Chapter Two

A Contextual Overview of Human Land Use and Environmental Conditions

Susan Lindström with contributions from Penny Rucks and Peter Wigand

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Introduction

The Lake Tahoe basin embodies the consequences of a long legacy of human and environmental history. Here, human land disturbances were initiated by millennia of low-intensity land management by the Washoe Indians and their prehistoric predecessors. Within a century's time, indigenous practices were replaced by profound resource exploitation by incoming Euro-American populations. During the last few decades, agency regulation has struggled to control explosive community growth induced by millions of tourists who visit the Lake Tahoe basin each year.

Changing attitudes and assumptions about Tahoe's environment have both enshrined and desecrated its landscape. Native Americans considered themselves stewards of the land and sustained a balanced relationship between human society and the environment. Nineteenth century arrivals viewed the Tahoe basin as a natural setting for Comstock-era capital investment and profit. Devastating practices, such as clear-cutting forests, were acclaimed by a society that celebrated human conquest of nature as progress. During the 20th century, the emerging dominance of the tourism industry was accompanied by a growing awareness of resource protection rather than resource extraction. However, the environmental pressure of large numbers of tourists and the growing residential population that serves them has transformed the Tahoe basin into a landscape that is, paradoxically, increasingly imperiled by its own attractiveness (Elliott-Fisk et al. 1997; Raymond 1992). Tahoe's future well-being depends directly on a healthy physical and socioeconomic environment, not only the public's perception of one. With this latest shift in land use paradigms, the direction of progress for 21st century users of the Tahoe basin is less clear. In this fragile context, the Lake Tahoe environment is becoming intensively managed, partly based on scientific research findings, such as those contained in this assessment of the Lake Tahoe watershed.

Human beings have been a component of the Lake Tahoe ecosystem for at least 8,000 to 9,000 years. Contemporary land management efforts to restore the Lake Tahoe ecosystem benefit from an understanding of the long-term ecological role of aboriginal people and Euro-American settlers in the dynamics of wild plant and animal populations and their physical environments. Past land management practices engendered environmental impacts that vary in space, time, scale, intensity, and consequence. Human disturbances range widely in scale, from pruning a patch of native shrubs to clear-cutting thousands of acres of timberland. Some resources were targeted in a single brief event, while others were affected for decades or generations. Furthermore, prehistoric and historic impacts may not have extended basin-wide, and some areas may have been relatively unaffected.

In order to shape an approach to ecosystem planning and resource management in the Tahoe basin, we ask a number of key questions regarding the physical and cultural conditions that existed in the past and the scope and scale of anthropogenic, or human-induced, disturbances that have altered these conditions:

- How have climate changes affected changes in Tahoe's overall physical and cultural environment? Under varying climatic

regimes, what sustainable environmental conditions are possible in the future and what type and scale of management treatments would be required to achieve them?

- What did pre-Euro-American terrestrial and aquatic ecosystems look like, and how have prehistoric and historic anthropogenic disturbances affected changes in plant and animal communities?
- What were the prehistoric and historic fire regimes in the Lake Tahoe basin?
- What are the past and present sources of sediment and nutrients in Tahoe's watershed that affect water quality?
- How has air quality and atmospheric visibility changed from prehistoric to present times?
- What are the historic underpinnings of causal relationships among the many socioeconomic and environmental factors in the Tahoe basin?
- What are the culturally important locales and biotic species in the basin and what are the threats to these resources?

To answer these and other questions and to establish standards by which environmental health and socioeconomic health can be measured, historical data sources that are uniquely tied to the human dimension of the ecosystem are explored, together with input from the biological, hydrological, and atmospheric sciences. History directs future decision-making by setting a baseline of reference conditions to determine how present conditions differ from past conditions, the reasons for that difference, and what sustainable conditions may be possible in the future. With knowledge of how past peoples interacted with their landscape, scientists and land managers can link this information to restoration and maintenance of current ecosystems. Paleoenvironmental, archaeological, ethnographic, and historic documentation offer great time depth and are used as independent and corroborative tools to achieve a nexus between historic conditions and contemporary research, monitoring, and adaptive management. Thus, using multiple sources of information, it may be possible to achieve an understanding that would not be possible using a single source of information by itself.

To document human disturbances and environmental conditions of the Lake Tahoe landscape and to register the changing human perceptions surrounding them through time, this contextual discussion draws on the existing literature, supplemented by personal notes and experience. The overview is far from exhaustive and data are uneven. Assembled at an earlier time and for a different purpose, data are adapted to fit into the current watershed assessment context; yet, the context is intended to be interpretive and comparative, beyond merely descriptive. Integral historic descriptions are dispatched to the summary time lines at the end of this chapter. Important environmental issues and questions involving biotic health, air and water quality, and socioeconomic well-being, topics that are fully explored in subsequent chapters, are introduced here to provide historical perspective. The deliberate incorporation of paleoenvironmental, archaeological, ethnographic, and historical data into truly multidisciplinary environmental planning efforts treads untested ground. Yet, in the context of ecosystem management, these lines of inquiry reveal the considerable extent to which cultural and environmental history can effectively guide future management.

Paleoclimate and Environmental History

Environmental Change in the Tahoe Sierra

The resolution of fundamental issues concerning the nature and timing of cultural-environmental associations has been influenced by the three-part model of climatic change for the 10,000-year Holocene period (Antevs 1925; Davis 1982). Antevs (1925) subdivided this period into the cool-moist Early Holocene, the hot-dry Middle Holocene, and the cool-moist Late Holocene. Internal details of these periods are not without controversy, especially as they apply to the timing, magnitude, and course of paleoenvironmental change in western North America, in general, and the Tahoe Sierra, in particular. Although details of Middle through Late Holocene climatic and ecosystem history are becoming much clearer in the Great Basin to the east, within the Tahoe Sierra,

current reconstructions lack resolution, and climatic trends are necessarily presented as broad time brackets. Changing aspects of the natural environment, which were of special importance to human populations inhabiting the Tahoe Sierra during the last 9,000 years, are summarized below and outlined in Table 2-1.

Early Holocene (10,000-7,000 Years Before Present)

By the Early Holocene, warming and drying caused glaciers to recede and Lake Lahontan, which flooded much of the Great Basin, to shrink. Although climates were relatively cool and moist compared to those of today, they were considerably warmer than those of the Late Pleistocene. Heavy winter precipitation, which had characterized the Late Pleistocene, continued during the Early Holocene. Pollen studies at Osgood Swamp near Meyers at South Lake Tahoe (Adam 1967) indicate that a cold-dry sagebrush steppe prevailed until about 10,000 BP. A shift to coniferous forest reflects the final arrival of montane woodland at higher elevations. Sparse human populations engaged in a highly mobile foraging economy based on large game hunting.

Middle Holocene (7000-4000 BP)

The Early Holocene was followed by a much warmer and dryer Middle Holocene period which caused many lakes in the western Great Basin to dry up and montane and semiarid woodlands to retreat to elevations higher than those at which they are currently found. Evidence of these changes includes the appearance of Utah juniper and single-leaf (piñon) pine around 5500 BP in woodrat middens (nests) from over 10,000 feet in the White Mountains southeast of the Tahoe basin (Jennings and Elliott-Fisk 1993). Semiarid woodland tree species ceased to be present in woodrat middens from lower elevations in the Virginia Mountains northeast of Lake Tahoe, where they are found today (Wigand 1997). The 8,600-year-old bristlecone pine tree-ring record from Methuselah Walk in the White Mountains also reveals generally drier conditions of the Middle Holocene (Graybill et al. 1994) (Figure 2-1). Locally, the water level of Lake Tahoe and Pyramid Lake declined, but these were among the few lakes that did not dry up completely. Fossil pollen taken from Osgood Swamp (Adam 1967) and Little Valley in the Carson Range bordering the east side of Lake Tahoe (Wigand and Rhode 1999) indicates the presence of more drought-tolerant species by the end of this period. Middle Holocene aridity in the Tahoe Sierra is further documented by the remains of submerged tree stumps, which stand rooted on the floor of Lake Tahoe, as deep as 20 feet below its present surface (Table 2-2; figures 2-2A and 2-2B). These ancient drowned forests date from between 6300 and 4800 BP (Lindström 1990, 1997). Shallowly submerged prehistoric milling features (bedrock mortars) occur lake-wide and may date from this or subsequent droughts (Figure 2-3). About 5500 BP the harshest period of Middle Holocene drought came to an abrupt end, as manifested by the drowned shoreside forests at Lake Tahoe and by the wetter conditions from eastern Washington at Wildcat Lake down to the northern Mojave Desert at Lower Pahranagat Lake (Figure 2-4) (Wigand and Rhode, in press). During this period, prehistoric populations increasingly exerted their influence in altering the landscape and affecting fauna and flora. Archaeological evidence indicates a gradual decrease in overall residential mobility, greater land use diversity, a broadened diet, and intensified use of plant resources.

Late Holocene (4000 BP to present)

The Late Holocene record appears to be punctuated by alternating intervals of cool-moist and warm-dry periods. More intensive human use of the Tahoe Sierra occurred during this period, as increasing populations of mixed-mode foragers/collectors ventured into the highlands on seasonal gathering, fishing, and hunting forays.

Neoglacial Period (4000 to 2000 BP)

Climates became cooler and moister, initiating the Neoglacial (or Neopluvial) period. Climates reached their Late Holocene cool-moist climax by 4000 BP, causing the rebirth of many Great Basin lakes, the growth of marshes, and minor glacial advances in the Sierra. Bradbury, et al. (1989) indicate that Walker Lake began to fill

Table 2-1—Correlation of local paleoclimatic and cultural sequence in the Tahoe Sierra.

YRS BP	YRS BC/AD	Climate	Localized Environmental Conditions	Prehistoric Sequence
	BC		**Late Pleistocene**	
>13,000	>15,000	cold-wet	-ancient Lake Lahontan floods Great Basin	
			-glaciers in Tahoe basin	
			-ice dam(s) dam Truckee R/raise Tahoe 100'	
			Early Holocene	
10-9000	>12-11,000	cold-dry	-cold sagebrush steppe at Osgood Swamp	
9000-7000	11-9000	warmer-dry	-glaciers melt/Lake Lahontan shrinks	Pre-Archaic Period
			-conifers invade Osgood Swamp	(Tahoe Reach Phase)
			Middle Holocene	
7000-4000	9000-6000	warm-dry	-desiccation of many lakes in Great Basin	
			-woodlands retreated to higher elevations	
			-drought-tolerant species at Osgood Swamp	Early Archaic
			-conifers grow 20' below surface of Tahoe	Period
			-Walker Lake and Carson Sink dry up	(Spooner Phase)
5500	7500	wet	-conifers drowned by rise in Lake Tahoe	
4700	6700	wet	-Walker River fills Walker Lake	
	BC/AD		**Late Holocene**	
			"Neoglacial"	
4000-2000	2000BC-	cool-moist/	-rebirth of Great Basin lakes/minor glacial advances	
	0AD	winter-wet	-conifers reinvade Osgood Swamp	Middle Archaic
			-rise in ground water floods Taylor Ck Marsh	(Martis Phase)
			-increased flows in Squaw Creek	
			-increased Truckee R flows/Pyramid L rises	
	AD		**Dry-Wet Intervals**	
~2000-1600	0-400	drought	-xeric vegetation invades Little Valley	
			-rise in fire frequency around Little Valley	
			-Pyramid Lake falls	
1300-1200	800-900	drought	-trees grow on Ralston Ridge Bog	
			-Cave Rock woodrat middens contain xeric plants	
1100	900	wet	-buried sand lens at Taylor Marsh/rise in Tahoe	Late Archaic
1100-900	900-1100	drought	-trees grow in Walker Lake and River	(Kings Beach Phase)
700-500	1300-1500	drought	-Truckee River stream flows reduced/conifers stressed	
			-trees grow in Walker River	
			-conifers grow in Donner and Independence lakes	
370-365	1580-1585	drought	-Truckee River stream flows reduced/conifers stressed	
			-Cave Rock woodrat middens contain xeric plants	
			"Little Ice Age"	
350-175	1600-1775	cold-wet	-lake levels rise	
			-glaciers reach greatest extent since Late Pleistocene	
			-cold conditions in Little Valley and at Lead Lake	
			-"old growth" forests develop in Tahoe basin	Washoe
			Dry-Wet Intervals	
~200-100	1700s-1800s	dry	-retrenchment of forests to higher elevations	
			-increased fire frequency	
			-conifers grow in lakes Tahoe/Independence/Donner	
	1875-1915	wet	-Truckee River flows above average	
	1928-1935	drought	-Tahoe drops below its rim	
	1982-1986	wet	-snowpack water content 200% of normal	
	1994	drought	-Tahoe drops to its recorded low level	
	1995-present	wet	-above normal precipitation	

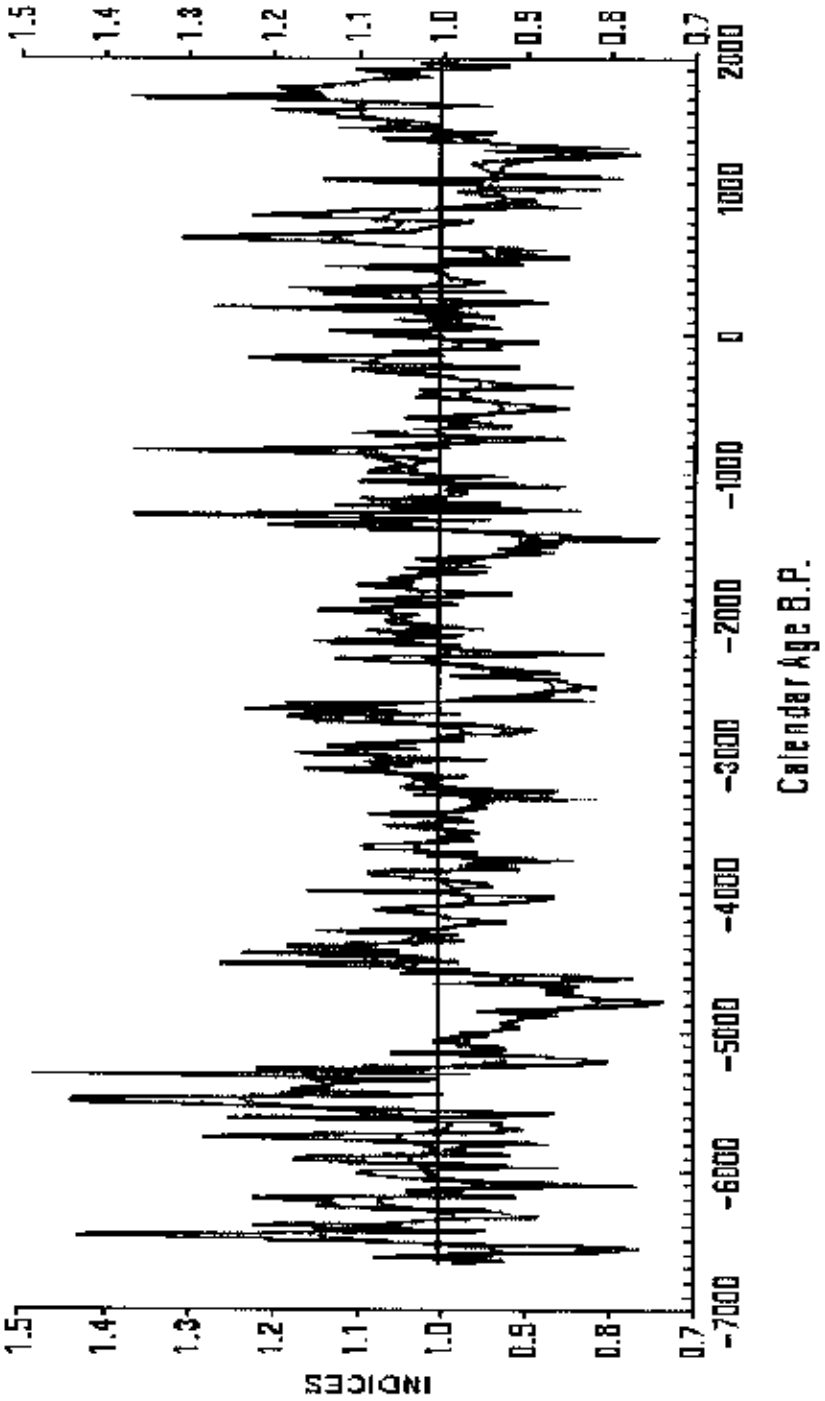

Figure 2-1—Tree ring indices record reflecting Holocene climate variation from Methuselah Walk in the White Mountains of the western Great Basin (Graybill et al. 1994). Value beneath the 8,600-year mean line indicate dry conditions, and values above the mean line indicate wet cycles. Extended drought has characterized several periods of Holocene, especially 7000 BP.

Figure 2-2A—Tahoe's rising waters drowned this tree stump sometime between 5,000 and 6,000 years ago (photograph courtesy of National Geographic Society).

Figure 2-2B—Tree stump submerged nearly 20 feet beneath the waters of Lake Tahoe. The stump pictured is seven feet tall and 3.5 feet across. rising waters drowned this tree about 6,300 years ago (photograph courtesy of National Geographic Society).

Figure 2-3—Prehistoric milling feature (bedrock mortars next to seated woman) exposed during the 1920s to 1930 drought near the outlet of Lake Tahoe (photograph courtesy of Jim Bell, Tahoe City).

Figure 2-4—Drought indices from the northern Great Basin (Diamond Pond, south-central Oregon), from the western Great Basin (Little Valley, eastern side of the east rim of the Tahoe basin), and the northern Mojave Desert (Lower Pahranagat Lake, northeast of Las Vegas). Wetter episodes lie above the mean lines at each site and drier episodes below the mean lines. The Little Valley record appears to be intermediate, reflecting some of the strong Pacific storm-dominated wet episodes of Diamond Pond and at least one relatively strong El Niño episode about 2000 BP.

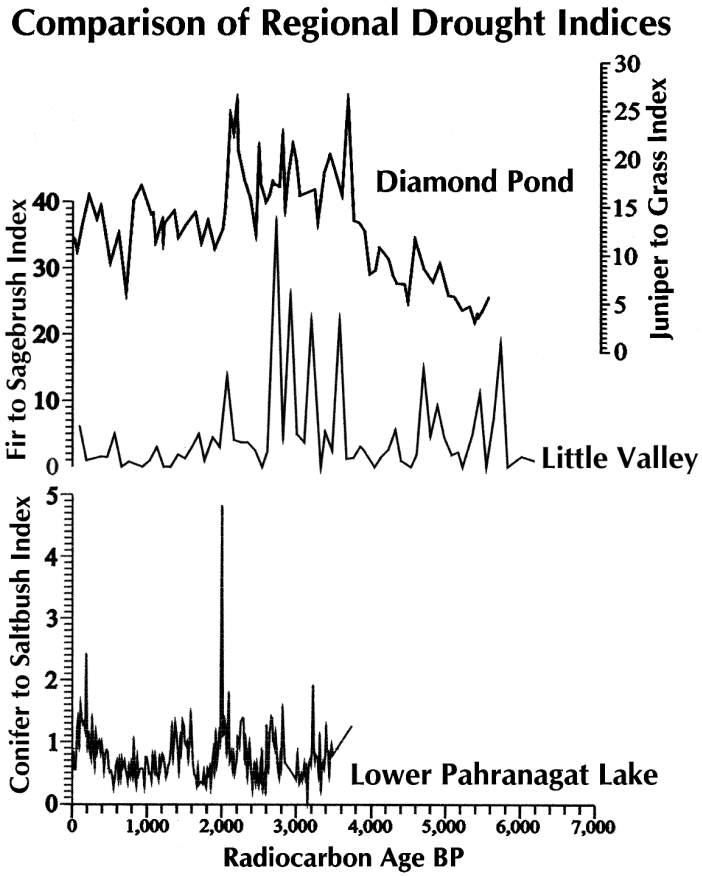

Table 2-2—Locations and radiocarbon dates of submerged tree stumps.
(Collected and Compiled by Susan Lindström)

Location	C-14 Yrs BP	Calibrated Yrs BP	Lab No.	Elevation	
Lake Tahoe					
Baldwin Beach	5510+90		*6304	Beta 33878	6210.87
Emerald Bay		4980+80	*5730	Beta 32851	6218.64
Tallac Estates		4870+60	*5640	Beta 13654	6220.70
Tallac Estates		4790+200	*5527	*no lab no	6222.75
Emerald Bay		4720+70	*5380	Beta 32852	6218.64
Baldwin Beach	4650+70		*5324	Beta 33879	6219.00
Trout Ck	4610+90		*5313	Beta 32847	6222.50
Trout Ck	4610+90		*5313	Beta 32848	6223.25
Trout Ck	4580+60		*5300	Beta 32846	6223.25
Tallac Estates		4520+60	*5197	Beta 13655	6220.70
Trout Ck		4500+60	*5126	Beta 32849	6222.50
Tallac Estates		4460+250	*5149	*no lab no	6222.70
Trout Ck	4370+80		*4931	Beta 32850	6222.50
Tallac Estates		4250+200	*4846	*no lab no	6222.75
Baldwin Beach	4250		-	Beta 56632	6205.83
Emerald Bay		110+60/AD 1840	-	Beta 32853	6225.00
Emerald Bay		50+60/AD 1900	-	Beta 32854	6225.00
Moon Dune Beach	148.5+mod/AD 1802	-	Beta 85132		6223.00
Trout Ck	4590+60		-	Beta 90207	6218.9
Trout Ck	4480+60		-	Beta 90208	6219.9
Up Truckee	230+50/AD 1720	-	Beta 90209	6222.9	
Cave Rock		30±50BP	**AD1695-1725/AD1815-1920	Beta 113817	6221.0
Rubicon Point		1240±40 BP	AD 680-885	Beta 133581	6210.0
Independence Lake					
southwest end	100+mod/AD 1850	-	Beta 32855	-	
southwest end	170+50/AD 1780	-	Beta 32856	-	
southwest end	690+50/AD 1260	-	Beta 32857	-	
Donner Lake					
northeast end		150+50/AD 1800	-	Beta 87324	(-)19
north-central end	490+50/AD 1433	-	Beta 70013	(-)34	
north-central end	469+60/AD 1490	-	Beta 70014	(-)34	
Fallen Leaf Lake					
southwest end	850±50	AD1050-1095/ AD1140-1265		Beta 133580	(-)90

*calibrated yrs bp = University of Washington, Quaternary Isotope Lab Radiocarbon Calibration Program, 1987, Rev. 1.3.
**calibrated yrs bp = Beta Analytic Radiocarbon Dating Laboratory.
Lake Tahoe elevation = 6,223.00 feet is elevation of natural sill of Lake Tahoe.
Donner Lake elevation = feet below dam base elevation; dam base elevation is 5,937.00 feet.
Independence Lake elevation = feet below dam base elevation; dam base elevation is unknown.

rapidly after 4700 BP, reaching its high-level mark 3,000 to 4,000 years ago. At Osgood Swamp and Little Valley, after about 4,000 BP, the onset of the Late Holocene period is marked by a shift from more drought-tolerant vegetation to greater dominance by the conifer species that characterize the Tahoe Sierra today. Radiocarbon dates on encrusting tufa at Pyramid Lake indicate that the lake rose from its Middle Holocene low and was above current levels by 3450 BP (Benson and Peterman 1995). This is confirmed by other data indicating that Pyramid Lake levels rose by about 3200 BP (Born 1972). The Truckee River is the primary tributary of Pyramid Lake, therefore the rise in lake level reflects

increased flows from the tributaries of the Truckee, and a rise in Lake Tahoe where the river originates. Born (1972) suggests that this was the result of a winter-wet climate that prevailed during this period and may have resulted in the renewal of cirque glaciers in the Sierra Nevada between 3200 and 2000 BP (Born 1972).

At Squaw Valley, small stream deposits became coarser, indicating increased flows (Elston et al. 1977). Pollen evidence from Taylor Creek Marsh at South Lake Tahoe indicates the formation of the marsh due to a rise in ground water levels after about 5000 to 4000 BP and before about 2900 BP, with the marsh becoming an open water environment around 2800 BP (West in Lindström 1985). Pollen records from Little Valley and from Lead Lake in the Carson Sink indicate that these cooler moister conditions continued until about 2000 BP, with drier conditions after this time (Figure 2-5) (Wigand and Rhode, in press). This is confirmed by additional dates on encrusting tufa from Pyramid Lake, indicating that lake levels remained high until at least 2100 BP (Benson and Peterman 1995).

Drought Intervals

This time is characterized by strong swings between very wet periods and very dry periods. A dry interval seems to have persisted from 2200 to 1600 BP. Pyramid Lake receded (Born 1972), and the water in Eagle Lake in Lassen County fell after 2000 BP. Relatively dry conditions continued, with summer-shifted rainfall and less severe winters between 1600 and 1200 BP. Wet cycles allowed single-leaf pine to expand significantly into the semiarid woodlands east of Lake Tahoe, with forests becoming more densely packed (Wigand and Rhode, in press). Dry times appear to have coincided with a rise in fire frequency in the montane woodlands at Little Valley in the Carson Range, an event linked with increased slope erosion and channel filling in the central Great Basin (Wigand and Rhode, in press).

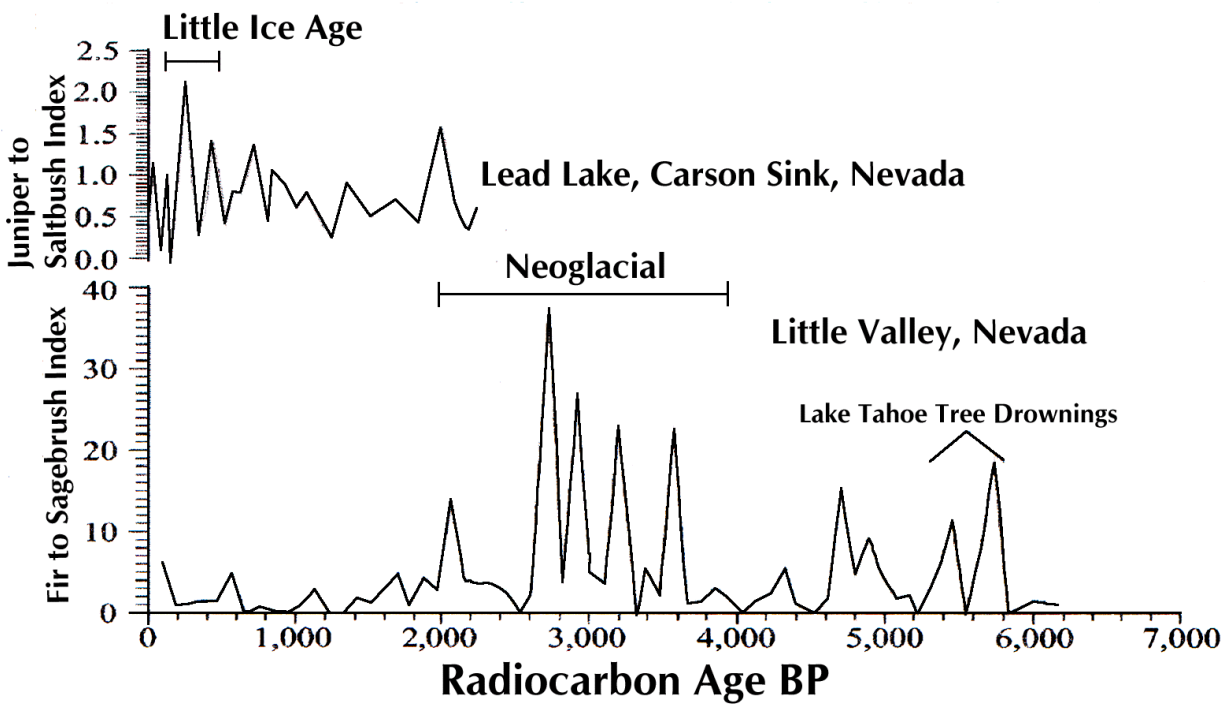

Figure 2-5—Comparison of drought indices from Little Valley, east rim of the Tahoe basin and Lead Lake in the Carson Sink. Event at 2000 BP is clear. Moister climate during the Little Ice Age, although evident in the Lead Lake and other records in the Intermountain West, is not as evident in the Little Valley record. This seems to reflect sample spacing in the top of the Little Valley core.

After 1200 BP increasingly drier conditions caused the retreat of both semiarid and montane woodlands. There is evidence of gradual drying from 1345 to 1145 BP, as trees grew on Ralston Ridge Bog south of Lake Tahoe due to low water tables (Serelj and Adam 1975). Preliminary analysis of ancient woodrat nests, recovered from the upper walls and ceiling of the cave at Cave Rock along Tahoe's southeastern shore, promise to provide some evidence of Tahoe's climate and forest composition during this period that can be tied into on-going research projects examining vegetation diversity and fire history throughout the Tahoe basin. Diagnostic plant remains recovered from the earliest stratum of these middens, dated so far at about 1360 BP, reveal the increasingly warm dry conditions that represented the beginning of the much drier period that has characterized the last millennium (Wigand 1997). However, the occurrence of a brief wet interval around 1,100 BP is suggested by the presence of buried A-horizon soils in association with a sand lens near Taylor Creek, indicating a rise in the level of Lake Tahoe and deposition of lake deposits as sand (Blackard in Lindström 1985).

A period of intense drought occurred from 1100 to 900 BP. Relict Jeffrey pine stumps, rooted in the Walker River stream bed, date to 920 BP and 660 BP (Stine 1992, 1994). Submerged stumps along the Walker Lake shorelands also yielded carbon-14 ages of 980 BP.

Intense drought returned again around 700 to 500 BP. The relationship between tree growth and stream flow in the upper Truckee River watershed indicates that intermittent drought conditions prevailed around 675 BP (Hardman and Reil 1936). Evidence of a dry period around 669 BP is provided by a series of deeply submerged tree stumps in Independence Lake north of Truckee (Table 2-2) (Lindström 1997). In addition, dozens of submerged tree stumps are located up to 30 feet below the present-day level of Donner Lake near Truckee (Table 2-2); carbon-14 samples from one stump date from 517 BP and 460 BP (Lindström 1997).

Another warm period, documented by reduced Truckee River run-off and the relatively narrow tree rings of pines growing in proximity to the river, is dated between 371 and 365 BP and again around 320 BP (Hardman and Reil 1936). A dated woodrat midden stratum from Cave Rock indicates that as late as 360 BP, climates were still very warm and dry in the Tahoe basin. This sequence of drought years and wet years is confirmed in pollen records from as far afield as Diamond Pond in the Harney Basin of south-central Oregon (Wigand 1987) and Lower Pahranagat Lake in the northern Mojave Desert of southern Nevada (Figure 2-4) (Wigand 1997).

Little Ice Age and Formation of Tahoe's Old Growth Forest (AD 1600 to 1775)

Between 350 and 175 years ago (1600 to 1775) a cool-wet climate, comparable to the Little Ice Age event of western Europe, dominated the region; lake levels again rose and cirque glaciers reformed in the Sierra, reaching their greatest extent since the latest Pleistocene. This event is recorded in pollen records from throughout the Intermountain West from as far north as Wildcat Lake in eastern Washington, Diamond Pond in southern Oregon, Lead Lake and Little Valley in western Nevada, and Lower Pahranagat Lake in southern Nevada (Figures 2-4 and 2-5) (Wigand and Rhode, in press). In these records the Little Ice Age is marked by the expansion of both semiarid and montane woodlands. Many of the old growth forests remaining in the Sierra and the Cascades today began to develop during this period.

At the end of the Little Ice Age, about 1825, drier conditions caused forests to retreat to higher elevations. Fire frequency increased, as the lower elevation and water-stressed portions of these forests dried (Wigand 1987).

Beginning about the mid-1700s through the mid-1800s, the level of Lake Tahoe (which supplies about 75 percent of the flow of the Truckee River in normal years) may have contributed relatively little water to the Truckee River. The decline of Little Ice Age climates is documented by radiocarbon dates of currently submerged tree stumps in the Tahoe Sierra (Table 2-2) (Lindström 1990, 1997). These include a stump in Lake Tahoe near the mouth of Upper Truckee River dating from about 1720, one in Emerald Bay dating to 1840, one from Moon Dune

Beach at Tahoe Vista dating from 1802, and one from Cave Rock with a calibrated date of 1695 to 1725/1815 to 1920. In addition, two submerged stumps from Independence Lake date from 1780 and 1850, respectively. Another stump from Donner Lake dates from 1800. (Given the problems of radiocarbon-dating materials that are less than 250 years old, these dates also may include the Little Ice Age event.)

Comstock Era and Beyond (1875 to Present)

The 40 years between 1875 and 1915 were the longest period during the historical record in which the flow of the Truckee River was above average. Tahoe reached its recorded high, with a lake surface level of 6,231.26 feet recorded on July 14 to 18, 1907; this is 8.26 feet above its natural rim, measured at 6,223 feet. This wet interval encompasses all of Comstock era logging and fluming activities and includes the first few decades of post-Comstock era forest regeneration. Relying on above-average precipitation, water reclamation projects were planned and initiated at Lake Tahoe and its tributary lakes and streams. Intensive livestock grazing began during the latter part of this wet period.

During the severe drought of 1928 to 1935, Lake Tahoe ceased to flow from its outlet for six consecutive years. The water crisis prompted several unsuccessful attempts by downstream water users to cut down or blast Tahoe's rim and to dredge the Truckee River channel; all were blocked by Tahoe lakeshore property owners. Eventually a compromise was reached, and millions of gallons of water were pumped out of the lake and into the Truckee River.

Wet years from 1982 to 1986 contributed to an average annual snow water content of up to 200 percent of normal. The year 1983 became the standard "high water year" for virtually all waterways within the Truckee River drainage basin.

Between 1987 and 1994 there was a period of drought in the Truckee River drainage basin. Although of the same duration as the 1928 to 1935 drought, the 1987 to 1994 drought was far worse. In the Lake Tahoe basin, the average annual snowpack water content was recorded at 29 percent of normal. Sustained drought increased the vulnerability of forests to severe insect attacks. By 1991 an estimated 300 million board feet of timber were dead or dying. On November 30, 1992, the surface of Lake Tahoe reached its record low from April 1990 to the present at 6,220.27 feet, 2.72 feet below its natural rim of 6,223 feet.

Although a trend of normal to above-normal precipitation initiated in 1995 continues to the present, drought will inevitably revisit the region. Investigations as part of the 1996 Sierra Nevada Ecosystem Project, revealed that Sierran climate, may be getting drier. Century-long droughts that have occurred within the last 1,200 years may recur in the near future.

The rapid rate of hydrologic response to changes in climate is epitomized by the El Niño cycles of the last 20 years. Even slight increases in precipitation can have amplified effects on runoff, where strong streamflow enhances erosion and delivery of sediments and nutrients to Lake Tahoe. Increased moisture also has promoted plant growth and added to the accumulation of forest fuels. These short-term observations are supported by sediment cores, which hold a record of long-term fire frequency in the charcoal that they contain. Data indicate that the greatest fire severity occurred during the droughts that punctuated the wetter episodes of the Holocene. The typical density of trees in the montane forest at middle and upper elevations assures the continued presence of abundant fuel, and, when coupled with increased susceptibility during a drier climate, both fire severity and frequency will increase.

The Influence of Climate on Environmental Sustainability

Although paleoecological reconstructions are currently incomplete, the scientific record provides compelling evidence of climate change and associated ecosystem change over the last 10,000 years. With this information, we are resolving questions regarding how climate change has affected Tahoe's overall physical and cultural environment. Imagine the constraints and opportunities arising from a drought-induced drop in lake level of 20 feet, as has occurred in the past. Thousands of acres of prime lakeshore could be newly opened for colonization by plants, animals, and humans. The

accompanying reduction in precipitation could radically increase current fire return intervals, stress the basin's biota, alter water quality, and hamper water-oriented recreation and tourism. In an opposing scenario, a rise in the precipitation could jeopardize lakeshore communities and cause certain terrestrial biosystems to shift to aquatic ones; amplified runoff could degrade water quality. In either event the socioeconomic well-being of the Tahoe basin would be undermined. Although hypothetical, both scenarios underscore the human dependency on climate and the importance of understanding climate change in planning for the future.

A growing consensus suggests that the pre-Euro-American condition of Tahoe's forest ecosystem is the desired future state (Elliott-Fisk et al. 1997). The feasibility of ecosystem restoration depends however, on the existence of climatic conditions similar to those that enabled the pre-Euro-American landscape. This may be an impossible goal. To draw an analogy, not only has Tahoe's canvas been altered, but the palette also has been transformed. The pre-Euro-American conditions of Tahoe's forest ecosystem reflect the cumulative influences of hundreds of years of forest dynamics. The clear-cutting of these forests during the last century effectively washed the canvas clean, creating a new landscape for both ancient endemic and new exotic biological species to colonize. These conditions were sustained under the influence of an entirely new series of climatic cycles that have occurred and will continue to occur in different orders, durations, and magnitudes. An examination of the paleoecology of the Tahoe basin will enhance our understanding of how the ecosystem has responded to different climates in the past. The findings may be used to derive predictions regarding the possible paths that the ecosystem may take in the future, under various scenarios of future climate and the impacts of anthropogenic activities. Although we may not be able to control the direction of future climate conditions, we can effect other parts of the ecosystem through the type and scale of our management activities so that we may achieve some measure of environmental sustainability.

Prehistoric Era (Prior to 1850s)

Prehistoric Land Use

The archaeological record suggests that Washoe Indians and their prehistoric ancestors have been a part of the Lake Tahoe ecosystem for at least 8,000 to 9,000 years. Soon after the retreat of Sierran glaciers, people entered the Tahoe basin. Climates warmed and dried rapidly, although conditions remained relatively cool and moist. The earliest archaeological evidence of human presence is found along Taylor Creek at South Lake Tahoe (Martin 1998). Elsewhere in the basin, early populations are represented by scant occurrences of isolated projectile points, typically manufactured from local banded metamorphic toolstone (gneiss) that was procured on Tahoe (Gardner's) Mountain. These sparse prehistoric populations have been equated with a Pre-Archaic mobile foraging society supported by large game hunting and nonintensive plant food processing and storage.

During the subsequent Early Archaic period, between about 7,000 and 5,000 years ago, prehistoric populations increasingly exerted their influence, altering the landscape and affecting fauna and flora. This period is associated with a marked warming and drying climatic trend and great environmental stress. Drying lowlands may have prompted human populations to travel to upland resource zones, such as the Tahoe basin, where prehistoric economies incorporated seed processing and fishing.

During the Middle Archaic period, dating from about 5,000 to 1,300 BP, climates became moister, and, with a return to more optimal living conditions, population densities increased. More intensive prehistoric use of the Tahoe Sierra began during this period, as mixed-mode foragers/collectors ventured into the highlands on seasonal gathering, fishing, and hunting forays. A hallmark of Middle Archaic prehistoric culture is the use of basalt to manufacture stone tools. The lithic landscape is marked by at least 17 distinct basalt flows that were the focus of prehistoric quarrying

activities. Quarriers were drawn to two known sources along Tahoe's north shore. One major flow extends from Martis Peak down to Carnelian Bay; the most prominently exposed within the Watson Creek drainage, it is called the Watson source. The other source, known as Incline Ridge, occurs above Incline Village, near the headwaters of Third and Incline Creeks. Basalt sources have distinctive chemical signatures (or fingerprints), and prehistoric basalt artifacts manufactured from these basalts can be traced back to their original source. The ability to trace the movement of prehistoric basalt artifacts allows us to track the movements of prehistoric populations and to understand ancient trade networks and patterns of cultural interaction and exchange. The importance of basalt from the Watson Creek Quarry as a toolstone source is indicated by its presence along the margins of the Sacramento Valley, about 35 miles to the southwest (Bloomer et al. 1997). Finding Watson basalt at such distances from its source suggests that neighboring groups were drawn to Tahoe's north shore to mine it or that local populations frequented the quarry to acquire toolstone for export.

