Section 15, Range 8 East, Township 29 South; UTM 496406E, 4238316N; elevation 4,685 ft. Original image (No. 10,486) held by the Utah State Historical Society, Salt Lake City, UT.

HM-401, 1942

HM-401, 2012

Plate HM-404

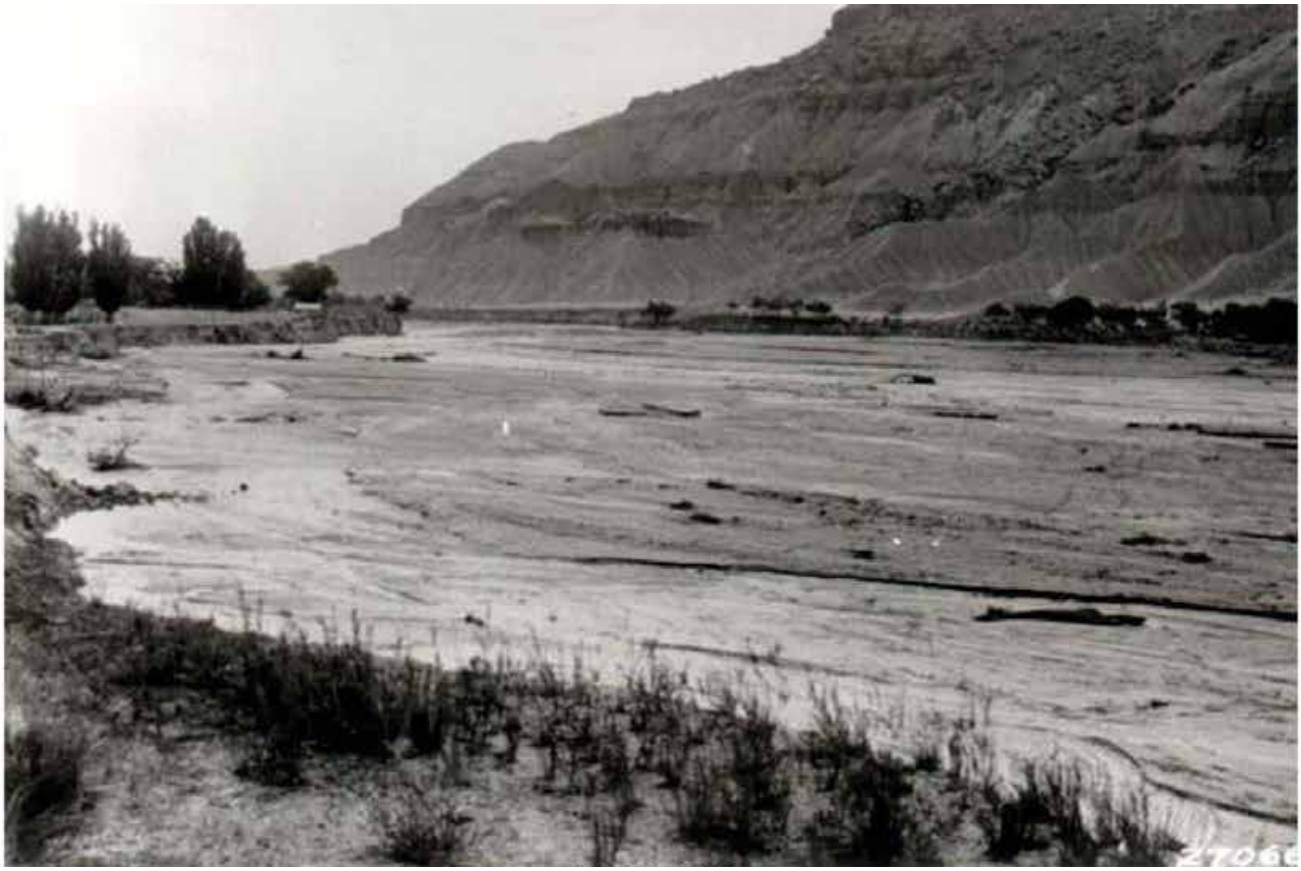
Caineville

1932 † 2012

Viewed east-southeast down the Fremont River from the old road on the western edge of Caineville, Utah. South Caineville Mesa is across the river on the right.

In 1932 the Fremont River was 300–400 yards wide at this point and had consumed a portion of the town. Note the building on the left bank in the distance, about to fall into the river. Today, the channel has stabilized and moved far to the south (right), where it is hidden from view. Tamarisk, willows, and cottonwoods have become established on what was once an active riverbed.

Original photograph taken by Reid Bailey in 1932; retake made by Charles E. Kay on May 20, 2012 (Photo No. 6247-16). Section 35, Range 8 East, Township 28 South; UTM 498169E, 4242533N; elevation 4,628 ft. Original image (C-439, Box 7, No. 270664) held by the Utah State Historical Society, Salt Lake City, UT.



HM-404, 1932

HM-404, 2012

Plate HM-424

Dirty Devil River

1984 † 2012

Viewed west from the southwest corner of the Utah Highway 95 bridge over the Dirty Devil River. The North Pinto Hills are on the skyline. In the distance, Muddy Creek on the right joins the Fremont River on the left to form the Dirty Devil. The flow is toward the camera.

All stream channels have narrowed, and woody riparian vegetation has increased, including willows, cottonwoods, tamarisk, and Russian olive.

Original photograph taken by Charles Hunt in 1984 (print from a color slide); retake made by Charles E. Kay on May 22, 2012 (print from a color slide). Section 2, Range 11 East, Township 28 South; UTM 526898E, 4250548N; elevation 4,290 ft. Original image (PO-568, No. 1-4-34) held by the University of Utah, Marriott Library Special Collections, Salt Lake City, UT.

HM-424, 1984

HM-424, 2012

Plate HM-437

Halfway Bench Exclosure

1967 † 2012

Viewed south down the west fence line of the Halfway Bench Exclosure, along the road to Angel Cove, southeast of Hanksville, Utah. BLM records do not indicate when the exclosure was built; however, there is a 1952 photo of the exclosure in the BLM's files. The fence apparently has been repaired or rebuilt over the years.

By 1967 a dense stand of nonnative grasses had developed inside the fenced area. Today, those nonnative grasses have died out and have been replaced by native species, including curly grass, shadscale, Indian ricegrass, winterfat, and Mormon tea. The area outside the exclosure is still heavily grazed by cattle.

Original photograph taken by the BLM on August 10, 1967; retake made by Charles E. Kay on May 23, 2012 (Photo No. 6257-4). Section 13, Range 11 East, Township 29 South; UTM 529943E, 4238488N; elevation 4,600 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-437, 1967

HM-437, 2012

Plate HM-442

Mount Hillers

1940 † 2012

Viewed northwest to the eastern flank of Mount Hillers, about 2 miles northeast of Starr Springs.

The area was very heavily grazed by domestic sheep in 1940. Judging by the hedged appearance in the original photo, all the blackbrush plants had been repeatedly browsed. The allotment is now grazed by cattle. Blackbrush has increased, as has pinyon-juniper. Mormon tea and sagebrush are also present, while perennial grass cover is minimal. A small amount of cheatgrass has invaded the land in the foreground. The 2003 Bulldog Fire burned parts of Mount Hillers in the distance.

Original photograph taken by the BLM in 1940; retake made by Charles E. Kay on May 24, 2012 (Photo No. 6257-23). Section 12, Range 11 East, Township 34 South; UTM 531056E, 4191223N; elevation 6,214 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-442, 1940

HM-442, 2012

Plate HM-443

Starr Springs

1940 † 2012

Viewed southwest to Starr Springs. A dense growth of willows and wild rose now blocks the original camera station, so the retake was made from the nearest open area, along the road in front of campsite number five in what is now a BLM campground (note the roof of a pit toilet, right-center).

The area was very heavily grazed in 1940. In the distance are cottonwoods. The shorter trees are oak brush.

Original photograph taken by the BLM in 1940; retake made by Charles E. Kay on May 24, 2012 (Photo No. 6257-29). Section 14, Range 11 East, Township 34 South; UTM 529743E, 4184146N; elevation 6,169 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-443, 1940

HM-443, 2012

Plate HM-447

Copper Creek Bench

1952 † 2012

Viewed north-northwest across upper Copper Creek Bench to the southern slopes of Mount Hillers, about 2 miles west of Starr Springs.

Pinyon, juniper, and mountain big sagebrush have all increased. Curly grass and blue grama are also present.

Original photograph taken by the BLM on May 14, 1952; retake made by Charles E. Kay on May 24, 2012 (Photo No. 6260-9). Section 15, Range 11 East, Township 34 South; UTM 527323E, 4188512N; elevation 6,161 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-447, 1952

HM-447, 2012

Plate HM-448

Upper Copper Creek Bench

1967 † 2012

Viewed west to one of the sandstone spires on the southern slopes of Mount Hillers, about 2 miles west of Starr Springs. A juniper now blocks the original camera station, so the retake was made a few feet further to the west (forward).

Years of excessive domestic sheep grazing removed the lower branches of the juniper nearest the camera in the 1967 photo. Pinyon, juniper, and sagebrush have all increased; grasses, primarily curly grass and blue grama, have declined. Cheatgrass has begun to invade the site. Apparently, livestock have not used this area in many years, but mule deer pellet groups were observed.

Original photograph taken by Charles Hunt in 1967 (print from a color slide); retake made by Charles E. Kay on May 24, 2012 (print from a color slide). Section 15, Range 11 East, Township 34 South; UTM 527075E, 4189743N; elevation 6,624 ft. Original image (PO-568, No. 1-5-83) held by the University of Utah, Marriott Library Special Collections, Salt Lake City, UT.

HM-448, 1967

HM-448, 2012

Plate HM-449

Upper Copper Creek Benches

1940 † 2012

Viewed north-northeast to Mount Hillers, about 2 miles west of Starr Springs.

By 1940 domestic sheep had eaten everything but the rocks. Note that all junipers in the 1940 image had their lower branches consumed by years of excessive domestic sheep grazing. Although the area is now part of a cattle allotment, a lack of cow piles indicates that livestock have not used the area in recent years. Mule deer pellet groups, though, were observed. Today, mountain big sagebrush, pinyon, and juniper have all increased. Curly grass and blue grama are also present. Judging by the vegetation in Plate HM-449, one would assume that sagebrush increased once sheep grazing was eliminated. Plate HM-448, however, which is just up-slope from this photo point, suggests that may not be the case. Instead, based on Plate HM-448, the area apparently went from being overgrazed, to being a native grassland, before being overrun by sagebrush.

Original photograph taken by the BLM in 1940; retake made by Charles E. Kay on May 24, 2012 (Photo No. 6260-30). Section 15, Range 11 East, Township 34 South; UTM 526966E, 4189428N; elevation 6,443 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-449, 1940

HM-449, 2012

Plate HM-452

Lower Oak Creek Canyon

1915 † 2012

Viewed northwest across lower Oak Creek Canyon on the Sandy Ranch.

Pinyon and juniper have increased, especially on the distant slope. Shrubs in the foreground, primarily sagebrush and fourwing saltbush, have declined.

Original photograph taken by George C. Fraser (2005) on July 13, 1915; retake made by Charles E. Kay on June 15, 2012 (Photo No. 6263-6A). Section 36, Range 7 East, Township 31 South; UTM 491940E, 4213942N; elevation 5,592 ft. Original image (WC-038, Box 3, No. 8-12) held by Princeton University Library Special Collections, Princeton, NJ.

