

# **Historic Land Use in the Tuolumne River Watershed**

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## **Introduction**

As European settlers arrived in America and moved west toward California, the soils they walked across were by no means virgin. Native Americans had been methodically grooming the North American landscape for thousands of years in order to efficiently utilize the native resources (Warren, 2003). As such, the supposed “natural” landscape Europeans encountered was actually an environment that had already been altered by the land uses of both Native Americans and Europeans, and would be subsequently shaped by European influences. Focusing specifically on Tuolumne Meadows within the Sierra Nevada Mountain Range, we will discuss how human land use has changed over time, and how the consequences of these land uses affect the landscape that we see today.

## **Native American Land Use Practices in Tuolumne Meadows**

Until the 1840s, the sole human influence in Tuolumne Meadows had been by local Native American tribes altering the landscape to suit their specific needs. The Natives Americans managed the land around them by: (1) Irrigating for local and small scale agriculture; (2) Pruning shrubs to create plants that were suited for basket weaving; (3) Selective harvesting and weeding, which changed the general plant species composition around them, and most importantly (4) burning native vegetation to mold the land into a more hospitable environment (Beesley, 2004).

Native Americans typically burned the land in 2-5 year cycles when the shrubs became obstacles, but still didn't have enough biomass or height to initiate a large scale forest fire (Beesley, 2004). Burning practices maintain grasslands and meadows by clearing brush, improving grazing conditions for deer, and reducing fuel accumulation. It also made the understory more “edible,” and stimulated nutrient and carbon cycling (Beesley, 2004). Lastly,

burning created “park like landscapes” in which the Native Americans could easily navigate (Beesley, 2004).

With their slow-paced anthropogenic disturbances, Native Americans had little impact on Sierran water systems, such as Tuolumne Meadows. They utilized fishing weirs and irrigation diversions, which only amounted to ephemeral modifications that were swept away yearly with spring runoff (Beesley, 2004). Conversely, Europeans utilized fishing methods such as netting and dynamiting, which were significantly more disruptive to the environment (Warren, 2003). Their practices may have quickly depleted the natural fish stocks, and increased the sediment load in streams and river channels.

### **The Market Hunt**

When settlers began arriving in the American West, they saw the environment as a wilderness needing to be tamed (Warren, 2003). This sentiment resulted in hunting competitions, in which hunters and firms sought to kill the most animals possible, often just for the sake of killing (Warren, 2003). With upwards of 35,000 deer hides reported in one season, many seasons of these competitions lead to a quick depletion in the native megafauna. This tendency - to hunt in unsustainable quantities for both meat, hides, and the sake of killing, has been named the Market Hunt. By 1810, all major large mammals were nearly extirpated from North America, which included the Tuolumne River Watershed (Warren, 2003). Slow recovery of some species, and extinctions of others, has caused the natural species structure in Tuolumne Meadows to shift.

Predators were among the first depleted by the Market hunt in order to prevent losses in domesticated herds. Targeted animals included bobcats, mountain lions, coyotes, and grizzlies (Beesley, 2004). The “professional hunt” was intended to take animals for cuisine, pelts, or both.

These hunters primarily sought out quail, rabbit, deer/elk and squirrel (Beesley, 2004). Large animals that were almost completely lost from the Sierras were pronghorn antelope, mountain sheep, wolverines, fishers, and martins (Beesley, 2004). These animals once added to the diversity in Tuolumne Meadows, and their reductions and absences continues to impact the area today.

### **Land Use in the Gold Rush Era**

The Gold Rush era that began in 1848 had negative direct and indirect effects on the Tuolumne Watershed (Limbaugh, 2004). Practices such as hydraulic mining, dredge mining, mercury use, and logging, have, in many cases, irreversibly impacted the watershed with their many residual effects (Purdy, 2010).

Many different methods of mining gold were employed during the Gold Rush in the Tuolumne. Hydraulic mining was very destructive in lower elevation areas in the watershed (Fig. 1). Vegetation and trees that previously thrived on these mountains and protected them from erosion, were washed away or buried under huge mounds of sediment and gravel (Purdy, 2010). The dislodged sediment lead to large mudflows and flooding, which in turn resulted in rivers choked with sediment, effectively disrupting flow. Sediment trails from various types of mining moved into the floodplains of the Central Valley, which probably buried or altered spawning sites of the native fish. The effects of hydraulic mining are present in New Don Pedro Reservoir to this day (Purdy, 2010).

One consequence of Europeans settling in the Tuolumne Watershed was the exponentially increasing demand for lumber. Wood was needed to construct mining towns, and build the structures needed for mines and dredging operations. Logging in the state went

unregulated, until the California Forestry Board was established and took hold in the state around 1890. Consequently, surrounding forests were wiped clean of large trees, allowing shade loving and fire susceptible vegetation such as cedar, white fir, and brush to take over (Fig. 2). This vegetation created a continuously increasing fuel load over time, which is one reason why we continue to see large catastrophic fires nearly every year in the Sierra's (Purdy, 2010). Historic fire suppression practices greatly contributed to the increase in large scale fires in the Sierra Nevada's as well.