The Late Archaic period, about 1,300 years ago to historic contact, has been equated with the Washoe, a distinct Native American culture described in ethnographic accounts written by early anthropologists. This period is marked by an overall xeric trend, with cool and moist episodes alternating with extended severe drought. Extreme climatic fluctuations may have allowed people to occupy the Tahoe highlands year-round at some times, but may have prohibited even seasonal occupation at other times. Throughout the Late Archaic, prehistoric populations continued to increase, as reflected in more intensive use of the Tahoe basin.

In broad terms, the prehistoric archaeological signature of the Tahoe Sierra reflects a trend from sparsely populated hunting-based societies in earlier times to growing populations that relied increasingly on diverse resources, especially plant foods, by the time of historic contact (Elston 1982; Elston et al. 1977, 1994, 1995). Sparse Pre-Archaic and Early Archaic populations are thought to have had minimal effects on environmental conditions in the Tahoe basin. Middle and Late Archaic populations are believed to have increasingly modified the landscape within the last 5,000 years until the historic period. This change in adaptive strategy and population size reflects native peoples' growing understanding of their environment and may be attributed partially to changes in the paleoclimate and subsistence base, and to prehistoric demographic change. Disruptions imposed by incoming Euro-American groups caused declines in Washoe population numbers and traditional resource use (Table 2-1).

Estimates of indigenous population vary considerably. Euro-American intrusion into the Tahoe territory apparently devastated the indigenous population; as early as 1859 it was estimated at only "900 souls", dropping to 800 in 1868. During this time, reservation agents resolved that there was no need to provide reservation land for the Washoe "since the tribe was nearly extinct" (Nevers 1976). Exact population figures prior to Euro-American contact are not known. Yet, it is estimated that the Washoe Tribe had one of the highest population densities in the western Great Basin. Relatively high estimates are attributed to the bountiful environment in which the Washoe lived (Price 1962).

Washoe History

The Washoe, or *Wa She Shu*, are part of an ancient Hokan-speaking residual population and have enjoyed a long tenure in their area of historic occupation. Lake Tahoe assumed the center of the Washoe physical and spiritual world, and they regard all "prehistoric" archaeological remains within the Tahoe basin as part of their heritage.

The annual trek to Lake Tahoe by the Washoe and their ancestors to fish, hunt, and gather plants has been well established. Every summer Washoe families revisited base camps that were commonly centered on fishing territories claimed along productive streams. Extended kin groups returned to harvest food, medicine, clothing, tools, and building materials from resource catchments associated with these family camps. Burden baskets were filled annually with resources needed for winter stores, as well as for immediate consumption. Visits sometimes extended through the fall and winter, if piñon pine-nut crops failed in the foothills to the east or if winters in the Tahoe uplands were relatively mild (Freed 1966). Year-round residence at

the lake, an alternative strategy for coping with drought or lower elevation resource failures, would have increased the need to conserve and manage resources at Lake Tahoe. Figures 2-1, 2-4, and 2-5 and tables 2-1 and 2-2 show periods of extreme drought when Washoe over-wintering at Tahoe would have been possible: 6300 to 4800 BP, 2200 to 1600 BP, AD 600 to 800, 900 to 1050, 1260 to 1500, 1430 to 1490, 1579 to 1585, and 1630.

An increasing body of ethnographic data provides an understanding that thousands of summers of sustained and systematic fishing, gathering, and hunting would have exerted at least localized influences on the biotic resources and the ecology of the Lake Tahoe basin. Existing ethnographic data include testimonies from Washoe people about resource use and principles of conservation, but there has been little research focused on specific harvesting techniques or horticultural and conservation practices. Where it has occurred, there is compelling evidence of extensive and systematic ecosystem management. Future ethnographic and linguistic research that is explicitly designed to address the particulars of indigenous land use and manipulation could go far in gaining some measure of the locations where sustained land tenure and management practices may have exerted the most influence in the Tahoe basin, the identification of specific management and conservation practices that may have localized influences on the Lake Tahoe ecosystem prior to 1860, and the identification of an expanded list of plants of cultural interest to the Washoe.

Subsistence and Land Tenure

Some understanding of when and how Lake Tahoe figured in the lives of the Washoe people before Euro-American contact aids in understanding the potential effects of the Washoe people on the Lake Tahoe ecosystem. It may not be the case that every Washoe individual converged on Lake Tahoe every year, as attested to by Downs (1966a) and others; however, it is clear that the Washoe named every stream entering Lake Tahoe, most of which were acknowledged to be camping and resource bases for specific kin groups (Freed 1966; Nevers 1976; Rucks 1995). Lake Tahoe and its tributaries are clearly recognized in multiple sources as the premier fishery in the region, and the Tahoe basin provided a summer residential base for the Washoe from which they collected plant and animal resources to complement fall and winter resources available from the western Sierran foothills and eastern valleys of the Great Basin. The temporal availability of food resources in the Tahoe uplands extended the season in which these resources could be collected far beyond their availability in the adjoining lowlands. In addition, the Washoe were positioned to trade with neighboring tribes, providing such upland resources as fish, deer hides, bracken fern, cedar bark, and medicinal plants (Davis 1961).

In spite of occasional skirmished, the Washoe held the Tahoe/Sierran crossroad for millennia. They granted some of their neighbors direct access, particularly those who were related by marriage. Although certain resources were shared and not claimed by any group, Washoe "ownership" of Tahoe's rich resource base was maintained by and communicated to potential trespassers by word-of-mouth and by occupation or possession. Occupation was signaled by the presence of nearby domestic camps. Permanent site "furniture" at these camps, such as bedrock milling features, further designated tenancy (Freed 1966). Men held claims to premier fishing locations by maintaining fishing "houses" and other improvements on streams. Certain plants needed to be tended, harvested, and cared for, and these activities provided indicators that they, too, were owned by the Washoe and that access was limited. Contemporary Washoe recall the laments of their mothers and grandmothers, worried about the degree to which plants were affected by grazing animals, drought, urbanization, and competing exotic plants, but, also by neglect (Rucks 1989-1999). Shrubs that were consistently harvested and pruned, such as service berry (*Amelanchier* spp.), mountain rose (*Rosa woodsii*), and willow (*Salix* spp.) would have been recognized as "somebody's:"

" . . . in the old days the older people, they had special places where they went . . . everybody had their special areas (for willow) . . . where a family would get . . . my grandmother did and my mother did . . . you know, you couldn't walk into some other area and gather . . ." Amy James and Belma Jones, ITC tapes, 1973).

Plants that were repeatedly harvested, dug, thinned, aerated, and even replanted would have been clearly recognized by others as cared for, tended and managed, and thus "claimed," which entailed finding the owner and asking permission to gather.

"Coyote had a camp by himself. Grizzly also had a camp. Coyote owned a place for getting wild potatoes [yampah], and Grizzly dug up some of them. Coyote abused her." (Bill Cornbread to Robert Lowie, 1926, from Tale 7, "Coyote and Grizzlies," in Lowie 1939.)

Siskin stated in 1939 that, at Tahoe, families owned fishing sites by streams and camped near there every summer. Washoe tended to converge along the south end of the lake where the fishing was best. Named camping locations and resource catchment areas appear in several sources (Dangberg 1927; d'Azevedo 1956, 1986; Freed 1966; Nevers 1976; Siskin 1939, 1984; Rucks 1995; Wright 1931-1972). Their locations allow us to stratify the potential effects of aboriginal resource use and environmental manipulation. It is clear most permanent camps were located at the lakeshore (especially at stream confluences) and in meadow complexes. The remarkably mobile Washoe were incredible trekkers, and the effects of aboriginal resource extraction and management extended well beyond the resource catchments tethered to these lakeshore, streamside, and meadow residential areas. Men and women walked many miles daily, leaving small children with camp tenders. Family groups relocated to higher altitude camps following the progressive availability of valued resources.

Manuel Bender listed some major resource localities in 1963 (Wright 1931-1972) in order of their importance according to "size, capacity and frequency of use for spawning by all the varieties of trout and other food fishes." This hierarchical order is assumed to reflect differential intensity of Washoe settlement and resource exploitation and management, which in turn, is reflected by the greater density of known archaeological sites (see discussion below). Bender's list of desirable drainages in descending order of resource value, from most to least important, follows:

Washoe Rank: Order of Importance	*Stream/Watershed*
1	Upper Truckee
2	Blackwood Creek
3	Taylor Creek
4	Ward Creek
5	Incline Creek (Third Creek)
6	Trout Creek
7	McKinney Creek
8	Meeks Creek
9	Sugar Pine (General Creek)
10	Cascade Creek
11	Glenbrook Creek

Siskin's (1939) Washoe consultants went on to designate the best fishing spot on the Upper Truckee, which was maintained by a single family (the Holbrooks) and inherited by men in the family for as long as anyone could remember. Bender's ranking the Upper Truckee drainage as number one is entirely consistent with other Washoe testimony. The Upper Truckee and the Taylor Creek drainages, along with the extensive wetland and meadow system at the south shore, are acknowledged by all sources as particularly valued resource areas. Richard Barrington, a prominent Washoe witness for assessing resources within the aboriginal territory for the Washoe land claim case stated in 1963 that the south shore of Lake Tahoe was particularly noted for "wild potatoes and onions" (Wright 1931-1972), a position reiterated by recent Washoe testimony.

Recent interviews have provided information about the value of Third Creek to Washoe families from the Reno area. Third Creek once fed an extensive wet meadowland, similar to that on the south shore but smaller.

No ethnographic sources emphasize resource concentrations on Tahoe's east-central side and on its north-central shore, a trend that is also borne out by the corresponding lack of sites in the archaeological record. This is not to say that these areas were not used—they were. Washoe noted that the north of Lake Tahoe was particularly good for

deer hunting, for instance, and there were several camps on Watson Creek; however, Washoe recollections of camps on the east-central shore are few. Washoe from Carson Valley, who trekked to the lake up Clear Creek and over Spooner Summit, are said to have bypassed the eastern shore headed south and continued up the western shore.

"Some fishermen, [from the valley], 'good walkers', would go to the western side of the lake and bring fish back to their camp" (Rucks 1989-1999).

The apparent residential emphasis along prime fishing streams and resource catchments on Tahoe's south, west, and northeast shores suggests and that these areas may have been subject to more intensive localized aboriginal land management. The corresponding de-emphasis on the north-central and east-central shores suggests that the resources may have been manipulated less here.

Horticulture and Vegetation Change

It is not known how Washoe horticultural practices at Lake Tahoe influenced the structure and composition of various habitats. Studies to measure these effects have not been conducted, but since Euro-American settlement, the Washoe have felt restricted from harvesting plants on any but sporadic and opportunistic bases. Several unstructured plant collecting trips sponsored by the USDA Forest Service-Lake Tahoe Basin Management Unit (USFS-LTBMU) in 1995 (Rucks 1996) and 1996 (Bloomer et al. 1997) have elicited descriptions and demonstrations of a variety of traditional practices and have indicated the potential of collaborative ethnographic research to produce substantial information about horticulture. Several Washoe specialists were asked to locate an area or areas they would like to see set aside for their use in gathering traditional plants. During the course of collecting trips, gathering practices and traditions were observed and discussed providing information that could be verified by other Washoe (Figure 2-6). Back home, where they took plants for others to identify, the Washoe collectors discussed their trips and were asked to look out for other plants on future collecting trips. These trips began a process of reinforcement and discovery that encouraged recall and experimentation. Washoe observations are incorporated into the appropriate sections below.

Planting and Reseeding

Alan Wallace, the environmental coordinator for the Washoe Tribe, recently stated that certain targeted plants, especially bulbs, were planted "wherever they were needed." Women systematically shook mature seeds from the flower heads as they gathered whole plants. Some of the seeds or the flower heads themselves, such as *Wyethia*, were scattered back into the collecting beds as a little offering performed as an integral part of the harvest. Cultural specialists have asked if they might plant more of certain species native to the Lake Tahoe basin, "the way our ancestors did, to encourage the ones left." One woman recently attested to "poking a little hole with your finger, and sticking the onion under the ground, wherever you are gathering them." Although she was referring to replanting bulbs too small to collect for food or those accidentally pulled when only the greens were sought, it is reasonable to conclude that bulbs were replanted in different areas. Women recently harvesting bracken fern at Meeks Meadow were observed pushing budding rhizomes stripped from segments they were harvesting back into the rich humus, acknowledging they were "giving something back," and "the ground must be pretty good here."

Pruning, Culling, Weeding, and Cleaning

Women spacing their harvest—"take one, leave two" were aware that they were thinning stands and that digging loosened the soil and encouraged regeneration. They consistently restored the ground surface after digging, acknowledging that this enhanced the seed bed. Debris was removed out of "respect" for the local species (d'Azevedo 1986). Straight bracken fern rhizomes, eagerly sought and hard to find due to many years of neglect, are known to need substantial thinning and harvesting to encourage new growth and to maintain beds that are long and thick and easier to harvest. Shrubs harvested for making baskets, fish traps, snowshoes, arrow

Figure 2-6—Washoe plant specialists harvest bracken fern rhizomes from Meeks Meadow (photograph courtesy of Penny Rucks, Reno).

shafts, and fishing poles were systematically pruned to encourage straight and healthy growth with varying degrees of flexibility. Washoe basket-makers state that utility and resiliency of baskets depended on the health of the raw materials; they can identify older baskets "made before the white man" (Rucks 1995) partially from the integrity of the willow itself. Heavy to light pruning was designed to achieve various qualities: a certain amount of shade was needed to achieve the correct combination of strength, length, diameter, and flexibility. The idea of "cleaning" and tending plants included weeding out competitors as part of the harvesting process.

Fisheries and Wildlife

The practice of cleaning and weeding out competitors extended to fishing, the primary focus of food procurement and settlement, at Lake Tahoe. In 1951, Hank Pete stated the following:

" . . . the native trout had black spots on their side. There were also suckers and white fish in various streams. During the spawning season, the women would get into the streams and seine the suckers out, so that the spawn would not be eaten by the suckers . . . at times, the suckers were eaten or dried."

Richard Barrington also reports culling "trash fish, suckers, shiners, and other undesirable fish" and throwing the "seed" of trout back into the stream (Wright 1931-1972).

Late summer/early fall deer hunting figured prominently as a male activity and provided hides and bones for tool-making. Mountain sheep were plentiful and have been described as an important source of meat in the "old days." Porcupine, marmot, chipmunk, yellow-striped and red-striped squirrel, and Belding ground squirrel were also hunted at Lake Tahoe.

" . . . the woodchuck or groundhog [marmot], prized for its fat in late summer; the Goldenhead chipmunk roasted in coals; the prairie dog [Belding ground squirrel], a smaller variety than in the Plains species also formed variety in meat. There were many of these small animals, it was the chore of boys to snare and trap these small animals in season when they are in peak condition. Of the large animals, the Grizzly, the black and brown bears existed in large numbers but were held in reverence and awe by the Indians and were not used as food. The only indigenous rabbit to Tahoe was the Snowshoe, which was hunted in late fall for the white fur and meat" (Manuel Bender in Wright 1931-1972).

Freed (1966) noted camping areas at Blackwood Creek and Watson Creek for trapping "ground squirrels and woodchucks." Hope Valley was mentioned for hunting ground squirrels (d'Azevedo 1955). Water fowl provided an additional resource.

"Water fowl existed in fairly large numbers in the swamp areas around the lake. The giant fowl—the Swan provided, in addition to meat, oil which was used as lubricant for chafing and as a remedy for chest rubs in colds. . . . Canada Geese, the Mallard, Canvasback and the Teal all existed in large numbers and provided plenty of eating which cannot be said to be true today." (Manuel Bender 1963, in Wright 1931-1972)

Bender described the importance and abundance of grouse and mountain quail. Swallow's eggs also were collected (Freed 1966). Both Siskin (1937-1941) and d'Azevedo (1955) make reference to mollusks, identified as "oysters," which were systematically gathered and dried.

"Got some up at the lake [Tahoe] last week in the river by Meyers Station [the upper Truckee] . . . you stick the shell's edge down a sandy hollow, then build a little fire on top, 'til they open. You get them in the summertime when the water's not to [sic] cold on your feet. . . . my grandmother used to dry them and keep them for wintertime . . ." (Clara Frank to Kathy d'Azevedo 1955).

Insects identified as grasshoppers, locusts, and "big green worms," are noted by Freed (1966) as having been collected at Lake Tahoe.

Fire

California vegetation evolved to tolerate fire; some species even require it. This adaptation may have been influenced by millennia of Native American micro-burning. The efficiency and scale of this practice would have varied with the climate and the fuel loads. There is some preliminary evidence that the Washoe deliberately set fires in the forest or valley. The evidence of burning is compelling enough to warrant additional research, and there are indications that the Washoe may now be more willing to discuss this practice than they have been in the past. Omer Stewart's 1963 testimony is the only source that makes an assertion regarding fire management. During testimony for the Washoe land claims case, the attorney George Wright asked Stewart, "What, if anything, did the Washoes do to better utilize the area by themselves and the fish and game?" Stewart responded, "The valleys were cleared by fire and the heavy brush burned off, making more accessible the area, the growth of seeds, feed for animals." (notes from Omer Stewart's Testimony to the Indian Claims Case Commission in 1963 in Wright 1931-1972).

Three Washoe individuals that Stewart (1941) interviewed in 1939 for his culture-trait list denied the practice. Downs (1966:46) maintained, " . . . the danger of range fire in the areas is high and extreme concern evidenced by the local whites has conditioned the Washo [sic] to deny ever having practiced such a 'despicable' habit."

Evidence for burning is inconclusive and d'Azevedo (1986) asserts and agrees with Downs that the Washoe are very likely to have denied this practice in order to maintain employment with valley ranchers on whom they depended after contact.

Siskin (1937-1941) described burn techniques. Deer: hunters lit "little fires of pine needles" behind them to drive the deer toward waiting hunters. The Washoe would prepare extensive piñon nut processing areas by burning off sage patches, approximately eight feet in diameter, to mound and roast cones. Sought-after plants, including sand seed (*Mentzelia dispersa*), are known to grow in burned areas. Fire was used to keep camps clean and to keep the forest open. One Washoe man recalled that when he was a small boy he watched his people burn the brush behind hot springs along the eastern Sierran front. Washoe basket-weavers recently asked the Bureau of Indian Affairs to burn out a willow stand located on tribal land "like our ancestors did" to kill insects and to promote new growth. They also suggested that rank stands of bracken fern in Meeks Meadow be burned off.

Looking at the dense stands of fir and pine near Meeks Bay, one woman asked: "How could a man have shot an arrow through this? You can't even see!" (Rucks 1989-1999). George Murphy, the first white settler in Meeks Bay, is reported to have burned down his cabin after losing control of a fire he set in the meadow to burn off rank weeds, like "the Indians used to" (Van Etten 1996).

The Washoe traditionally burned the camp and dwelling of someone who had died, a practice quickly outlawed by concerned whites in Carson Valley.

Fires caused by lightning may have decreased (or eliminated) the need for intentional burning in the Tahoe basin. "It is, of course, possible that the frequency of brush fires caused by lightning made supplementary burning unnecessary. Certainly, in the Carson Valley two or three such fires a week is (sic) not unusual during the late summer. Or, perhaps because the Washoe usually moved toward Lake Tahoe for the spring fishing, there may have been no point in fall burning to encourage early seed bearing in the valleys" (Downs 1966a).

Intentionally set fires were strategically timed and placed, such that native burning extended the range, increased the frequency, and altered the timing of natural fires. In the Tahoe basin, fortuitous lightning strikes, which often occur in the late summer and along barren ridges, may not have served the needs of prehistoric populations. Fire setting practices concentrated around lakeshore camps and inside prime meadow resource catchments. Systematic and localized micro-burning by Native Americans would have kept down fuel loads, resulting in low intensity fires that may not have left telltale fire scarring on trees. Native burning may not be reflected in the 2,000 year-old fire return intervals established by fire ecologists for the region. However, recent studies along Tahoe's east shore suggest high fire frequencies, more than might be expected without human intervention, with 15-year occurrences, primarily in September and October (Taylor 1997). Although fires set by the Washoe tended to be contained in time and space, it is possible that some of these low-intensity burns spread beyond control, especially during droughts, and caused higher intensity fires that left fire scars. The data are unclear at this point, but they raise questions regarding Native American influence on historic fire regimes in the Tahoe basin (Taylor 1999). Future assessment of the frequency and distribution of fires, density and distribution of aboriginal camp locations, key resource catchment areas, and travel corridors should shed light on this issue.

Conservation

"What things do I think the white culture should adopt from the Indian culture that would enrich it? One of the uppermost things, right now, is in ecology. . . . They've [the Indians] practiced conservation, they've practiced rotation of hunting and such as that. . . . The concept of valuation that the white man has, we feel, is too much in the area of monetary, not so much as preservation of natural life or how the country should be preserved for the next generations, . . . and I think the white society is beginning to realize the fact that much of the things that has been destroyed should be restored, which, I think, should've been planned to begin with." (Dressler 1972)

Persistent harvesting in an area by an extended kin group may have jeopardized resource supply and prompted a need for conservation. Restrictions on harvest from a given area insured the potential for future growth (d'Azevedo 1986). Collectors taught children at a very early age to "leave some."

" . . . Young hunters and fishermen were thoroughly indoctrinated in the importance of leaving "seed" for next year. . . . It was drilled into all providers of food that from one pool with five fish, only two fish could be killed. A female and two males had to be left as seed for next year. The same practice was observed in game. So well established was this rule and so well observed that the white people merely took it for granted that the fish and game were just prolific without any means to perpetuate the source. . ." (Manuel Bender 1963, in Wright 1931-1972).

"Usually Indians left females at spawn-beds. Used as bait so that buck-fish stop there [in non-

spawning season]. . . . Take either buck or female fish" (Mike Holbrook, 1930s, in Siskin 1939-1941).

"Usually, the Indians killed the buck deer, but the dry does or non-bearing does were killed, especially during the winter months. The Indians tried to keep a balanced herd of deer, rather than kill off all the buck deer" (Hank Pete to George Wright 1951, in Wright 1931-1972).

The Washoe rotated collecting areas. The harvest occurred after seeds matured in order to assure future harvests. Prior to gathering, women offered prayers to the plants and for the blessing of their utensils and other equipment.

Archaeological Sites, Resource Catchments, and Environmental Manipulation

In the absence of historical records beyond 150 years, the archaeological record provides information to address the question of potential disturbances of indigenous plant and animal communities. Areas with high densities of archaeological sites may be areas where aboriginal people manipulated resources to a greater extent.

The true nature and extent of the surviving archaeological record of the Lake Tahoe basin is yet to be determined because only a percentage of the area has been systematically surveyed. According to files maintained at the USFS-LTBMU, over 50,000 acres of federal land (32 percent of the nearly 159,000 total acres of federal land) have been surveyed for archaeological remains. The amount of archaeological survey coverage conducted on state and private lands in the basin is unknown. At least 581 archaeological sites and 306 miles of linear features (for example, roads, railroads, and flumes) have been recorded on surveyed federal land. In addition, another 289 sites are recorded on nonfederal land. Many archaeological sites remain to be recorded. Unfortunately, a greater number have been destroyed by historic and modern land disturbance. Preservation problems persist since acidic soils and extreme weather rapidly decompose perishable artifacts. Sites representing the main nuclei of Washoe existence at Lake Tahoe are lost under contemporary community development.

The known archaeological sites and archaeological coverage in the Lake Tahoe basin are summarized by watershed (Table 2-3). Sites of Native American occupation in the Lake Tahoe basin are unevenly dispersed. Archaeological evidence is confirmed by Washoe recollections, which disclose that certain areas were visited more frequently than others.

Variability in the density of archaeological sites is probably caused by proximity to specific aboriginal travel corridors to resource-rich zones. The Tahoe basin's rim of a broad and forested ridge would not have presented an obstacle to travel. Topography alone did not dictate routes of ingress and egress. Social taboos and the relative mobility of prehistoric groups, as determined by the structure of their seasonal migration, also influence the number and placement of archaeological sites (Lindström and Hall 1994).

The highest densities of archaeological sites occur along Tahoe's south shore. Marsh and meadow resources in the middle to lower reaches of the Upper Truckee River, Trout and Taylor creeks were extraordinarily rich, and their fisheries were unsurpassed. Luther Pass was a main travel route. Native American populations entering from Carson Valley took initial advantage of bountiful resources in Hope Valley, within the West Carson River drainage, and then traveled down the Upper Truckee River subwatershed, Tahoe's major fishery. The Upper Truckee River was a travel route for the Washoe's westward trek to the Sierra foothills to gather foodstuffs, to trade, and to visit friends and relatives.

Similarly, the entrance into the resource-rich zones in Tahoe's northwest quadrant may have been channeled along the Truckee River corridor through the Tahoe reach, with its many tributary streams and resource catchments. Although numerous prehistoric sites are recorded within the Truckee River corridor (Elston et al. 1977), Washoe place names are entirely absent. This may be explained, in part, by the fact that the Washoe people were excluded from the Tahoe reach very early in the historic period. As early as 1852, the area served as a

Table 2-3—Archaeological site distribution and density in the Lake Tahoe basin.

Watershed-Meadow Features	Archaeological Coverage	Prehistoric Sites	Historic Sites/Linear
Upper Truckee/Trout/Saxon/Heavenly Valley	fair	70 sites/32 mi linears	
Upper Truckee River	fair	46	
Trout Creek	good	12	
Saxon Creek	fair	4	
Heavenly Valley Creek	good	2	
Emerald Bay/Cascade-Fallen Leaf Lakes/ Taylor Creek	fair	30 sites/10 mi linears	
Emerald Bay	(? - state park)	1	
Tallac Creek	complete	2	
Taylor Creek	complete	30	
Meeks/Rubicon Bays	fair	4 sites	
Meeks Bay	good	3	
Rubicon Bay	poor	3	
McKinney Creek	poor	1	
Sugar Pine Point (General Creek)	(? - state park)	1	
Blackwood Creek	good	12 sites	
Ward Creek	good	11	4 sites/4 mi linears
Page Meadows	none	1	
Truckee River (Tahoe City)	fair	2	1 site
Burton Creek	fair	4	2 sites
Watson Creek	good	28	15 sites/several mi linears
Carnelian Canyon Creek	poor	1	
Griff Creek	good	6	9 sites/several mi linears
(Tahoe Vista)	fair	2	
(Brockway)	none	1	
1st/2nd/3rd/Incline/Mill Creeks	fair		41 sites/~15 mi linears
First Creek	fair	2	
Second Creek	fair	1	
Third/Incline Creeks	fair	39	
Marlette/Spooner/Glenbrook/Logan House/ Lincoln Creeks			92 sites/~100 mi linears
Marlette Lake	good	14	
Secret Harbor Creek	good	2	
Skunk Harbor	good	1	
North Canyon Creek	(? - state park)	1	
Spooner Lake	good	11	
Glenbrook Creek	good	2	
Cave Rock	complete	1	
Marla Bay/Burke/Edgewood Creeks	fair		33 sites/several mi linears
Marla Bay	fair	1	
Elk Point	fair	1	
Burke Creek	good	2	
Edgewood Creek (Rabe Meadows)	fair	8	

major Euro-American travel corridor, containing a wagon road and later a railroad. It was a short-lived mining center in 1863. The Truckee Lumber Company logged the area intensively during the 1870s, using the river channel to raft saw logs; intense logging continued through the 1910s.

Another major travel corridor near Mt. Rose channeled prehistoric populations from Truckee meadows into the Tahoe basin, funneling them directly through the resource-rich zone of the Tahoe meadows and down to plentiful fish, plant, and animal resources along Tahoe's northeast shore (Lindström and Bloomer 1994). High site densities within the Incline/Third creeks drainages are confirmed by recent Washoe testimony (Rucks 1996). The lowest archaeological site densities in the basin occur on Tahoe's east-central shore, although there are clusters of sites around major meadow complexes such as Spooner, Marlette, and Glenbrook. For example, a 12,000-acre survey conducted here disclosed no prehistoric archaeological sites and only six isolated artifacts. The lack of prehistoric remains suggests that this area was not a major travel corridor and that resource-rich zones were relatively limited. This pattern is supported by Washoe recollections. Also, the east shore contains Cave Rock, a key Washoe cultural-spiritual landmark that is to be avoided by all but a few sanctioned Washoe spiritual practitioners.

Tahoe's north-central zone lacks prehistoric sites. An exception is the Watson Creek corridor, which served as a shortcut to the Tahoe reach and was a target of Middle Archaic basalt quarriers. Washoe land use on the north-central shore is poorly documented.

Relatively few archaeological sites have been recorded on Tahoe's western divide. Site clusters are located along Ward and Blackwood Creeks. Exceptions include the documented Washoe trail up McKinney Creek to Georgetown and lakeshore meadows along Meeks Creek, which are significant to contemporary Washoe plant collectors.

Native American presence in the southeast quadrant of the lake, centering within the corridor along Kingsbury Grade, is not well documented in the archaeological record. However, Rabe Meadows along Edgewood Creek is known to be a key Washoe resource catchment.

The present archaeological inventory suggests that the lowest site densities in the Tahoe basin occur along the east-central shore, followed by the north-central and west-central shores, respectively. Site densities are highest along the south shore (especially within the Upper Truckee River/Trout/Taylor Creeks subwatersheds), followed by the Mt. Rose corridor (along the Incline/Third Creeks subwatersheds) and in the northwest (along the Truckee River corridor). Judging from the foregoing data, the potential for prehistoric resource manipulations may have been greatest along Tahoe's south, northeast, and northwest shores in the Upper Truckee River/Trout/Taylor Creeks, Incline/Third Creeks, and Truckee River subwatersheds.

Even after Euro-American "encroachment," the legal term the federal government used to describe the process by which the Washoe gradually lost their territory circa 1848 (Rucks 1996), the Washoe continued their treks to the lake, and some may have sustained limited subsistence traditions in the wake of destructive Euro-American industries, such as logging, grazing, and commercial fishing. The Washoe were intent on remaining on their traditional lands; many Washoe chose not to relocate, so families lived and worked on the fringe of Euro-American settlement (d'Azevedo 1986; Nevers 1976; Rucks 1995). The Washoe maintained links to their ancestral areas around Lake Tahoe by working for loggers, dairymen, fishermen, and, especially, resort owners. The men worked as guides and the women performed domestic labor or made baskets to support the tourist trade. Many Washoe were able to maintain their connections with Tahoe's south shore by supporting multiple resorts established in Lake Valley. Archaeological deposits at the south shore, which contain bedrock milling features and late 19th and early 20th century trash deposits of Euro-American origin, and Washoe oral history both indicate that traditional plant management continued at the south shore well into the 20th century, albeit on a reduced scale (Freed and Freed 1963; Rucks 1995; Siskin 1984). Washoe

families performed wage labor and continued to camp for extended periods along Trout Creek in Lake Valley until the 1940s (Peters and Peak 1984). They also occupied areas in the vicinity of Incline and Third Creeks, partly because subdivisions were not developed there until relatively late in the 1960s (Rucks 1996). Unlike the populations at South Lake Tahoe and Incline, Washoe populations and their traditional land use practices may have been displaced much earlier from other areas around the lake, areas without resorts that could have supplemented Washoe incomes. For example, Washoe recollections contain very few details regarding the north shore; traditional use was probably suspended with the onset of Comstock-era logging from the 1870s to the 1880s. The periodic harvest of mixed conifer stands on the north shore until recent times would have subjected biotic communities to more frequent disruption and might have discouraged the continuation of indigenous subsistence practices. Stands elsewhere that were clear-cut before the turn of the century, especially along Tahoe's east and south shores, were subjected to relatively little or no post-Comstock logging, allowing forests and their associated plant and animal communities to regenerate. Washoe land management traditions may have persisted somewhat longer here.

Culturally Important Plants and Traditional Use Areas

The Washoe Tribe has developed a comprehensive land-use plan (Washoe Tribal Council 1994) that includes goals of reestablishing a presence within the Lake Tahoe basin, revitalizing Washoe heritage and cultural knowledge, protecting traditional properties within the cultural landscape, and harvesting and caring for traditional plant resources (Rucks 1996:3). The Washoe plan aims to reintroduce traditional plant gathering practices and collect oral histories relevant to land and resource use and management, diet, social and economic history, organization, and beliefs (Rucks 1996). Fulfilling some of its federal responsibilities to tribal sovereign governments (USDA 1995), the LTBMU has invited Washoe plant specialists to participate in a series of field trips to begin identifying areas suitable for plant collection and horticultural management (Figures 2-7A and 2-7B) (Bloomer et al. 1997; Rucks 1996). The issues are not simply the presence or absence of traditional plants, but their vigor, their environment, and their physical attributes. Medicinal plants, for instance, are particularly sensitive and may be nurtured by the potential collector for several seasons before they are collected. To be useful for basketry, such plants as bracken fern must have structural characteristics that are promoted by systematic harvesting and thinning.

Prehistoric populations around Lake Tahoe regarded many hundreds of montane plants as significant. (Ethnobotanically important plants of the north-central Sierra Nevada are listed in a number of sources; see Table 2-4 for a compilation.) Some species were intensively collected, conserved, and managed for sustainable harvest. Categories of these important plants include those sought after to fill winter stores (as opposed to those collected primarily for immediate consumption), entire plants harvested for food, plants with seed resources, and plants used for medicinal purposes. There is an overwhelming consensus from all accounts that preparing food for winter stores was a focus of attention. This emphasis is linguistically coded by a specific term that distinguishes storable winter food as "real food" (d'Azevedo 1986). In addition, species in which the whole plant could be harvested for food, such as, *Allium* spp., *Perideridia* spp., *Lewisia* spp., *Lilium* spp., *Calochortus* spp., and *Brodiaea*, were likely to have been affected by aboriginal horticulture. The distribution and relative density and vigor of this category of plants, especially those that also were harvested for winter storage, may most accurately reflect the effects of harvesting and horticulture for sustained yields (e.g., Anderson 1993a). Seed resources also were important; sand seed (*Mentzelia dispersa congesta*) in particular is still actively sought and gathered. Cultural knowledge and interest in medicinal plants persists due to the relatively low profile collectors can maintain when seeking an individual plant, as compared to wholesale "harvests." There is significant concern among plant specialists that medicinal plants are

Figure 2-7A—As part of Washoe goals to reestablish a presence at Lake Tahoe, elders visit an archaeological site on Tahoe's north shore and discuss traditional land use practices (photograph courtesy of Susan Lindström, Truckee).

Figure 2-7B—Washoe elders discuss their surroundings in their native tongue; the session was videotaped as part of the ongoing Washoe Language Project (photograph courtesy of Susan Lindström, Truckee).

particularly vulnerable to over-collection and misuse by non-Washoe people.

A list of plants important to Washoe collectors (Table 2-4), has been compiled from the data of recent field work and published sources (e.g., d'Azevedo 1986; Fowler 1986; Nevers 1976). It also draws heavily from the unpublished field notes of d'Azevedo and Jacobsen, to which Kathleen d'Azevedo, Ed Montgomery, and Juanita Schubert contributed significant ethnobotanical information. The list reflects the information that Washoe practitioners are comfortable sharing. They acknowledge that this is but a small sample of the knowledge of their ancestors and that time and history have badly eroded a vast Washoe botany. They also are concerned about the misuse and appropriation of cultural information but hope that the plants will benefit from focused management and that they can begin a process of recapturing some of their more fragile resources and knowledge by active restoration and management.

Comstock Era (1850s to 1900)

Since John C. Fremont's historic sighting of Lake Tahoe on Valentine's Day in 1844, most early descriptions of the Lake Tahoe basin are framed in terms of its astounding natural beauty and economic potential. The stunning color and purity of the cobalt-blue water, the amazing size and abundance of fish in the lake, and the luxuriant forest in its surrounding basin are all prosaically noted. Though these early commentators were profoundly impressed by this extraordinary natural phenomenon, they mention only in passing the "Indian" inhabitants (Lindström et al. 1998). The philosophy and outcome of indigenous land management went unnoticed by the newcomers, who viewed the landscape as "natural" and "unowned." Such misconceptions supported their justifications for taking Tahoe land and resources from a people who seemingly never owned or managed them in the first place. Although the Washoe were largely excluded from Lake Tahoe, one element of Washoe culture that permanently remained is its name. Variously known as "Mountain Lake," "Lake Bonpland," and "Lake Bigler," the name "Tahoe," adopted in popular jargon early on, is derived from the Washoe word *da'ow*, signifying "lake." Lake Tahoe was not officially named by the California legislature until 1945.

Logging

The history of lumbering in and around the Lake Tahoe basin takes place within the larger history of Nevada's Comstock Lode. The Comstock could not have been so extensively developed without the sources of water and wood that were supplied by the Tahoe basin (Elliott 1973). It has been said that the silver mines of the Comstock are the tombs of the Sierran forests (DeQuille 1877). The urgent demand for fuel wood and construction lumber by the growing settlements and the mines themselves (with their square-set timbering system and steam-powered mills) devastated the supply. Areas east of the Carson Range were depleted of timber followed by harvest in the Lake Tahoe basin. Cutting commenced in the Carson Range on the east side of the lake and spread to the west and north shores and finally to the south shore. The silver mines were the chief consumers of wood and timber, with a secondary consumer being the Central Pacific Railroad (CPRR) and the wood markets it served.

Pre-Euro-American Forest Characteristics

Historical records and photographs (Scott 1957, 1973) indicate that many timber stands of the Lake Tahoe basin were clear-cut (or nearly so), with little regard for streamside areas. Uncut trees served as seed trees for the next generation of forests (Wheeler 1992). Logging techniques of the day relied heavily on cross-country skidding, which damaged existing young growth and thus future stand regeneration. Environmental degradation was compounded by coincident erosion of decomposed granite soils. Soil compaction and the destruction of humus in and around wood camps may have created artificial openings that have survived for over a century. Clear-cutting on hillsides accelerated erosion, releasing sediment loads into the lakes and streams of the basin. Intensive logging probably left forests fragmented and contributed to the decline or extinction of birds and mammals that required structurally complex forest habitat (Elliott-Fisk et al. 1996).

Table 2-4—Washoe cultural plants.

Botanical Names[1]	English Vernacular
Abies concolor	white fir
Achillea millefolium	yarrow
Allium campanulatem biseptrum (S. Watson)—by K. Anderson from specimen	Sierra onion
Allium validum—from specimen	swamp onion
Amelenchia alnifolia—from specimen	western service berry
Angelica breweri—Train	angelica
Arctosatphylos spp. (uva ursi, according to Rowley, but probably *nevadensis*)—not identified by Schubert	manzanita
A. patula—from description	green-leaf
Balsamorhiza sagittata—from specimen	arrow-leaf balsam
Barbarea orthocerus—by K. d'Azevedo from specimen	winter cress
Brodiaea hyacinina—by Rucks from specimen	white brodiaea
Brodiaea lutea—by Rucks from specimen	golden brodiaea or pretty face
Calchortus nuttallii—from specimen*;* cannot find in Weeden	sego lily
Camassia sp.	blue camas
Chlorogalum pomeridiam—identified by description (not specimen). This plant does not grow above 5,000' but is reported at Lake Tahoe	soap root
Cicuta douglassi—from specimen	water hemlock
Descaurania sp.—from specimen	tansy mustard
Fragaria sp.—from description	wild strawberry
Heracleum lanatum—from specimen	cow parsnip
Habernaria spp.—Rucks from specimen	Rein orchid
Lewisia sp.—Rucks from specimen	bitter root
Libocedrus decurrens	incense cedar
Ligusticum grayi—Rucks from specimen	Gray's lovage
Lilium parvum—by Rucks from specimen	alpine lily
Lomatium dissectum—from specimen	fern-leaved lomatium
Lupinus latifolius—Rucks from description	lupine
L. paoyphyllus ssp. Superbus—Rucks from description	lupine
Mentzelia dispersa congesta—from specimen	Nevada stickweed
Montia perfoliata var. depressa (Jepson)—from specimen.	miner's lettuce
Nicotiana attenuata—from specimen	coyote tobacco
Osmorhiza occidentalis—from specimen	western sweet cicely
Paeonia brownii—by Rucks from specimen	Brown's peony
Pedicularis groenlandica—by Rucks from specimen	elephant head

Table 2-4—*(continued)*

Botanical Names[1]	English Vernacular
*Perideridia sp. (*three species (*parishii, howellii,* and *bolanderi* are edible and may account for two of the "unknown potatoes")—by K. d'Avevedo from specimen	yampah, Indian potatoes
Petiphyllum pelatum—by K. d'Azevedo from specimen	Indian rhubarb
Pinus lambertiana	sugar pine
Prunus virginiana var. demissa—from specimen.	western choke cherry
Pteridium aquilinum var.—from specimen	bracken fern
Ribes aureum Pursh.—from description; this spp. not in Weeden	golden currant
Ribes roezeli—from specimen	Sierra gooseberry
Ribes velutinum—from specimen	plateau gooseberry
Rosa californica—from specimen	wild rose
Salix spp.	willow
Sambucus caerulea (*mexicana* C. Presl)—by K. Anderson from specimen	blue elderberry
Sium suave—from specimen	water parsnip
Smilacina stellata—from specimen	false Solomon's-seal
Sphenosciadum capitellatum—from specimen	ranger's buttons
Thalictrum fendleri—from specimen	meadow rue
Typha latifolia—from specimen	cattail
Veratrum californicum—Train	corn lily
Wyethia mollis—from specimen	mule's ear
Zigadenus venenoseus—Train	death camas

Note:
[1]Unless otherwise noted, after Weeden 1986; identifications by Juanita Schubert, 1957, unless otherwise noted.