HM-452, 1915

HM-452, 2012

Plate HM-457

Upper Oak Creek Bench

1915 † 2012

Viewed southwest across Siphon Canyon to upper Oak Creek Bench on the Sandy Ranch. The Waterpocket Fold is in the distance. Pinyon and juniper now block the original camera station, so the retake was made from the canyon rim, which is further to the south. The Sandy Ranch's Oak Creek siphon is just to the west of the photo point.

Across the canyon in the 1915 photo is a linear disturbed area running from right to left through the center of the image. This is the Sandy Ranch's Oak Creek irrigation ditch, which today is in a buried pipe next to an unimproved dirt road. Pinyon and juniper have increased; sagebrush has declined.

Original photograph taken by George C. Fraser (2005) on July 13, 1915; retake made by Charles E. Kay on June 15, 2012 (Photo No. 6263-27A). Section 27, Range 7 East, Township 31 South; UTM 488569E, 4214387N; elevation 5,809 ft. Original image (WC-038, Box 3, No. 9-1) held by Princeton University Library Special Collections, Princeton, NJ.

HM-457, 1915

HM-457, 2012

Plate HM-461

Stevens Narrows

1915 † 2012

Viewed west just above Stevens Narrows on upper Sweetwater Creek. The original camera station is now blocked by two junipers, so the retake was made about 20 feet forward.

Sagebrush and greasewood are common in the drainage nearest the camera. The low-growing shrubs on the surrounding hills are primarily shadscale. Juniper has increased. Curly grass is also present.

Original photograph taken by George C. Fraser (2005) on July 11, 1915; retake made by Charles E. Kay on June 16, 2012 (Photo No. 6268-11). Section 13, Range 9 East, Township 32 South; UTM 511030E, 4207997N; elevation 6,524 ft. Original image (WC-038, Box 3, No. 8-10) held by Princeton University Library Special Collections, Princeton, NJ.

HM-461, 1915

HM-461, 2012

Plate HM-462

Apple Brush Flat

1915 † 2012

Viewed northwest across Apple Brush Flat to the southern end of Stevens Mesa.

Sagebrush, squaw apple, and pinyon-juniper have all increased. Blue grama, Mormon tea, and snakeweed are also present.

Original photograph taken by George C. Fraser (2005) on July 9, 1915; retake made by Charles E. Kay on June 16, 2012 (Photo No. 6268-16). Section 22, Range 9 East, Township 31 South; UTM 508691E, 4216964N; elevation 6,414 ft. Original image (WC-038, Box 3, No. 7-7) held by Princeton University Library Special Collections, Princeton, NJ.

HM-462, 1915

HM-462, 2012

Plate HM-465

Burro Wash

1940 † 2012

Viewed west-southwest near the head of Burro Wash, with the Waterpocket Fold in the distance. The original photo is captioned, "Gone with the Wind." The photo was taken to document the soil loss that was occurring at the time from wind erosion, which was caused by overgrazing. As domestic sheep stripped away the native vegetation, the sandy soil was exposed, allowing wind to move the soil across the landscape. Although cattle graze the Burro Wash today, erosion is minimal because grasses, including sand dropseed, curly grass, and Indian ricegrass, have increased and now hold the sandy soil in place. Mormon tea and snakeweed are also present.

Original photograph taken by the BLM in 1940; retake made by Charles E. Kay on June 17, 2012 (Photo No. 6268-26). Section 19, Range 8 East, Township 30 South; UTM 491928E, 4226472N; elevation 5,229 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-465, 1940

HM-465, 2012

Plate HM-473

Granite Ridges

1964 † 2012

Viewed north-northwest across the Granite Ridges to Wickiup Ridge on the right skyline.

Conifers have increased, including Douglas-fir, limber pine, pinyon, and juniper. Oak brush has also increased, as has sagebrush in the foreground. Forage production has decreased near the camera. This decrease is most likely due to drought, since that area has recently been grazed only by bison and mule deer, not by livestock, as evidenced by a lack of cow piles. The 2003 Lonesome Beaver Fire burned a portion of Wickiup Ridge, including stands of curl-leaf mountain mahogany.

Original photograph taken by the BLM in 1964; retake made by Charles E. Kay on June 18, 2012 (Photo No. 6271-24A). Section 26, Range 10 East, Township 31 South; UTM 519962E, 4214777N; elevation 9,324 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-473, 1964

HM-473, 2012

Plate HM-474

Eagle City

1962 † 2012

Viewed west up Crescent Creek to Eagle City, which was established in 1892 (Murphy 1999, 139). The cabin seen in the original image has been removed, and none of the old logs are present.

Woody vegetation has increased, including pinyon, juniper, narrow leaf cottonwood, Utah serviceberry, oak brush, Douglas-fir, and spruce.

Original photograph taken by Packer Hamilton ca. 1962; retake made by Charles E. Kay on June 18, 2012 (Photo No. 6271-30A). Section 31, Range 11 East, Township 31 South; UTM 522178E, 4213980N; elevation 7,779 ft. Original image (No. 15,301) held by the Utah State Historical Society, Salt Lake City, UT.

HM-474, 1962

HM-474, 2012

Plate HM-476

Mount Pennell

1967 † 2012

Viewed south to The Horn and Mount Pennell, with Mount Hillers on the left skyline.

Pinyon, juniper, Douglas-fir, and limber pine have increased in the foreground. Note the chaining in the 1967 image (right edge) and how it is filling in with pinyon-juniper today. There is also a post-1967 chaining along the road to Pennell Pass in the retake. In 2003 much of Mount Pennell and all of the north side of Mount Hillers were burned by the Bulldog Fire, a high-intensity crown fire that burned everything in its path.

Original photograph taken by Charles Hunt in 1967 (print from a color slide); retake made by Charles E. Kay on June 18, 2012 (print from a color slide). Section 9, Range 10 East, Township 32 South; UTM 516735E, 4210742N; elevation 9,312 ft. Original image (PO-568, No. 1-5-182) held by the University of Utah, Marriott Library Special Collections, Salt Lake City, UT.

HM-476, 1967

HM-476, 2012

Plate HM-478

South Creek

1964 † 2012

Viewed north-northwest across South Creek to Nasty Flat. North Summit Ridge is on the right-center skyline. The photo point is on South Creek Ridge, just above the main road.

Conifers have increased, including pinyon, juniper, Douglas-fir, ponderosa pine, limber pine, and spruce. Although a few aspen stands successfully regenerated 35–40 years ago when mule deer numbers were low (Kay and Bartos 2000), in general most aspen stands have declined. Today most aspen suckers have been and are repeatedly browsed by mule deer, preventing aspen height growth. Bison now heavily use the area in the foreground.

Original photograph taken by the BLM in 1964; retake made by Charles E. Kay on June 18, 2012 (Photo No. 6274-18). Section 4, Range 10 East, Township 32 South; UTM 515955E, 4211412N; elevation 9,479 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-478, 1964

HM-478, 2012

Plate HM-484

Sweetwater Valley

1958 † 2012

In 1958 the BLM established the C-3-1 range monitoring site on the Steel Butte Allotment. The view is to the east. The photo point is located about 2 miles south of the King Ranch and 200 yards east of the main road. All the steel stakes are still present, including the sign board along the main road.

Common species include fourwing saltbush, greasewood, snakeweed, squaw apple, curly grass, needle and thread, Indian ricegrass, and cheatgrass. A few of the small junipers that were invading the area in 1958 have died; others have become established.

Original photograph taken by the BLM on September 3, 1958; retake made by Charles E. Kay on June 19, 2012 (Photo No. 6277-11A). Section 8, Range 9 East, Township 32 South; UTM 505811E, 4209576N; elevation 5,942 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-484, 1958

HM-484, 2012

Plate HM-486

Sulphur Creek

1932 † 2012

Viewed west up Sulphur Creek in Capitol Reef National Park.

Cottonwoods, willows, and other riparian vegetation have increased, while the stream channel has narrowed.

Original photograph taken by Reid Baily in 1932; retake made by Charles E. Kay on June 20, 2012 (Photo No. 6277-20A). Section 14, Range 6 East, Township 29 South; UTM 478243E, 4237725N; elevation 5,379 ft. Original image (No. C-439, Box 3, Number 270669) held by the Utah State Historical Society, Salt Lake City, UT.

HM-486, 1932

HM-486, 2012

Plate HM-501

Fremont River

1930 † 2012

Viewed east-northeast down the Fremont River, from the upper bridge in Capitol Reef National Park during a flood event.

The stream channel has narrowed, and woody riparian vegetation—primarily cottonwoods and willows—has increased.

Original photo taken by Arthur Ingelsby ca. 1930; retake made by Charles E. Kay on June 20, 2012 (Photo No. 6282-10). Section 14, Range 6 East, Township 29 South; UTM 478430E, 4237451N; elevation 5,390 ft. Original image (C-345, Box 2, Folder 4, No. 11) held by the Utah State Historical Society, Salt Lake City, UT.

HM-501, 1930

HM-501, 2012

Plate HM-502

Notom Bench

1958 † 2012

In 1958 the BLM established the C-1-2 range monitoring site on Notom Bench. The view is to the west-northwest, with the Waterpocket Fold in the distance. The steel stakes could not be relocated.

Juniper has increased, as have curly grass and Indian ricegrass. Other species include Mormon tea, yucca, and pricklypear cactus.

Original photograph taken by the BLM on September 2, 1958; retake made by Charles E. Kay on June 21, 2012 (Photo No. 6282-15). Section 13, Range 7 East, Township 30 South; UTM 490313E, 4228048N; elevation 5,487 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-502, 1958

HM-502, 2012

Plate HM-504

Kimble and Turner Peak

1937 † 2012

Viewed southwest to Kimble and Turner Peak from Bartons Peak. A mining road to Bromide Basin is visible in the retake.

Conifers have increased, including Douglas-fir, limber pine, spruce, and subalpine fir. Oak brush and Utah serviceberry have also increased. There are a few small pockets of aspen in both images. The dead Douglas-fir in the retake were killed by the Douglas-fir beetle.

Original photograph taken by Charles Hunt (No. 585) in June 1937; retake made by Charles E. Kay on June 26, 2012 (Photo No. 6282-20). Section 35, Range 7 West, Township 32 South; UTM 520044E, 4213397N; elevation 10,036 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-504, 1937

HM-504, 2012

Plates HM-505 and HM-506

Bartons Peak

1937 † 2012

Viewed north from Bartons Peak over the Granite Ridges and down Bull Creek. Bull Mountain is on the right skyline. Wickiup Ridge is also on the right but nearer the camera, in the mid-distance. Plates HM-505 and HM-506 form a panorama.

Conifers have increased, including pinyon, juniper, Douglas-fir, limber pine, spruce, and subalpine fir. Oak brush, Utah serviceberry, and curl-leaf mountain mahogany have also increased. The road to Wickiup Pass is visible in the retake (upper-left-center edge), as is part of the area burned by the Lonesome Beaver Fire in 2003.

Original photographs taken by Charles Hunt (Nos. 579 and 580) in June 1937; retakes made by Charles E. Kay on June 26, 2012 (Photo Nos. 6282-26 and 6282-29). Section 35, Range 7 West, Township 32 South; UTM 520044E, 4213397N; elevation 10,036 ft. Original images held by the U.S. Geological Survey Photographic Library, Denver, CO. Photo mosaic compiled by Doug Page, BLM, Cedar City, UT.

