Methods in Historical Ecology: A Case Study of Tintic Valley, Utah

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Abstract—Through use of repeat photography, archival research, and field observation to reconstruct landscape vegetation patterns and changes across a 120 year period in the upper Tintic Valley of central Utah, researchers found significant changes in landscape vegetation pattern over time, including change in pinyon-juniper woodland area. Previously reported massive woodland harvest associated with early mining, domestic and agricultural activities elsewhere in the Intermountain West also took place in Utah. The impact on woodland area of the agricultural "bull" fence alone was significant. More recent study area woodland expansion also occurred. Because intensive industrial activity associated with development of the Tintic Mining District occurred prior to the taking of the study's 1911 photographs, those photos failed to reflect presettlement, or even early settlement, vegetation conditions. Overall, results suggest that historical ecological studies must employ a range of overlapping methodologies to accurately interpret the nature and direction of landscape vegetation change. Such information is useful for managing regional ecosystems now and into the future.

This study was undertaken to provide a historical context for proposed long-term watershed research in pinyon-juniper woodlands in Tintic Valley, Juab County, Utah. The study objective was to describe and, where possible, quantify landscape changes occurring in the study area from the time of Euroamerican settlement to the modern period. Reported here are results pertaining specifically to historic impacts on the pinyon-juniper woodlands of the study area.

Ecological histories have been widely used to characterize changes in vegetation cover over time (Bahre 1991; Hadley and Sheridan 1995; Hastings and Turner 1965). Such studies can be a useful point of departure for managers seeking guidelines for managing regional ecosystems now and into the future. Because the historical ecological record is commonly fragmented, a variety of techniques are generally employed to achieve research objectives. In this study, no single methodology was able to provide a complete picture of change in the study area. Repeat photography, archival research, oral histories, field observations and the regional ecological literature all provided clues for understanding changes in the Tintic landscape over time. The results of this study support the view that historical ecological studies must employ a range of overlapping methodologies to accurately interpret the nature and direction of landscape change.

Materials and Methods

Archival Research

This study included an intensive survey of archival materials for references to Tintic Valley vegetation, records of ore, fuelwood and charcoal production, smelting and milling activities, and human population in the Valley in the era of biomass fuels. From this information, estimates of early settlement era (1870-1900) industrial, agricultural, and domestic fuelwood consumption were derived.

Oral Histories and Field Observations

Oral histories, maps, field measurements, and historical photographs were employed to quantify the settlement era use of juniper trees for livestock fencing ("bull fence") within the study area.

Domestic fuelwood consumption was estimated from population figures for the area (USDC 1910, USDI 1900, 1890, 1880), using an assumed fuelwood consumption rate of one cord per person, per year (Bahre 1991; Hadley and Sheridan 1995).

Quantities of cordwood and charcoal consumed in Tintic Valley mills and smelters in the biomass fuel era (1869-1880) were estimated using published figures for ore production (Butler and others 1920; Heikes 1919) and fuel consumption for the era (Raymond 1873).

Estimates of woodland area cleared for fuelwood were derived from published estimates of cordwood yields from pinyon-juniper woodlands (Young and Budy 1986, 1979). Wood used in agricultural fence construction was similarly translated to hectares cleared using woodland density estimates derived by applying a plotless density technique (Bonham 1989; Cottam and Curtis 1956) to witness tree data from the 1872-1874 General Land Office Survey of the study area (Gorlinski 1874).

Paired Photographs

1911 photographs of portions of the study area (Lindgren and Loughlin 1919), obtained through the national archives of the U.S. Geological Survey, were rephotographed in 1995, using methods outlined in Rogers (1982) and Rogers, Malde and Turner (1984).

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Results

Woodland Harvest

Domestic Fuelwood—Domestic fuelwood consumption for the 1870-1900 period was estimated to have been 74,000 cords, as follows:

Decade:	1870-79	1880-89	1890-99
Cords:	12,250*	19,520*	42,230

* incomplete data

Industrial Fuels—Assuming 12 cords of wood or 33 bushels of charcoal required to process 10 tons of ore under favorable conditions (Raymond 1873), roughly one cord of wood or its charcoal equivalent was consumed per ton of ore processed. With 132,500 tons of ore processed within the District between 1870 and 1890, (Raymond 1873) a conservative estimate of cordwood consumed in processing Tintic's ores in that decade is 132,500 cords. Note that this figure is both conservative with respect to ore processing and ignores the use of wood fuels for brick making, industrial purposes other than ore processing, and the preprocessing of ores by small, independent operators.