### **The Effects of Grazing in Tuolumne Meadows**

During the period of unregulated grazing in the 1850s, it is estimated that Tuolumne Meadows contained 12-15,000 cattle and pack stock, which caused significant environmental degradation within the Tuolumne Watershed. Grazers, including pack stock, affect a meadow's water quality by redistributing nutrients and sediment, altering microbial communities through defecation and urination, compacting soils, and eliminating riparian vegetation (Ostoja et al. 2014, and Clow et al. 2011). Riparian vegetation acts as an anchor for sediment and keeps the non-native microbial communities from entering the river (Ostoja et al. 2014). The loss of vegetation also can increase the water temperature of a river (Derlet et al. 2014). The effects of grazing in Tuolumne Meadows were further compounded when damaged soils allowed excessive contaminants to be transferred through the watershed as a result (Ostoja et al. 2014).

Higher algae and microbial levels due to increased nutrient transport is correlated with areas consistent with historical grazing and human recreational use (Myers and Whited, 2012). Animal waste runoff causes microbial growth due an increase in nutrients, such as phosphorous and nitrogen. (Ostoja et al. 2014, and Derlet et al. 2014). Myers and Whited (2012) found that

rivers within Tuolumne County had significantly higher levels of eutrophication and higher levels of water pathogens as a result of grazing. Evidence shows that Tuolumne Meadows still contains trace amounts of *E. coli* which correlates with historical grazing and current recreational activities in the meadow (Clow et al. 2011).

Even a short period of heavy grazing can alter a meadow's soil and vegetation composition for an unpredictable amount of time. For example, in Tuolumne Meadows, current conditions reflect excessive bare ground, but with soils that have a high organic content (National Parks Service, 2006). Grazing and subsequent soil compaction disrupts the rhizomatous sod layer that keeps the meadow soils rich in nutrients, and disrupts the Meadow's ability to support complex native plant communities, dominated by perennial grasses (National Parks Service, 2006). This, coupled with bioturbation by rodents, has caused the native perennial plants to be replaced by invasive annual plants (National Parks Service, 2006). The establishment of these new plant communities has served to establish a "new equilibrium" plant community in the meadow.

Regulation of harmful historic grazing was first seen in 1890, when the US Cavalry was sent into Tuolumne Meadows to eliminate thousands of livestock (Ostoja et al. 2014). However, present day evidence suggests that communities such as these will not revert to natural conditions without the aid of human methods. Although grazing has had lasting effects on Tuolumne Meadows, it is reported that now only 600 pack stock animals travel through every year (Clow et al. 2014). As such, the meadows have begun to recover due to current environmental regulations regarding grazing on public lands (Clow et al. 2011).

## **Current Land Use in Tuolumne Meadow - Conclusion**

Tuolumne Meadow became part of Yosemite National park in 1864, when it began to be used for non-consumptive recreational purposes (Beesley, 2004). Currently there are campgrounds situated just south of the confluence of the Lyell and Dana forks of the Tuolumne River (Fig. 3). At maximum capacity, the campgrounds can hold nearly 2,000 people, making human-wildlife conflict at the campground common; thus, campers are required to use metal bear lockers to store all food and toiletries. These lockers prevent bears from becoming conditioned to visit campsites for food, and are meant to save bear's lives. Tuolumne Meadows is also used to access to other recreation, including hiking, rock climbing, backpacking, birdwatching, and fishing (National Parks Service, 2015). Current human land use is limited and seasonal, and therefore is much less disruptive than the mass grazing and mining practices of the past. Recreational use, however, forces the meadows into maintaining a "new equilibrium" plant community, by perpetuating bare and dry soils (National Parks Service, 2006). It will take active, inventive, and intensive restoration work to restore Tuolumne Meadows back to the conditions of pre-European settlement.

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**Figure 1.** Malakoff diggings in Nevada County. Example of hydraulic mining during the Gold Rush. Runoff from the mining continues to impact the Yuba River. 1882

<http://www.calisphere.universityofcalifornia.edu/browse/azBrowse/Gold+rush>



**Figure 2.** Railroad logging in the Cherry Creek Watershed part of the Yosemite-Sugar Pine Logging Operation. Sierra Nevada Logging Museum.

<https://snlm.wordpress.com/logging-history/>



**Figure 3.** A map of Tuolumne Meadows campground showing the layout and abundance of campsites now available to tourists.

<http://www.nps.gov/yose/planyourvisit/tmcamp.htm>