The prudent use of dendrochronology in many scientific fields of inquiry has a long standing. Using dendrochronology to date historic mining operations in California’s Trinity County has been useful in comprehending the timeline of poorly documented mining operations as well as dating sequences of placer mining strategies. Two placer mines of variable ages, Ohio Flat and The Premier Hydraulic Mine, with supporting excavated data, provide the focus of this presentation.

The Trinity River watershed since Euro-American contact in the late 1840s has had a rather difficult stint due to gold mining, logging and dam building. These activities have seriously disrupted the anadromous fisheries and the economic and spiritual attachment of local populations to the salmon and other fish in the system. To rectify this disorder, various tribes (e.g., Hoopa and Yurok) and State and Federal agencies (Department of Water Resources, Bureau of Reclamation, and Bureau of Land Management, among others) have embarked on a multi-year program of stream and river restoration aimed at increasing the salmon population in the river system. These activities, including sediment clean-out, mine tailing sorting for spawning gravels, channel re-alignment, sediment disposal, erosion control, etc., have in turn been damaging to historic sites primarily related to episodes of gold mining within the river and adjoining terraces and uplands that occurred from 1848 until the 1950s.

This account primarily discusses archaeologically-related activities from the 1980s to the second decade of the twenty-first century paradoxically tied to mitigation of impacts from historic mining operations along the main stem of the river in the section between Lewiston and Douglas City in Trinity County, California, and secondarily to other management operations. More specifically, it is chiefly related to dendrochronology studies of two placer mining operations, one at Ohio Flat (CA-TRI-943H), and the other at what has been designated by archaeologists as The Premier Hydraulic Mine below Limekiln Gulch (CA-TRI-2475H) (Figure 1). Other nearby archaeological dendrochronology studies of note include archaeological mitigation at historic placer mining site AG-TPUD-8 (BLM No. CA-030-1859) along Weaver Creek for a utilities switchyard (Reese et al. 2009), and work on the Smith Flat placer mining complex (BLM No. CA-030-2126) near Douglas City (Rooker 2017). In both studies the dendrochronology investigations were directed at dating the mining complexes.

**BACKGROUND**

Dendrochronologically studies of archaeological sites have a long history in the United States. And use of dendrochronology to date various sites and features related to mining has seen major application in Europe and elsewhere and in the United States, including Hattori and Thompson’s 1987 study of the Cortez Mining district in Nevada, where pinyon-juniper woodlands were impacted by mining-related activities, and Blankenship et al.’s (2009) use of tree ring dating of wooden leaching vats at a saltpeter mine in Tennessee to date the chronology of the site. Wilke and Swope (1989) successfully used tree ring counts to date an early prospecting venture at the C & K hard rock mine in the Providence Mountains of California’s San Bernardino County. Tree ring dating of post mining, or late mining mature trees, growing within the placer mined ground can supplement other avenues of investigation into the chronological placement of an early mining site.
In undertaking tree ring dating of the living trees, certain assumptions and tree selection must be considered. For this study, only mature conifers were selected, generally those that were the largest. Douglas-fir (*Pseudotsuga menziesii*) and ponderosa pine (*Pinus ponderosa*) tree rings were measured using a Swedish increment borer device at the two main sites (Figure 2).