HM-505-506, 1937

HM-505-506, 2012

Plate HM-507

Bromide Basin

1937 † 2012

Viewed west from below Bartons Peak, up Crescent Creek to Bromide Basin. Limber pine now block the original camera station, so the retake was made from the nearest open area, which is a little further down-slope. Note the new mining roads in the retake, as Bromide Basin and Crescent Creek are the main, gold-producing areas in the Henry Mountains.

Conifers have increased, including pinyon, juniper, limber pine, Douglas-fir, and spruce. Aspen has increased on the slopes above Crescent Creek (right).

Original photograph taken by Charles Hunt (No. 586) in June 1937; retake made by Charles E. Kay on June 26, 2012 (Photo No. 6281-32). Section 35, Range 7 West, Township 32 South; UTM 520020E, 4213372N; elevation 10,031 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-507, 1937

HM-507, 2012

Plates HM-510 and HM-511

Mount Pennell

1937 † 2012

Viewed north from the top of Mount Pennell, down Dark Canyon and across Slate Creek to South Summit Ridge (the higher ground on the left skyline). Plates HM-510 and HM-511 form a panorama.

Conifers and other woody vegetation have increased, including pinyon, juniper, Douglas-fir, ponderosa pine, spruce, subalpine fir, and oak brush. This increase is especially evident on the midslopes of South Summit Ridge. The open areas to the left of The Horn (on the left in the center of the photo) in the retake are mostly pinyon-juniper chainings. Much of the land in the foreground and the area to the right of The Horn was burned by the Bulldog Fire in 2003.

Original photographs taken by Charles Hunt (Nos. 587 and 588) in August 1937; retakes made by Charles E. Kay on June 27, 2012 (Photo Nos. 6285-11 and 6285-14). Section 10, Range 10 East, Township 33 South; UTM 518383E, 4201011N; elevation 11,410 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO. Photo mosaic provided by Doug Page, BLM, Cedar City, UT.

HM-510-511, 1937

HM-510-511, 2012

Plate HM-512

Pistol Ridge

1915 † 2012

Viewed southeast from Pistol Ridge to Corral Point on the right skyline, with South Summit Ridge in the distance.

Conifers have increased, including pinyon, juniper, Douglas-fir, and spruce; aspen has declined.

Original photograph taken by George C. Fraser (2005) on July 9, 1915; retake made by Charles E. Kay on June 28, 2012 (Photo No. 6285-22). Section 20, Range 10 East, Township 31 South; UTM 514932E, 4216945N; elevation 9,559 ft. Original image (WC-038, Box 3, No. 8-10) held by Princeton University Library Special Collections, Princeton, NJ.

HM-512, 1915

HM-512, 2012

Plate HM-514

South Summit Ridge

1938 † 2012

Viewed northwest form South Summit Ridge to Bull Creek Pass and North Summit Ridge.

Conifers have increased in the distance, including pinyon, juniper, Douglas-fir, limber pine, and spruce. The upper treeline, however, appears unchanged. A portion of North Summit Ridge (right-center) burned in the 2003 Lonesome Beaver Fire.

Original photograph taken by Charles Hunt (No. 805) in September 1938; retake made by Charles E. Kay on August 10, 2012 (Photo No. 6302-31A). Section 27, Range 10 East, Township 31 South; UTM 518000E, 4214780N; elevation 11,111 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-514, 1938

HM-514, 2012

Plate HM-515

North Fork of Bulldog Creek

1959 † 2012

In 1959 the BLM established the E-1-1 range monitoring site on the Pennell Allotment. The steel stakes could not be relocated.

Pinyon, juniper, and oak brush have increased. The foreground was chained and seeded with crested wheatgrass, but sagebrush now dominates the site. Pinyon and juniper that established after the earlier treatment were recently hand-felled. Utah serviceberry is also present.

Original photograph taken by the BLM on October 12, 1959; retake made by Charles E. Kay on August 11, 2012 (Photo No. 6320-2). Section 8, Range 10 East, Township 32 South; UTM 515211E, 4209700N; elevation 8,260 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-515, 1959

HM-515, 2012

Plate HM-529

Burro Wash

1911 † 2012

Viewed northwest up Burro Wash, just above its confluence with Sandy Creek. There is a new road on the right.

All the dark-colored shrubs in the foreground of both images are greasewood. Burro Wash has down-cut 10–20 feet. Cottonwoods have increased. Most tamarisk was recently top-killed by the introduced tamarisk beetle. Pinyon and juniper appear to have increased in the distance.

Original photograph taken by C.T. Lupton (No. 280) in 1911; retake made by Charles E. Kay on August 14, 2012 (Photo No. 6323-23). Section 33, Range 8 East, Township 30 South; UTM 494516E, 4224107N; elevation 5,084 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-529, 1911

HM-529, 2012

Plate HM-533

Apple Brush Flat

1911 † 2012

Viewed southeast across Apple Brush Flat. Steel Butte is on the right skyline, and Mount Pennell is on the skyline in the center. Pinyon-juniper now blocks the original photo point, so the retake was made from the nearest open area.

Pinyon and juniper have increased; fourwing saltbush has declined. Other species include Mormon tea, snakeweed, curly grass, Indian ricegrass, and needle and thread.

Original photograph taken by C.T. Lupton (No. 282) in 1911; retake made by Charles E. Kay on September 8, 2012 (Photo No. 6326-20). Section 8, Range 9 East, Township 31 South; UTM 504990E, 4219048N; elevation 5,789 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-533, 1911

HM-533, 2012

Plate HM-543

Eggnog

1940 † 2012

Viewed southwest down Bullfrog Creek to the line camp known as Eggnog. Note the small cabin in the 1940 image (upper-right-center) and the new, larger cabin surrounded by tamarisk in the retake.

The stream channel has narrowed, and cottonwoods have increased. As indicated by all the livestock trails in the 1940 photo, the area to the right of the creek was very heavily grazed. Today it is more vegetated. Common species include greasewood, rubber rabbitbrush, shadscale, and blackbrush.

Original photo made with camera tilted slightly to the right. Original photograph taken by the BLM in 1940; retake made by Charles E. Kay on September 10, 2012 (Photo No. 6328-30). Section 18, Range 10 East, Township 35 South; UTM 513678E, 4180468N; elevation 4,509 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-543, 1940

HM-543, 2012

Plate HM-560

Halfway Wash

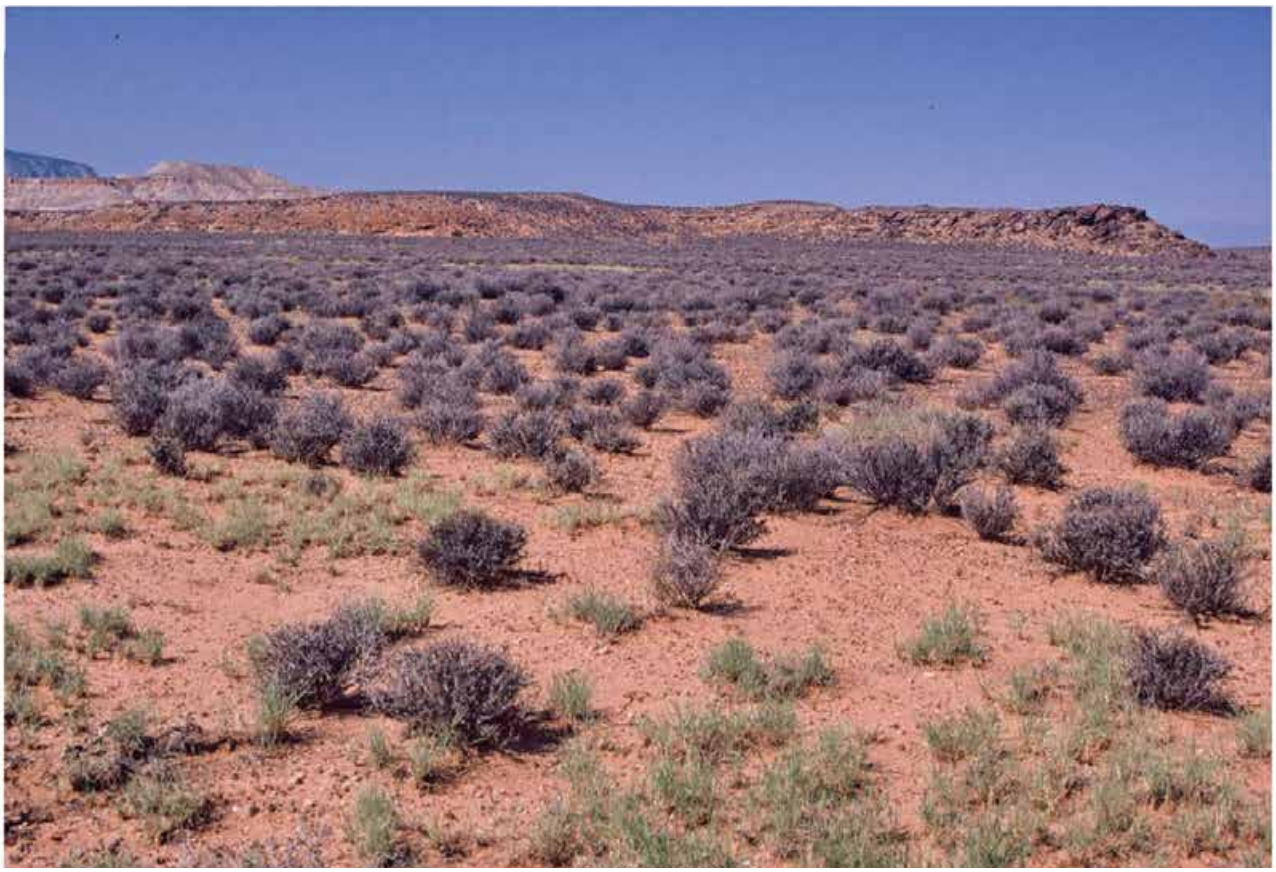
1959 † 2012

In 1959 the BLM established range monitoring site D-4-2 above Halfway Wash. The photo point is located south of the road that runs from Utah Highway 95 in the east to the Fairview Ranch in the west, south of Hanksville. The steel stake was relocated.

There has been a corresponding increase in blackbrush and a decrease in grass cover, mostly curly grass. Mormon tea is also present.

Original photograph was taken by the BLM on October 1, 1959; retake made by Charles E. Kay on September 13, 2012 (Photo No. 6335-21). Section 11, Range 11 East, Township 30 South; UTM 526851E, 4229491N; elevation 5,076 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-560, 1959



HM-560, 2012

Plate HM-563

Mount Ellen

1915 † 2012

Viewed north to Mount Ellen from North Summit Ridge.

The upper treeline has not changed. The dark-colored shrubs are currants.

Original photograph taken by David Rust ca. 1915; retake made by Charles E. Kay on September 14, 2012 (Photo No. 6335-32). Section 16, Range 10 East, Township 31 South; UTM 516321E, 4218324N; elevation 11,291 ft. Original image (David Rust Collections, Box 6, unnumbered negative) held by the LDS Church Archives, Salt Lake City, UT.

HM-563, 1915

HM-563, 2012

Plate HM-567

Mount Ellen

1936 † 2012

Viewed northeast from the summit of Mount Ellen to East Saddle, Horseshoe Ridge (middle ground, bare of trees in 2012), and Bull Mountain (tallest mountain on right).

Much of Horseshoe Ridge burned in the 2003 Lonesome Beaver Fire. Elsewhere conifers have increased, including pinyon, juniper, ponderosa pine, Douglas-fir, limber pine, and spruce. Conifers have also invaded aspen stands.