What did the Tahoe landscape look like before logging took place? In a recent study of forest sample plots along the west side of the Carson Range, "Comparisons of the composition, density, and sizes of Comstock era stumps with live trees on the same sites clearly demonstrate[s] that contemporary forests in the Carson Range are very different from the ones first encountered by early European settlers" (Taylor 1997).

Additional perspectives on characteristics of pre-Euro-American forests can be gained through the climate record, historic period accounts, and archaeological observations of the logging landscape. Although at least two-thirds of the basin was clear-cut, it is important for the purposes of ecosystem reconstruction to know the location of both logged and unlogged areas, when the areas were logged, and how and to what degree they were logged.

Climate Record

Comstock-era harvesting targeted stands that had matured during the mid-1600s to mid-

1800s, a period of generally cooler and wetter conditions coincident with the Little Ice Age. During this 200 to 300 year period, cooler and wetter conditions limited the negative impacts of potential stresses on the forest (for example, droughts, fires, and insect infestations) and favored the growth of conifers in the Tahoe basin. Undoubtedly, these Little Ice Age conditions contributed to the size and vigor of trees that impressed many early observers. The high precipitation noted during the harvest period of the 1870s to the 1890s and subsequent high flows of the Truckee River have been matched only by the flows caused by El Niño events of the early 1980s. Wetter conditions also facilitated steam-powered logging technology and enhanced water supply engineering and the viability of flumes, pipelines, and reservoirs.

Historic Period Observations

Scientific studies indicate that the structure and composition of modern forests in the Lake Tahoe basin are very different from the pre-Euro-American forests (Leiberg 1902; McKelvey and Johnston 1992; Sudworth 1900; Taylor 1997). Overall, virgin stands were more open and composed of trees that varied greatly in diameter. Early explorers described the forests of the Tahoe basin as "dominated by giant pine trees with so much room on the forest floor that riders could travel at full gallop without losing their hats" (*San Francisco Chronicle*, August 21, 1995). Second growth stands are currently 10 times denser with trees that are considerably smaller in diameter (Taylor 1997). Tahoe's pine forests, once dominated by Jeffrey and sugar pine, are now fir forests, dominated by white and red fir. These scientific findings are supported by historic period observations. For instance, Captain James H. Simpson (1883) recorded the following on his 1859 government expedition west through Lake Valley.

"*June 13, Camp No. 38, Genoa.* . . . The ride this morning the most charming I have had for a long while. Lake Valley is like a beautiful park, studded with large, stately pines. The glades between the trees are beautifully green, and the whole is enlivened by a pure, babbling mountain-stream, the most southern and principal branch of the Truckee, coursing along northwardly to its expansion, Lake Bigler. The pines of various kinds are very large, and attain a height of probably from 100 to 150 feet. Their diameter is not infrequently as much as 8 feet, and they sometimes attain the dimension of 10 feet."

With an eye on the understory, George H. Goddard (1855) passed through the same area as Simpson and wrote "*Sept. 2 Sunday*—Walked some two miles down the valley. There were a number of currant bushes near the trail, some of which were loaded down with remarkably fine currants, nearly as large as gooseberries and fine flavored. . . . *Sept. 14*—The ground in many places is literally covered with strawberry vines, or sun-flowers."

Mark Twain (1962) shared similar observations during his stay in the mid-1860s. "It was yellow-pine timberland—a dense forest of trees a hundred feet high and from one to five feet through at the butt."

Prior to the onset of large-scale logging, DeQuille (1877) maintained that "Many of the sugar-pine trees about Lake Tahoe are five, six, and some even eight feet in diameter; all are very tall and straight."

Theodore Judah (1862), who surveyed the route of the transcontinental railroad through the Truckee Basin in 1862, was similarly impressed. "The sugar pine of these lands often runs 125 feet high without a limb, and often measures 8 feet through at base."

Not only were the trees "larger than life," but they grew in unbelievable bounty. In 1883, Edwards's *Tourist's Guide and Directory of the Truckee Basin* boasted "The [timber] supply may be said to be never ending . . . . It is beyond the power of man to estimate when it will be exhausted."

In this setting of superabundance, Comstock-era logging commenced and continued with such voraciousness as to nearly wipe out all of the accessible stands within 25 years. However, not all forests were clear-cut, some trees were harvested selectively to suit varying wood markets. In addition to saw logs, timber was cut for cordwood, railroad ties, charcoal, shingles, lath, boxes, and doors and sashes. Each of these items required specialized and selective timber cutting to make the best product.

In 1947, Galloway wrote "The trees that furnished the lumber and wood for the Comstock

were the conifers, which family includes pines, firs, and cedars. The Western White Pine or Silver Pine, makes a sparse growth throughout the region in elevations from 8000 to 9500 feet. It was worthless for lumber or wood. Sugar Pine is found between elevations 4000 to 8000 feet. It grows to heights from 160 to 180 feet, and in diameter from 4 to 7 feet. It is valuable for building purposes, as being soft it is easily worked and produces a greater percentage of clear lumber. Western Yellow Pine [ponderosa pine] was abundant, ranging from 4000 to 8000 feet elevations. The trees grow to heights from 125 to 140 feet, and in diameters 3 to 4 feet, but in some instances up to 6 feet. Yellow Pine was best for general purposes, having a good percentage of clear lumber and being stronger than Sugar Pine. The Jeffrey Pine, which differs somewhat from Yellow Pine, grows in the region in similar sizes and general characteristics. Generally the two trees are all called Yellow Pine. White or Silver Fir was abundant in the Tahoe region. It was cut mostly into firewood, together with the pine tops left in logging. It takes a long time to dry, and as it warps badly, it was not used for building. The extreme diameter reached 5 feet and the range was from 4000 to 7500 feet. The Douglas Fir, or Douglas Spruce, is found around Lake Tahoe, but not on the eastern slope of the mountains. It reaches heights of 100 to 150 feet, and diameters from 3 to 6 feet. On account of the strength of the wood, it is one of the most valuable of forest trees. Red Fir grows over the entire region, but was not very abundant or accessible, being found between elevations 7000 to 8500 feet, and in diameters up to 5 feet. Red Cedar [incense cedar] was used principally in structures in contact with the ground, the heart wood only being resistant to decay...There is no hemlock or spruce in the Tahoe region, and the only tamarack is the useless Lodgepole Pine, so called" (Galloway 1947).

Although it is apparent that the Jeffrey, sugar, and ponderosa pines were favorites, lumbermen eventually found that there was a market for fir and cedar as well. Fir stands were logged after the turn of the century for paper pulp (Knowles 1942; Wilson 1992). Stands of cedar were harvested for shakes and shingles. Accordingly, some timber tracts were not clear-cut at once; rather, stands such as those at Tahoe's north and northwest shores were reentered over time for different purposes.

Historic Stump Fields

Less than three decades after the forests in the Tahoe basin were initially clear-cut, Leiberg (1902) observed "It is not possible to state with any degree of certainty the quantity of timber cut from the portion of the Truckee Basin [and north and west Lake Tahoe basin] examined. Much was cut so long ago that the stumps have rotted down. . . . "

Yet, over a century after cutting, historic cut stumps remain in certain areas of the Tahoe basin and are a potentially productive avenue of study. Taylor (1997) quantitatively described pre-Euro-American forest conditions and processes in his dendroecological study of sample plots of cut stumps left by Comstock logging on the east shore of Lake Tahoe (Carson Range). He concludes "Prior to Euro-American settlement, forests on well drained sites at high altitude were dominated by red fir and western white pine. Small patches of lodgepole pine were also present in some stands. . . . Large areas may have been covered with mature and/or old-growth stands. . . . In the original forests both large and small diameter stems were . . . typically clumped at several scales" (Taylor 1997). "Pre-Euro-American lodgepole pine forests were less dense and had trees in a wide range of size-classes and stands were a mosaic of stems which were clumped at various spatial scales" (Taylor 1997).

In another study (Lindström and Waechter 1995, 1996), comparisons among six stump fields on Tahoe's north shore and northeast shore, ranging in size from about 10 to 60 acres each, show marked contrasts in stump diameter and density. Stump fields sampled on the north shore, on average, may have been composed of larger trees at least twice as densely packed, and sometimes up to 17 times, as stands on the northeast shore, with average stump diameters being 35 and 30 inches, respectively. These average stump diameters are consistent with log diameters recorded in scaling records dating from 1887 to 1890 in the Trout Creek

drainage in South Lake Tahoe (Figure 2-8). The large diameters of harvested timbers are depicted in period photographs (Figures 2-9A and 2-9B).

Fire Frequency

Fire historically has been a companion to logging, as written records, burned stumps, and log structures attest. After Comstock-era cutting, forests were vulnerable to fires as never before. "There is little litter except on areas logged or culled to considerable extent, where masses of tree tops and rejected portions of trunks form great heaps of debris" (Leiberg 1902).

Some of the most serious fires fed on debris in cutover areas and owed their origins to sparks from steam-powered logging equipment or friction points in cable skidding. Costly fires occurred along the railroad where cordwood, ties, mine timbers, or lumber awaiting shipment were ignited by cinders from wood-fueled locomotives. Very destructive fires also occurred at mills, where burning sawdust and slab piles were constant flammable hazards. Blazes in cut forests ran virtually unchecked through slash and second growth, creating sufficient heat to destroy humus and to harden clay in the soil (Strong 1984). Consequently, forest regeneration was delayed for years due to seedlings and saplings damaged by fire and logging. Seldom was there any coordinated attempt at fire suppression; indeed, many of the residents in the basin evidently looked upon wildfires as useful agents in clearing the land of brush and undesirable trees (Strong 1984).

Eroding Logging Roads as Conduits of Sediment in Tahoe's Watershed

Heyvaert (1998) estimated that during Comstock-era logging, sediment deposition rates into Lake Tahoe increased seven- to 12-fold over rates of deposition before disturbance. One source of sediment may have been from the miles and miles of historic log haul roads, skid trails, and flumes that form dendritic patterns along basin mountainsides. Many of these roads have since eroded into trenches with depths of up to six feet. Some eroded roads are now only recognizable as drainage channels and are appropriately characterized as "sensitive environmental zones" by forest managers. These roads are most densely packed along the east and south shores, with highest densities and most severe erosion along Trout and Saxon Creeks in south Lake Tahoe. Maps depict the focus of past human disturbance (Figure 2-10). Over the century, these entrenched roads likely served as conduits, introducing sediments into Tahoe tributaries (and they may continue to do so). Sediment loading may have been particularly extreme in shallow, decomposing, granitic soils and immediately following Comstock logging events, before the ground surface had an opportunity to stabilize. In addition, the timing of Comstock-era road construction coincided with a period of increased moisture and runoff that would have further aggravated erosion problems. DeQuille (1877), in a historic period account, comments on the negative impacts on the watershed due to Comstock logging,: "The time is not far distant when the whole of that part of the Sierra Nevada range lying adjacent to the Nevada Silver-mining region will be utterly denuded of trees of every kind. Already one bad effect of this denudation is seen in the summer failure of the water in the Carson River. The first spell of hot weather in the spring now sweeps nearly all the snow from the mountains and sends it down into the valleys in one grand flood, whereas while the mountains were thickly clad with pines the melting of the snow was gradual and there was a good volume of water in the river throughout the summer and fall months."

Perhaps the most visible lasting example of such erosion is the North Flume, which flowed from Third Creek to a tunnel above Marlette Lake. Erosion channels generated by washouts appear as tremendous vertical erosion scars on Incline Mountain that can still be seen from across the lake. Increased flows of sediment and silt into spawning gravels, coupled with the diversion of streams, may have been partially responsible for the extinction or decline of native trout (Elliott-Fisk et al. 1996).

Environmental Consequences of Lumber Company Harvesting Strategies

Beginning in 1859, a few individuals staked small timber claims to supply the handful of sawmills established to outfit local needs. The earliest lumber and fluming operations were small-scale and

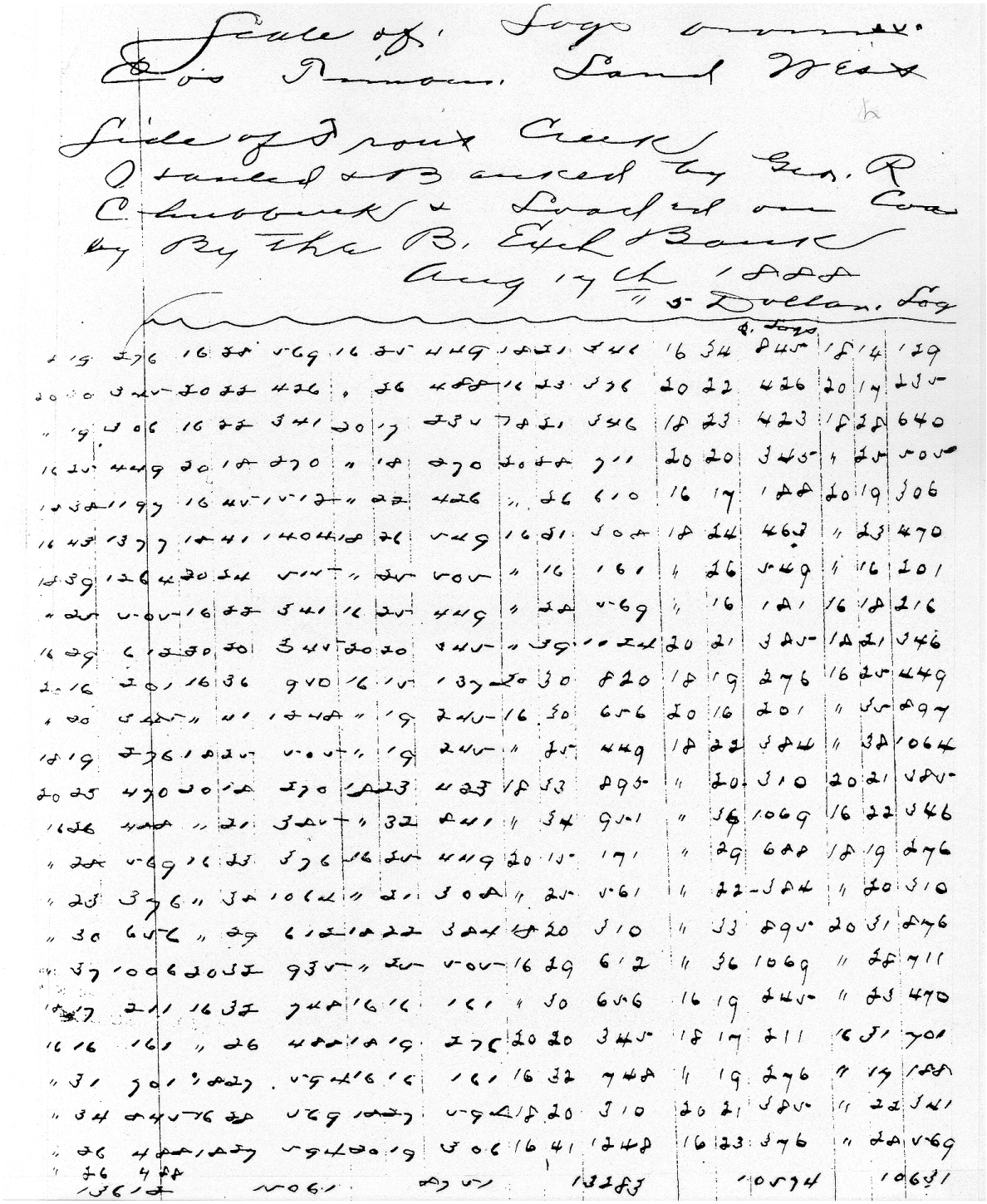

Figure 2-8—Page from Log Scale Record Book 1887-1888, logs scaled on "Co.'s Land West of Trout Creek" (on file CTLFC Records 1864-1946 NC73/9/36,37,38/Box 24); log lengths are presented in the far left column, log diameters in the center column, and volumes in the right column with summed totals.

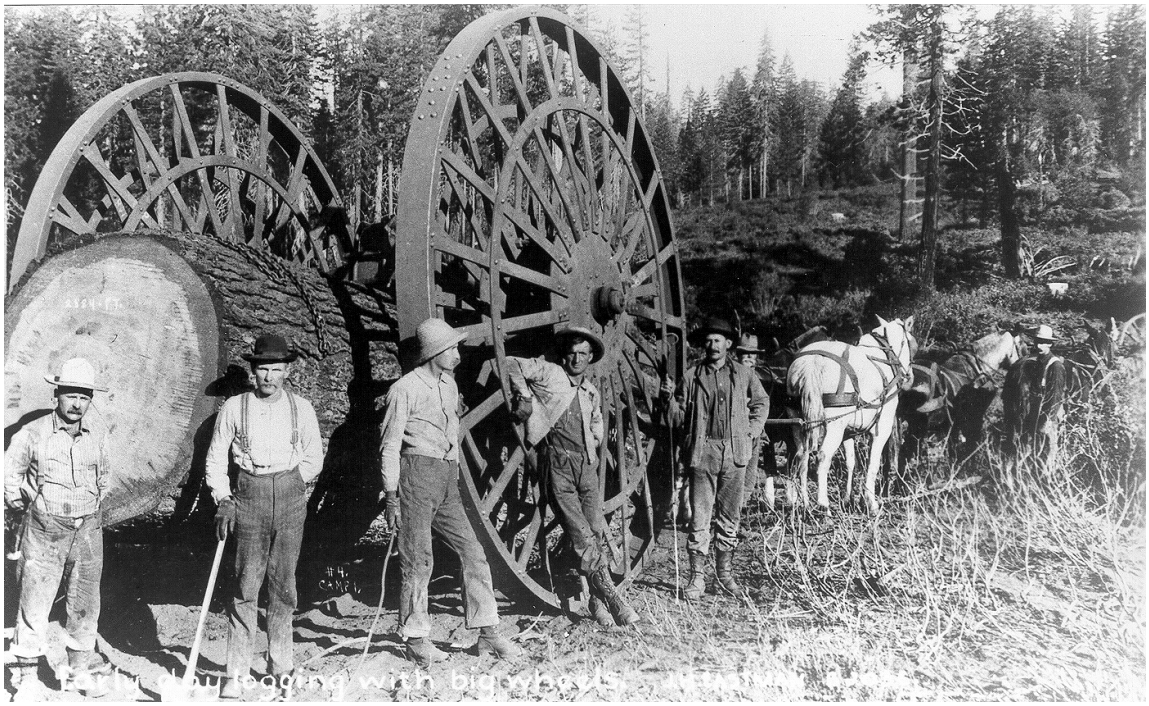

Figure 2-9A—Early day logging in the Tahoe Sierra with big wheels; note the large diameter log (photograph courtesy of Nevada Historical Society).

Figure 2-9B—Logging the Tahoe Sierra in 1895; note the large diameter logs (photograph courtesy of Nevada Historical Society).

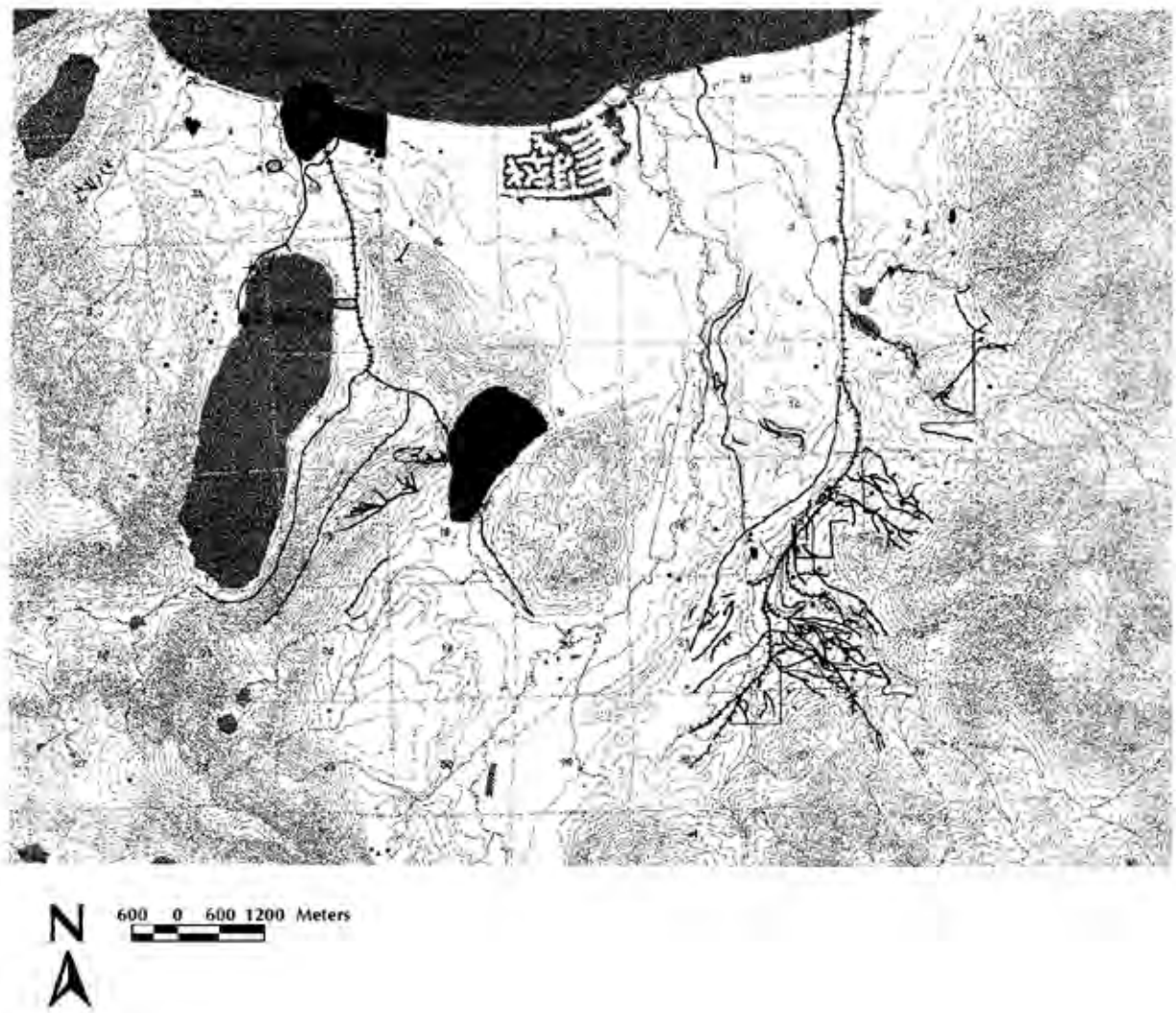

Figure 2-10—Historic logging roads and railroads in South Lake Tahoe; note the density of linear features within the Trout/Saxon creek drainages.

scattered along Tahoe's east shore (around Spooner Summit and Glenbrook) and in Lake Valley (South Lake Tahoe), later expanding to the west and north shores. Mark Twain joined the ranks of these lumber pioneers when he staked claim to a small tract of timber near Glenbrook in the early 1860s, then watched as it went up in smoke after his unattended campfire got out of control. These few small sawmills, established in the Tahoe basin during the 1860s to supply local needs, preceded the large-scale logging to come. Clear-cut logging began in earnest in 1873 with the arrival of large lumber and fluming companies stoked with capital to finance large mills and to establish an elaborate network of logging barges, railroads, wagon roads, V-shaped flumes, water storage reservoirs, and associated wood camps and mills. The system was designed to cut and move the lumber over the Tahoe divide and down to the mines of Washoe and the markets served by the CPRR (Figure 2-11). Timber was largely transported from the basin by V-flume down to the railroads; mutual business ties naturally developed among lumber, water, and railroad interests. To meet the vast labor demands, these companies hired immigrant workers, including a large number of Chinese.

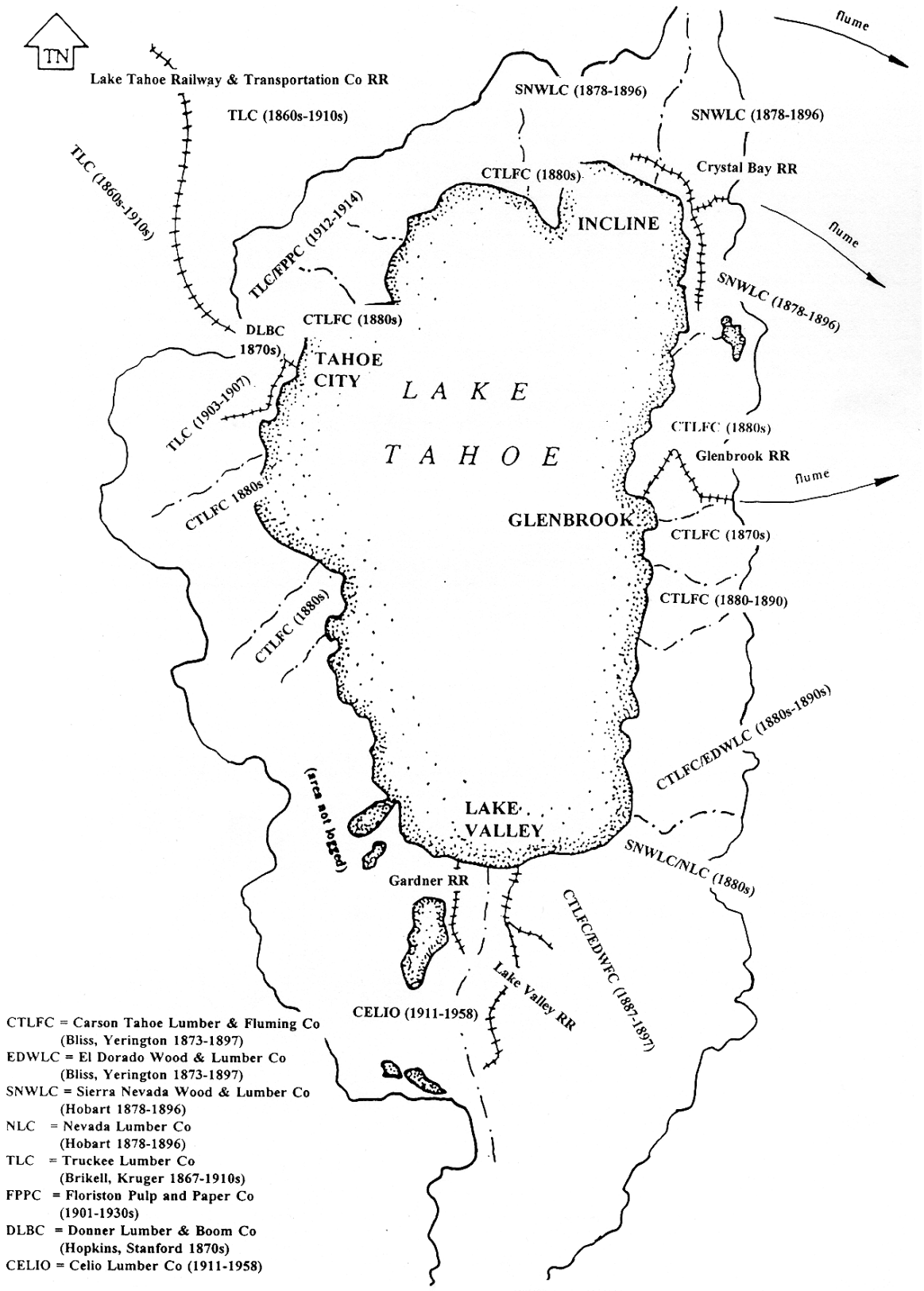

Figure 2-11—Major lumber operations in the Lake Tahoe basin.

The Carson Tahoe Lumber and Fluming Company (CTLFC) emerged as the chief lumber operator under the ownership of D. L. Bliss, J. P. Yearington, and D. O. Mills. Their headquarters were at Glenbrook. From 1873 until 1898, an elaborate "super-system" of rafting operations, railroads, V-flumes, wagon and skid roads, and wood camps supplied their mills at Glenbrook from their basin-wide timber holdings. Logs were rafted to the Glenbrook mills, and lumber was hauled from there to Spooner Summit by railroad and then sent by flume down to storage yards near Carson City for transport by the Virginia and Truckee Railroad (VTRR) (figures 2-12 to 2-15). The company monopolized the Comstock trade and eventually came to control approximately one-fifth of the Tahoe basin's land, including substantial stretches of lakefront (Goodwin 1971). It held vast timber tracts on Tahoe's east-central and south shores, with smaller discontinuous holdings on the north and west shores. As companion organizations, the CTLFC worked closely with the El Dorado Wood and Fluming Company (EDWFC) in logging their lands and later in marketing and leasing their respective holdings. Within 25 years, the CTLFC had cut 750 million board feet of lumber and 500,000 cords of wood in the Tahoe basin.

The Sierra Nevada Wood and Lumber Company (SNWLC), owned by W. S. Hobart, was the second largest logging operation. The company owned approximately 55,000 acres of timberland in the Tahoe basin. Cutting occurred from 1873 to 1896 and was concentrated around Incline in Tahoe's northeast quadrant, with some harvesting on the southeast shore. Company operations included a narrow-gauge railroad, a rafting system on Lake Tahoe, a network of V-flumes and log haul roads, and a mill and tramway at Incline (figures 2-11 to 2-15). Lumber was hauled by tram from the mill to a V-flume, which first passed through a tunnel, built originally by the Virginia and Gold Hill Water Company (VGHWC) to augment its supply of water from the Sierra Nevada. From here lumber was floated down the Lakeview hill to a flume dump and storage yard that was served by a spur track from the VTRR (Elliott 1973).

Logging in the northwestern part of the Tahoe basin was done primarily by the Truckee Lumber Company (TLC). The TLC, under the ownership of E. J. Brickell and W. H. Krueger, maintained holdings along the Truckee River Canyon and on the mountains above Tahoe City, cutting from 1867 until the 1910s (Figure 2-11). The Donner Lumber and Boom Company (DLBC), headed by CPRR managers Mark Hopkins and Leland Stanford, also operated in the Truckee River corridor. The company was granted authority in 1870 to construct a dam at Tahoe's outlet to impound water used to float logs and cordwood down the Truckee River channel to Truckee (Figure 2-11).

The Pacific Wood, Lumber and Flume Company (PWLFC) operated between 1877 and 1888 under the direction of the mining conglomerate Flood, Fair, Mackay, and O'Brien. The company owned timber stands in the extreme northeastern area of the basin near Mt. Rose, cutting in the Hunter and Evans Creek drainages (Figure 2-11). Wood was transported in a 15-mile V-flume all the way to Huffaker's Station on the VTRR.

Lumber company records, supplemented by the archaeological remains of logging activities, guide the assessment of changes in plant and animal communities by revealing where and when anthropogenic disturbances occurred. History and archaeology delineate the subwatersheds where logging disturbances were relatively short-lived (lasting perhaps a single season), as well as such locales as Glenbrook and Incline that endured intense impacts for decades and the areas that escaped impacts altogether.

The scale and intensity of Comstock-era logging, as well as the timing of harvest, was not uniform throughout the basin. The progression of harvest was tied to the proximity and accessibility of timber stands. Figure 2-16 shows the irregular distribution of logged lands. Specific dates of cutting in Tahoe's subwatersheds are listed in the logging timeline on Table 2-5 and are shown on Figure 2-17. Large stands of timber initially were cut during the mid-1870s on Tahoe's east central shore around Spooner Summit, and clear-cutting was complete by the 1880s (Taylor 1997).

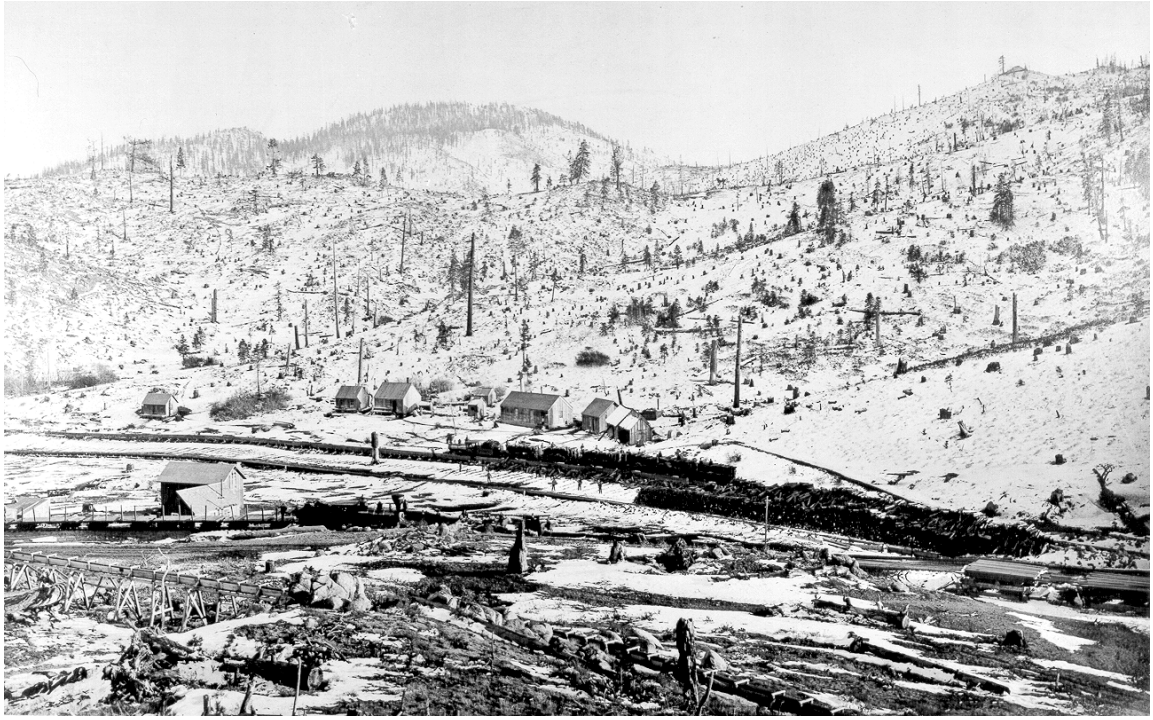

Figure 2-12—Spooner Summit 1876, looking northwest from a point now located on the north side of Highway 50; Glenbrook Railroad is unloading milled lumber for transport to Carson City via V-flume; note cutover slopes (photograph courtesy of Nevada Historical Society).

Figure 2-13—Spooner Summit ca 1870s, looking southeast; Highway 50 now passes through the foreground; note cutover slopes (photograph courtesy of Nevada Historical Society).

Figure 2-14—V-flume on Spooner Summit ca 1870s, looking northwest from a point now located on the north side of Highway 50; view is a closeup of logging train and lumber loading decks shown in Figure 2-13; note cutover slopes (photograph courtesy of Nevada Historical Society).

Figure 2-15—Mill at Incline ca 1880s to 1890s; note cutover slope (photograph courtesy of Nevada Historical Society).

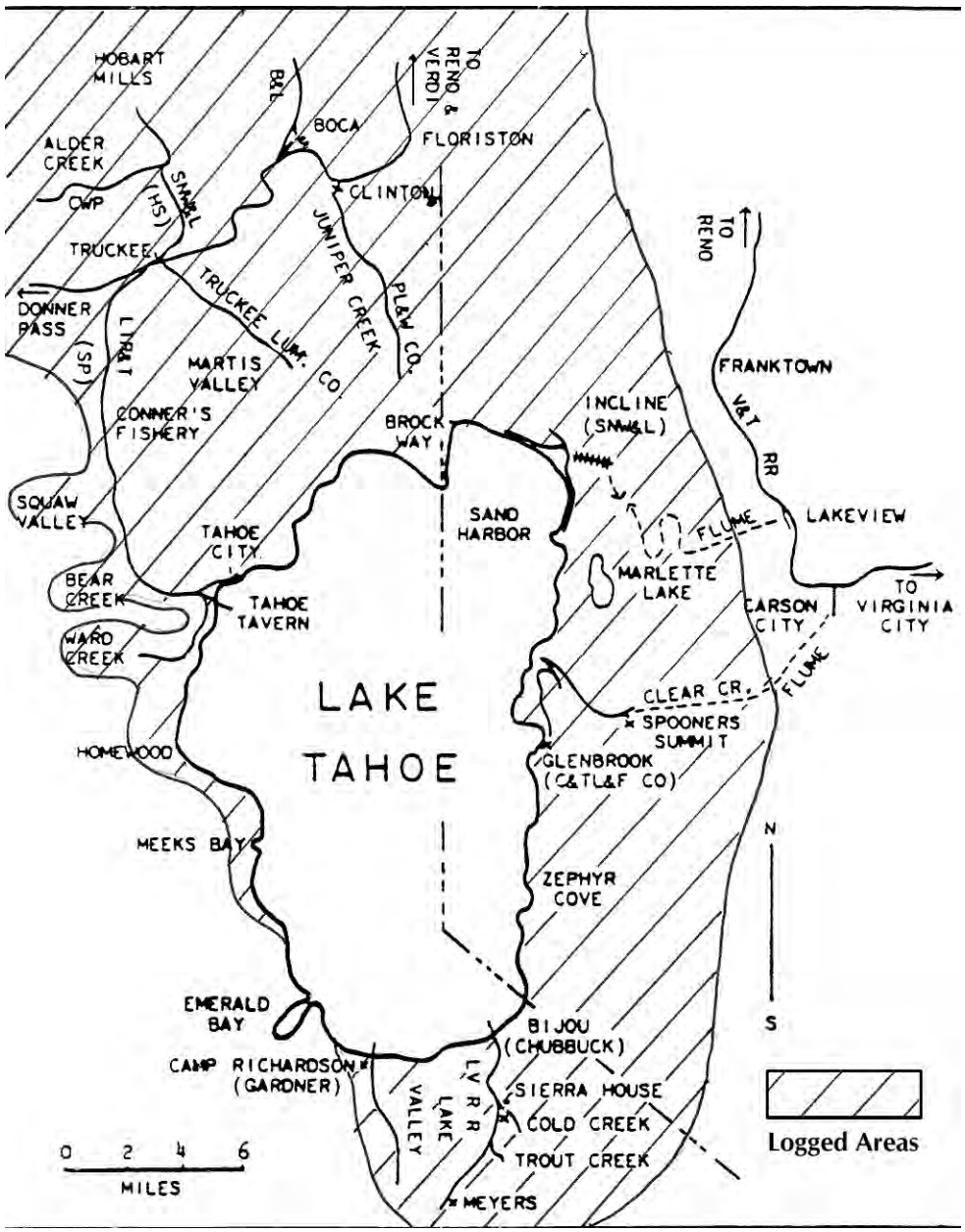

Figure 2-16—Schematic map showing estimated extent of historic logging in the Tahoe basin (map template modified after Myrick 1962:417).