Non-Fuel Uses—Figure 1 shows a bull fence located within or immediately adjacent to the study area at the Homansville Mill site (Seamons 1992). Field measurements of bull fence remnants in the study area yielded a mean of 3.9 trees per meter of fence. Measurements derived from this photograph yielded an estimate of 7.7 stems per meter. At least 40.65 km of McIntyre Ranch boundary fence in or near the study area are known to have been fenced in this manner (Mr. Steele McIntyre, personal communication, August 1995), resulting in an estimate of 158,500 stems used in fencing the McIntyre Ranch alone. Note that this figure does not include cross fencing with bull fence, which field observation also revealed, nor does it include posts used to support wire fence erected elsewhere in the study area. The figure also ignores other uses of the District's woodland trees; as mine timbers, or ties for narrow gauge railways associated with the District's mines. Consequently, while the figure of 158,500 stems was used as an estimate of the number of trees harvested for non-fuel uses in the Tintic area in the early settlement era, it is believed to be an extremely conservative estimate.

Total Woodland Harvest—Total woodland harvest for the 1870-1910 period is estimated to have been between 9,795 and 86,397 hectares, as follows:

Industrial fuels	4,469-53,620 ha
Domestic fuels	2,497-29,960 ha
Other uses	2,830 ha
Total	9,795-86,397 ha

The wide range in estimated harvest area is due to the range in estimated cordwood yields (1-12 cords per acre or 2.47-29.64 cords per ha) from pinyon-juniper woodlands (Young and Budy 1979).

Photographic Pairs

Figures 2 through 11 are paired photographs showing vegetation changes in the East Tintic Mountains across 84 years. Captions are based upon those of Lindgren and Loughlin (1919). Each photograph's USGS archive number follows Loughlin's name.

Figure 1—Bull fence, Homansville Mill, 1870's. (Seamons 1992).

Without exception, these photographs show an increase in the areal extent and/or density of woodland vegetation across the 84 year interval. Particularly dramatic is the increase in woodland cover in the north end of the Valley as seen in figure 2 and in the saddle of Quartzite Ridge, figure 3. Significant increase in woodland cover is also apparent on the south-facing slopes north of Ruby Hollow, above the site of Silver City (fig. 4-6).

The dynamic nature of Tintic Valley's vegetation across the 1911-1995 interval can be seen in figures 7 and 8. In both the 1911 and 1995 photographs, the west slope of Sunrise Peak is dominated by non-woodland vegetation. Rather than reflecting stasis in vegetation physiognomic type on this site, however, these apparently similar vegetation patterns bracket a period of woodland establishment, crown closure, catastrophic fire and management intervention. On this site in 1911, a young woodland stand can be seen on the lower slopes of the mountain. By 1994, the entire slope was covered with a dense stand of juniper, which burned in a fire in August of that year. By the time the photograph was retaken in 1995, the area had been chained and seeded to crested wheatgrass, at least superficially recreating vegetation conditions reflected in the 1911 photograph. Note the standing dead trees visible on the steeper upper slopes above the chaining. Thus, a complete cycle of woodland establishment and elimination by crown fire occurred within the temporal interval of this set of photographs.

These photographs cover that part of the study area in which towns and mines were concentrated and where several early smelters and mills were also located (Creque 1996). Vegetation patterns visible in the distance in figures 2 and 4, suggest, however, that the increase in woodland extent and density from approximately 1911 to 1995 has been generally the case across the Valley.

Discussion and Conclusions

In this study, an exhaustive archival survey failed to identify useful landscape photographs of the study area prior to a set of USGS photographs taken in 1911 (Loughlin 1911). While repeat photographs taken over 80 years later (Creque 1996) show a clear increase in woodland cover and tree