Original photograph taken by Charles Hunt (No. 735) in September 1936; retake made by Charles E. Kay on September 14, 2012 (Photo No. 6340-14). Section 9, Range 10 East, Township 31 South; UTM 516272E, 4219268N; elevation 11,477 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-567, 1936

HM-567, 2012

Plate HM-568

North Summit Ridge

1936 † 2012

Viewed south along North Summit Ridge from the summit of Mount Ellen.

The upper treeline has not changed, although conifers, mostly spruce and Douglas-fir, have increased in height and numbers. The dark-colored shrubs are currants. Conifers in the lower right of the retake burned in the 2003 Lonesome Beaver Fire.

Original photograph taken by Charles Hunt (No. 734) in September 1936; retake made by Charles E. Kay on September 14, 2012 (Photo No. 6340-15). Section 9, Range 10 East, Township 31 South; UTM 516272E, 4219268N; elevation 11,477 ft. Original image held by the U.S. Geological Survey Photographic Library, Denver, CO.

HM-568, 1936

HM-568, 2012

Plate HM-573 and HM-574

Straight Creek

1937 † 2012

Viewed west-southwest up Straight Creek on the east side of Mount Pennell. Plates HM-573 and HM-574 form a panorama.

Except for a small patch of conifers on the uppermost ridge, the entire area was burned by the 2003 Bulldog Fire. Oak brush in the foreground has successfully resprouted, as has aspen across the creek.

Original photographs taken by Charles Hunt (Nos. 620 and 621) in July 1937; retakes made by Charles E. Kay on September 16, 2012 (Photo Nos. 6343-11 and 6343-13). Section 11, Range 10 East, Township 33 South; UTM 520147E, 4200306N; elevation 8,456 ft. Original images held by the U.S. Geological Survey Photographic Library, Denver, CO. Photo mosaic compiled by Doug Page, BLM, Cedar City, UT.

HM-573-574, 1937

HM-573-574, 2012

Plate HM-577

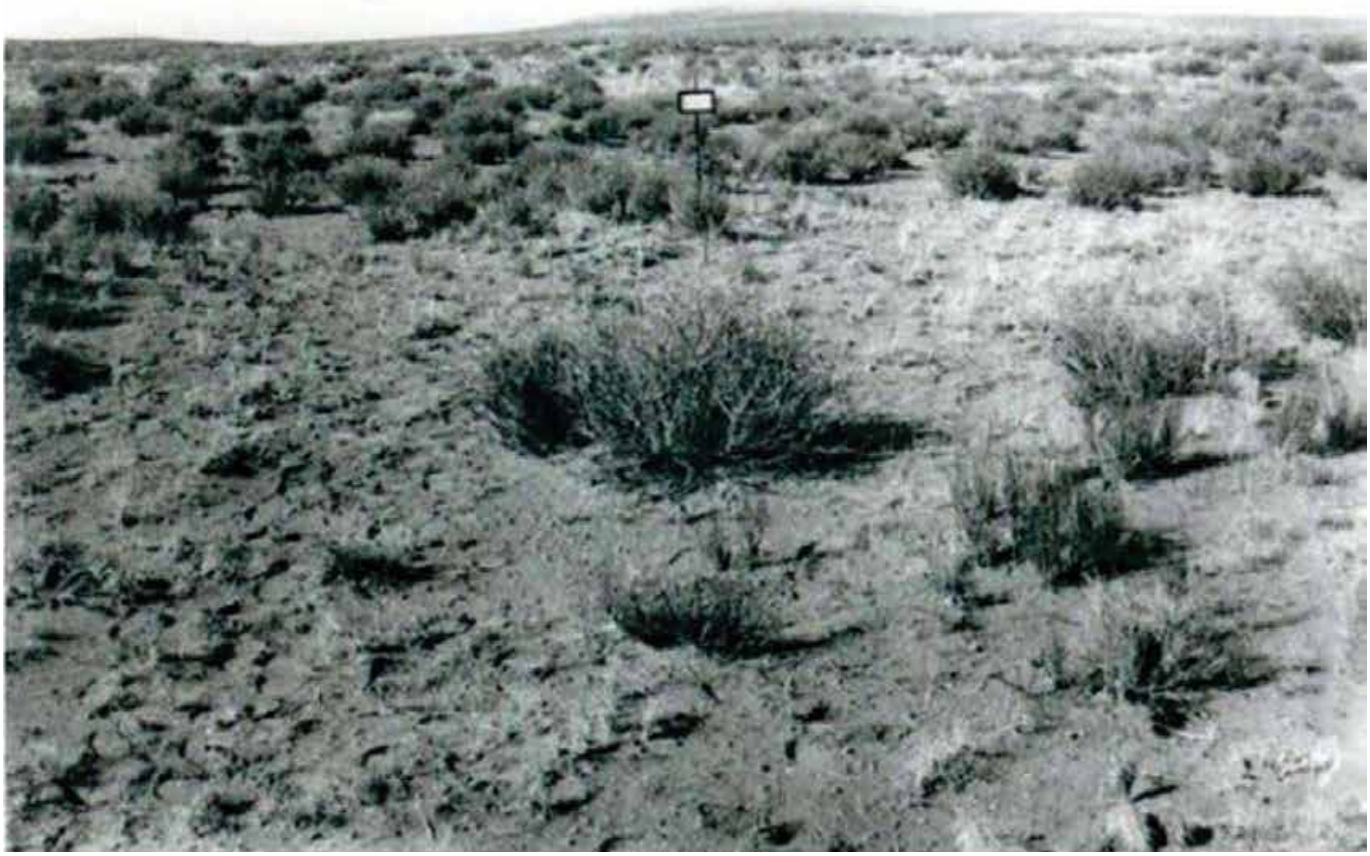
Burr Desert

1959 † 2012

In 1959 the BLM established range monitoring site D-2-1 west of Adobe Swale reservoir in the Burr Desert. The view is to the north. All the steel stakes were relocated.

Blackbrush has increased, while curly grass has declined. Other species include Mormon tea and pricklypear cactus.

Original photograph taken by the BLM on September 29, 1959; retake made by Charles E. Kay on September 16, 2012 (Photo No. 6343-26). Section 28, Range 13 East, Township 30 South; UTM 543191E, 4224958N; elevation 5,325ft. Original image held in the BLM's range files, Hanksville, UT.



HM-577, 1959

HM-577, 2012

Plate HM-582

Burr Desert

1972 † 2012

In 1972 the BLM established the Burr Point 3 range monitoring site on the Burr Point Allotment. The view is to the southeast, and all the steel stakes were located. The steel fencepost in the distance has been moved to the top of a sand dune on the left so that it is easier to locate.

The area is more vegetated today, and there is less wind erosion than in the past. Turbinella oak has increased, as has Mormon tea. Other species include Indian ricegrass and sand dropseed.

Original photograph taken by the BLM in 1972; retake made by Charles E. Kay on September 17, 2012 (print from a color slide). Section 23, Range 12 East, Township 30 South; UTM 537579E, 4226878N; elevation 4,990 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-582, 1972

HM-582, 2012

Plate HM-597

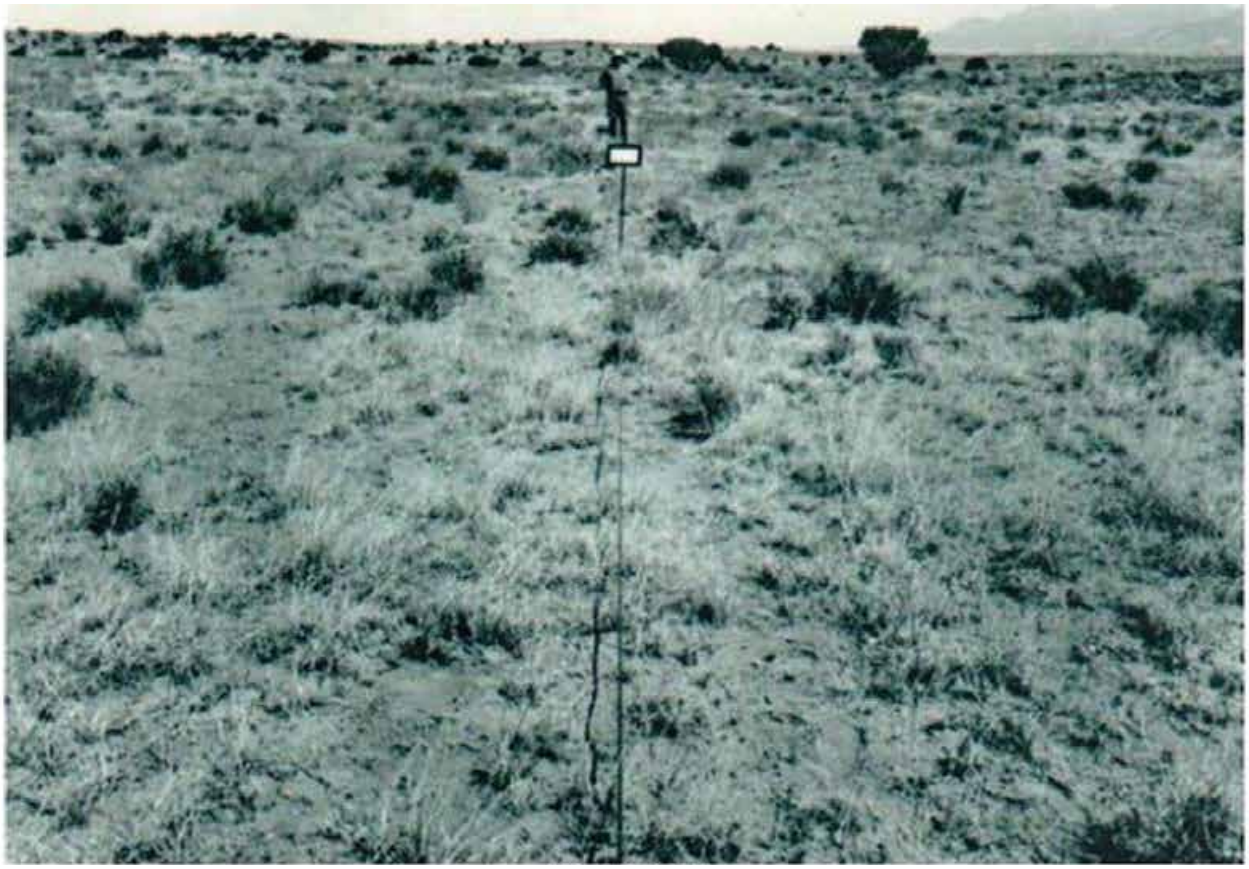
Big Thompson Mesa

1959 † 2012

In 1959 the BLM established range monitoring site C-7-1 on Big Thompson Mesa. The view is to the north-northwest. Mount Pennell is on the right skyline. The steel stake was relocated.

Blackbrush has increased. Other species include juniper, Mormon tea, snakeweed, curly grass, Indian ricegrass, and pricklypear cactus.

Original photograph taken by the BLM on September 22, 1959; retake made by Charles E. Kay on November 16, 2012 (Photo No. 6358-14). Section 33, Range 9 East, Township 35 South; UTM 506603E, 4174164N; elevation 5,180 ft. Original image held in the BLM's range files, Hanksville, UT.



HM-597, 1959

HM-597, 2012

Plate HM-599

South Big Thompson Mesa

1963 † 2012

In 1963 the BLM established range monitoring site C-15-2 on South Big Thompson Mesa (a.k.a. Little Thompson Mesa). The view is west to the Waterpocket Fold. The steel stake was relocated.