Table 2-5—Summary of logging in the Lake Tahoe basin.

Area	Small-scale Cutting (Date/Individual)	Large-scale Cutting (Date/Company)
South Shore		
Lake Valley	1859-1887 (independent)	-
	1885-1886 (Chubbuck for CTLFC)	1887-1897 (CTLFC/EDWLC)
Camp Richardson/Tahoe Mt	-	1875-1885 (Gardner for CTLFC)
Meyers	1911-1958 (Celio Lumber Co)	-
Upper Trout Creek	1946 (Placerville Lumber Co)	-
West Shore		
McKinney Bay	1867-1877 (contractor for CTLFC)	-
Meeks/Rubicon Bays	1878-1884 (contractor for CTLFC)	-
Sugar Pine Point	1878-early 1880s (contractor for CTLFC)	-
Blackwood Canyon	1890 (contractor for CTLFC)	-
Northwest Shore		
Ward Canyon	1863-1877 (contractor for CTLFC)	1903-1907 (TLC)
Tahoe City/Burton Creek	1880s (contractor for CTLFC)	1912-1914 (TLC/FPPC)
	1927-1933 (independent)	-
	-	1992 (USFS Twin Crags TS)
North Shore		
Agate Bay	1864-1878 (independent)	-
	1878 (contractor for CTLFC)	-
Tahoe Vista	1881 (contractor for SNWLC)	-
Dollar Point	1884 (contractor for CTLFC)	-
Griff Creek	1920s-1927 (independent)	-
Watson Creek	-	1947 (Fibreboard)
Martis Peak/Brockway	-	1960s (Fibreboard)
	-	1989 (USFS Watson TS)
	-	1992 (USFS Brockway TS)

Table 2-5—*(continued)*

Area	Small-scale Cutting (Date/Individual)	Large-scale Cutting (Date/Company)
Northeast Shore		
Incline to Mt. Rose	1876-1878 (Marlette & Folsom for SNWLC)	1878-1896 (SNWLC)
	-	1960s (Boise Cascade)
East Shore		
Spooner/Glenbrook	1861-1873 (independent)	
east shore Marlette to Daggett Pass	-	1873-1890s (CTLFC)
White Hill (Spooner Summit)	-	1873-mid-/late 1870s (CTLFC)
Logan House/Lincoln Cks (upper reach)	-	mid-1880s (CTLFC)
Slaughterhouse Canyon	-	1885 (CTLFC)
Logan House Creek (lower reach)	-	late 1880s-1890 (CTLFC)
Marlette Lake	1950s (commercial logger)	-
Southeast Shore		
Edgewood	1860s-early 1870s (independent)	-
Edgewood/Kingsbury/Daggett Pass	-	1880s-1890s (SNWLC, NLC; CTLFC, EDWLC)
Kingsbury	1949-1954 (Placerville Lumber Co)	-

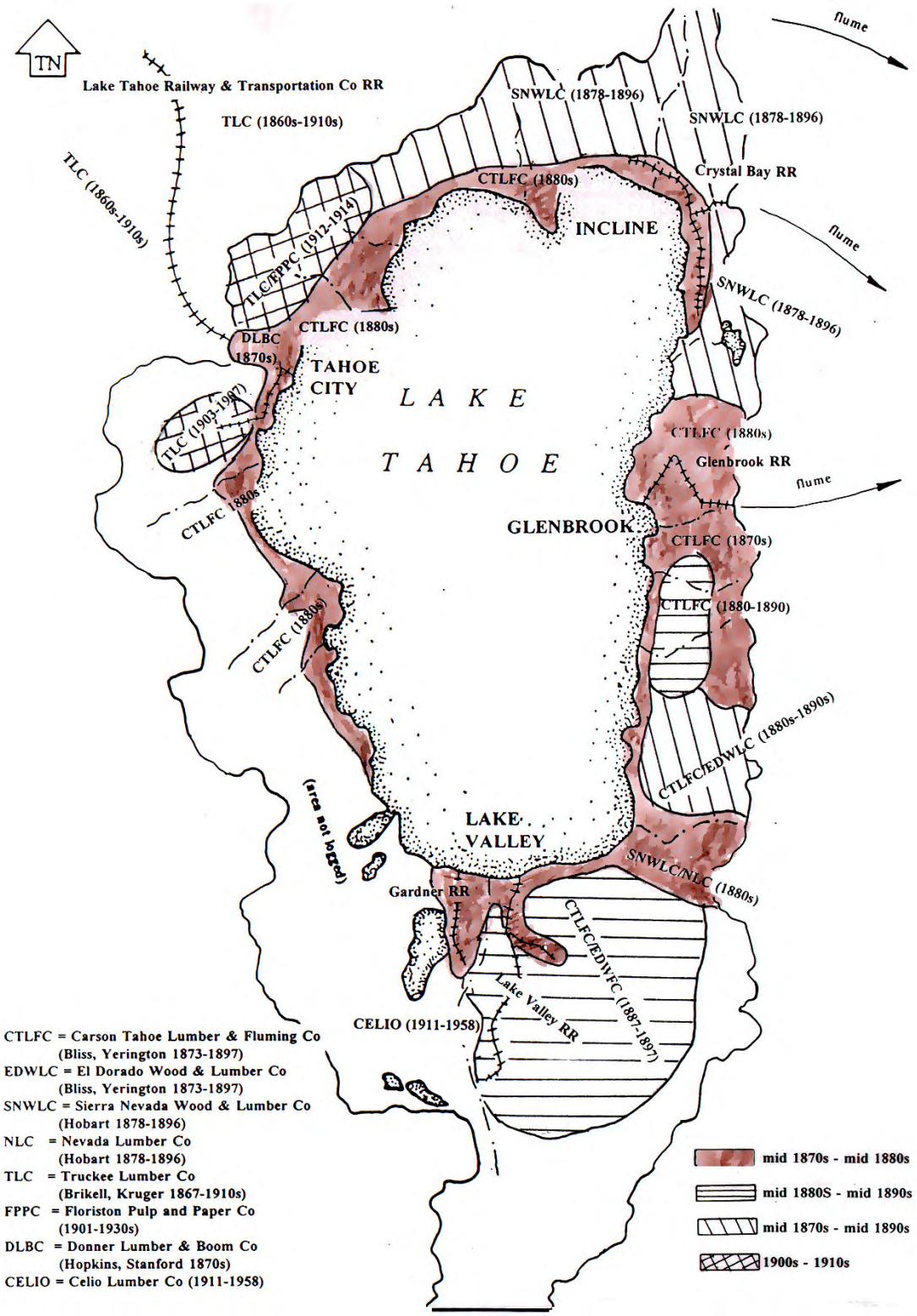

Figure 2-17—Schematic map of large-scale cutting (based on archival/archaeological/dendrochronological data).

During the late 1870s to mid-1880s, more distant stands were tapped, with more limited harvest occurring in selected pockets along Tahoe's west shore and in discontinuous tracts on the north shore above Agate and Carnelian bays and on the southeast shore around Kingsbury. The 1880s also saw the extensive clear-cutting of large timber tracts above Incline. Vast stands in Lake Valley on the south shore were not clear-cut until the very late 1880s and 1890s. Less desirable fir stands were logged during the 1900s to 1910s for paper pulp. Throughout the period, a few minor independent operators harvested cedar for shakes and shingles and cut pine for local use. Marked differences in company harvesting strategies in the Tahoe basin have been considered by Lindström and Hall (1997) in terms of chronology, geography (topography, hydrology, vegetation), land ownership, corporate structure, available markets, technology, labor, socio-cultural organization, ethnicity, and archaeology. The activities of the CTLFC in all quadrants of the basin provide an example of these differences, as presented by Lindström and Hall (1997) and summarized below.

To facilitate their east shore operations, the CTLFC commanded immense, contiguous timber blocks, on which an impressive network of transport and milling operations was located. Steep terrain prohibited conventional railroad logging, and a small narrow gauge railroad functioned more like a tram. East shore harvests were among the company's most intensive and extensive, with correspondingly severe environmental impacts. East shore operations were also the company's earliest, with most cutting occurring during the 1870s and 1880s. (Logging by the SNWLC in its vast holdings between Incline and Mt. Rose may have been similarly intensive and extensive.)

Logging by the CTLFC in Lake Valley on Tahoe's south shore occurred relatively late; largescale logging didn't begin until the later 1880s and ended in 1898. As with earlier east shore operations, the CTLFC owned large, contiguous timber blocks within which it developed a complex harvest and transport network. Level terrain accommodated railroad logging and an accompanying system of wagon haul and skid roads. In addition, the CTLFC enjoyed the advantages gained by new steam technologies. Support services provided by local suppliers and a local labor force increased production. Accordingly, the vast timber resources on the south shore were fully exploited in less than 10 years.

In contrast to east and south shore operations, CTLFC's north shore holdings consisted of largely disjunct timber blocks of smaller size, juxtaposed in checkerboard fashion with plots owned by competing lumber companies. Harvest and transport were accomplished by a variety of small-scale independent contractors. Company-sponsored logging occurred here during the 1880s, and impacts were considerably less intensive and extensive.

Similarly, west shore operations were accomplished by independent contractors without the benefit of an integrated log harvest and transport infrastructure. Harvest was confined to accessible stands near the lake and more distant forests were not penetrated. Cutting was relatively early (late 1870s to 1880s), and stands on the west shore, overall, were the least affected in the basin.

From the standpoint of Comstock-era logging interests, mixed conifer stands of pine, fir, and cedar on the north and south shores were generally more productive than homogenous pine forests on the drier east shore. Also, north and south shore stands were more accessible than forests on the steeper east shore or the rugged west shore. Harvest commenced in the late 1870s on the north shore, and between 1888 and 1889 on the south shore.

Overall, second growth north shore forests could be reentered sooner than south shore stands. With a market demand for cedar shingles and the opening of a pulp and paper mill on the Truckee River in 1901, loggers reentered mixed stands on the north shore to cut fir and cedar left by Comstock-era loggers. The Lake Tahoe Railway and Transportation Company (LTRTC) established a tourist railroad, which also transported wood products down the Truckee River canyon to the mainline at Truckee. In general, forests on Tahoe's north shore experienced recurrent logging disturbance, whereas second growth stands elsewhere in the Tahoe basin were largely left to regenerate for many decades following their initial disturbance.

Patterns in the geography, land ownership, technology, and chronology of historic logging operations are mirrored in the density and distribution of archaeological logging remains. Despite comparable archaeological coverage, far more sites have been inventoried on the south and east shores than the north and west shores. For example, a 700-acre survey for the Pioneer Timber Sale on Tahoe's south shore disclosed an intensive Comstock-era logging network that includes a 13-mile railroad that was fed by 16 miles of wagon haul roads, one V-flume that extended 2 miles, and at least 28 railroad camps and wood camps (Lindström and Hall 1997). A survey of 5,600 acres for the North Shore Ecosystems project on the north-central shore (an area eight times larger than the Pioneer Timber Sale area) resulted in discovery of one historic logging camp dating from the 1910s, a cedar sawmill from the 1920s, two Comstock-era logging chutes, and several isolated artifacts (Lindström and Waechter 1996). A 12,000-acre survey of the Spooner-Big Gulp Timber Sale on the east-central shore (only twice the size of the north shore survey) revealed a vast inventory of Comstock-era logging remains, including a nearly 9-mile railroad, more than 80 miles of wagon haul roads, flumes, and skids, 60 wood camps, and three saw mills (Lindström and Hall 1994).

Forest Conservation Ethics

Published documents, company records, oral histories, and physical evidence suggest that logging interests did little to conserve the natural environment, and for the first several decades, logging practices were unregulated. Yet, the entire Tahoe basin was not clear-cut. At least 38 old-growth stands have been located within Tahoe's upper and lower montane forests. Inaccessible stands, excessively large trees, and deformed trees were left due to difficulty in transport or milling. Stands around resorts were preserved for aesthetic reasons. Some laudatory accounts characterize D. L. Bliss, principal of CTLFC (the largest Comstock-era lumbering firm in the Tahoe basin), as a conservationist in that even during the height of the demand for timber, he took steps to preserve the Tahoe basin's natural beauty, requiring that trees under 15 inches diameter be left standing and exempted "particularly scenic" parts of the forest from any cutting at all (McKeon 1984; Wheeler 1992). Shaw et al. (1948) comment on the company's cutting practices at Tahoe.

"We gladly record his [D. L. Bliss's] far-reaching operations which were productive and always mindful of conserving Nature's gifts for the continued enjoyment of coming generations. Few are the lumbermen earning such a reputation."

The extent to which Bliss' conservation ideas were actually put into practice and the degree to which they had enduring effects on the landscape are presently unclear.

Fishing

The two great lakes joined by the Truckee River—Lake Tahoe and Pyramid Lake—are the only lakes within the Lahontan drainage system of the western Great Basin that did not dry up over the past 10,000 years. While fisheries within other drainages of the Lahontan system were depleted, Lake Tahoe retained an extraordinarily productive and stable native fishery for thousands of years (Hickman and Behnke 1979; Hubbs and Miller 1948; La Rivers 1962; Snyder 1917). Yet, in a matter of decades, the native fishery—once blithely regarded as inexhaustible—was reduced to a fraction of its former abundance, and the Lahontan cutthroat trout became extinct.

Washoe Fishing

Fish constituted one of the most important subsistence resources for the Washoe and their prehistoric ancestors (Lindström 1992, 1996). Native cutthroat trout and a variety of sucker, chub, and "minnow" species commonly inhabited upland drainages. Trout weighing 10 to 20 pounds were common in Lake Tahoe and its tributaries, and the Washoe speared, netted, and trapped the fish. The spawning runs were times of intense activity. The Washoe, carrying baskets waded into the streams, scooped up fish, and tossed them onto the bank (Downs 1966). As the fish migrations tapered in the summer and water levels dropped, the Washoe built dams to divert small streams and to collect stranded fish (Downs 1966a; Freed 1966). The effects of the

aboriginal diversion of streams within the Tahoe basin were far more subtle than Comstock-era water engineering feats, yet they did influence localized stream flows and fishery. Freed (1966) recorded 32 Washoe fishing camps around the shores of Lake Tahoe, most near the mouths of tributary streams. As part of the Washoe Land Claims Case, Manuel Bender (Manuel Bender 1963, in Wright 1931-1972) named Tahoe's most productive fisheries in the order of their importance: the Upper Truckee, followed by, Blackwood, Taylor, Ward, Incline (Third Creek), Trout, McKinney, Meeks, Sugar Pine (General Creek), Cascade and Glenbrook, respectively. Siskin's (1939) Washoe consultants also placed greatest emphasis on the Upper Truckee River (named "trout stream") and Trout Creek (named "whitefish stream") (Mike Holbrook, 1930s, in Siskin 1939).

The Washoe took all types and sizes of fish; apparently large trout were most highly valued. They distinguished two types of "big trout" in the Truckee River system: an early summer spawner (*imgi*), weighing up to 50 pounds with a prominent humped head and snubbed nose ("like pig"), and a spring spawner (*imgi cahat*), smaller and darker in color, weighing not more than 10 pounds (Siskin 1939). George Snooks reported that during the spring of 1925, he " . . . took 17 in one day. From 3-4 ft. each. 6 largest weighed 110-125 lbs" (George Snooks in Siskin 1939). Whitefish were reported to be large and abundant. In Trout Creek, whitefish (*matishau)*, measuring up to two feet long and weighing 10 to 15 pounds, appeared "by the thousands in October." At first, the Washoe strongly resisted Euro-American incursions into their fishing grounds during the 1850s to 1860s, but as a market developed, some Washoe attempted to compete by selling fish commercially and were admonished for doing so. In the 1860s, H. C. Blackwood allegedly shot a member of the Washoe Tribe for setting a fish trap on Blackwood Creek. Elsewhere, Washoe fish traps were removed.

" . . . We drove to Griff's Creek, a tributary of Lake Tahoe. O'Neill had located an Indian fish trap [weir] on the creek several days before. . . . It was a most ingenious contrivance for catching fish, made from woven green willows. The Indians who were working this engine of destruction for numberless spawn fish, were camped beside the creek. We ordered them to leave the lake and took out their trap. We worked over an hour and a half to get it out of the water. . . "(*Wadsworth Dispatch*, December 3, 1892).

Size and Structure of Tahoe's Fishery

While the fishing practices of Tahoe's native inhabitants often went unreported by early Euro-Americans, comments on the bountiful fishery appeared in numerous writings. Tahoe was characterized as a "piscatorial bonanza," and, until the 1920s, the size and abundance of Tahoe trout and fantastic catch records were consistently reported. In 1863, W. H. Brewer (Brewer, August 23, 1863, in Brewer 1974), a member of the California State Geological Survey, was amazed at the 20- to 30-pound trout in Lake Tahoe. The largest trout recorded as caught up until 1872 was a native cutthroat at 29 1/2 pounds. A 31 1/2-pound cutthroat was taken at Tallac (South Lake Tahoe) in 1911 to set a new lake record (Behnke 1979; Calhoun 1944; Juday 1906; 1911 Tallac Brochure in Scott 1957; Snyder 1917). Unconfirmed reports of trout weighing in at 45, 50, and even 70 pounds were made (Scott 1957). The following historic period observations allow us to assess how this aspect of Tahoe's aquatic ecosystem has changed from historic times to the present (Figures 2-18 and 2-19).

"In the summer of 1875, C. F. McGlashan of Truckee estimated that 20 to 25 market fishermen were working the lake, averaging 45 to 60 pounds of fish each day on deep line" (Scott 1957).

"[1878] Five hundred pounds per day is not unusual work for a single spearman in a stream just north of McKinney's forks, about 400 yards above its mouth" (*Sacramento Daily*, June 1878 in *Sierra Sun* October 18, 1984).

"[1881] J. Ballard of San Francisco landed 33 silvers in two hours before breakfast. William Pomin's catch of 25 'pogies' [trout] the same day was barely considered newsworthy. Finally two fishermen outdistanced their rivals when they set

Figure 2-18—Large cutthroat trout caught at Tahoe ca early 20th century (photograph courtesy of Jim Bell).

Figure 2-19—Fishing at Tallac in 1893; everyone has a fish, including the dog (photograph courtesy of Jim Bell).

an all-season record—65 trout in four hours, aggregating 115 pounds in weight" (Scott 1957).

"[ca. 1880s] Fishing guides Mayo and Hurley, along with Pomin and Morgan, were consistent producers, each man regularly averaging 75 pounds daily during the summer season" (Scott 1957).

"The 'Great Sweepstakes of 1881' took place in August of the year. Ten young ladies and their escorts brought 112 fish to boat in a three-hour period with the winning "high line" among the group taking 25 of the combined total using a single hook only" (Scott 1957).

The *Carson Appeal* reported an incident one June evening where nearly 1,000 pounds of lake trout were taken. "The fish crowded around the submerged light by the hundreds, whereupon Dalles just pulled his [gang] hooks to the surface through the milling mass, hauling one or more trout in each time he retrieved the line" (Scott 1957).

Juday's (1906) data suggest that sport and commercial catches at Tahoe approached 75,000 pounds in good years (Cordone and Frantz 1966). Similar fantastic catches were reported in other tributary lakes and streams within the Truckee River drainage system. However, most of these accounts date from between the 1870s and the 1920s, a time when abnormal concentrations of fish became impounded behind dams and when representation of various age classes in each catch was affected by the obstruction of spawning runs. In these unnatural aggregations of fish, old and large adults were overrepresented relative to juveniles (Lindström 1992, 1996).

Trout were not the only abundant species in the lake. Snyder (1917) commented on masses of tui

chub feeding, but not spawning, in the shallows around Lake Tahoe.

"Large schools of lake [tui] chubs gather around wharves, fallen trees, and other sheltered places. At the mouth of Fallen Leaf Creek (Taylor Creek), Lake Tahoe, at times the rising water slowly spreads out over the meadows and when covering the ground but a few inches is invaded by great schools of this species. After sundown they appear in countless numbers, thrashing about in the grass and rushes. When approached, they either scurry off in great haste, sometimes diving into a bunch of grass or settle down perfectly still. On the approach of daylight they return to deeper water."

Snyder (1917) also described spawning Lahontan redside at Tahoe in abundant numbers.

"While examining Fallen Leaf Creek [Taylor Creek], a tributary of Lake Tahoe, on June 10, large schools of this species were observed making their way up the smaller tributaries, progressing chiefly at night, when they might be seen or heard struggling over the small rapids and leaping the miniature falls . . . "

Historical Decline

" . . . why is it that the Truckee River, once known throughout the country as the grandest trout stream in the West, is now one of the poorest?" (*Reno Evening Gazette* March 1908).

Like its timber, Tahoe's fisheries were thought to be limitless. As early as 1858 the fishery supplied local markets and, with the completion of the transcontinental railroad in 1869, markets as far away as San Francisco and Chicago. Cutthroat trout, along with whitefish, were abundant in sufficient numbers to support a commercial fishery from 1859 until 1917 (Scott 1957). By the 1870s 25 commercial operators were using long seines and large trawlers to harvest tons of trout. In 1880 alone, 70,000 pounds of Tahoe trout were shipped by railroad from Truckee, and wagon loads of fish, each weighing from 1,000 to 2,000 pounds, were marketed at Comstock settlements. In 1904 up to 80 commercial fishing boats were operating on Tahoe.

Harvesting methods were wasteful. The underlying principle prescribed removing the maximum amount of trout in the minimum amount of time. Nineteenth and early 20th century fishermen commonly used techniques such as poison, traps, dams, nets, grab hooks, and dynamite. A series of laws was passed beginning in the 1860s in an attempt to halt the wholesale slaughter of fish. The laws limited the timing and method of catch, and placed constraints on dumping sawdust and other pollutants into waterways. After 1911 the catchable limit was reduced from 100 pounds per day per fisherman to 50 pounds (Scott 1957). Finally, in 1917, the California legislature banned commercial fishing at Tahoe to protect the endangered trout, but the irreversible damage was done. Since the 1860s excessive commercial fishing, dam construction, disturbance of spawning grounds, obstruction of spawning runs, pollution of the watershed, and competition from introduced species combined to cause the demise of the native cutthroat trout (Lindström 1992, 1996; Townley 1980). By 1929 the cutthroat trout could no longer migrate up the Truckee River, and by 1938 both the Lake Tahoe and Pyramid Lake strains of cutthroat trout were extinct.

With the demise of native fish populations, attempts were made to restore the sport fishery by stocking exotic aquatic species. The unanticipated but subsequent hybridization, competition, predation, disease, and taking of spawn completely decimated the native population of cutthroat trout (Behnke 1979; Juday 1906; La Rivers 1962; Moyle 1976; Scott 1957, 1972; Snyder 1917; Townley 1980). Exotic introductions between 1875 and 1920 focused upon apex (top) predators, such as Mackinaw and golden trout. Between 1920 and 1965 Mysis shrimp and lower trophic level fish were introduced. Introductions from 1965 to the present involved illegal efforts to establish angling possibilities with such species as bass. (Specific dates and locations of fish stockings are listed in the fisheries timeline.)

Water Management

"Piscatorial bonanza" aside, Mark Twain appears to have had poor luck luring the large Tahoe trout to his bait, as the crystal clear waters exposed his line.

"We fished a good deal, but we did not average one fish a week. We could see trout by the thousand winging about in the emptiness under us, or sleeping in shoals on the bottom, but they would not bite—they could see the line too plainly, perhaps" (Twain 1962).

Twain was greatly impressed by Tahoe's extraordinary clarity. Adrift on a small boat along Tahoe's north shore, he found Tahoe's water to be as transparent as Tahoe's air (Twain 1962).

"So singularly clear was the water that when it was only twenty or thirty feet deep the bottom was so perfectly distinct that the boat seemed floating in the air! Yes, where it was even *eighty* feet deep. Every little pebble was distinct, every speckled trout, every hand's-breadth of sand . . . . Down through the transparency of these great depths, the water was not *merely* transparent, but dazzlingly, brilliantly so. All objects seen through it had a bright, strong vividness, not only of outline, but of every minute detail, which they would not have had when seen simply through the same depth of atmosphere. So empty and airy did all spaces seem below us, and so strong was the sense of floating high aloft in mid-nothingness, that we called these boat excursions 'balloon voyages.'"

Tahoe water has been coveted and controlled since the construction of the first dam by the DLBC near its outlet in the 1870s. Since that time, a series of water diversion schemes to empty Tahoe water via tunnel and conduit into the growing municipalities of San Francisco and Carson Valley were unsuccessfully proposed. To accommodate logging and water supply engineering, meadow systems above Lake Tahoe were strategically dammed to form reservoirs, and water was diverted before ever reaching the lake. Spooner Meadow was transformed into a reservoir during the 1870s to supply water for flumes to transport wood. In 1876, to meet the growing needs of the Comstock, the VGHWC drew water from Marlette Lake, flumed it inside a tunnel through Tahoe's eastern divide, and piped it down to Virginia City. That same year, an early predecessor of Pacific Gas and Electric (PG&E) constructed a tunnel through Tahoe's western divide and diverted the waters of Echo Lake into the American River basin. The construction of the North Flume by the VGHWC further augmented Virginia City's water supply by tapping Third Creek and all intervening drainages in Tahoe's northeast quadrant, south to Tunnel Creek, where waters were transported via flume through a tunnel in the divide. The North Flume operated year-round from around 1877 until the 1950s. The artificial raising and lowering of lake levels with the construction of dams at Lake Tahoe's outlet since 1870 have altered the composition of lakeshore plant and animal communities, inhibited fish migrations, and accelerated backshore erosion.

The high level of water clarity and quality is one of Lake Tahoe's most notable characteristics. Early on, sawdust and slash contributed to the degradation of water quality in lakes and streams, and growing human populations have continued to pollute the lake's water with the introduction of minerals and organic substances that have upset the aquatic community developed under the natural regime. Recent studies of Tahoe's lake sediments (Goldman and Byron 1986; Heyvaert 1998) have detected two distinct periods of disturbance, as measured by a surge of organic deposits. One coincides with historic clear-cutting between the 1870s and 1890s, and the more prominent other episode of mass sedimentation correlates with the tenfold increase in the population of the Tahoe basin since 1960. The sediment data suggest that the lake's water quality recovered rather quickly when clear-cutting ceased, unlike the chronic and sustained effects of erosion caused by post-1960s urbanization.

Transportation and Community Development

Tahoe's proximity to wood, water, mineral, rangeland, and recreational resources justified the investment of a significant amount of capital and energy into transportation to and within the basin. Between 1852 and 1855, an emigrant route was established along Tahoe's north shore (now Highway 89 and Highway 28), connecting Auburn and Virginia City through Squaw Valley. The Placer County Emigrant Road traversed the Truckee River Canyon (Highway 89) and Tahoe's north shore (Highway 28). During this same time, the Georgetown-Lake Bigler Trail was forged westward from McKinney Creek, passing through Rubicon

Springs and terminating at Georgetown. By 1860 the Tahoe Truckee Turnpike (Highway 89) opened through the Truckee River Canyon. The Placerville Road ("Johnson's Cutoff"), constructed between Placerville and Virginia City in the 1850s, followed earlier emigrant and wagon routes over Echo Summit and along Tahoe's south shore (Highway 50). In 1852 to 1854, the Carson Emigrant Ridge Road connected with Johnson's Cutoff, crossing over Spooner Summit (Highway 50). Between 1858 and 1859 Luther Pass (Highway 89) became the favored route through the Tahoe basin, bypassing lower Lake Valley. Its popularity was short-lived, as traffic was siphoned away in 1860 to 1861 by the new Kingsbury-McDonald Grade (Highway 19/207) over Echo Pass and Daggett Pass, the trail taken by the Pony Express. In turn, this route was superseded by the Rufus Walton Toll Road, which opened in 1862, from Glenbrook over Spooner Summit (Highway 50). Construction of the new Lake Bigler (Tahoe) Wagon Road in 1863 further channeled the flow of travel over Echo Pass and through the Tahoe basin, away from Kingsbury Grade and over Spooner Summit.

The opening of the transcontinental railroad in 1869, which reached Truckee and was connected to Tahoe's north shore by stage in the 1860s and by rail in 1901, fostered a fledgling tourist economy. That same year, the Truckee-Hot Springs Road (Highway 267) was constructed over Brockway Summit between Truckee and Brockway Springs, giving further access to the railroad. The first continuous road was built over Mt. Rose in 1891, connecting the Reno area and Lake Tahoe ("The Road to Incline"/Highway 27/431). Within the Tahoe basin steamships were the primary mode of transportation from 1864 until the 1910s when the first automobiles traveled to the Lake Tahoe basin. A summary of the development of transportation in the Lake Tahoe basin is presented in Table 2-6.

Fremont's sighting of Lake Tahoe in 1844 heralded the population growth to come. Later that year, six members of the Stevens-Murphy-Townsend emigrant party became the first Euro-Americans to stand on the shores of Lake Tahoe; they detoured from the main party headed for Donner Pass and instead crossed the Sierran divide above McKinney Creek. After the discovery of gold in California in 1848, thousands of Americans trekked westward, some passing through the Tahoe basin. By the mid-1850s, during the height of the gold rush, trading posts and way stations were established on the southern lake route. Land patents were filed by enterprising persons—ranchers, hostelers and commercial fishermen moved in to take advantage of the lucrative business opportunities. The area became a crossroads between the adjacent mining regions of California's Mother Lode and Nevada's Comstock Lode. The first log cabin was built in Lake Valley at the south end of the lake in 1851, and by 1854 a permanent trading post was established there, with a post office designated in 1861. The first log cabin was not built at the north end of the lake until 1861.

During the 1860s, traffic east from California, lured by Nevada's Comstock silver mines, brought more hordes of treasure seekers over the southern lake route. New roads were opened along Tahoe's north shore. Thousands traveled along these roads with hundreds of freight wagons loaded with supplies for the growing mining centers. By the 1860s settlements had sprung up along these routes (Table 2-7). By 1865 up to 15 hostelries had been established to supply customers with hay, vegetables, dairy products, and fish. At first, small meadows and family vegetable gardens supplied the needs of the individual toll stations and inns. As demands escalated, meadowlands were quickly preempted (usually in units of 160 to 320 acres), wherever wild hay (*Phleum alpinum*) could be harvested and beef and dairy cattle could be grazed. With hay selling by the pound and fresh food at a premium, land changed hands rapidly and speculation prevailed. Some ranchers neglected even to acquire legal title (Strong 1984). By the 1870s at least 13 commercial dairies were in operation around the basin, producing butter and milk both for local consumption and for export. Commercial hay production reached over 800 tons annually. The ranching industry was seasonal, and the Tahoe basin was typically used as summer range for livestock. Horace Greeley described this seasonal pattern in an article published in the *New York*

Table 2-6—Summary of transportation developments in the Lake Tahoe basin.

Date	Historic Name	Location	Modern Highway
1850s	Georgetown-Lake Bigler Trail	McKinney Ck(Rubicon) Georgetown	-
1852	Johnson's Cut Off	Echo Summit(Lake Valley) Spooner Summit	Highway50; Pioneer Trail
1852-1854	Carson Emigrant Ridge Road	Echo Summit(Lake Valley) Spooner Summit	Highway50; Pioneer Trail
1852-1855	Placer County Emigrant Road	Truckee River Canyon(North Shore	Highway89; Highway28
1858	Luther Pass	Echo Summit(Luther Pass	Highway89
1860	Tahoe-Truckee Turnpike	Truckee River Canyon(Tahoe City	Highway89
1860	Kingsbury-McDonald Grade	Echo Summit(Lake Valley(Daggett Summit (Pony Express Trail)	Highway50; Highway19/207
1862	Rufus Walton Toll Road	Glenbrook(Spooner Summit	Highway50
1863	Lake Bigler (Tahoe) Wagon Road	Echo Summit(Lake Valley(Spooner Summit	Highway50; Pioneer Trail
1869	Transcontinental Railroad	Donner Pass(Truckee(Reno	-
1869	Truckee-Hot Springs Road	Truckee(Brockway Summit(Brockway Springs	Highway267
1860s-1910s	(steamer travel)	Lake Tahoe	-
1891	Road to Incline	Reno(Mt Rose Pass(Incline	Highway27/Highway431
1901	Lk Tahoe Railway Trans Co RR	Truckee(Tahoe City	-
1910s	(auto travel)	Tahoe basin	-
1914-1915	Lincoln Highway	Echo Summit(Lake Valley(Spooner Summit	Highway50; Pioneer Trail
1925	(road encircles Lake Tahoe)	Tahoe basin	-
1928-1935	(major road upgrades)	Tahoe basin	-
1935	(paving of Highway 50,89,28,27/431)	Tahoe basin	-
1950-1960	Mt Rose Highway	Reno(Mt Rose Pass(Incline	Highway27/431
1959	Kingsbury Grade paved	Kingsbury(Daggett Pass(Gardnerville	Highway19/207
1964	Interstate 80	Donner Pass(Truckee(Reno	Int 80

Table 2-7—Summary of community development in the Lake Tahoe basin.

Date	Location
	Settlements
1860s+	Lake Valley, McKinneys, Tahoe City, Lake Forest, Agate Bay, Tahoe Vista, Kings Beach, Glenbrook, Edgewood
1870s+	Carnelian Bay
	Resorts
1860s+	Lake Valley, Tahoe City, Brockway, McKinneys, Glenbrook
1880s+	Emerald Bay, Sugar Pine Point, Blackwood
1890s+	Homewood
1910s+	Homewood, Meeks Bay
1920s+	Marla Bay
1950s-1960s+	Stateline, Crystal Bay (casino-hotels)
	Subdivisions
1920s+	Lake Valley, Tahoe City, Kings Beach, Tahoe Vista, Brockway
1930s+	Lake Forest
1950s-1960s+	West Shore, North Shore, Southeast Shore
1970s+	Incline Village, Glenbrook

Tribune recounting his trip through Lake Valley during this early period (*Tahoe Tattler* V.4, No. 2, July 8, 1938, "Meadow to Marsh: Tahoe '38"):

"There is fine grass on Lake Bigler and several hundred cows are kept there in summer, making butter for the California market; when snow falls, these cattle are driven down to the valley of the Sacramento, where the rains are now commencing, and there they live without hay until June. Business is very lucrative, land costing nothing and being unfenced. Taking into account gold, timber, and grass, the Sierra Nevada is probably the richest and most productive mountain chain on earth."

Lake Valley, located along the Placerville Road, became the largest producer of hay, dairy, and agricultural products in the Tahoe basin. The *Sacramento Daily Union* (July 7, 1857) reported: "Messrs. Gilbert & Garrish, who recently arrived from Salt Lake, with some 600 head of cattle, have driven them to Lake Valley to summer there."

In the summer and fall of 1862, 400 tons of hay were cut in Lake Valley's meadowland (Scott 1957). In 1870 the "California Products of Agriculture" census showed that 228 tons of hay had been baled in the Lake Valley Township (Scott 1957). In 1875, C. F. McGlashan noted in his "Resources and Wonders of Tahoe" that Lake Valley annually turned out 14 tons of butter and cheese, for which two cooper shops manufactured butter firkins from the local white fir. Butter sold at the high price of 42 cents a pound and was, according to McGlashan, "in great demand for epicures." During the productive season from June to November, butter was kegged, eggs crocked, beef cattle fattened, and hay baled. Lake Valley was characterized as a "hay and dairy producing center, dotted with fertile ranches" where ranchers contributed most of the 800 tons of hay cut along Tahoe's shoreline in 1875 (Scott 1957). That year hay was no longer sold by the pound but brought the "deflated" price of $30 a ton in Carson. In 1880 a period correspondent reported that "The valley affords pasturage for 1800 cows" (Scott 1957).

Similar dairying and haying operations were conducted at locales other than Lake Valley during this period, but on a much reduced scale. Hay and dairy enterprises were based around meadows surrounding Burton Creek/Antone Meadows (near Tahoe City and Lake Forest), on Meeks Creek at Meeks Bay, around Griff Creek near Tahoe Vista and Kings Beach, along Glenbrook Creek at Glenbrook, on Edgewood Creek at Rabe Meadow, and at Marla Bay.

Tourist resorts, integral elements of these growing communities, were newly established in Lake Valley, Tahoe City, Brockway, McKinneys, and Glenbrook (Table 2-7). By the 1880s tourism was flourishing, with more resorts established in Lake Valley, Emerald Bay, Sugar Pine Point, Blackwood, and Tahoe City.

Impacts on Lakeshore Meadow Systems

The pathway of human disturbance in the Tahoe basin is chronicled by the movement of people, goods, and services through the area. The evolution of road systems mirrors the development of Tahoe's forest lands and adjacent communities. This history can be traced on maps depicting the routes of transport. Accompanying human impacts likely corresponded to the growing number of travel corridors and associated communities. Agriculture and seasonal stock grazing largely centered on lakeshore meadows in proximity to settlement. Vegetable farming and stock grazing beginning in the 1850s likely altered the composition and vigor of native plants. The primary impact to upland meadows was large-scale sheep grazing after 1900.

Post-Comstock Era (1900 to 1950s)

By the turn of the century, the Lake Tahoe basin had been stripped of marketable timber, and large-scale cutting ceased. As the Comstock mills "devoured their birthright," they were forced to close. Approximately two-thirds of all marketable timber in the Tahoe basin had been harvested, with an estimated 60 percent of land in the Lake Tahoe watershed clear-cut. Remaining lands were largely alpine, barren of useful timber or inaccessible. Logging continued in the post-Comstock era on a reduced scale and within a more restricted range. Lumber companies leased or sold for as little as 50 cents per acre cutover lands to grazing interests or

abandoned them to obtain back taxes (Manson 1899). Logging railroads were salvaged as tourist railroads with capital and energy funneled into a growing summer tourist economy. The Washoe continued their treks to the lake and maintained connections to ancestral areas, largely under the employ of resorts and the growing tourist industry. Traditional plant management continued on the fringe of "white" settlements, but on a very reduced scale.

Suppression of Washoe Ways

Throughout the first part of the 20th century, the formerly close Washoe associations with Lake Tahoe were made distant and difficult by the new exclusionary laws and general intolerance of Tahoe residents. The Washoe were discouraged from maintaining native lifeways, as tribal members were forced to live in colonies away from the lake, converted to Christianity and sent to government-sponsored schools.

"After the passage of the General Allotment Act of 1887, 160-acre plots 'scattered . . . in the most desolate and waterless sections of the Pinenut Range, or elsewhere on lands not already claimed by White settlers' were granted to individual Washoe. Lands around Lake Tahoe and in fertile valley floors had been petitioned, but none were included. In 1891 the Carson Indian School (later known as Stewart Indian School) was opened through federal legislation and enforced enrollment of hundreds of Washoe, Paiute and Shoshone children. During WWI, Washoe men 'were urged by Indian agents and local White citizens to register for the draft. Some objected . . . [since] they had never been granted citizenship or the right to vote.' In 1917 the federal government purchased small tracks of land for the Washoe. Forty acres in Carson Valley was placed in trust, becoming the Dresslerville colony, and another 40 acres on the outskirts of Reno became the Reno-Sparks colony where 'many northern Washoe were compelled to settle.' Citizenship was granted in 1924, although segregation in public facilities and schools was maintained until the 1950s. During the 1920s Indian Agents were actively involved in abolishing 'heathen' traditional Washoe ceremonies and medicinal practices. In 1936 the Tribe's Corporate Charter was ratified, a Tribal Council formed, and a constitution adopted, achieving federal recognition under the provision of the Indian Reorganization Act of 1934. In 1970 their land claims case, initiated in 1951, was settled, awarding them five million of the 42.3 million requested as compensation for their homeland, approximately 10,000 square miles surrounding the Tahoe basin" (after various publications by d'Azevedo and summarized in Rucks 1996).