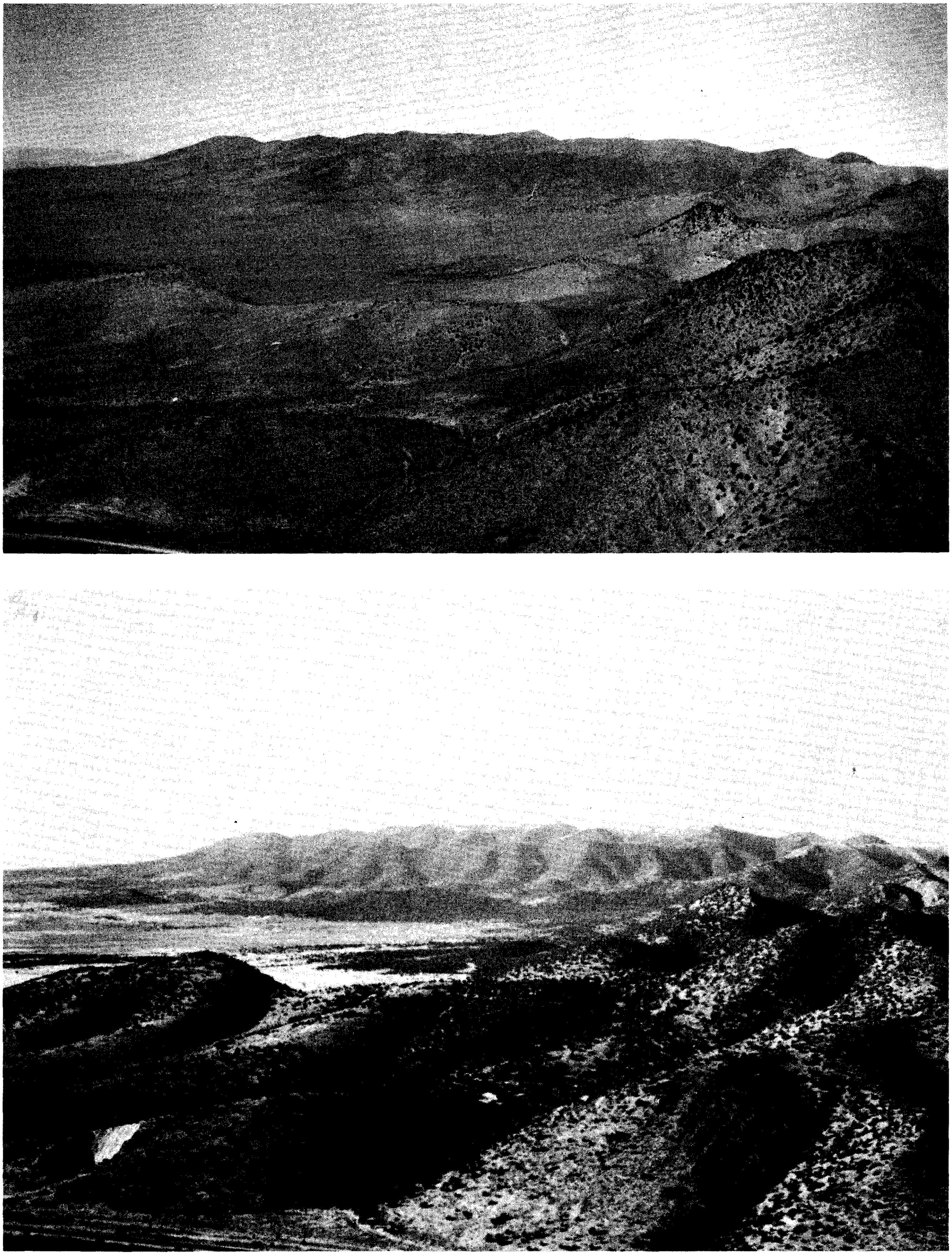

Figure 2—Foothills northwest of Eureka and head of Tintic Valley. Above: 1911 (Loughlin 18). Below: 1995.