One factor of importance in assessing the age of the trees through growth ring measurements is to determine the timing of regeneration following mining and ground disturbances, including both soil/sediment removal and tailings/waste rock/slickens deposition. Shatford et al. (2007) discuss regeneration of conifers in the Klamath-Siskiyou Mountains after forest fires. The archaeological studies discussed herein give some idea of possible regeneration rates in this same physiographic area. One factor, of course, is the seed rain from neighboring trees not within mined ground. Paullin (2007:186) notes that Douglas-fir trees’ seed years are irregular in nature. What is not known is whether tree removal may have occurred during the mining period, or the local frequency of fires and regeneration. Furthermore, there are other factors to consider in ecosystem recovery/conifer regeneration such as the sprouting of shrubs and hardwoods, aspect, elevation, and climate (cf. Gray et al. 2005). There is also depredation of seeds by deer mice (cf. McDonald 1983:6) and other animals and depredation of young conifers by animals such as deer (McDonald 1983:7); and factors like direct radiation, air temperature, soil moisture, respiration, and nitrogen cycling (cf. Zald et al. 2008:177). Obviously, the type of sediment/soil, if any, left behind after mining is a factor, and environments hostile to regeneration appear to exist today in these mined locations. On the other hand, following Gray et al. (2005:198), reductions in...
shrub cover may have benefited tree establishment. Spurr and Barnes (1980:410-411) have discussed primary forest succession in mining spoils of variable types. They note that, eventually, vegetation on mining spoils will be similar to those on undisturbed land. Paullin (2007), in a related study in Oregon, used dendrochronology to date the reforestation of lumber camps where the trees had been removed prior to abandonment, by dating younger trees growing inside the site perimeter.

Shatford et al. (2007:142-143) found that, in their regeneration study plots, “the period of establishment was surprisingly protracted (extended) and variable.” They observed in one plot of 30 cells that there was immediate and rapid filling in some cells; in others there was initially delayed (4-9 years) and then rapid filling, slow but constant filling, or chronically limited (up to 19 years after a fire) filling. McDonald’s (1983) study in the northern Sierra Nevada discovered natural regeneration to be most abundant near the forest edge and least abundant near the center following clearcutting. Furthermore, McDonald (1983:8) realized that height growth of ponderosa pine seedlings in the northern Sierra Nevada study areas depended on many variables, including competition from woody shrubs, other conifers, and deer browsing. “Fourteen-year old pine seedlings, growing in dense manzanita, for example, ranged in height from 4 to 14 feet (1.2 to 4.3m) with less leader growth each year as their general health and vigor declined.”

The implications from the above are that the tree ring dating is only approximate, and that many factors affect the rate of regeneration following mining. Importantly, the estimated dates provided by
dendrochronology should be considered minimal. Local Bureau of Land Management, Forest Service, and private foresters have indicated anecdotally to this writer that pine generates first, that regeneration can be immediate or can take over 10 years. Dilworth (1976:157), in nearby Oregon, used a figure of 5-7 years for regeneration of Douglas-fir. However, a standard figure of five years for regeneration can be used (see Hann and Scrvani 1987) and that measurements of tree rings at Diameter at Breast Height (DBH) should consider the tree seven years old to reach that height, whether Douglas fir, ponderosa pine, or sugar pine (Pinus labertiana), the latter species among those sampled in the Rooker study listed above. Furthermore, a local forester at the BLM office in Redding (Walter Herzog, personal communication 2017) believes that ponderosa pine will likely sprout first in drier, less-shaded areas than sugar pine and Douglas-fir. Paullin (2007:189) notes that some trees do not produce an annual growth ring when stressed, or the ring can be so small as to be visible only with a microscope.

Obviously these estimation figures for initial growth used in this study are approximations, but these are the ones selected. In this way to the actual tree ring count, 12 years were added. In other words, there is an allowance of five years for initial sprouting and seven years for growth to be accounted for when measuring the tree ring count at your breast height.

OHIO FLAT

The Ohio Flat mining area (CA-TRI-943H) is situated on an area of older bench gravels just below the confluence of Grass Valley Creek and the Trinity River (see Figure 1). This area was apparently being mined as early as the 1850s, and continued until about 1900 (Kelly and McAleer 1986:1). These authors have described the various features at the site summarized below. Most evidence suggests ground sluicing with the possibility of some limited hydraulic mining, with at least 15-25 feet of overburden and gravels removed, leaving the traces evident today.