Common species include blackbrush and curly grass, with a limited amount of snakeweed and Indian ricegrass. This mesa top is waterless and surrounded by cliffs, and there was no sign of use by livestock or wildlife.

Original photograph taken by the BLM on July 16, 1963; retake made by Charles E. Kay on November 16, 2012 (Photo No. 6358-22). Section 22, Range 9 East, Township 36 South; UTM 508585E, 4168708N; elevation 4,980 ft. Original image held in the BLM's range files, Hanksville, UT.

HM-599, 1963

HM-599, 2012

Plate HM-603

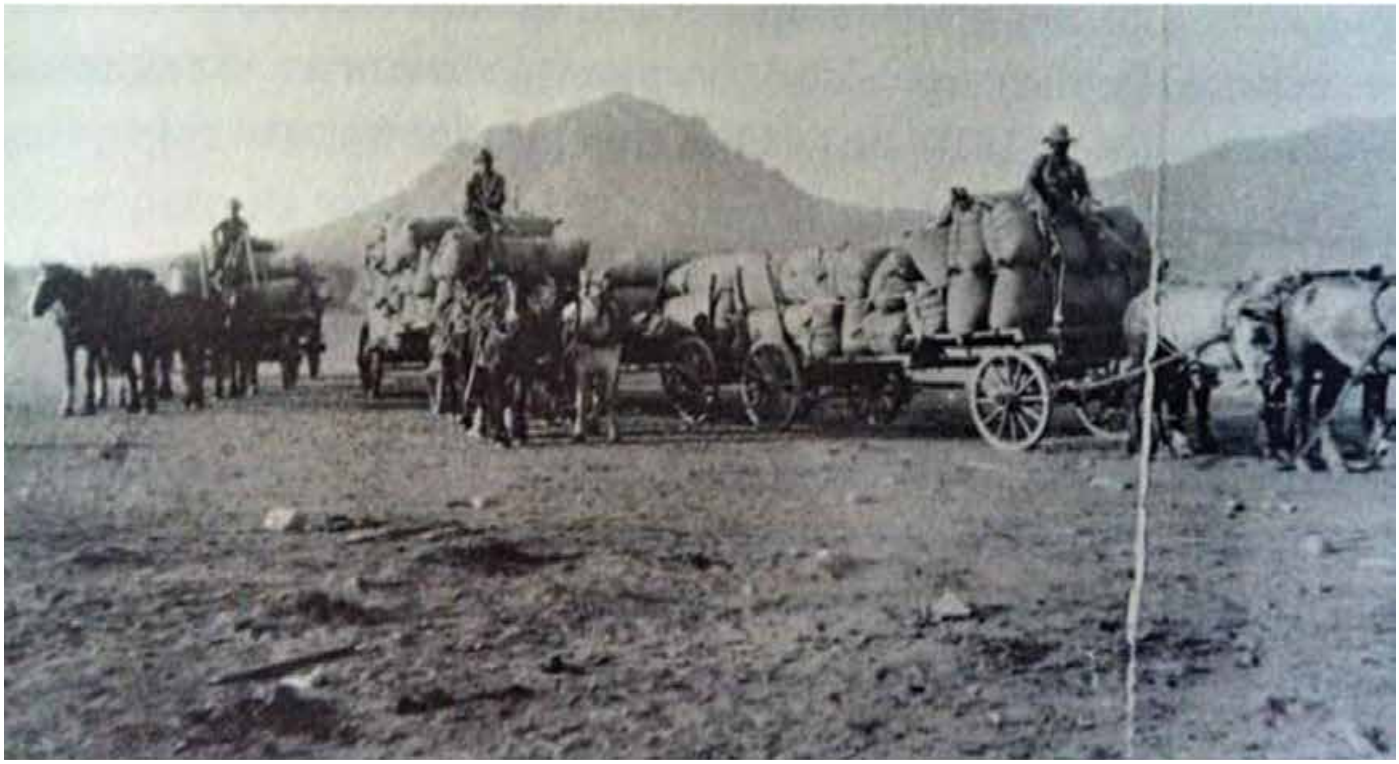
Fairview Ranch

1920 † 2013

Viewed southeast just to the south of the Fairview Ranch. Bull Mountain is in the distance.

The original photo shows three freight wagons loaded with large bags of wool. In the past, thousands of sheep were sheared each year at the Fairview Ranch, and the surrounding area was heavily overgrazed by those animals (see Plates HM-363 and HM-365). The foreground is more vegetated now than in earlier times. Today, curly grass, rubber rabbitbrush, snakeweed, and pricklypear cactus are common.

Original image taken by an unknown photographer ca. 1920; retake made by Charles E. Kay on April 22, 2013 (print from a color slide). Section 8, Range 11 East, Township 30 South; UTM 522836E, 4229564N; elevation 5,227 ft. Original photo from Murphy (1999, 161).



HM-603, 1920

HM-603, 2013

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Appendix A

Henry Mountains Repeat Photo Locations and Elevations

This table of UTM coordinates for the 608 Henry Mountains repeat photos of Charles E. Kay was provided by Doug Page, BLM, Cedar City, UT.

Henry Mountains Repeat Photo Locations and Elevations (UTM Zone 12N, NAD 83)

Plate No.	Easting	Northing	Elevation	Subject-Location
1	480746	4237574	5,338	Fremont River – Capitol Reef National Park
2	477217	4237973	5,510	Sulphur Creek
3	477711	4237483	5,461	Sulphur Creek
4	483512	4236659	5,203	Fremont River
5	480643	4237633	5,346	Fremont River
6	480912	4237267	5,322	Fremont River
7	480987	4237111	5,302	Fremont River
8	478564	4237369	5,400	Fremont River - Sulphur Creek
9	478229	4236969	5,426	Fremont River Valley
10	479853	4233555	5,652	Capitol Reef National Park
11	479845	4233482	5,668	Capitol Reef National Park
12	483667	4229239	5,630	Capitol Wash
13	478294	4237561	5,480	Sulphur Creek
14	480808	4237433	5,327	Fremont River
15	478462	4237779	5,502	Fremont River - Sulphur Creek
16	478507	4237653	5,440	Fremont River
17	478008	4237589	5,640	Fremont River Valley
18	483701	4236748	5,197	Fremont River
19	478564	4237493	5,464	Fremont River
20	481680	4229389	5,376	Capitol Wash
21	479463	4237907	5,420	Fremont River
22	497703	4188996	5,662	Burr Canyon
23	497703	4188996	5,662	Burr Canyon
24	497647	4189017	5,701	Burr Canyon
25	497518	4189091	5,816	Burr Canyon
26	502499	4215593	5,508	Sweetwater Creek
27	499220	4214955	5,583	Blind Canyon Trail
28	499205	4214954	5,582	Blind Canyon Trail
29	496013	4238300	4,693	Fremont River

Henry Mountains Repeat Photo Locations and Elevations (UTM Zone 12N, NAD 83)

Plate No.	Easting	Northing	Elevation	Subject-Location
30	518782	4247009	4,380	Fremont River
31	511238	4245731	4,424	Skyline Rim
32	495980	4238279	4,678	Fremont River
33	495561	4236923	4,904	Blue Dugway
34	495561	4236923	4,904	Blue Dugway
35	495682	4237063	4,888	Blue Dugway
36	495607	4236919	5,043	Blue Dugway
37	495607	4236919	5,043	South Caineville Mesa
38	497083	4239153	4,669	Fremont River
39	497083	4239153	4,669	Fremont River
40	497265	4239619	4,679	Fremont River
41	497492	4240679	4,654	Fremont River
42	491794	4234306	5,067	Caineville Reef
43	508042	4246408	4,603	Fremont River
44	509425	4246581	4,637	Factory Butte
45	508581	4246443	4,600	Henry Mountains
46	508581	4246443	4,600	Factory Butte
47	508581	4246443	4,600	Factory Butte
48	516050	4246587	4,413	Dakota Sandstone
49	515923	4246630	4,387	Fremont River
50	522066	4247282	4,375	Summerville Formation
51	525320	4248528	4,290	Fremont River
52	522466	4246900	4,322	Fremont River
53	522504	4246886	4,319	Fremont River
54	522446	4246842	4,364	Fremont River
55	523554	4247340	4,303	Fremont River
56	526792	4250631	4,311	Dirty Devil and Fremont Rivers
57	526802	4250618	4,257	Dirty Devil and Fremont Rivers
58	526802	4250618	4,257	Dirty Devil River
59	526789	4250503	4,243	Dirty Devil River
60	526117	4250179	4,259	Fremont River
61	526117	4250179	4,259	Fremont River
62	524052	4247404	4,310	Fremont River Valley
63	524340	4247407	4,299	Fremont River Valley
64	524327	4247409	4,296	Fremont River Valley
65	524924	4247141	4,294	Hanksville
66	524924	4247149	4,324	Hanksville

Henry Mountains Repeat Photo Locations and Elevations (UTM Zone 12N, NAD 83)

Plate No.	Easting	Northing	Elevation	Subject-Location
67	524917	4247221	4,302	Hanksville
68	525139	4247370	4,302	Bull Creek
69	523529	4247573	4,305	Fremont River
70	500520	4202238	5,061	Trachyte Creek
71	525386	4196732	8,174	Bulldog Peak
72	525411	4196733	7,434	Bastian Reservoir
73	525411	4196733	7,434	Bastian Reservoir
74	525524	4197320	7,065	Mount Hillers
75	525524	4197320	7,065	Big Ridge
76	525524	4197320	7,065	Big Ridge
77	524453	4196429	7,410	Cass Creek Peak
78	520794	4198944	8,351	Browns Knoll
79	520794	4198944	8,351	Straight and Browns Creeks
80	520794	4198944	8,351	Bulldog Ridge
81	522684	4198774	8,163	Mount Pennell
82	522684	4198774	8,163	Coyote Benches
83	521296	4198589	8,120	Mount Pennell
84	521356	4200705	7,910	Mount Pennell
85	521356	4200705	7,910	Mount Pennell
86	520376	4203612	8,376	Mount Pennell
87	520355	4203498	8,403	Mount Pennell
88	520724	4204159	8,094	Ragged Mountain
89	517120	4203641	8,707	Mount Pennell
90	517120	4203641	8,707	Mount Pennell
91	518716	4205369	7,912	The Horn
92	518710	4205423	7,938	The Horn
93	516807	4203945	8,519	Mount Ellen
94	516807	4203945	8,519	South Creek Ridge
95	517023	4206986	7,860	Pennellen Pass
96	517023	4206986	7,860	Pennellen Pass
97	516952	4208084	7,953	Pennellen Pass
98	516952	4208084	7,953	Pennellen Pass
99	518352	4209962	8,573	Slate Creek
100	520168	4211405	9,050	Ragged Mountain
101	520536	4211288	8,971	Copper Ridge
102	520564	4211291	8,970	Copper Ridge
103	520518	4211198	8,935	Mount Pennell

Henry Mountains Repeat Photo Locations and Elevations (UTM Zone 12N, NAD 83)