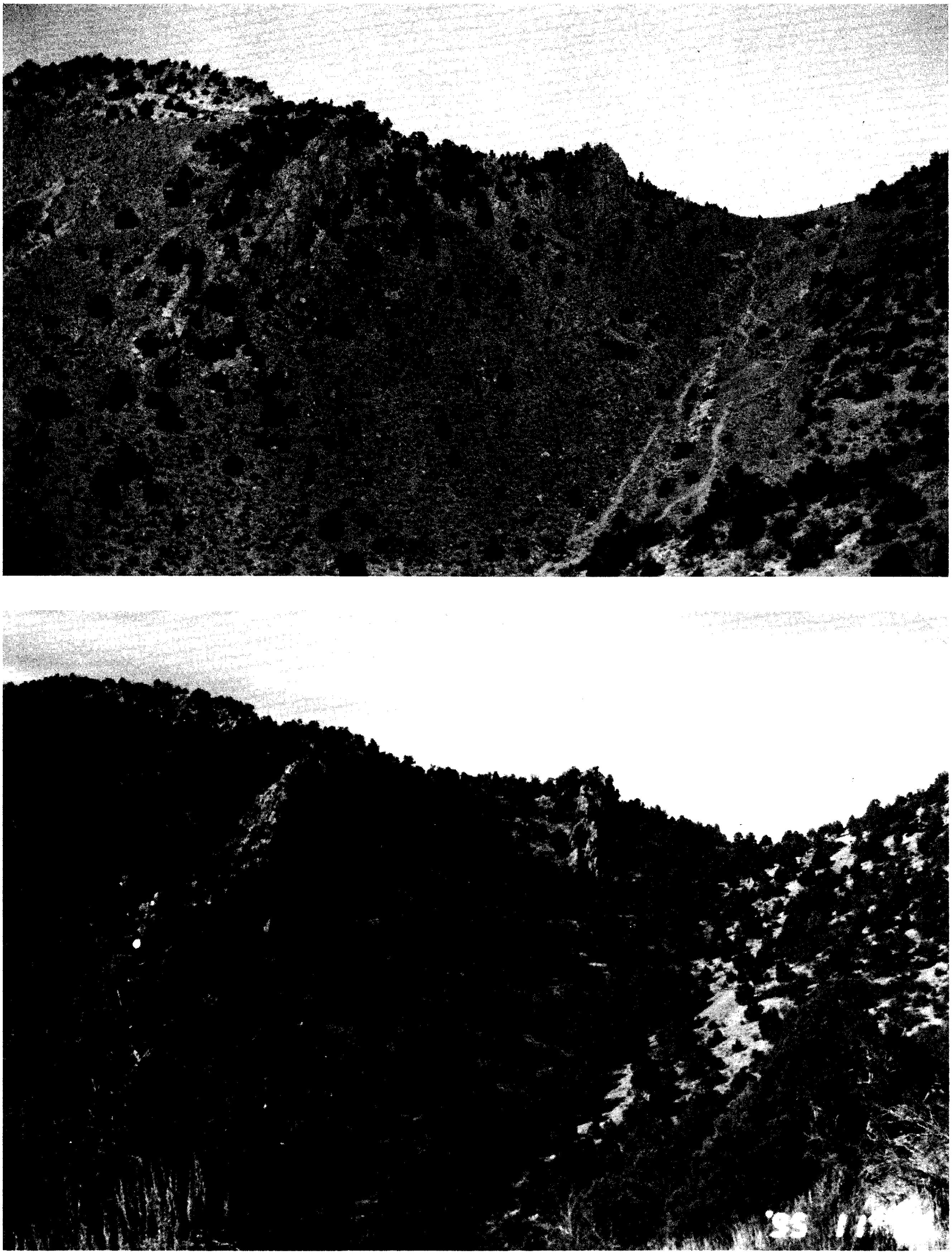

Figure 3—East-west fault south of the saddle east of Quartzite Ridge. Above: 1911 (Loughlin 19). Below: 1995.

Figure 4—East Tintic Mountains, looking north from Treasure Hill across Ruby Hollow. Above: 1911 (Loughlin 6). Below: 1995.