Since water at these Trinity mines facilitated the gold recovery, ditches brought this valuable commodity from nearby Grass Valley Creek. At Ohio Flat, as the gravels were worked deeper, flumes and pipes delivered water and deeper and deeper drains removed the waste water and served to wash the gold into ground sluices along these drains (Figure 3). As the alluvium included all sizes of clasts, the cobbles and boulders removed from the operations are found in various patterns on the landscape (Figure 4). Kelly and McAleer (1986:2) note that “the boulder piles stand in high contrast to other areas where flume lines, dams, sluices, trails, and walls remain to give us an understanding of the techniques used to mine the gravels.” Aside from the historic documentation and a few scattered artifacts such as an opium tin, boiler part, riffle segment, tin containers, and penstock pieces, it was thought worthwhile to attempt to date the sequence of mining using tree ring dating keeping in mind that the more recent mining activities likely destroyed earlier evidence.

At Ohio Flat, because researchers were seeking the chronological network of mining periods and an internal sequence of mining operations, a series of tree ring dates was secured from over 30 conifers. It was assumed that, because of the heavy mining imprint, the trees growing on the site post-dated the operations. Only the largest trees in mined locations were selected (Figure 5). Complications aside as discussed above, the relative dates of abandonment of a number of different areas suggested by the tree ring counts reflect the sequences indicated by topography and superposition, although trees size was not always related to age (Figure 6).

The earliest readings show a cessation of mining between 1860 and 1881 in the area of the site that forms the northern tip of a tailings location on an apex of a bend in the Trinity River. One flume/drain system within this north zone dates to about 1874, and other flume and ditch systems in this zone also have been dated, including a possible later intrusive mining operation chronologically placed prior to 1892 (Kelly and McAleer 1986:26).
Figure 3. Ground sluice at Ohio Flat.

Figure 4. Ohio Flat tailings.
Figure 5. Dated tree in tailings drain at Ohio Flat.

Figure 6. Ohio Flat deep drain.
The eastern and western mining units possibly integrated in the eastern side by a ditch distribution system are tree-ring dated from 1882 to 1900. Finally, mining features toward the center and southern part of the complex have been tree-ring dated as having been abandoned before 1910 and perhaps before 1903 (see Figure 6).

Summarizing Kelly and McAleer (1986:26-27), this mining complex was the focus of emigrant miners, including Germans and Chinese, from the 1850s to about 1910. The flat appears to have been mined in a series of operations beginning with ground sluicing at the north-central bend in the river and finishing here about 1881. Subsequent locations were mined after about 1881, with final mining in the earliest 1900s in the southern and western aspects of the site. Thus, mining was initiated with shallow surface sluicing on the bench by the river, possibly with surface ditches or flumes. Ensuing placering extended deeper into the bench gravels with more drains, flumes, and water (Figure 7).

**THE PREMIER HYDRAULIC MINE**

At The Premier Hydraulic Mine, one cannot be certain about sequences of operations, but almost assuredly early river bed mining and surface placering of the near-river bench gravels occurred prior to the hydraulicking which obscured the earlier operations. Tree ring dating is one mechanism for dating the latest operations (Figure 8).

The site today contains a presumed residential complex at its southern end that was test excavated, a work station at its northern end that was also test excavated (Figure 9), and various features including an upper ditch, two hydraulic benches (the second a rock-defended terrace with alluvium removed, shown in Figure 10), headwalls (Figure 11), open drains and a drain tunnel, test pits, tailings and slickens, and a circular rock feature (Nickels et al. 2015). The 16 good tree ring dates collected from the study range between 1880 and 1900, with an average date of 122 years before present (1888) based on the 2010 sampling. The oldest date obtained was from a Douglas-fir growing high up the sloping headwall, likely closest to a point of seed dispersal. However, the distribution of dated trees seems rather consistent across the site in terms of ages. Furthermore, the dates on the seven ponderosa pine trees average 121 years and the dates for the nine Douglas fir samples average 122 years. It would appear that the species does not seem to matter in terms of regeneration at this locality, that both species sprouted about the same time. What is more, the tree regeneration results suggest this larger-scale placering/hydraulicking operation as a whole was not particularly long-lasting, and any within-site variations are not evident using this technique. The southern residential/activity locus shows a longer sequence, perhaps not necessarily entirely related to hydraulic mining, especially in terms of Depression-era artifacts that were recovered.