Plate No.	Easting	Northing	Elevation	Subject-Location
104	521670	4211056	8,987	Copper Ridge
105	521682	4211039	8,969	Ragged Canyon
106	520534	4211972	8,734	Copper Basin Spring
107	520169	4217291	9,779	Mount Ellen
108	520169	4217291	9,779	North Summit Ridge
109	517333	4215361	10,482	Bull Creek Pass
110	517367	4215317	10,482	Bull Creek Pass
111	517367	4215317	10,482	Bull Creek Pass
112	517289	4215499	10,503	Bull Creek Pass
113	517291	4215597	10,507	Bull Creek Pass
114	517369	4214138	10,344	Upper Dugout Creek
115	515911	4213119	9,585	South Summit Ridge
116	515183	4213802	9,590	Durfey Butte
117	515183	4213802	9,590	Durfey Butte
118	515183	4213802	9,590	Durfey Butte
119	515183	4213802	9,590	Durfey Butte
120	517254	4213339	10,467	South Creek
121	517254	4213339	10,467	Nasty Flat and Durfey Butte
122	516488	4211474	9,978	South Creek
123	516488	4211474	9,978	South Creek
124	513271	4213970	8,383	McClellan Spring
125	506466	4213024	6,025	Steele Butte
126	504342	4217270	5,920	Pete Steele Bench
127	504342	4217270	5,920	Pete Steele Bench
128	512506	4212915	7,861	South Creek Chainings
129	512506	4212915	7,861	South Creek Chainings
130	512506	4212915	7,861	South Creek Chainings
131	512506	4212915	7,861	South Creek Chainings
132	518926	4226245	6,180	Mount Ellen Peak
133	518926	4226245	6,180	Mount Ellen Peak
134	527861	4224543	5,102	Granite Ranch
135	532665	4213427	5,002	Seep Wash
136	532665	4213427	5,002	Seep Wash
137	532665	4213427	5,002	Little Egypt
138	532808	4215593	5,034	Seep Wash
139	546829	4198509	3,920	North Wash
140	547595	4196089	3,797	North Wash

Henry Mountains Repeat Photo Locations and Elevations (UTM Zone 12N, NAD 83)

Plate No.	Easting	Northing	Elevation	Subject-Location
141	525372	4214708	6,540	Crescent Creek Bench
142	525372	4214708	6,540	Crescent Creek Bench
143	544498	4204280	4,253	North Wash
144	544647	4203437	4,173	North Wash
145	533153	4208713	5,012	Cottonwood Wash
146	533911	4206183	5,012	Cottonwood Wash
147	544572	4202115	4,120	North Wash
148	527873	4202007`	6,085	Coyote Benches
149	525533	4201796	6,465	Coyote Benches
150	525533	4201796	6,465	Coyote Benches
151	527882	4201903	6,076	Coyote Benches
152	527882	4201903	6,076	Coyote Benches
153	533960	4193840	6,244	Mount Hillers
154	529976	4188974	6,091	Star Ranch
155	529976	4188974	6,091	Star Ranch
156	529914	4188898	6,078	Star Ranch
157	526094	4241985	4,512	Summerville Formation
158	528770	4188166	6,225	Little Rockies
159	529914	4188898	6,078	Mount Holmes
160	529635	4206648	5,680	South Fork - Slate Creek Divide
161	529635	4206648	5,680	South Fork - Slate Creek Divide
162	529635	4206648	5,680	South Fork - Slate Creek Divide
163	529635	4206648	5,680	South Fork - Slate Creek Divide
164	515516	4235556	4,872	Bert Avery Seep
165	515516	4235556	4,872	Bert Avery Seep
166	515516	4235556	4,872	Bert Avery Seep
167	515516	4235556	4,872	Bert Avery Seep
168	515517	4235573	4,879	Bert Avery Seep
169	515618	4235602	4,872	Bert Avery Seep
170	525673	4214186	6,514	Crescent Creek
171	525673	4214186	6,514	Crescent Creek
172	520057	4211383	8,991	Raggy Draws
173	520057	4211383	8,991	Raggy Draws
174	526939	4207958	6,416	South Fork Ridge
175	526939	4207958	6,416	South Fork Ridge
176	526939	4207958	6,416	South Fork Ridge
177	526939	4207958	6,416	South Fork Ridge

Henry Mountains Repeat Photo Locations and Elevations (UTM Zone 12N, NAD 83)

Plate No.	Easting	Northing	Elevation	Subject-Location
178	526939	4207958	6,416	South Fork Ridge
179	526785	4209076	6,244	South Fork Ridge
180	526785	4209076	6,244	South Fork Ridge
181	526785	4209076	6,244	South Fork Ridge
182	526785	4209076	6,244	South Fork Ridge
183	526785	4209076	6,244	South Fork Ridge
184	526785	4209076	6,244	South Fork Ridge
185	527103	4209639	5,779	Pyserts Hole
186	527103	4209639	5,779	Pyserts Hole
187	527103	4209639	5,779	Pyserts Hole
188	527103	4209639	5,779	Pyserts Hole
189	527103	4209639	5,779	Pyserts Hole
190	493731	4204565	5,607	Sandy Creek
191	493731	4204565	5,607	Sandy Creek
192	493731	4204551	5,610	Sandy Creek
193	498355	4191030	5,021	Halls Creek
194	497501	4189092	5,814	Muley Twist Canyon
195	497809	4214379	5,463	Blind Trail Wash
196	497809	4214379	5,463	Blind Trail Wash
197	501507	4215513	5,558	Wildcat Mesa
198	477621	4237789	5,426	Capitol Reef National Park
199	474421	4240013	6,128	Capitol Reef National Park
200	482048	4229258	5,752	Capitol Reef National Park
201	497614	4241335	4,640	Fremont River
202	520015	4247077	4,417	Fremont River
203	527127	4166045	4,526	Cane Spring Desert
204	534458	4169272	4,577	Cane Spring Desert
205	532227	4184086	5,257	Milk Creek Pass
206	531686	4180486	5,316	Mount Ellsworth
207	532901	4184615	5,172	Mount Holmes
208	530625	4207463	5,470	Pinto Knolls
209	530347	4207271	5,557	Pinto Knolls
210	530625	4207463	5,470	Pinto Knolls
211	530535	4206816	5,487	Pinto Knolls
212	535395	4190051	4,814	Woodruff Hole
213	520829	4189180	5,580	Cow Flat
214	518820	4185193	5,278	Cow Flat Point

Henry Mountains Repeat Photo Locations and Elevations (UTM Zone 12N, NAD 83)

Plate No.	Easting	Northing	Elevation	Subject-Location
215	524206	4196297	7,392	Stanton Pass
216	523496	4190125	6,486	Indian Spring Bench
217	523381	4190287	6,542	Mount Hillers
218	526057	4188323	6,039	Copper Creek Bench
219	522019	4180319	4,778	Hansen Creek Airstrip
220	518007	4172624	4,849	Clay Point
221	513703	4180508	4,489	Eggnog
222	492597	4206068	5,569	Upper Sandy Creek
223	494347	4212504	5,359	Sandy Creek Bench
224	494550	4211059	5,407	Sandy Creek Bench
225	496742	4215063	5,345	Blind Trail Wash
226	499059	4211069	5,619	Upper Blind Trail Wash
227	498848	4211181	5,576	Upper Blind Trail Wash
228	495902	4218993	5,204	Blind Trail Wash
229	493876	4214235	5,537	Sandy Creek Benches
230	493618	4219022	5,215	Lower Sheets Gulch
231	493618	4219022	5,215	Lower Sheets Gulch
232	494781	4210684	5,333	Lower Spring Canyon
233	488082	4214905	5,826	Oak Creek Canyon
234	488164	4214891	5,818	Oak Creek Canyon
235	487685	4215188	5,856	Oak Creek Canyon
236	492728	4225177	5,185	Burro Wash
237	490423	4228160	5,545	Notom Bench
238	498082	4218331	5,788	Wildcat Mesa
239	505063	4216790	5,886	Wildcat Mesa
240	503579	4221386	5,763	Stevens Mesa
241	504349	4224468	5,759	Stevens Mesa
242	503349	4227963	5,633	Stevens Mesa
243	503349	4227963	5,633	Stevens Mesa
244	508955	4219604	6,281	Cedar Creek Bench
245	505226	4210092	5,871	Sweetwater Creek
246	511854	4207891	6,665	North Fork of Bulldog Creek
247	504998	4219046	5,789	Apple Brush Flat
248	499474	4216084	5,671	Poison Wash Flat
249	497206	4193103	5,131	Oyster Shell Reef
250	498305	4191002	5,080	Upper Halls Creek
251	498334	4191026	5,084	Swap Canyon

Henry Mountains Repeat Photo Locations and Elevations (UTM Zone 12N, NAD 83)

Plate No.	Easting	Northing	Elevation	Subject-Location
252	478565	4237797	5,439	Fremont River - Capitol Reef National Park
253	516567	4235813	4,806	Lower Birch Creek Valley
254	516124	4231350	5,184	Blue Valley Bench
255	514955	4233597	4,991	Blue Valley Bench
256	513807	4237034	4,835	Blue Valley Bench
257	510582	4238763	4,861	Lower Oak Creek - Cottonwood Creek Bench
258	509875	4233774	4,969	Lower Oak Creek Bench
259	512678	4230371	5,156	Cottonwood Creek Bench
260	518733	4228003	5,685	Dugout Bench
261	519722	4228723	5,501	Lower McClellan Wash
262	520117	4230678	5,284	Dugout Bench
263	520117	4230678	5,284	Dugout Bench
264	524774	4234777	4,784	Cow Wash
265	524529	4225861	5,742	Bull Mountain
266	522846	4229769	5,175	Fairview Ranch
267	522846	4229769	5,175	Fairview Ranch
268	528125	4242069	4,479	Dry Valley Wash
269	528345	4221421	5,445	Upper Poison Spring Flat
270	527094	4221083	5,658	Granite Creek
271	526796	4215131	6,215	Crescent Creek Bench
272	524075	4216071	6,866	Butler Wash Bench
273	520066	4214917	9,292	Granite Ridges
274	520799	4211314	8,860	Copper Ridge
275	522222	4214224	7,864	Eagle Bench
276	534287	4201962	5,006	Trachyte
277	525426	4201679	6,467	Coyote Benches
278	522083	4198357	8,011	Browns Knoll
279	521106	4196187	7,731	Mud Spring
280	521411	4200816	7,840	Upper Coyote Bench
281	522601	4200478	7,295	Coyote Bench
282	520249	4203429	8,438	Willow Spring Flat
283	517785	4203840	8,850	Horn Spring Basin
284	516532	4207239	7,775	Pennell Pass
285	515377	4208528	7,768	Head of Bullfrog
286	515942	4206008	7,787	Airplane Spring
287	514245	4205610	7,035	Lower Bullfrog Chaining
288	518967	4205384	7,772	Horn Creek

Henry Mountains Repeat Photo Locations and Elevations (UTM Zone 12N, NAD 83)

Plate No.	Easting	Northing	Elevation	Subject-Location
289	518712	4207179	7,669	Slate Creek
290	517237	4207388	7,726	Ragged Mountain
291	510053	4220712	6,710	Cedar Creek
292	509086	4219704	6,409	Cedar Creek Bench
293	509086	4219704	6,409	Cedar Creek Bench
294	515957	4213277	9,570	Nasty Flat
295	515871	4211808	9,250	South Creek
296	516528	4212793	9,596	North Fork of South Creek
297	514667	4211801	8,608	North Fork of South Creek
298	514667	4211801	8,608	North Fork of South Creek
299	512636	4211257	7,631	South Creek Chaining
300	512869	4213653	8,206	McClellan Spring
301	514129	4213178	8,590	Willow Spring
302	517878	4213769	11,267	Bromide Basin
303	517878	4213769	11,267	Bromide Basin
304	517878	4213769	11,267	South Summit Ridge
305	517727	4213604	11,267	South Summit Ridge
306	517723	4213597	11,249	Bromide Basin
307	517723	4213597	11,249	Bromide Basin
308	517556	4213292	11,067	South Summit Ridge
309	517556	4213292	11,067	South Summit Ridge
310	517556	4213292	11,067	South Creek
311	517578	4212806	11,091	South Summit Ridge
312	517633	4212776	11,005	Bromide Basin
313	517633	4212776	11,005	Bromide Basin
314	518474	4212704	11,086	Bromide Basin
315	517956	4213861	11,409	South Summit Ridge
316	517976	4213913	11,416	South Summit Ridge
317	517955	4213979	11,400	Granite Creek
318	513392	4218480	8,926	Upper Cedar Creek
319	514534	4218312	9,524	Upper Cedar Creek
320	514534	4218312	9,524	Upper Cedar Creek
321	514534	4218312	9,524	Upper Cedar Creek
322	513710	4217714	8,856	Star Flat
323	488511	4214690	5,659	Oak Creek Canyon
324	508457	4204316	6,857	Tarantula Mesa
325	498479	4202586	6,292	Tarantula Mesa