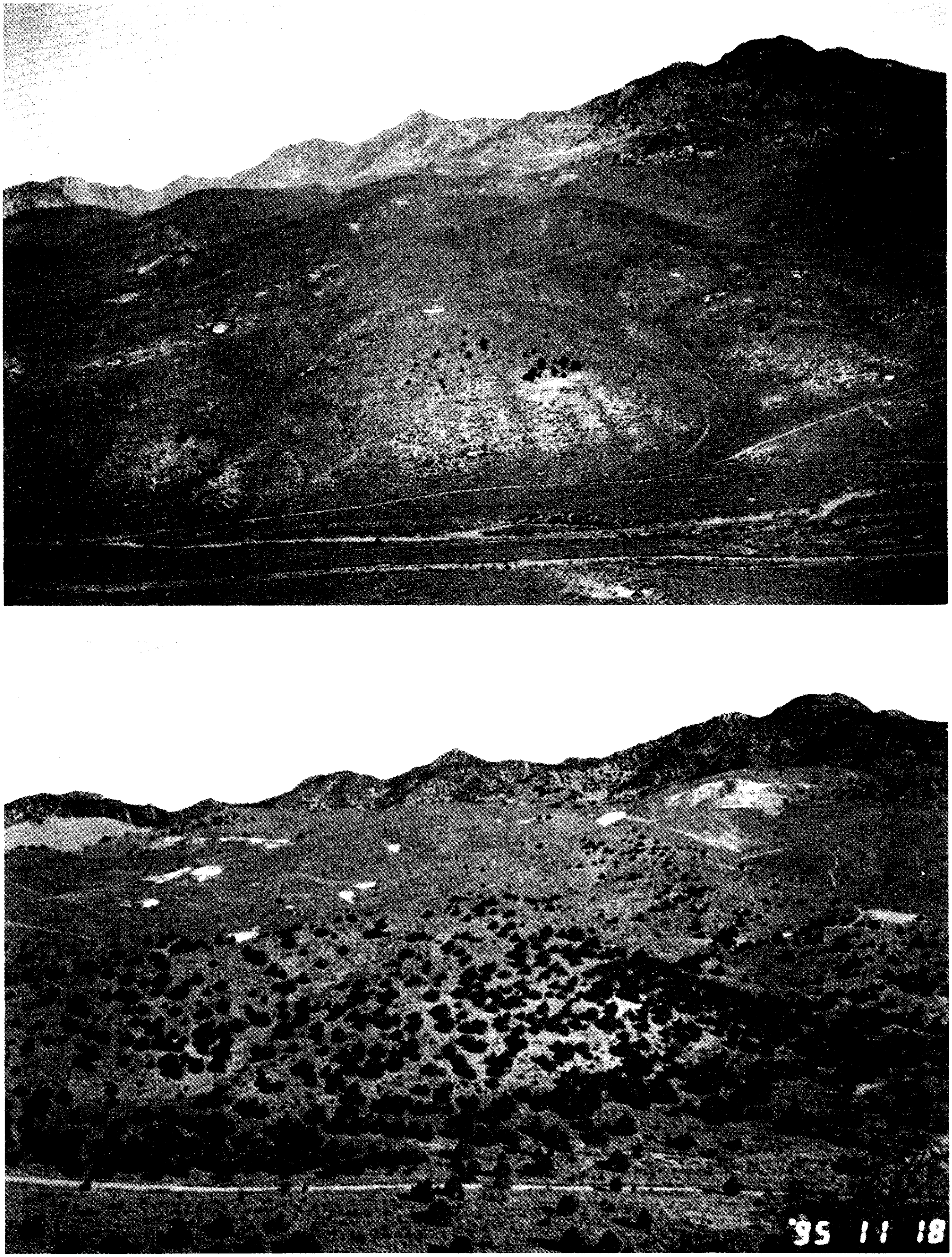

Figure 5—East Tintic Mountains, looking north from Treasure Hill across Ruby Hollow. Above: 1911 (Loughlin 5). Below: 1995.

Figure 6—East Tintic Mountains, looking north from Treasure Hill across Ruby Hollow. Above: 1911 (Loughlin 4). Below: 1995.