On December 2, 1970, the Indian Claims Commission awarded the Washoe Tribe just over $5,000,000 for the whole of their traditional territory, which included Lake Tahoe at its center. The Washoe were awarded compensation for the value of the natural resources at the date they "lost" their territory, considered to be December 31, 1862. Timber in the Nevada portion of their territory, including the Pine Nut Hills, was valued at $300,000, while minerals from the Gold Hill Mining District were valued at $2,401,500 (Washoe Claims Case 447:448). This ended an 11-year court battle. The docket included findings that:

"From 1848 to 1863 [their territory] was overrun by miners, settlers, and others with the approval, encouragement and support of the United States government. Encroachment continued with increasing intensity until by December 31, 1862 the tribe had lost all of its lands" (Washoe Claims Case 447:448).

Since the 1870s Washoe leaders formally protested to government officials (including the President of the United States) complaining of the loss and destruction of their lands for which title had never been extinguished by treaty. Petitions, demands, and trips to Washington continue to the present. The 1950s marked a period of Washoe protest, during which the people registered their objections to the nontraditional usage of cultural/spiritual locales in the Tahoe basin (for example, Cave Rock) and the despoliation of ancestral resources (Lindström et al. 1999).

Logging

Only a handful of small companies operated during the first decades of the 20th century,

harvesting stands ignored by Comstock loggers (also see Leiberg 1902). One shingle mill used cedar stands from Griff Creek during the 1920s, and a small sawmill operated on Burton Creek from 1927 to 1933). Neither of these operations cut more than half a million board feet annually. C. G. Celio & Sons operated a larger local lumber mill between 1911 and 1958, cutting around Meyers on lands they had not leased or sold to the CTLFC. The Placerville Lumber Company also was involved in small-scale logging in Upper Trout Creek in 1946, and, in 1947, Fibreboard logged lands near the mouth of Watson Creek (Carnelian Bay).

Localized logging in the northwest quadrant of the Tahoe basin commenced after construction of the Floriston Pulp and Paper Company's (FPPC) mill along the Truckee River in 1901. Fir stands overlooked during Comstock era lumbering were targeted for the production of paper pulp (also see Leiberg 1902). Construction of the LTRTC's tourist railroad along the Truckee River and through the Tahoe Reach in 1901 afforded a means of timber transport for renewed logging in proximity to the line. Between 1903 and 1907 the TLC built a logging railroad up Ward Canyon and intensively logged the area. Stands also were harvested in Squaw Valley and Alpine Meadows around this time. From 1912 to 1914 the FPPC logged fir stands on TLC land in the Burton Creek watershed north of Tahoe City.

Post-Comstock-Era Forest Characteristics

In 1902 John Leiberg surveyed and reported on cutover lands in the northern Sierra Nevada as part of a study of forest conditions by the Department of Interior, US Geological Survey. Lands examined included the California side of the Lake Tahoe basin from Rubicon Bay (on Tahoe's west shore) north to State Line Point (between Agate and Crystal bays on Tahoe's north shore). He described the forest types and compositions and briefly discussed destructive activities and reforestation.

"The areas logged clean or culled comprise 170,000 acres, or nearly 59 per cent of the forest land [from Rubicon Bay north to State Line Point]. The areas not cut over or unculled are, with a few large exceptions, situated in places difficult of access or carrying timber not fulfilling the requirements of the loggers. . . .Nearly all of the terraces bordering Lake Tahoe and the accessible mountain slopes and canyons have been logged, the cut varying from 10 to 99 per cent. . . . The summits and slopes of Mount Pluto Ridge from Mount Pluto eastward have been logged, with the exception of a few hundred acres on the crest of ridges directly north of Agate Bay. The timber on those summits was exclusively Shasta fir, 70 per cent logged. On the lower northern slopes of Mount Pluto Ridge the cut has been from 70 per cent to nearly total, culls of white fir being the only species of tree left. From the lake outlet down the canyon of Truckee River, on all the areas between Truckee and Mount Pluto Ridge . . . the cut of merchantable timber has been total" (Leiberg 1902).

Professor Marsden Manson, civil engineer and conservationist, made similar notes in 1899, just three years before Leiberg's visit (1899).

"Around Lake Tahoe the timbered areas have been entirely swept off with the exception of a few thousand acres around Tallac and some at the north end, reserved by the owners for later use. The mountain sides around the Hot Springs [Brockway], and nearly all of the moraines and flats around the south and east side of the lake, have been denuded.

A year later, Sudworth (1900) reported a "general lack of herbaceous growth, an irregular reproduction of timber species, and general absence of small-sized timber intermediate between seedlings and the large timber." Leiberg (1902) believed climate, fire, insects, logging, and grazing to be "the forces of destruction at work in the forest."

"If the present rate of cutting and grazing is continued, the general condition of the forests at the end of the century, or even fifty years hence, will be about as follows: The . . . basins will have been wholly denuded of large timber, and in its place will have come a sapling growth, heavy and close set in some places, open, under sized, and brushy in others. Most of it will consist of white fir, for the yellow pine which has given the present forest its chief value will form a comparatively small percentage of it" (Leiberg 1902).

Leiberg observed a near absence of sugar

pine, with yellow pine forfeiting its former dominance to red and white fir, lodgepole pine and incense cedar. He classified the "shore terraces of Lake Tahoe from Frosts [Rubicon Bay] to State Line Point" as containing "Yellow pine, 3 to 5 per cent; white fir, 60 to 80 per cent; now and again a sugar pine of small size . . ." (1902).

"In past times, before logging operations commenced, it [yellow pine] may have been the dominant species as regards the number of trees, but owing to the vast amount of cutting it is so no longer. It has been more exhaustively logged than any other species in the type except the sugar pine, and restocking has not kept pace with the cutting" (Leiberg 1902).

"Along the western and northern shores of Lake Tahoe there formerly existed a narrow belt of heavy forest having sugar pine as one of its component trees. At the present time few scattered trees of the species still remain, but most of them were long ago cut out. The proportion of young sugar pine in the reforestation on these closely logged tracts is insignificant. . . . The tree is losing ground at a rapid rate on all the areas logged. . . . In place of its former ratio of 20 to 25 per cent the coming forest will contain only 2 or 3 percent at the most, while on the unlogged tracts it is maintaining its present ratio" (Leiberg 1902).

"White fir is increasing its ratio in the restockings, partly at the expense of the yellow pine, partly as an offset to a lessened percentage of sugar pine. . . . In the Truckee Basin it is largely replacing the yellow pine on the logged areas, and in the coming forest will amount to 60 to 75 per cent of growth, against 25 to 40 per cent in the original uncut stands. Its increase throughout the region examined is due to exhaustive logging of yellow and sugar pine and sparing of white fir" (Leiberg 1902).

"This species [red fir] is abundant and vigorous in all reforestation of the yellow-pine type, whether after logging or fires" (Leiberg 1902).

Leiberg attributed the increasing numbers of incense cedar (a species he found "valueless," due to worm holes) to the abnormally large number of seed trees remaining on the cutover areas (Leiberg 1902).

Leiberg observed considerable chaparral in the post-Comstock forest. "The timber is invariably set in heavy undergrowth, which has come in as a sequel to extensive forest" (Leiberg 1902). Most of the chaparral grew on the shore terraces of Lake Tahoe (Leiberg 1902). James (1914) also noted that chaparral covered slopes and prevented the growth of tree seedlings.

Sterling (1904), reporting to the US Bureau of Forestry two years after Leiberg's visit, also observed that Jeffrey pine was rare and that considerable areas had reverted to brush, with original forests remaining only on inaccessible slopes.

"The forest is much reduced in density; brush and reproduction are competing for possession of the openings. The sugar pine has disappeared almost entirely. . . . The finest of the Jeffrey pine and yellow pine and white fir has been removed, fir production in general [is] replacing the pine; while considerable areas have reverted entirely to brush" (Sterling 1904).

In his study of forest sample plots in the Carson Range, Taylor (1997) confirmed these early 20th century observations. Jeffrey pine forests are primarily 100- to 130-year-old second growth stands in which trees less than 50 centimeters in diameter at breast height (dbh) are nearly 10 times more dense than pre-Euro-American forests and lodgepole pine has regenerated prolifically (Taylor 1997). These dense, white-fir dominated forests experienced significant insect attacks during the severe droughts of 1921 and 1937 (Elliott-Fisk et al. 1996) and during the drought of 1987 to 1994.

Grazing

During the 1850s over 500,000 sheep crossed Nevada on their way west to California markets. From 1865 to the 1890s millions of California sheep were herded east from California over the high Sierra to mining camps of the Great Basin and railheads in the plains (Douglass and Bilbao 1975). Bands were large, 1,000 head at a minimum, and most herds contained an average of 1,000 to 1,500 ewes (Mallea-Olaetxe 1992). By the 1860s to 1870s, sheep bands were moved from western foothills into the high Sierra over Tahoe's western and northern divides. When logging ceased at the turn of the century, cutover lands along Tahoe's south, north, and east shores were leased or

sold to ranchers for grazing. A livestock business developed around the lush meadows and the growth of vegetation in cutover areas provided at least temporary sources of stock feed. Lake-level lands generally supported cattle, and high meadows were used for sheep. With no restrictions on grazing, sheepherders grazed their livestock at will, sometimes too early in the season. Shepherds started persistent small fires in order to improve forage for the following season. These practices had a variety of negative ecological consequences. In an effort to control overuse by regulating the timing and location of herds, grazing in the Tahoe basin was restricted in the 1930s to allotments assigned to individual permittees (Elliott-Fisk et al. 1996).

Itinerant Basque shepherds left their personal mark on the Tahoe landscape in the form of aspen carvings (Figure 2-20). They chose crossroads, streamlands or popular sheep camps as strategic locales to carve "billboards" in the aspen groves. These served to mark territories, and the names and dates carved on trees document the years sheep were grazed and identify the roads and trails they followed (Mallea-Olaetxe 1992). In the Tahoe basin, carvings commonly date after the turn of the century and represent the months of June through September. Most carvings date from the 1920s and 1930s, and continue into the 1950s, indicating sheep grazing activities to be most intense during these times. The lifespan of the aspen tree marks the effective lifespan of the aspen art. Stands of quaking aspen may persist for more than 200 years (Jones and Schier 1985); however, longevity of aspen stands is usually less due to climate, fire, soil, disease, succession to conifers, and impacts from livestock and logging. The messages of over 13,000 carvings have been entered into a computer data base in the Basque Studies Department at the University of Nevada. Basque scholars have interpreted the handwriting on trees and compared it with the growing list of Basque oral histories to trace historic stock trails, grazing areas, dates and intensity of use, and the herders/ companies involved. This is an extraordinary historical resource for further research.

Vegetation Change and Incidence of Fire

Increasing human populations in the Tahoe basin and surrounding region were supplied with meat, milk, butter, and cheese from sheep and cattle that denuded high elevation alpine areas and lower elevation wetlands, meadows, and forest floors. Sheep were thought to be more destructive than cattle. The Washoe were especially affected by the impacts of livestock grazing in the basin, which caused declines in many plants important to their people (Elliott-Fisk et al. 1996). Early season entry into rangelands and excessive overgrazing exterminated native browse species in many areas, increased erosion, slowed forest regeneration, and altered forest stand structure (Leiberg 1902; Sudworth 1900).

"Excepting in high mountain meadows, all of which are fenced and which are grazed by cattle, the principal forage for sheep and cattle on the open forest range consists of a few hardy shrubs and low broad-leaf trees. There are practically no grasses or other herbaceous plants. The forest floor is clean. The writer can attest the inconvenience of this total lack of grass forage, for in traveling over nearly 3,000,000 acres not a single day's feed for saddle and pack animals was secured on the open range. . . . It is evident that formerly there was an abundance of perennial forage grasses throughout the forest in this territory. . . . It would seem that this bare condition of the surface in the open range has been produced only through years of excessive grazing by millions of sheep—a constant overstocking of the range" (Sudworth 1900).

"The trampling of thousands of sheep pastured on these slopes during summer and fall reduces the soil, to a depth of 6 or 8 inches, to the consistency of dust. Rain washes this dust into the creeks and rivers, and heavy winds lift it up and carry it far away. . . . [Tree] seeds are largely shed in July and are trampled into the ground and destroyed. All seedling trees on the sheep runs are either cut off below the ground by the sharp hoofs of the animals or uprooted and trampled. In these runs, where trees have succeeded in establishing themselves, they are bent and stunted. Nothing whatever except excessive sheep grazing prevents a uniform stand of timber of medium density on these grassy glades, and while sheep are pastured there they never will return to forest cover" (Leiberg 1902).

Figure 2-20—Basque aspen carvings (arborglyphs).

Sheep herders were criticized for deliberately setting fires to improve the range and to facilitate movement of sheep through the forest. Upon leaving "fed-out" seasonal grazing lands, Basque shepherds set fire to high elevation meadows and shrublands and burned many large downed trees.

"Shorn of its wealth and beauty, [the Tahoe basin] has been partly burned over to give a few sprouts to hungry hordes of sheep" (Manson 1899).

". . . All the fires observed during the last summer closely followed the sheep camps" (Leiberg 1902).

"No less than seventeen such fires of this kind were found on the trail of one band of sheep, covering a distance of 10 miles" (Sudworth 1900).

"The belief is generally held that the sheep herders fired the country in all directions and have been responsible for most of the fires of recent years" (Leiberg 1902).

"The chaparral areas will be brush covered, very much as they are, because they will be burned now and then so as to furnish fresh browse for the sheep, and the burnings will serve only to increase the density of the next stand of chaparral" (Leiberg 1902).

Not all meadows were subject to over-grazing, however. Photographs taken in 1930 of "Rowland's Marsh" (now the site of Tahoe Keys in South Lake Tahoe) show an extensive and virtually unfragmented meadow/wetland system (Orr and Moffitt 1971). Many bird species associated with wetlands and meadows were recorded in Orr and Moffitt (1971) during this period, suggesting that these surviving and intact systems provided valuable habitat in the basin.

Although overgrazing in many wetlands and meadows and on forest floors throughout the basin during the first half of the 20th century produced lasting changes in communities of grasses, forbs, and shrubs (McKelvey and Johnston 1992), erosion caused by grazing in the 20th century was not nearly as great as that which occurred during the 19th century Comstock logging era. Impacts of grazing are not detected in lake sediment cores. The sediment record does not reflect a significant rate of increase in lakebed deposition between 1900 and 1950, as was the case between the 1870s and 1890s (Heyvaert 1998).

Water Management

A long history of conflict, litigation, and policy making surrounds the prized water resources of the Lake Tahoe basin (Jackson and Pisani 1974). After the Comstock era, controversy over the fate of its waters intensified. Tahoe had become a critical water source for adjoining lowlands to the east. "Excess" water initially was appropriated for hydroelectric power and reclamation projects for desert communities under the 1902 National Reclamation Act, sponsored by Senator Newlands of Nevada. This necessitated variations in lake level that were incompatible with the interests of upland resorts and navigation, all of whom relied on a constant high lake level for the tourist industry (Landauer 1995). Subsequent negotiations for water appropriations were controversial and politically charged.

In 1913 the original dam on the lake's outlet at Tahoe City (built by the DLBC in the 1870s) was upgraded by a power syndicate supported by the US Department of the Interior. Periodic droughts prompted attempts by downstream users to dredge, cut, and blast the lake's outlet; these actions were averted by court injunctions obtained by Tahoe property owners. Water crisis during the droughts in 1924 and in 1930-1931 occurred when the lake level dropped so low that no water could leave the lake to supply Nevada farmers with water via the Truckee River. Ultimately, water was pumped over the lake's rim to supplement Nevada's water supply. Continuing conflicts between property owners at Lake Tahoe, power suppliers, families and farmers depending on access to the water downstream, and the Pyramid Lake Paiute Tribe (who were entitled to Truckee River water by treaty) reached a peak during the 1930s. Compromise was achieved in 1934 with the Truckee River Agreement, which provided for the conservation and control of the Truckee River drainage basin and led to the construction of Boca Reservoir and the development of alternative supply strategies. Accelerated population growth after the World War I made earlier compromises unworkable, and in 1955 the California-Nevada Interstate

Compact Commission was established to reach mutual water apportionment between the two states. The commission was a prelude to the subsequent joint management and regulation of Lake Tahoe's geographically bounded ecosystem by a series of local, regional, state, and federal groups.

Transportation and Community Development

In terms of community development, the post-Comstock era is characterized as a period of "boom and bust." After the Comstock lumbering boom, the basin's population declined, and the area experienced a deep economic depression from which it did not completely recover until the tourist boom following World War II (Strong 1984). In the post-Comstock era, land values plummeted so that cutover tracts could be purchased for back taxes or for no more than $1.50 per acre. Roads were neglected and became impassable, inns and post offices went out of business, and logging camps, mills, flumes, and railroads lay abandoned to deteriorate among the rotting stumps of the cutover land (Strong 1984; Scott 1957).

Yet, against this backdrop of environmental devastation, a fledgling tourist industry began to develop. Some of the vast capital reserves accumulated from timber interests were invested in the construction and operation of lakeshore resorts. Logging railroads and steamers were converted to tourist transport. To many 19th century tourists, Tahoe's natural beauty was hardly compromised by deforestation; viewsheds marred by abandoned lumber mills and vast tracts of timberless land were featured on the local scenic touring agenda right along with Emerald Bay and Cave Rock. Lake Tahoe became an increasingly popular recreation destination, and the area's economy gradually began to rely on tourism rather than logging (Strong 1984). For four prosperous decades, between 1860 and 1900, settlement was dictated by lumbering; communities mushroomed quickly around almost every sawmill. As the mills shut down, many of the associated settlements were deserted. However, the handful of lumbering centers that built their future on tourism continued to prosper, initiating the trend toward urbanization and year-round residency in the Tahoe basin.

To accommodate community development and the influx of visitors in the post-Comstock era, travel networks were expanded throughout the basin. Tourism around the turn of the century was the pastime of the wealthy elite who frequented elegant resorts for extended periods. Travel to Tahoe by train and then across the lake by steamer was time consuming and expensive. The LTRTC established a tourist railroad through the Tahoe Reach in 1901, connecting the transcontinental railway station at Truckee with Tahoe City. From Tahoe City, the company provided public transit to other points around the lake by steamers. This system, the only means of public transport to Tahoe until 1942, fostered tourism and promoted the development of a year-round community at the lake (Landauer 1995).

The state of California authorized the survey of new roads over Echo Summit in 1895 and over Donner Summit in 1909. As greater ease of passage to and through the Lake Tahoe basin was permitted by increasing availability of automobiles, the face of tourism was radically changed. Motorized vehicle traffic increased after 1913, with the nation's first transcontinental road, the Lincoln Highway. It routed along Tahoe's south shore (along the historic Pioneer Trail). By 1925 an auto road circled the lake. Paving of or improvements to highways 89, 28, 27/431, 19/207, and 50 during the 1930s opened the western, northern, eastern, and southern shores, respectively. Highway 50 opened year-round after World War II. Gradually, the intrabasin road system was enlarged to link communities and to open access into back country areas for recreation and Forest Service administration. Air travel also became a popular way to reach the basin after the Sky Harbor Airport (southeast of the lake) opened in 1946 and began landing DC-3s full of tourists. In the late 1950s this was replaced with a larger safer airport, which operated until 1995.

Middle class auto tourists visited for shorter periods and desired less elegant accommodations than their elite 19th and early 20th century counterparts. The old luxury resorts closed by the mid-20th century. New opportunities for recreation and entertainment arose as access to the area

improved. As people of more modest means camped or vacationed in rustic hotels and cottages, Tahoe's backwoods were explored and enjoyed by increasing numbers of recreationists. In response, the USFS initiated patrols for visitor safety and established fire lookouts, along with remote guard stations and outpost ranger stations. Outlying forest service facilities were linked with main offices by a fairly extensive system of improved horse trails and telephone lines. In addition to the long-established recreational attractions, such as hiking, fishing, sightseeing, sailing, and speedboat racing, small ski resorts opened during the 1930s and 1940s. By 1949 ski lifts were operating at Granlibakken, Meyers, and Echo Summit (Landauer 1995). The gaming industry took hold in 1931, when the Nevada Club casino opened on the state line at the south end of the lake, followed in the next two decades by Cal-Neva, Harvey's, Harrah's, and other casinos.

To accommodate the growing numbers of seasonal visitors and permanent residents, development kept pace with demands. During the 1930s, "building booms" were reported in the *Tahoe Tattler* (August 16, 1938, July 21, 1939, August 18, 1939), with 2,000 people visiting the lake during a high season that lasted between July and August. Tahoe boosters continued to actively draw visitors, mainly by seeking the patronage of various transportation companies. The title and content of the Tahoe Vacation Guide for 1940, published by the *Tahoe Tattler*, draws attention to this link between transportation and development in the content and title of their guide, "Tahoe Business: Improved Transportation, Communication Bring Growing Tahoe Trade."

"From such humble beginnings . . . Tahoe business and trade has grown to an annual $5,000,000 level. . . . Earliest lake travelers came by horseback or afoot. In the early 60's the Pony Express route crossed the Lake Valley [South Lake Tahoe] plain. . . . The first Tahoe City-Truckee highway was built in 1861 as a toll road. . . . For a time an old wagon road led into Tahoe from Rubicon Springs and Wentworth, El Dorado county, but since 1910 it has fallen into disrepair and is currently being patched up again. The lake exit via Mt. Rose was built in 1916. Not until 1927 did paved highways circle the lakeshore. And at the same time the first oil was sprinkled over the gravel path from Tahoe City to Truckee. . . . Paved highways meant a big upsurge of business. Daily bus service penetrated the lake that year [1927]. Only two years before, the old narrow gauge railroad had given way to broad gauge standard railway cars connecting with Southern Pacific mainliners at Truckee. In 1934, the Clear Creek grade from Spooners summit to Carson City gave Tahoe a first class exit to Nevada. The Mt. Rose road was rebuilt in 1935. The growth has been steady, though marked by decades of unusual expansion. . . . The Twenties probably saw the greatest business expansion in Tahoe's history. In those short thriving years, Chambers and Meeks Bay resort came into being, a $200,000 wing was added to the [Tahoe] Tavern, among many other expansions. The last five years, Tahoe commercial expansion has taken another spurt. Notable are the growth and development of Kings Beach, Bijou, the Tahoe Valley "Y," and scores of small attractive markets, eateries, and small service institutions. Today, approximately 150 businesses operate around Tahoe's 97 miles of shore. . . . The peak summer population is estimated at about 30,000. Winters, some 2,000 remain to play in the snow. Tahoe real estate with improvements is valued at upwards of $20,000,000, with Placer County, Calif., in the lead. Of the future, no Tahoe businessman will predict. . . . All agree, however, that much room is still available for continued expansion, mindful at the same time of preserving natural scenic beauty unspoiled by signs and shanties."

Closing comments in this article reflect a noticeable shift in attitudes during the 1940s. The drive to develop it is now tempered by the desire to preserve natural beauty.

In the 1950s the Lake Tahoe Realty Board was established to standardize building codes around the lake. The spirit of post-war boosterism led local businesses and a newly formed Chamber of Commerce to promote the area aggressively (Strong 1984). With the initiation of the two most important service industries in the basin—legalized gambling began in the 1930s, and the ski industry's expansion

after the Winter Olympics at Squaw Valley in 1960—Tahoe's threshold rate of growth reached new levels (LTAC 1963). Subdivisions, hastily planned and built, accommodated a new population of permanent residents employed by the ski and gaming industries.

Throughout the 1940s and 1950s, community development put more pressure on the basin's limited sewage disposal system, as sewage effluent was sprayed directly onto the land in many watersheds and subsequently was released into the basin's streams and lakes (Strong 1984). In this era of unchecked development, unregulated use of the Lake Tahoe basin was coming to an end.

Agency Regulation

Preliminary regulation of resources in the Tahoe basin began as early as 1883, when the California Legislature created the Lake Bigler Forestry Commission specifically to address the problem of overcutting in the Tahoe basin and the need to protect the lake and its surrounding land for the use of tourists. The commission also called for the creation of a "park," to be formed by the transfer of state, federal, and private land to the state of California. In 1913, following controversy over the use of the lake's water, the Lake Tahoe Protection Agency was organized as the first environmental group dedicated to the preservation of Tahoe's beauty, providing added impetus to the efforts to declare Lake Tahoe a national park (Landauer 1995). After several of these campaigns failed, a final proposal was defeated by Congress in the 1930s on the grounds that the proposed area was already degraded and over-commercialized (Landauer 1995). Objections to land transfers that would ultimately profit the CPRR prevented further action to protect Tahoe as a national park (Pisani 1977).

A forest reserve, which included lands within the present Tahoe and Eldorado national forests, was established between 1893 and 1900 (Landauer 1995; Strong 1984). No effective management plan or organization existed until the national forest system was created in 1907, when the Tahoe basin was divided and portions were allocated to the jurisdictions of the Tahoe, the Toiyabe, and the Eldorado national forests. Although a "multiple use" policy was implemented, logging and water management remained the primary concerns. In 1911, the first USFS ranger station was established near Meyers. During the 1910s rangers in the reserve were charged with preventing and halting fires, enforcing fish and game regulations, overseeing timber sales, and conducting experiments in reforestation (James 1914). In 1933, the USFS was authorized to manage its forests intensively and to suppress fires (Elliott-Fisk et al. 1996).

The historic concentration of land ownership in the hands of the giant lumber companies set the stage for the transfer or sale of large blocks of land to private buyers or to the state and federal governments for incorporation into parks and national forests (Mackey 1968). Large blocks were available on the Nevada side of the lake; fewer large parcels were available on the California side of the lake, where lumber interests had not secured as many large tracts. Because cutover timberland (and even lake frontage) in remote mountainous country had little value, there was little incentive for the companies to subdivide their holdings for piecemeal sale after the timber was gone. Thus the millionaire George Whittell acquired a continuous strip of former CTLFC and SNWLC timber holdings that stretched from Crystal Bay all the way south to Zephyr Cove.

In contrast to the 19th century national policy of transferring land out of the public domain for the purposes of private enterprise, 20th century policies shifted to the acquisition and retention of public lands for park and conservation purposes. Until the 1920s and 1930s, most of the basin's land (especially lakefront property) was privately owned (Elliott-Fisk et al. 1996). Gradually, resource management agencies began to acquire more land for public trust. In 1920 the USFS acquired 115 acres of private land at Echo Lake and other land on Tahoe's north shore. With these acquisitions, it owned 25 percent of the land in the basin, although some was leased for homes, resorts, and businesses. In 1927 California officially established a parks commission, and, by the 1950s, both California and Nevada began acquiring and managing land around the lake (Landauer 1995). Nevada created its first

park at Sand Harbor in 1958 (Landauer 1995).

Agency control in the Tahoe basin dramatically changed land use patterns after 1900, especially with regard to fire suppression. The greater vulnerability of Tahoe forests to fire in the post-Comstock logging era fostered the philosophy that fire was a destructive force to be eliminated if possible. A member of the US Bureau of Forestry (Sterling 1904) visited the Tahoe basin in 1904 and reported on the aftermath of Comstock-era logging. He noted that fires had disproportionately affected the regeneration of lakeshore stands and that heavy litter and abundant chaparral in other areas created significant fire hazards. Fire suppression was increased after 1910 when a special gasoline-powered boat patrolled the lake to spot and attempt to control fires from June through September (James 1914). By the mid-1920s all national forests (and national parks) in California and the Sierra had fully developed policies, procedures, and organizations to suppress fire in their jurisdictions. These policies were forged despite post-Comstock-era observations by foresters, who acknowledged the frequency of both natural and human-caused fires in the Tahoe basin.

"Fires ravaged the forest long before the American occupation of California. The aboriginal inhabitants undoubtedly started them at periodic intervals to keep down the young growth and the underbrush. When the miners came, fires followed them. Contemporaneous with the advent of the miners, or soon after, came the flock masters with their sheep" (Leiberg 1902).

"Commencing in the southern part of the basin, all the slopes leading to Rubicon Bay are badly burned; 40 to 60 per cent has been destroyed, and the slopes are covered with heavy brush growths. Going north from Rubicon Bay, all the shore terraces have been burned over; many of the fires appear to have followed the logging camps, others antedate them. From the lake shores fires have spread into the adjacent mountains in all directions, burning lanes through the forest or thinning the stands, brush growths replacing the forest in some localities, grassy or weedy swards in others. About 38 per cent of the timber has been destroyed. The next big burns are found in the canyon of Truckee River from the lake outlet down on the southwestern slopes of Mount Pluto, on the terraces back of Carnelian Bay, and on the high ridges north of Agate Bay. Extensive fires have swept all these tracts, rarely, however, involving total destruction, but thinning the forest from 30 to 70 per cent and creating extensive brush growths" (Leiberg 1902).

Charles H. Shinn, a USDA Forest Service agent, visited the basin in 1902 and reported sighting many small and smoldering fires, especially on the California side of the basin, viewing "four to ten in one day's travel." In his dendroecological study of sample plots in the Carson Range, Taylor (1997) found that "Between 1160 and 1871 fires burned somewhere within the Jeffrey pine zone every three years. . . . These data suggest that both small and large fires were common in pre-Euro-American Jeffrey pine forests. . . . The cumulative effect of these low intensity fires on forest stands was to create open (low density) patchy forests where patches of relatively large diameter trees varied widely in size."

Leiberg (1902) seemed to recognize the positive effects of fire and his observations of logged stands in the north and western portions of the Tahoe basin in 1902 prompted him to question the validity of fire suppression.

". . . Let anyone . . . examine the sapling stands now springing up in old-growth forests where fire has been kept out during the last twelve or fifteen years. . . . These sapling stands, composed of yellow pine, red and white fir, and incense cedar, singly or combined, are so dense that a man can with difficulty force his way through. But for the stature of the species composing them they would constitute chaparral."

In 1924 a congressional act was passed clearly establishing fire exclusion as a national policy. Fire suppression formed the basis of forest service policy until the 1960s, after which time doubt over the merits of total suppression led efforts to reintroduce fire as a management strategy. Controlled burn in the modern setting is problematic, both in terms of public health and safety and visual qualities.

Prior to the agency adoption of a fire

suppression policy, a debate ensued whether to allow "light" or "Indian burning" instead of total suppression. The Washoe and their prehistoric ancestors had been practicing resource management through fire for generations, but their example was ignored. Some perspective on changing fire management policies is gained from a public relations article that appeared on a 1930 map of the Tahoe National Forest. (At that time the northern half of the Tahoe basin was under the jurisdiction of the Tahoe National Forest.)

"The fire-protection policy of the Forest Service seeks to prevent fires from starting and to suppress quickly those that may start. This established policy is criticized by those who hold that the deliberate and repeated burning of forest lands offers the best method of protecting those lands from the devastation of summer fires. Because prior to the inauguration of systematic protection California timberlands were repeatedly burned over without the complete destruction of the forest, many people have reached the untenable conclusion that the methods of Indian days are the best that can be devised for the present. This argument assumes that controlled burning of forests, either in the spring or fall, is easily practiced at slight expense, with negligible damage to the forest, and with relatively complete removal of the accumulated debris which inevitably forms in any growing forest. It has been found, however, that actually to carry out controlled burning in our diversified mountain topography is exceedingly difficult and costly. Experience has shown that 'controlled' fires costs between 35 cents and $1 per acres. And since this must be done every few years, the cumulative cost soon becomes prohibitive for any but the holder of a very small parcel of land. Again, while in theory selecting the proper time of year for burning seems simple, practice demonstrates that rarely are conditions such that fires will start without developing into devastating conflagrations with all the characteristics of the summer fires which the practice seeks to prevent."

"The stock argument of those who advocate the 'light burning' of forests is that fire exclusion ultimately leads to the building up of supplies of inflammable material to such an extent that the uncontrollable and completely destroying fire is certain to occur. The experience of the Forest Service in California, after 20 years or more of fire fighting, does not lead to any such conclusion."

"The contention of the 'light-burning' advocates that periodic fires improve grazing conditions, kill the 'wood-beetles,' and make hunting easier also can be proved incorrect. While at first periodic burning may increase the stand of forage, continuation of the practice kills out the less hardy plants, fosters the growth of weeds and shrubs, and turns the range into a brush patch.

"The 'wood-beetles' spoken of by 'old-timers' are not destructive to green timber, but live entirely in dead trees. Entomologists have proved that the destructive insects which live in green and not dead trees readily attack trees weakened by repeated fires.

"Brush in the forest undoubtedly makes hunting difficult, but it furnishes a home for game. When the brush and forest are destroyed, the homes and breeding places of the wild life are destroyed, along with countless thousands of game birds and animals. Even with the present methods of forest protection the yearly loss of wild life by fire is enormous. How much more would be this loss were fires regarded with indifference or as necessary evils!

"The existing policy of the Forest Service in fire prevention and suppression has not been reached on the basis of guesswork. It represents continuous and critical study of forest fires. Fire exclusion is the only practical principal on which our forests can be handled if we are to protect what we have and insure new and more fully stocked forests for the future" (excerpted from "The 'Light Burning' Fallacy," USFS Tahoe National Forest Map, California-Nevada, 1930—forest visitor comments on the back of the map; map on file Special Collections, Shields Library, University of Nevada, Reno).

Urbanization (1950s to Present)

Discussions of water and sewage problems occupied increasing amounts of space in Tahoe's local papers by the 1950s. During the early 1960s, Tahoe planners were speculating about a "saturation population," expected to occur in about 2010, when all useable land would be occupied and no new

growth could occur (LTAC 1963).

Building on the rapid growth of the recreation and tourism industries after World War II, several events during the 1960s stimulated new levels of development in the Tahoe basin. In 1960 the Winter Olympic Games at Squaw Valley attracted millions of people to the area, most for their first visit, and generated enormous enthusiasm for winter sports (Landauer 1995). Shortly thereafter, Interstate 80 was completed—designed and built to facilitate snow removal and to maintain winter access to Lake Tahoe and Reno. Its opening in 1964 ensured access to and from the Tahoe basin not only for skiers but also for tourists and potential permanent residents (Landauer 1995). Reflecting this social and economic shift, summer homes were converted into year-round residences for seasonal employees of the recreation, service, and gaming industries. In 1965 South Lake Tahoe became an incorporated city, indicating signs that Tahoe's economy and communities were stabilizing. Between 1960 and 1980 Tahoe's population multiplied five times, with the number of homes increasing from 500 to 19,000 units (Strong 1984). Several major housing developments were built on converted wetlands. The most notable and extensive was the Tahoe Keys subdivision, which required 750 acres of functioning wetland at the mouth of the Upper Truckee River to be dredged and filled. Another notable development in the 1960s, Incline Village, was built on parts of a 9,000-acre tract at Crystal Bay, formerly owned by George Whittell.

Improvements in facilities within the basin greatly increased the area's capacity for development (Landauer 1995). In 1968, after a decade of controversy and logistical problems, sewage export from the basin was finally achieved. By 1975 almost all the basin's wastewater was exported, effectively stimulating further subdivision and development of land and increasing the demands on the basin's resources (Elliott-Fisk et al. 1996). By 1970 49,000 subdivided lots and hundreds of miles of new access roads existed in the basin. The 1970s also saw a turn toward Tahoe's more ethnically diverse populations of the 1870s. In 1990 the basin supported 52,591 residents (TRPA 1996) and an estimated 200,000 tourists on peak holidays (Elliott-Fisk et al. 1996). More than 30 ski areas operated in or near the basin every winter, supplemented by year-round activities, such as gambling, boating, and other outdoor sports. Together, these industries formed a $1 billion recreation-based economy, employing more than 20,000 people in 1996 (Elliott-Fisk et al. 1996). Based on projections from the 1990 census, it is estimated that by 2005, there will be 47,855 housing units in the Lake Tahoe basin and a population of 57,588. Although the basin's population has remained relatively stable over the past decade, growing numbers of residents in the adjoining counties create additional pressures on Tahoe's environment and economy.

Logging

Logging occurred through the 1960s, especially on private lands along the north shore where second-growth pine was harvested. In the mid-1980s drought increased the vulnerability of many stands to severe insect attacks. By 1991 an estimated 300 million board feet of timber were dead or dying (Elliott-Fisk et al. 1996) and salvage logging began on the east, north, and southwest sides of the lake. Thinning of stands, prescribed fire, and mechanical brush treatments were initiated and continue to be used to reduce fuel loads and to restore the forests' ability to withstand natural disturbance (Elliott-Fisk et al. 1996; USFS 1998).

As of 1991, approximately 68 percent of the land area in the basin was forested. Isolated stands in steep and inaccessible areas and stands within viewsheds surrounding lakeshore estates escaped logging and are considered old growth. At least 38 old growth stands have been located within Tahoe's upper and lower montane forests and remain as a valued and visible part of the basin ecosystem. About 95 percent of the total area of forest in the basin is second growth conifer stands, of which approximately 40 percent is mixed fir (with a dbh of 12 to 24 inches). Approximately 12 to 15 percent of the basin's land area is developed with residential or commercial buildings. Approximately 70 percent of this developed land is in forested areas. Most of the forest today is accessible via dirt roads or hiking trails.

In this urbanized forest setting, biotic

structure and function have been simplified and significantly altered by the removal of trees, creation of roads, and landscaping with nonnative plants. Although the full impact of urbanization on forest biodiversity in the basin remains unknown, it is clear that the modern forest has been shaped by historic circumstances involving climate, timber harvesting practices, and fire suppression policies. All have combined to create a vegetational change and ecosystem response over the last century that have become the focus of contemporary forest health concerns in the Tahoe basin.

Grazing

Grazing has continued on private land and on allotments throughout the urbanization period. In the 1990s four USFS allotments totaling 31,600 acres (13,000 acres of which are in riparian zones) supported 336 cow/calf pairs and 50 horses or mules each summer (Pepi 1999). Livestock impacts on public lands have varied from year to year, as grazing is allowed only when the ground is judged to be dry enough to support livestock.

Wetlands and meadows have experienced rapid change during the urbanization period. Since 1900 approximately 75 percent of marshes and 50 percent of meadows have been degraded. Around 25 percent of the basin's marshlands were developed between 1969 and 1979 (Elliott-Fisk et al. 1996). The Tahoe Keys project, for example, filled, fragmented and highly altered 750 acres of the once intact "Rowland's" Marsh. The marsh, located at the mouth of the Upper Truckee River, originally occupied about 1,300 acres and extended 4.3 kilometers (2.6 miles) along the shoreline of Lake Tahoe, from Al Tahoe to Camp Richardson's Jamison Beach. It remains the largest marsh in the Lake Tahoe basin, but its hydrologic function has been compromised by the Tahoe Keys development. Since the early 1980s, agencies such as the USFS's the Santini-Burton program and the California Tahoe Conservancy (CTC) have been involved in efforts to purchase and restore environmentally sensitive lands, especially wetlands and sites of significant erosion, like Rowlands Marsh near Tahoe Keys (Elliott-Fisk et al. 1996).

Air Quality

The local generation of airborne pollutants by wood stoves, wildfires, and vehicle emissions (especially during periods of high tourist visitation), combined with increasing pollution generated by out-of-basin sources , such as those coming from urban areas adjoining Tahoe to the east and west, have combined to create a significant environmental concern in the last few decades. Summer visibility may have been poor during prehistoric times, as on the average, 30 acres or so were burning somewhere in the basin every day from May through October. Small lightning-caused fires and microburns by Native Americans would have rarely reached to tops of trees but probably did deposit a smoky haze layer over the lake each morning. Later in the day, this smoke would have dissipated and would have been blown eastward into what is Nevada by the midday winds. Still, in the morning, the view along the length of the lake would have been obscured, although the mountains and ridges above the thin haze layer would have been sharp and clear.

Historic information on air quality is available through 19th century first-hand observations. For instance, an anecdote by Mark Twain, although somewhat fanciful, conveys a message:

"The air up there in the clouds is very pure and fine, bracing and delicious. And why shouldn't it be?—it is the same angels breathe" (Twain 1962).

Unlike Twain, some historic accounts note smoky skies and the incidence of fires during the historic period. Photographs taken during Comstock-era logging show smoke in the air.

Visibility between roughly 1900 and 1960 was probably better than it had ever been before or since, due to fire suppression efforts by public agencies.