Henry Mountains Repeat Photo Locations and Elevations (UTM Zone 12N, NAD 83)

Plate No.	Easting	Northing	Elevation	Subject-Location
326	501312	4201292	6,443	Tarantula Mesa
327	504062	4201117	6,578	Tarantula Mesa
328	488554	4214690	5,751	Oak Creek Canyon
329	488554	4214690	5,751	Oak Creek Canyon
330	497284	4224275	5,111	Bloody Hands Gap
331	497137	4226513	5,171	Bloody Hands Gap
332	474239	4239969	6,168	Whiskey Flat
333	479466	4234565	5,595	Grand Wash
334	483146	4229096	5,651	Capitol Wash
335	483144	4229075	5,652	Capitol Wash
336	483913	4228874	5,531	Capitol Wash
337	491066	4232182	5,205	Caineville Reef
338	491794	4234306	5,067	Caineville Reef
339	490352	4233046	5,227	Notom Desert
340	495776	4237195	4,835	Blue Dugway
341	494817	4236562	4,819	Caineville Reef
342	512224	4246274	4,441	Blue Valley
343	522249	4247591	4,327	Dead Horse Butte
344	503298	4244516	4,551	North Caineville Mesa
345	502819	4244504	4,547	North Caineville Mesa
346	521809	4227228	5,608	Bull Creek
347	522983	4225106	6,109	Bull Mountain
348	527838	4224501	5,086	Granite Ranch
349	527195	4218894	6,184	Granite Creek
350	527195	4218894	6,184	Granite Creek
351	533013	4192073	6,897	Woodruff Airstrip
352	515799	4177273	4,548	Clay Point
353	537695	4171732	5,061	Ticaboo Mesa
354	532398	4226547	4,937	Burr Desert
355	544655	4201817	4,078	North Wash
356	542734	4214183	5,371	Cedar Point
357	536054	4218346	5,028	Cedar Point
358	533557	4208589	4,950	Trachyte Point
359	529954	4188875	6,054	Starr Ranch
360	533845	4190678	5,595	Woodruff Hole
361	533845	4190678	5,595	Woodruff Hole
362	529914	4188894	6,052	Starr Ranch

Henry Mountains Repeat Photo Locations and Elevations (UTM Zone 12N, NAD 83)

Plate No.	Easting	Northing	Elevation	Subject-Location
363	522840	4229700	5,182	Fairview Ranch
364	522840	4229700	5,182	Fairview Ranch
365	522840	4229700	5,182	Fairview Ranch
366	498851	4211138	5,584	Upper Blind Trail Wash
367	493929	4214205	5,487	Sandy Ranch
368	493778	4235836	4,795	Sand Wash Bridge
369	493746	4235812	4,794	Sand Wash Bridge
370	480984	4237213	5,210	Fremont River
371	480788	4237512	5,307	Fremont River
372	477061	4238266	5,472	Sulphur Creek Bridge
373	476986	4238258	5,470	Sulphur Creek Bridge
374	477023	4238311	5,470	Sulphur Creek Bridge
375	474167	4239975	6,173	Chimney Rock
376	474396	4239997	6,154	Whiskey Flat
377	478114	4237697	5,440	Sulphur Creek
378	484134	4226216	5,945	Pleasant Valley
379	484134	4226216	5,945	Pleasant Valley
380	484147	4226183	5,945	Pleasant Valley
381	484147	4226183	5,945	Pleasant Valley
382	484117	4226158	5,954	Pleasant Valley
383	484117	4226158	5,954	Pleasant Valley
384	495167	4236402	4,835	West of Blue Dugway
385	501056	4244028	4,589	North Caineville Mesa
386	501888	4244358	4,585	North Caineville Mesa
387	507246	4246139	4,502	North Caineville Mesa
388	495353	4236640	4,901	West of Blue Dugway
389	495582	4236925	4,913	Blue Dugway
390	495582	4236925	4,913	Blue Dugway
391	495673	4237042	4,913	Blue Dugway
392	479763	4233905	5,600	Grand Wash
393	478551	4235476	5,683	Danish Hill
394	490716	4233383	5,173	Old Notom Road
395	491121	4233885	5,119	Old Notom Road
396	491712	4233989	5,112	Caineville Reef
397	513034	4246812	4,413	Blue Valley
398	509889	4246428	5,449	Golden Stairs
399	497260	4238462	4,664	South Caineville Mesa

Henry Mountains Repeat Photo Locations and Elevations (UTM Zone 12N, NAD 83)

Plate No.	Easting	Northing	Elevation	Subject-Location
400	496538	4238304	4,678	Fremont River
401	496406	4238316	4,685	Fremont River
402	497607	4241407	4,652	South Caineville Mesa
403	498006	4242306	4,623	South Caineville Mesa
404	498169	4242533	4,628	Caineville
405	498242	4242897	4,663	Caineville
406	495965	4238183	4,710	Fremont River
407	522479	4246961	4,331	Fremont River
408	522461	4246963	4,336	Hanksville Irrigation Dam
409	522466	4246973	4,330	Fremont River Crossing
410	522455	4246963	4,335	Fremont River Dam
411	522526	4246937	4,306	Fremont River Bridge
412	522486	4246893	4,324	Fremont River Bridge
413	521837	4247073	4,357	Utah Highway 24
414	526195	4250526	4,294	Muddy Creek
415	526168	4250539	4,273	Muddy Creek
416	526205	4250492	4,260	Muddy Creek
417	526132	4250491	4,275	Muddy Creek
418	520963	4232576	4,986	Dry Valley
419	524699	4236413	4,760	Bull Creek Road
420	522652	4223643	6,422	Bull Mountain
421	528625	4231402	4,911	Halfway Wash
422	522544	4246944	4,327	Fremont River Bridge
423	522488	4246888	4,346	Fremont River Bridge
424	526898	4250548	4,290	Dirty Devil River
425	526864	4250573	4,273	Dirty Devil River
426	526829	4250525	4,261	Dirty Devil River
427	526807	4250513	4,236	Dirty Devil River
428	526807	4250513	4,236	Dirty Devil River
429	526775	4250491	4,239	Dirty Devil River
430	526563	4250409	4,242	Muddy Creek
431	526809	4250632	4,262	Dirty Devil River
432	526800	4250617	4,268	Dirty Devil River
433	525086	4247026	4,312	Bull Creek
434	525086	4247026	4,312	Bull Creek
435	529666	4238508	4,594	Halfway Bench
436	529931	4238477	4,596	Halfway Bench

Henry Mountains Repeat Photo Locations and Elevations (UTM Zone 12N, NAD 83)

Plate No.	Easting	Northing	Elevation	Subject-Location
437	529943	4238488	4,600	Halfway Bench Exclosure
438	529891	4238487	4,594	Halfway Bench Exclosure
439	529946	4238488	4,494	Halfway Bench Exclosure
440	530024	4238384	4,585	Halfway Bench Exclosure
441	535392	4194813	5,784	Black Table
442	531056	4191223	6,214	Mount Hillers
443	529743	4189146	6,169	Starr Springs
444	528751	4188204	6,252	Mount Hillers
445	527312	4188032	6,056	Mount Hillers
446	526830	4186509	5,722	Copper Creek Bench
447	527323	4188512	6,161	Copper Creek Bench
448	527075	4189743	6,624	Upper Copper Creek Bench
449	526966	4189428	6,443	Upper Copper Creek Benches
450	526966	4189428	6,443	Upper Copper Creek Benches
451	525037	4188990	6,313	Mount Hillers
452	491940	4213942	5,592	Lower Oak Creek Canyon
453	491407	4213618	5,625	North Coleman Valley
454	491219	4213726	5,632	Oak Creek Bench
455	491219	4213726	5,632	Oak Creek Bench
456	491219	4213726	5,632	Oak Creek Bench
457	488569	4214387	5,809	Upper Oak Creek Bench
458	488081	4214907	5,826	Oak Creek Canyon
459	488442	4214364	5,800	Sandy Ranch Flume
460	505593	4212570	5,912	King Ranch
461	511030	4207997	6,524	Stevens Narrows
462	508691	4216964	6,414	Apple Brush Flat
463	491721	4224859	5,186	Rock Formation
464	491939	4226476	5,233	Burro Wash
465	491928	4226472	5,229	Burro Wash
466	490026	4231045	5,289	Grave, Notom, Utah
467	490026	4231045	5,289	Grave, Notom, Utah
468	490026	4231045	5,289	Grave, Notom, Utah
469	490026	4231045	5,289	Notom, Utah
470	488378	4214307	5,800	Sandy Ranch Flume
471	515853	4211360	9,427	South Creek Ridge
472	521497	4211137	8,949	Copper Ridge
473	519962	4214777	9,324	Granite Ridges

Henry Mountains Repeat Photo Locations and Elevations (UTM Zone 12N, NAD 83)

Plate No.	Easting	Northing	Elevation	Subject-Location
474	522178	4213980	7,779	Eagle City
475	519518	4211482	9,376	Copper Ridge
476	516735	4210742	9,312	Mount Pennell
477	515885	4211405	9,433	South Creek Ridge
478	515955	4211412	9,479	South Creek
479	517057	4208527	8,085	The Horn
480	517940	4204166	8,716	The Horn
481	515802	4206009	7,737	The Horn
482	502816	4200284	6,594	Tarantula Mesa
483	505811	4209576	5,942	Sweetwater Valley
484	505811	4209576	5,942	Sweetwater Valley
485	478434	4237429	5,390	Fremont River
486	478243	4237725	5,379	Sulphur Creek
487	478430	4237436	5,390	Fremont River
488	477893	4237938	5,419	Sulphur Creek
489	478537	4237469	5,439	Fremont River
490	478222	4236951	5,433	Fremont River Valley
491	478437	4237435	5,385	Fremont River
492	478427	4237436	5,390	Fremont River
493	478415	4237440	5,380	Fremont River
494	478367	4237714	5,414	Sulphur Creek
495	478367	4237714	5,414	Sulphur Creek
496	478552	4237591	5,413	Fremont River
497	478552	4237591	5,413	Fremont River
498	478524	4237626	5,393	Fremont River
499	478578	4237612	5,393	Fremont River
500	478754	4237787	5,390	Fremont River
501	478430	4237451	5,390	Fremont River
502	490313	4228048	5,487	Notom Bench
503	490313	4228048	5,487	Notom Bench
504	520044	4213397	10,036	Kimble and Turner Peak
505	520044	4213397	10,036	Bartons Peak
506	520044	4213397	10,036	Bartons Peak
507	520020	4213372	10,031	Bromide Basin
508	519585	4213316	9,843	Bromide Basin
509	519260	4213061	9,873	Bromide Basin
510	518383	4201011	11,410	Mount Pennell