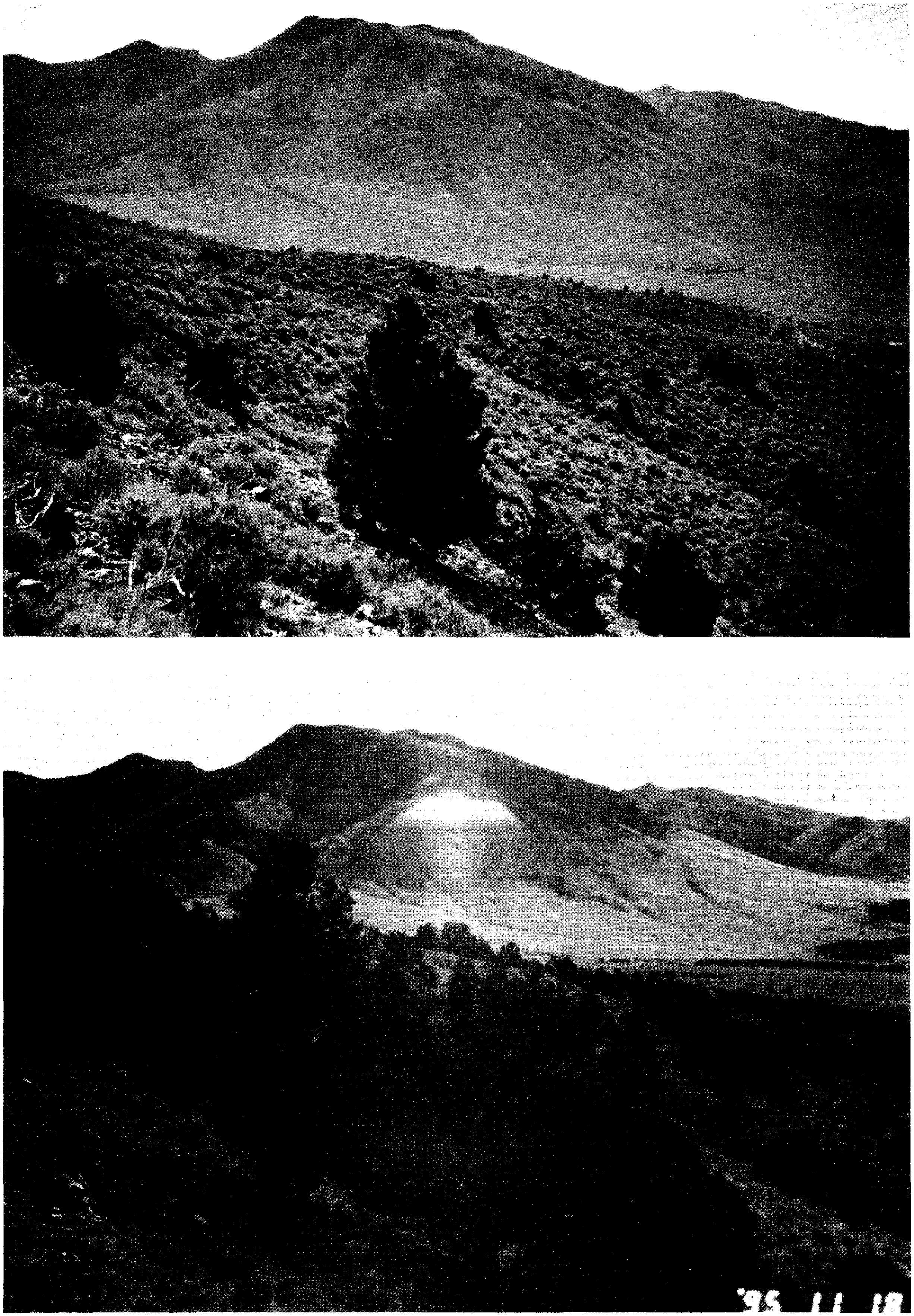

Figure 7—Sunrise Peak, looking south from Treasure Hill. Above: 1911 (Loughlin 9). Below: 1995.

Figure 8—Volcano Ridge, looking south from Treasure Hill. Above: 1911 (Loughlin 10). Below: 1995.

Figure 9—Mammoth and surrounding mountains. Above: 1911 (Loughlin 22). Below: 1995.