Water Quality

Lake sedimentation records that reflect disturbance caused by Comstock-era logging indicate that, in the absence of extensive road building and

development, the watershed recovered quickly from this disturbance with minimal effect on the lake's water quality (Heyvaert 1998). However, the cumulative effects of development in the Tahoe basin over the last few decades have proved deleterious. The lake has responded to increased nutrient loading from the streams, atmosphere, and ground water with steadily increasing algal growth (eutrophication) and a progressive loss of transparency.

Concern for the basin's water quality has steadily increased since the 1960s, as research continues to reveal the impacts of urban pollution (particularly sewage and runoff) on the basin's subwatersheds and on Lake Tahoe itself. Most sources of pollution have had long-lasting effects. For example, in the 1970s Heavenly Valley Creek still carried high nutrient loads, five years after sewage effluent was no longer released nearby (Strong 1984). In addition, human-induced soil erosion and development of Tahoe's lakeshore wetlands and marshes are primarily responsible for the historic decline in Lake Tahoe's clarity, accelerating the release of nutrients from the watershed and a reducing the lake's capacity to cleanse itself (Elliott-Fisk et al. 1997). Since the 1980s the USFS has initiated numerous erosion-control and stream-restoration projects.

Regional Planning

In this context of urbanization and rapid growth, the modern era of regulated regional planning began. As the Tahoe basin was undergoing its latest boom of development, a number of research studies disclosed evidence of serious degradation of many aspects of Tahoe's environment. This news prompted the states of California and Nevada to sign the Bi-State Compact in 1969, creating the Tahoe Regional Planning Agency (TRPA). TRPA is a government agency intended to serve as administrative lead in establishing a regional approach to land use planning and regulation. A number of auxiliary planning agencies, conservancies, and special interest groups and coalitions have since emerged in response to the management policies of TRPA and due to the indeterminate administrative responsibilities of federal, state, county, and municipal governments and the private sector (Elliott-Fisk et al. 1997). In 1982 TRPA established a series of thresholds, which set limits for the use of the basin's natural resources and in 1987 enacted a Code of Ordinance, which severely curtailed areas for future development, as well as the type of development allowed.

Although controversy and confrontation arising from the rapid rate of social and economic growth and the equally rapid rate of environmental degradation have characterized this era of urbanization, the dependence of the economy on a relatively healthy natural environment has finally been widely acknowledged (Elliott-Fisk et al. 1996). The purchase and regulation of land by agencies has set the stage to ensure that forested communities are conserved into the future. In the late 1960s the USFS, facilitated by the Land and Water Conservation Fund Act of 1965, began acquiring private estates around the lake. In 1964 Nevada passed a State Parks Bill and turned 5,000 acres of the Whittell Estate into the Lake Tahoe Nevada State Park (expanded to 13,000 acres in 1967). The LTBMU was created in 1973 to administer portions of three adjoining national forests in the basin as a single entity. In 1974, the USFS purchased 10,000 acres in the northwest sector of the basin and 645 acres at Meeks Bay. In 1989, the Nevada Wilderness Protection Act preserved land north of Incline now known as the Mount Rose Wilderness Area (Landauer 1995). By 1980 the USFS owned 65 percent of the land in the basin, and by 1996 USFS holdings had increased the total to 77 percent (Elliott-Fisk et al. 1996). Current public ownership now stands at 85 percent of the 202,250 acres total land area.

Human Dynamics, Economic Health and Social Well Being

In his two books on the environmental history of the Lake Tahoe region, Douglas Strong describes the emergence of concern about the relationship of environmental quality to economic activity (Strong 1984, 1999). In its earliest forms, this concern did not fully articulate the link between ecology and economy. There was a manifest desire to protect private property rights and to make

profits. Those goals certainly were driven by the knowledge that the region's character gave value to property and drew customers to businesses. But, only in the last few decades has there been a conscious and continuing discussion about how communities can best sustain or improve their economies to support high quality environmental management.

In this discussion all parties acknowledge that the stunning beauty and wide range of recreational opportunities at Lake Tahoe drive the basin's economy. Residents, business people, land owners, and environmentalists are now asking questions about the quality of community life. Many believe there are measurable relationships among a healthy community, a healthy economy, and a healthy environment. History informs this concern. It is common knowledge that human use of the Tahoe basin has left lasting scars on the environment. But community action, with the help of state and national support, has mitigated some of those scars. The concern of the people of Tahoe together with the wealth and support of the state and nation form the foundation for environmental protection.

Individuals who have long experience in the basin—through jobs with public agencies, through ownership and stewardship of private land, or simply through loving and visiting the place—provide an important "institutional history" that lends perspective to the debate about balancing economic vitality, community well being, and environmental quality. They have witnessed the mistakes. They have participated in the restoration. Their combined historical knowledge suggests that environmental quality does not have to be sacrificed for economic vitality and community health. On the contrary, strong communities support strong economies and healthy environments. The evolving discussion over what makes a strong community now goes beyond the obvious and important factors, such as good schools, good libraries, good health services, and good recreational facilities. The current discussion embraces the questions of affordable housing, the integration of minority ethnic groups, and the serving of a growing retirement population, to name just three. It includes the facts that increasing wealth will drive up land and housing prices and that year-round traffic overload diminishes the quality of life for both resident and visitor.

Scientific Research and Humanistic Applications

In the Tahoe basin the scientific community has long been recognized as an important participant with regulatory agencies in the policy-making process. During the 1970s, academic and government institutions initiated long-term and systematic scientific research on the Tahoe basin to enhance regional planning efforts; the research continues to the present day.

Initially, the focus on lake clarity drove environmental decision-making in the Lake Tahoe basin; but growing concern over the entire ecosystem has identified other sources, such as biological diversity, forest health, air quality, and socioeconomic health. Lake clarity depends on the larger system and it indicates the status of other linked elements. This watershed study marks the first explicit attempt to synthesize all these issues and to address long-term sustainability for the total system.

Ecosystem History and Paleoenvironmental Studies

Paleoenvironmental investigations being conducted by Quaternary scientists use a variety of data to address issues crucial to current and future environmental health of the Tahoe basin and surrounding areas. From a knowledge of past climate patterns and ecosystem response, a sense of sustainable vegetation conditions is gained. Paleo-environmental data contribute to understanding the frequencies, durations, magnitudes, and rates of climatic change and the environmental responses to these changes. In particular, these data indicate the norm. Issues related to landscape evolution, drought, floods, changing fire regimes, and long-term water quality are addressed from the perspective of long-term ecosystem processes. Information derived on each of these issues has economic, aesthetic, and health impacts on the people that visit and live at Lake Tahoe, and it can be used in public education programs to enhance visitor appreciation of Lake Tahoe's natural environment. Work currently being conducted includes the following.

1. Pollen, plant macrofossil, and charcoal studies around Lake Tahoe and the western Great Basin are being used to reconstruct climate and vegetation histories. These show the close connection between climate and forest dynamics over thousands of years.
2. Reconstructed vegetation histories for the last thousand years highlight the decrease in biodiversity of Lake Tahoe forests since European settlement. This decline has led to the forest's greater sensitivity to drought, disease, and fire.
3. Long-term relationships among forest fuel buildup, climate, and changing fire regimes (to include the potential role of human-induced fires) are being clarified as the dates and densities of charcoal recovered from sediment records are analyzed. These records suggest that future potential global warming will result in significant increases in fire frequency in the Tahoe basin.
4. Reconstructed vegetation histories are providing evidence for past wet and dry cycles and their return intervals. Within the last few decades the great variation in the level of Lake Tahoe has affected both upland and lowland users of Tahoe water. Radiometric dating of forests submerged up to 20 or more feet below the current surface of Lake Tahoe reflect periods of drought during the last 6,500 years, and even the last 1,000 years, that dwarf those of today.
5. Sequences of tree rings from forests in the region of Lake Tahoe furnish a record of past stream flow for drainages entering and leaving Lake Tahoe. In addition, correlation of these records with other paleoflood sequences from the Truckee, Carson, and Walker rivers indicate the kinds of climates under which frequencies and magnitudes of floods increase in the drainages of the central Sierra Nevada and suggests the role that Lake Tahoe may play in these events.
6. Finally, studies of present and past molluscan assemblages are providing proxy data for reconstructing past changes in water chemistry/quality resulting from paleoclimatic variation.

Water and Air Quality

The extensive research and monitoring programs of the Tahoe Research Group (TRG) have provided clear evidence for the onset of cultural eutrophication in ultra-oligotrophic Lake Tahoe. This continuous, long-term evaluation of lake chemistry and biology since the early 1960s has shown that algal production is increasing at a rate greater than 5 percent per year and clarity is declining at the alarming rate of 0.5 meters per year. Scientific investigations during the period 1959-1996 demonstrated that multiple stressors—such as land disturbance, habitat destruction, air pollution, accelerated erosion, extensive road networks, drought and flood hydrology, timber and fire management practices, urban runoff, creation of impervious surfaces, introduction of exotic species, and heavy use of road salt—have interacted to degrade the basin's airshed, terrestrial landscape, and streams, as well as the lake itself.

The first scientific observations of Lake Tahoe were made as early as the 1880s by John LeConte of the University of California at Berkeley. Intensive studies began in 1959 by Charles Goldman at the University of California at Davis, who founded the TRG. During this period, TRG scientists began their now continuous sampling of water temperature, chemistry, light transmission, zooplankton, and phytoplankton productivity and were able to make important discoveries concerning such phenomena as algal growth, eutrophication, changes in water clarity, lake nitrogen and phosphorus chemistry, and nutrient limitation. This project was one of the earliest to use the watershed approach to water quality and limnology and to incorporate sociologic, economic, and regulatory concerns. These surveys have provided information for efforts to arrest the decline in Lake Tahoe water quality. With the need to acquire a more extensive data base for land use planning and watershed management, the Lake Tahoe Interagency

Monitoring Program (LTIMP) was established in 1979 to collect water and air quality information on Lake Tahoe necessary to support the extensive regulatory and research activities in the basin. This program enables long-term effective monitoring and measurement necessary for detecting trends in dynamic ecosystems of lake and stream water quality and atmospheric nutrient loading.

Heritage Values

Efforts to restore Lake Tahoe's ecosystem benefit from an increased understanding of the long-term ecological dynamics between historic human communities, plant and animal communities and the basin's physical environment. Archaeology and ethnography rely on the interpretation of heritage remains, resources that offer information with great time depth and serve as independent and corroborative elements with which to link historic conditions and contemporary research, monitoring, and adaptive management. Heritage resources are uniquely tied to the human dimension of the Lake Tahoe ecosystem and guide future decision-making by setting a baseline of reference conditions to determine how present conditions differ from past conditions, the reasons for that difference, and the sustainable conditions that may be possible in the future. A knowledge of how people shaped past ecosystems is then directly applied to the restoration and maintenance of future ecosystems. Heritage resources require preservation, conservation and appropriate management.

Archaeology

In the absence of historical or oral history records beyond 150 years, the archaeological record offers information to address the question of potential disturbances of indigenous plant and animal communities in the prehistoric past. Here, associations may be found between the distribution and density of archaeological sites and the relative degree of anthropogenic disturbance, with locales containing higher site densities being some indicator of locales subject to greater disturbance by prehistoric and historic peoples. Accordingly, archaeological remains are viewed as more than the evidence people left on a landscape; they are the expressions of human interaction with that landscape. Forests in the Tahoe basin, then, are both "habitat and artifact" (Forney 1995), a repository of information about the human-induced changes in the Lake Tahoe basin and their corresponding environmental conditions.

History

When conservatively interpreted, first-hand accounts from period observers provide a reliable view of the past, with observations on the size, structure, and species composition of the pre-Euro-American forest. Other archival sources, such as lumber company records, contain quantitative data on species mix and stem diameters. Some data are adequately precise to facilitate the identification of environmental reference conditions for specific areas (located by township/range/section) and times (by season and year of harvest). Historic deeds and assessors records document land transfers and may indicate the year lands were cut (or grazed) and the amount of timber harvested. Comparisons of historic and contemporary photographs illustrate point-specific landscape changes and general environmental conditions.

The Ethnographic Past and Washoe Present

Prior ethnographic research has not focused on traditional Washoe resource harvesting techniques or horticultural and conservation practices, topics of timely concern in present ecosystem restoration efforts. There is compelling evidence of extensive and systematic management. Future research along these lines promises the disclosure of specific management and conservation practices that may have influenced the Lake Tahoe ecosystem in the past and that may contribute to its future management.

Washoe people and their tribal government are eager to renew their ties to Lake Tahoe and to participate in the restoration and maintenance of a healthy watershed, inclusive of the human enterprise. Recognized as a sovereign nation, the Washoe Tribe is working in partnership with federal agencies to reestablish more than a "place name" presence in the

Lake Tahoe basin for the 21st century. In 1994 the Washoe Tribal Council developed a Comprehensive Land Use Plan that includes goals to reinstate ancestral land management practices at Lake Tahoe, including the harvest and care of traditional plant resources (Washoe Tribal Council 1994). The tribe is sponsoring an oral history program that incorporates, as a key component, on-site visits and interviews with elders at traditional areas around Lake Tahoe (Wallace 1999). The USFS has engendered interest in identifying anthropogenic landscapes resulting from traditional Washoe land use practices. Although detection of these landscapes is hindered by the profound landscape alterations caused by succeeding Euro-American populations, contemporary Washoe plant specialists can still share traditional information and reintroduce practices that once contributed to sustainable ecosystems in the Tahoe basin. One objective of compiling this Washoe botanical knowledge is to promote management, including watershed restoration, that would favor plants targeted by contemporary people and engage Washoe plant specialists and land managers in active adaptive management strategies. Another objective is to identify the traditional plants most likely to have been heavily managed in the past and whose populations and vigor would be most affected by systematic harvesting and horticulture. The ultimate goal is to document indigenous harvesting and management practices, to reintroduce some, and to design research that might enable the effects of aboriginal horticulture to be quantified (Anderson 1993a, 1993b).

Increasingly, vocal tribal overtures demand that the Washoe be considered serious stakeholders in land management issues at Tahoe. At a presidential environmental summit in 1997, members of the tribe were praised for their long history of stewardship in the Tahoe basin. In turn, the Washoe Tribe asked that all people who now share, live upon, or use their ancestral resources also be responsible guardians of their traditional lands. In the wake of President Clinton's visit to Lake Tahoe, the Washoe Tribe and the USFS signed a landmark agreement to return the use of more than 400 acres of land within the Tahoe basin to the tribe under a special use permit. Clinton is the sixth president since 1877 that the Washoe have petitioned to return their lands for traditional use. The Washoe desire to demonstrate actively their philosophy on resource stewardship and land restoration at Lake Tahoe. These "reacquired" areas will be used to reinstate ancestral land management practices and to return Indian people to their ancient homeland for cultural renewal.

Changing Land Use Paradigms and Ecosystem Consequences

Past land use ideals have been physically transposed upon Tahoe's present landscape—Native American stewardship engaged a balanced relationship between human society and the environment. Climate change, 19th century clear-cutting, and decades of fire suppression have combined with increasing urbanization during the 20th century to diminish lake clarity and forest biodiversity. The resulting "greening" of Lake Tahoe and the demise of about one-fourth of the second growth forest within the last two decades presents an awesome challenge to land managers and conveys a powerful message to the public that carries impending social and economic costs. Thus, each decade of the last 150 years of human history at Tahoe has sharpened the dilemma of how to have a decent way of life without spoiling this place, confounding the direction of 21st century users of Lake Tahoe.

Leaders and observers now recognize the very complexity of the web of relationships among the elements of social well being, economic vitality, and environmental quality. It is more than timbering and erosion, more than burning and smoke, and more than personal watercraft and noise. Acknowledging this complexity has established Tahoe as a powerful laboratory for learning. The Tahoe region no longer exports a product, but rather an "experience" (TRPA 1996). Increasingly, the Tahoe experience offers residents and visitors the beauty of mountain scenery and the pleasure of recreation and the intellectual opportunity to learn about its biophysical and cultural heritage dimensions. As knowledge and information become more a part of the lives of visitors and residents, the lake and surrounding forests will become more an object of learning and source of information.

Tahoe is a world model for advice on how to move understanding and attendant management of complex human-environment systems to a new and more effective level by using the history of place in an informed way. The Lake Tahoe basin management experience is evolving to be one of the best examples of adaptive ecosystem management in the world. It has become an especially useful model for ecosystems elsewhere that are also undergoing change from historic logging and grazing, fire suppression, forest overstocking and declining forest health, degradation of riparian corridors and wetlands, restoration activities, recreational pressures, declining air quality, and the many forms and impacts of urbanization (Elliott-Fisk et al. 1997). An understanding of these historic disturbances can effectively guide future management in the Lake Tahoe basin.

Time Line of Paleoclimate and Environmental History in the Lake Tahoe Basin

<13,000 BP Glaciers occupy much of the Tahoe Sierra, especially the valleys lying southwest of Lake Tahoe; a large glacier dams the Truckee River at the mouth of Squaw Valley, raising the level of Lake Tahoe at least 100 feet above its current level; many of the basins east of the Sierra are flooded by extensive lakes; the largest of these, pluvial Lake Lahontan, floods much of the western Great Basin and is fed by the Truckee, Carson, Walker, Humboldt, Smoke Creek, and Quinn rivers; around the Lahontan Basin, sagebrush steppe with scattered juniper woodland, occasionally mixed with stands of white-bark pine, blanket the slopes surrounding these lakes.

13,000 to 11,500 BP Great Basin pluvial lakes shrink by 11,500 BP, reaching their lowest stands since 27,000 BP; down-cutting of river channels to new base levels follows the drop in lake levels; glacial melt begins in earnest; between 13,000 and 12,000 failure(s) of the ice dam at the mouth of Squaw Valley result in several catastrophic floods that sweep down the Truckee River Valley, altering its morphology by eroding huge swaths of sediment and depositing it in the Fernley Basin; drier climate results in the retreat of white-bark pine from lower elevations and the movement of desert scrub into abandoned lake bottoms.

11,500 to 10,000 BP Colder climate corresponding to the Younger Dryas period of Europe results in a brief, relatively minor resurgence of Sierran glaciers and of pluvial Lake Lahontan and in retrenchment of warmer climate vegetation; a cold-dry sagebrush steppe prevails until about 10,000 BP, when there is a shift to coniferous forest; at lower elevations in the Great Basin to the east, a juniper woodland with a more xeric shrub understory clings to the slopes surrounding these shallow lakes and marshes; ancient hunting peoples live in the area and probably hunt the remnant herds of Pleistocene herbivores, which include two kinds of horse, camel, bison, shrub ox, and Columbian mammoth.

10,000 to 7000 BP (Early Holocene) Climates warm and dry rapidly, reaching their Holocene maximum by 9000 BP; glaciers retreat to near their Holocene minimum, and lakes and marshes in the basins east of Lake Tahoe shrink to their smallest extent and, in some cases, even disappear; eolian erosion of dry lake and marsh areas commences on a large scale in the Great Basin; much of this material accumulates as downwind dunes or as blankets of eolian sediment on the mountain ranges of the Great Basin; slope erosion on a massive scale begins due to much reduced vegetation cover; as a result, many stream channels fill with stacks of sediment; montane forest species arrive en masse from the south and from lower elevations west and east of the Lake Tahoe basin, transforming the landscape cover from shrub steppe to forest; in the Great Basin to the east, juniper woodlands retreat from their Pleistocene extent to positions near their current limits.

7000 to 4000 BP (Middle Holocene) Period of warm dry climate during which the cumulative effects of Holocene drought reach their climax; more drought tolerant species climax before 5500 BP; continued desiccation of lakes in the western Great Basin; Lake Tahoe and Pyramid Lake decline but are the only ones that do not dry up (ancient drowned forests at Tahoe date between 6300-4800 BP, and submerged stumps stand rooted

on the lake's floor up to 20 feet below its surface); many streams reduce to trickles, and the Truckee River may even cease to flow; Pyramid Lake may lie more than 210 feet below its current level; eolian erosion and depositional activity declines as playas become armored with silts and clays, and the amount of fresh, erodible sediments provided by tributary streams declines dramatically; at the heads of tributary streams slope erosion, due to much reduced vegetation cover and stream channel filling, is still very active; juniper-dominated semiarid woodland retreats upslope in Great Basin mountain ranges by as much as 1,000 to 2,000 feet; subalpine woodland disappears from some Great Basin ranges in which it had existed since the Pleistocene and survives in only the highest mountain ranges; desert shrub vegetation advances up the slopes surrounding the many valleys of the Great Basin; native peoples limit their activities on the floors of these dry basins, concentrating instead on the resources of Great Basin uplands and the mountain ranges and highlands surrounding the Great Basin; between 5600 and 5400 BP, a major regional episode of wetter climate, evidenced from the plateau of eastern Washington to the northern Mojave Desert, results in forests in Lake Tahoe drowning, sagebrush replacing greasewood communities, and springs being reactivated in the southern Great Basin and northern Mojave Desert; in Little Valley, downslope movement of white and red fir, together with greater abundance of riparian species, such as willow, birch, and alder, herald this event; renewed dry conditions (not approaching the conditions before 5500 BP) continue with additional brief episodes of moister climate until 4000 BP.

4000 BP Climates become cooler and moister, initiating the Neoglacial (Neopluvial) period, which lasts for the next 2,000 years; rebirth of Great Basin lakes, or at least of marshes, follows, as does the minor resurgence of glaciers in the Tahoe Sierra; Pyramid Lake rises well above its current level, indicating that the Truckee River is flowing again and receiving significant contribution from Lake Tahoe; greatest abundance of white and red fir in Little Valley marks this period; in the Great Basin to the north and east, major downslope expansion of juniper-dominated semiarid woodland and contracting of desert shrub communities characterize the next 2,000 years.

4000 to 2800 BP A marsh forms along the lower reaches of Taylor Creek, due to a rise in ground water levels from about 5000-4000 BP; an open water environment exists at Taylor Creek marsh around 2800 BP.

4000 to 1300 BP (Late Holocene) There is a significant shift from more xeric vegetation to the dominant conifer species that are present today; the record appears to be punctuated by alternating intervals of cool-moist and warm-dry periods.

2200 to 1600 BP A subsequent warm-dry interval persists; Pyramid Lake recedes below its current level, and Eagle Lake (Lassen County) falls after 2000 BP (Eagle Lake was well below its current level from at least 7000 to 5000 BP); many other marsh areas contract or disappear; semiarid woodland retreats in the western and northern Great Basin.

1600 to 1100 BP Warm conditions with slightly wetter, summer-shifted rainfall pattern results in major expansion of piñon pine into juniper-dominated semiarid woodland in the western Great Basin east of Lake Tahoe.

1300 BP to Historic Contact The period is marked by an overall xeric trend, punctuated by cool/moist cycles alternating with cycles of severe drought; tree-rings from the Sierra Nevada confirm that except for the "Little Ice Age" (and perhaps two other brief episodes), this period is characterized by climates drier than those of today.

AD 600 to 800 Continuing dry conditions are indicated by trees growing on Ralston Ridge Bog (south of Lake Tahoe) due to low water tables; submerged stumps at Rubicon Point, Lake Tahoe, date between AD 680 to 885.

AD 850 A brief wet interval is indicated by the presence of buried A-horizon soils in association with a sand lens near Taylor Creek, indicating a rise in the level of Lake Tahoe and deposition of lake deposits as sand.

AD 900 to 1050 A period of substantial drought is suggested by relict Jeffrey pine stumps, rooted in the Walker River stream bed, that date to AD 1030; submerged stumps in Walker Lake date to AD 970; submerged stump in Fallen Leaf Lake dates between AD 1050 and 1265.

AD 1260 to 1500 Another severe drought

occurs, as indicated by relict Jeffrey pine stumps, rooted in the Walker River streambed, that date to AD 1290; in the Truckee River watershed, the relationship between tree growth and stream flow indicates that intermittent drought conditions prevail around AD 1260; a dry period around AD 1281 is supported by submerged tree stumps, which indicates a substantial drop in Independence Lake (a Truckee River tributary).

AD 1500 During the last 500 years, a wet climate, punctuated by intermittent but substantial droughts, begins to dominate the region, with rising and lowering lake levels and advancing and retreating cirque glaciers.

AD 1430 to AD 1490 Drought is indicated by dozens of tree stumps submerged up to 30 feet below the present level of Donner Lake (also a Truckee River tributary), dating between AD 1433 and 1490.

AD 1579 to 1585 and AD 1630 Another warm period is documented by tree ring studies and Truckee River runoff.

Mid-1600s to Mid-1820s Generally cooler wetter conditions coincident with the European "Little Ice Age" event result in brief regrowth of Great Basin lakes and reexpansion of semiarid woodlands in the Great Basin and northern Mojave Desert; Tahoe's old growth forests develop during this time.

Mid-1700s to Mid-1800s The level of Lake Tahoe may have been occasionally below its rim; these episodes may be documented by a submerged stump in Tahoe offshore of the Upper Truckee River dating from about AD 1720 (230±50 BP uncalibrated), one in Emerald Bay dating to AD 1840 (110±60 BP uncalibrated), one from Moon Dune Beach at Tahoe Vista dating from AD 1802 (148.5±mod uncalibrated), and one from Cave Rock with a calibrated date of AD 1695-1725/1815-1920; two submerged stumps from Independence Lake date from AD 1780 (170±50 BP uncalibrated) and AD 1850 (100±mod uncalibrated), respectively; one stump from Donner Lake dates from AD 1800 (150±50 BP uncalibrated); given the problems of radiocarbon-dating materials less than 250 years old, these dates may also bracket the "Little Ice Age."

1875 to 1915 A period of greater precipitation is indicated by above-average flows of the Truckee River; northern Great Basin lakes reach high levels, matched only by the lake highs resulting from El Niños of the late 1979s and early 1980s.

1907 (July 14-18) Lake Tahoe attains its highest recorded lake surface level at 6,231.26 feet (11.00 feet mean sea level [MSL] above its lowest recorded surface level of 6,220.26 feet MSL, recorded on November 30, 1992).

1912 During an extreme drought, an attempt by the USRS and the TRGEC to dredge the Truckee River channel at Tahoe City and cut down its rim is blocked by lakeshore property owners through a court injunction.

1924 Drought drives downstream farmers to persuade Lake Tahoe property owners to allow the lake to be pumped when it falls below its natural rim.

1928 The Truckee River Basin experiences the beginning of a severe drought; lasting from 1928 through 1935, this drought would not be exceeded in severity until the 1987-1994 drought.

1950 A major winter flood dramatically increases flows into Lake Tahoe and the Truckee River.

1982 to 1986 A period of wet years results in an average annual snow water content of up to 200 percent of normal; 1983 becomes the standard high water year for virtually all waterways within the Lake Tahoe and Truckee River basins; this episode occurs throughout the northern Great Basin, as lakes reach their highest level since the mid-1870s.

1987 to 1994 An eight-year drought begins in the Truckee River drainage basin; although of the same duration as the 1928-1935 drought period, the 1987-1994 drought is far worse; the Lake Tahoe basin records an average annual snowpack water content down to a low of 29 percent of normal; Tahoe attains its lowest recorded lake surface elevation over its entire period of record (April 1900 to present); on November 30, 1992, Lake Tahoe reaches its record low at 6,220.27 feet MSL, 2.72 feet below its natural rim of 6,223 feet MSL (11 feet below its highest lake surface level of 6,231.26 feet MSL, recorded on July 14-18, 1907).

1991 Sustained drought subjects timber stands to severe insect attacks; by 1991 an estimated 300 million board feet of timber are dead or dying; salvage logging begins on the east, north, and southwest sides of the lake; thinning, prescribed burns, and mechanical brush treatments are implemented to reduce fuel loads and to restore forest health.

1995 A near-record water year of precipitation in the Lake Tahoe and Truckee River basins recharges ground water and replenishes nearly empty reservoirs; this trend of normal to above-normal precipitation continues to the present.

1996 The *Sierra Nevada Ecosystem Project* is released, a $6.3 million study and assessment commissioned by the US Congress and funded by the USFS; the 3,200-page study, written by 107 scientists, is intended as a tool for policy makers planning for the future of the Sierra Nevada; an important finding is that Sierran climate, which drives the biosystem as the source of much of California's and western Nevada's water, may be getting drier; century-long droughts that have occurred within the last 1,200 years may recur in the near future.

1997 (January 1) Lake Tahoe and the Truckee River Basin experience severe and extensive flooding that exceeds 100-year flood records.

Time Line of Transportation and Community Development

1844 (February 14) While conducting an expedition for the US Bureau of Topographical Engineers, John C. Fremont views Lake Tahoe from Red Lake Peak—the first Euro-American to do so.

1844 (May) Six members of the Stevens-Murphy-Townsend emigrant party become the first Euro-Americans to stand on the shores of Lake Tahoe; they leave the main party on the Truckee River and, instead, cross the Sierran divide above McKinney Creek.

1848 (January) The initial rush to the California gold fields bypasses the Lake Tahoe basin in search of easier routes that don't involve dual summit crossings.

1850s Georgetown-Lake Bigler Trail leads westward from McKinney Creek, through Rubicon Springs, and terminates at Georgetown.

1851 Tahoe's first Euro-American settler establishes a trading post at Lake Valley.

1851 Lake Tahoe receives its official name, Lake Bigler, in honor of California's governor, John Bigler. (The name Tahoe, a misnomer derived from the Washoe word *da'ow* and signifying "lake," does not become the official designation until 1945.)

1852 "Johnson's Cut-Off" is laid out, connecting Placerville and Carson Valley through Lake Valley via Echo Summit (Highway 50/Pioneer Trail).

1852 to 1854 Carson Emigrant Ridge Road connects with Johnson's Cut-Off, crossing over Spooner Summit (Highway 50).

1852 to 1855 Placer County Emigrant Road is established through Truckee River Canyon (Highway 89) and along Tahoe's north shore (Highway 28); road connects Auburn and Virginia City through Squaw Valley and Tahoe.

1855 G. H. Goddard and S. H. Marlette commence the California state boundary survey through the Tahoe basin.

1858 to 1859 Luther Pass (Highway 89) becomes the favored route through the Tahoe basin, bypassing lower Lake Valley.

1859 The discovery of silver near Virginia City causes a reverse migration from west to east; this time the Tahoe basin becomes a crossroads between California's Mother Lode and Nevada's Comstock Lode; several new routes are opened through the basin, the most popular of which are along Tahoe's south shore (Highway 50/Pioneer Trail).

1860s Glenbrook Bay becomes the east shore over-water terminus for the toll pack trail leading from Georgetown to McKinney Bay; from Glenbrook, travelers proceed eastward to Virginia City.

Early 1860s Settlements are established at Lake Valley, McKinney's, Tahoe City, Lake Forest, Agate Bay, Tahoe Vista, Kings Beach, Glenbrook, and Edgewood.

1860s Early resort era begins with resorts in Lake Valley, Tahoe City, Brockway, McKinneys, and Glenbrook; ranchers, hostlers, and commercial fishermen in Lake Valley profit from the lucrative

business of supplying travelers and the growing mining centers; up to 15 hostelries are established by 1865, supplying customers with locally grown hay, vegetables, dairy products, and fish.

1860 Tahoe Truckee Turnpike (Highway 89) opens through Truckee River Canyon.

1860 to 1861 The new Kingsbury-McDonald Grade (Highway 19/207) is developed over Echo Summit and Daggett Pass and siphons travel away from Luther Pass; it is designated as the Pony Express Trail.

1862 Rufus Walton Toll Road is opened from Glenbrook over Spooner Summit (Highway 50).

1863 The new Lake Bigler (Tahoe) Wagon Road channels the flow of travel over Echo Summit and through the Tahoe basin, away from Kingsbury Grade and over Spooner Summit.

1866 Over a period of three months, 6,667 pedestrians, 3,164 stage passengers, 5,000 pack animals, 2,564 teams, and 4,649 cattle travel the Lake Tahoe Wagon Road along Tahoe's south shore.

1869 The nation is joined by the first transcontinental railroad; connections to Tahoe's north shore by stage from Truckee promote tourism at an early date; lake front resorts soon flourish at Tahoe City, Glenbrook, and Tallac.

Truckee-Hot Springs Road (Highway 267) is constructed over Brockway Summit between Truckee and Brockway Springs.

1860s to 1910s Steamer traffic dominates travel in the Tahoe basin; roads are generally in poor condition and do not yet circumvent the lake.

1873 John LeConte conducts initial limnological studies on Lake Tahoe.

1870s A settlement is established at Carnelian Bay.

1880s Tourism flourishes with more resorts established in Lake Valley, Emerald Bay, Sugar Pine Point, Blackwood, and Tahoe City.

1883 The California Legislature creates the Lake Bigler (Tahoe) Forestry Commission, specifically to address the problems of overcutting, and plans for tourism; the commission unsuccessfully calls for creating a national park at Tahoe, to be formed by transferring state, federal, and private land to the state of California; objections stemmed from the fact that the land transfer would ultimately profit the Central Pacific Railroad.

1891 First continuous road is built over Mt. Rose Pass connecting Reno and Lake Tahoe ("The Road to Incline"/Highway27/431).

1898 The Lake Tahoe basin is stripped of marketable timber, and large-scale cutting ceases; logging railroads are salvaged, and capital and energy are funneled into a growing tourist industry.

1899 A 37,550-acre forest reserve is created, including Desolation Wilderness, Glen Alpine, and the lakeshore between Camp Richardson and Rubicon Bay; 13 acres at the former fish hatchery near Tahoe City are set aside to eventually become the site of California's first state park.

1900 A second effort to establish Lake Tahoe as a national park is blocked.

1901 Completion of the LTRTC railroad connecting Tahoe City with the Southern Pacific mainline at Truckee is a major boost for tourism; at Tahoe City, rail passengers are transferred to luxury steamers to lakewide destinations; Tahoe becomes the playground for the wealthy elite, and exclusive resorts are built or expanded near Tahoe City, Carnelian Bay, Brockway, Glenbrook, Tallac, and Emerald Bay.

1905 By this time ten communities with separate post office addresses have been established around Tahoe's lakeshore.

1907 With the creation of the national forest system, forest reserves are renamed national forests and the Tahoe basin is segmented under the jurisdictions of the Tahoe, the Toiyabe, and the Eldorado national forests; agency control dramatically changes land use patterns here, especially with regard to fire suppression, increased recreation, and the construction of summer homes.

1910s The first automobiles travel to the Lake Tahoe basin, ushering in a new era of tourism.

1911 The first USFS ranger station is established near Meyers; rangers are charged with preventing fires, enforcing fish and game regulations, administering timber sales, and experimenting with reforestation.

1912 A third attempt to designate the Tahoe

basin as a national park is defeated. Bliss, Yerington, and Mills estates, which once owned one-fifth of the land in the Tahoe basin, still retain 40,000 acres of cutover land and now offer it for subdividing.

1913 Distrusting government intentions, prominent Lake Tahoe property owners file articles of incorporation, forming LTAC, the first environmental group created specifically to preserve the lake's beauty by protecting its environment.

1914 Auto traffic to Tahoe increases after the main road through South Lake Tahoe (Highway 50/Pioneer Trail) and the road over Donner Summit (Highway 40/Int 80) are designated as part of the Lincoln Highway, the nation's first coast-to-coast highway.

1918 A fourth pursuit to assign national park status to the Tahoe basin is unsuccessful.

1920s Initial subdivisions prompt the development of independent utility companies to provide basic water and power utilities; early subdividing occurs in Lake Valley.

1925 The first auto loop road encircling the Lake Tahoe basin is completed.

1928 to 1935 The US Bureau of Public Roads expands and upgrades auto roads within the Tahoe basin and improves ingress and egress outside the basin; easy auto access encourages the development of tourist facilities geared to a wider public and spells the demise of the exclusive resorts; tourist visits are short and more frequent; accommodations in auto courts and campgrounds are on the rise.

1930s With a fledgling building boom, Tahoe boosters actively draw visitors and prospective residents, mainly by seeking the patronage of various transportation companies; a final proposal to establish Lake Tahoe as a national park is unsuccessful, given prior degradations by logging and over-commercialization; George Whittell acquires a continuous strip of property from the Bliss and Hobart estates that stretches from Crystal Bay south to Zephyr Cove; Federal and state agencies begin acquiring privately owned parcels and managing them for the public trust.

1931 Gaming becomes legal in Nevada, and a new growth industry takes off on the Nevada side of Lake Tahoe.

1935 An improved highway encircles Lake Tahoe; during the 1930s, the paving of highways 50, 89, 28, and 27 (now 431) opens up Lake Tahoe basin-wide.

1945 The name "Lake Tahoe" is officially designated.

1949 The Nevada and California legislatures pass laws prohibiting the discharge of wastes directly into Lake Tahoe or its tributary streams; on the California side, the Lahontan Regional Water Quality Control Board assumes regulatory responsibility.

1949 Ski lifts are operating at Granlibakken, and Meyers and Echo Summits.

1940s A renewed era of intense subdivision development begins after WWII; growing communities prompt the establishment of a number of independent utility companies to provide basic public infrastructure.

1950s By the 1950s building boom, discussions on water and sewage problems occupy more space in Tahoe's local newspapers; as development puts more pressure on the existing sewage disposal system, a temporary solution is found by spraying effluent directly onto the land; the gaming industry expands at Lake Tahoe.

1950 The Tahoe Realty Board is established to standardize building codes around the lake.

1955 The Joint California-Nevada Interstate Compact Commission is formed, working together to produce a draft interstate compact for consideration by each state's legislature in 1968.

1956 Heavenly Valley Ski Resort opens.

1958 A bill introduced in the state legislature to relocate the highway above Emerald Bay by constructing a bridge over the mouth of the bay is defeated by conservation interests.

1959 Limnological measurements on Lake Tahoe begin.

1960s Major subdivisions are developed, especially at Tahoe's south shore (Tahoe Paradise, Golden Bear, and Meadow Lakes), and summer homes are converted to permanent residences; between 1960 and 1980, housing in the Tahoe basin

increases from 500 to 19,000 homes, with many developments built on converted wetlands; planners talk in terms of a "saturation population," expected to occur in about 2010, when all useable land is occupied and no new growth can occur.

1960 The Squaw Valley Winter Olympics provoke growth in the Lake Tahoe basin and firmly establish Lake Tahoe as a year-round resort destination.

1962 Scientists, using an eight-inch secchi disc and a hydrophotometer, find that the disc is discernible in Lake Tahoe at a depth of 136 feet and light is detectable at 500 feet.

1963 The first significant, multidisciplinary scientific assessment of the entire Lake Tahoe basin ecosystem is completed by LTAC; the TRG publishes the first of many reports on lake limnology; air quality monitoring begins.

1964 Interstate 80 opens and facilitates year-round access to the Lake Tahoe basin.

1965 South Lake Tahoe incorporates as a city.

1967 Awaiting approval of TRPA, California creates the California Tahoe Regional Planning Agency (CTRPA) as a "watchdog" organization.

1968 Sewage is exported from the Lake Tahoe basin; by 1975 almost all wastewater is transported outside the basin; resolution of sewage problems allows for more land development.

1968 The Joint California-Nevada Interstate Compact Commission creates TRPA to oversee land-use planning and environmental issues within the Lake Tahoe basin.

1969 The Lake Tahoe Regional Planning Compact is adopted; under the compact, city, county, state, and federal governments collectively address land use planning, environmental regulation, and ecosystem restoration and monitoring.

1969 In a repeat test, the secchi disc is visible at 100 feet, a loss of 36 feet of visibility in seven years (equating to an annual four percent reduction in the clarity of the lake's waters); the National Environmental Protection Act (NEPA) is passed, establishing the United States Environmental Protection Agency (USEPA) and requiring that Environmental Assessments (Eas) and Environmental Impact Statements (EISs) be undertaken for major construction projects.

1970s New rates of sediment deposition into Lake Tahoe are found to increase four times over predisturbance rates; an era of systematic scientific research of the Lake Tahoe basin ecosystem begins; it is marked by collaboration among university, agency, and independent scientists that continues to the present day.

1970 49,000 subdivided lots and hundreds of miles of roads exist in the Tahoe basin; the last of the major subdivisions are developed at Incline Village and Glenbrook.