Henry Mountains Repeat Photo Locations and Elevations (UTM Zone 12N, NAD 83)

Plate No.	Easting	Northing	Elevation	Subject-Location
511	518383	4201011	11,410	Mount Pennell
512	514932	4216945	9,559	Pistol Ridge
513	518106	4214721	11,128	South Summit Ridge
514	518000	4214780	11,111	South Summit Ridge
515	515211	4209700	8,260	North Fork of Bulldog Creek
516	515211	4209700	8,260	North Fork of Bulldog Creek
517	515179	4209675	8,237	North Fork of Bulldog Creek
518	525984	4242511	4,443	Dry Valley
519	522461	4246970	4,341	Fremont River
520	524519	4246906	4,391	Hanksville, Utah
521	531265	4232756	4,764	Halfway Wash
522	528939	4247615	4,497	Hanksville Desert
523	528368	4248989	4,382	Hanksville Desert
524	528395	4248989	4,302	Hanksville Desert
525	530301	4237598	4,615	Halfway Bench
526	530303	4237576	4,616	Halfway Bench
527	534585	4243497	4,480	Hell Hole Swale
528	495547	4236911	4,917	Blue Dugway
529	494516	4224107	5,084	Burro Wash
530	492304	4234911	4,955	Sand Wash
531	479806	4233611	5,643	Grand Wash
532	473803	4240372	6,132	Chimney Rock
533	504990	4219048	5,789	Apple Brush Flat
534	493179	4219753	5,354	Sheets Gulch Benchlands
535	493131	4219734	5,352	Sheets Gulch Benchlands
536	495301	4211797	5,346	Sandy Creek Bench
537	495301	4211797	5,346	Sandy Creek Bench
538	498816	4189993	4,990	Halls Creek
539	519441	4173721	4,900	Clay Point
540	519441	4173721	4,900	Clay Point
541	517671	4172232	4,869	Clay Point
542	517671	4172232	4,869	Clay Point
543	513678	4180468	4,509	Eggnog
544	509691	4178531	5,098	Clay Canyon - Butt Canyon Bench
545	509262	4178429	5,107	Clay Canyon - Butt Canyon Bench
546	532647	4191045	5,808	Woodruff Flat
547	533646	4191723	5,778	Woodruff Flat

Henry Mountains Repeat Photo Locations and Elevations (UTM Zone 12N, NAD 83)

Plate No.	Easting	Northing	Elevation	Subject-Location
548	529513	4171668	4,486	Cane Spring Desert
549	529513	4171668	4,486	Cane Spring Desert
550	529606	4162412	4,253	Cane Spring Desert
551	529606	4162412	4,253	Cane Spring Desert
552	534525	4168172	4,561	Smith Fork Desert
553	534525	4168172	4,561	Smith Fork Desert
554	534942	4173548	5,376	Smith Fork
555	537790	4171505	5,081	Ticaboo Mesa
556	522599	4190775	6,299	Pennell Creek Bench
557	520746	4189393	5,632	Cow Flat
558	520780	4189480	5,639	Cow Flat
559	536910	4199311	4,995	Black Table
560	526851	4229491	5,076	Halfway Wash
561	526849	4229548	5,077	Halfway Wash
562	516666	4217490	11,493	North Summit Ridge
563	516321	4218324	11,291	Mount Ellen
564	516302	4218420	11,240	Mount Ellen
565	516478	4218294	11,156	Mount Ellen
566	516647	4218302	11,182	Mount Ellen
567	516272	4219268	11,477	Mount Ellen
568	516272	4219268	11,477	North Summit Ridge
569	516272	4219268	11,477	Mount Ellen
570	516226	4218671	11,054	Mount Ellen
571	516684	4217440	11,499	North Summit Ridge
572	516674	4217423	11,500	South Summit Ridge
573	520147	4200306	8,456	Straight Creek
574	520147	4200306	8,456	Straight Creek
575	532638	4201966	5,337	Farmers Knob
576	541471	4222467	5,174	Burr Desert
577	543191	4224958	5,325	Burr Desert
578	543160	4224955	5,324	Burr Desert
579	542997	4226604	5,449	Burr Desert
580	532556	4214810	5,002	Little Egypt
581	532522	4214548	5,001	Little Egypt
582	537579	4226878	4,990	Burr Desert
583	531897	4229662	4,783	Burr Desert
584	532653	4227026	4,816	Burr Desert
585	532626	4227024	4,827	Burr Desert

Henry Mountains Repeat Photo Locations and Elevations (UTM Zone 12N, NAD 83)

Plate No.	Easting	Northing	Elevation	Subject-Location
586	518421	4234901	4,628	Birch Creek
587	518421	4234901	4,628	Birch Creek
588	512365	4231138	5,087	Cottonwood Creek
589	512365	4231138	5,087	Cottonwood Creek
590	525421	4248410	4,313	Fremont River
591	498607	4242888	4,667	Caineville, Utah
592	498607	4242888	4,667	Caineville, Utah
593	533812	4202457	5,049	Trachyte Ranch
594	533880	4202348	5,095	Trachyte Ranch
595	533880	4202348	5,095	Trachyte Ranch
596	533728	4202336	5,037	Trachyte Ranch
597	506603	4174164	5,180	Big Thompson Mesa
598	506597	4174169	5,181	Big Thompson Mesa
599	508585	4168708	4,980	South Big Thompson Mesa
600	508585	4168708	4,980	South Big Thompson Mesa
601	507362	4171950	5,017	Big Thompson Mesa
602	513298	4246782	4,431	Abbott Hotel
603	522836	4229564	5,227	Fairview Ranch
604	522239	4247639	4,350	Dead Horse Butte
605	521654	4241661	4,563	South Pinto Hills
606	534766	4207672	4,890	Cottonwood Wash
607	534766	4207672	4,563	Cottonwood Wash
608	510992	4181390	4,749	Butt Canyon

Appendix B

Features and Elevations

Name	Elevation (ft.)†	Name	Elevation (ft.)†
Bartons Peak	10,036	Kimble and Turner Peak	11,143
Big Ridge	8,423	Mount Ellen Peak	11,506
Big Thompson Mesa	5,200	Mount Ellsworth	8,235
Black Table	6,244	Mount Hillers	10,737
Blue Valley Benches	5,000	Mount Holmes	7,998
Boulder Mountain	11,082	Mount Pennell	11,438
Bromide Basin	10,300	Navajo Mountain	10,346
Browns Knoll	8,162	North Caineville Mesa	6,000
Bull Creek Pass	10,485	North Pinto Hills	4,646
Bulldog Ridge	10,060	North Summit Ridge	11,491
Bull Mountain	9,187	Notom Bench	5,500
Butler Wash Bench*	6,800	Oak Creek Bench	6,200
Caineville Reef	5,000	Oyster Shell Reef	5,300
Cass Creek Peak	9,428	Pennellen Pass	7,818
Cedar Creek Bench	6,300	Pete Steele Bench	5,900
Chimney Rock	6,414	Pinto Knolls*	5,621
Clay Point	4,900	Pistol Ridge	10,000
Copper Creek Benches	5,800	Ragged Mountain	9,113
Copper Ridge	9,180	Sandy Creek Bench	5,300
Corral Point	9,850	Skyline Rim	4,800
Coyote Benches	6,600	South Caineville Mesa	5,942
Crescent Creek Bench*	6,700	South Creek Ridge	9,424
Danish Hill	5,818	South Fork Ridge*	6,200
Dead Horse Butte*	4,398	South Pinto Hills	4,800
Deer Heaven	10,687	South Summit Ridge	11,419
Dry Lakes Peak	10,451	Stanton Pass	7,384
Dugout Bench	5,600	Steele Butte	6,896
Durfey Butte	9,580	Stevens Mesa	5,871
East Saddle (gap)	9,945	Summerville Formation*	4,800
Factory Butte	6,221	Table Mountain	8,521
Farmers Knob	5,460	Tarantula Mesa	7,124
Golden Stairs*	4,500	The Horn	9,189
Granite Ridges	9,152	Ticaboo Mesa	5,000
Halfway Bench	4,600	Wickiup Ridge	9,806
Horseshoe Ridge	9,538	Wildcat Mesa	6,030
Indian Spring Benches	6,500	†*Elevation may be an average.* **Local Name.*	

Appendix C

Common and Scientific Names of Plants in the Study

Common Plant Name	Scientific Name	Common Plant Name	Scientific Name
alfalfa	*Medicago sativa*	narrowleaf cottonwood	*Populus angustifolia*
aspen	*Populus tremuloides*	narrowleaf yucca	*Yucca angustissima*
big sagebrush	*Artemisia tridentata*	needle and thread	*Hesperostipa comata*
birchleaf mountain mahogany	*Cercocarpus montanus*	oak brush	*Quercus gambelii*
bitterbrush	*Purshia tridentata*	phlox	*Phlox* spp.
blackbrush	*Coleogyne ramosissima*	pinyon	*Pinus edulis*
black sage or black sagebrush	*Artemisia nova*	ponderosa pine	*Pinus ponderosa*
blue grama	*Bouteloua gracilis*	pricklypear cactus	*Opuntia* spp.
broom snakeweed	*Gutierrezia sarothrae*	river birch	*Betula occidentalis*
cattails	*Typha* spp.	rubber rabbitbrush	*Ericameria nauseosa*
cheatgrass	*Bromus tectorum*	Russian olive	*Elaeagnus angustifolia*
chokecherry	*Prunus virginiana*	Russian thistle	*Salsola tragus*
curl-leaf mountain mahogany	*Cercocarpus ledifolius*	sagebrush	*Artemisia* spp.
curly grass (galleta)	*Pleuraphis jamesii*	Sandberg bluegrass	*Poa secunda*
currant	*Ribes* spp.	sand dropseed	*Sporobolus cryptandrus*
desert trumpet	*Eriogonum inflatum*	scarlet globemallow	*Sphaeralcea coccinea*
Douglas-fir	*Pseudotsuga menziesii*	shadscale	*Atriplex confertifolia*
Engelmann spruce	*Picea engelmannii*	sheep fescue	*Festuca ovina*
fleabane daisy	*Erigeron* spp.	snowberry	*Symphoricarpos oreophilus*
fourwing saltbush	*Atriplex canescens*	spruce	*Picea* spp.
Fremont cottonwood	*Populus fremontii*	squaw apple	*Peraphyllum ramosissimum*
greasewood	*Sarcobatus vermiculatus*	squirreltail	*Elymus elymoides*
groundsel	*Senecio* spp.	subalpine fir	*Abies lasiocarpa*
Indian paintbrush	*Castilleja* spp.	tamarisk	*Tamarix ramosissima*
Indian ricegrass	*Achnatherum hymenoides*	turbinella oak	*Quercus turbinella*
intermediate wheatgrass	*Thinopyrum intermedium*	utah serviceberry	*Amelanchier utahensis*
juniper	*Juniperus* spp.	wild Nootka rose	*Rosa nutkana*
limber pine	*Pinus flexilis*	willow	*Salix* spp.
locoweed	*Astragalus* spp.	winterfat	*Krascheninnikovia lanata*
lupine	*Lupinus* spp.	woods rose	*Rosa woodsii*
Mormon tea	*Ephedra viridis*	yarrow	*Achillea millefolium*
mountain big sagebrush	*Artemisia tridentata vaseyana*	yellow rabbitbrush	*Chrysothamnus viscidiflorus*

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A Study in Repeat Photography