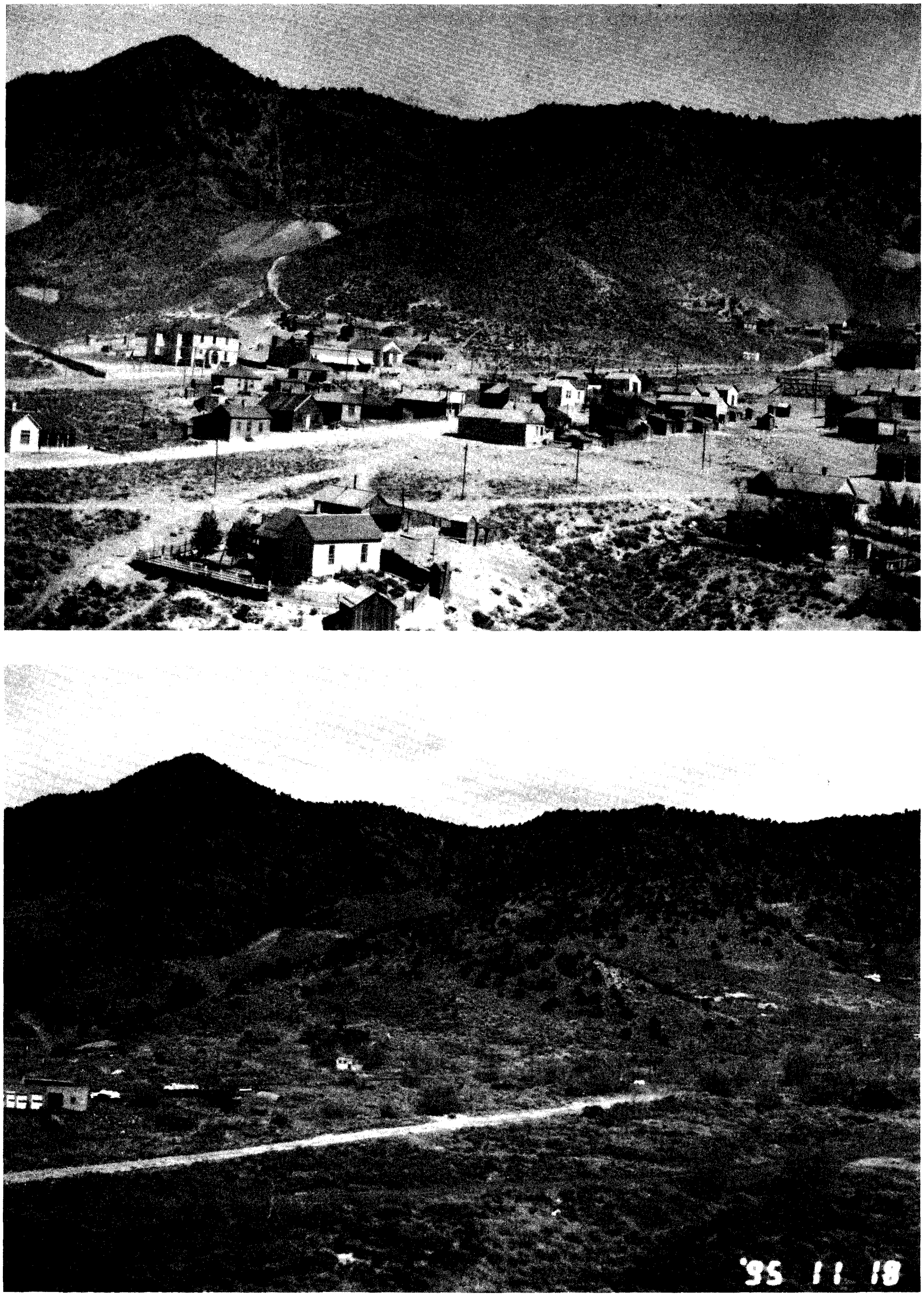

Figure 10—Mammoth and surrounding mountains. Above: 1911 (Loughlin 23). Below: 1995.

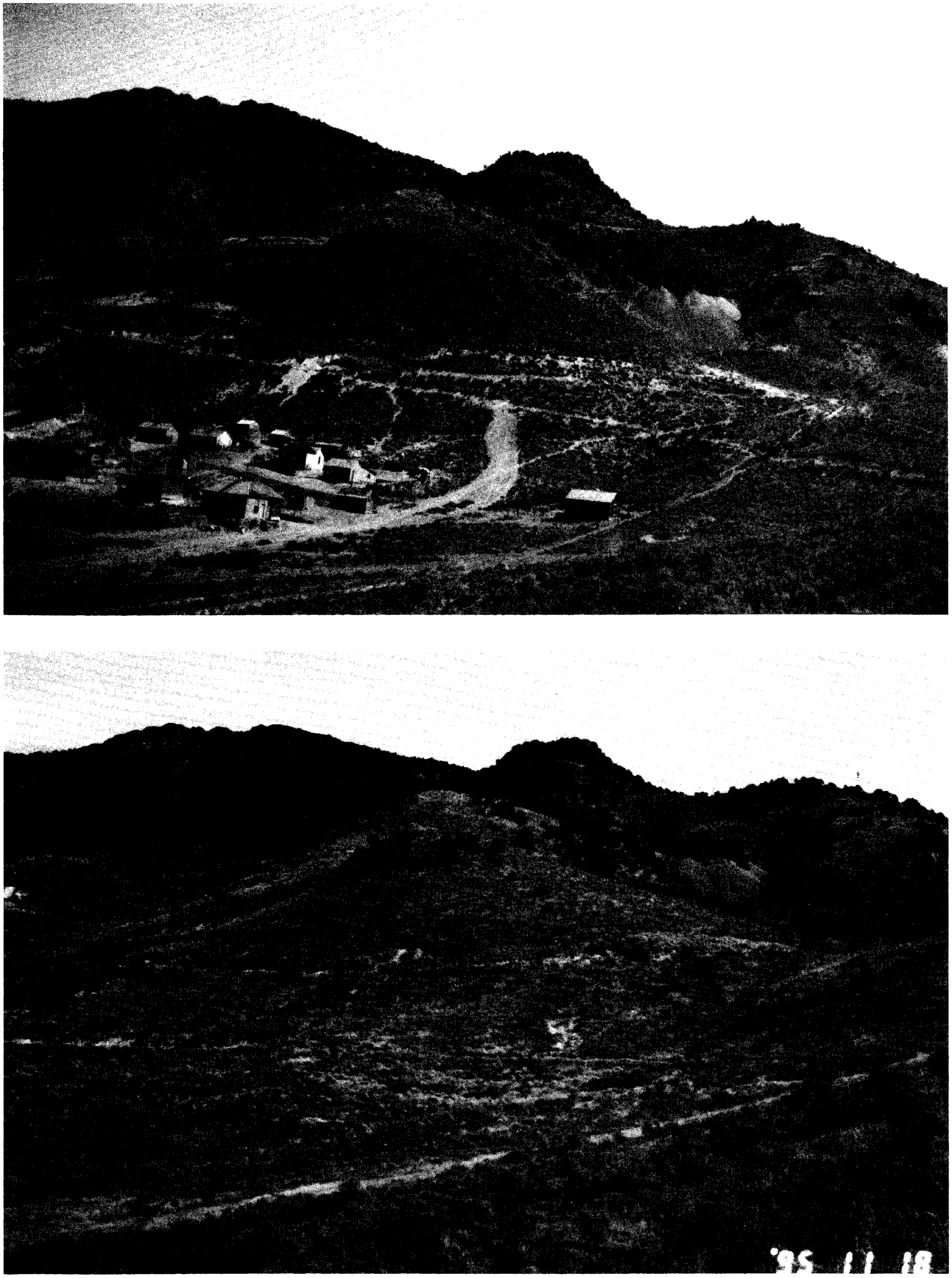

Figure 11—Mammoth and surrounding mountains. Above: 1911 (Loughlin 24). Below: 1995.