1972 The Clean Water Act is passed, based on the 1965 Water Quality Act.

1973 The Endangered Species Act (ESA) is passed, superseding and strengthening the Endangered Species Preservation Act of 1966 and the Endangered Species Conservation Act of 1969; the Lake Tahoe Basin Management Unit (LTBMU) is created to administer portions of three adjoining national forests in the Tahoe basin as a single entity.

1974 CTRPA proposes temporary construction restrictions on the California side of the lake until the completion of its master plan; building permits are drawn by lot by a blindfolded Catholic priest; in a storm of protest, hearings on building permits require monitoring by police.

1980s The acquisition of additional public lands and restoration of their natural environments becomes an important resource management strategy in the Tahoe basin; heightened research expands programs monitoring environmental conditions in the Lake Tahoe basin; a repeat test using the secchi is visible at 75 feet, a loss of 61 feet in about two decades.

1980 President Jimmy Carter creates the Lake Tahoe Federal Coordinating Council (LTFCC) to address environmental problems at the lake.

1981 After his landslide victory, President Reagan quickly rescinds the order creating the LTFCC.

1982 CTRPA is phased out upon the adoption of ordinances to revamp TRPA's governing body and to implement a new regional

plan with stronger environmental controls.

1982 TRPA establishes thresholds for the basin's natural resources and enacts a code of ordinance to regulate all land use activities here; thresholds are subject to periodic review.

1985 to 1987 Under TRPA leadership, the Consensus Building Workshop brings together stakeholders who have been battling over resource conservation/development issues for years; the workshop creates new options and produces innovative programs for managing lands in the Tahoe basin.

Early 1990s Tahoe Truckee Regional Economic Coalition (TTREC) is formed to monitor social and economic trends and to plan regionally for economic change.

1990 An exchange program between students and scientists working at Lake Tahoe and at Siberia's Lake Baikal (the largest and deepest freshwater lake in the world) is established; native peoples—the Washoe at Tahoe and the Buryat at Baikal—participate in the cultural exchange, with shared goals of reestablishing a presence on traditional lands.

1996 Public ownership stands at 85 percent of the 202,250 acre landbase, with 77 percent under federal jurisdiction; approximately 68 percent of the total land area is forested with dense, second-growth stands, generally lacking in diversity; up to 15 percent of the land is developed with residential/commercial buildings; 75 percent of marshes and 50 percent of meadows have been degraded; several plant and animal species have become endangered or extinct; the introduction of exotic or invader species has negatively affected surviving native communities; Lake Tahoe is the single most important recreation component of the Sierra Nevada economy; the Lake Tahoe basin registers over 52,600 residents and supports a $1 billion economy employing more than 20,000 people; an estimated 200,000 tourists visit on peak holidays, with visitor days estimated to exceed 23 million annually; the recreation industry includes over 30 ski areas, water- and land-based attractions, and a large gaming establishment; with a $1 billion recreation-based economy, the importance of maintaining a healthy natural environment is widely acknowledged; the *Sierra Nevada Ecosystem Project* (SNEP) is released—a study and assessment commissioned by the US Congress and funded ($6.3 million) by the USFS; the 3,200-page study, written by 107 scientists—to aid policy-makers planning for the future of the Sierra Nevada.

1997 (July) At the request of Nevada Senator Harry Reid in 1996, President Clinton convenes a federal conference on issues surrounding the environmental condition and degradation of Lake Tahoe; President Clinton praises the Washoe for their long stewardship in the Tahoe basin; the Washoe Tribe asks that all people who now share, live upon, or use their ancestral resources be responsible as guardians of these traditional lands, just as the Washoe have been for thousands of years.

1998 Federal funding is allocated for a multidisciplinary and interagency watershed assessment study entitled, *Institutional Assessment of the Lake Tahoe Basin*; the purpose of the assessment is to provide a means for achieving a desired future for the Lake Tahoe basin ecosystem by integrating available data regarding its physical, biological, and socio-cultural components.

Time Line of Human Land Use and Environmental Conditions in Lake Tahoe Basin

Logging

1859 to 1870s Limited logging of easily accessible stands in Lake Valley for local consumption.

1861 Small-scale lumbering and fluming operations begin at Glenbrook by Augustus Pray and the Lake Bigler Lumber Company; initial operation produces 10,000 board feet a day and shingles; Samuel Clemens (Mark Twain) stakes a timber claim nearby then watches as it goes up in smoke after his unattended campfire burns out of control.

1861 to 1873 Spooner Summit is worked by a number of small-scale logging and fluming enterprises; the most accessible stands are harvested during these early years due to limitations of log transport.

1860s to 1870s Small-scale independent cutting of easily attainable timber around Edgewood.

1863 to 1877 Small-scale cutting of easily accessible stands up Ward Canyon under wood contract to CTLFC.

1864 to 1878 Small-scale cutting of reachable timber by independent wood contractors around Agate Bay for local/regional consumption.

1867 to 1875 Independent cutting of accessible land around McKinney Bay and Sugar Pine Point.

1875 to Early 1880s Cutting around McKinney Bay and Sugar Pine Point by a number of wood cutters under contract to CTLFC.

1871 Establishment of saw mill near Daggett Pass.

1873 to 1897 With headquarters at Glenbrook, the CTLFC emerges as the chief lumber operator, monopolizing the Comstock trade with large timber holdings that reach basin-wide; as companion organizations, the CTLFC works closely together with the rather shadowy EDWLC in logging their lands and later in marketing and leasing their respective holdings; from 1873 until 1897, CTLFC operates a "super-system" of rafting operations, railroads, V-flumes, wagon and skid roads, wood camps, and saw mills; lumber is hauled to Spooner Summit by railroad and flumed down to storage yards near Carson City for transport by the VTRR; CTLFC eventually comes to control approximately one-fifth of the Tahoe basin's land area, including substantial stretches of lakefront; when operations cease in 1898, the CTLFC had cut 750 million board feet of lumber and 500,000 cords of wood in the Tahoe basin.

Mid- to Late 1870s Stands around White Hill (Spooner Summit) cutover by CTLFC.

1875 to 1885 M. C. Gardner railroad logging operations between Camp Richardson and Tahoe Mt. (east of Fallen Leaf Lake) under contract to CTLFC.

1877 Cutting under contract to CTLFC up Ward Creek Canyon.

1878 Initial cutting on Agate Bay by wood contractors for CTLFC.

1878 to 1884 Meeks Bay is hub of CTLFC west shore logging and rafting operations centered around Sugar Pine Point, Meeks Canyon, and Rubicon.

1878 to 1897 SNWLC, the second largest lumbering and fluming outfit in the Tahoe basin, commences operations in the northeastern quadrant of the basin; the SNWLC also does considerable cutting in the southeastern quadrant of the basin; in partnership with its land-holding subsidiary, NLC; SNWLC owns 55,000 acres in the basin, about 43,000 acres are logged in Washoe and Douglas counties, with the remaining 12,000 acres in Placer County being traded away to the TLC after SNWLC cutting ceases in the basin; the company operates a logging complex, which includes a narrow-gauge railroad, rafting on Lake Tahoe, an inclined tramway, V-flumes, wagon haul roads, wood camps, and a mill at Incline.

1880 Along Tahoe's east shore, 10 primary V-flumes are sending 33,300,000 board feet of timber annually to storage yards on the other side of the Carson Range; this major network is fed water and wood from many miles of secondary V-flumes, U-flumes and box flumes; lands owned by EDWLC in the vicinity of Kingsbury are cutover.

1881 Cutting around Agate Bay under contract to SNWLC; Tahoe Vista marine terminal for SNWLC.

Early 1880s Choicest and most easily accessible lumber is cut over around McKinney Bay and Sugar Pine Point.

1880s Cutting of accessible stands around Tahoe City.

Mid-1880s Stands along South Camp Peak (upper Logan House/Lincoln Creeks) are cutover by CTLFC; timber along Kingsbury Grade is cut under contract to SNWLC.

1884 Choicest and most easily accessible lumber is cut over between Meeks and Rubicon bays; Dollar Point is logged under contract to CTLFC.

1885 Stands in Slaughter House Canyon are cutover by CTLFC; cutting ends around Tahoe Mt.; Gardner goes bankrupt and salvages railroad to CTLFC.

1885 C. W. Chubbuck begins railroad logging operations up Cold Creek (Lake Valley) under contract to the CTLFC.

1886 Chubbuck goes bankrupt and sells railroad in Lake Valley to CTLFC, to be incorporated into the LVRR.

1887 to 1897 CTLFC conducts large-scale cutting in Lake Valley with their LVRR and LVF.

Late 1880s to 1890 Stands in lower reaches of Logan House Creek are cut over by CTLFC.

1890 Logging up Blackwood Canyon conducted under contract to CTLFC; red fir is harvested near Stanford Rock.

Ca. 1890 CTLFC acquires 8,000 acres around Daggett Pass from SNWLC/NLC; subsequent logging by CTLFC is probable.

1897 SNWLC/NLC ends logging operations in the Tahoe basin; CTLFC/EDWLC shuts down their Glenbrook mills and end cutting in the Tahoe basin.

1898 The Lake Tahoe basin is stripped of marketable timber, and large-scale cutting ceases; logging railroads are salvaged, and capital and energy are funneled into a growing tourist industry; approximately two-thirds of all marketable timber in the Tahoe basin has been harvested by this time, with 60 percent of the Lake Tahoe watershed clearcut, remaining land is largely alpine, barren, or inaccessible.

1903 to 1907 TLC builds logging railroad up Ward Canyon and intensively logs area.

1910s A resurgence of logging commences after construction of FPPC mill in 1901; fir stands, ignored during Comstock-era lumbering, are targeted, especially those along Tahoe's north and northwest shores.

1912 to 1914 FPPC logs fir stands on TLC land in Burton Creek watershed (north of Tahoe City).

1911 to 1958 C. G. Celio & Sons operate local lumber mill, with cutting around Meyers.

1920s to 1927 Small shingle mill is established on Griff Creek.

1927 to 1933 Small saw mill operates on Burton Creek, cutting 240 surrounding acres.

1946 Small-scale logging by Placerville Lumber Company occurs in upper Trout Creek.

1947 Fibreboard logs lands near the mouth of Watson Creek (Carnelian Bay).

1960s Logging continues in the Tahoe basin (especially on private lands on the north shore) but on much reduced scale.

1980s to 1990s Modern logging is limited to fuelwood and saw log sales aimed at fire and vegetation management along Tahoe's north and south shores; stands on east shore are not reentered until insect salvage operations in the mid-1990s.

1990s Sustained drought subjects timber stands to severe insect attacks; by 1991 an estimated 300 million board feet of timber are dead or dying; salvage logging begins on the east, north, and southwest sides of the lake; thinning, prescribed burns, and mechanical brush treatments are implemented to reduce fuel loads and to restore forest health.

Fishing

1854 Washoe spear and net hundreds of trout in Lake Valley and try to prevent Euro-Americans from fishing; several Washoe place names incorporate the words "trout" or "whitefish" or "fish", suggesting their abundance and cultural importance.

1859 onset of commercial fishing on Lake Tahoe when the "Fishery" is established near the mouth of the Upper Truckee River.

1862 William W. Lapham's "Fish Market Landing" is established at Stateline; Burke and Company use a half-mile seine to take tons of Tahoe trout daily from the area between Bijou and Round Hill.

1863 W.H. Brewer, member of the California State Geological Survey, is amazed at the 20-30 pound trout in Lake Tahoe; Tahoe's is characterized as a "piscatorial bonanza" and until the 1920s, the size and abundance of Tahoe trout and fantastic catch records are consistently reported.

1864 Attempt to halt the wholesale slaughter of fish with the enactment of a law forbidding "whites" to take fish between 10/15 and 4/1, with open season fishing confined to hook and line; Washoe are immune to state laws and continue to fish as "fronts" for a growing commercial industry.

1868 Pringle and Hurley establish "Lake Fishery" hatchery at Tahoe City to exploit Tahoe's Lahontan cutthroat trout.

late 1860s Legislation is enacted by the

Nevada Territorial Legislature in an effort to control over-fishing and the pollution and obstruction of streams.

1870s Twenty-five commercial operators fish Tahoe; tons of Tahoe trout are shipped east and west out of Truckee in iced railroad cars.

1870s Additional legislation is enacted to control over-fishing and the pollution or obstruction of streams from logging and fluming activities.

1880s Non-native brook trout are planted in Marlette Lake and fish are used to stock surrounding alpine lakes; trout in Marlette Lake become so plentiful that suckers are planted to eat the eastern brook's spawn, after which time the suckers have to be removed; lumber mill ponds are used, not only to store logs, but to raise trout to meet the demands of sportsmen and commercial suppliers' more earnest attempts are made to legislate over-fishing and the pollution or obstruction of streams from logging and fluming activities.

1880 70,000 pounds of Tahoe trout are shipped by railroad; wagon loads weighing from one to two thousand pounds each are marketed on the Comstock.

1887 First planting in the region occurs as Gilmore Lake is planted with game fish.

1887 Mackinaw trout are introduced into Lake Tahoe, with subsequent plantings in the later 1880s and 1890s; with the extinction of Tahoe's Lahontan cutthroat trout, the Mackinaw will become the most important sport fish

1889 further regulatory legislation is passed to protect the fishery by prohibiting sawdust dumping.

1891-1893 Non-native brook trout are planted in Lake Tahoe.

1895 Mackinaw fingerlings are introduced into lakes above Meeks Bay.

1896-1910 A commercial fishing outfit bases out of Carnelian Bay.

1900 Even after logging, Upper Truckee River abounds with whitefish and remains a popular Washoe fishing stream.

1904 Eighty commercial fishing boats are operating on Tahoe.

1917 The California legislature bans commercial fishing at Tahoe to protect the endangered Lahontan cutthroat trout.

1920s Mackinaw trout have migrated down from the lakes above Meeks Bay and are now established in Lake Tahoe.

1922-1928 The extinction of Lake Tahoe's Lahontan cutthroat trout takes place during this period—extinction is a result of decades of over-fishing, habitat pollution, obstruction of spawning runs, and introduction of non-native species.

1938-1944 During this time the Pyramid Lake Lahontan cutthroat trout also becomes extinct; both Tahoe and Pyramid Lake strains of trout have survived in these lakes for over 10,000 years; both have become extinct in a matter of decades.

1944 Over 14 million non-native fish are planted in the lake from 1944 to about 1960; Kokanee salmon are introduced to Lake Tahoe; the Heenan Lake strain of Lahontan cutthroat trout are introduced annually in Taylor Creek and the Upper Truckee River from 1956 through 1964.

Water Management

1865 Alexis von Schmidt initiates the first major controversy over Tahoe water with his plans to supply San Francisco by diverting water down the Truckee River near Squaw Valley and via tunnel through the divide above the North Fork of the American River.

1870 To further his water scheme, Alexis von Schmidt acquires land at the lake's outlet and constructs a small dam.

1871 von Schmidt's scheme fails, as legal suits over Lake Tahoe water rights are threatened.

1876 To meet the growing needs of the Comstock, the VGHWC draws water from Marlette Lake; this water is flumed through Tahoe's eastern divide via tunnel and piped down to Virginia City; predecessor to PG&E constructs a tunnel through Tahoe's western divide and diverts the waters of Echo Lake into the American River Basin.

1877 VGHWC raises the level of Marlette Reservoir to 37 feet, doubling its capacity to supply water to Virginia City.

Ca. 1877 Construction of the North Flume by the VGHWC augments water supply to Virginia

City; the flume taps Third Creek and all intervening drainages in Tahoe's northeast quadrant, south to a tunnel through Tahoe's eastern divide on Tunnel Creek; the flume is in year round operation until ca. 1950s.

1880 Francis G. Newlands targets Lake Tahoe as part of a network of proposed reservoirs in the Sierra Nevada to serve future development in Nevada.

1887 A third parallel water pipe taps the waters of Marlette Lake to serve growing municipal and mining water needs of the Comstock; Nevada and Lake Tahoe Water and Manufacturing Company unsuccessfully propose a four-mile water diversion tunnel through the Carson Range to divert Tahoe water into the Carson Valley.

1900 Californians renew interest in capturing Lake Tahoe as a water supply; plans are stopped, not only by the formidable engineering requirements, but by strong opposition from Nevadans.

1901 James E. Church begins studies and measurements of snowpack water content on Mt. Rose's summit, thereby pioneering the science of snow surveying.

1902 Congress commits to the construction of irrigation projects in the west with the passage of the National Reclamation Act and creation of the USRS (later renamed USBOR).

1902 USRS opens negotiations for the purchase of the Lake Tahoe Dam at Tahoe City from the DBLC; downstream power companies have previously entered into purchase negotiations with the DBLC; TRGEC (predecessor to SPPC) buys the Lake Tahoe Dam including 54 acres of land surrounding the outlet and negotiates rates with four industrial consumers of water power downstream.

1907 (July 14-18) Lake Tahoe attains its highest recorded lake surface level at 6231.26 feet (11.00 feet MSL above its lowest recorded surface level of 6220.26 feet MSL, recorded on November 30, 1992).

1909 Tahoe lakeshore property owners oppose another unsuccessful tunnel scheme plans to take water eastward from Lake Tahoe and store it in a large reservoir to be constructed at Washoe Lake; flows would be diverted down Steamboat Creek (a tributary of the Truckee River) and water would be available to farmers in the lower Carson River Basin.

1912 during an extreme drought, an attempt by the USRS and the TRGEC to dredge the Truckee River channel at Tahoe City and cut down its rim is blocked by lakeshore property owners through a court injunction.

1913 The USRS and TRGEC replace the old rock-filled timber crib dam at Tahoe City (originally constructed by the DLBC in 1870) with a concrete slab and buttress structure containing 17 vertical gates; the new dam is located 400 feet downstream from the lake's natural rim.

1915 USRS assumes full control of the Lake Tahoe Dam, along with 14 acres of adjoining property at the outlet; all water rights, not appropriated by downstream power companies (up to the top four feet), are allocated to the federal government.

1919 The Truckee-Carson Irrigation Project is officially renamed the Newlands (Irrigation) Project, in honor of Nevada Senator Francis G. Newlands.

1924 Drought drives downstream farmers to persuade Lake Tahoe property owners to allow the lake to be pumped when it falls below its natural rim.

1928 The Truckee River Basin experiences the beginning of a severe drought; lasting from 1928 through 1935, this drought would not be exceeded in severity until the 1987-1994 drought.

1930 Drought-stricken downstream water interests start digging a diversion trench at Tahoe's rim (with plans to dynamite the dam itself) but are stopped by a court injunction obtained by Lake Tahoe property owners.

1935 The Truckee River Agreement for the conservation and control of the Truckee River drainage basin establishes conditions under which water can be taken from Lake Tahoe when it falls below its natural rim; water is to be stored in the top 6.1 feet (established at between 6223.0 to 6229.1 feet MSL), thereby creating a storage capacity of approximately 744,600 acre-feet.

1950s The North Flume, in operation on Tahoe's northeast shore since the 1870s, is abandoned; deep erosion scars created by flume

wash-outs are still clearly visible on Incline Mountain.

1954 The U.S. Army Corps of Engineers makes stream improvements on the Truckee River, enlarging the channel from the Lake Tahoe Dam downstream.

1959 Radiocarbon is used to measure algal primary productivity in Lake Tahoe and other aquatic ecosystems.

1964 Algal bioassay experiments are used to evaluate effect of nutrient pollution on Lake Tahoe.

1967 Warnings about accelerated eutrophication as the "Bad News from Lake Tahoe" written by Charles Goldman for the non-technical public in the publication, *Cry California*.

1968 A formal compact between Nevada and California guaranteed more than two-thirds of Tahoe's surplus water for large-scale development at the lake, with Nevada gaining surplus water for irrigation from the Truckee, Carson and Walker rivers; the compact ignored the rights of Pyramid Lake Paiute and threatened the ecological health of Pyramid Lake.

1969 Review of limnological and primary productivity studies at Lake Tahoe.

1970 Beginning of extensive series of studies on the distribution, production and ecology of crayfish in Lake Tahoe.

1971 Signing of the California-Nevada Interstate Compact allocates Lake Tahoe's waters and apportions Truckee River water between the two states; role of trace nutrients (e.g., iron) in limiting primary productivity are studied

1972 Ecophysiology of bacterial populations in Lake Tahoe stimulated by siltation; surface sediments on the bottom of the lake are characterized; deep living phytoplankton populations in the lake are first studied; the concept of the lake microcosm, an ecosystem out of balance, continues to be presented.

1973 First detailed investigation of optical properties and color of Lake Tahoe; report of lake mounds in Tahoe; remote sensing of sediment plumes from the Upper Truckee River; first linkage to saving Lake Tahoe and Lake Baikal; association between bacteria, fungi, the decomposition of organic matter and nutrient recycling in large, deep lakes is demonstrated.

1974 Publication of "Eutrophication of Lake Tahoe Emphasizing Water Quality" provides early example of applied and integrated limnological research.

1975 Primary productivity of Lake Tahoe's nearshore regions examined; public education regarding the danger signs for Tahoe's future as the decline in air and water quality continues; use of lake nitrate concentration as an indicator of deep mixing is first reported; the effects of kokanee salmon on stream ecology are considered; sewage effluent spraying near a south shore tributary are found in discharge flow to Lake Tahoe; long-term changes in the primary productivity of Lake Tahoe are brought to light; the first evidence for a significant change in Lake Tahoe's zooplankton structure following the introduction of the opossum shrimp, *Mysis relicta* is found.

1976 The influence of sediment inflow on phytoplankton primary productivity is observed; nitrogen fixation associated with terrestrial vegetation in Ward Valley is measured; nitrogen uptake and release in the Lake Tahoe basin forested watershed is studied.

1977 Tritium is used as a tracer to study lake mixing.

1978 Study of nutrient limitation using natural phytoplankton populations; trophic status and nutrient loading for Lake Tahoe is reviewed; the impact of kokanee and opossum shrimp introductions of Lake Tahoe biological ecology is assessed; an extensive series of projects on zooplankton ecology are initiated.

1979 Water and nutrient transport via groundwater from Ward Valley into Lake Tahoe are assessed; energy and water budgets for Lake Tahoe are developed; monograph is published on nutrient transport in surface runoff from the Ward Creek watershed.

1980 Detailed studies of attached algal growth along the shoreline of Lake Tahoe begin; evidence is found for algal heterotrophy and ecological implications for deep living phytoplankton; first LTIMP report is published.

1981 Chemical allelopathy is found in aquatic systems; two decades of change in Lake Tahoe are reviewed.

1982 Environmental factors affecting Lake

Tahoe zooplankton are studies; the importance of deep mixing to the nutrient budget of Lake Tahoe's surface waters is realized.

1983 Factors regulating stream water chemistry in subalpine environments are assessed, as are the role of deep mixing in internal nutrient loading and algal growth, the importance of atmospheric deposition in nutrient loading to lakes, and the role of benthic nitrogen fixation in Lake Tahoe.

1984 Recent sedimentation is associated with the fertility of Lake Tahoe; initial paleolimnological studies begin; zooplankter *Daphnia* returns to Lake Tahoe; the ecology of deep chlorophyll and patterns of precipitation, climate and primary productivity over decadal time scales are considered.

1985 Investigations of *Mysis* and zooplankton ecology and attached algal growth and distribution continue; long-term data sets are used in limnology.

1986 The first five years of LTIMP sampling and Lake Tahoe's response to long-term nutrient loading are reviewed.

1987 The dynamics of the deep chlorophyll layer in Lake Tahoe are studied; the urbanization of Lake Tahoe basin becomes a microcosm for the study of environmental change with continuing development.

1988 Food resources and zooplankton populations in Lake Tahoe are studied, along with the integrated analysis of the onset of cultural eutrophication on Lake Tahoe.

1989 The relationship between land-use and tributary water quality is assessed, as is the importance of meteorological forcing in explaining interannual fluctuations in primary production; studies of the Lake Tahoe fish community structure begins.

1990 Changes in phytoplankton community structure are recognized; deep mixing and annual productivity and forest fires, atmospheric deposition and primary productivity are related; the importance of long-term research in ecological management is emphasized.

1991 Increased precipitation acidity at Tahoe is detected; the 25-year history of mysids and lake trout of Lake Tahoe is reviewed; the ecology of the littoral zone fish community is studied.

1992 Studies concern the sources of variability in the primary productivity record at Lake Tahoe, the surface runoff water quality and the effects of BMPs, the use of wetlands for water treatment, and lake trout spawning in Tahoe.

1993 Nitrate transport is found in Tahoe tributaries; long-term change is documented in algal nutrient bioassay experiments; the linkage between the conservation of Lake Tahoe and Baikal is revisited.

1994 Long-term atmospheric deposition data is analyzed in relation to Tahoe's nutrient budget; the timing, distribution and abundance of kokanee spawning in a Lake Tahoe tributary is studied; the effects of shoreline structures are assessed in relation to the summer habitat use by littoral-zone fishes in Lake Tahoe; trophic interactions and population dynamics of lake trout and kokanee salmon are studied.

1995 Long-term changes in Lake Tahoe nutrient chemistry are analyzed.

1996 Spawning of shorezone fisheries and water quality impacts of marina dredging are investigated; the concept of a lake clarity model is introduced.

1997 Nutrient limitation becomes a determinant of watershed management strategy; phosphorous loading to Lake Tahoe from tributary inflow using LTIMP data base is analyzed and biologically available phosphorus is investigated.

1998 Water quality, watercraft use and ecotoxicology issues are integrated; a whole-lake nutrient budget with inputs and losses is developed; paleolimnological study of Lake Tahoe emphasizes land disturbance, changes in sedimentation and recovery.

1998 Bottom of Lake Tahoe is mapped by USGS (excluding the nearshore zone).

1999 Historical water clarity data from 1967-1996 are analyzed.

Grazing

Mid-1850s to 1860s Markets created by teamsters traveling through Lake Valley prompt the development of seasonal farming and ranching; meadowlands are quickly preempted (usually in units of 160 to 320 acres).

1860s During this early period most dairying and ranching co-occurs with budding

settlements in Lake Valley, Tahoe City, Kings Beach, Glenbrook, and Edgewood.

1860s to 1870s Sheep bands are moved from western foothills into the high Sierra over Tahoe's western divide into Glen Alpine, Meeks, McKinneys, and Blackwood creeks watersheds and over Tahoe's northern divide into the Tahoe City, Burton and Griff creeks watersheds.

1870s At least 13 commercial dairies are in operation, producing butter and milk for both local consumption and export; during the early Comstock era, commercial hay production reaches over 800 tons annually.

1900s to 1930s With the demise of logging, cut-over lands along Tahoe's south, north and east shores are sold to ranchers for grazing; lake lands generally support cattle; high meadows are used for sheep; bands are large, 1000 at a minimum, and most herds number an average of 1000 to 1500 ewes; the earliest recorded aspen carvings documenting Basque shepherds in the Tahoe basin date from 1899; most aspen art dates during the 1920s-1930s and into the 1950s, indicating grazing activities to be most intense during this period.

1900 Sudworth observes that sheep grazing occurs basin wide, with some areas denuded of grass and shrubs.

1930s Grazing in the Tahoe basin is restricted to allotments assigned to individual permittees in an effort to control overuse by regulating the timing and location of herds.

Time Line of Human Land Use and Environmental Conditions, Upper Truckee River/Trout/Saxon/Heavenly Valley Creeks Watersheds (Lake Valley) T12N/R18E

Paleoenvironmental Sites

Pollen Records: Osgood Swamp (Adam 1964a, 1964b, 1965a, 1965b, 1967, 1973, 1974); Meyers Grade Marsh and Grass Lake (Dorland 1980); Ralston Ridge (Sercelj and Adam 1975)

Recorded Archaeological Sites

63 prehistoric sites: Upper Truckee River = 46; Trout Creek = 12 ; Saxon Creek = 4; Heavenly Valley Creek = 1

70 historic sites; one railroad logging system totaling about 13 miles of grade and 16 miles of wagon haul roads and a two-mile V-flume; many miles of transportation routes

Native American Use

da'ow ("the lake")—Washoe place name for Lake Tahoe

mes a—Washoe place name for Lake Valley

Washoe camp one mile north of Meyers along the Upper Truckee River; minnows and suckers are caught here and bears are a problem; bedrock mortars in the vicinity.

Washoe camp is on west side of Upper Truckee River, west of Big Meadows; many fish traps are in the area.

gobiba—Washoe place name for Fountain Place (below Freel Peak); area is along prehistoric trail between Woodfords and Tahoe, up Willow Creek Canyon and down to Sierra House on Trout Creek.

mesuk wa't'a—Washoe place name for outlet of Echo Lake.

ImginwO'tha (*Imgi* "cutthroat trout" *wO'tha* "river")—Washoe name for camp 200 yards east of Upper Truckee River and one mile from the lake.

mesuk malam—Washoe place name for Upper Truckee/Trout Creek delta (swamp).

t'sigohu w'at'a—name for Washoe camp on Trout Creek tributary near Sierra House (Cold Creek).

MathOcahuwO'tha (*mathOcauwa'* "white fish" *wO'tha* "river")—name for fall camp on Trout Creek to catch whitefish and collect ripening berries.

dew'ltelgking ("sound made pestles pounding in mortars")—name for Washoe encampment east of Highway 50 on Trout Creek (on the old Johnson Ranch).

The James, a Washoe family, live on Trout Creek; Ben James works for Tallac Resort as a caretaker and backcountry horse guide and tends dairy and beef cattle around Taylor Creek.

In the Washoe Claims Case, Washoe consultants rank the Upper Truckee drainage, inclusive of Washoe Meadows (golf course) and the Meyers vicinity, as the number one resource area; this is entirely consistent with other Washoe testimony. This and the Taylor Creek drainage and

extensive wetland and meadow system at the south shore are acknowledged by all sources as particularly valued resource areas, as major fisheries, and as an extensive array of plant resources. Richard Barrington, a prominent Washoe witness for assessing resources within the aboriginal territory for the Washoe Land Claim, states in 1963 that the south shore was particularly noted for "wild potatoes" and "onions" (George Wright Papers), a position reiterated by recent testimony.

Out of a list of the 10 most desirable watersheds in descending order of resource value, Washoe testimony from the Washoe Land Claims Case ranks the Upper Truckee River as the most valued fishery in the Tahoe basin, with Trout Creek being sixth (Bender 1963 in George Wright papers).

1854 Washoe spear and net hundreds of trout in Lake Valley and try to prevent Euro-Americans from fishing.

1901 Washoe camp in Lower Lake Valley; Washoe camp behind Rowland's Lake House near the Lake House Road (photograph).

Ca. 1900s Historic Washoe camp east of Bijou (photograph).

Early 1910s Lewis Fillmore, a Washoe, is employed by Knox Johnson as caretaker at Sierra House; One Wolf, also a Washoe, works at Sierra House as a handyman and woodcutter.

Early 20th Century Washoe fish abundant whitefish populations in Trout Creek; even after logging, Upper Truckee River abounds with whitefish and remains a popular Washoe fishing stream.

1940 With the growing populations in Lake Valley, Washoe discontinue using Trout Creek area altogether.

Prehistory and Washoe History

10,000 to 7000 BP (Early Holocene) Climates warm and dry rapidly, causing glaciers to melt and Lake Lahontan to shrink; oldest human occupation of Tahoe region dates from 8000 to 9000 BP, with the initial influx of people soon after glacial retreat; sparse Pre-Archaic and Early Archaic populations engage in a foraging economy based on high residential mobility and large game hunting.

7000 to 4000 BP (Mid-Holocene) Much warmer and dryer period; desiccation of many lakes in the western Great Basin; Lake Tahoe and Pyramid Lake decline but are the only ones that do not dry up; ancient drowned forests at Tahoe date from between 6300 and 4800 BP, and submerged stumps stand rooted on the lake's floor up to 20 feet below its surface; Tahoe waters also conceal submerged archaeological features and inundate prehistoric living sites; prehistoric populations increasingly exert their influence in altering the landscape and affecting fauna and flora through a gradual decrease in overall mobility, greater land use diversity, a broadened diet, and intensified use of plant resources.

4000 to 1300 BP (Late Holocene) Pollen data indicate a shift from more xeric vegetation to the dominant conifer species that are present today; the record appears to be punctuated by alternating intervals of cool-moist and warm-dry periods; intensive Middle Archaic use of the Tahoe Sierra begins during this period, as mixed-mode foragers-collectors venture into the highlands on seasonal gathering, fishing, and hunting forays.

1300 BP to Historic Contact The period is marked by an overall xeric trend, punctuated by cool-moist periods alternating with periods of severe drought; such extreme climatic fluctuations may have allowed for year-round residence in the Tahoe highlands at some times and prohibited even seasonal occupation at other times; prehistoric populations continue to rise, as reflected in more intensive use of all parts of the Tahoe environment; this time is equated with the Late Archaic prehistoric period and the ethnographic Washoe; Lake Tahoe assumes the physical center of Washoe territory and the spiritual center of the Washoe world.

1848 Even after Euro-American "encroachment" (the legal term the federal government used to describe the process by which the Washoe gradually lost their territory since ca. 1848), the Washoe continue to trek to the lake to harvest plant resources, fish, and later work as domestic laborers and game guides for resorts.

1877 Washoe leaders make formal protest to government officials (including the President of the United States), complaining of the destruction of

their lands, for which title has never been extinguished by treaty; futile petitions, demands, and trips to Washington continued to the present.

1887 After passage of the General Allotment Act of 1887, unclaimed 160-acre plots are granted to individual Washoe; the Washoe petition lands around Lake Tahoe, but none are granted.

1917 The federal government purchases small tracks of land for the Washoe near Reno and Carson City, upon which many Washoe are obliged to settle; this, along with the active abolishment of certain Washoe land use traditions by Indian agents, further discourage Washoe presence in the Tahoe basin.

1945 The name "Tahoe," a popular historic misnomer derived from the Washoe word *da'ow* and signifying "lake," becomes the official designation.

1950s The 1950s mark a period of focused protest by the Washoe, who register their objections to the nontraditional usage of spiritual locales and the despoliation of ancestral resources within the Tahoe basin; modern laws and intolerance by Tahoe residents drastically limit Washoe access to the basin; nevertheless, Tahoe remains a compelling element in Washoe consciousness, and they continued to visit the lake where possible.

1951 The Washoe Tribe initiates a land claims case for compensation of lost homelands in and around the Tahoe basin.

1970 The land claims case initiated by the Washoe Tribe in 1951 is settled, awarding them $5 million of the $42.3 million requested as compensation for their lost homeland, amounting to 10,000 square miles and including Lake Tahoe at its center.

1990 An exchange program between students and scientists working at Lake Tahoe and at Siberia's Lake Baikal (the largest and deepest freshwater lake in the world) is established; native peoples—the Washoe at Tahoe and the Buryat at Baikal—participate in the cultural exchange, with shared goals of reestablishing a presence on traditional lands.

1994 The Washoe Tribal Council develops a comprehensive land use plan that includes goals of reestablishing a presence within the Lake Tahoe basin and revitalizing Washoe heritage and cultural knowledge, including the harvest and care of traditional plant resources and the protection of traditional properties within the cultural landscape.

1997 (July) At the request of Nevada Senator Harry Reid in 1996, President Clinton convenes a federal conference on issues surrounding the environmental condition and degradation of Lake Tahoe; members of the Washoe Tribe are represented on a presidential panel at this environmental summit; President Clinton praises the Washoe for their long stewardship in the Tahoe basin; in turn, the Washoe Tribe asks that all people who now share, live upon, or use their ancestral resources in the coming decades be responsible guardians of these traditional lands, just as the Washoe have been for thousands of years.

1997 In the wake of Clinton's visit to Lake Tahoe, a landmark agreement is signed between the Washoe Tribe and the USFS to return the use of more than 400 acres of land within the Tahoe basin to the tribe under a special use permit; Clinton is the sixth president since 1877 that the Washoe have petitioned to return their lands for traditional use; the Washoe aim to actively demonstrate their philosophy on resource stewardship and land restoration at Lake Tahoe; these reacquired areas will be used to reinstate ancestral land management practices and to return Indian people to their ancient homeland for cultural renewal.

Transportation and Community Development

1848 John Calhoun "Cock-Eye" Johnson opens route over Echo Summit and through lower Lake Valley (Highway 50/Pioneer Trail/Highway 19/207).

1851 Martin Smith is first Euro-American settler in Lake Valley.

1852 Emigrants camp in Lake Valley.

1854 Asa Hershel Hawley homesteads 160 acres in Lake Valley and pioneers new route into upper Lake Valley.

Luther's Pass is surveyed and Hawley's Grade is improved, syphoning traffic into Upper Lake Valley (Highway 89).

1859 Yank's Station is established; other

way stations are soon built along the new road through lower Lake Valley (Highway 50/Pioneer Trail).

1860 Pony Express route is designated through Lake Valley over Echo Summit and Daggett Pass (Highway 50/Pioneer Trail/Highway 19/207); this route is heavily used by passenger and freight wagon traffic en route to the Comstock during the early 1860s.

1861 Post office is established in Lake Valley.

1863 The new Lake Bigler (Tahoe) Wagon Road channels the flow of travel over Echo Pass and through the Tahoe basin, away from Kingsbury Grade and over Spooner Summit (Highway 50); this route is heavily used by passenger and freight wagon traffic en route to the Comstock during the early 1870s.

1898 A fire starts near Meyers in September and sweeps up the mountains to the east.

1903 A fire southeast of Bijou burns for more than three weeks.

1923 to 1924 To provide basic water and power utilities for growing communities, Tahoe Electric Power Company appropriates surplus waters on Cold Creek and at Star Lake.

1924 Frank Globin's Al Tahoe Hotel and Water Company develop three settling ponds on Cold Creek.

1952 to 1956 Al Tahoe Hotel and Water Company builds Lake Christopher as a reservoir and stocks it with fish.

1930s Meyers, Al Tahoe, and Bijou subdivisions are thriving.

1936 CTLFC/EDWFC trade away 8,000 acres to Eldorado National Forest.

1940s Highway 50 over Echo Summit and Highway 89 from Truckee to Tahoe City are improved all-weather roads with year-round maintenance.

1945 Aram Harootunian offers 670 lots at Al Tahoe.

1950s Expanded gaming industry at the lake.

1956 Heavenly Valley Ski Resort opens.

1960 Squaw Valley Winter Olympics.

1960s New subdivision developments (Tahoe Paradise, Golden Bear, and Meadow Lakes).

Logging

1859 to 1870s Small-scale logging to supply lumber for local settlers and way stations.

1859 Pixley's Mill on Heavenly Valley Creek (T12N/R18E/S3).

1860 Woodburn's Mill on Trout Creek (T12N/R18E/S15), with a daily output of between 6,000 and 10,000 board feet.

1873 Woodburn acquires 560-acre timber tract around his mill (T12N/R18E/S15).

1874 CTLFC/EDWFC begin acquiring timber tracts in Lake Valley.

1877 EDWFC is assessed on 8360 acres in T12N/R18E.

Early 1880s CTLFC owns 5960 acres in T12N/R18E.

1883 to 1895 CTLFC acquires 3800 acres in T12N/R18E.

1884 G. W. Chubbuck acquires 1,200 acres of timber land near Bijou and logs land for EDWFC.

1885 Chubbuck constructs a four-mile logging railroad from the lake up Cold Creek (financed by CTLFC and later incorporated into LVRR).

1886 Initial operations on CTLFC's LVRR.

1887 CTLFC commences logging with LVRR; key archaeological features of the railroad logging system recorded within T12N/R18E include a 13-mile railroad fed by 16 miles of wagon haul roads and one two-mile V-flume, along with at least 28 railroad/wood camps; historic roads have since eroded into trenches up to six feet deep.

1888 Woodburn owns 2,200 acres surrounding his mill in T12N/R18E/S15.

1888 Peak year for CTLFC saw log/cordwood production in Lake Valley, with a total of 1,027,753 board feet (BF).

First year for production figures for LVRR at 159,000 BF (15 percent of over one million BF total lumber shipped by CTLFC); LVF constructed by CTLFC up Cold Creek; first year for production figures for LVF at 180,000 BF (18 percent of total BF of lumber shipped by CTLFC).