Based on the dendrochronology results, it would appear that the hydraulic mining activities most likely occurred from as early as about 1880 into the 1890s and even just past 1900. This estimate is based on a number of assumptions. It has been assumed that the trees cored were among the first to regenerate following the cessation of mining activities and overall are representative of the site, with trees cored both near the headwall and closer to the river. Furthermore, there are assumptions made regarding the time it took for regeneration and the age of the tree as measured at DBH. Overall, this approach, when used with other information, should help place this operation into its historic niche.

Bailey (2008:28) may provide a clue to the mining operations in question at The Premier location that would perhaps correlate with the site’s dating results when he noted that Trinity County was not affected by the anti-debris laws of the Central Valley water systems: “…hydraulic mining activity with no debris containment regulations flourished after the 1884 Sawyer decision.” Furthermore, “The Mining and Scientific Press, newspapers and other mining-related bulletins trumpeted the fact that while Sierra hydraulic mining activity was all but dead, Trinity County hydraulic mines were expanding, with the trend likely to continue….,”
Figure 7. Plan view map of sequences of mined ground at Ohio Flat.
Figure 8. Map of The Premier Hydraulic Mine.
Figure 9. Excavations at The Premier Hydraulic Mine north locus.

Figure 10. The Premier Hydraulic Mine remnant bench
Archaeological testing of the northern activity locus provided useful data that helped to define specific activities here and an associated time period, when the results are used in concert with the dendrochronology data. For instance, there was an ornate suspender clasp with a patent date of March 4, 1880 (Figure 12A); spent ammunition rounds, double seam cans (dating to as early as 1895), and hole-in-top cans (dating to as early as 1850). Both types of cans were used well into the twentieth century. The spent ammunition rounds provide several interesting clues to dating the site. One round was typed as a “Winchester No. 12 Blue Rival” shot gun shell with a manufacture date of 1894 to 1904. A second 12-gauge spent ammunition round, identified as the “No. 12 US Conical Climax,” was manufactured by the United States Cartridge Company between 1879 to as late as 1946. A .44 caliber spent ammunition round, identified as “44 WFC WRNCO,” was manufactured by the Winchester Rifle Company and dates as early as 1873 but is still a common type used today. Also found in this concentrated activity locus were keys (Figure 12B), nails–mainly cut but with a few wire, umbrella/parasol parts, metal tools, bottle parts (including amethyst glass shards); worked sheet metal, a rivet button, a suspender buckle, possible brass opium tin fragments, and a sherd of Chinese wintergreen ware (see Nickels et al. 2015 for a detailed list). These items were superimposed on older workings. The lower locus included Chinese brownware ceramics, scissors, white improved earthenware vessel sherds, cut nails, cast stove parts (Figure 12C), liquor bottle shards, metal tools, and other metal items (Figure 12D), as well as a chimney foundation and even a light scattering of later Depression-era artifacts.

SUMMARY

Dendrochronology at placer mining sites in the northern California mountains is a valuable supplemental tool in dating operations, identifying sequences of procedures, and even studying environmental recovery. Understandably, this procedure must be used in concert with other dating and
interpretation techniques, including historical research and archaeological discovery. Dendrochronology at the two main sites discussed herein (and as was the case in the Reese et al. 2009 and Rooker 2017 studies) has helped further our perception of the broad-based historical operations and attendant lifeways in the nineteenth century capitalistic endeavors that were directed toward the recovery of gold and earning a living in this changing physical and economic landscape of Trinity County.

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