density, interpretation of pre- and post-settlement vegetation dynamics from these photographic pairs alone could easily lead to erroneous conclusions (Lanner 1977, 1981). Because intensive industrial activity associated with development of the Tintic Mining District occurred prior to the taking of the 1911 photographs employed in this study, those photographs failed to reflect presettlement, or even early settlement, vegetation conditions. Rather than revealing presettlement conditions of the study area landscape, Loughlin's photographs reflect conditions after 40 years of intensive resource exploitation associated with the early industrial development of one of the West's most productive mining Districts. For the first decade of that period, biomass constituted the only fuel available for operation of some 30 mills and smelters in the District, many of which were located on or near sites shown in Loughlin's photographs. In the same decade, a rapidly growing human population depended exclusively on biomass fuels for domestic purposes, and biomass fuels continued to meet a significant proportion of industrial and domestic fuel needs into the 20th century (Creque 1996). Livestock fencing, timbering requirements—particularly for the smaller mines and ties for the District's narrow gauge railroads—similarly drew heavily upon the District's woodlands.

While paired, multitemporal photographs provide indisputably valuable information regarding site or landscape changes across the temporal interval of the photographic pairs, a number of factors contribute to render interpretation of the ecological significance of vegetation changes documented by repeat photography alone problematic (Lanner 1977, 1981). These include the fact that early photography rarely records pre-Euroamerican settlement landscape conditions, either because such settlement and attendant land use changes predated the advent of photographic technology, or because landscape conditions did not capture the attention of the early photographer(s) of a particular region. Early photography tended to focus upon images of daily life in and around settlements, with the surrounding landscape playing an incidental role, if any, in the photographic image. Even where the landscape or plant communities were the subjects of interest, it was common for the photographer to limit his range of focus to those areas immediately adjacent to transportation corridors, such as roadsides or railroad corridors.

This study reveals the magnitude of early agriculture, domestic activities and biomass-fueled industry on the woodlands of Tintic Valley. Though not, to the knowledge of these investigators, previously reported, the impact of the bull fence, a common feature of early Intermountain ranches, was alone found to be an important factor in post-settlement reduction in tree cover. While these historical impacts on the pinyon-juniper woodlands of Tintic Valley appear extreme, they are consistent with reports from mining districts elsewhere in the region (Lanner 1981; Young and Budy 1979).

The study contributes to an improved understanding of the historic-era dynamics of the Tintic landscape and provides a point of reference for current and future management of the Valley landscape ecosystem. In a broader context, the study underscores the need for multiple lines of investigation in historical ecological research.

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Sustaining and Restoring a Diverse Ecosystem

Abstract

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A symposium held September 15–18, 1997, in Provo, UT, and Sanpete County, UT, provided information on the ecology, management, resource values, and restoration of pinyon-juniper communities in the Interior Western United States. The conference was hosted by the USDA Forest Service, Rocky Mountain Research Station and the Utah Division of Wildlife Resources in cooperation with personnel from other agencies and organizations. Oral and poster presentations were given by scientists, land managers, and educators. Also included was a field tour to observe distribution and areas of occurrence of various woodland types. Mechanical chaining and seeding demonstrations exhibited operational procedures, removal of competition, and creation of multiple seedbeds. Comparisons of older treatments where introduced species were planted were made with more recent restoration plantings designed to restore native understory herbs and shrubs. The field tour also emphasized identification and characterization of successional or transition stages resulting in thresholds in vegetative composition that influence management practices.

This conference focused on four topics. First was identifying the principal pinyon-juniper community associations, defining areas of distribution, and characterizing climatic, biotic, edaphic, and human influences upon community structure. Second were several discussions of resources associated with pinyon-juniper communities. Topic three focused on methodologies and practices available to restore disturbed pinyon-juniper woodlands to natural assemblages of native species. The fourth topic examined the implications of management practices upon community distribution, species composition, and presence of introduced species. Management to sustain diverse pinyon-juniper communities is an important issue. In addition, management of disturbed sites is equally important as weeds continue to invade and spread, fire frequency and damages are increasing, and continued alteration of plant communities limits management options.

Keywords: restoration, range resources, succession, cheatgrass, native seed, watershed, wildlife, soil

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