1888 and 1895 Woodburn sells 2,200 acres to CTLFC.

1889 126,000 BF production for LVRR operation (14 percent of CTLFC total BF lumber shipped); 80,000 BF production for LVF operation (nine percent of total lumber shipped by CTLFC).

1890 184,000 BF production for LVRR (44 percent of total lumber shipped by CTLFC); 53,000 BF production for LVF (13 percent of total lumber shipped by CTLFC).

CTLFC assessed on 4680 acres in T12N/R18E.

1889 to 1891 Years of most intensive timber harvest in Lake Valley.

1893 Major LVRR expansion in T12N/R18E.

EDWFC assessed on 9100 acres in T12N/R18E.

1897 T12N/R18E (and Lake Valley in general) completely cutover.

1898 LVRR torn up and recycled as tourist railroad between Truckee and Tahoe City (LTRTCRR).

1911 C. G. Celio & Sons operate local lumber mill at Meyers and conduct small-scale logging.

1912 CTLFC taxed on 5,040 acres in T12N/R18E.

1915 to 1917 Celio cuts 500,000 feet annually.

1946 Small-scale logging by Placerville Lumber Company in upper Trout Creek.

1958 Celio ceases lumbering operations.

1955 to 1970s Timber stands along Trout Creek, upper Saxon Creek, and around Meyers are reentered; logging occurs on a fairly small scale.

1980s to 1990s Modern logging limited to fuelwood and saw log sales aimed at fire and vegetation management; (A comparison of modern log scaling records in T12N/R18E and those from 1887 indicate that the 1887 forest was once composed of Jeffrey pine/sugar pine/cedar; the forest is now dominated by Jeffrey pine/lodgepole pine/white fir/cedar. Historic log diameters, once up to 52 inches, are now about 30 inches, with average diameters of historic stands being 26.4 inches and modern stands 14 to 16 inches.)

Fishing

1859 Commercial fishing on Lake Tahoe dates to 1859, when the fishery is established near the mouth of the Upper Truckee River.

Ranching/Grazing

Mid-1850s to 1860s Markets created by teamsters traveling through Lake Valley prompt the development of seasonal farming and ranching; meadowlands are quickly preempted (usually in units of 160 to 320 acres).

1862 In the summer and fall of 1862, 400 tons of hay are cut in Lake Valley's meadowland.

1870 The "California Products of Agriculture" census shows that 228 tons of hay have been baled in the Lake Valley Township.

1875 C. F. McGlashan notes in his "Resources and Wonders of Tahoe" that Lake Valley is still mainly a "hay and dairy producing center, dotted with fertile ranches" and that Lake Valley ranchers contribute most of the 800 tons of hay cut along Tahoe's shoreline in 1875.

1880 A period correspondent reports that "the valley affords pasturage for 1800 cows."

1880s to 1890s Bartons graze dairy cattle on Barton Meadows (along the east of the Upper Truckee River near the lakeshore).

1900 Harry O. Comstock and Melville Lawrence graze cattle on Robert Woodburn's cutover timber holdings along Trout Creek.

1908 Chris and Knox Johnson run cattle on large tracts in Lake Valley; Johnsons own about 1,200 acres around Bijou Meadows (entailing an area from the radio towers near the South Tahoe Public Utilities District emergency water retention basin, down to Bijou); they lease other lands within a radius of Bijou and Lake Christopher and Fountain Place and Meyers.

1908 to 1950s Johnsons, Lake Valley's pioneer irrigators, develop a ditch system and a series of small dams on Trout, Cold, and Heavenly Valley creeks and water Bijou and Trout meadows during the summer; ditches loose about 50 percent of their water through the porous granitic soils.

Late 1910s to 1930s CTLFC sells 4,940 acres of cutover land to local ranchers for grazing.

1912 EDWFC leases 2,446 acres to Comstock and Lawrence for grazing.

1914 Some of Comstock and Lawrence's lands are acquired by rancher, John C. Scott.

1915 to 1916 Dresslers first use High Meadows as summer sheep grazing range; herds are driven up from Carson Valley via Highway 19/207, Highway 50, Pioneer Trail, and USFS 21N21 and driven back via Mott Canyon; Dresslers have no herdsman, so sheep wander onto adjoining grazing lands; subsequent owners of this land, the Trimmers, hold tighter controls on their herds.

1919 Scott acquires additional grazing land from the CTLFC in 1919; Scott also purchases Hiram Barton's holdings.

1922 and 1926 Bartons acquire grazing land from the CTLFC.

1922 Chris Johnson owns 2,470 acres of land; Knox Johnson's holdings total 1,167 acres.

1928 John E. Dunlap operates a diary ranch on a 1,600-acre tract of land purchased from the CTLFC on the west side of the Upper Truckee River floodplain in what is now Gardner (Tahoe) Mountain, Tahoe Island Park, Tahoe Keys, and Tamarack Subdivision.

1929 to 1933 Johnsons acquire additional grazing lands from the CTLFC; they lease other grazing lands from the CTLFC, which are later exchanged to Eldorado National Forest.

Time Line of Human Use and Environmental Conditions, Emerald Bay/Cascade and Fallen Leaf Lakes/Taylor Creeks Watersheds

Recorded Archaeological Sites

33 prehistoric sites: Emerald Bay = 1; Tallac Creek = 2; Taylor Creek = 30

30 historic sites; one railroad logging system, with six to 10 miles of grade and associated wagon haul roads and skids; a few miles of transportation routes

Native American Use

Washoe camp across the highway from Camp Richardson; the area contains a Washoe burial ground and bedrock mortars; camp abandoned ca 1940.

Washoe camp (bedrock mortars) on the beach at Tallac.

daugacacuwO'tha ("clear water river")—name for Washoe camp along Taylor Creek for spring/summer trout fishing and the collection of birds eggs in Taylor Creek Marsh.

Washoe camp (bedrock mortar) on west side of mid reaches of Taylor Creek.

dawgasa siw da'ow—Washoe place name for Fallen Leaf Lake.

debelelelek ("reddened or smeared red")—Washoe place name for "Little" Tallac Creek (where spiritual being was killed).

dEyEli'bukhwOnhu—Washoe fishing site at the mouth of Cascade Creek.

salita s ("sunshine coming in")—Washoe place name for Emerald Bay.

hoga da'ow—Washoe place name for Cascade Lake.

hoga or *dahoga ma'lam wa't'a*—Washoe place name for Cascade Creek.

Out of a list of the 10 most desirable watersheds in descending order of resource value, Washoe testimony from the Washoe Land Claims Case ranks Taylor Creek as the third most valued fishery in the Tahoe basin (Bender 1963 in George Wright papers).

The Taylor Creek drainage and extensive wetland and meadow system at the south shore are acknowledged by all sources as particularly valued resource areas and as major fisheries and for an extensive array of plant resources. Richard Barrington, a prominent Washoe witness for assessing resources within the aboriginal territory for the Washoe Land Claim, states in 1963 that the south shore was particularly noted for "wild potatoes" and "onions" (George Wright Papers), a position reiterated by recent testimony.

Transportation and Community Development

(Access to the area is primarily by boat until the completion of a road encircling the lake in 1925.)

1880s Emerald Bay is daily excursion spot for tourists.

1884 to 1947 Emerald Bay Resort (small-scale) developed.

1928 Mrs. L. J. Knight builds Vikingsholm.

1880 "Glen Alpine Tonic Water" commercially bottled and distributed statewide.

Logging

1872 M. C. Gardner acquires large timber holdings between Camp Richardson and Tahoe Mt.

1875 Gardner contracts to provide 60 million feet of logs to CTLFC and constructs a railroad.

1883 Gardner expands his logging railroad from six to 10 miles.

1885 Cutting ends around Tahoe Mt.; Gardner goes bankrupt and sells abandoned railroad to CTLFC as salvage.

Fishing

1887 Gilmore Lake is planted with game fish by Nathan Gilmore (first planting in the region).

1890s Tallac Fish Hatchery established at Baldwin Beach (mouth of Taylor Creek).

Grazing

1860s to 1870s Nathan B. Gilmore drives sheep from Placerville to summer pasturage at Glen Alpine.

Time Line of Human Land Use and Environmental Conditions, Meeks Creek Watershed/Meeks and Rubicon Bays

Recorded Archaeological Sites

6 prehistoric sites: Meeks Bay = 3; Rubicon Bay = 3

4 historic sites; no linear features

Native American Use

mugaulu'wO'tha—name for Washoe fish camp on Lonely Gulch; trout runs are brief and Washoe protect themselves and their catch from bears.

ma'yalawO'tha—name for Washoe midsummer camp on Meeks Creek below Highway 89 bridge to catch fish and gather berries and seeds; Meeks Creek known as a mineral springs; Washoe move their summer camps from Meeks Creek to McKinney Creek early 1900s.

wO'thanamIna—name for Washoe camp in Rubicon Bay (Paradise Flat).

ta gi—Washoe place name for Rubicon Creek.

Out of a list of the 10 most desirable watersheds in descending order of resource value, Washoe testimony from the Washoe Land Claims Case ranks Meeks Creek as the eighth most valued fishery in the Tahoe basin (Bender 1963 in George Wright papers).

Transportation and Community Development

(Access to the area is primarily by boat; access by road is limited until the completion of a road encircling the lake in 1925.)

1919 G. V. Kehlet develops Meeks Bay as a campground resort.

Logging

1878 Meeks Bay is the hub of CTLFC west shore logging and rafting operations centered around Sugar Pine Point, Meeks Canyon, and Rubicon Bay.

1884 The choicest and most easily accessible lumber is cutover.

Grazing

1862 Meeks and Company cut 25 tons of wild hay.

1878 G. T. and J. A. Murphy graze milk cows on the meadow.

1884 to 1919 Murphy Brothers expand their grazing operations and acquire 640 acres of cutover land from CTLFC and run dairy and beef cattle in Meeks Meadow for the next 35 years.

Time Line of Human Land Use and Environmental Conditions McKinney Creek Watershed (Homewood/Chambers/Sugar Pine PT)

Recorded Archaeological Sites

2 prehistoric sites: McKinney Creek = 1; Sugar Pine Point = 1

Native American Use

malka—Washoe place name for Homewood Canyon.

duku dawata ("loud creek, river")—Washoe place name for Madden Creek.

Washoe camp at Rubicon (mineral) Springs during their acorn trek westward.

dukhmI'ImwO'tha—name for Washoe fish camp on General Creek.

cu'wE'thUkhwO'tha (*cu'wE'thUkh* [service berry] *wO'tha* "river")—camp on McKinney Creek for fishing and collecting medicinal plants.

Out of a list of the 10 most desirable watersheds in descending order of resource value, Washoe testimony from the Washoe Land Claims Case ranks McKinney Creek as the seventh most valued fishery in the Tahoe basin, with General Creek at Sugar Pine Point being the ninth place holder (Bender 1963 in George Wright papers).

Transportation and Community Development

(Access to the area is primarily by boat; road access is limited until the completion of a road encircling the lake in 1925.)

1850s Georgetown-Lake Bigler Trail up McKinney Creek to Rubicon Springs and over divide to Georgetown.

1862 J. McKinney first settles here.

1860s McKinney's is the terminus of the trail from Georgetown, California; from here, travelers cross Lake Tahoe to Glenbrook Bay and proceed east to Virginia City.

1863 McKinney's Hunters Retreat is established, along with vegetable garden and dairy.

1887 Bellevue Hotel is built at Sugar Pine Point.

1894 Moana Villa Hotel is constructed at Homewood.

1910s Hotel Homewood is built at Homewood.

Logging

1867 to 1877 Agustus Colwell preempts 900 acres of timberland fronting on McKinney Bay (McKinney Creek south to Sugar Pine Point) and builds steam-powered saw mill; he leaves shoreline timber, instead cutting the southwest slopes of McKinney Creek Canyon, then east over the mountains toward Meeks Bay.

1875 to 1877 Colwell contracts for CTLFC on McKinney Creek and engages in small-scale cutting of most easily accessible timber stands.

1878 Nat Stein, Michele Spooner, and George W. Wiggins log Sugar Pine Point (probably under contract to CTLFC).

Early 1880s CTLFC booms 60,000 feet of sugar pine each week from Sugar Pine Point area.

1881 CTLFC plans to set up "Chinese Wood-Choppers" at Sugar Pine Point.

Grazing

1862 Burton and Company cut 75 tons of wild hay from a narrow strip flanking McKinney Creek.

Time Line of Human Land Use and Environmental Conditions, Blackwood Creek Watershed

Recorded Archaeological Sites

1 prehistoric site; (multiple bedrock mortar sites west of Barker Pass)

2 historic sites; no linear features

Native American Use

dawma lim ti yel ("large confluence")—Washoe place name for Blackwood Creek; Washoe camp is on the south side of a small hill north of Blackwood Creek; Washoe trap ground squirrels and marmots, gather berries and wild rhubarb, and fish; major trail up Blackwood Canyon to Georgetown.

Out of a list of the 10 most desirable watersheds in descending order of resource value, Washoe testimony from the Washoe Land Claims Case ranks Blackwood Creek as the second most valued fishery in the Tahoe basin (Bender 1963 in George Wright papers).

1860s H. C. Blackwood shoots a Washoe for setting a fish trap on creek.

Transportation and Community Development

(Access to the area is primarily by boat; road access is limited until the completion of a road encircling the lake in 1925.)

1880 McConnels run small resort ("Idlewild").

Logging

1880 Yerington et al. (i.e., CTLFC) purchase land at mouth of Blackwood Creek.

1890 Logger Winnie Smith runs two-mile long log chute up to Stanford Rock to harvest red fir

stand; logs are rafted to CTLFC's Glenbrook Mill.

Grazing

1863 H. C. Blackwood runs stock in the meadow.

1860s W. S. Cothrin pastures sheep in the back country.

1873 George Conners runs a sheep camp in the upper reaches of Blackwood Creek.

Time Line of Human Land Use and Environmental Conditions, Ward Creek Watershed

Recorded Archaeological Sites

12 prehistoric sites

4 historic sites; one four-mile railroad logging grade

Native American Use

daugaica—name for Washoe camp in the upper reaches of Ward Creek; "a few acorn trees grew here"; Washoe fish camp at the outlet of Ward Creek; bedrock mortar located farther upstream.

Out of a list of the 10 most desirable watersheds in descending order of resource value, Washoe testimony from the Washoe Land Claims Case ranks Ward Creek as the fourth most valued fishery in the Tahoe basin (Bender 1963 in George Wright papers).

Transportation and Community Development

(Access to the area is primarily by boat; road access is limited until the completion of a road encircling the lake in 1925.)

1961 Small-scale home site development in association with Alpine Meadows Ski Area.

Logging

1863-1870s Augustus and Rube Saxton Mill at mouth of canyon; small-scale cutting is all the way to Twin Peaks.

1877 Todman cuts on small-scale under contract for CTLFC.

1877 Giant forest fire destroys choice timber near the mill.

1903 to 1907 TLC builds logging railroad up Ward Canyon and more intensively logs area.

Grazing

1910 to 1940 watershed is grazed.

1920s to 1930s Most intense period of grazing in the headwaters.

Time Line of Human Land Use and Environmental Conditions Truckee River (Tahoe City)

Recorded Archaeological Sites

2 prehistoric sites

1 historic site

Native American Use

daubayOdu'E' ("running over")—Washoe camp on the hill overlooking the outlet; they fish and collect grasshoppers and swallow eggs at nearby Swallow's Cave.

Transportation and Community Development

1852 to 1855 Placer County Emigrant Road is established through the Truckee River Canyon and along Tahoe's north shore (Highway 89/Highway 28).

1860 Tahoe Truckee Toll Road is constructed through Truckee River Canyon (Highway 89).

1861 First log cabin built.

1863 Tahoe City townsite laid out.

1868 Tahoe City becomes official townsite and resort community.

1880s Tourism flourishes and resorts expand.

1901 Construction of LTRTCRR connecting Truckee and Tahoe City.

1901 to 1964 Tahoe Tavern operates as a major tourist landmark.

1924 Bittencourt Subdivision built.

1946 Fairway Subdivision built.

1947 Bunker Subdivision built.

1952 Lake Terrace Subdivision built.

Logging

1880 Tahoe City is a "medium large" logging camp.

1882 Logging contractor, Nat Stein, relocates his logging camp to Tahoe City.

Ca 1880s Davis and Notewares shingle mill is established.

1900 to 1909 TLC logs its lands, which are now accessible by the LTRTCRR.

1912 to 1914 FPPC contracts to log fir on 2,120 acres in Placer County belonging to the TLC (north of Tahoe City and belonging to the TLC).

Fishing

1868 Pringle and Hurley establish Lake Fishery hatchery at Tahoe City; they experiment with the introduction of nonnative species.

Grazing

1862 Wild timothy hay is harvested from meadows surrounding Tahoe City

Time Line of Human Land Use and Environmental Conditions, Burton Creek Watershed (Lake Forest)

Recorded Archaeological Sites

4 pre historic sites

2 historic sites within the watershed; few miles of transportation routes

Native American Use

wO'thanamIn—Washoe camp at mouth of Burton Creek where whitefish are taken and grasshoppers and tree-dwelling worms are collected in nearby meadows; the whitefish run here is earlier than on Trout Creek.

diphEhkwO'tha (*diphEkh* "white paint" *wO'tha* "river")—Washoe camp near the mouth of Burton Creek where they obtain fish, berries, and sunflower seeds.

Transportation and Community Development

1852 to 1855 Placer County Emigrant Road is established along Tahoe's north shore (Highway 28).

1859 Initial settlement and early tourist center at Burton's Island Farm (Lake Forest); vegetables are cultivated and timothy hay is harvested.

1863 35 tons of timothy hay are harvested at Burton Creek Meadows.

1930s Commercial development of Lake Forest.

Logging

1912 to 1914 FPPC contracts to log fir on 2,120 acres in Placer County belonging to the TLC; (A field inventory sample of historic cut stumps on a 10-acre plot within a 100 percent fir stand in the upper reaches of Burton Creek disclosed 17.4 stumps/acre with a 35-inch average diameter and a maximum diameter of 55 inches.)

1927 to 1933 R. H. Watson operates small sawmill on Burton Creek at half a million board feet annually; Watson cut second growth stands on 240 surrounding acres.

1992 USFS Twin Crags timber sale.

Grazing

1880s to 1910 Dairy operations in Antone Meadows.

Time Line of Human Land Use and Environmental Conditions Watson Creek Watershed (Carnelian Bay)

Recorded Archaeological Sites

29 prehistoric sites: National Register Prehistoric Watson Creek Basalt Quarry District = 28; Carnelian Canyon Creek = 1

15 historic sites; several miles of transportation routes

Native American Use

masundawO'tha (*masun* "slow" *wO'tha* "river")—Washoe camp on Watson Creek, up from the lake; groups might spend a whole summer to fish, hunt ground squirrels and marmots, and gather several kinds of seeds, mushrooms, locusts, and berries.

Transportation and Community Development

1852 to 1855 Placer County Emigrant Road established along Tahoe's north shore (Highway 28).

1873 Dr. Bourne's Hygienic Health Resort established.

1876 Settlement established at Carnelian Bay.

1880s James Cleland acquires Dr. Bourne's resort (71 acres in T16N/R17E/S22) and grows vegetables and bales timothy hay on meadowlands bordering Carnelian Canyon Creek.

1910 First subdivision established.

Logging

1874 CTLFC begins acquiring timber tracks.

1884 A. W. Pray, R. Saxton and J. Lubeck log Dollar Point (probably under contract to CTLFC).

1947 Fibreboard Products Inc. log T16N/R17E/S17,20,W_21.

1989 USFS Watson timber sale.

Fishing

1896 to 1910 Flick Brothers acquire Carnelian Bay land fronting the water and fish commercially.

Time Line of Human Land Use and Environmental Conditions, Griff Creek Watershed (Tahoe Vista/Kings Beach/Brockway)

Recorded Archaeological Sites

9 prehistoric sites within watershed: Griff Creek = 6; Tahoe Vista = 2; Brockway = 1

9 historic sites; several miles of transportation and logging roads

Native American Use

gumlE'phEl wO'tha—Washoe camp on Griff Creek; Washoe prohibited from placing fish traps.

lo om ("hot springs")—Washoe place name for Brockway Springs.

Transportation and Community Development

1852 to 1855 Placer County Emigrant Road (Highway 28) along north shore.

1869 Truckee-Hot Springs Road (Highway 267) between Truckee and Brockway.

Agate Bay

Early 1860s Temporary settlement to supply trout and wild hay to mining camps in Martis Valley.

1881 H. E. Casey (and others) logging under contract to CTLFC and SNWLC.

Tahoe Vista

1865 Pine Grove Station established by a wood contractor.

1880s Marine camp for saw log shipments to SNWLC at Sand Harbor; cordwood camp and shingle mill locale.

1911 Casino/hotel established.

1914 First subdivision built.

Kings Beach

1864 Wiggins Station established by wood contractor as a logging camp and small mill community.

1925 Begin era of subdivisions.

Brockway

1869 Brockway Hot Springs Resort.

1920s Casino/club/golf course added to resort; subdividing begins.

Crystal Bay

1927 Subdivision/casino development.

1960s The casino "Sinatra Years" and a boost to local economy.

Logging

Ca. 1864 Davis and Scott Shingle Mill near SR 28/Highway 267 intersection.

1864 to 1872 George W. Wiggins Shingle Mill established (with Nat Stein) near SR 28/Highway 267 intersection.

1865 D. W. Wright cordwood camp at Tahoe Vista.

1872 John Griffins Saw Mill at Kings Beach.

1878 Initial cutting by wood contractors for CTLFC.

1880s Steam-powered shingle mill at Tahoe Vista; Tahoe Vista marine terminal for saw logs cut on Martis Peak under contract with SNWLC.

1881 H. E. Casey saw log and cordwood contract with SNWLC; logs rafted from Agate Bay to Sand Harbor.

(A field inventory sample of historic cut stumps from three 10- to 15-acre plots in Tahoe Vista disclosed average stump diameters of 38.5, 33, and 32.1 inches, maximum stump diameters of 66, 66, and 46 inches, average stump densities of 7.9, 5.6 and 2.5 per acre and a species composition of pine [76 percent, 76 percent and 72 percent), cedar (four

percent, 24 percent and 14 percent) and fir (four percent, zero percent and 14 percent], respectively.)

1920s to 1927 Roy Andrews cedar shake/shingle saw mill on East Branch Griff Creek; ice harvested on log ponds; mill is also a front for illegal boot-leg operations.

1960s Logging by Fibreboard Corp in Martis Peak/Brockway area.

1992 USFS Brockway timber sale.

Ranching/Grazing

1860s to 1930 Local dairy business flourishes on large scale in the upper reaches of Griff Creek.

1862 William Wallace and Lambo Company harvest 25 tons of wild hay near SR 28/Highway 267 intersection; water is diverted from Griff Creek for irrigation.

Time Line of Human Land Use and Environmental Conditions, First/Second/Third/Incline/Mill Creeks Watersheds T16N/R18E

Recorded Archaeological Sites

41 prehistoric sites: First Creek = 2; Second Creek = 1; Third/Incline Creeks = 39

41 historic sites; five-mile logging railroad and many miles of associated wagon haul roads and flumes, including the eight-mile long North Flume

Native American Use

ma'goiyatwO'tha—Washoe camp near mouth of Incline Creek for collecting berries.

wa aba am ("plunging into water")—Washoe place name for Third Creek.

Recent interviews have provided information about the value of Third Creek to families from the Reno area and is ranked fifth out of ten streams by Washoe. Third Creek once watered an extensive wet meadowland, similar to south shore (Bender 1963 in George Wright Papers).

Out of a list of the 10 most desirable watersheds in descending order of resource value, Washoe testimony from the Washoe Land Claims Case ranks Incline/Third Creek as the fifth most valued fishery in the Tahoe basin (Bender 1963 in George Wright papers).

(Given the late period subdivision development, Washoe traditionalists continue to harvest plants around Incline Village up until the last several decades.)

Transportation and Community Development

1852 to 1855 Placer County Emigrant Road (SR 28) along north shore.

1891 First continuous road over Mt. Rose Pass connecting Reno area and Lake Tahoe ("The Road to Incline"/SR 27/SR 431).

1929 Highway 28 route between Spooner Summit and Incline is graded.

1930s George Whittell acquires a continuous strip of property from the Bliss and Hobart estates that stretches from Crystal Bay south to Zephyr Cove.

1932 Grading of SR 27 between Incline and Mt. Rose Pass.

1950 to 1960 Construction of SR 431 (replacing SR 27).

1959 9,000 acres of the Whittell estate are sold to Crystal Bay Development Company as Incline Village.

1968 Crystal Bay Development sells Incline Village to Boise Cascade Corporation.

1973 After limited logging, Boise Cascade lands are acquired by Incline Village General Improvement District for subsequent development.

Logging

1876-1898 Overall large-scale cutting, with intensive cutting lasting half that long.

1878 Initial cutting by SNWLC probably commences about one mile north of Crystal Bay.

1879 to 1894 SNWLC Incline Mill operates at 75,000 feet a day.

1880 SNWLC builds a 4,000-foot tramway at its Incline mill; at the top, wood is dumped into a V-flume (built originally by the VGHWC) and carried through a tunnel down to Washoe Valley to a storage yard served by the VTRR; a steamer rafts logs from timber holdings in Tahoe's southeast shore to Sand Harbor, where logs are loaded onto a logging railroad bound for the mill.

1881 to 1890 Most intense period of timber harvest and engineering for water supply and wood transport.

1889 SNWLC initial cut is 8 million feet of lumber and 50,000 cords of fuel wood.

1881 to 1885 SNWLC peak cordwood production in Washoe County.

1887 Incline Mill produces a peak cut of 12 million feet of lumber.

1883 43,000 acres of SNWLC land in the Tahoe basin are stripped of trees.

1890 to 1891 SNWLC peak operations close down.

1894 Last major logging season for SNWLC.

Late 1960s to Early 1970s Limited logging around Incline by Boise Cascade.

(A field inventory sample of historic cut stumps from a 60-acre plot on Third Creek disclosed 0.7 stumps/acre of fir and pine, with an average diameter of 33 inches; a 60-acre sample along First Creek produced 1.4 stumps/acre of mostly pine, with an average diameter of 27 inches; maximum stump diameters in both samples are 56 inches.)

Grazing

1910s to 1950s With demise of logging, cutover lands are converted to grazing.

Water Management

1875 VGHWC raises Marlette Dam to 37 feet, forming a lake 1 3/4 miles long by 3/4 mile wide, containing 2,000 million gallons of water and doubling its capacity to supply water to Virginia City.

1877 In partnership with the SNWLC, the VGHWC constructs a 4.38-mile box flume northward from Marlette Lake Dam to the West Portal of the tunnel into the Carson Range divide; water supplies Virginia City.

Ca. 1877 Construction of the North Flume by the VGHWC to supply water to Virginia City; flume tapped waters of Third Creek and all intervening drainages south to the tunnel on Tunnel Creek; flume was in year-round operation until ca. 1950s.

1939 VGHWC deeds five inches of water from the North Flume to Norman Biltz at Incline Lake.

1944 Major washout of the diversion works along the North Flume.

1950s North Flume is abandoned.

1959 Curtis-Wright Co. raises the Marlette dam to 52 feet, increasing the lake's storage capacity to 3.4 billion gallons (10,400 acre feet of water).

Time Line of Human Land Use and Environmental Conditions, Marlette and Spooner Lakes/Glenbrook, Logan House, and Lincoln Creeks Watersheds

Paleoenvironmental Sites

Pollen Record: Little Valley (Wigand and Rhode, in progress)

Recorded Archaeological Sites

32 prehistoric sites: Marlette = 14; Secret Harbor = 2; Skunk Harbor = 1; N. Canyon = 1; Spooner Meadows = 11; Glenbrook Creek = 2; Cave Rock = 1

92 historic sites center around a nine-mile logging railroad and comprise more than 60 miles of wagon haul roads and skids, over 20 miles of flumes and associated reservoirs, about 75 wood camps, and several saw mills; many miles of emigrant and freight toll roads

Native American Use

dawmaladup solno ("fog on top")—Washoe place name for Spooner Summit.

damalili da aw—Washoe place name for Marlette Lake, on old trail crosses over the mountains from Little Valley to Incline.

Washoe camp is at Sand Harbor.

phagathsami—Washoe fishing camp is on Marlette Creek.

dawma lim demse fil—Washoe place name for Secret Harbor Creek.

daumaladuphwO'tha—main Washoe camp at Glenbrook; from here they walk up to Slaughterhouse Creek to fish and down toward South Point to gather berries; Washoe live here even after Euro-Americans settle.

suina—Washoe camp on south side of Glenbrook Creek.

dE'Ekwadapoc ("standing gray rock")—Cave Rock is a Washoe cultural landmark that is

respected, feared, and avoided by most Washoe, except spiritual practioners.

Washoe fish camp on unnamed creek draining into Zephyr Cove.

Out of a list of the 10 most desirable watersheds in descending order of resource value, Washoe testimony from the Washoe Land Claims Case ranks Glenbrook Creek as the tenth most valued fishery in the Tahoe basin (Bender 1963 in George Wright papers).

Transportation and Community Development

1852 to 1854 Carson Emigrant Ridge Road over Spooner Summit (Highway 50).

1860 A. W. Pray et al. settles on Glenbrook Bay.

1861 Community at Glenbrook Bay is established at Walton's Landing; it is considered the east shore over-water terminus for the toll pack trail leading from Georgetown, California, to Upson Bay (McKinney's) on Tahoe; travelers proceed eastward to Virginia City.

1862 Rufus Walton Toll Road from Glenbrook over Spooner Summit (Highway 50).

1863 Lake Bigler (Tahoe) Toll Road channels flow of travel out of Tahoe basin over Spooner Summit (Highway 50); hotel/way station established along Lake Tahoe Wagon Road at Zephyr Cove (Highway 50); Michele Spooner and Company establish Spooner Station at Spooner Summit (Highway 50/Highway 28 intersection).

1865 Rilla Ranch occupies present day Marlette Lake.

1866 Glen Brook House is constructed, and the enduring role of Glenbrook as a hostelry and tourist resort begins; Telegraph office is established at Glenbrook.

1860s to 1870s Period of most intensive use of travel corridor by freight and stage wagons (Highway 50).

1914 to 1915 Route over Spooner Summit is designated as the Lincoln Highway (the nation's first transcontinental highway); entrance of automobile era.

1925 Lincoln Highway is incorporated into Highway 50.

1929 Highway 28 route between Spooner Summit and Incline is graded.

Late 1930s White Hill Ski Area (Spooner Summit) offers a T-bar lift; the ski area's life is short-lived by a lack of snow and the opening of Heavenly Valley Ski Area in 1956.

1930s George Whittell acquires a continuous strip of property (45,000 acres) from the Bliss and Hobart estates that stretches from Crystal Bay south to Zephyr Cove.

1976 Glenbrook Inn closes.

Late 1970s Bliss family sells Glenbrook property for the private Glenbrook subdivision.

Logging

1861 Small-scale lumbering and fluming operations begin at Glenbrook by Agustus W. Pray and the Lake Bigler Lumber Company; initial operation produce 10,000 board feet a day and shingles; Samuel Clemens (Mark Twain) stakes a timber claim nearby then watches as it goes up in smoke after his unattended campfire goes out of control.

1861 to 1873 Timbered lands west of Spooner Summit are worked by a number of small-scale logging and fluming enterprises.

1863 Spooner and Carl operate shingle mill between Spooner Summit and Glenbrook.

1866 Pray et al. incorporate as the Lake Tahoe & Empire Flume Company and build a 14-mile flume.

John and Thomas Elliot construct a sawmill near Spooner's Summit.

1868 Summit Fluming Company is incorporated by the Elliot Brothers et al.

1868 to 1873 CTLFC begins acquisition from small-scale independent operators of timber ranches and fluming companies on Tahoe's east central shore, acquiring 50,000 acres of timberland by 1873.

Late 1860s The Summit Fluming Company constructs first dam to form Marlette Lake; (the original Marlette Basin was a meadow).

Ca. 1868 to 1873 Wetlands in Spooner Meadow are dammed to form Spooner Lake, with accompanying ditch diversions into and away from the reservoir.

1870 Oliver Lockie and Company acquire a 400-acre timber ranch at Spooner Summit; they establish cordwood and saw log camps and run

shingle mill and saw mill; A. W. Pray logs Zephyr Cove and rafts sawlogs to his Glenbrook mill.

1871 Marlette Lake covers 500-600 acres.

1873 CTLFC commences large-scale cutting; large wood receiving and sending lumber yard is established at Spooner Summit at the head of the Clear Creek Flume, which floats lumber and cordwood down to storage yards on the VTRR spur near Carson City; CTLFC raises dam at Marlette Lake to 24 feet

Ca. 1873 CTLFC constructs South Wood Camp to Spooner Summit V-Flume; CTLFC expands old Summit Flume to now run 6.4 miles from South Camp Peak to the receiving ponds at Summit Summit; several splash ponds, dams, and holding ponds are constructed along the route; fluming operations are facilitated by a network of access roads and the establishment of a main wood camp near the beginning of the South Wood Camp V-Flume; wood camp is closed in 1894; CTLFC constructs Marlette Lake to Spooner Summit V-Flume; CTLFC expands flume (originally build in 1870 by the Summit Fluming Company between Marlette Lake and Spooner Summit) to now run 8.6 miles; flume is used to augment water supplies on Spooner Summit, float cordwood, and supply water to the flume complex within Secret Harbor Creek drainage; CTLFC constructs North Canyon to Spooner Summit/Station U-Flume; originally constructed in 1863 to supply water to the Spooner and Carl Shingle Mill, CTLFC expands this flume into a system of four parallel flumes about 40 to 50 vertical feet apart in the vicinity of Spooner Summit' CTLFC constructs Summit Ponds, three small reservoirs at Spooner Summit, to collect surplus water from converging flumes and augment the flow in the Clear Creek Flume; CTLFC constructs the Secret Harbor Creek V-Flume, a flume complex of six cordwood V-flumes, water-carrying U-flumes, and ditches that tap Secret Harbor Creek.

1876 G. W. Chubbuck subcontracts to supply cordwood from Zephyr Cove to Pray; Largest CTLFC cut at Glenbrook mills is recorded in this year.

1877 Year of CTLFC's peak harvest for east shore operations.

1879 CTLFC cutting around Spooner Summit is phased out; one of the first telephone systems in the west is installed between Glenbrook and Carson City.

Mid- to Late 1870s Estimated dates of logging from dendrochronological sampling of remnant historic cut stumps and green trees disclose that Spooner Summit (White Hill) and the upper reaches of Glenbrook Creek and Montreal Canyon Creek (T14N/R18E/S13) are cut by the mid- to late 1870s.

Mid-1880s Estimated dates of logging from dendrochronological sampling of remnant historic cut stumps and green trees disclose that most stands on South Camp Peak and the upper reaches of Logan House, North Logan House, and Lincoln creeks are logged in the mid-1880s.

1885 Estimated dates of logging from dendrochronological sampling of remnant historic cut stumps and green trees disclose that Slaughter House Canyon is logged ca. 1885.

Late 1880s to 1890 Estimated dates of logging from dendrochronological sampling of remnant historic cut stumps and green trees disclose that stands along the lower reaches of Logan House Creek are logged in the late 1880s and in 1890.

1890s CTLFC acquires Zephyr Cove from Hobart Estate (SNWLC).

1892 CTLFC abandons North Wood Camp.

1894 CTLFC abandons South Wood Camp.

1897 CTLFC shuts down Glenbrook mills.

1950s Isolated pockets of timber are cut southwest of Marlette Lake.

Fishing

1880s Nonnative trout are planted in Marlette Lake, and fish are used to stock surrounding alpine lakes; trout in Marlette Lake become so plentiful that suckers are planted to eat the eastern brook's spawn, after which time the suckers have to be removed.

Ranching/Grazing

1860 A. W. Pray et al. harvest wild hay and plant grain and vegetables in Glenbrook meadow with a yield of 60 bushels of wheat and four tons of timothy hay per acre; the native hay crop is so profuse that a horse-drawn reaper is needed to harvest it.

1900s to 1930s The earliest recorded aspen carvings documenting Basque shepherds in the Tahoe basin date from 1899 and are found in Secret Harbor drainage; most aspen art dates during the 1920s to 1930s and into the 1950s, indicating grazing activities on the east shore to be most intense during this period.

Time Line of Human Land Use and Environmental Conditions, McFaul/Burke/Edgewood Creeks Watersheds (Kingsbury)

Recorded Archaeological Sites

12 prehistoric sites: Marla Bay = 1; Elk Point = 1; Burke Creek = 2; Edgewood Creek = 8

33 historic sites; many miles of log haul/skid roads

Native American Use

atabi samat ("fish swimming through, fish passage")—Washoe place name for McFaul Creek.

lamwO'tha (*lam*, [bedrock] mortar; *wO'tha*, river)—Washoe camp near Edgewood Creek; noted for fishing and [service] berries, two kinds of roots and a grass seed.

Washoe camp near Burke Creek (contains a bedrock mortar).

Washoe camp (with bedrock mortar) on the lakeshore west of Stateline.

Transportation and Community Development

1860 Friday's Station established as Pony Express stop.

1860 to 1861 Pony Express route up Kingsbury Grade (Highway 207).

1922 Resort established at Marla Bay.

1931 Legalization of gaming in Nevada.

1938 Zephyr Cove becomes part of southern extent of George Whittell extensive east shore holdings.

1940s to 1950s Increase in gaming houses/hotels/restaurants around Stateline.

1956 Heavenly Ski Resort opens; expansion occurs after the 1960 Winter Olympics at Squaw Valley.

1959 Kingsbury Grade (Highway19/207) is paved over Daggett Pass.

Logging

1860s to Early 1870s Establishment of small, independent timber ranches and wood lots around Edgewood.

1870s EDWFC initiates large land acquisitions around Daggett Pass (including the Summit Mill).

1871 Establishment of steam-powered sawmill up the canyon toward Daggett Pass.

1872 to 1879 SNWLC/NLC purchase about 8,000 acres, with the intent of large-scale logging in 1880; CTLFC acquires this land in 1890.

1880 EDWFC lands are cutover by 1880.

1884 McFaul cuts cordwood around Edgewood.

1889 Under contract with the SNWLC, G. N. Folsom cuts 520-acre timber track between the foot of Kingsbury Grade to Daggett Pass; saw logs are rafted to Sand Harbor; a shingle mill is constructed up the canyon; Folsom bases his operations out of the logging settlement of Hobart (near Round Hill).

1890 CTLFC acquires all of SNWLC/NLC 8,000 acres (subsequent logging by CTLFC is probable).

1893 Folsom increases his timber holdings to 610 acres; lumbering activity at Hobart is at its peak.

1896 Folsom's southeast shore operations are reduced to cordwood cutting.

1897 Cutting ceases in the area.

1939 EDWFC lands are purchased for back taxes and sold to the Clover Valley Lumber Company in 1940; the company conveys the land to George Whittell in 1941.

1949 to 1954 Timber pockets north of Kingsbury Grade are logged by Placerville Lumber Company.

Fishing

1862 William W. Lapham's "Fish Market Landing" is established at Stateline; Burke and Company use a half-mile seine to take tons of Tahoe trout daily from the area between Bijou and Round Hill.

Ranching/Grazing

1860s to 1890s Meadows between Edgewood and Zephyr Cover are grazed.

1864 Timothy hay is harvested at Marla Bay.

1876 G. W. Chubbuck cuts timothy grass at Zephyr Cove.

1884 McFaul pastures dairy cows.

1898 Robert L. Bence leases meadowlands in Folsom's former holdings and runs dairy cattle. Meadows are purchased by Park family (Park Cattle Company) and grazed until recent decades.

Mid-1900s Chris Rabe purchases meadows and farms/ranches the area.

Ca. 1960s Meadows are still used as cattle range.

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